97th Congress
1st Session } COMMITTEE PRINT NO. 3

REPORTING OF INFORMATION CONCERNING THE ACCIDENT AT THREE MILE ISLAND

A REPORT

PREPARED BY

THE MAJORITY STAFF

OF THE

COMMITTEE ON

INTERIOR AND INSULAR AFFAIRS

OF THE

U.S. HOUSE OF REPRESENTATIVES

NINETY-SEVENTH CONGRESS

FIRST SESSION

MARCH 1981

Printed for the use of the
Committee on Interior and Insular Affairs

U.S. GOVERNMENT PRINTING OFFICE
75-801 O WASHINGTON: 1981

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COMMITTEE ON INTERIOR AND INSULAR AFFAIRS
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

March 3, 1981

Members of the Committee on Interior
and Insular Affairs
U.S. House of Representatives
Washington, D.C. 20515

Dear Colleagues:

Pursuant to fulfillment of its nuclear oversight responsibilities, the Subcommittee on Energy and the Environment of the Committee on Interior and Insular Affairs conducted an inquiry into the March 28, 1979 accident at the Three Mile Island nuclear station. As part of this effort we sought to determine the reason for the lapse of two days before State and Federal officials became aware of the true dimensions of the accident's severity. The failure of plant managers to report accurately and fully on the accident conditions could have resulted in unnecessarily large radiation exposures to the public if a major radiological release had occurred during the early stages of the accident--an eventuality that would have been judged appreciable on the basis of information available some five hours after the accident began.

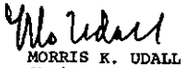
The Committee majority staff have prepared the following report on this matter. Included in the report is a finding that:

> "The record indicates that in reporting to State and Federal officials on March 28, 1979, TMI managers did not communicate information in their possession that they understood to be related to the severity of the situation. The lack of such information prevented State and Federal officials from accurately assessing the condition of the plant; in addition, the record indicates that TMI managers presented State and Federal officials misleading statements (i.e. statements that were inaccurate and incomplete) that conveyed the impression the accident was substantially less severe and the situation more under control than what the managers themselves believed and what was in fact the case."

The reporting failures at Three Mile Island call into question a fundamental premise upon hich the nuclear regulatory framework is founded. This premise is that licensees will voluntarily provide State and Federal officials with information affecting the public health and safety. While it would have seemed that the Nuclear Regulatory Commission would have considered it one of its primary responsibilities to get to the bottom of why the reporting failures occurred, the Commission and its staff showed little inclination to do so. After considerable prodding from the outside, the Commission did conduct an investigation which led a Commission majority to take a relatively weak enforcement action which seems inconsistent with stronger actions taken in other instances where the failure to comply with the Commission's requirements was much less significant than that which occurred at Three Mile Island. The Commission's weak enforcement action and the associated report prepared by the NRC Office of Inspection and Enforcement have had the effect of obscuring the issue.

I believe that the following report helps to set the record straight. I commend it to your attention.

Sincerely,



MORRIS K. UDALL
Chairman

NOTE TO READERS

A substantial portion of this report consists of excerpts from transcriptions of interviews conducted during the course of the various TMI investigations. In order to minimize the likelihood that interviewees would appear to have made statements that in fact they had not made, interview excerpts were, except for obvious transcription errors, transferred unchanged to this report from the transcripts produced by the TMI investigatory groups.

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REPORTING OF INFORMATION CONCERNING THE ACCIDENT AT THREE MILE ISLAND

I. Introduction

At 9 a.m. on March 28, 1979, information available in the control room of Unit 2 at the Three Mile Island (TMI–2) nuclear generating station indicated that the reactor had been severely damaged and that the plant was in a condition not covered by its emergency procedures. Control room personnel were aware that a portion of the reactor's cooling water had been lost via a pressure relief valve that had been stuck open for more than 2 hours. As a result of the loss of water, the main coolant pumps could no longer function as the system became steam bound. Temperature sensing devices indicated that a portion of the reactor core was being cooled by steam rather than water and some of the temperatures were of such a magnitude as to suggest the production of substantial quantities of gaseous hydrogen, a product of a chemical reaction between steam and the zirconium tubes which held the uranium fuel pellets. Very high radiation levels in the containment building indicated escape of radioactive gases from a significant portion of the fuel rods.

The NRC's Special Inquiry Group (SIG) report shows that uncertainties at 9 a.m. on March 28 as to how and whether the reactor could be brought to a stable cooling configuration raised the possibility of further degradation leading to melting of the core and a large radiological release. The SIG concluded the situation at the plant was such as to warrant a recommendation to State officials that there be a precautionary evacuation of the first few miles around the plant and that there be an alert for an evacuation of an area within a 10 mile radius.[1]

Ultimately, at about 8 p.m., 16 hours after the accident began, a relatively stable cooling mode was achieved. Between 9 a.m., when the signs of severe trouble were clear, and 8 p.m., however, there continued to be uncertainty as to the prognosis. During this period at least two major changes were made in the strategy being used to bring about stability, and at 1:50 p.m., hydrogen combustion [2] and a consequent

[1] SIG, Vol. II, Part 3, p. 983.

[2] All references to hydrogen explosions or fires in this discussion concern the hydrogen detonation outside the pressure vessel in the containment building that occurred at 1:50 p.m. on March 28, the first day of the accident. This is not the potential explosion that directly concerned the NRC in the period March 30–April 1, when the Commission believed there was a possibility of a detonation or fire within the pressure vessel resulting from generation of oxygen which might react with the hydrogen bubble that was believed to occupy a substantial volume at the top of the pressure vessel. Subsequent analyses appear to indicate that there was no mechanism under conditions then prevailing within the pressure vessel that could lead to net production of oxygen, and therefore there need not have been serious concern about an explosion within the pressure vessel. While there may have been no danger in this period from an explosion within the pressure vessel, other dangers had not passed and a further deterioration of reactor systems might have led to a major radiological release. For example, on the afternoon of Friday, March 30, prior to concern having arisen about an oxygen buildup in the pressure vessel, Chairman Hendrie discussed with Harold Denton the potential need for a precautionary evacuation owing to the possibility that something might go wrong during the process of removing hydrogen from the primary cooling system. (See, for example, transcript of March 30, 1979 Commission meeting at p. 110.)

pressure increase in the containment building caused concern that the containment building integrity might have been breached.

While the SIG concluded that a precautionary evacuation was warranted at 9 a.m. on March 28, State and Federal officials, judging from information they released during the first 2 days of the accident, were largely unaware until March 30 of significant information available to TMI supervisors who were present. As a result, during the most dangerous hours of the accident, State and Federal officials were unable to make an accurate assessment of the necessity to undertake emergency measures for which they were responsible.

The failure of State and Federal officials to comprehend the nature of the TMI–2 accident could have resulted in unnecessarily high radiation exposures had the situation deteriorated to the point where a major release of radioactive materials occurred. Because officials were not aware that the accident was of such a severity that there was a significant threat to the public health and safety, they did not take the precautionary actions regarding an evacuation, such as those postulated by the NRC's Special Inquiry Group.

In view of the seriousness of the potential consequences of inadequate disclosure of conditions at TMI–2, it is important to understand why significant information was not provided to authorities responsible for taking emergency actions. Did TMI–2 managers fail to provide information to State and Federal officials as a result of a lack of understanding of the data available to the management? Did the communications failure result from a belief that the regulations did not require reporting of significant information that was not provided to public officials on March 28? Or did the failure result from a willful withholding of information in order to engender an impression that the accident was less severe than was actually the case? The answers to these questions will help to determine whether current NRC reporting requirements need to be revised or whether there is a need for more stringent enforcement of existing regulations.

Since beginning its inquiry into the accident at Three Mile Island, the House Committee on Interior and Insular Affairs Subcommittee on Energy and the Environment has sought to determine the cause of the reporting failures that occurred during the first 2 days of the accident. This issue was resolved neither by the Subcommittee's inquiry conducted in April and May 1979 nor by the inquiries conducted by the NRC's Office of Inspection and Enforcement in the spring and summer of 1979, by the President's Commission on the Accident at Three Mile Island, by the NRC's Special Inquiry Group, and by the Senate Subcommittee on Nuclear Regulation.

The Subcommittee has continued its inquiry into the matter out of a belief that there must be assurance that the reporting failures experienced during the accident at TMI do not recur. Such assurance will be derived, in part, from as complete as reasonably possible an understanding of what prevented the dissemination of important information from TMI on March 28 and 29, 1979.

This report is based largely on materials compiled in the course of the above mentioned inquiries and by the investigation initiated by the NRC's Office of Inspection and Enforcement in March 1980. The total record leads to the conclusion that reporting failures were due neither to lack of sufficient data in the TMI–2 control room nor to inadequate

understanding of that data. The record raises question as to whether the failure to report information available to and understood by TMI–2 management constitutes a violation of the NRC's reporting requirements. The record also raises questions as to whether the reporting failures were willful and whether one or more of the TMI managers may be subject to the penalties provided for by the Atomic Energy Act with regard to instances of willful failure to comply with the Commission's regulations.

This report addresses in sequence: section II, the emergency management organization at Three Mile Island after 7 a.m. on March 28, 1979; section III, availability and comprehension of information indicating the severity of the accident; section IV, NRC reporting requirements; and section V, information flow from the plant to State and Federal officials. Section VI contains conclusions.

II. Emergency Command Team

In considering the kinds of data that were available, it is useful to keep in mind the emergency management organization and procedures established by Station Manager Gary Miller. Upon his arrival at the TMI control room shortly after 7 a.m., he organized a group for the purpose of analyzing information and determining what actions should be taken. In a statement dated May 7, 1979 and presented to the Subcommittee on Energy and the Environment on May 24, Miller described this command structure:

> My primary goal was to protect the public and our actions were an attempt to minimize releases, project and recommend evacuation, if warranted, with maximum advance notification, to terminate the incident and to stabilize the unit.
>
> The first concern I had as I arrived in the control room at approximately 7:05, was to become fully cognizant of the situation as it existed and once I fully understood the plant conditions and the radiation emergency, I immediately took charge of the control room and appointed senior people to direct the necessary evolutions in the vital areas to assure that the public was protected, that the release was monitored, that communications were occurring and that the plant was brought in steps to a stable condition. The command setup, which I just described, met frequently throughout the day. The group presented unit conditions, status of emergency plan actions, shared opinions, discussed technical data, and made recommendations. Discussions were held with management, and/or Babcock & Wilcox, Lynchburg, the State, the NRC, and following these evaluations, I made appropriate decisions and so directed the implementation to the control room and informed others both inside and outside the plant as necessary.
>
> Basically, I set up this emergency command team in the early hours as I arrived at the plant and the radiation emergency was in progress, by essentially forming my senior people into a network to supervise, conduct the emergency and report to me while bringing the plant to a safe condition. Mr. Ross was put in charge of operations to direct the shift supervisor, Mr. Dubiel was put in charge of radiation concerns, including radiation surveys, onsite-offsite teams, accountability—check, assembly of people, getting in contact with the emergency control station (ECS); etc., Mr. Seelinger was in overall charge of Unit 1, the Emergency Control Station, the Unit 1 Control Room and to assure that all facets of the emergency plan were followed.
>
> Mr. Logan was charged to assure that all the required procedures and plans were reviewed and to look through each to assure that every item was covered, this included the pro-

> cedures for both emergency plan and for the unit itself, and to provide me assurance that all actions were being taken and to be sure the notification calls were made, that management was notified, and all communications were in-place. Mr. Lee Rogers was requested to provide technical assistance plus link-up with his home office as he could. Mr. Kunder was in charge of technical support and communications and Mr. Shovlin was in charge of emergency maintenance.
>
> * * * * *
>
> Because of my training, I felt a strong obligation to the public and to making sure that there was minimal release of radioactivity and that there was evacuation in plenty of time if that was required. The phone, the pressure, the fact that the plant was in a state that I had never been schooled in, combined to make conditions almost intolerable. However, the Control Room remained calm as can be testified to separately. All of the meetings of the command team were held in the Shift Supervisor's Office in a calm atmosphere, at a point removed from the Control Room, and the decision-making was done precisely, at intervals dictated by the plant, and in no case longer than 30 to 40 minutes apart.
>
> (E&E TMI-2, Part II, pp. 253–256.)

III. Availability and Comprehension of Information

A. Awareness of Open PORV as Cause of Low Pressure in Cooling System

At approximately 6:22 a.m., TMI Shift Supervisor Brian Mehler (who had arrived at the plant about 5:45 a.m.) shut the block valve located upstream from the leaking power operated relief valve (PORV). Following closure of the PORV, the primary cooling system pressure increased and the reactor building pressure decreased, indicating that heretofore the system had experienced for more than 2 hours a loss of coolant accident via the PORV which had not closed as it should have following the drop in pressure after the initial pressure increase at about 4 a.m. Some control room supervisors were aware that the malfunction of the PORV (sometimes referred to as the electromatic valve) explained the low system pressure and high reactor building pressure, believing therefore that the source of the problem had been found. TMI–1 Supervisor Ken Bryan recalled (GPU, Bryan, 4/26/79, p. 7) that Supervisor Mike Ross had called him from the Unit 2 Control Room saying, "Hey dummy, you know that electromatic's leaking by? . . . We just isolated it." Ross told NRC investigators on April 28, 1979 that prior to closure of the block valve, the operators were not aware the PORV was open: "I'm under the assumption that they felt (the PORV) was closed, because sometime in that time gap we went ahead and isolated it, and the reactor coolant pressure started to drop. So we felt that the electromatic (i.e. the PORV) had in fact been passing." (I&E, Ross, 4/25/79, p. 12).

In a subsequent discussion with NRC investigators, Ross engaged in the following dialog concerning the leaking PORV, the closure of the block valve, and the inference as to what had been going on until that time:

> Hunter. In the previous tape and (sic) I want to clarify something. At the time the power operated relief valve, block valve was closed, okay, which occurs at 2.2 hours in that range, do you recall the pressure transient or the events that occurred or the things that you do recall seeing when the valve was closed?
>
> Ross. Yeah I basically just got there when that particular thing happened. I was still trying to digest what was going on around me. A pretty frightening sight walking into something like this. I am sure you can understand. Right after it was closed, Zewe turned around and said, "Geeze, that was it, the reactor building pressure is going down." So he figured he had found where it was going at that time. [I&E, Ross, 5/19/79, p. 11–12].

Bill Zewe, the supervisor of the shift on duty during the early hours of the accident discussed with SIG investigators his understanding that the PORV had been leaking and that in essence there had been a small break LOCA. Thus, on September 11, 1979, Zewe and shift foreman Fred Scheimann engaged in the following dialog with George Frampton, SIG Co-Director.

> Frampton. What about after the EMOV (PORV) block valve was closed off? Did you then realize very shortly that that had been the main leak?
>
> Zewe. Yes.
>
> Scheimann. Yes.
>
> Frampton. Then you realized that in essence you had a small break LOCA; right?
>
> Zewe. True.
>
> Frampton. Thereafter, didn't you continue to face a situation in terms of the plant parameters that it was very difficult to understand why the plant was behaving that way?
>
> Zewe. No, as soon as we closed the electromatic valve the pressure in the reactor building started to go down. The pressure in the coolant system started to come up. So we knew then that we once again had a tight stem (sic, system) which we didn't have before but didn't perceive we didn't have a tight stem (sic, system). So from then on we knew that that was the leak and we were already on our maximum capacity of high pressure injection and just continued on that path to pressurize up.
>
> (Zewe et al., SIG, 9/11/79, p. 92.)

Zewe also recalled on September 4, 1980 that his conclusion about the PORV having been open as the cause of the plant status had been discussed with others:

> Q. With whom did you discuss this conclusion?
>
> A. At that time there were several people present in the control room and it was more of a collective type conclusion once we had shut the block valve from the electromatic and the pressure changed dramatically. We just concluded that it had been opened, but I really didn't have a feel for exactly how long.
>
> Q. Would you identify those people for us?
>
> A. My control room operators were still present, the shift foreman was still present, Brian Mehler was present, George Kunder was present, I believe Mike Ross was present at that point and Ken Brian and I am not sure of all of the others involved. I believe that Mr. Logan was also present at that point in time.
>
> (Zewe, I&E, 9/4/80, pp. 11–12.)

In describing closure of the block valve, Mehler engaged in the following dialog with NRC investigators on September 3, 1980.

> A. Well, if you want to talk about when I got there, what I looked at, I looked at the pressurizer level, I looked at the pressure, and it was obvious that we were not recovering pressure, and there was only two reasons why we couldn't:

either the heaters weren't functioning, or we had a leak somewhere. And I proceeded to have people check the heater breakers and I also punched out the thermocouple readings on the PORV which it's called now—it used to be called the electromatic—and the relief valves, the code, and upon looking at that, I decided that the PORV was leaking through, and upon closing the block valve, we did start recovering pressure. And by looking at that and seeing that the pressurizer was solid, I made the assumption that we did from the steam voids in the hotlegs, and I made that assumption based on that the hotleg is the highest point in the system. Also, you know, that the pressurizer was solid, and you had to have a steam void somewhere to be recovering pressure.

Q. After you shut the block valve and saw primary system pressure recover, did you conclude that the EMOV had been open for a period of time and was contributing to the plant status, low pressure, high level?

A. I did—upon closing the block, I assumed we found the problem. I did not know how long it was open at that time.

(Mehler, I&E., 9/3/80, p. 7.)

In a statement to SIG, TMI–2 Superintendent for Technical Support George Kunder stated, ". . . after the general emergency was declared, and it was recognized that voiding had occurred . . . " there had been discussion of the relief valve. Kunder said that, "At that time, I presumed someone had determined that the relief valve had in fact stuck open and that is how we lost the inventory of water. It pretty much became common knowledge what had happened."

(SIG, 9/18/79, pp. 40–41.)

In his September 18, 1979 conversation with the Special Inquiry Group, Kunder engaged in the following dialog with regard to his perception that the closure of the block valve had resulted in the system pressure increasing:

Q. Do you recall learning shortly after the conversation [i.e., the conference call prior to 7 a.m.] that the block valve had been closed and some indication that this was having an impact on the system that the pressure was going back up?

A. I believe that I wasn't there.

Again, after we had declared the general emergency and I had been told that we were trying to figure out what happened to the water and I think it became apparent to the group after that time that that is what had transpired.

Whoever closed the block valve relayed that information and it eventually filtered back to myself. I am certain that I didn't know that until after we declared a general emergency and we had pieced together, very quickly, what we believe had occurred.

Q. And that might have been an hour later or more?

A. It might have been.

(Kunder, SIG, 9/18/79, pp. 46–47.)

In his September 4, 1980 meeting with I&E, Kunder did not recollect when precisely or how he learned that the PORV had been opened. In discussing the foregoing quote he stated:

When I say that it became common knowledge, I think I was referring to the fact that when bits and pieces of the accident scenario became known, as part of the general development of information and disseminating that to the staff, it just became known by the rest of the staff, and that was just my perception at the time. But I cannot tell you for sure if that was in the morning, in the afternoon, or later.

(Kunder, I&E, 9/4/80, p. 9.)

TMI Supervisor Joe Chwastyk arrived in the TMI–2 control room late in the morning on March 28. On September 4, 1980 he engaged in the following dialog with NRC investigators with regard to his knowledge of the open PORV (EMOV):

Q. On 3/28/79 were you aware that a continuous relief path through the open EMOV and block valve had existed for a period greater than two hours or for an extended time period on the morning of the accident?

A. I was aware that the flow path was there and that, you know, Mehler had secured it sometime early that morning. Is there anything further?

Q. How did you find out about it?

A. One of two ways, and probably this way. When I got to the control room I essentially looked at the panel to find out what the plant status was and then I started to ask questions of people that were up at the panel. You know, during that time frame is probably when I found out about it.

By Mr. Moseley:

Q. Let me go back to the previous question. Even though you may not have known that it was open for two hours and twenty minutes, or whatever the exact number was, were you aware that it was open for a significant period of time longer than just a few minutes?

A. I was aware that it was open, yes, longer than a few minutes, yes.

Q. Did you have some feel for longer than a few minutes like hours?

A. Well, yes. Probably I figured it was about two hours. I think now, I am not sure, but I remember, you know, six o'clock is supposedly the time that it was closed. I don't know if I knew that at the time or if I knew it subsequent to what had happened. Maybe I had better retract that. I am not sure if I knew how long it was open or not.

Q. Let me phrase it this way. You knew it had been opened longer than it should have been opened?

A. Yes, definitely.

Q. And it was opened long enough to have caused a real problem?

A. Yes. Well, I knew it was open long enough that our total reactor coolant inventory was below nominal. That much I knew.

By Mr. Craig:

Q. Did you discuss the open EMOV with Miller, Rogers, Kunder, Urbine (sic), Zewe, Logan, Ross or Mehler?

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A. On March 28th? I guess I have to ask you what you mean by discuss?

Q. Really there are two questions there. Were you aware that when Mehler shut the valve you had a rather rapid pressure recovery in the primary system?

A. I was aware that the relief valve was stuck open and when Mehler closed the valve that stopped the release and I probably assumed that the pressure would recover. You know, whether or not someone actually told me that or not, I don't remember.

Q. Did you have any discussions concerning the time duration that the valve was opened?

A. Like I mentioned earlier, I don't know. I don't know if the six o'clock closing of the valve was something I knew at that time or subsequent to that time.

(Chwastyk, I&E, 9/4/80, pp. 49–51.)

Gary Miller has been unable to recall whether he was informed on March 28 that the PORV had been opened for an extended period of time. On September 5, 1980, he engaged in the following dialog with NRC investigators:

Q. What I am really trying to get at is were you aware on the morning of March 28th that the PORV had been opened for some period of time? Perhaps you didn't know it was 2 hours and 20 minutes, or whatever the time frame was, but for some extended period of time?

A. I can't recall discussing the status of that valve prior to my arrival after I arrived, if that makes sense to you. In other words, I can't recall any conversation relative to four to six in the morning about what was going on because of the fact that what was going on then was much more important. The historical review hadn't started in anybody's mind. I don't recall that today.

Q. Are you saying you don't recall having knowledge that the PORV had been opened for some extended period of time?

A. I don't recall that.

Q. What explanation were you given for the recovery of pressure, the rather rapid recovery of pressure?

[Counsel and witness refer to document.]

A. What time is that?

Q. This is between six and seven.

When you came in and were briefed what explanation were you given for that?

A. You know, I can't recall specifics. I know there was discussion on the phone at six in the morning about the depressurizer and that type of thing, but I can't come back and remember that specific discussion.

Q. But during the six o'clock phone call the concern was that the pressure in the system and the pressurizer level didn't match. The pressurizer level was high while the pressure in the system was low. After the closure of the block valve and being directed to increase in pressure, now you no longer had

that discontinuity. What explanation were you given for that?

A. I just can't recall.

Q. You don't recall any discussion that occurred in the think tank or in your briefing when you arrived on the status of the EMOV?

A. The discussions I recall in the think tank involved the use of the block valve and the EMOV for vending off for the plant conditions we were in then and not the plant conditions that had progressed up to that point.

(Miller, I&E, 9/5/80, p. 19–21.)

While Miller did not recall being informed that the PORV had been stuck open for an extended period, others recall with varying degrees of certainty that he was informed. When asked whether on March 28 he had discussed with Gary Miller shutting of the block valve, decreasing containment pressure and increasing primary system pressure, Zewe said:

> I am certain that we talked about it, but I am not sure exactly what time frame it actually took place. Like I have stated before, I tried to cover everything that we had done and what had happened whenever he came and took charge and that should have been among them.
>
> (Zewe, I&E, 9/4/80, p. 12.)

Ross was asked on September 24, 1980 if it had been discussed with Miller whether the open PORV might have created the problem. Ross engaged in the following dialog with NRC investigators:

Q. Let me make sure that I understand what you said.

Have you said that the fact that the PORV was open for a period of time much in excess of what you would expect it to have been open, and that this was discussed by members of the think tank and members of the supervision on watch or in the control room in the early morning of March 28? Is that what you have said?

A. I am saying to my recollection we did have knowledge that it was open for a period—a long period of time. I can't testify what conclusion we drew from that at this time.

Q. And can you tell me, was this specifically discussed, do you recall this specific discussion of this which included Mr. Miller?

A. Specific discussion? No. It was discussed in the think tank, in passing, definitely. I can't say to you I remember distinctly. We passed this on to Miller. We talked for more than a minute about this particular valve.

(Ross, I&E, 9/24/80, p. 21.)

B. THROTTLING OF HIGH-PRESSURE INJECTION

Unaware until about 6:20 a.m. that the PORV was leaking water, the operators severely limited the amount of water being pumped into the reactor by the high-pressure injection system. The record is unclear with regard to the hour at which full flow from the high pressure

injection was begun. Kunder (who arrived in the control room at about 4:50 a.m.) was asked by NRC investigators about the condition of high-pressure injection shortly after he arrived. Kunder responded:

> When I came in I didn't see it but I understood too that the high pressure injection was secured. Someone mentioned that the letdown was occurring; they were trying to reduce the level in the pressurizer. I can't remember if I looked at the high pressure injection valves, I do know where they are in the panel, to ascertain that for myself or not, I just can't remember.
>
> (Kunder, I&E, 4/25/79, p. 8.)

Kunder also discussed throttling of the high-pressure injection with the Special Inquiry Group on September 18, 1979 as follows:

> Q. You testified that you had no basis to disbelieve what you were seeing in the control room?
> A. Right.
> Q. Did there come a time when you began to disbelieve?
> A. No. The whole time I questioned it and I don't think that there was any one time when I disbelieved it.
> By Mr. FRAMPTON:
> Q. Mr. Kunder, I believe you said at some point shortly after you came in you asked the operator how long high pressure injection had been on and they said, "Not very long"?
> A. Right.
> Q. What did you understand that to mean? That the actuation had been recent and not at the beginning of the transient?
> A. No. I perceive that as meaning when the reactor cooling system pressure decreased to the actuation point the high pressure injection came on and that the reactor cooling system level—they had pressurized level recovery and they secured it within a brief period of time. It would not be consistent with a high level.
> In other words, if you were to leave the high pressure injection, in effect, for the full flow, that it develops for a long enough time, I would expect to see the pressurized level increase and in fact, the reactor cooling system would go solid.
> Q. So they were telling you that the HPI had only been on for a short period of time at the beginning of the transient before it was throttled or turned off, is that right?
> A. That is my perception.
>
> (Kunder, SIG, 9/18/79, pp. 32–33.)

In answer to a question as to whether before 11 a.m. on March 28 it had been generally discussed that a combination of the PORV being opened and HPI being off could have resulted in a substantial loss of inventory, Ross said:

> I think we discussed the fact that high pressure injection had been off for some time or throttled back. I don't think we ever related it to fully uncovering the core that early. We were concerned that possibility existed.
>
> (Ross, SIG, 9/18/79, p. 12.)

Zewe told the NRC Special Inquiry Group that:

> Once we shut the electromatic relief isolation valve at about 6:15 or so, from that point until 7:00 we had full high pressure injection on. (SIG, Zewe et al., 9/11/79, p. 9.)

Data indicating the level in the borated water storage tank (BWST) however, suggests that high-pressure injection flow averaged less than 400 gallons per minute between approximately 6:20 a.m. when the block valve was closed and 7 a.m., thus implying that HPI flow was less than the amount Zewe recalled.

Zewe said that the status of high-pressure injection was a matter discussed with Miller. Zewe engaged in the following discussion with NRC investigators on September 4, 1980:

> Q. Did you at any time that day discuss the status of the high pressure injection and let-down systems with Mr. Miller?
> A. Yes.
> Q. Would you tell us what the substance of those conversations were?
> A. Well, throughout the day we had discussed the status of the high pressure injection system and the status of the letdown system throughout the whole day at various intervals.
> Q. Did you discuss the status of these two systems as they existed prior to 8:30 a.m. in that letdown had been increased and high pressure injection had been stopped for a while and then throttled?
> A. Yes, we did discuss that.
> Q. Would you tell us the context of those discussions?
> A. When Mr. Miller arrived I was briefing him on what had taken place to that point until he arrived. As I recall, I described the actions that we took up to that point which included increasing the letdown at various times and also verifying high pressure injection flow and then further reducing it.
>
> (Zewe, I&E, September 4, 1980, pp. 4–5.)

Miller has told investigators that he did not want the HPI flow to be secured without instructions from him:

> . . . somewhere in the early morning, and I got there at 7 or 7:05 somewhere in the first hour and a half it was throttled beyond the point where I wanted it to be and I very strongly told Zewe and Ross personally that it wouldn't be secured without me personally. That is the one strong conversation that I can remember.
>
> (Miller, I&E, 9/5/80, p. 7.)

Miller has also said he recalled that:

> . . . somewhere between 8 and 9 in the morning, it was turned off. See, I've got to phrase this really when I got the watch between 7 and 7:30, it was on to my knowledge, it didn't bother me. The statements I just made really occurred somewhere between 7:30 and 8:30 when I was told or when I remember hearing, they had turned it off at that time, I

pulled Ross back into the shift supervisor's office where I could be alone with him and I told him in quite strong language that he should not turn it off without talking to me personally the rest of the day. That was the one thing that he couldn't do without seeing me.

(Miller, I&E, Tape #159, 5/7/79, p. 50.)

C. TEMPERATURE DATA

Primary system pressure and temperature data were the principal indicators of whether the TMI–2 core was being cooled adequately and whether the core had been damaged. This data indicated whether there were steam spaces within the primary system and whether the steam space extended into the reactor core. The temperature data also indicated whether core cooling had failed to the point where steam was reacting chemically with the zirconium fuel cladding, producing gaseous hydrogen and zirconium oxide.

The most significant temperature data was provided by temperature sensors located in the hot legs which normally carried water from the reactor pressure vessel to the steam generators, and by 52 temperature sensors placed above the reactor core. (The primary cooling system is depicted in Figures I–A and I–B.)

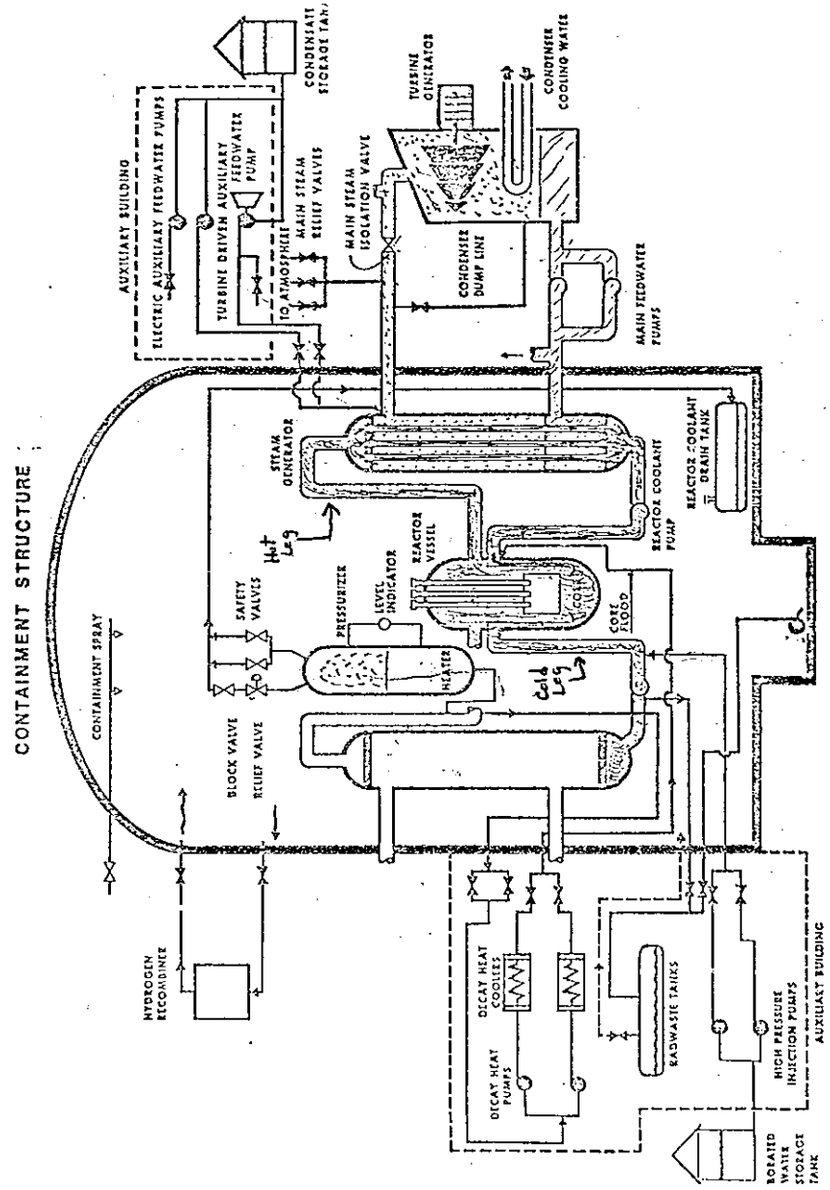


FIGURE I–A

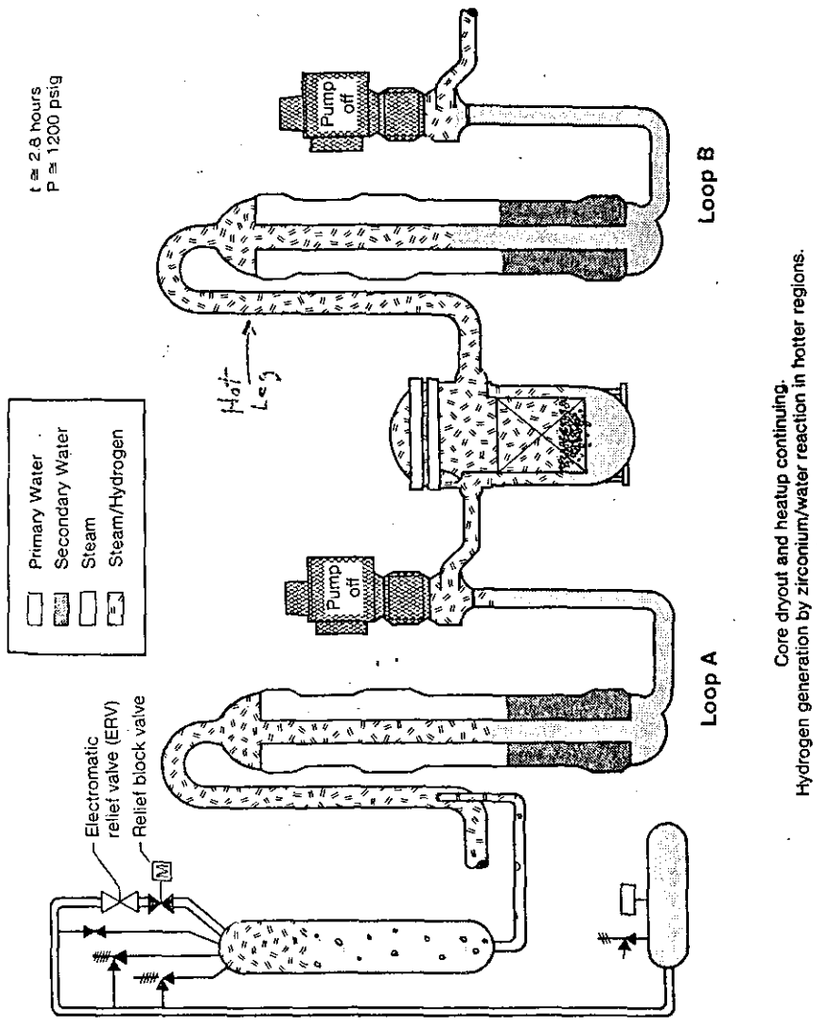


FIGURE I–B

At approximately 6 a.m. on March 28, temperature data began to indicate clearly that portions of the reactor core had become uncovered. Between 8 and 9 a.m. in-core thermocouple data indicated the high likelihood of a substantial steam-cladding interaction.

Several questions exist with regard to the temperature data: to what extent were TMI managers aware of it; to what extent did they interpret it along with other data to mean that there was steam within the primary cooling system; to what extent did they infer from this data the existence of a steam-cladding reaction; and to what extent was this data reported to State and Federal authorities?

The following excerpts from the record of the TMI inquiries indicate the following: Control room personnel's general awareness of hot-leg temperatures in excess of 700 degrees, a clear indication of the presence of steam in the hot legs; some awareness that the temperatures in excess of 700 degrees meant that the steam space had extended into the core; limited awareness that data from the in-core thermocouples indicated temperatures in excess of 2000 degrees above the core; and no admission by those having managerial responsibilities as having made the connection between the very high temperatures and a steam-cladding reaction. One technician involved in taking the in-core measurements prior to 9:30 a.m. on March 28 said the temperatures were of a magnitude to suggest to him that, "You've got a meltdown coming." (See p. 29.) [At least one supervisor (who was unaware of the direct measurements made of the in-core thermocouple voltages) has stated he inferred on March 28 from the 1:50 p.m. pressure pulse that there had been a hydrogen explosion in the containment building, and this supervisor says that others were aware of this event and its significance. (See pp. 71, 75–76.)]

D. HOT-LEG TEMPERATURE

Hot-leg temperature data at TMI–2 were normally presented on a computer printout and on a strip chart recorder mounted in the reactor control room. The computer was programed to record data between 520 degrees F. and 620 degrees F.; when the temperatures were outside this range, the computer printed question marks. The strip chart was capable of recording temperatures up to 800 degrees F. (See Figure II.)

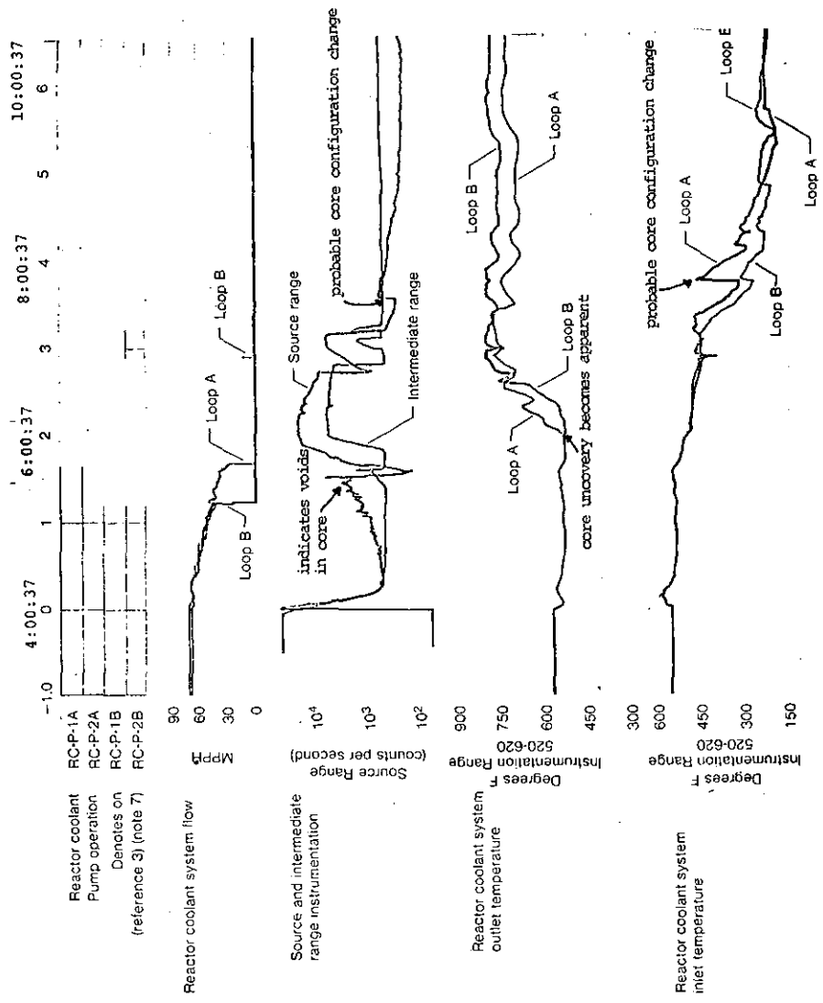


FIGURE II

Apparently owing to the computer being incapable of indicating hot-leg temperatures in excess of 620 degrees F., Station Manager Gary Miller, soon after he arrived at about 7:05 a.m., directed that a meter able to indicate the full range of hot-leg temperature be set up in the control room:

> When I turned to focus on plant conditions, an initial concern was that the hot-leg indication was off-scale. I asked that an extended scale readout device be connected to the hot leg RTD (resistance temperature measuring device).
>
> (E&E, TMI–2, part 2, p. 297.)

Miller stated that:

> . . . the extended hot leg temperature readout device indicated 720°F. (Ibid.)

Any temperature exceeding 660°F at the then prevailing pressures (which ranged up to 2,200 psi) clearly indicated the presence of superheated steam and probably, that the core was or had been uncovered.

The readings from the hot-leg instrument are also referred to by Ivan Porter, TMI–2 Instrument and Control engineer, and by John Flint, an engineer employed by Babcock and Wilcox who was stationed at TMI. Porter had been responsible for setting up the instrument, and he told NRC investigators that after initially questioning the validity of the readings he had checked some of the temperature readings taken from instruments within the core (see below) and that:

> . . . to me it confirmed that, what I was seeing on the RTD. That we had temperatures greater than 700 degrees in the plant, since 700 [3] degrees was full scale on the computer, and I was reading greater than 700 on the hot-leg RTD.
>
> (Porter, I&E, 5/21/79, p. 15.)

John Flint recalled that at this time (sometime after 9:00 a.m.):

> . . . Ivan Porter showed me a special setup with a RTD, that was approximately 724 degrees. (I&E, Tape 323, p. 34.)

Flint also noted that he himself had monitored the strip chart recorder in the control room which was recording the data Flint refers to in the preceding quote. This chart showed hot-leg temperatures indicating superheated conditions in the primary system which in turn indicated sections of the core had been uncovered (i.e. in a steam rather than water environment) for a significant portion of the period between 5:40 a.m. and 7:50 p.m.,[4] the latter being the time at which a relatively stable cooling arrangement was established. The strip chart shows that the hot-leg temperatures rose rapidly from the temperature at which water boiled for the prevailing pressure (i.e. saturation temperature) to superheated temperatures following shutdown of the last of the main sector coolant pumps at approximately 5:40 a.m.

Notes taken by B&W staff in Lynchburg, Va. on March 28 indicate awareness that personnel at TMI were not using the hot-leg temperature data as indicative of the current status of core covering. In effect, the notes state the pressurizer temperature was being used as the basis for inferring core output temperature since the flow of water was from

[3] This is in reference to the in-core thermocouples discussed below. The computer could indicate the in-core temperatures up to 700° whereas it could indicate the hot-leg temperatures only to 620°.

[4] See figure II, p. 18.

the reactor pressure vessel, into the pressurizer, and out the top of the pressurizer.[4a] The hot-leg temperature sensor was measuring the temperature at the top of the hot leg where steam and/or noncondensible gases were blocking flow through the steam generator. Therefore, the temperature at the top of the hot leg was more indicative of temperatures that had existed earlier (when the core was uncovered, e.g. at 7 a.m.) rather than later in the morning (e.g. 11 a.m.) when it was believed that the core was probably being cooled via high pressure injection flow through the core and out the pressurizer.

On September 4, 1980, Zewe engaged in the following dialog concerning the hot-leg temperatures and significance thereof:

> Q. On 3/28 did you recognize that the temperatures which were in the 740 to 800 degree range, those temperatures in excess of 705 degrees meant that the system had to contain superheated steam?
>
> A. Yes. Once we had seen that the temperatures were that high and we consulted the steam tables, yes.
>
> Q. Did you also recognize that it was above the critical temperature for steam?
>
> A. I really didn't correlate that with the critical temperature for steam.
>
> Q. When you were looking at the steam tables and recognized that superheated steam existed in the primary system, with whom did you have conversations regarding this superheated steam?
>
> A. All those present in the control room from the operation staff and from the management that were there were aware of the conditions but I really do not recall at when with who.
>
> (Zewe, I&E, 9/4/80, p. 18.)

In an interview with I&E inspectors on July 11, 1979, Kunder recalled (Tr. at 11) having been aware on March 28 that hot-leg temperatures were ". . . in the order of 700 or 800 degrees." On September 18, 1980 Kunder engaged in the following dialog with SIG investigators:

> Q. How did the high hot leg temperatures figure in this evaluation?
>
> A. We were looking desperately for those temperatures to show a decrease and that would point towards an improvement in our condition.
>
> Throughout a good portion of the morning and I guess into the afternoon, those temperatures were not responding as we were hoping them to respond in order to use those as a basis for suggesting core cooling was improving.
>
> Q. Were the hot leg temperatures disbelieved?
>
> A. No, I never disbelieved the hot leg temperatures. I thought they were about 800 degrees, in that range.
>
> I think that we had believed in those because we had more than one RTD telling us the same information.
>
> Q. So what you are saying is the hot leg temperatures showed you that you might not be getting out of the core cooling with this particular mode of cooling?

[4a] NUREG–0760, p. 111–6.

> A. At the time I viewed the hot leg temperatures of being representative of voiding steam in the core, I visualized the reactor cooling system as being steam bound in the upper section of the core and hot legs themselves. Since we were relieving steam through the electromatic relief valve at various portions of time in the morning and afternoon, that we were removing some heat. We could not confirm from those indications whether that removal of heat was adequate to keep the core safely cooled or improve the cooling of the core. We did not have indications that would conclusively confirm that the core was covered in its entirety.
>
> I believe that there was some possibility that we were having steaming in the core which was contributing to some voiding and I guess in a technical sense you could say the core was not fully covered but it was being cooled to some extent. That is the way I think I perceived things at that time.
>
> (Kunder, SIG 9/18/79, pp. 54–55.)

On September 4, 1980, Kunder engaged in the following dialog with I&E investigators:

> Q. George, you have previously testified that on the morning of March 28, 1979, after the reactor coolant pumps were shut off, the hot-leg temperatures steamed up. You were impressed by the magnitude of 700 to 800 degrees of the hot-leg temperatures. You perceived the core as being cooled by overheated steam. That is, you were considerably in excess of the saturation temperature.
>
> And, you never disbelieved the hot-leg temperatures because you had more than one RTD telling you the same information.
>
> Did you at any time on March 28, 1979, discuss this information or its implications with Messrs. Miller, Rogers, Flint, Herbein, Zewe, Mehler, or Chwastyk?
>
> A. I would have been engaged in various strategy discussions with Mr. Miller, and Mr. Rogers, throughout the morning, and that information was a parameter that was a factor in those discussions. But I don't remember any specific discussions. I just remember that at various times we assembled in the shift supervisor's office, and perhaps out in the control room, and discussed what we were going to do next because we recognized that we did have a need to establish cooling that we could identify with, and conclusively say was a situation that was under control.
>
> I really cannot remember any specifics, though.
>
> (Kunder, I&E, 9/18/80, pp. 11–12.)

Ross' recollection of his awareness on March 28 of hot-leg temperatures was expressed to I&E investigators on September 24, 1980 in the following dialog:

> Q. Mr. Ross, others have testified that the hot-leg temperatures which were measured by the digital voltmeter set up by Mr. Porter were known by think tank members and discussed in the meetings.

Were you aware that the instruments indicated temperatures of 700 to 800 degrees Fahrenheit?

A. I was aware they indicated temperatures around 700 degrees.

Q. What was your assessment of these temperatures? What did they mean to you?

A. They meant to me that I didn't have a cooling method for the core, is what it meant at the time. Today it means something different to me, as it does to any operator. But at the time it meant to me that I didn't have an adequate cooling method in the core.

Q. And you related it to method rather than coolant available?

A. I don't think I ever said, Oh, I've got a low level. I think I said, hey, I'm not removing the heat.

Q. Did you at any time on March 28th discuss the implications that you drew of these temperatures with Mr. Miller.

A. I think we did discuss them in the think tank.

(Ross, I&E, 9/24/80, p. 25–26.)

E. CREDIBILITY OF IN-CORE THERMOCOUPLE DATA

Other sources of temperature data were the 52 thermocouples installed inside the reactor pressure vessel above the fuel assemblies. These thermocouples sensed water (or steam) temperatures at particular points across the top of the core. Each thermocouple provided an indication of the temperature conditions above a particular fuel assembly while the hot-leg temperature sensing devices (discussed above) normally indicated the *average* temperature of water (or steam) leaving the reactor pressure vessel. There were, in fact, large differences between average temperatures as measured in the hot legs and the peak temperatures measured by the individual in-core thermocouples. It was these peak in-core temperatures that confirmed not only that the core was uncovered, but that the zirconium cladding was reacting with steam, producing hydrogen and zirconium oxide.

One or more TMI personnel showed an early and continuing interest in the in-core temperatures. They instructed the computer to print these temperatures at about 8:34 a.m., 8:47 a.m., 11:10 a.m., 12:40 p.m., 4:11 p.m., 6:30 p.m., 7:59 p.m., 8:56 p.m., and 9:56 p.m. Between 6 a.m. and 6 p.m. the temperature data for at least 40 percent of the thermocouples (EPRI, Fig. cl-11) were printed as question marks, indicating either that the thermocouples had failed or that the temperatures were in excess of 700 degrees F. Because some of the thermocouples alternated between indicating question marks and temperatures less than 700 degrees, it was more plausible that the readings were indicative of temperatures in excess of 700 degrees than indicative of instrument malfunction.[5] Moreover, if many had been damaged while others continued to function, this in itself would have been a reasonable indication that something major had happened in the core

[5] By approximately 12:45 a.m. on March 29 the thermocouples were mostly indicating temperatures less than 700 degrees and were apparently used thereafter as a prime indicator of core conditions.

resulting in disabling of the thermocouples. The following excerpts from interviews conducted by TMI investigators indicate that TMI personnel did in fact believe the in-core thermocouples were providing useful information.

John Flint, Babcock and Wilcox engineer stationed at TMI, told General Public Utilities investigators in an interview held on April 20:

> . . . shortly after I came in we also started calling up on the computer the in-core thermocouples attempting to establish what had happened in the core. Many of them were indicating questions marks which indicated that they were greater than their 700 degree F range. Only one or two seemed to indicate that they were in fact bad. These temperatures were monitored for the rest of the day to follow what was happening to the core.
>
> (Flint, GPU, 4/20/79, p. 5.)

Flint also told NRC I&E Inspectors that:

> When we first started dumping them out (i.e. calling up the in-core thermocouple data from the computer) many of them had question marks, which indicated they were above their normal scale of 700 degrees not printing out "bad" which would indicate that they had failed. Over the next few hours these thermocouples gradually came back on scale[;] we recovered more and more of them and towards late afternoon I believe we had most of them indicating on scale.
>
> (Flint, I&E, Tape 58–59, 4/23/79, p. 8.)

Gary Miller stated to IE inspectors:

> I was never trained that those thermocouples were too much of a device you were to use but I used them because they were the only indicator [of] what was going on in the core I had that was direct. So, I did utilize them but only to tell me that what I had was that severe, more than to prescribe a procedure or action or something.
>
> (Miller, I&E, Tape 160, 5/7/79, p. 12.)

Ivan Porter told NRC investigators:

> . . . I believe shortly after 7, he [station manager, Gary Miller] asked me about the readings on the in-core temperature detectors, and I punched out several of them [i.e., asked for computer printouts] . . .
>
> (Porter, I&E, Tape 237, 5/21/79, p. 14.)

Porter said he reported the results (i.e. temperatures in excess of 700 degrees F.) to Miller who asked Porter whether there was any way of measuring the thermocouple voltages in order to determine how much in excess of 700 degrees the temperatures might be. Porter told Miller that he thought he could get the information by connecting a digital voltmeter directly to the wires leading from the reactor core and measuring thereby the voltages (and therefore the temperatures) being fed into the computer. At this point there are varying recollections as to exactly who it was that Porter told to make the

measurements, as to how many measurements Porter requested, and as to the disposition of the data that was obtained.

In any event, four technicians in addition to Porter either participated in making the measurements, or observed as they were being made. One technician, whom the NRC investigators have designated Instrument Man B (IMB) in deference to his wish for anonymity, stated that:

> . . . Two of the thermocouples, the first few we had measured, were around 700 to 800 degrees, specific temperatures I can't quote you, I don't know. We had taken one off and we had measured 2600 degrees in and about that vicinity, it was very close to that. At that time neither one of us believed that this was a true reading because after seeing two, three that were 700, 800 degrees, 2600 was hard to believe so we decided to take a few more off. . . . I believe through the course of testing thermocouples, we had at least 10 or 12 we had disconnected the total. We had seen temperatures ranging anywhere from I know there was a bottom of about 690 degrees to uppers of 3700 to 4000 degrees.
>
> (IMB, I&E Tape 315, June 20, 1979, p. 11.)

While cladding temperatures probably did exceed 3,500 degrees, there is disagreement as to whether temperatures as high as 4,000 degrees were actually measured since it is unclear that the thermocouples would function at such temperatures. There is general agreement, however, that at least five people (Porter, Maintenance Foremen Bennett and Gilbert, Instrument Man Thomas Wright, and Instrument Man B) were directly aware of the instrument readings indicating temperatures in excess of 2,000 degrees F.; that is, temperatures at which there would be significant production of hydrogen. According to IMB, Porter questioned the validity of the measurements which consisted of four or five readings; and the technicians verified them using another meter (Ibid, pp. 14–17) to make measurements of 51 of the 52 thermocouples. Nine of the 51 were in excess of 2,000 degrees F. Where there was overlap, the second set of measurements, taken shortly after the first, confirmed the first set. IMB told the NRC investigators:

> Now the second set of readings did in fact correlate the original set of readings that was taken with the thermocouple reader. The general feeling at least amongst Jim (Wright) and myself was that the readings we had were true and accurate. All five of us that were present there did in fact visually see the actual readings we had taken both off the thermocouple reader and millivolt reader. All five of us did in fact verify that the millivolt reading through the conversion table was correct. So I am sure we didn't read the wrong table or the wrong one or something of that nature.
>
> (IMB, I&E Tape 315, June 20, 1979, p. 18.)

Bennett, Wright and IMB have stated with varying degrees of certitude their conclusion that the data indicated the core was uncovered. IMB told the investigators:

> . . . it was the general consensus amongst the instrument people there that the core was definitely uncovered, we kind of found it hard to believe that this many high temperatures that we had seen that all those incores would have been bad and the only way that they could have went bad that radically would be an uncovering of the core, and a super overheating. (Ibid., p. 17.)

Bennett:

> We had possibly uncovered the core was the only way we could see that you could have obtained temperatures of that magnitude. (Bennett, I&E, Tape 311, 6/19/79, p. 18.)

Wright:

> I feel then that there was a definite sign then that the core had definitely been uncovered to the point where it suffered damage. But it, I still say that, you know, I'm there to take the data. I'm not there to analyze it. So I gave them my personal opinion as in the, yeah, I do believe we did suffer some damage there. (Wright, I&E, Tape 310, June 15, 1979, p. 14.)

Porter has stated that after the first four or five readings had been taken that he brought the data to Miller; that he (Porter) told Bennett that he (Bennett) could continue to make measurements if he desired but that Porter did not see what use they would be. Porter has been ambiguous as to whether he was aware on March 28, that a second set of in-core measurements was made. The following are excerpts from Porter's discussions with NRC investigators with regard to circumstances leading to the taking of a second set of in-core thermocouple measurements and Porter's awareness of them:

> PORTER. Well, we couldn't get readings on the computer, so that's why we went downstairs. And we took the readings of the digital indicator. On the digital indicator you have to disconnect and hook up each one. And with the numbers I was getting, I couldn't see the value in reading them that precisely. So, they went ahead and took a complete set with just reading the millibles (sic, millivolts) on the terminals.
>
> FASANO. The second set confirmed the first?
>
> PORTER. I don't recall seeing 7 millible (sic, millivolt) readings again, at that time. In fact, it was sometime later, I was even aware that they existed. I guess I forgot they took them, quite frankly. I'm sure they must of have told me. Well, they do confirm it though. They are still scattered anywheres from 200 degrees to 2,500 which is about what I saw on the digital readout. There are just more of them.
>
> * * * * *
>
> Q. Do you know why additional readings were taken? Did you direct additional readings to be taken?
>
> A. (Porter) I don't think I directed it. I think Skip [Bennett] and I discussed it, and I told him it was his option, if he wanted to, and to go ahead and use the millivolt reader

to take the readings. But I didn't see the value we were going to get from the readings, considering the spread of values we were getting, and I knew we had readings that were too low to be real.

(Porter, I&E, 9/24/80, p. 7.)

* * * * *

Q. Did Mr. Bennett inform you that a complete set of readings had been taken?
A. (Porter) I don't recall that he did.
Q. When did you learn that a complete set had been taken?
A. (Porter) I believe it was May 7th.

(Porter, I&E, 9/24/80, p. 12.)

Nelson Bennett who supervised the technicians in the course of their making the measurements engaged in the following dialog with NRC investigators in which he recalled he had informed Porter that a complete set of measurements had been taken:

Mr. CRAIG. Who took the sheet on which the readings were recorded up to Unit II Control Room?
Mr. BENNETT. I did.
Mr. CRAIG. Was Ivan Porter informed a complete set of readings had been taken?
Mr. BENNETT. Yes, he was.
Mr. CRAIG. Was anyone else in the Control Room informed, or who would have overheard that?
Mr. BENNETT. I don't believe so.
Mr. CRAIG. And do you remember what you reported to Ivan Porter when you told him a complete set had been taken?
Mr. BENNETT. I don't remember the exact words.
Mr. HARPSTER. Do you recall what the substance of your conversation with Ivan Porter was when you told him about the readings?
Mr. BENNETT. Yes, you know, I'm trying to think now.
I remember he had obtained the initial readings we had taken down there and converted to temperature and I believe it was just, more or less, a statement that I had completed a complete set of all the thermocouples, written them in the Readings Book and placed on the Computer Council (sic, counsel).

(Bennett, I&E, 9/29/80, pp. 6–7.)

In a previous discussion with NRC investigators, Bennett also recalled having informed Porter of the complete set of measurements:

CRESWELL. So after you complete the measurements in the range of 8:45, 8:50 what happens then?
BENNETT. Myself, Mr. Gilbert, Mr. Yeager and Mr. Wright proceeded up to the Control Room. I believe Mr. Wright and Mr. Yeager then returned to the Unit 2 instrument shop. I had placed the computer . . . the point identification book back on the computer console. I had informed Mr. Porter that there was several thermocouples that were extremely hot in

the neighborhood of 2000 degrees Fahrenheit and then I believe that was about it I think I took the time . . . at that time I looked at the post trip re . . . not the post trip review . . . the sequence of events that had typed out of the computer that morning and then myself and Mr. Gilbert returned to the Unit 2 instrument shop.

(Bennett, I&E Tape 311, June 19, 1979, pp. 18–19.)

In answer to a question as to whether after making the second set of in-core measurements the information had been reported to Ivan Porter, Wright recalled:

WRIGHT. Yeah. He [Ivan Porter] wanted us to take down what all the readings were with all the point numbers and we had, again, we just had like a scrap of paper with us that we marked this stuff down on. And we took all the readings, you know, as in .1 through .20, I'm not sure how many points there are, but we took them all down with the corresponding millivoltage readings next to them and we turned them in to Ivan. I'm not sure if it was directly to Ivan or if we gave them to, say, Doug or Skip or whoever. But, eventually we were supposed to get to Ivan, I'm not sure. I'm very sure he saw them, you know, but I don't know if he saw the converted figures as far as what the temperatures were. He, you know, we had them in millivolts then.

(Wright, I&E Tape 310, June 15, 1979, p. 18.)

IMB's recollection concerning the reason for the second set of measurements and Porter's awareness of them is related in the following dialog with NRC inspectors:

CRESWELL. Who was present at that time?
IMB. That's Mr. Bennett, Mr. Gilbert, Mr. Porter. Okay Mr. Porter kind of doubted our word and didn't believe the readings. [Note: This presumably refers to the first set of readings.]
FASANO. How do you know he doubted your word?
IMB. . . . . he did turn around and look at us and says I don't believe your readings. Are you sure you're taking your readings correctly or is the thermocouple connected to the reader properly. So after assuring that, he wanted a verification that the thermocouple reader was working so the only verification we could really give not having type "K" material around to check it out was to get millivolt reader and measure the actual voltage coming up from the incore. So at this time I don't know who went up to get the meter, I believe it might have been Mr. Gilbert or Mr. Bennett went up to get a millivolt meter. (IMB, I&E Tape 315, June 20, 1979, pp. 14–15.)

* * * * *

IMB. Anyhow getting back to the subject, we had obtained a digital voltmeter with a cross reference table for voltage to temperature wise for Type K Indicators and we had reverified I would say at least 75 percent of the thermocouples we had originally taken readings on and especially the hot

ones, the very hot ones, the 2600, 3000, 4000 degrees one we had seen. The two instruments both agreed with each other so at that time Mr. Porter had left the room.

(IMB, I&E Tape 315, June 20, 1979, p. 16.)

In his statements to NRC investigators Porter has been ambivalent with regard to what he believed the significance of the in-core data to be. When asked whether he believed a reading of 2300 degrees to be anomalous, he stated:

I didn't know. I guess I was afraid it was real.

(Porter, I&E Tape 237, May 21, 1979, p. 20.)

But Porter also suggested that the measurements were not believeable. He said that in reporting to Gary Miller that Miller had asked him what he (Porter) thought the thermocouple measurements had meant. Porter told the NRC investigators that he was not sure of what his response to Miller had been, but that:

. . . my personal evaluation was that they (the thermocouples) had been destroyed.

(Ibid., p. 19.)

IMB told the investigators, however, that he had told Porter that he (IMB) believed the temperatures readings (presumably the initial four or five readings) indicated that the core was uncovered. IMB's recollection concerning his discussion with Porter regarding the significance of the in-core readings, as described in part on page 24, was:

CRESWELL. IMB, is there any doubt in your mind at the time all the measurements are completed that Mr. Porter has been told by the people down there that they feel the temperature indications indicate the core was uncovered.

IMB. Did he believe us?

CRESWELL. I say is there any doubt in your mind that he had not been told or that he had been told, sorry, that he had been told.

IMB. Oh, no, I personally told him that and he was physically there to read the readings. He saw the actual temperatures we had. This is why the first time he didn't believe it.

FASANO. Fasano speaking. When the verification of the measurements were made, using the millivolt meter was the information then given to the same individuals and how, what was the response to the second set of readings that tended to verify, at least correlate to the original readings.

IMB. OK. Now the second set of readings did in fact correlate the original set of readings that was taken with the thermocouple reader. The general feeling at least amongst Jim and myself was that the readings we had were true and accurate. All five of us that were present there did in fact visually see the actual readings we had taken both off the thermocouple reader and millivolt reader. All five of us did in fact verify that the millivolt reading through the conversion table was correct. So I am sure we didn't read the wrong table or the wrong line or something of that nature. At that

time between Mr. Bennett and myself, Mr. Wright, Mr. Gilbert, we had pretty well came to the conclusion the core was uncovered. I believe Ivan (Porter) didn't really want to believe what was really taking place. I don't know whether it was an attitude of, "hey, your measurements are wrong, you guys don't know what the heck you're doing or whatnot." I think the general consensus throughout the whole first day was number one nobody really knew what was actually happening, number two, some that had an inkling of what was happening didn't really want to believe what was going on. Once you start seeing a temperature of 3,000 to 4,000 degrees in a core, well . . . the first thing that starts coming to mind, you've got a meltdown coming. The core is uncovered.

(Ibid, pp. 17–19.)

Bennett has stated that he had the feeling that Porter agreed the temperatures indicated the core had been uncovered.

CRESWELL. After the second set of measurements was taken, do you recall any discussion, any further discussion of the core being uncovered?

BENNETT. Yeah, I believe that came up as a topic of discussion and we, I can't remember who said what, . . . there was no formal statements made down there at that time, just the technicians, and myself and Mr. Gilbert talking. It seemed . . . I was under the impression that the core had possibly been uncovered.

CRESWELL. Did you make a statement to Ivan Porter to that effect?

BENNETT. Yes, I believe we did when he was down there (i.e. when the initial 4 or 5 measurements were being made), and we had pretty much taken to believe the first reading we got up around 2000 degrees.

CRESWELL. What was his response?

BENNETT. I don't really remember what his verbal response was. I have a feeling that he was more or less in agreement with everybody else that was down there. We had possibly uncovered the core was the only way we could see that you could have obtained temperatures of that magnitude.

(Bennett, I&E Tape 311, 6/19/79, pp. 17–18.)

Wright's recollection as to whether Porter believed the in-core measurements:

CRESWELL. OK. Did you or did anybody with you make a statement that they thought that the core had been uncovered?

WRIGHT. My partner who works primarily in Unit 1; we have four people per shift, usually, and two people in Unit 1 and two people in Unit 2. My counterpart, I suppose, the First Class on the team that Unit 1 was also along as my helper in the relay room, his name is Bill Yeager. He had made the remark that the core's uncovered, "Look at that. The core's uncovered." Now, again, people say things, but that's, he did come up and say that.

CRESWELL. OK. Was Mr. Porter there whenever he said that?

WRIGHT. Ivan came down, like I said, when we were almost done taking the first five readings and by looking at the one that was 2,000 degrees, he (IMB), you know, he turned around and said to Ivan, "Look, you know, it's uncovered. You got 2,000 degrees down there." But, of course, you know, you can't really make that type of decision, but that's what he did say.

CRESWELL. You would be careful about making a decision based on one reading, is that what you're saying?

WRIGHT. I, myself...

CRESWELL. You personally . . .

WRIGHT. I, myself don't stick my foot in my mouth, to speak. I've learned enough to step back and look at things a little bit more before I jump to conclusions, and . . .

CRESWELL. After the second set of figures, where a second set of measurements were made. Do you feel that a statement like that could be made . . .

WRIGHT. I feel . . .

CRESWELL. More rationally . . .

WRIGHT. I feel then that there was a definite sign then that the core had definitely been uncovered to the point where it suffered damage. But it, I still say that, you know, I'm there to take the data. I'm not there to analyze it. So, I gave them my personal opinion as in the, yeah, I do believe we did suffer some damage there.

CRESWELL. That's the time . . .

WRIGHT. Which, by that time Ivan already knew that anyhow because he had said, "Yeah, it doesn't look good," or something similar to that. Like I said, we were doing quite a few things and quite hectic.

(Wright, I&E Tape 310, June 15, 1979, pp. 13–14.)

Whatever it was that Porter believed about the validity of the in-core data and whatever he actually told Station Manager Gary Miller, Miller told NRC investigators:

> . . . (T)he instrument tech came back and Ivan told me that some read 200, some read 400 and some read 2500 and some didn't read. Then he explained to me that if they were really hot they would melt and form other junctions and that the calibration wouldn't be good anymore. So you know the bottom line here was that they [the in-cores] are hot, they were hot enough that they scared you, as far as what you're looking for. It told me that the reason the computer was off scale at 700 degrees F. . . . The in-cores were reading anywhere from 2500 or so, and I picked 2500. It could have been higher than that. But that you know, I was looking for a gross indicator and I had it. . . . I know that we were superheated and all that sort of thing. I don't think we tumbled to that kind of lodge [sic, logic?] but we just know we didn't have a control, we were out of control. We knew the situation was one we hadn't anticipated too many times here.
>
> (Miller, I&E Tape 159, May 7, 1979, pp. 51–52.)

It remains unclear with regard to who saw the total set of data obtained from the in-core measurements. This data when plotted on a map of the core showed hot regions within the core and cold regions on the periphery. See Figure III.

FIGURE III

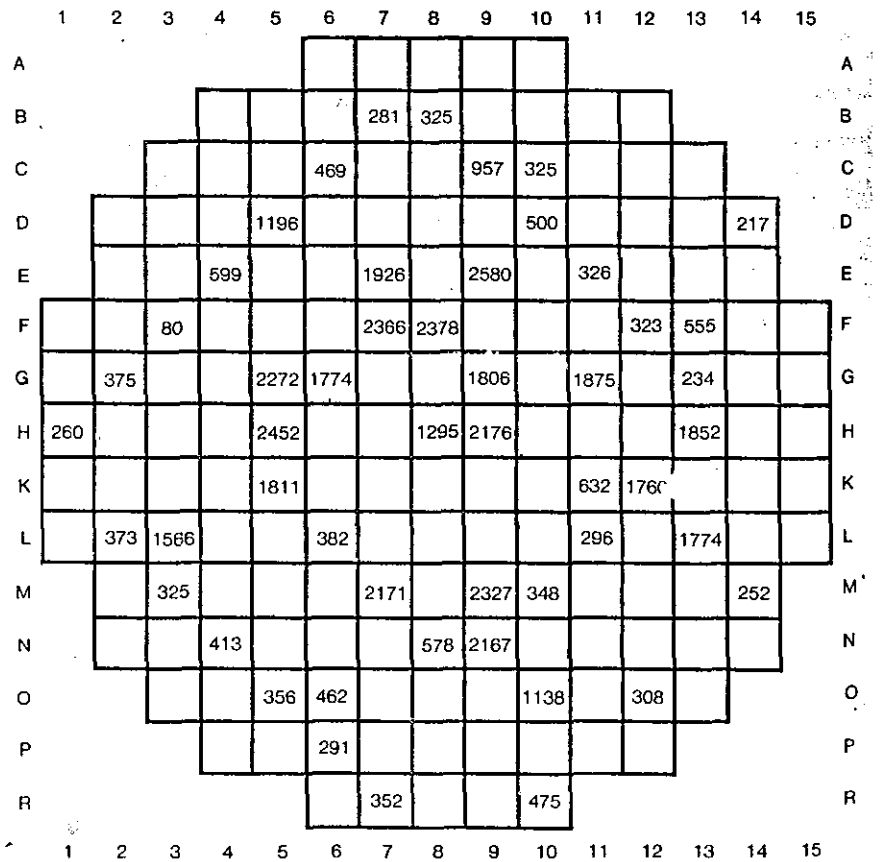


Figure CI-12. Map of Core Exit Temperature (°F)
240–330 min.

Mike Ross, a TMI–I superintendent, who was a member of the group making decisions on March 28 engaged in the following dialog with NRC investigators:

> HUNTER (NRC investigator). Okay. Do you recall in the discussions, think tank discussions, that the thermocouple temperatures were, in fact, brought up in the discussions?"

Ross. Thermocouple temperatures were brought up to Gary Miller, and I guess the bottom line they got out of that, was that they were not conclusive. It showed the core was hot, basically. I was going to say his range varied, very scattered. He had like . . . He was saying he had various temperatures scattered throughout. So, well, Gary and he discussed it, and basically I think the bottom line was yeah, the core is hot, or it is at least hot.

(Ross, I&E Tape 226, May 19, 1979, p. 42.)

That the in-core thermocouples had indicated temperatures in excess of 2,000 degrees (implying probable hydrogen production) was apparently not reported to the NRC during the first few days of the accident. Victor Stello (then NRC Director of Operating Reactors under Harold Denton) said he had not known of such measurements until the week of April 1. Roger Mattson (Director of Systems Safety under Harold Denton) stated to the E&E Task Force on May 9 that this was the first he had heard of such temperatures.

Stello, however, had been concerned on March 28 about data indicating superheated conditions in the hot-legs. He requested computer printouts of the in-core thermocouple data. There ensued the following dialog between Three Mile Island and the NRC's Incident Response Center in Bethesda:

VOICE. First of all, I can't get the in-core temperatures. Okay?

VOICE. You cannot get them?

VOICE. They print out question marks.

VOICE. They print out question marks?

VOICE. Yes.

VOICE. Okay, what's that mean?

VOICE. That means that either the computer point is messed up—okay?

VOICE. Yes.

VOICE. Or that the line—you know, the—where you sense it, that line's broken or something's messed up with that line. Okay? They were printing earlier. Yeah, the computer just won't—the computer won't spit out a good number for them. They're trying all of them to see if we can get any of them to print. Okay?

(01–033–CH 2/20–MEM–10.)

Based on the foregoing discussion, NRC I&E investigators stated that at approximately 4:10 p.m. on March 28: "Reported incore temperatures unavailable. Supervisor (at TMI) reports to NRC they (in-cores) are all printing question marks which means either the computer point or the sensor is malfunction (sic)."

(NUREG 0600, IA–101.)

Yet practically coincident with the conversation in which the NRC was told that the computer was printing out question marks, the computer was in fact displaying not only question marks but also two on-scale readings, one indicating that thermocouple 9–H was showing a temperature of 596.9 degrees F., and the other showing thermocouple 6–L indicating a temperature of 562.1 F. Both temperatures were indicative of superheated conditions in the core and

the likelihood that the reason for the question marks was high temperature rather than a malfunction of the instruments.

A reproduction of the computer printout follows:

```
        16:03:13    182.7 135.1 591.4 474.7 457.4  581. 421.6 376.3 285.9
        16:10:13    182.5 128.9 591.5 476.0 456.6  586. 421.3 376.3 285.0
        16:11:32  DATA  0493  IN INCORE T/C  8-H TEMP          -???.?
        16:11:41  DATA  0494  IN INCORE T/C  9-H TEMP           596.9
        16:11:49  DATA  0495  IN INCORE T/C  9-G TEMP          -???.?
        16:11:57  DATA  0496  IN INCORE T/C  8-F TEMP          -???.?
        16:12:06  DATA  0497  IN INCORE T/C  9-E TEMP          -???.?
        16:12:14  GROUP TREND
                  OPERATOR GROUP C
                    1032  0386  0390  0389  0468  0393  0472  0483  0469
        16:12:51    182.2 121.9 591.1 476.4 456.0  591. 420.8 376.3 285.0
        16:13:44  DATA  0498  IN INCORE T/C  7-F TEMP          -???.?
        16:13:53  DATA  0499  IN INCORE T/C  7-E TEMP          -???.?
        16:14:03  DATA  0500  IN INCORE T/C  6-G TEMP          -???.?
        16:14:12  DATA  0501  IN INCORE T/C  5-G TEMP          -???.?
        16:14:22  GROUP TREND
                  OPERATOR GROUP C
                    1032  0386  0390  0389  0468  0393  0472  0483  0469
        16:15:02    182.0 116.7 591.0 477.9 455.2  595. 420.5 376.3 285.1
        16:15:54  DATA  0502  IN INCORE T/C  5-H TEMP          -???.?
        16:16:03  DATA  0503  IN INCORE T/C  5-K TEMP          -???.?
        16:16:13  DATA  0504  IN INCORE T/C  6-L TEMP           562.1
        16:16:22  GROUP TREND
                  OPERATOR GROUP C
                    1032  0386  0390  0389  0468  0393  0472  0483  0469
        16:17:03    181.8 110.6 591.1 478.2 454.3  595. 420.3 376.4 285.0
        16:17:54  DATA  0505  IN INCORE T/C  7-H TEMP          -???.?
        16:18:03  DATA  0506  IN INCORE T/C  8-H TEMP          -???.?
        16:18:13  GROUP TREND
                  OPERATOR GROUP C
                    1032  0386  0390  0389  0468  0393  0472  0483  0469
        16:18:54    181.6 107.0 591.2 478.9 454.1  598. 420.0 376.4 285.1
        16:19:47  DATA  0507  IN INCORE T/C  9-H TEMP          -???.?
```

Although the in-core thermocouple data was printed at least 9 times between 8:00 a.m. and 10:00 p.m. on March 28 there appears to be no record of any set of such data having been transmitted to the NRC's Incident Response Center in Bethesda.

D. NEUTRON DETECTORS

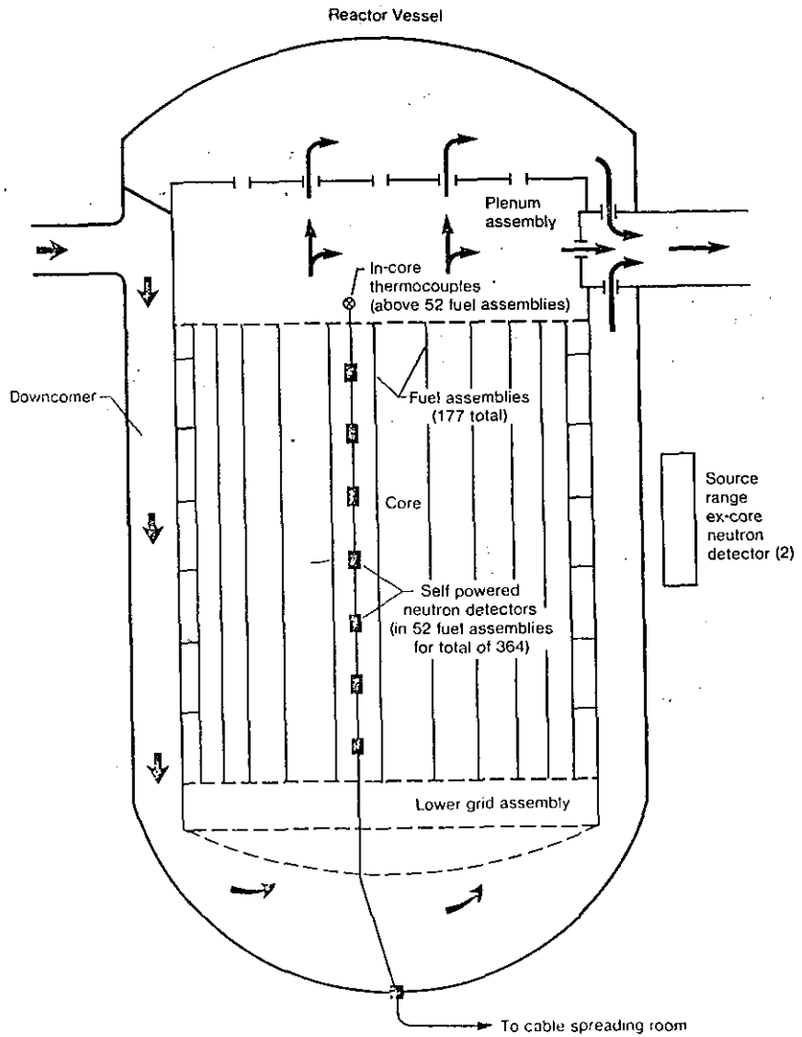
TMI–2 instrumentation included neutron detectors mounted outside the reactor pressure vessel and 52 strings of detectors mounted inside. Both in-core and ex-core detectors are installed for the purpose of providing operational data; during normal operations, the in-core neutron detectors indicate power production at various locations within the core. During the TMI accident both in-core and ex-core detectors provided data indicating the core was uncovered.

The ex-core instruments indicated increased neutron levels. These were interpreted initially as indicating that the reactor was near the critical point where a self-sustaining chain reaction might be occurring. The operators believed that this might happen as a result of insufficient boron concentration in the primary system coolant. In actuality the apparent increase in neutron flux resulted from the fact that neutrons—produced at small rates in a reactor core even when the reactor is subcritical—because of voids in the core, were more likely to be leaked from the pressure vessel and were therefore reach-

ing the ex-core instruments in greater numbers. In short, the increased neutron flux was due to the pressure vessel having lost water and not to a restart of the chain reaction.

The in-core neutron detectors also yielded data indicating that the core was uncovered and the depth of the uncovering. Once the water level went below the neutron detector and the temperature of its surroundings rose, the detector responded to the higher temperatures and became, in effect, a temperature sensitive device which provided indirect indication of water level in the core. (See figure IV.)

FIGURE IV



Basic reactor configuration and instrument locations.

The record is unclear as the extent to which the TMI supervisors used the neutron detector data as an indication that the core had been uncovered. The record shows that increased counting rates were initially interpreted as an indicator of the reactor going critical. As a result, additional boron was injected into the primary cooling system. During the morning of March 28, B&W engineer John Flint looked at the neutron detector data and concluded that in all probability the increased counting rates were due to a change in the leakage path. Flint told the I&E inspectors:

> Indications for the source and intermediate range (neutron detectors) appeared to be normal, for this period of time following a shutdown condition. I did notice, however, that there were several blips on the recorder for source/intermediate range and in conversation with Ed Fredericks he informed me that they thought at the time that they were going critical and that they had added additional boron to the system. At this time, I informed them that in all probability this was not the case, that there had been a change in leakage flux path from the reactor core to the detectors and it was not in fact the case the reactor going critical again.
>
> (Flint, I&E Tape 58 & 59, May 23, 1979, p. 4.)

E. HIGH RADIATION LEVELS IN REACTOR COOLANT SYSTEM AND IN CONTAINMENT BUILDING

At 6:35 a.m. a radiation monitor mounted at the top of the containment building indicated radiation levels of about 0.1 Roentgen (R) per hour. By 7:30 a.m. this monitor was indicating levels in excess of 10,000 R per hour [6] in the vicinity of the monitor due to fission product gases near the top of the dome. (Approximately 50 percent of persons exposed to this dose rate would receive a lethal dose in about 4 minutes.) These radiation levels implied that radioactive fission product gases had been released from a significant fraction of the fuel rods; the only way such a release could have occurred would have been through development of cracks or perforations in the cladding.

At approximately 8:50 a.m. on March 28, a reactor coolant sample was obtained by technicians who, in order to obtain it were required to enter a room where radiation levels approximated 200 R/hour. Analysis of the sample and knowledge of the procedure by which it had been obtained would have indicated fuel rod failure much more extensive than that publicly reported on March 28. The record is unclear as to who among the TMI managers was aware of the sample or the conclusions reached from analyzing it. It is also unclear as to the time at which the NRC was informed of the analysis. The taking of the sample (but not the circumstances of its analysis) is discussed at length in Section II of NUREG 0600.

F. UNCOVERING OF THE CORE

As the primary cooling system continued to lose water, the water level in the pressure vessel dropped below the tops of the fuel rods. The fuel was then cooled by steam rather than water, and as the water

[6] Miller recalled that at about 7 a.m. the dome monitor was indicating on the order of 50,000 R/hour.

[Miller, Tape No. 158, 5/7/79, p. 26.]

level dropped further, cooling became inadequate. The temperature of the zirconium tubes holding the uranium fuel pellets rose to a point where the zirconium reacted chemically with the steam, producing the hydrogen and zirconium oxide.

The manifestations of the core being uncovered have been discussed in previous sections: superheated conditions in the hot-legs and above the fuel, high radiation levels in the reactor containment building, and high neutron fluxes outside the pressure vessel. Several of those present interpreted this information to mean the core had been uncovered. Others recall being unsure as to whether it had been uncovered or not. The recollections in this regard as presented to TMI investigators are as follows.

As is indicated above, the technicians who measured the in-core thermocouple voltages concluded that the high temperatures they observed implied that the core had been uncovered. (Supra, p. 25.)

John Flint, the B&W engineer stationed at the site told I&E investigators (9/2/80, p. 4) that it had been his impression on March 28 that the PORV had been open for 12 to 15 minutes and that it was not until 2 days later that he "found out that it had been open for several hours." He was also apparently unaware of the throttling of the high-pressure injection and of the direct measurements of the in-core thermocouple voltages indicating temperatures in excess of 2,000 degrees. On the basis of temperature and neutron data, Flint did conclude, however, at 10:30 a.m. or thereabouts that the core had been uncovered earlier, even though it appeared to him that by 10:30 a.m. it was again covered. Flint engaged in the following dialog with the Kemeny Commission interviewers. The answers are Flint's:

> Q. When you reached the conclusion that the core had been uncovered approximately an hour to an hour and a half after you arrived, which would be something in the order of 10 to 10:30, did you tell anyone?
> A. Yes, I did. I believe I mentioned it to Lee Rogers at the time.
> Q. What was his reaction?
> A. I believe he went to discuss it with Gary Miller and George Kunder.
> Q. Were you present during that discussion?
> A. No, I was not.
> Q. Did he report back to you?
> A. I don't remember him addressing that specific question, no.
> Q. Did you ever find out what discussion he had with Kunder and Miller with respect to core uncovery?
> A. Not that I can remember, no.
> Q. Did you tell anyone else that you had reached the conclusion that the core had uncovered?
> A. Bell Zewe, Ed Fredericks.
> Q. What was their reaction?
> A. I would say surprised.
> Q. It was news to them?
> A. Yes.

> Q. It was news to Rogers, too, when you told him?
> A. That is correct, so far as I know.
> (Flint, TMI Comm., 6/30/79, pp. 23–24.)

In a discussion with I&E investigators on September 2, 1980, Rogers was vague about his March 28 conversations with Flint and he conveyed the impression that he did not get the idea from these conversations that the core had been uncovered:

> Q. Did you discuss any time that day the core exit thermocouple readings with the exception of can we really believe them, with Miller, Kunder, Flint, Herbein or Chwastyk?
> A. That's hard to recall at all. The answer to that has to leg temperatures, sort of backed each other up?
> Q. Did you have a conversation with John Flint with respect to the hotleg temperatures that he felt that the temperature indication, both the core exit thermocouples and the hotleg temperatures, sort of backed each other up?
> A. Not that I remember, no.
> Q. Based on your discussions with John Flint, did you believe that the core had been uncovered on the morning of 3/28/79?
> A. I never remember reaching that conclusion at all. I more or less felt that from the time I was there, all the indications to me were that we had water in the core, and not trying to put together anything prior to that. I don't remember any conclusion on that line whatsoever.
> Q. Water in the core meaning that the core was entirely covered?
> A. I was confident of that during the time I was there, yes.
>
> By Mr. MOSELEY.
> Q. In this morning, Mr. Flint described a discussion with you of his inferences from the nuclear instrumentation. You don't recall such a discussion?
> A. No, I don't. The answer is no.
> (I&E, Rogers, 9/2/80, pp. 27–28.)

Shift Supervisor Bill Zewe told NRC investigators, on the one hand that "I never thought myself that the core had been uncovered," (IE, 9/4/80, p. 20) but also that they did not know how much water was in the system which raises the question as to what the basis was for believing the core to be covered, particularly in view of the indications that the core had in fact been uncovered. Zewe's dialog with NRC investigators on this point follows:

> Q. Did you at any time on the day of the accident discuss primary system inventory with Mr. Miller?
> A. I don't recall the specifics, but, yes, the core cooling and primary system inventory—not quantitatively, but was one of the highest priorities we had, yes. But I don't recall saying how many gallons or whether or not the—how full the system was, because we really didn't know at that point.

* * * * * * *

Q. I think his question, if I may, is trying to differentiate between something that might be described as a general concern for inventory and one that might be described as specific. Were the discussions centered around the fact that there was an inventory problem?

A. We discussed at various times whether the core was being cooled and whether the core indeed was always—remained to be covered, and we concluded that it was.

By Mr. HOEFLING.

Q. Who are the "we" that you are referring to?

A. Operating and managing staff that was in the control room at the time.

Q. Did that include Mr. Miller?

A. Mr. Miller and Mr. Ross.

Q. Mr. Rogers?

A. Ross.

Q. I understand that. Mr. Rogers?

A. Mr. Rogers was there. I am—some time during the day, yes, he was there during some of the conversations, but when he arrived and that, I'm not sure of that.

(Zewe, I&E, 9/4/80, pp. 27–28.)

Ross told I&E investigators that the question was raised as to whether the core was covered but that, as he recalled it, the question did not stem from the observation that hot-leg temperatures were in the range of 700 to 800 degrees. NRC investigators said to Ross:

OK. You have told us what your assessment of these temperatures were, in the range of 700 to 800. Was the assessment of any of the members of the think tank different from your own?

(Ross, I&E, 9/24/80, p. 28.)

Ross answered:

That I can't really say. I can say in our discussions, no one jumped up and down and said the core is uncovered. A couple of times the question was raised, are we sure it's covered. But no one related the temperature at that time to either superheat or anything, any of the things we would do today. (Ibid.)

It is unclear from the foregoing what inference, other than that the core was or had been uncovered, was drawn from the observed temperatures.

Ross told I&E investigators in a discussion held prior to the one quoted above that uncertainties as to whether the core was covered had led to the decision at approximately 11:30 a.m. to change from the pressurization strategy to the attempt to depressurize the primary system. Ross' statement in this regard appears in the following section, "Uncertainty as to Adequacy of Core Cooling."

Contrary to Ross' recollection that no one had related superheat to the core uncovery, Kunder told NRC investigators that superheated temperatures had indicated to him that the core had been uncovered:

CRESWELL. What was your interpretation of the superheated temperatures? Did that indicate the core was not covered or covered to you?

KUNDER. Well, it indicated that the core had been uncovered and that we thought that we were getting at least cooling to the core such that effectively it was covered. It probably had a lot of voids in the thing but it was being cooled and cooled through the superheating mechanism cause I know it was sometime in the middle of the morning when we were meeting with Gary and Lee Rodgers and so forth. The thing that was scaring me was the thought that we were putting water in the core from high pressure injection and it was boiling off and concentrating boric acid and I was really scared that we would end up blocking flow lanes and stuff you know with the boric acid unless we'd get enough cooling water near to really get some sort of circulation and the only circulation that we could conceive of getting was to blow fluid out the electromatic relief valve which was the only place that we could find any kind of venting path and hopefully carry over whatever other mechanism would exist would at least minimize any kind of buildup of boric acid and . . . but . . . I know the feeling that I had was that we were cooling the core but at a elevated temperature in through the steaming process because we I don't think I thought in terms of the supercritical steam point I don't think that thought went through my mind but at that point I'm not sure I was prepared to think of that sort of thing but I knew that we probably had a bubble in there, a steam bubble, so to avoid and I couldn't define it in my own mind or really get a feel for what it was like but as long as we were pumping in the high pressure injection that was the only thing we could do other than try and start a pump and that had been tried by others and it was apparently unsuccessful at that point.

(I&E, Kunder, 7/11/79, pp. 10–11.)

Kunder told NRC investigators in a subsequent interview:

So it's apparent that we had high temperatures and I was concerned as well as the rest of the group that the high pressure injection may not be doing an adequate job getting enough water to the core to keep it cool and we think we became of the frame of mind that we did have a *vapor binding effect in the core.*

(Kunder, I&E Tapes 246 & 247, May 17, 1979, p. 44, italic added.)

In an interview conducted on September 4, 1980 NRC investigators referred to previous Kunder testimony:

Q. George you have stated in previous testimony and let me quote from your testimony here: "In my own mind, I believe, and in the minds of almost everybody there, we thought that we were pumping steam. We were pretty well aware that we had at least a half-hour, or maybe a lot sooner than that. We really blew it because, indeed, we had lost coolant. I guess it was within maybe the next 15 minutes or half-hour when I, along with everyone else, recognized that we had significant steam void inside the reactor coolant system. We were concerned at that point that we might be uncovering the core."

These statements seem to indicate that there was general agreement as to the apparent inventory problems. Did you at any time on March 28, 1979, discuss, overhear, or become aware of any conversations with regard to the primary system inventory?

A. I think we just covered that area. We were part of a command team, and that subject was our main concern. I cannot remember specific conversations, but I am sure there were.

Q. Let me ask you more directly, do you recall specifically were the conclusions of core uncovery and the loss of coolant discussed with Gary Miller on March 28, 1979?

A. I don't remember any specific discussions. It was the subject of discussion that morning.

(Kunder, I&E, 9/4/80, pp. 21–22.)

James Seelinger, former Superintendent of TMI Unit I engaged in the following dialog with NRC investigators regarding his perception on March 28 that high radiation readings indicated the TMI–2 core was or had been uncovered:

Q. Am I fair, then, in saying that when you gave this testimony on September 5th, it was your belief, or your recollection of March 28th, that the core had been partially uncovered, in your mind, to cause that type of radiation level?

A. A fair statement is the statement I made on September the 5th, which I will read again because you did not finish all of the statement.

"In terms of coverage of the core, we obviously had some very significant radiation problems. Those problems come from something like uncovery of the core. So, whether it was still uncovered, or whether it had ever become partially uncovered, I think it was probably in our minds that at one time, it at least suffered some amount of uncovery. The exact status of it at the time, we were fighting to determine."

That, sir, represents my best recollection at the time and, I think, accurately reflects my thinking at the time.

Q. Let me take you to page 86 of the same interview, line 21.

"We didn't know if the core was covered, or, at least, felt that by putting the core flood tanks in, we could assure we were putting water in to cover the core if the core were not covered."

Is it fair to say that that statement on September 5th at least infers that there is some doubt in your mind on March 28th as to whether or not the core had been partially uncovered?

A. Sir, I feel the statement on page 86 is directly supportive and coincident with lines 1 and 2 on page 75: "The exact status of it,"—meaning the core—"at that time, we were fighting to determine."

Q. Did you believe at any time on March 28th that the core could have been partially uncovered?

A. Yes, sir.

Q. Did you believe at any time on March 28th that the core had partially been uncovered?

A. Yes, sir.

(Seelinger, I&E, 10/14/80, pp. 57–59.)

* * * * * * *

Q. Mr. Seelinger, I think you already stated you believed the core uncovery was the result of the radiation readings that you were seeing; is that right?

A. Could you please ask that question again?

Q. You just stated that you believed on the 28th that the core had been partially uncovered.

A. Yes, sir.

Q. I believe we have already asked the question; I just wanted to restate it: Why you believe the core had been partially uncovered on the day of the accident.

Mr. McBride. You want him to restate why he believed that?

Mr. Craig. Yes.

The Witness. I believe that from the high radiation readings that I was seeing.

By Mr. Craig.

Q. So that you believe the core was uncovered possibly partially uncovered on 3/28 in the morning, right after you saw the radiation readings; is that correct?

I am trying to get when you came to the conclusion that the core could have been partially—or, was partially—uncovered.

A. I need you to phrase your question more carefully.

Q. When on 3/28, 1979, did you believe the core had been partially uncovered?

Mr. McBride. When did he believe it, or when was it uncovered?

Mr. Craig. No.

I don't want you to try to identify what point in the accident sequence the core was uncovered.

By Mr. Craig.

Q. When did you believe—When did you come to the realization?

A. I think that, to the best of my recollection, when I heard that any of the radiation monitoring alarms were offscale high in Unit 2, that the postulation went through my mind that the core could have been partially uncovered to have had these kinds of radiation readings.

By Mr. Moseley.

Q. That puts it in the morning, early morning time frame?

A. Yes, sir.

By Mr. Hoefling.

Q. You used the word: "Could" when you made that statement.

Are you saying, as well, it could not?

I want to get a feel for the strength with which you are identifying the time at which you realized the core had been uncovered.

Was it at that early point in the morning?

A. The time point in the morning that I learned that we had many of the radiation monitoring alarms offscale high was a

period of time when I was in Unit Number 1 and knew very little about plant conditions in Unit 2.

I subsequently learned more about plant conditions in Unit 2, as I recall, when I went to the Unit 2 control room.

So, I used the word: "Could" because I can't, sitting here today, recognizing, or, at least, feeling like I didn't know any specific plant conditions with certainty while I was in Unit 1.

I didn't feel I could make the statement without putting: "Could" at that point in time.

Q. Right.

Now, can you help us out with identifying with some more precision when you felt—when you did reach that realization. Was it at this 8:00 to 10:00 interval, when you were in the Unit 2 control room?

A. I would say that when I learned of plant conditions while in the Unit 2 control room and still had the offscale radiation readings, that the two did not contradict each other, and therefore, the "Could" is strengthened and is a stronger kind of conclusion than when I was in the Unit 1.

Q. In all likelihood, would you have reached that conclusion prior to leaving the Unit 2 control room that morning?

A. Yes, sir.

(Seelinger, I&E, 10/14/80, pp. 59–62.)

* * * * * * *

Q. I am only a layman, but, to me, the conclusion of partial core uncovery is a significant one.

Would you share that view that that conclusion was significant?

Was it significant to you?

Mr. McBride. On 3/28/79?

Mr. Hoefling. On 3/28, in the approximate time frame from 8:00 to 10:00 that morning.

The Witness. Yes, sir; it was significant to me, and it was significant to me in the context of the radiation readings which I was trying to deal with, and it was significant to me in what I thought was being passed off-site, in terms of those radiation readings.

By Mr. Hoefling.

Q. But, you didn't discuss that specific conclusion, partial core uncovery, with anyone?

A. No, sir.

(Seelinger, I&E, 10/14/80, p. 67.)

Station Manager Gary Miller has made several statements with regard to his perception as to whether the core was or had been uncovered. The report of the Senate Subcommittee on Nuclear Regulation quotes Miller as having said in a meeting held 2 weeks after the accident:

> Based on the instruments we had we didn't know whether the core was covered. (Senate, p. 114.)

When asked whether he had inferred that there might be an inventory problem from the facts that the HPI flow had been throttled, that let-down flow was increased, that the reactor coolant pumps were shut off because they were not pumping water, that the PORV had been open for some extended period of time, that the hot-leg temperatures were significantly higher than one would expect and in fact indicated superheated conditions, Miller responded:

> A. We inferred that there was an inventory problem, and we were certainly aware of some fuel damage because of the readings in the building. But to infer that the core had, say, been empty, we didn't arrive at that point in our minds. I had never discussed that in my whole life prior to March 28th. Therefore I was concerned and action was taken to ensure water went on the core. As to whether the core coverage was of a certain amount based on those things, I can't recall that lucid a discussion of that, other than assurance that the core was kept covered.
>
> Q. Given these indications, isn't there reason to suspect that it might not be?
>
> A. There is reason to suspect that it might not be, yes.
>
> (Miller, I&E, September 5, 1980, p. 36.)

In an interview with the NRC Special Inquiry Group on September 20, 1979, Miller described his concern about the possibility of the core being uncovered:

> Q. In a prior I. & E. interview you mentioned that as you recall it, the group that you were consulting with spent a good part of the morning not totally convinced that the core was completely covered.
>
> A. (Affirmative nod.)
>
> Q. Is that an accurate characterization of your state of mind?
>
> A. I think as we met we were trying to give ourselves the absolute assurance that we were covering the core, and I think that we understood that there was steam in a lot of the system. There are not very many indicators of core level that you are taught about. And I think, therefore, there were—we were questioning ourselves as to whether high pressure injection was, in fact, going on the core.
>
> And I think there were members of the group that were just not totally convinced that all of it was going on the core. And that was discussed in probably, I think, most of the meetings.
>
> Q. Did you ever put together the high or very high temperatures that might be in portions of the core with this concern about possible uncovery or a possible state of steam heat removal rather than water contact with the fuel elements?
>
> A. I don't remember discussing boiling in the core. I do remember us discussing, assuring that the coverage was there over the core and that we were—we were concerned about the high temperatures and the steam environment that we were under in most of the system.

And we didn't—I don't think we thought back about whether there had been uncoverage as much as we thought is it still totally covered. We didn't discuss boiling water in the core that I remember.

Q. I think, if not you, other members of that group have testified before that periodically over the morning you got together and said in substance, okay, now do we all think the core is covered. Do you remember that?

A. I remember. I think I remember the core coverage was probably the biggest thing I could—you know, the single issue among the group. Other than the emergency plan, which we—which we took on each time.

Q. But you were definitely not convinced that you had flow through the core; that is, you thought that the high pressure injection water might be by-passing the core or parts of the core?

A. We discussed that that could be done. I think the temperature indication on the cold indications told us that some of it was going in. And I think we discussed that. Okay. I think we had no way of assuring ourselves what the level in the system was.

(Miller, SIG, 9/20/79, pp. 17–19.)

In a statement dated May 7, 1979, Miller said:

> The command group met periodically throughout the morning and restated our objectives, re-reviewed the emergency plan and communications. Our concerns became one of a fear that HPI might be short circuiting the core to the Reactor Building floor, that possibly the core might not be covered, and the potential of having RCV–2 fail (open or shut). Instruments available did not convince us that water was in fact on the core but my firm decision was to always maintain high pressure injection. The group discussed and I directed that we go down in pressure and attempt to use the core flood tanks to convince ourselves that the core was covered and possibly through this mechanism we might get the plant towards the decay.
>
> (Miller, E&E, TMI–2, 5/7/79, p. 269.)

In an interview with I&E investigators on May 7, 1979, Miller said:

> We couldn't start pumps, they cavitated. We knew we had steam bubbles, we knew we had to pull (sic) pressurizer, I had told Mr. Ross that we did not secure HP injection without me personally being involved. *We were not in our minds convinced the core was totally covered.*
>
> (Miller, I&E Tape 158, May 7, 1979, p. 23, italic added.)

The foregoing was in reference to conditions after Miller had issued instructions that high pressure injection flow was to be maintained unless he approved otherwise. Since Miller expressed doubt as to whether the core was in fact covered with high pressure injection turned on, when there was reason to believe the core was being cooled by fluid pumped into the pressure vessel and out the hot-leg, he would have had more reason to doubt the core was covered earlier when the high pressure injection had been turned off, heat was not being removed via the steam generators, and the temperature sensors were indicating superheated conditions above the fuel assemblies and in the hot-legs.

G. UNCERTAINTY AS TO ADEQUACY OF CORE COOLING AND RECOGNITION THAT PLANT WAS IN A CONDITION NOT COVERED BY WRITTEN PROCEDURES

After the last of the reactor coolant pumps was shut down at approximately 5:40 a.m. on March 28, the TMI operating and emergency procedures no longer applied to the conditions existing in the plant. Until a reactor coolant pump was started at approximately 8 p.m., the principal path for heat removal was via the PORV block valve at the top of the pressurizer. During this period a relatively small amount of heat was removed via the reactor letdown system and by reflux cooling in the steam generators. The method of cooling (involving pumping water into the pressure vessel with high pressure injection (HPI) pumps, through the hot-leg and pressurizer, and thence through the PORV block valve) was known as "feed and bleed," a procedure for which the operators had not been trained, and one for which there were no written procedures. The following excerpts from interviews indicate the plant managers were in fact aware they were using a cooling procedure for which they had no training and one for which there were no written procedures. They were so uncertain as to the effectiveness of the strategy at high pressure that they switched at about 11:30 a.m. to a strategy involving depressurization of the system.[7] The latter, if successful, would have allowed cooling by the decay heat removal system which was one in whose use the plant personnel were schooled.

TMI–2 Technical Superintendent, George Kunder, has provided extensive comments to TMI investigators with regard to his perception on March 28 as to the cooling procedures and adequacy thereof:

> KUNDER. OK. I believe, as I indicated on the previous date, somewhere around 45 minutes to an hour after declaring the site emergency and getting the emergency plan fairly underway we—we being Gary Miller, Jim Seelinger and Mike Ross, Lee Rogers, and myself—met generally as a small group to discuss strategy and our perceptions about where we were and where we thought we should be going. Because it was pretty clear based on the hot leg temperatures existent in the core at that time that we were into a very serious problem, that we did not yet have the cooling of the reactor well under control. I think the general perception at the time was that we intuitively thought that we had the core covered. I think by that time we felt that we were getting water into the core, but there was no indication that hit you in the head and said

[7] "Operators indicated that at this time they believed that pressurizer heaters were unavailable and concerned that EMOV block valve might fail open. Didn't appear to be getting anywhere so the group decided to drop pressure to get core flood tanks (CFT) to float on core.

"Operators were controlling pressure with the HPI and EMOV. The staff was concerned that the HPI flow might be bypassing the core; since $T_h \sim 620$, $T_c \sim 220$ and the pressurizer water space RTD was relatively constant at 350° F. They wanted to make sure the core was covered; so they decided to depressurize in an attempt to get Core Flood initiation and ultimately to initiate DHR below 400 psig." (Quote from NUREG, 0600, p. IA–74, 75.)

"Yeah, you are covered." So, that concern was under consideration. I also, I know, was personally concerned about the potential for concentrating boric acid in the core through the process of just cooling the core by steaming. And we were somewhat in a boiling pot mode, or so we thought, at that point. I recall specifically expressing that concern to the group.

We were also concerned and discussed the fact that we had been using high pressure injection to get water into the reactor for, perhaps, an hour or an hour and a half, at that point. I don't recall seeing any real clear or substantial changes in RCS parameters, such as pressure and temperatures. Temperatures were still high and the pressure was still low. We were fairly well convinced in our own minds that we had a bubble of steam in the top of the reactor and in the hot legs. We were trying to consider ways in which we could vent off steam to effect a better cooling, or ways that we could assure ourselves that high pressure injection water was indeed flowing preferentially into the reactor versus some other sneak path. At that point, we were somewhat concerned that maybe there was some sort of a sneak path existing, which could bypass some of the flow around the reactor, such as perhaps leakage around the plenum assembly and out into a hot leg and right out the pressurizer vent or the pressurizer EM valve—let me think—no, I guess that was closed. But at any rate, we were concerned that we weren't getting—we may not be getting enough cooling to the core. So, all those concerns, put together, were the subject of our discussions. And we were also afraid that since these parameters weren't changing very readily that we may end up being in this mode for a considerable period of time and then run out of water from the BWST, and then the next choice would be to go on reactor building recirculation type of cooling. I think we all felt that that was very undesirable, from the standpoint of drawing whatever contaminants that you can potentially pick up in the reactor building in through the decay mode system and then through the makeup purification system and into the reactor again. Long term, we were hoping to avoid that, but that was not a real major consideration, I don't think. We were concerned about running out of water in the BWST ultimately, and having to go to another mode of cooling. We finally, I think mutually, came to agreement that we should try and raise pressure in the system.

My memory really fails me now, I can't remember now if the electromatic valve was . . . I think at some point we opened the valve. I can't remember if we opened it prior to pressurizing up to the 2,000 pound point where we cycled pressure, or not. It's just not clear in my mind, I guess I can review the curve but as I sit here now it's just not clear in my mind anymore. But we did decide to raise pressure. We must have had the valve open because I think I recall we closed it. I believe we probably had it open because we were figuring . . . yeah, it's starting to come back a little bit. I think we had the valve open because of the concern for getting flow through the core, not just putting water into it and having the water flash to steam and leave all the boron behind. We were trying to come up with a way of getting water through the core, guaranteeing we're getting flow through the core and sweeping it in that fashion. I believe that's the rationale that was used to keep that valve open. Later in the morning, we mutually agreed that it might best be to pressurize up and then continue that venting, because you would tend to, of course, achieve the higher saturation temperature effect, that would hopefully minimize boiling and any of those effects in the core. So, at that juncture we closed the valve, left it closed, allowed pressure to come up in the system, and then continued to vent out the pressurizer, which was the only place we could see that it was possible to get a flow through the system. And that's what we did. I guess that takes us up to the point that you are interested in.

(I&E, Kunder, 5/17/79, pp. 46–48.)

Kunder told NRC investigators in a subsequent interview:

Q. On March 28, 1979, what was your evaluation of the hot-leg temperatures when they sharply increased after the reactor coolant pumps were shut down?

A. My general recollection is that they indicated that we had an abnormal situation in the plant. I think that those conditions were beyond the bounds of plant conditions that I was used to dealing with.

My general perception of the reactor coolant system was that it was indicative of the voiding that we had. I cannot recall specifically when I reached that general feeling, or that conclusion. It was sometime, of course, after the temperatures went up, and after many discussions with different people. You gradually reached that perception.

I cannot remember any specific time frame for me to draw that conclusion.

Q. John Flint of B&W testified that he advised several people, including Lee Rogers and Gary Miller, that the magnitude of the temperature of the super-heated steam would preclude the ability to collapse the bubble.[7a]

Were you aware, on March 28, 1979, or did you take part in, or overhear any discussions of these concerns?

A. I can't remember specific discussions, but John was part of the management team, so to speak. He certainly had input. I had specific discussions with him that I recall relative to the indications of the source and intermediate range detectors, but I don't remember any specific discussions that we had relative to the high temperatures and the process you discussed.

Q. Do you recall a concern of your inability to pressurize the plant because of the release set points to a point where you could collapse the bubbles?

A. We had a lot of concerns that day, but looking at it from the point of view you have expressed, I really can't re-

[7a] The record indicates that others were concerned that it would be difficult to condense the steam that blocked circulation of water between the pressure vessel and steam generators. (See Appendix I).

member. I will have to say that I just don't recall reviewing it specifically the way you have mentioned it.

Q. You previously testified that on March 28, 1979, your interpretation of the super-heated temperatures indicates that the core had been uncovered and that it was being cooled by the super-heated steam. Was this information discussed at any time on March 28, 1979, with Messrs. Miller, Rogers, Flint, Herbein, Zewe, Mehler, or Chwastyk?

A. Again, I think the perception I had was similar or the same as the general perception of the rest of the management team. A large part of our discussions was directed toward what strategy we would take to try and assure that the core was covered. It meant what strategy we would take to get enough water into the system and achieve plant status that we could guarantee that we had the core covered.

I think intuitively we all hoped, or believed that we had the core covered, at least I did. But there was not enough positive information to say without a doubt that that was the condition, and to relax, so to speak. Thus, we continued to define our goals, and I am speaking of general goals, and come up with a strategy that got ourselves in a condition where we could say for sure that the plant was back under total control.

Q. George, let me ask you a question which is similar. As I have reviewed your previous testimony, and your conversations with Don Haverkamp on that morning, I had the impression that you were very seriously concerned that the core was uncovered at some time, and in fact that it was being cooled through this super-heated steam mechanism.

Did you express these concerns in this think tank meeting, or meetings, as they were held throughout the morning?

A. I remember one specific feeling that I had relative to cooling of the core, and that relates to the fact that if we were getting water into the core and it was evaporating, and that is the mechanism I was thinking of, removing heat through the evaporation of the water. Then, of course, as that steam would contact other hot material, it would become superheated, that would achieve some cooling.

But I remember being concerned about the precipitation of boron, and by this time, by the way, it would have been sometime around the middle of the morning, and I believe that it was after my conversation with Don Haverkamp. I don't recall any more as to what terminated that conversation, but that thought and concern was in the back of my mind.

Basically, I think my feeling was that I was hoping that that was not going to be a real problem, and I had no way of knowing whether that was going to be an eventual problem or not, but the only way of avoiding that problem was to keep water chugging into the core, and keep it there.

We did have high pressure injection established at that point, and it seemed to me to be about the only thing that we could do. There were no other alternatives that were obvious to us, or I am sure that we would have perhaps taken a different course of action, a different strategy.

Q. Let me ask you, did you discuss these concerns on how you perceived the core as being cold with the other members of the management team?

A. We had discussions throughout the morning. I am fairly certain I verbalized that specific concern, and everybody else verbalized the concerns they had. We all came to reach an agreement on the course of action which seemed to be the best course of action to take at that point.

Q. Do you feel that people were in agreement with your understanding of the way the core was being cooled that morning?

A. My perception was that we all shared the same general understanding, although I would have to say that it was more of a qualitative feel for what was going on, rather than a quantitative understanding because we did not have knowledge of actual level in the core. We did not know how much water we had in the system. We believed we had enough, but at least, I think on my part, it was more of an intuitive feel for the conditions in the system.

Q. Did you discuss or did you overhear or learn of any conversations with regard to the implications of this super-heated temperatures that morning?

A. I don't recall any specific conversations relative to that. Most of the time we were focusing on how to get to the basic plant in a control mode of cooling, one that we understood and one that we had experience in through our training, and so forth, and that was either to try and achieve decay heat removal operation, using the decay heat removal pumps. Ultimately it was, as I recall, our goal, and we tried a number of strategies toward achieving that goal, and we did try to keep in mind what we would do if those individual strategies would fail, and have some backup plan.

But I don't recall either taking the opportunity, or being able to really sit back and think, and focus on some of the academic aspects, shall we say, of parameters that we were seeing. I think what pretty much motivated me personally was my desire to see the plant in a controlled mode that I could identify with as being safe, and my background in operations which I think tended to make me react in that way.

Q. How did you account, or what was your feeling toward the continued extremely hot temperatures over the duration of the day?

Did this generate a concern about whether or not you were achieving your objectives, as the temperatures stayed up over the course of the day?

A. Certainly, it was a very frustrating experience to not be able to restore the plant to a status that I was comfortable with. To the best of my recollection, my belief was that there was a lot more water loss than could be made up in a very short period of time by the high pressure injection system. So that it would take some period of time to regain control.

Also, if you look at the fact that one of our strategies was to attempt to reduce the pressure to hopefully discharge some

of the contents of the flood tanks in the RCS, and hopefully get down to a pressure we get on decay heat removal, we had to discharge steam from the pressurizer by the electromatic relief valve, and that process would cause a loss of water in itself, so that would add to the time it would take to fill the system with the water.

So all those things combined, I guess, were cause for me to accept the fact that it would take a long time to get the system filled with water, and reestablish core circulation.

(Kunder, I&E, 9/4/80, pp. 12–18.)

On May 17, 1979, Kunder told NRC investigators:

> We had recognized that after all the scenario transpired at that point we were indeed without a lot of water in the core in the reactor coolant system and we had to charge a lot of water into the thing and try and keep it cool and at that point we were not certain that we had a clear blow path through the core. I indicated before that I personally was very concerned about the potential for continued feeding the water into the core and subsequent steaming of that water leaving behind boron, high boron concentration to get to the point of crystallization. And I was very deeply concerned that you know we really didn't have things under control as yet and we still had a lot of work to do plan our strategy and Gary Miller pretty much led the way on getting the group together and discussing alternatives. I can't recall the specific discussions.
>
> (Kunder, I&E, 5/17/79, pp. 44–45.)

Mike Ross gave the following rationale (suggesting uncertainty as to the adequacy of the "feed and bleed" strategy then being used) for reducing system pressure:

> Ross. Well, it was difficult in our mind that, one, we were purposely going to let an awful lot of steam to be produced in boiling . . . We, you know, we had to do some boiling at the time. Maybe that is good and maybe that is bad. It is particular where you are sitting I guess. We knew we were going to dump a lot of something to the reactor building. The reason we felt at least I felt that that was the path to go at the time, was based on a couple of things. One, we were running out of water in BWST and we hadn't gained an inch. I mean we hadn't gained any headway in where we were trying to go our goal being one to establish some mode of cooling, a reliable mode of cooling to the core. Two, we, at least I wasn't sure that we purposely or we in fact had the core covered and all high pressure injection was going through the core. I was not totally convinced. I didn't have anything to tell me. Hey, high pressure injection is in fact going through the core. So based on that, we discussed going down with the goal being one, to let the core flood tanks come in and verify that yeah, the reactor was in fact covered, two, give it a drink of water. That is a little coarse I know, but give it a drink of water if it wasn't getting it, and maybe go on decay heat removal which is a forced mode of cooling. That is what we were trying to do at that time.

On September 24, 1980, Ross made additional statements concerning his March 28 beliefs about the adequacy of core cooling and the most appropriate strategy to be followed:

> Q. You testified today and in previous testimony that you were aware that the HPCI was secured for a long period, that the pumps were pumping steam, that the EMOV had been open for an extended period, that the hotleg temperatures were higher than expected.
>
> What evaluations did you make of the significance of this?
>
> A. Our evaluations weren't very thorough that day, admittedly, but the evaluation we made is we didn't have a known method to cool the core, and we were trying to cool the core with high pressure injection.
>
> (Ross, I&E, 9/24/80, pp. 33–34.)
>
> * * * * * * *
>
> Q. Do you recall when the concern that the core might not be covered—which led to the repressurization strategy, do you recall when this first became of concern and was being discussed?
>
> A. Timewise, I do not, of course, because times are a blur, as I'm sure you gentlemen understand. I think it became a concern the more we talked about it, because we didn't have indications the plant was cooling down, you know, firm indications. I think we grew concerned that we weren't reaching a stable condition.
>
> (Ross, I&E, 9/24/80, p. 65.)

TMI–2 supervisor Chwastyk told NRC investigators that he did not like the "feed and bleed" procedure for cooling the core:[7b]

> . . . primarily because it's so alien to operating the plant. And I personally felt . . . it wasn't giving us enough information of what we had in the plant, and it was just adding confusion to the operators because it was such an abnormal way to operate." (SIG, Chwastyk, 10/11/79, p. 6.)

At approximately 9:30 a.m. on March 28, a transcript of a telephone conversation between TMI station manager Gary Miller and Metropolitan Edison officials in Reading, Pa. shows Miller's awareness that the plant was in a condition not encompassed by the operating procedures. Miller responds to Met-Ed's Troffer's expressed wish that as soon as possible the plant situation revert from a "general emergency" to a "site emergency" by explaining:

> The reason we have not . . . is because to be honest with you we've been assessing the plant. We don't know where the hell the plant (sic) was going. See the situation we're in is a delicate one because we actually have plant integrity. If we had a leak we'd be all right . . . We've been trying to figure out how to cool down in the most expeditious fashion without releas-

[7b] When asked how, at the time of his arrival at the plant, control room personnel appeared to perceive the severity of the accident, Chwastyk said, ". . . there were rumors, thre were conjectures of total core damage to very little core damage." (Chwastyk, SIG, 10/11/79, p. 59.)

(Chwastyk also told investigators that it was when he became aware that 50,000 gallons had been added to the primary cooling system (apparently late in the afternoon on March 28) that, "I personally knew that we had a lot bigger problem than I originally

ing and without damaging too much. That's taking a pretty hard assessment.[8]

The foregoing indicates that Miller was uncertain as to whether the quantity of fluid being pumped into the primary cooling system and allowed to exit via the PORV block valve was sufficient to keep the reactor core from heating to unacceptable temperatures; he appears to be stating that if the plant integrity was not intact (i.e. if there was a larger hole in the system than the PORV block valve orifice) they would have been able to revert to an approved emergency procedure, thereby acquiring assurance that the core would be brought to a stable cooling configuration.

In the course of subsequent interviews with TMI investigators, Miller made several statements indicating his awareness on March 28 that the plant was in a condition with respect to which there were no approved emergency procedures and in a condition where he was not sure that the strategy they were employing was in fact providing adequate cooling of the core.

> Q. What was your evaluation of the meaning of superheated steam in the system?
>
> A. It is very hard to not be clouded by what I have read in the last year or so. I just don't recall discussions of that in those concise terms because the cooling method we were in wasn't recognized anywhere that had ever been studied.
>
> The fact that you come in and all the indicators are off scale high wasn't a recognized condition for this reactor plant and it is hard to recall what that meaning was of something that hadn't had much training or discussion in the years of operation. So from a standpoint of what I know today and methods and means of countering this type of problem are different than they were on March 28th. The discussion involved how to cool the core from a condition that we didn't have recognized in any formalized training or implemented document.
>
> (Miller, I&E, 9/5/80, p. 31.)
>
> * * * * * * *
>
> Q. What did you conclude was the source of the superheat, if it wasn't core uncoverage? Again, I am asking what you think.
>
> A. You know, it is very hard to specifically remember what I thought that day. From the time we got there and started the reactor coolant pumps we knew there wasn't water in the hot legs. Where was the water level at? There was no recognition or instrumentation to tell you that.
>
> So what I was thinking was that we had to keep water moving into the core. Where was the level at? We had to make sure we took every precaution through the whole fabric of the thing to keep water moving on to the core, and I can't remember any more of what I thought that day other than the

[8] Entire transcript reproduced in appendix A.

> fact that there was recognition that there wasn't a full system. That is why the concern about water. That is why the concern about keeping the water on occurred to me in the early hours. It was the only known method I knew of of assuring core coverage.
>
> (Ibid., p. 32.)
>
> * * * * * * *
>
> Q. Yes, but I am trying to get you to help me understand poor cooling of the core. What does that mean to you?
>
> A. And I am saying that what it means is that we were out of a recognized cooling mode and therefore we knew that we had to have more cooling. We didn't know how much more.
>
> (Ibid., p. 43.)
>
> * * * * * * *
>
> . . . . A loca [occurring some 10 hours after initiation of the accident] wasn't something that would have made a difference in this crisis because we were already in as severe a crisis as we ever could get into. (Ibid., p. 133.)
>
> * * * * * * *

On April 12, 1979, Miller told General Public Utilities investigators that:

> . . . We, being me and Lee Rogers, called Lynchburg pretty early, and we sat in the room and every hour tried to figure out how to keep pumping water into it. But all we were doing was pumping that BWST [Borated Water Storage Tank] through the electromatic to the floor. Nothing was changing, so you know we pumped 12′ or 13′ out of BWST and my fear was pumping 50 feet out and the core still hot and no water in the BWST. So our goal was to somehow get some circulation going, either natural circulation from steam generators or reactor pump, using HP injection the whole time. My memory is that we pumped against the electromatic at fairly high pressures like 1800 or 2200 psi. We could have pumped against the codes, but we assessed that what we'd do is get the same flow through the codes without being able to see pressure. We pumped through there until around 11 in the morning, at which time we decided to take a shot at getting on core flood. And the reason we took a shot at core flood—now remember Lynchburg was on the phone with a lot of good advice, but it was clear that it was my decision—we assessed that if we could get down and activate core flood tanks and we saw them dump on the core we could get assurance that the core had some water on. We couldn't tell that; we were scared that wasn't happening. Radiation was all over the place, everything was off scale. You got nothing in the core that tells you about water level; you got no pressurizer level, since it's solid; no way of drawing the bubble; I didn't have any heaters; I didn't have any letdown; and we had radiation in every room we went to. Didn't even

have oil pumps for some of the RC pumps; couldn't get in some of the rooms; the readings were horrendous.
(Miller et al, GPU, 4/12/79, pp. 24–25.)

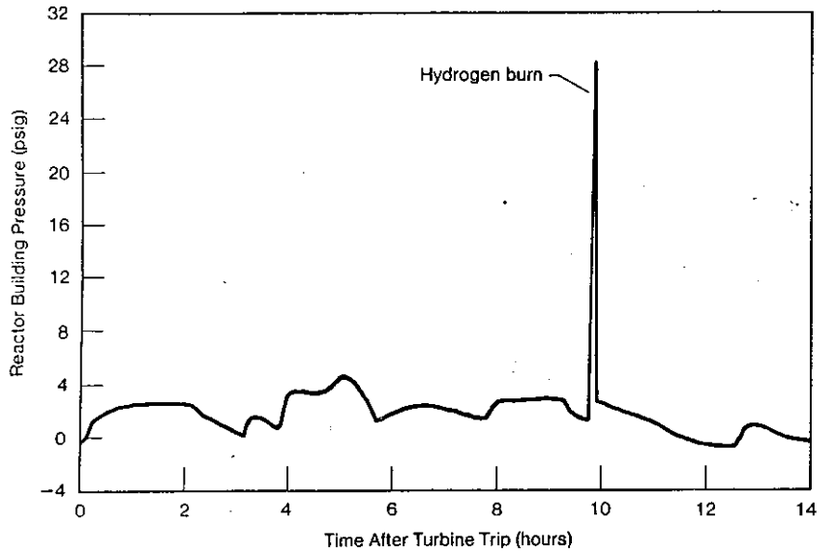
. . . Our major concern was that the fuel didn't degrade any more than it had degraded from thereon, and to somehow figure out how to prevent that and how to stop this. I didn't really feel that we were stopping at the initial stages; I was scared of running out of water. The outside pressure that I was getting indicated that you could just pump this thing solid—and I couldn't get it solid. You could have pumped all day—but I'm convinced without pumping water up the hotlegs—because you had to collapse those bubbles. We didn't have a 4000 pound system. It was a hell-of-a scenario. (Id., pp. 28–29.)

H. HYDROGEN COMBUSTION

During the morning and early afternoon on March 28, a significant portion of the hydrogen produced in the zirconium steam reaction was released from the reactor cooling system into the containment building via the pressurizer relief valve. At approximately 1:50 p.m. the hydrogen ignited.[8a] What is probably more accurately described as a fire than an explosion caused several effects including a 28-pound-per-square-inch (psi) pressure pulse in the containment building.[9] This pulse was recorded on the strip chart that recorded containment building pressure. It was also recorded on a series of other pressure measuring devices which used the containment pressure as a reference.[10] The fire raised temperatures in the containment from about 125 degrees to 175 degrees F, an increase of 50 degrees dissimilar to any other temperature changes observed that day; these temperature data were recorded on strip charts in the control room.[11] The increased temperatures triggered several alarms. The containment pressure pulse also actuated various emergency systems, most notably the equipment that caused water and sodium hydroxide to be sprayed into the containment building.

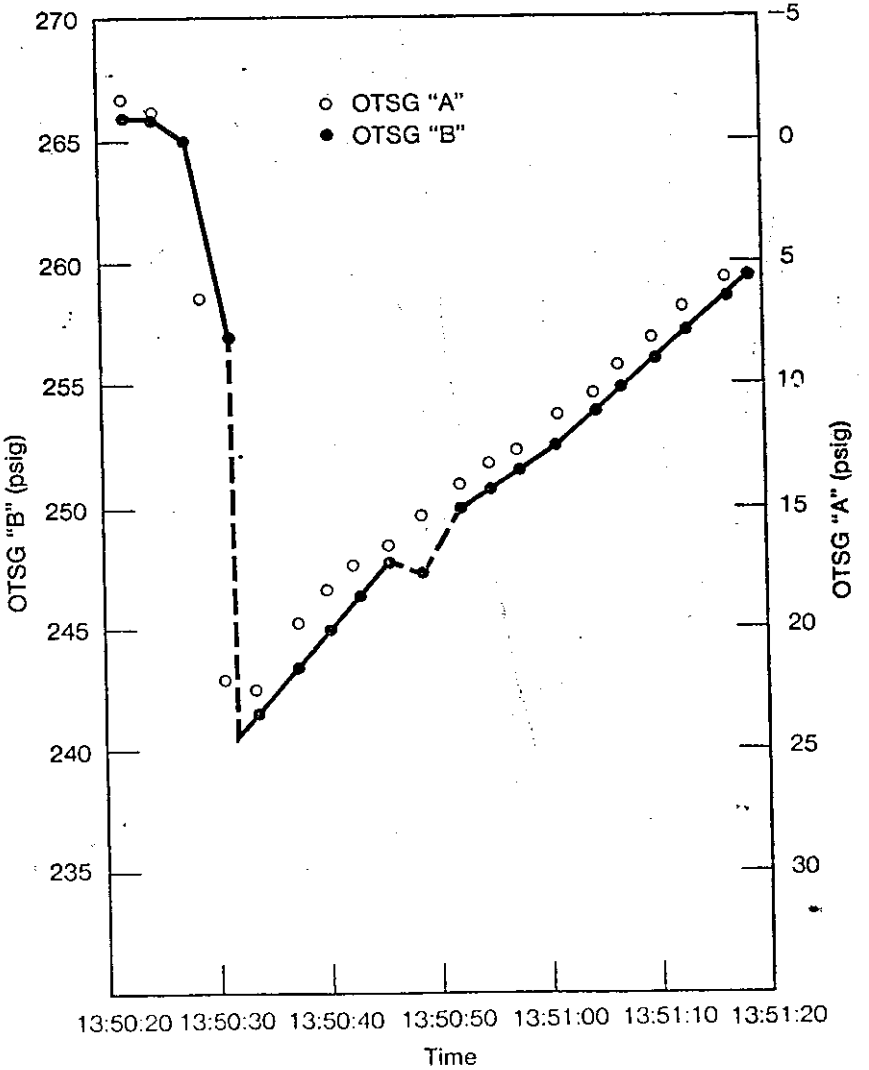
[8a] See footnote 2, p. 1.
[9] See figure V–A, p. 55.
[10] See figure V–B, p. 56.
[11] See figure V–C, p. 57.

FIGURE V–A



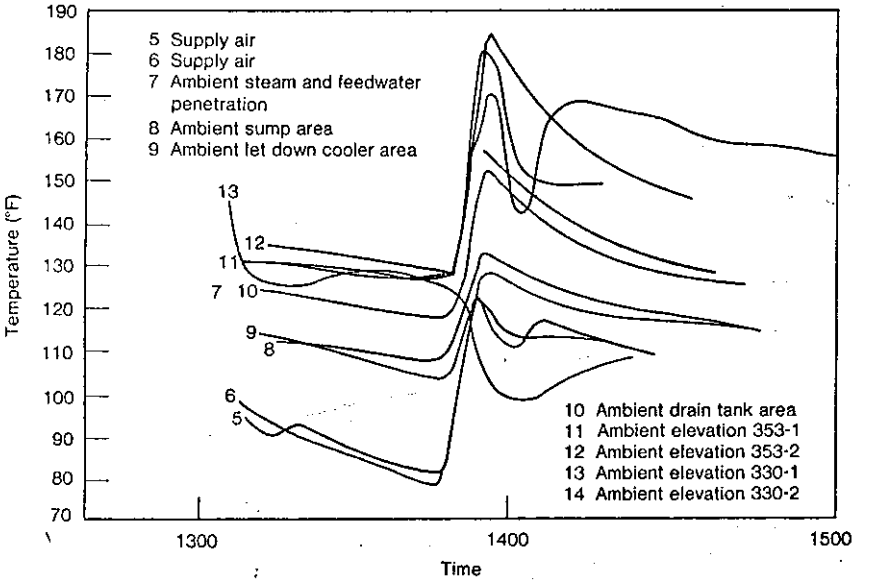
Reactor Building Pressure Versus Time

FIGURE V-B



Effect of H_2 ignition on measured steam pressures.

FIGURE V–C



Reactor building temperatures during hydrogen ignition.

Officials at NRC headquarters in Washington and Bethesda did not become aware of the hydrogen denotation until March 30.[11a] State officials, including Lieutenant Governor Scranton, who were briefed in Harrisburg within 1 hour of the detonation were not told about it then, and they apparently did not learn of its occurrence until 2 days later, on March 30. At least one TMI supervisor has testified that he informed an NRC inspector in the TMI–2 control room that the pressure spike on the containment building pressure recorder represented a real pressure increase. The NRC inspector has denied that he was so informed, and whether informed or not, he apparently did not report it to his superiors. The most likely reason for the inspector's failure to report the spike, assuming he was aware of it, is that he did not understand its significance. It is also possible, but unlikely, that the inspector was aware of the pressure pulse and its significance, but did not report it through an oversight or through intent.

Statements made to TMI investigators indicate the following: most of those present in the control room were aware on March 28 of the pressure spike[11b] and associated actuation of containment sprays; several of those present were aware on March 28 that a detonation possibly involving hydrogen, had occurred; and Station Manager Gary

[11a] Appendix H contains a transcript of discussion at a March 30 Commission meeting where the Commissioners were informed of the discovery of the reactor building pressure pulse and its possibly indicating a hydrogen explosion.

[11b] Four Commissioners subsequently stated they had been unaware until May 1979 that the persons in the control room knew of the pressure spike in the containment at the time it occurred. One Commissioner stated he was not sure when he learned that the pressure pulse had been observed by persons in the control room at the time it occurred, but that in any event he did not know this during the critical time of the accident. (E&E, TMI–2, pp. 190–193.)

Miller (notwithstanding his failure to recollect being aware on March 28 of the pressure pulse, actuation of containment sprays, discussions of hydrogen production, and the need to take certain actions based on the existence of hydrogen) was more likely than not aware of the detonation and its significance.

The hydrogen detonation was a clear indication that the accident was much more severe than Federal and State officials believed at the time it occurred. Chairman Hendrie answered "Yes, clearly," to the question of whether the fact of a hydrogen explosion would suggest the possibility of deformations in the core that might block flow of cooling water. (E&E, TMI–2, pp. 195.) He elaborated by noting, "A flammable hydrogen concentration in the containment could only have resulted from substantial zirconium-water reaction, and that would have meant core overheating and substantial damage to fuel cladding that could cause flow blockage." (Ibid.) He stated also in response to the question as to whether it would be important that he know of such deformation in order that he might develop appropriate plans for dealing with the situation: "Yes, very important: lack of this knowledge at the time it occurred delayed our understanding of the actual condition of the reactor for almost two days." (Ibid., p. 196.)

The question thus arises as to why TMI managers failed to clearly inform the NRC and State of Pennsylvania of the event and its significance as soon as they themselves understood what had happened.

The following discussion supports the conclusion that on March 28, the TMI Station Manager and some of his subordinates were more likely than not aware of the detonation and its potential significance. The discussion that follows is based on excerpts and inferences from the record of the TMI investigations conducted by the President's Commission, the NRC, and the Senate Subcommittee on Nuclear Regulation.

TMI supervisors, who have said they did not believe the pressure pulse to have been real, have given any of three explanations in support of their statements as to why they had not recognized that the pressure pulse and associated actuation of safeguards systems had in fact been an indication of a real increase in containment building pressure.

1. The explosion manifestations were caused by spurious electrical signals.
2. Because the pressure did not remain at a high level, the cause of the pulse was not important, and the operators were too engrossed with establishing a stable cooling configuration to pay attention to it.
3. They did not think it could have been real because nothing in their training led them to believe such a detonation might occur.

The first of these explanations should be considered in light of plant design considerations and the simultaneous occurrence of pressure and temperature effects indicative of a real pressure pulse. The second and third explanations should be considered, on the one hand, in light of the TMI supervisors' training and multiple indications of core uncovery and hydrogen production, and, on the other hand, that their training did not prepare them for situations in which significant quantities of hydrogen would be produced.

The following excerpts from the record concern whether the electrical malfunctions could have caused the pressure pulse. TMI–2 Reactor Operators Ed Frederick and Craig Faust engaged in the following dialog with the E&E TMI Task Force:

> MYERS. What could have had two of those three sensing devices sense high pressure and lead them to think the pressure was high, other than high pressure, real high pressure, actual high pressure? Is there anything that decides the pressure is going up that could have led those sensors to think the pressure was high?
>
> FREDERICK. A test signal.
>
> MYERS. Would a test signal go to two of them at the same time?
>
> FAUST. No. In fact, you would have to hook it up.
>
> FREDERICK. It would have to be a lengthy manual action to get it to do it, other than actual building pressure.
>
> MYERS. Is there anything that you can think of other than excess building pressure that could have simultaneously led the meter to read 28 pounds per square inch and to turn on the spray tanks or turn on the containment spray?
>
> FREDERICK. No; it had to be high level pressure.
>
> FAUST. There had to be a pressure surge in the building for it to happen.
>
> (E&E, TMI Part 1, May 9, 10, 11 & 15, 1979, p. 147.)

At a later date (on September 11) Frederick told interviewers from the NRC's Special Inquiry Group that he did not believe the pressure spike to have reflected a real increase in pressure because his training had not informed him as to the possibility of such a spike. Frederick stated that none of the persons present thought it plausible that the pressure in a 2-million-cubic-foot building could rise and fall so rapidly. Frederick stated:

> That's why none of us considered it plausible. It's impossible to do that.

SIG interviewer Ron Haynes responded:

> I wouldn't say it was impossible. I thought it actually occurred.

Frederick then stated:

> Based on our training, it was impossible. It was completely foreign. If you look back through everybody's training and the FASR and safety analysis and the building construction, you will not see a paragraph that projects that type of transient. Nor will you see it in anybody's training so far as—that is so particularly foreign and unbelievable that it has absolutely no significance. That's why nobody did anything about it for two days.
>
> (Faust, et al., SIG, September 11, 1979, pp. 264–265.)

Hugh McGovern, a TMI operator, made a statement to Met-Ed's Bubba Marshall at approximately 3 a.m. on March 29 wherein Marshall's notes show McGovern stating that at 2 p.m. on March 28 there had been ". . . an RX building pressure spike that went off scale on narrow range meter—definite spike straight up, straight back

down—had meter—definite spike straight up, straight back down—had full Rx building (Spray pumps & BS–VPS, DH–V8's) isolation and cooling. Someone secured spray pumps, shut BS–Vi's and DH–V's (Hugh did) and unisolated equipment for building."

These notes are a contemporaneous record (prepared some 30 hours before NRC officials in Bethesda knew about the spike) confirming that control room personnel were aware of the spike at the time it occurred. These notes do *not* suggest, as did some personnel in subsequent interviews, that the control room personnel ascribed the spike to anomalous electrical signals. (Control room logs, presumably prepared on March 28, are a further contemporaneous confirmation of control room personnel awareness of the spike at the time it occurred although these logs indicate respectively that the pressure pulse was 4 and approximately 5 psi. See p. 89.)

On October 9, 1980, Joseph Scheimann, who was on duty as a control room foreman at the time the accident began, engaged in the following dialog with NRC investigators regarding Scheimann's recollection as to what he saw when the pressure pulse occurred.

> Q. Could you describe your recollection of what you saw when the spike occurred?
>
> A. Okay. At the time the spike occurred, I was controlling pressure in the RCS by throttling on the electromatic block valve. At the time the spike occurred I had just gone to open on the electromatic.
>
> Q. What evidences did you personally observe and hear of the spike?
>
> A. Essentially what I heard amounted to something along the line of "Look at that pressure." That is all because I was over minding the pressure control.
>
> Q. Were you aware that the SFAS had come in?
>
> A. I had heard somebody say something to the effect that the building spray pumps had started.
>
> [I&E, Scheimann, 10/9/80, p. 4.]

Instrument Engineer Ivan Porter was asked by NRC investigators whether Porter thought the pressure spike could be explained by any form of instrument malfunction. Porter responded:

> I would think not. It did look like a real spike to me. That was when I was specifically asked if it could be real.
>
> (Porter, I&E Tape 237, May 21, 1979, p. 35.)

With regard to whether he saw the pressure pulse on March 28, Porter said:

> But somehow I have a feeling, I didn't look at those charts until the next day. I'm not specifically sure that I was aware of it that day. I know that I very specifically remember a discussion where we looked at the chart, was asked if it could possibly be real, and I also look at the wide ranged pressure chart and saw that [the pulse] showed up as a decrease in pressure on the wide range reactor coolant system pressure, but I sincerely believe that that was the next day that I looked through the stuff.[12] (Ibid., p. 34.)

[12] Even if Porter is correct, that the spike was not perceived to be real until the "next day", i.e. March 29, there remains the question as to why the NRC was not informed until March 30, a question which has not been addressed by the TMI investigations.

It is not clear, if Porter's feeling about not having looked at the data on March 28 is correct, what it was that caused the delay in examining the data, and if the delay did occur, what it was that led to the examination of it on March 29. Lending support to his conclusion that the spike was real was Porter's finding a similar negative spike in the reactor coolant system pressure history. Such a negative spike would be expected since reactor coolant system pressure was measured using the containment building pressure as a reference; when the containment pressure went up, the reactor coolant system pressure would appear to go down. As noted above, a similar negative pressure pulse was observed in other pressure histories.[13]

Shift Supervisor William Zewe said that he had observed the pressure spike to occur at the moment the pressurizer relief valve was cycled, but that he did not associate the spike with an explosion. He said that he had not been aware of temperatures in the core of sufficient magnitude for the cladding-steam chemical reaction to have occurred. Zewe was apparently unaware of the in-core thermocouple measurements that implied production of hydrogen. Zewe said, not knowing what the spike could have been, that he ascribed it to an electrical malfunction associated with the operation of the valve. While Zewe may have considered the pressure pulse to have been an electrical anomaly, others seemed concerned that it was real.

TMI Supervisor Joseph Chwastyk said:

> . . . I actually saw the recorder, the pressure recorder on the building, spiked upward. I didn't know what caused it but the fact that the spray valves started indicated to me that we actually had some kind of pressure spike, either on the sensors or in the building itself. I was not sure. The spike of course started all the building spray pumps, decay heat pumps, etc. The pressure spiked up and it was only up briefly, as a matter of fact, a couple of heart beats. I know because I missed those heart beats. It came right back down again."
>
> (Chwastyk, I&E, 5/21/79 p. 9.)

Chwastyk (who arrived in the control room between 11 a.m. and 12 noon, and who was apparently not aware of the direct measurements of the in-core temperatures) also referred to an explosion in describing how it was that he came to realize that the reactor core might have been significantly damaged:

> It was like I said, everybody was pretty busy and I didn't want to stop anybody from what they were doing so I just tried to get a feel for what was happening by looking around and asking the operators at the panel what they were doing. Up until the time or sometime after the *explosion* and it dawned on me what it was, I didn't know how much core damage we had." [14] (Italics added) (Ibid., p. 18.)

The following discussion and excerpts from the TMI investigations relates to Station Manager Gary Miller's awareness of the symptoms of the hydrogen detonation and the manner in which the symptoms

[13] See Figure V–B, p. 56.
[14] See p. 66.

were diagnosed. Miller wrote that while in the control room on March 28:

> I heard a noise at approximately 1:50 p.m., however I did not associate it with the burning of hydrogen or the actuation of the safeguards system at that time. I was first aware of the recorded pressure pulse and associated actuation of the safeguards system on Friday morning, March 30, 1979.
>
> (E&E, TMI, Part 2, May 12 & 24, 1979, p. 298.)

Miller told I&E investigators on September 5, 1980 that:

> The spike in the building, I am sure, was never, or its attendant actuation was not discussed with me.
>
> (Miller, I&E, 9/5/80, p. 134.)

Miller engaged in the following dialog with I&E investigators in which he sought to explain why he had not been aware of the pressure pulse and associated actuation of safety systems:

> Mr. STELLO. Why didn't you recognize it [the actuation of safety systems caused by the pressure pulse in the reactor building] that day? That is a conflict I have a very, very difficult time with. The one thing that all of us are aware of, sensitive to, everybody in this industry, is if we get a safety injection signal, an ECC signal, that is important and we are all trained to recognize we just got it. How could you be standing there having had one and not know it?
>
> The WITNESS. The only answer I can come up to with that is, you know, I was on the way out of there and was relieving the post and heading for the state [to brief the Lieutenant Governor]. I feel that if I had stayed there, you know, my recognition might have been better. I am not trying to get over that question, but I just feel the sequence I was in at the same time, you know, cause me, you know, to be exiting the site and, you know, I wasn't concentrating at that time on that particular set of parameters. If the people there concluded it was an instrument error, for instance, it might not have gotten to me in a timely manner.
>
> Mr. STELLO. You are missing my point. I didn't care what anybody else was doing. I am just visualizing you standing there when it happened and you were there. Now, the whistles and the bells go. Equipment starts that was originally shut down. You are standing there. Is this not something that you were very sensitive to if you got an SI signal?
>
> The WITNESS. The only answer I can come up to with that sensitivity that day was already heightened to the crisis we were in. It isn't like I was standing in the control room on an operating day and I had an ES. It is like I had been in that control room for five hours under a crisis situation and I can't answer your question of why didn't this new thing cause me to provide new emphasis on the situation because I already was putting the maximum emphasis on it. I just can't answer, you know, the question that you are asking me without considering the situation I was in.
>
> (Miller, I&E, 9/5/80, pp. 126–127.)

Others who were present say that Miller was aware of the pressure pulse at about the time it occurred. When Reactor Operator Frederick was asked whether others in the control room had reacted to the pressure spike, Frederick stated:

> I think Mr. Marshall tried to figure it out, and Gary Miller was particularly interested in it.
>
> (E&E, TMI Part 1, May 9, 10, 11, & 15, 1979, p. 145.)

An NRC inspector made the following notes based on a statement made to him by Donald Raymond. Raymond is an NRC inspector who was at TMI on March 30, when the pressure pulse and the possibility of a hydrogen explosion became general knowledge. These notes concern Raymond's perception of Miller's knowledge on March 28 of the pressure pulse and associated events.

> In an additional interview NRC Inspector William Raymond conducted at approximately 11:15 a.m. on May 8, 1979, Inspector Raymond stated his notes reflect a meeting conducted on March 30, 1979 in which Mr. Gary Miller, section superintendent, was asked to comment on the March 28 activation of the containment spray system. Inspector Raymond states that Miller, in discussing the event, recalled hearing a thump at his location in the Unit 2 control room, concurrent with the activation of an EMOV valve in the containment by one of the CROs, and concurrent with the activation of the containment spray system. Inspector Raymond recalls Miller's postulation of the association between these three events and the possibility that a hydrogen burn may have occurred.
>
> (Excerpt from May 8, 1979 Raymond Statement reproduced in Raymond, I&E, 10/7/80, p. 4.)

In the course of the October 7, 1980 interview with I&E, Raymond implied at one point that he was no longer certain that the foregoing excerpt referred to Miller's knowledge on March 28, but when pressed he engaged in the following dialog with NRC investigators:

> By Mr. HOEFLING.
>
> Q. Okay, Bill. Do you have any reason to believe that Miller heard a thud at approximately 2 p.m. on March 28th?
>
> A. Yes, I do, based on the conversation that I heard on Friday. As Gary spoke about things that occurred in the Unit 2 control room on Wednesday, the way he said it would appear to show objectively that Gary knew about the thud on Wednesday.
>
> Q. Can you recall what he said?
>
> A. I'm going to very loosely, if I could summarize his words, it's something to the effect of, "Do you remember when we heard the thud on Wednesday?"
>
> Q. Okay. Now let's go to actuation of the containment sprays, which we all now know occurred on Wednesday at approximately 2 p.m., March 28th.
>
> Do you have any reason to believe that Gary Miller knew at or close to the time of the actuation of the sprays that they had actually actuated?

A. As I recall, in the same statement where Gary talked about hearing the thud, he may have also mentioned the actuation of the building spray, which again, thinking back on it, would seem to indicate he knew of both of those events at the same time.

Q. You say he may have mentioned it. You're not certain?

A. I'm not certain, based upon what I remember now, and I'm probably relying upon the statements made back in May—on May 8th of 1979.

Q. You're referring now to the draft statement?

A. That's correct.

Q. You recognize that draft statement was a reconstruction of an oral interview?

A. That's correct. I recognize that, but again, after thinking about this, and talking about what I recall, I would—I would—I seem to—I'm not being very positive here. I will state that he appeared to have known about the actuation of the containment spray system, as well as the thud, on the 28th.

Q. Okay. Now let's turn to the pressure spike indication which again, as we all now know, was recorded at the time of the hydrogen burn on 3/28, approximately 2 p.m.

Do you have any reason to believe that Gary Miller knew of that recording at or close to the time it was actually made on the 28th?

A. No. In the conversations that I overheard on Friday morning, there is nothing that I remember in hearing that would indicate that Gary positively knew about the pressure spike.

Q. Was the pressure spike discussed?

A. On Friday morning, the pressure spike, together with the building spray activation, together with the thud, were all mentioned as—were all mentioned during the discussion in support of the conclusion that, yeah, that was probably a hydrogen burn on Wednesday.

Q. But to your recollection, there was no indication by Miller that he knew of a pressure spike on the 28th?

A. To my recollection, there was no indication that he knew of the pressure spike.

Q. Okay. Turning to the actuation of the EMOV valve on 3/28 at approximately 2 p.m. when the hydrogen burn occurred, do you have any reason to believe that Miller knew of that on 3/28, in the timeframe of the hydrogen burn?

A. In regard—I can be least positive in my statements regarding the EMOV, because I cannot recall that at all now, so I'll——

Q. You cannot recall that at all, looking at this draft document, which indicates you speaking to that point to the I&E interviewer? This does not help you refresh your recollection on that point?

A. That's correct.

(Raymond, I&E, October 7, 1980, pp. 12–15.)

James Higgins, an NRC inspector who arrived at TMI at about 10:05 a.m. on March 28 and remained at the site or vicinity thereof

had the following recollection concerning Miller's awareness and interpretation on March 28 of the pressure spike and associated events:

By Mr. Craig.

Q. I believe the question before we went off the record was, was Gary Miller aware that the containment spray pumps had come on on Wednesday, the day of the accident?

A. From reviewing my previous notes and depositions now to refresh my mind on my discussion with Gary Miller on Friday, it appears to me that on Friday, Gary Miller was piecing this all back together, and that really on Wednesday he was aware of these—the fact there had been a spike, the spray pumps coming on, and a thud, but had never really connected them or even given much of a second thought to any of them on Wednesday. But now I guess I got the impression from my discussion with Gary Miller on Friday, that it was the first time he was really tying these things together and attaching any significance to them.

Q. Let's go over these one at a time.

A. Okay.

Q. Was Gary Miller aware on Wednesday of the thud?

A. Yes.

Q. Was he aware that containment spray pumps came on?

A. I believe so.

Q. Was he also aware of the pressure spike as indicated by the recorder?

A. I believe so, but again the only reason I say that is from reviewing what I said when I made my depositions, and right now I cannot say for certain.

(Higgins, I&E, 10/7/80, pp. 25–26.)

Zewe stated in a deposition for the Special Inquiry Group that Mr. Miller was in the control room when the pressure pulse occurred (Zewe, *et al.*, SIG, 9/11/79, p. 257). Zewe also stated that:

> I found it so hard to believe that anyone [15] who was in the control room observing anything would have missed that (the spike) or turning off the pumps or any of the discussions at all. [Ibid., p. 260.]

Mike Ross, who was TMI–I Operations Supervisor, but acting as second in command to Miller at TMI–2 on March 28 stated when asked whether he was present when the pressure spike occurred:

> Yes. I was near the console at that time and if we are talking about the same time was around 2:00, sometime in the area. And at that time we got an ES signal and some of the components restarted, decay heat, what have you. We got building isolation again and we took care of that and we looked back and the control room operator said "Jeese the spray pumps are running" and we looked back at the charts

[15] TMI–2 Superintendent for Technical Support George Kunder has stated that on March 28, he was unaware of the pressure spike. (Kunder, I&E, 5/23/79, p. 50.) This recollection appears inconsistent with Zewe's statement that it seemed to him that the spike could not have been missed by anyone in the control room. The seeming inconsistency may be explained by the fact that at about the time the spike occurred, Kunder was in Unit 1 gathering information to be used in briefing the Lieutenant Governor. (Kunder, I&E, 4/25/79, p. 53.)

at that time. We saw a fairly large spike on the chart and the exact pressure at this time I don't know, . . . it was around 30 pounds. *My thought at the time and Miller was out there with us and he questioned he said*, "jeese you know I thought I heard something, too." We are moving down the road there 100 miles an hour and we looked at it and we said "Jeese the spike was so short it must have been an instrument." That was our reasoning at the time. We reached over and we said you can shut the spray pumps off now because the pressure came right back to 0, . . . almost very, very rapid return and we shut the spray pumps off. I now know that spray pumps were on about five minutes when looking back because I did look back on that particular one. I personally didn't associate it at the moment with any kind of explosion in the building. *I associated it with an instrument problem perhaps and I think so did Miller at the time* because we just went on to something else. It wasn't until the next day that we thought about anything like that and started looking back. (Ross, I&E Tape 226, May 19, 1979, pp. 3–4.) [Italics added.]

Shift Supervisor Chawstyk who had observed the pressure spike but did not hear the noise referred to by Gary Miller told the NRC investigators of a suggestion made to Miller on the basis of the spike having occurred upon operation of the pressurizer relief valve:

> CHWASTYK. No, I did not hear the noise. But that was the point at which I had assumed that we did have some kind of explosion in the building. And that is when I suggested to Gary Miller we no longer cycle the electromagnetic relief valve because it had . . . the explosion . . . or rapid rising pressure in the reactor building corresponded to opening the electromagnetic relief valve.
>
> (Chwastyk, I&E Tapes 232–233, May 21, 1979, p. 18.)

Chwastyk stated in subsequent interviews with the SIG that he recalled informing Gary Miller of his concern that an explosion had occurred. On October 11 he said that on March 28 he had been concerned even prior to the explosion that water should be pumped into the primary at a higher rate and that:

> It was right after the hydrogen explosion and I mentioned that I correlated the opening of the valve with the detonation period that I again went to Gary Miller and explained what I thought had happened as far as the hydrogen detonation and the simultaneous opening of the valve, and it was shortly after that, Gary Miller got back to me and said go ahead and draw the bubble.
>
> (Chwastyk, SIG, 10/11/79, p. 18.)

Miller, however, does not recall having told Chwastyk to draw the bubble. He told SIG investigators:

> I don't remember that. In my mind, I don't believe I was operating with the bubble in the pressurizer.
>
> (Miller, SIG, 10/30/79, p. 26.)

The question thus exists as to who, if anyone, instructed Chwastyk to cease the depressurization strategy which was terminated prior to or upon the closing of the block valve at about 3:08 p.m. On the one hand is Miller's not recalling such an instruction and on the other hand is Chwastyk's testimony that he sought and received permission from Miller, and:

> Remember at this time I could not do anything on that console without prior approval from Gary Miller.
>
> (Chwastyk, SIG, 10/11/79, p. 17.)
>
> For any changes I had to go through Gary Miller who was essentially the man in charge of the control room.
>
> (Chwastyk, I&E, Tape 232/233, 5/21/79, p. 13.)

Ross also recalled that prior to leaving the site for the Lieutenant Governor's office, Miller had issued, "Two very clear instructions. One: Don't steam the generator to the atmosphere. The second instruction I had was, Don't make any major changes in the plant condition."

(Ross, SIG, 9/18/79, p. 39.)

On October 30, Chwastyk was asked again whether he thought he had mentioned the possibility of a hydrogen explosion to Gary Miller in so many words, or discussed what that would mean or what had happened to the system. Chwastyk replied:

> My best recollection of that is that I did relate to Gary that we had some sort of an explosion. Whether I said it was hydrogen or not, I'm not sure. But I remember distinctly putting together the operation of the valve and the spike, and I think I relayed those thoughts to Gary.
>
> (Chwastyk, SIG, 10/30/79, p. 17.)

When told that Gary Miller did not recall learning of the explosion until two days later on March 30, Chwastyk stated:

> Well that could very well be true. Again, I can't absolutely—if Gary said—I may not have told him what I thought at the time, because I really wasn't certain.
>
> (Ibid., pp. 19–20.)

Chwastyk was then asked again for his best recollection and the following dialog ensued:

> Q. I understand. Let me ask you this: Was there any—strike that. Let me start it a different way: When you saw this and then [put] it together what you thought had happened, that must have been something that gave you some cause for concern?
>
> A. Yes. It scared the hell of me.
>
> Q. Did you think that this was something that better ought not to be generally broadcast around the control room and outside? Was there any reason to keep this fairly close among the people who were there in light of the fact that it was fairly alarming?
>
> A. I'll say this: I didn't go out in the control room and broadcast it, no. It did scare me, therefore, I'm sure I didn't just make it general knowledge to everybody in that control

room. I'm sure I did pick out specific individuals that, my counterpart types of people, and talked to them about it.

Q. You said you think that you probably discussed it with Brian Mehler, and your best recollection is that you discussed it with Gary Miller. Do you have a pretty specific recollection of who else you may have actually discussed it with on the 28th?

A. I have some recollection of talking to someone from the NRC about it. At the time, I did not have the time to discuss possibilities with him, and I think I related that I think there may have been some kind of explosion in the building, but I didn't know what.

(Ibid., pp. 20–21.)

At the end of the October 30 interview Mr. Chwastyk was again asked by the Metropolitan Edison attorney participating in the deposition, about whether he had told Gary Miller on March 28 that he had correlated the pressure spike with a possible explosion:

Mr. DIAZ. I don't want to put words in your mouth. You recall making the inference, but you don't recall whether you conveyed that inference to Gary Miller; is that correct or incorrect?

The WITNESS. My best recollection is that I did related (sic) that information to Gary. That's the best I can remember. How much of that information though, what information I gave him, I definitely don't remember. I do know that I gave him the information of the bank (sic), the valve opening simultaneously with the pressure spike.

Now, if I related that or if I put that together and told him that I thought it was a hydrogen explosion, if I thought it was an explosion at all, I don't remember.

(Ibid., pp. 28–29.)

In sum, on May 21, 1979, Chwastyk told I&E investigators that he believed on March 28 that an explosion had occurred, and that he had told Station Manager Gary Miller that they should no longer cycle the electromagnetic relief valve because the pressure pulse had corresponded to opening of this valve. On October 11, Chwastyk said, "after the hydrogen explosion", he went to Gary Miller and explained what he, "thought had happened as far as the hydrogen detonation and the simultaneous opening of the valve." (Chwastyk, SIG, 10/11/79, p. 18.) When pressed as to whether he actually did tell Miller that he thought there had been an explosion, Chwastyk (for the first time, on October 30) said that he could not be sure, although he thought he did. It is not clear from the record what was the basis for Chwastyk's changing his mind except that his recollection differed from Miller who had said he (Miller) did not recall learning on March 28 that there had been an explosion.

Chwastyk engaged in the following dialog with NRC investigators on September 4, 1980 wherein he states that he had surmised an explosion, probably involving hydrogen had occurred and that he had related this to Miller:

Q. During your testimony of 5–21–79, and again later on 10–30–79, you addressed your conversations with Gary Miller regarding the conclusion that the spike was related to the operation of the EMOV.

What is now your best recollection with regard to the substance and time of this conversation?

A. My best recollection, as I have testified before, I think I talked to Gary Miller not long after the spike actually occurred.

Q. Did anyone else participate in these conversations, or was anyone standing by who would overhear them?

A. When I talked to Gary?

Q. Yes.

A. No. I think that Gary was in the shift supervisor's office by himself.

By Mr. MOSELEY.

Q. Could you give us the substance of your recollection of the substance of the conversation with Miller?

A. Well, essentially, I think—The substance was that—Again, as I remember it, I put together the spike, the spray pumps coming on, the simultaneous operation of the valve, and someone telling me about a loud noise they heard into, actually, some kind of explosion in the building.

I talked to Gary about that with the idea—because of that, get permission to redraw the bubble, to get the bubble back into the pressurizer so we would know where we stand as far as the reactor cooling system.

This is substantially why—It was one of the reasons why. That was the object that I used in discussing this with Gary Miller, to again get permission to redraw the bubble.

Q. So you really believe that there was a real pressure spike.

A. Yes, as I remember it.

Until that time [i.e. approximately 1:50 p.m., the time at which the pressure pulse occurred], I did not really know what the status of the plant was. I only knew what I was told. But when I put together the explosion and the hydrogen, I knew then that we had suffered at least some core damage. I did not know how to quantify it simply because, you know, it could have been a localized explosion, like I mentioned earlier, or it could have been a minimal amount of hydrogen.

That was about the time that I understood that we did have core damage.

By Mr. MOSELEY.

Q. Did you conclude this Zirc water reaction on March 28th?

A. In my mind, you know, when I put the explosion together and it was hydrogen, you know, it came from Zirc water, it was just an assumption I made.

Q. So you did conclude that the core had heated up sufficiently to cause the Zirc water reaction.

A. Yes.

Q. You reached that conclusion in the afternoon of March 28?

A. Yes.

By Mr. CRAIG.

Q. Did you discuss your concerns or inferences concerning core damage and hydrogen with anyone?

A. I discussed the explosion, you know, and my thoughts at the time, which were that there had been a hydrogen explosion. I don't think that I went into Zirc water reaction creating hydrogen, or an explanation or discussion of what happened. I think that I pretty much assumed that hydrogen explosion, and the hydrogen came from one place, Zirc water reaction on the core.

By Mr. MOSELEY.

Q. But given that this is something that none of us ever expected to see, it was not enough to move you to have conversations with others about your conclusions of Zirc water reaction?

A. No. I think that it was enough for me to know that it was just an explosion, and possibly a hydrogen explosion.

By Mr. CRAIG.

Q. When you discussed your recommendation not to cycle the block valve, and your discussion about core damage and the hydrogen, what reaction did people have to that, specifically, Gary Miller, Brian Mehler, and in general anybody else that you have talked to?

A. By reaction, do you mean, did anybody panic?

Q. No. I mean, did Gary Miller say, "Oh, come on." Did they believe what you were saying? Did they take you seriously? Were they going to think about it? Was it one of those, "Okay, Joe," and then he went on with what he was doing?

A. I would have to say, Brian Mehler believed me that we had had an explosion.

Gary Miller, I assume—I have no reason to believe that he did not at least think about it, and take it under advisement.

(Witness conferred with counsel.)

A. The reason that I say I think Gary took it seriously is because it was very soon after I related to him what happened that he gave me the okay to go and draw the bubble to find out where the hell we were at as far as water. This was, of course, a major change in the way we had been doing it before.

Q. Do you remember when Gary left to go to the Lieutenant Governor's office?

A. I remember vaguely that he left. When it was——

Q. Can you relate that conversation when you talked to Gary Miller about hydrogen and then you got permission to draw the bubble and the time to his departure to talk to the Lieutenant Governor?

A. It was before he left to talk to the Governor, I know that.

By Mr. MOSELEY.

Q. I am having a little trouble with time. I thought that you had said earlier that your conclusion on the hydrogen and the Zirc water reaction was shortly before the restart of the reactor cooling pumps. Did I misunderstand you?

A. Yes, I think you did. I did not mean to intimate that a bit.

Q. Straighten me out by saying it again, and relating it in time.

A. It was shortly after—again, time really did not have much meaning. It was shortly after—when I say shortly, I mean within 15 minutes to a half-hour after the—probably even less than that because although it seemed like a lot of time, I don't think that it really was.

It was shortly after the actual explosion and the pressure spike in the building that I surmised that it was, in fact, an explosion and probably a hydrogen explosion, and I related that to Gary. This was prior to Gary leaving for the Governor's office, as far as I can remember.

(Chwastyk, I&E, 9/4/80, pp. 24–27.)

Q. Did you have any conversations on the 28th concerning primary system inventory with Gary Miller?

A. I'd have to say yes, but indirectly, okay? And that was when I went to Gary and requested permission to redraw the bubble in the pressurizer to find out where we stood inventory-wise.

Q. Did you explain to him that's why you wanted to draw the bubble?

A. Yes. (Chwastyk, I&E, 9/4/80, p. 62.)

The following concerns the time at which Chwastyk was given permission to draw the bubble:

Q. Concerning your attempt to redraw the bubble on 3/28/79, can you explain the sequence of events and times related to those actions? And you can refer to this chart from the Rogovin Report, also.

A. Can I ask you what—what is your question? When did I start?

Q. What did you do when you started to draw the bubble? What did you see?

A. Okay. Okay, I got the permission to go ahead and redraw the bubble somewhere around 2:00 o'clock. The first step we did, of course, was to turn on the heaters, and then I think we sent some one of our operators out to verify that we didn't have any of our heaters tripped; if they were, to reset them.

(Chwastyk, I&E, 9/4/80, p. 67.)

Q. You said you got permission about 2:00 o'clock. You seemed relatively confident of that time. Can you tell us why that sticks out as——

A. Well, it was not very long after the spike in the reactor building. You know, I said 2:00 o'clock, it was somewhere in the neighborhood of 2:00 o'clock. It wasn't 2:00 o'clock exactly because I'm sure I couldn't even say that, but——

Q. Is it related to Miller being there or not being there? Would that have an effect on it?

A. Well, yeah, in the sense that, you know, one of my—when I first took over the control room, one directive was not to do anything to the plant unless I could improve the——

Q. And you did get permission from Miller to draw the bubble around 2:00 o'clock?

A. Yes.

Q. Who else heard this instruction or participated in this conversation?

A. No one that I'm aware of. I think Gary was in the shift supervisor's office by himself at that time, and again this was, you know—as soon as it dawned on me what had happened with the pressure spike, you know, I went into the shift supervisor's office, relayed that information to Gary, and asked permission once again to reestablish the bubble to find out where we stand. And it was soon there afterwards—the reason I remember it was soon was because it kind of surprised me. You know, I expected more of a time lag to get the information passed on to where it was being passed on, and to be thought over and discussed wherever—wherever they were making these decisions, and then go back to me. But it was a fairly short amount of time between the time I asked Gary, you know, again for permission to reestablish the bubble until he gave me the word to go ahead and do it.

By Mr. CRAIG.

Q. You just made one request of Gary Miller to reestablish the bubble?

A. No, no. I had requested it earlier, soon upon taking the control room. I think—I know I asked as soon as I took the control room, and I think I asked him between that time and the spike again and, you know, nothing had happened, and then I definitely know I asked immediately after the spike.

The only thing I'm not sure of, if and how many times I asked him between the time I took the control room and the spike. (Chwastyk, I&E, 9/4/80, pp. 69–71.)

Mr. MCBRIDE. Another question is, after your conversation with Mr. Miller about the pressure spike, the fact that you believed that an explosion had taken place, did you make any assumption with respect to whether Mr. Miller had passed along that information either to his superiors or to the NRC?

The WITNESS. I assumed—he was their emergency director, and he would pass that information along up our chain, and also making the necessary NRC notification.

By Mr. MOSELEY.

Q. Let me ask a couple of questions related to that. In answer to the question, you used the term explosion. Was the term explosion used on March 28?

A. I don't know that. I remember the word "real," that the pressure spike, or the explosion was real, because in the previous discussions I had, there was some doubt like I mentioned earlier.

When it dawned on me what had happened, the first person that I went to was Gary Miller.

Q. In your discussions with, we will assume it was Mr. Neely, did you have the perception that he understood what you were telling him?

A. I assumed that he understood what I told him, that the pressure spike or the explosion, whatever word I used, was real. I assumed that he knew what that meant. I am not sure that that answered your question.

Q. I am not sure it did either.

What I am looking for is whether you felt he perceived the significance of this, either by the questions he asked, or by comments that he made, or by any other actions that you saw him take.

A. I assumed that he knew what I was talking about, and when he left I just assumed that he went back to notify his chain, whoever it was at that time, which I don't know. That is the only thing that I assumed at that time.

By Mr. GAMBLE.

Q. He did not, in fact, indicate to you what he was going to do when he left?

A. No. He just walked away.

(Chwastyk, I&E, 9/4/80, pp. 105–106.)

The following discussion between Chwastyk and NRC investigators relates to Chwastyk's perception that, not only had there been a real pressure increase in the containment, but that the increase might have been sufficient to breech the containment integrity.

Q. Joe, during the recess you had a chance to finish reviewing the portions of your October 30, 1979, deposition before the Special Inquiry Group that was referenced before the recess, specifically page 20.

Now, going back to the question of what did you mean by not broadcasting, would you explain that to us again?

A. Yes. It was just simply—you know, I would not make a general statement to the control room, or the personnel in the control room, the announcement type.

Q. What was it that caused you to be scared?

A. Well, it was a combination of things. One, it was the explosion itself. You know, the fact that it was possible that the explosion could have been of a higher magnitude that could have, you know, done some damage or more damage than what it did do, primarily violate containment. That was, you know, the first thing that came through my mind.

The second thing that came through my mind was the fact that we did in fact suffer some core damage. That one is not as clear simply because there are so many variables that I didn't know how to interpret. For instance, you know, what kind of ventilation did we have around that pressurizer and, you know, was this stuff really concentrated around the pressurizer, or was it thoughout the whole building. You know, I had no means of knowing those things.

Q. On 3/28 or even 3/29 was the possibility of containment integrity ever being breeched ever discussed?

A. I am not sure "discussed" would be the proper word. You know, it entered my mind that it may have been breeched. As a matter of fact, the pressure dropping, you know, as fast as it did, one of the things that came through my mind was that possibly it did have some kind of pressure increase in the building, and I think I mentioned this earlier, a steam leak, and simultaneously containment was breeched and we are therefore relieving the pressure. You know, we checked everything we possibly could and found that wasn't the case.

Mr. MOSELEY. What specifically did you check and whom did you ask to check this?

The WITNESS. Well, things like the steam generator pressures, the containment isolation, you know, the valves to ensure that the valves were closed, that were supposed to be closed were closed, I think, and I don't really remember, you know, I can't say, and this doesn't stand out in my mind, but I think I had someone get the procedure for loss of coolant which describes containment isolation and verify that, you know, what was supposed to be isolated was in fact isolated. You know, reactor coolant pressure, of course. There were a number of things that we did check just to verify the fact that we did still have containment, and not only to verify that we did still have containment but also to try to determine what caused it, you know, did we have either a loss of coolant or a steam leak or something that caused pressure to go up and simultaneously lost containment. We checked everything we could and didn't find anything.

Mr. MOSELEY. Did you specifically ask for the radiation monitoring people to make a quick survey around the building to see if there was activity leading out?

The WITNESS. I remember directing someone to make an inspection of the containment. I think it was an operator type person. It wasn't a health, physics or radiation control person, and it was probably a shift foreman, a senior CRO, or something of that nature, because you must understand how, you know, the chain of command there is. Essentially the shift foreman directs the operators, the control room operators primarily and the control room operators direct the auxiliary operators who work out in the plant.

I asked and directed someone to make an inspection. Now, I don't remember who, you know. It was just a possibility that came into my mind, you know, that something in containment or some part of the structure itself had possibly broken or fell apart. I didn't really believe it but I thought it was something that I had to check anyway.

Mr. MOSELEY. Did you discuss with Miller, Kunder, Ross or others that you were having these checks made?

Mr. MCBRIDE. Maybe the problem with the question is could you explain who you mean the others to be?

The WITNESS. Let me say, normally I would as part of the report, you know, to the chain, in other words, Gary Miller, I would not only explain what had happened but what I am

doing about it. Whether I did that in this case or not, I don't remember.

Mr. MOSELEY. What about to Ross or Kunder and maybe Zewe? Zewe was the nominal shift supervisor at that time, right?

The WITNESS. It is possible, but I really can't remember. Again, you know, the way I work I would have under normal conditions, and whether or not I did in this case I just can't remember.

Mr. MOSELEY. You just don't recall.

The WITNESS. I just don't recall.

Mr. MOSELEY. Do you recall whether you discussed the results of these checks, some statement of confirmation that everything is okay, we have checked the containment and it is still good?

The WITNESS. Again, no, I don't recall, but, again, knowing the way I operate, I assume I would have. I don't recall that I did.

By Mr. CRAIG.

Q. Do you remember how long it took before you got a report back on that check of the containment?

A. I don't know that I ever got the report back on that outside, you know, check of the containment. I guess I don't remember because I think by the time they could make any kind of inspection I had come up with the idea, and quote if you will, of the hydrogen explosion. And I think after that I just sort of forgot about the containment check.

(Chwastyk, I&E, 9/4/80, pp. 32–36.)

Chwastyk engaged in the following dialog concerning his discussion about the pressure spike with TMI Supervisor Brian Mehler.

Q. Could you try to recall the approximate time or related event in the substance of the conversation with Brian Mehler concerning the pressure spike?

A. As I remember, I was at the console when the pressure spiked, and Mehler was somewhere in the background. Of course, I did not know what caused the pressure spike, and Mehler came over and asked why the spray pumps were on. I really told him, I don't know why they are on. I don't know why they started, but we got a bad pressure spike. This thing was happening, and I did not know what it was.

By the time it came back down to about where it had been before the spike, someone then asked permission to secure the spray pumps and I denied it because I did not why they had started to start with, and until I had a better feel of why they started and what was happening, I did not want to secure them.

After a few seconds or minutes, I don't know what, it looked like the pressure was going to stay down, and then I did allow that the spray pumps be secured. Mehler was either at the spray pump or in that vicinity at the time.

After we secured the spray pumps and secured the other equipment, then I discussed what had happened, some of the

possibilities. I think that it was during this period of discussion that we decided, somehow, I am not sure what the wording was, but that we kind of felt that something had happened in the building because of the spray pumps starting simultaneously with the spike.

(Chwastyk, I&E, 9/4/80, pp. 9–10.)

Mehler himself has said that he believes there was general awareness of the occurrence of the pressure pulse:

Q. Was there a reason why you wouldn't have discussed it with Gary Miller, or it wasn't discussed? Can you recall?

A. Well, I don't know. I—the reason I made the assumption that everyone was aware of it, because everyone came out to the control room. It was obvious to anyone in the control room that it happened, and I did discuss it with a gentleman from the NRC.

By Mr. Moseley.

Q. You would consider it to be general knowledge, then, both that the containment spike had occurred, and that the sprays had come on?

A. That's correct.

(Mehler, I&E, 9/3/80, p. 14.)

* * * * * * *

Q. Mr. Mehler, you indicated right after the pressure spike, you assumed it was common knowledge, and everyone came out in the control room. Who were you speaking about coming out in the control room?

A. When I make that assumption, when the pressure spike occurred, I was in the shift supervisor's office. I do not recall who all was in the office at the time, but upon seeing the people move around there when we got the SAS, I knew it myself, I got up and went out to the control room and so did, I would say, the majority of the people in that room, and they had to be aware of the pressure spike, because we all went over to the console where the pressure indication was, and we looked at it, and we seen spray pumps running, and we discussed it.

Q. Do you recall any of the people who were in that room? I realize you don't know them all, but——

A. I believe Mr. Miller was there, and it's only—I'm not sure, and I believe Mr. Ross. But, you know, I would never say definitely they were there.

(Mehler, I&E, 9/3/80, p. 16.)

* * * * * * *

Mehler engaged in the following dialog with NRC investigators concerning his training with regard to what was necessary to activate the containment building spray pumps, training from which he learned that two out of three pressure sensors would have to detect high pressure in order for the containment sprays to be triggered.

Q. What training had you received prior to the TMI–2 accident with regard to the instrumentation and logic associated with reactor building pressure?

A. I don't quite understand your question.

Q. The instrumentation and logic associated with activating containment spray pumps?

A. Okay.

Q. Those kind of things.

A. We've had—I couldn't tell you when I had the specific training or anything, but I do know we had training on it, and it's based on you have to have an ES signal, plus two out of three logic of 30 pounds to start spray pumps. You know, that training itself could have been any time over a period of a year from probably 1969 up till the day of the accident.

(Mehler, I&E, 9/3/80, p. 12–13.)

In a similar vein, Mehler told investigators that he believed the instruments to have indicated occurrence of a real pressure pulse and not to have been a manifestation of spurious electrical signals. Mehler referred to the pressure pulse as having originated with a chemical reaction; he stated that he did not recall thinking that a hydrogen detonation might have occurred.

Q. Okay, I think in your I&E interview you said that you thought initially that the pressure spike in the containment, when you saw it, was probably due to somebody fooling around with the transmitter.

A. Yes, I said that. But then I also said it couldn't have been possible because building spray pumps started.

Q. Which meant that there had been a pressure signal that went through and started the building spray pumps?

A. Right.

* * * * * * *

Q. Now, after looking at it in that initial dismissal, did you later realize that there had been pressure in the containment that caused that spike on the instrument?

A. Yes.

Q. Do you have any idea what could cause that kind of a rapid pressure spike?

A. I know Joe and I talked about it later on that day, about what could have caused it and I don't think hydrogen entered into it. We thought maybe some kind of chemical reaction or something happened because it was up and down so quick.

Q. That is Joe Chwastyk?

A. Yes.

Q. So you really didn't have a good diagnosis?

A. I personally didn't think hydrogen could form that quick in the building to that concentration to cause it in that period of time. (Mehler, SIG, 10/11/79, p. 13–15.)

Mehler also recalled in his conversations with investigators that on March 28 he had been told not to turn on oil pumps in the containment, apparently out of concern that electrical sparks might be produced

which could cause detonation of hydrogen in the containment structure. On October 11, Mehler told SIG investigators that:

> . . . I do know sometime after the pressure spike happened we were told not to start equipment because they assumed that it [the pressure spike] could happen again and they probably put it that there was hydrogen in there, but that was sometime after 1:50. Now how far past that, I don't know. And I do not, I said—well, to Gary Miller I said—he said don't start any more oil pumps and I said we don't have to, I already tested them all, because they were concerned—but how far into the afternoon at that time, I don't know whether it was 4:00, 2:00 or what, but it was sometime after.
>
> (Ibid., p. 16.)

Mr. Mehler was interviewed again on October 30 and at this time he was less certain that the above noted instruction not to start the pumps had been given on March 28. The following exchange took place during the October 30 interview where the questions are being asked by Mr. Frampton of the SIG and the answers are Mr. Mehler's:

> Q. Since the interview that our group did with you on October 11, as indicated by Mehler Exhibit No. 2, you have become less certain that this instruction and the conversation you had with Mr. Miller was on Wednesday, the 28th.
>
> A. That is correct.
>
> Q. What is it that has caused you to doubt the recollection that you had before?
>
> A. I've talked to some other people that were there on the 28th, and also thinking back upon it, you know, I cannot be certain that it did happen on the 28th.
>
> Q. In talking with other people—well, let me ask you who you have talked to about it?
>
> A. I've talked to Gary Miller, Mike Ross, Joe Chwastyk,[15a] Bill Zewe, and none of them recollect that instruction being given on the 28th.
>
> Q. Do any of them recollect such an instruction being given on the 29th?
>
> A. I don't think they would say specifically that it happened on the 29th either, but I do believe some of them recollect it being given.
>
> Q. Do you remember which ones?
>
> A. I think Joe does.
>
> Q. Any of the other people?
>
> A. I don't know.
>
> Q. In your conversations with them, what is it that they have said that's made you think that your recollection is probably wrong that it was the 28th?
>
> A. Well, they would have been in the room the same time I was to hear the instructions, and it seems funny, if I would be the only one that remembered it happening on the 28th when there were other people in the room that don't remember it.

[15a] Chwastyk told NRC investigators on September 4, 1980 that to the best of his recollection the instruction not to operate equipment was given on March 28. (See pp. 81, 82, 86–87, 88.)

> Q. So this is in part conversations with other people that you have had and in part sort of a general reconstruction of events that's made you think that you're wrong in thinking it was the 28th; is that fair to say?
>
> A. That's fair to say, and also, you know, quite a bit happened the 28th. And I did come back the 29th. It could have very well been the 29th, and I wouldn't even say for certain it was the 29th right now.
>
> Q. It's conceivable it could have been the 30th?
>
> A. I wouldn't want to get definite and say it was—you know, I'm just not certain right now which day it was.
>
> Q. Would it be fair to say that your own recollection, faulty or not, standing alone, has been that it was the 28th, but that in talking to other people, you think that your recollection is most likely to be somewhat faulty and it was more likely that it was the 29th?
>
> A. That's correct.
>
> (Mehler, SIG, 10/30/79, p. 15–17)

Chwastyk also recalls being told, ". . . not to restart any equipment in the reactor building. And someone at the time had just finished starting a piece of equipment." Chwastyk said he thought the equipment referred to was the DC oil pumps on the reactor coolant pumps, presumably the same pumps referred to by Mehler. Chwastyk said that he thought the instruction had not been issued on Wednesday, March 28,[15c] because he remembered receiving it in the supervisor's office, and ". . . I don't think on Wednesday I was in the shift supervisor's office at all." (SIG, Chwastyk, p. 16, 10/30/79.) This recollection of Chwastyk is referred to in the SIG report (Volume II, Part 3, p. 907) and is part of the basis for the SIG conclusion that Mehler was probably incorrect when he remembered the discussion, about not turning on the oil pumps, as having occurred in the shift supervisor's office on Wednesday, March 28. On the other hand, TMI supervisor Mike Ross did recall Chwastyk being in the shift supervisor's office of March 28:

> At times Joe (Chwastyk) would come into the think tank, (i.e. the shift supervisor's office where supervisory personnel convened during the day for the purpose of assessing events and deciding upon actions to be taken) where we were at, and he would enter discussions.[15b]
>
> (Ross, SIG, 10/30/79, p. 15.)

The SIG report, prepared prior to the NRC I&E inquiry begun in March, 1980, does not mention that Ross' recollection as to Chwastyk's appearance in the shift supervisor's office conflicted with Chwastyk's recalling that he did not think he had been in this office on Wednesday, March 28. The SIG report notes but does not comment upon a further discrepancy in the testimony of Mehler and Miller: Mehler testified that it was Miller who gave the instruction not to start the pumps even though the date was uncertain; i.e., Mehler's own recollection was that the instruction had been issued on the 28th, but after talking to other people, he said that his recollection was most likely faulty and it was more likely that it was the 29th. (Ibid.) Miller, on the other hand, did not recall at any time having

[15b] Chwastyk himself told NRC investigators on September 4, 1980 that to the best of his recollection he had been in the supervisor's office on March 28. (See p. 85.)

[15c] Chwastyk subsequently changed his testimony, stating that to the best of his recollection, the instruction not to operate equipment was given on March 28. (See footnote 15a.)

given an instruction not to start pumps or even having been in the control room on the 29th at 9:15 p.m. which was the Special Inquiry Group's conclusion regarding the time at which the instruction had been given.

(SIG, Vol. II, Part 3, p. 908.)

On September 3, 1980 Mehler was again asked about his recollection and changes therein regarding a March 28 directive not to start equipment in the containment building. Mehler said the changes from his recollection as of October 11, 1979 to that stated on October 30, 1979 were based on his having talked only to Chwastyk and Zewe (not Ross and Miller, in addition to Zewe and Chwastyk, as he had said in his SIG interview on October 30, 1979) and it was on the basis of these discussions that he decided that he had been wrong about receiving on March 28 the instruction not to turn on equipment in the containment building. However, Chwastyk, as indicated below, says that he did not tell Mehler that the instruction had not been issued on the 28th, and that it was in fact Chwastyk's recollection that this was the day on which it had been issued. Furthermore, the most likely time for issuance of the instruction was after 6 p.m., the approximate hour at which Zewe had left the control room. Therefore, Zewe would not have been present had the instruction been issued after 6 p.m., and thus it is unclear what would be Zewe's basis for leading Mehler to believe that his (Mehler's) recollection was faulty. (See Mehler, I&E, 9/3/80, p. 27–28.)

On September 3, 1980 Mehler recalled, as he had previously (Mehler, SIG, 10/11/79, p. 16), that it was Miller who gave the instruction although the day on which it was given remained unclear in his mind. Mehler engaged in the following dialog with NRC investigators:

Q. Your best recollection now is that an instruction was given.

A. That's correct.

Q. By whom was it given?

A. Mr. Miller. (Mehler, I&E, 9/3/80, p. 30–31.)

* * * * * * *

Q. Your recollection is quite certain that it was Mr. Miller who gave this instruction. Could it have been anyone else? You're quite certain it was Mr. Miller?

A. The best I recall, it came from Mr. Miller.

(Ibid., p. 32.)

* * * * * * *

In a meeting with I&E investigators on September 4, 1980 Chwastyk presented additional recollections (and clarification of previous recollections) with regard to his awareness of the hydrogen detonation, its significance, and the instruction not to start equipment in the containment building, an instruction Chwastyk now appears certain was issued on March 28:

Q. At what time and what logic caused you to conclude that the spike was caused by hydrogen?

A. The time, I have to say, the time really did not have much meaning on the 28th. I don't think it was very long simply because it did not take us long to—It did not take the spike long. The spike was not there very long. Mehler and I

did not go into a two-hour or three-hour discussion. It was just a matter of exchanging ideas.

It was shortly thereafter that someone related to me that they heard a noise of some type. Again, I don't remember who related that to me. Somehow, the noise, the pressure spike, the operation of the valve which was being operated all came together, and it scared the hell out of me. That is when I assumed that we had had some kind of explosion, a hydrogen explosion.

Q. Your best recollection is that it was on 3–28?

A. Yes.

Q. On testified on 5–21–79 that you recommended to Gary Miller that the EMOV should not be cycled. What was the basis for your recommendation not to cycle the EMOV?

A. The basis for the recommendation was what I have just related. The operation of that valve with the pressure spike, I therefore assumed that there was something wrong with the operator motor, or some kind of connection there that was causing a spark.

Q. Was your concern based on the failure of the motor for the block valve?

A. No, I will be quite frank with you, my first concern was, Holy Christ, we had an explosion in there, and if we operate that valve we may have a bigger one. Of course, you know, I did not think it through and the fact that the first burn should have burned anything that was there.

Q. Were you concerned about localized concentrations of hydrogen?

A. Well, yes. I will state also that I assumed that the explosion was localized in the pressurizer area. One of my concerns was that there may be other pockets around there, and that would be dangerous.

Q. Why didn't your concern or recommendation include other equipment inside containment?

A. At that time, we were not operating any other equipment in the containment. Our mode of cooling was cycling the valves.

Q. If other equipment was to have been energized, would you have recommended to Gary Miller that that not be energized also?

A. I will be quite frank with you, I did not think in those terms. As a matter of fact, there was word put out not to operate in the equipment, and I sort of kicked myself for not thinking about that myself?

By Mr. HOEFLING:

Q. When was that word put out, do you recall?

A. To the best of my recollection, it was on the 28th.

Q. Who put it out?

A. I assume that it came from Gary Miller, but I cannot say that Gary Miller told me specifically.

Q. You mean that it might have been passed along from someone else?

A. Yes, and I am not sure of that.

By Mr. MOSELEY.

Q. You don't recall who gave you that order or instruction?

A. I am just trying to think about it.

I will be quite frank. Again, I don't remember, but I think Gary Miller was there, but whether he actually said it or not, I don't remember.

By Mr. HOEFLING.

Q. But your best recollection is that it came out on the 28th?

A. Yes.

By Mr. MOSELEY.

Q. Following up on the same thing, do you recall any reason for the order or instruction not to operate equipment? Was any reason for this order or instruction?

A. I don't remember now if it was stated, or I just assumed that it was so that we did not cause any more sparking.

Q. You don't recall which?

A. Can I talk to my lawyer?

Mr. MOSELEY. We will go off the record.

[Discussion was held off the record.]

Mr. MOSELEY. We are back on the record.

The WITNESS. May we have the question asked again?

By Mr. MOSELEY.

Q. The question was, do you recall at the time that the order was given whether or not there was a statement as to why the equipment was not to be operated?

A. Again, I don't remember specifically that the reason was given or that I just assumed it that this was to prevent sparking in the building.

I do remember the circumstances and who was present. Essentially Gary Miller had mentioned, and Brian Mehler was there. Mehler said something to the effect that it was too late, and that he had just started some piece of equipment in the building.

I remember some comment of mine to the effect, and this was sometime later, "Don't worry about it because we have burned up that was in there anyway."

Q. That was your comment?

A. That was my comment.

By Mr. GAMBLE.

Q. To Mr. Mehler?

A. Yes.

Q. And Mr. Miller?

A. To whoever was there.

By Mr. MOSELEY.

Q. Mr. Miller, to your recollection was there?

A. Yes, to my recollection he was.

(Chwastyk, I&E, 9/4/80, p. 14–18.)

On September 4, 1980, Chwastyk engaged in discussion with NRC investigators indicating that no general announcement was made in the control room regarding the instruction not to start equipment in the containment. In addition, Chwastyk recalls that he was not sure as to the extent the instruction had been followed since they had recently started a piece of equipment and "nothing happened," i.e. there had been no indication of a hydrogen detonation. The discussion follows:

Q. How was that order transmitted?

A. Again, I don't remember specifically Gary Miller giving that order specifically to me. I do remember that soon after it was given, Gary Miller and myself were discussing something when Mehler walked in. How the order was actually transmitted, I don't know.

Q. It was not somebody saying to you in a calm voice, "Don't restart any electrical equipment," as opposed to somebody standing back and saying in a loud voice, so that other people could hear, "Don't restart any electrical equipment in the containment."

A. It was not a general announcement made in the control room. I remember that definitely.

By Mr. HOEFLING.

Q. Would that kind of order or direction be recorded in a log?

I am not familiar with plant operation, but normally would something like that be recorded or logged?

A. It is difficult to answer because I cannot think of an analogy to use during normal operations for an order like that.

Q. So it is unclear.

A. Yes.

Q. So you don't have a feel for one way or the other.

A. Let me say this. During normal operations, or right now, for that matter, there are a number of ways that we would prevent operation of equipment if we did not want it operated, and that would be tagging it out, which involves a lot of time to get instituted.

Prior to that time, it would have been a verbal type of communication to whoever was in charge of the shift. Right now, presently, the shift foreman. If I had a piece of equipment that I did not want run, I would institute the proper tagging, whether it be safety tagging, or a caution tag, or something of that nature, but until the time that the tags were placed, I would give a verbal order by way of the shift foreman not to operate that equipment. But I don't think that they would log it.

By Mr. MOSELEY.

Q. In this circumstance, wouldn't that be sort of well publicized to all the operators in the control room because each of them may have had some reason to operate some equipment?

A. Normally it would, except for the fact that at the time the word was put out, it started a piece of equipment and nothing happened. So I am not too sure how far we carried it out. I don't think that we did at all because that was about the time we were starting the reactor cooling pump.

Q. This would have been about six o'clock in the afternoon?

A. Between 4:00 and 10:00, I guess.

Q. The pump was bumped at about 7:30.

A. I remember, to the best of my recollection, that it was about that time that we were getting ready to run the reactor cooling pump that all of this happened.

Q. Could you tell me from your knowledge what precipitated at this point in time, some six hours or five hours after the time of the explosion? Had there been discussion of this? What caused the long time period?

A. I don't know, to tell you the truth. All I can relate is what I remember, and my first impression was, "Oh hell, why didn't I think of that."

After I thought about it a little more, I thought, oh hell, we have already burned it up in there. We have not been recycling the valves, so we have not been putting any more hydrogen in the building.

How the order came about, I just don't know.

Q. I just wondered if you overheard or knew of any conversations in the interim in which this was being discussed?

A. No, I didn't, or at least I don't remember any.

By Mr. GAMBLE.

Q. Do you recall hearing any comments from any of the personnel who received this order, operators or anyone, indicating that they understood the order was to prevent any sparks?

A. I don't really remember that the order got out to the control room operators. As I think about it now, there would be no reason to because we had just started some equipment in the building.

Whether the word got out to them prior to my knowing what happened, I don't know.

Q. Was there any discussion amongst the personnel, aside from Mr. Mehler, Mr. Miller and yourself, which you have talked about earlier?

Was there any discussion along the lines, "Well, we don't have to worry about this problem because we just started these pumps and nothing happened," any discussions along that line?

A. The one between Mehler, myself and Miller, I definitely know about.

(Ibid, p. 19–22.)

The following is Chwastyk's explanation presented on September 4, 1980 regarding his previous recollection that he had not been in the shift supervisor's office on March 28, a recollection that was part of SIG's basis for concluding that the directive not to start equipment was given after March 28.

> Q. Ross has testified on the 30th to the SIG that you were in the shift supervisor's office on March 28th, and today you have also likewise testified that you were in the shift supervisor's office. Is that correct?
>
> A. Yes.
>
> Q. You, however, testified on the 30th to the same group, the SIG group, that you don't recall being there on March 28th, and this is in relation to again the sparking potential. It is your recollection, however, today that you were indeed in the shift supervisor's office on March 28th?
>
> A. Well, yes, it is, but when I answered that question previously I answered it in terms of that was not my station, you know, I was not doing anything specifically in the shift supervisor's office other than going in and making reports or getting directives, you know, depending on what it was.
>
> Q. Well—go ahead.
>
> A. That is essentially what I meant about not being in the shift supervisor's office. You know, I didn't go in there and hold lengthy discussions on the plan of attack, which was going on at the time. I wasn't involved in that type of thing. I was in the office, you know, just to receive my orders and to make reports only.
>
> Q. Well, the reason I asked the question of course was the fact that two people, yourself and another person, testified that you weren't there on that day, weren't in that office on that day. Those two testimonies were taken to discount that the order was given on the 28th. I just want to clarify that it is now today your recollection you were in the shift supervisor's office on that day, and I have done that.
>
> A. Yes.

(Chwastyk, I&E, 9/4/80, p. 45–46.)

On September 4, 1980 Chwastyk engaged in the following dialog with NRC investigators wherein he seeks to explain how Mehler might have gotten from him the impression that the instruction concerning equipment in the containment had *not* been given on March 28. Chwastyk tells the investigators that it was in fact his recollection that the instruction to not start equipment *was* given on March 28.

> By Mr. HOEFLING.
>
> Q. Joe, let me go back to something we have already talked about. This is the instruction not to start electrical equipment that we talked about earlier. What you basically said was that the instruction was given on March 28th by Miller not to start any electrical equipment in the containment.
>
> Now, we have talked to Brian Mehler on this same subject, about the instruction and when it was given. This is how that spun out. On October 11th, 1979 Brian testified on this subject and he said basically what you have said that he recalled the instruction having been given by Miller on the 28th. After that he had some doubts, reconsideration, what-have-you, and he later testified that he wasn't sure when the instruction was given. He wasn't sure if it was given on the 28th or the 29th. He still recalls such an instruction being given, but he didn't know when it had been given.
>
> We talked to Brian about this yesterday and asked him what prompted him to think about this and begin to doubt the time. He indicated that he had some conversations. Specifically he said he had a conversation with you. He asked you did you recall the instruction being given on the 28th and that you told him that it had not been given on the 28th, to your recollection.

Do you recall talking to Brian about this subject?

Mr. McBride. Before you answer that. He may have said that on October 30th, but so far as I recall he didn't say specifically yesterday that Mr. Chwastyk said what you just related that he said.

(Short pause.)

Mr. Hoefling. Can I read from the Mehler interview.

Mr. McBride. Please.

Mr. Hoefling. This is Brian talking yesterday.

Mr. Craig. Excuse me. For the record, that is the Mehler interview of 9/3/80.

Mr. Hoefling. This is the question to Brian.

"Question: Who did you talk to?

"Answer: I believe I talked to Joe and Bill.

"Question: Chwastyk?

"Answer: Chwastyk and Zewe, and I really don't know who else.

"Question: What did they say? What did you ask them?

"Answer: I asked them if they recalled the conversation where they said not to start any electrical equipment in the reactor building.

"Question: What did they say to that?

"Answer: They don't recall that conversation happening on March 28th."

The Witness. I remember a conversation with Mehler about that. I am not sure I remember exactly, you know, what was said. My first impression when you asked that was that Mehler related to something about someone saying that it didn't happen until the 29th. He wanted to know what I thought, or maybe even to try to help him, you know, in his own mind, you know, get it straight on when it happened. It seems to me I remember, at least I think I remember saying something to the effect that—I think essentially I told him, you know, that he has just got to go with what he remembered, and I may have made a comment of something to the effect that, you know. I didn't think it happened on the 29th, but I don't remember saying that.

The only thing I remember of that conversation was my not wanting to impress anything on Mehler, or him not impressing anything on me. I don't think I really wanted to talk about it. You know, I sort of glossed over it and tried to change the subject type thing.

By Mr. Hoefling.

Q. But you don't recall telling Mehler that it didn't happen on the 28th or anything like that?

A. Well, I don't really remember. I may have.

Q. You may have said that to him, that it didn't happen on the 28th?

A. I may have. I don't know why. Again, I really didn't want to discuss it with him at the time, and I may have just said it to close out the conversation.

Q. But you are clear that the instruction was given on the 28th?

A. Yes, to the best of my recollection, it was given on the 28th, you know, and I think it was after Miller came back from seeing McGovern.

Q. And you are clear that Brian did come up to you, I suppose it would have been after the——

A. Yes.

Q. What do you recall of that conversation? Can you recall when that happened?

A. No, I don't recall when it happened. I remember it was right about the time we were getting, you know, all the interviews. You know, I didn't know where we stood, and I was told not to discuss it by a number of people. I really didn't want to discuss anything that happened.

Q. You were told not to discuss what?

A. Well, on similar previous interviews, you know, it was mentioned not to, you know, discuss—maybe not even at the interviews. Maybe it just came from someone else. I don't know. We had been given instructions not to talk amongst ourselves about some of these items and I never did. I never really sat down and went through the whole scenario of what happened with, you know, for instance, of what some of the control room operators saw.

Q. So the general instruction that you were operating under was not to discuss the events on the 28th with others?

A. Yes, essentially.

Q. And it was your personal objective not to impress others with what happened on that date or to receive impressions?

A. Exactly. Exactly. And I think that is the thinking.

Q. Why would you then have told Brian that it happened on the 28th during such a conversation?

A. Well, the only reason I can think of, and I don't remember specifically, is that it may have been a way to close out the conversation.

Q. Wouldn't that have broken the "standing policy"?

A. No. I think, and I probably said it under the assumption that if you think it happened on the 28th, you know, that is what you have got to go with, you know, and I will go with what I thought. I don't know if I mentioned, you know, what I thought at the time to Mehler. As a matter of fact, I remember trying not to, you know, give him an impression of what I thought simply because I didn't think it was right for us to be talking about it because we were told not to.

Q. But still you recollect you told him it did not happen could not have happened on the 28th?

Ms. Boast. Excuse me, I can't hear you.

By Mr. Hoefling.

Q. I said but still during that conversation you recollect that you told him it did not happen on the 28th? I am trying to get a feel for what the words were that you gave to Brian on the subject.

A. You know, as I think about it a little bit, I think it came out in the context of someone, you know, it was Zewe or Miller or something said that it happened on the 29th. And I said,

well, if they said it happened on the 29th maybe it did. I think that was the kind of context that we held our conversation in.

Q. Do you recall telling him that you thought it happened on the 28th during that conversation?

A. No, I tried to stay away from telling him what I thought, quite frankly.

Mr. HOEFLING. Okay, Joe, let me show you page 16 of your deposition given on October 30th, 1979, to the Special Inquiry Group. I want you to look at that page.

(Document handed to the witness.)

By Mr. HOEFLING.

Q. Joe, is the substance of the testimony on that page that you weren't sure whether the instruction had been given on the 28th? Is that what you were saying there?

A. Yes, I think that is what it says. At this time, you know, when I did this interview I wasn't sure that it was the 28th simply because, you know, I didn't really have time to think about it and relate it to you.

Q. What is your recollection now?

A. Well, my recollection is now that it did happen on the 28th and it was about the time we started those reactor coolant pumps, you know, the first reactor coolant pumps. But again, you know, this is some time period even after that interview. I think it was about that time, and again I can't be absolutely sure. (Chwastyk, I&E, 9/4/80, pp. 36–42.)

A reactor operator, Theodore Illjes, who arrived in the control room after the detonation, told NRC investigators that he had been briefed on the reactor building pressure pulse:

> I was told they had a spike on both indications of the reactor building pressure recorder. There was some discussion as to what it was. A hydrogen explosion was discussed. This was later in the evening.
>
> (Illjes, I&E Tape 261, May 23, 1979, p. 6.)

When asked again as to whether the discussion of a possible hydrogen burn had taken place on the first evening (March 28) Illjes said:

> As far as I know that possibility was discussed that evening. (Ibid., p. 10.)

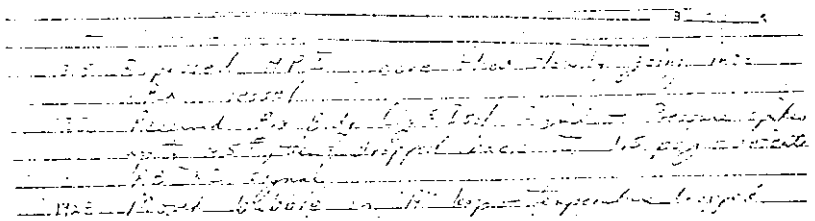
Mr. Herman Dieckamp, President of General Public Utilities, stated in a May 9, 1979, mailgram to Chairman Udall:

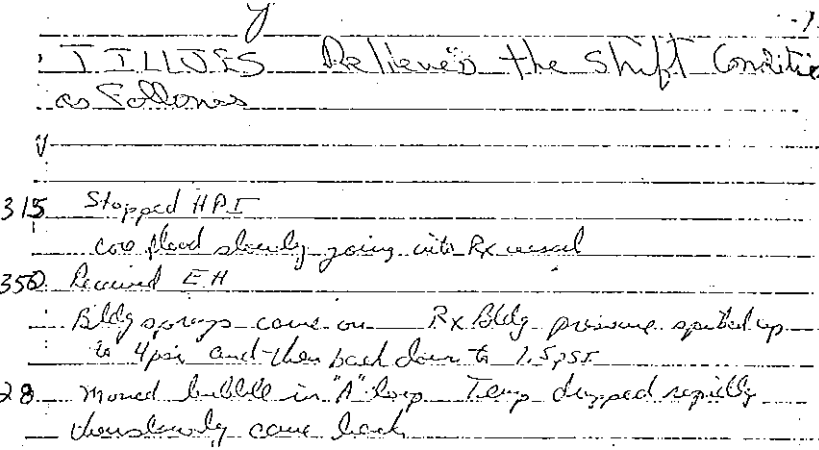
> There is no evidence that anyone interpreted the "pressure spike" and the spray initiation in terms of reactor core damage at the time of the spike nor that anyone withheld any information. (See Appendix G.)

Log Entries

Two logs containing a listing of significant events that occurred on March 28 indicate that a pressure pulse occurred at approximately

1:50 p.m. One log lists the pressure spike as having been 4 pounds per square inch and accompanied by actuation of reactor building sprays; the other log lists the pulse as having been approximately 5 pounds per square inch, and does not mention the containment sprays. The reports of the TMI investigations do not address adequately the question as to why the pressure pulse was indicated to have been 4 or 5 psi when in reality it was approximately 28 psi. For example, the SIG report states only that: "Furthermore, an entry in the control room operator log book for the afternoon of March 28 notes that at 1:50 p.m. an engineered safeguards initiation signal was received, the reactor building sprays came on, and the reactor building pressure spiked up to 4 psi." (SIG, Volume II, Part 3, p. 905.)





Increased Containment Temperature

As indicated above (Figure V–C, p. 57) containment temperature increased following occurrence of the pressure pulse at approximately 1:50 p.m. The record of the TMI inquiries does not indicate the extent to which such temperature recording devices were monitored, the nature of interpretations assigned to the data recorded thereon, and, if the instruments were not being monitored and/or the data were not being analyzed, whether this constituted a significant failing on the part of TMI personnel.

Alarm Printer

In the 30-second interval beginning at the time of the pressure pulse, approximately 100 system parameters reached levels or conditions sufficient to trigger an alarm. During the 1-second interval following the pulse, 28 alarms were triggered. When the pulse occurred, the alarm printer was apparently jammed by a backlog and the printer did not begin showing these alarms until approximately 3:02 p.m. The record of the various inquiries does not indicate whether the alarm printer was being monitored, and what if anything was inferred from the large number of alarms apparently set off by the pressure pulse. The inquiries do not address the question as to whether the triggering of these alarms should have made clear to the TMI operators that the recorded pressure pulse reflected a true increase in pressure and not spurious electrical signals.

Alarm data follows:

[illegible]	[illegible]	[illegible]	[illegible]	NAT DFT CLG TMR NO FL(GPM)	-??.??	
15:46:14	NORM	0042	NAT DFT CLG TMR NO FL(GPM)	.00		
15:47:02	BAD	1137	FLUX 6-G LEVEL 2 (NANOAMPS)	-????.		
15:47:50	BAD	1021	RB AIR CLG COILS B EMER DISCH	-???.?		
15:48:40	NORM	1021	RB AIR CLG COILS B EMER DISCH	52.1		
15:50:00	ALARM	PRINTER RETURN-TO-NORMAL				
15:50:10	COINT	2984	RCP 2B UPPER OIL POT LVL 2	LOW		
15:50:10	COINT	2985	RCP 1B UPPER OIL POT LVL 2	LOW		
15:50:10	COINT	2983	RCP 2A UPPER OIL POT LVL 2	LOW		
15:50:00	COINT	2994	DHP A MTR STATUS	NORM		
15:50:00	COINT	2995	DHP B MTR STATUS	NORM		
15:50:01	COINT	3167	4 PSI RB PRESS RED CH TRIP	HIGH		
15:05:25	ATRA	0397	RC LOOP B INLET TEMP WIDE 2	ATR 02	200.0/	2.0
15:50:01	COINT	3168	4 PSI RB PRESS GRN CH TRIP	HIGH		
15:50:01	COINT	3169	4 PSI RB PRESS YEL CH TRIP	HIGH		
15:50:02	COINT	3241	DH REMOVAL PMP 1A	ON		
15:05:05	ATRA	0397	RC LOOP B INLET TEMP WIDE 2	ATR 02	150.0/	2.0
15:50:02	COINT	3242	DH REMOVAL PMP 1B	ON		
15:50:02	COINT	3245	INTMD CLG PMP 1C-P-1A	OFF		
15:50:02	COINT	3246	INTMD CLG PMP 1C-P-1B	OFF		
15:50:02	COINT	3278	ES BLDG ISLN SW ACT B CH-1 TRIP	TRIP		
15:50:02	COINT	3279	ES BLDG ISLN SW ACT B CH-2 TRIP	TRIP		
15:50:21	COINT	3280	ES BLDG ISLN SW ACT B CH-3 TRIP	TRIP		
15:50:21	LOW	0151	INTER CLG PUMP DISCH PRESS	109.5		
15:50:21	COINT	2018	ES ACT A 2/3 LOGIC EMER INJ GP1	ACT		
15:50:21	COINT	2019	ES ACT A 2/3 LOGIC EMER INJ GP2	ACT		
15:50:21	COINT	2020	ES ACT A 2/3 LOGIC EMER INJ GP3	ACT		
15:50:21	COINT	2027	ES ACT A 2/3 LOGIC BLDG ISLN GP1	ISLN		
15:50:21	COINT	2028	ES ACT A 2/3 LOGIC BLDG ISLN GP2	ISLN		
15:50:21	COINT	2029	ES ACT A 2/3 LOGIC BLDG ISLN GP3	ISLN		
15:50:21	COINT	2033	ES BLDG ISLN SW ACT A CH1 TRIP	TRIP		
15:50:21	COINT	2034	ES BLDG ISLN SW ACT A CH2 TRIP	TRIP		
15:50:21	COINT	2035	ES BLDG ISLN SW ACT A CH3 TRIP	TRIP		
15:50:21	COINT	2043	ES ACT B 2/3 LOGIC EMER INJ GP1	ACT		
15:50:21	COINT	2044	ES ACT B 2/3 LOGIC EMER INJ GP2	ACT		
15:50:21	COINT	2045	ES ACT B 2/3 LOGIC EMER INJ GP3	ACT		
15:50:21	COINT	2052	ES ACT B 2/3 LOGIC BLDG ISLN GP1	ISLN		
15:50:21	COINT	2053	ES ACT B 2/3 LOGIC BLDG ISLN GP2	ISLN		
15:50:21	COINT	2054	ES ACT B 2/3 LOGIC BLDG ISLN GP3	ISLN		
15:50:22	COINT	2881	RCP 1A LOWER OIL POT LVL 4	LOW		
15:50:22	COINT	3170	4 PSI RB PRESS BLUE CH TRIP	HIGH		
15:50:22	COINT	2881	RCP 1A LOWER OIL POT LVL 4	NORM		
15:50:25	COINT	2881	RCP 1A LOWER OIL POT LVL 4	LOW		
15:50:25	COINT	2882	RCP P1C MTR STATUS	RUN		
15:50:25	COINT	2884	RCP 1B LOWER OIL POT LVL 4	LOW		
15:50:25	COINT	2886	RC PUMP 2A SEAL LEAK TK LVL	HIGH		
15:50:24	COINT	2884	RCP 1B LOWER OIL POT LVL 4	NORM		
15:50:25	COINT	2883	RCP 2B LOWER OIL POT LVL 4	LOW		
15:50:25	COINT	2993	DSP A MTR STATUS	RUN		
15:50:25	COINT	2994	DSP B MTR STATUS	RUN		
15:50:[illegible]	COINT	3286	ES BLDG SPRAY SW ACT B CH2 TRIP	TRIP		
[illegible]	[illegible]	[illegible]	ES BLDG SPRAY SW ACT A CH1 TRIP	[illegible]		
[illegible]	[illegible]	[illegible]	ES BLDG SPRAY SW ACT A CH2 TRIP	[illegible]		
[illegible]	[illegible]	[illegible]	ES BLDG SPRAY SW ACT A CH3 TRIP	[illegible]		
[illegible]	[illegible]	[illegible]	ES ACT A 2/3 LOGIC RB SPRAY	[illegible]		
[illegible]	[illegible]	[illegible]	RCP 2B LOWER OIL POT LVL 4	[illegible]		
[illegible]	[illegible]	[illegible]	ES ACT B 2/3 LOGIC RB SPRAY	[illegible]		
[illegible]	[illegible]	[illegible]	ES BLDG SPRAY SW ACT B CH1 TRIP	[illegible]		
[illegible]	[illegible]	[illegible]	ES BLDG SPRAY SW ACT B CH2 TRIP	[illegible]		
[illegible]	[illegible]	[illegible]	CLR 1A OUTLET	[illegible]		
[illegible]	[illegible]	[illegible]	CLR 1B OUTLET	[illegible]		
[illegible]	[illegible]	[illegible]	ES BLDG SPRAY SW ACT B CH3 TRIP	[illegible]		
[illegible]	[illegible]	[illegible]	ES BLDG SPRAY SW ACT B CH3 TRIP	[illegible]		

[illegible]	CONT	3261	ES BLDG SPRAY SW ACT B CH2 TRIP
15:50:54	CONT	3050	ES ACT B 2/3 LOGIC RB SPRAY
15:50:52	CONT	3264	ES BLDG SPRAY SW ACT B CH2 TRIP
15:50:52	CONT	2036	ES BLDG SPRAY SW ACT A CH1 TRIP
15:50:52	CONT	2037	ES BLDG SPRAY SW ACT A CH2 TRIP
[illegible]	CONT	2038	ES BLDG SPRAY SW ACT A CH3 TRIP
15:50:52	CONT	2039	ES ACT A 2/3 LOGIC RB SPRAY
15:50:55	HIGH	0405	RC PRESS REL VLV RV1A OUT TEMP
15:50:55	HIGH	0404	RC PRESS REL VLV RV1B OUT TEMP
[illegible]	HIGH	0422	RCP 1A AIR TEMP DEGF
15:50:55	HIGH	0425	RCP 1B AIR TEMP DEGF
[illegible]	LAO	0451	IC RCP 1A COOL OUTLET TEMP
15:50:56	LAO	0475	SP STARTUP FDWTR FLOW A (IN/H2O)
15:50:59	CONT	2983	RCP 2A UPPER OIL POT LVL 2
15:50:40	CONT	2984	RCP 2B UPPER OIL POT LVL 2
[illegible]	CONT	2956	RC PUMP 2A SEAL LEAK TK LVL
15:50:41	CONT	2980	RCP 2A UPPER OIL POT LVL 1
15:50:41	CONT	2981	RCP 2B UPPER OIL POT LVL 1
15:50:41	CONT	2982	RCP 1A UPPER OIL POT LVL 2
[illegible]	CONT	2985	RCP 1B UPPER OIL POT LVL 2
15:50:42	CONT	2956	RC PUMP 2A SEAL LEAK TK LVL
15:50:44	NORM	0305	RP LOOP A RC DELTA PRESS (INH2O)
15:50:45	CONT	2979	RCP 1A UPPER OIL POT LVL 1
15:50:45	CONT	2030	ES ACT A BLDG ISLN CH1 DEFEATED
15:50:46	CONT	2018	ES ACT A 2/3 LOGIC EMER INJ GP1
15:50:46	CONT	2019	ES ACT A 2/3 LOGIC EMER INJ GP2
15:50:46	CONT	2020	ES ACT A 2/3 LOGIC EMER INJ GP3
15:50:46	CONT	2027	ES ACT A 2/3 LOGIC BLDG ISLN GP1
15:50:46	CONT	2028	ES ACT A 2/3 LOGIC BLDG ISLN GP2
15:50:46	CONT	2029	ES ACT A 2/3 LOGIC BLDG ISLN GP3
15:50:46	CONT	2032	ES ACT A BLDG ISLN CH3 DEFEATED
[illegible]	CONT	3045	INTMD CLG PMP IC-P-1A
15:50:47	CONT	3047	ES ACT B BLDG ISLN CH1 DEFEATED
15:50:48	CONT	3049	ES ACT B BLDG ISLN CH3 DEFEATED
15:50:48	CONT	3246	INTMD CLG PMP IC-P-1B
[illegible]	CONT	2043	ES ACT B 2/3 LOGIC EMER INJ GP1
[illegible]	CONT	2044	ES ACT B 2/3 LOGIC EMER INJ GP2
[illegible]	CONT	2045	ES ACT B 2/3 LOGIC EMER INJ GP3
[illegible]	CONT	2052	ES ACT B 2/3 LOGIC BLDG ISLN GP1
[illegible]	CONT	2053	ES ACT B 2/3 LOGIC BLDG ISLN GP2
15:50:48	CONT	2054	ES ACT B 2/3 LOGIC BLDG ISLN GP3
[illegible]	CONT	2005	RCP 1B UPPER OIL POT LVL 1
15:50:51	NORM	0151	INTER CLG PUMP DISCH PRESS
[illegible]	CONT	2001	RCP 1A LOWER OIL POT LVL 4
[illegible]	CONT	3121	RCP PIC MTR STATUS
[illegible]	LOW	0183	INTER CLG PUMP SUCT PRESS
[illegible]	NORM	1123	FLUX 7-F LEVEL 4 (NANOAMPS)
[illegible]	NORM	1136	FLUX 7-E LEVEL 7 (NANOAMPS)
15:51:09	LAO	1140	FLUX 6-G LEVEL 5 (NANOAMPS)
[illegible]	LAO	0530	IN INCORE T/C 10-R TEMP
15:51:15	LOW	0965	RP CH A RC FLOW LOOP A (PCT)
[illegible]	[illegible]	[illegible]	RP CH B RC FLOW LOOP A (PCT)
[illegible]	[illegible]	0197	RP CH C RC FLOW LOOP A (PCT)
[illegible]	[illegible]	[illegible]	RP CH D RC FLOW LOOP A (PCT)
[illegible]	[illegible]	[illegible]	RP CH A RC TOTAL FLOW (PCT)
[illegible]	[illegible]	[illegible]	RP CH B RC TOTAL FLOW (PCT)
[illegible]	[illegible]	[illegible]	RP CH C RC TOTAL FLOW (PCT)
[illegible]	[illegible]	[illegible]	RP CH D RC TOTAL FLOW (PCT)
[illegible]	[illegible]	[illegible]	LOOP HOT CONT CTR 2-32A CLR
[illegible]	[illegible]	[illegible]	LEAKAGE CLSD CLG PUMP IC-1-P/
[illegible]	[illegible]	[illegible]	FLUX 10-K LEVEL 1 (NANOAMPS)
[illegible]	[illegible]	[illegible]	FLUX 11-E LEVEL 5 (NANOAMPS)
[illegible]	[illegible]	1126	FLUX 7-B LEVEL 7 (NANOAMPS)
[illegible]	[illegible]	[illegible]	RCP 1A UPPER OIL POT LVL 1

I. SUMMARY: MANAGEMENT AWARENESS OF REACTOR CONDITIONS

Upon arriving in the TMI–2 control room at approximately 7:05 a.m., Station Manager Gary Miller established a "command" group, consisting of senior plant personnel, which convened frequently during the day for the purpose of discussing plant conditions and developing a response to them. Miller stated that the group meetings ". . . were held in the shift supervisor's office in a calm atmosphere, at a point removed from the control room, and the decisionmaking was done precisely, at intervals dictated by the plant, and in no case longer than 30 to 40 minutes apart." (Supra, pp. 4–5.) The record of the TMI investigations shows that on March 28, the TMI plant managers were aware of information indicative of a situation much more perilous than was reported to State and Federal officials.

Stuck Open PORV

Zewe, Ross, Mehler, and Bryan have made statements to NRC investigators indicating that prior to 7 a.m. they were aware that the leaking PORV had been the cause of symptoms observed in the early hours of the accident. Zewe stated that closure of the block valve had caused primary system pressure to increase and reactor building pressure to decrease. (Supra at 7.) Ross said reactor building pressure decreased following closure of the block valve, and recalled Zewe commenting on this to him. (Supra at 6.) Mehler, who arrived at about 5:45 a.m. said that ". . . upon closing the block, I assumed we found the problem." (Supra at 8.) Chwastyk, who arrived between 11 a.m. and noon recalled that "when he got to the control room" he had found out about the stuck open PORV and that Mehler had stopped the flow from the system by closing the block valve. (Supra at 9.) Miller said he did not recall having been aware on March 28 of the PORV having been open for an extended period of time. (Supra at 10.) Zewe, however, said he had briefed Miller upon his arrival as to what happened up to that time, and that among the matters covered in the briefing "should have been" the shutting of the block valve, decreasing containment pressure, and increasing primary system pressure. (Supra at 11.) Ross recalled that information about the PORV having been opened had been passed on to Miller. (Supra at 11.) Kunder's statements indicate that he became aware of the PORV having been open sometime after the General Emergency had been declared, probably no later than 8:30 a.m. (Supra at 8.)

Throttling of High Pressure Injection (HPI)

Zewe knew about the HPI status because he had been the shift supervisor under whose direction the HPI controls were manipulated. Zewe said (Supra at 13) that he had discussed with Miller the status of the HPI and letdown systems as they had existed prior to 8:30 a.m. Kunder said (Supra at 12) that when he arrived at about 4:50 a.m. he became aware that HPI had been secured.

In answer to a question as to whether prior to 11 a.m. there had been discussion of the fact that an open PORV and HPI being turned off could have resulted in a substantial loss of inventory, Ross said (supra at 12) that he thought the fact of the HPI having been off or throttled back had been discussed. While Zewe recalls having told Miller about the HPI and others recall Miller having been present when it was

discussed, Miller himself has never made a clear statement as to whether or not on the morning of March 28, he knew that the HPI had been throttled during the period the PORV was open. Miller was concerned, however, when he found that the HPI had been throttled after his arrival at about 7 a.m.; Miller recalls his having issued strong instructions that the HPI not be throttled again without his explicit instructions. (Supra at 13.) The preponderance of evidence (including the likelihood that he would have insisted in the periodic meetings of the command group on having been informed as to what had transpired prior to his arrival) suggests that Miller, following his arrival, was informed as to the state of the HPI prior to his having arrived at the site.

Superheated Conditions in Hot-Legs

Miller was aware that the hot-leg temperatures were in excess of 620 degrees, the upper limit of the computer readout, and consequently he instructed that an instrument capable of indicating temperatures in excess of 620 degrees be attached to the hot-leg temperature sensor. Miller recalled that the latter device indicated 720 degrees (Supra at 19), a temperature that Miller, on the basis of his training would have known to imply the existence of superheated conditions in the hot-leg. Ivan Porter, a TMI engineer, was responsible for connecting the device to the hot-leg and was aware of hot-leg temperatures in excess of 700 degrees. (Id.) John Flint, a B&W engineer at the site, said that Porter had shown him the setup that was indicating hot-leg temperatures in excess of 700 degrees. (Supra at 19.) A strip chart at the back of the control room showed the hot-leg temperature record; this record was monitored by Flint; but his statements are ambiguous with regard to whom he discussed this data which clearly indicated heating and uncovering of the core that began shortly after the last of the reactor coolant pumps was turned off at about 5:40 a.m. Zewe said that he had recognized temperatures in excess of 700 degrees to have indicated the presence of superheated steam; Zewe further recalled conversations with plant managers about this, although he did not recall the names of managers with whom such conversations occurred. (Supra at 20.) Kunder was aware of hot-leg temperatures on the order of 700 or 800 degrees (Supra at 20.) Ross said he was aware of temperatures around 700 degrees which at this time meant to him, "I didn't have a cooling method for the core." (Supra at 22.)

Superheated conditions above the core. (*See Supra at 22–23.*)

John Flint, a B&W engineer at the site, monitored the computer printout which indicated question marks for temperatures in excess of 700 degrees. Flint said, "Only one or two seemed to indicate they were in fact bad. These temperatures were monitored for the rest of the day to follow what was happening in the core." (Supra at p. 23.) Miller said that he " . . . was never trained that those thermocouples were too much of a device which you were to use but I used them because they were the only indicator (of) what was going on in the core. (Id.) Porter recalled that shortly after 7 a.m. Miller had asked him about the in-core readings and that he had called for the computer to print them. In all, the computer was called upon to print in-core thermocouple data at least 9 times between 8 a.m. and 10 p.m. on March 28. (Supra at 22.) Because the thermocouple data was valid for higher

temperatures than could be processed by the computer, Miller asked for direct measurements of the thermocouple voltages. These were made between 8 and 9 a.m. The data showed 9 out of 51 thermocouples indicating temperatures in excess of 2,000 degrees. One technician told NRC investigators that the data was such that " . . . it was the general consensus amongst the instrument people there that the core was definitely uncovered." (Supra at 25.)

The foreman in charge of making the measurements said, "We had possibly uncovered the core was the only way we could see that you could have obtained temperatures of that magnitude." (Id.) Another technician said, "I feel then that there was a definite sign then that the core had definitely been uncovered to the point where it suffered damage." (Supra at 25.) Ivan Porter, the engineer who, at Miller's request, had instructed the technicians to obtain the data, has given conflicting testimony as to whether he believed the data was credible. At various times he implied he did not believe the data because of the wide scatter in the readings. But when pressed as to whether he considered a reading of 2,300 degrees to be anomalous, Porter said, "I don't know. I was afraid it was real." (Supra at 20.) Three of the technicians involved in making the measurements recollect that Porter did accept the data as a valid indicator of core conditions. (Supra 28–30.) Miller has implied at times that he did not believe the in-core data, but as indicated above he also said that he had used them because they were the only indicator of what was going on in the core and that, "So, I did utilize them to tell me that what I had was that severe, more than something to prescribe a procedure or action or something." (Supra at 23.)

Miller also said, with regard to the direct measurements of the in-core thermocouple voltages: "So you know the bottom line here was that they (the in-cores) are hot, they were hot enough that they scared you, as far as what you're looking for. It told me that the reason the computer was off scale at 700 degrees F . . . The in-cores were reading anywhere from 2,500 or so, and I picked 2,500. It could have been higher than that." (Supra at 30.) Ross said the thermocouples were discussed in the think tank: "Thermocouple temperatures were brought up to Gary Miller, and I guess the bottom line they got out of that, was that they were not conclusive. It showed the core was hot, basically." (Supra at 32.)

Core uncovering and uncertainty as to adequacy of core cooling

Prior to 10:30 a.m. on March 28, B&W Engineer John Flint concluded that the core had been uncovered earlier and he said he informed Lee Rogers (his B&W supervisor at the site), Bill Zewe and Ed Frederick of his conclusion. Flint said he believed that Rogers had gone off to discuss his (Flint's) conclusion with Kunder and Miller. (Supra at 36.) Kunder said the high temperatures indicated to him that the core had been uncovered. (Supra at 39.) Apparently in reference to the situation between 9 a.m. and 10:30 a.m., Kunder also expressed concern that cooling water from the high pressure injection might be bypassing the core and therefore not adequately cooling it. (Supra at 46.) Ross said in reference to the strategy employed prior to 11:30 a.m. that there was uncertainty as to whether the core had been uncovered. (Supra at 50.)

Seelinger said that he had concluded on the basis of radiation alarms on the morning of March 28 that the core had been partially uncovered. (Supra at 40–42.) Miller said in a statement quoted on page 114 of the Senate report: "Based on the instruments we had, we didn't know whether the core was covered." While the record contains no clear statement by Miller indicating whether on March 28 he believed the core was or had been at least partially uncovered for some part of the day, Miller did say that, "We were not in our minds convinced the core was actually covered." (Supra at 44.) The foregoing statement concerns conditions after Miller had instructed that the high pressure injection not be turned off without his approval. On the basis of his understanding of reactor theory, including the significance of superheat, it is likely that Miller did understand by 9 a.m. on March 28 that portions of the core had been uncovered for some interval during the period between 6 a.m. and 9 a.m. It is also likely that Miller was uncertain with regard to the adequacy of first, the "feed and bleed" strategy pursued between 9 a.m. and 11:30 a.m., as he himself admitted in the course of postaccident discussions, and second, the depressurization strategy initiated at about 11:30 p.m. and pursued until an uncertain hour, but in any case no later than approximately 3:08 p.m. when the pressurizer block valve was closed.

Awareness that there were no Written Emergency Procedures Applicable to Conditions Existing in Plant

Miller's recorded comments to Troffer at Met-Ed at approximately 9:30 a.m. on March 28 indicate an awareness that the plant was in a condition that had not been analyzed. ". . . to be honest with you we've been assessing the plant . . . We don't know where the hell the plant was going. The situation we're in is a delicate one because we actually have plant integrity . . . If we had a leak we'd be all right." Miller also stated ". . . the cooling method we were in wasn't recognized anywhere that had ever been studied . . ."[16] The discussion in the think tank ". . . involved how to cool the core from a condition that we didn't (sic) have recognized in any formalized training or implemented (sic) document." (Supra, p. 52.) Miller also said, after referring to the high in-core temperature: ". . . but we just know (sic) we didn't have control, we were out of control. We knew the situation was one we hadn't anticipated too many times here." (Supra, p. 31.) Kunder, in referring to the abnormal situation in the plant said, "I think that those conditions were beyond the bounds of plant conditions that I was used to dealing with." (Supra, p. 47.) Ross said with regard to conditions as they existed on March 28 that: "Our evaluations were not very thorough that day, admittedly, but the evaluation we made is we didn't have a known method to cool the core, and we were trying to cool the core with high pressure injection. (Supra, p. 51.) Chwastyk stated that he did not like the "feed and bleed" cooling procedure, ". . . primarily because it's so alien to operating the plant." (Supra, p. 51.)

Awareness of Hydrogen Burn and Symptoms Thereof

Persons in the control room at the time the pressure pulse occurred were generally aware of it. Zewe said he found it hard to believe that anyone could have missed it or the ensuing discussions of it.

[16] Full transcript of conversation at appendix A.

(Supra, p. 65.) TMI–2 operator, Ed Frederick said that Gary Miller was particularly interested in the pressure spike on the chart recorder. (Id., p. 63.) Ross said that he was aware of the pressure pulse and that he was standing near Miller when the pressure pulse occurred. (Supra, p. 65.) Chwastyk said that soon after the pressure pulse occurred, he realized that it had been real, that it was indicative of core damage, that he explained his conclusions to Gary Miller, and that on the basis of these he recommended that they no longer cycle the PORV because the explosion had appeared coincident with opening of this valve. (Id., pp. 69–73.) Chwastyk recalls that he was concerned that the containment integrity might have been breeched by the pressure pulse; he recalls directing that a radiation survey be made outside the containment to determine whether cracks had developed in the concrete containment building. (Supra, pp. 73–75.)

Chwastyk also told I&E investigators that to the best of his recollection that someone (he assumed Miller) had given a directive on March 28 that equipment in the containment building not be turned on and the record indicates that the basis for this directive was concern that turning on equipment would cause a spark that would ignite hydrogen feared to be in the building. (Supra, pp. 81–88.) Mehler recalls having believed that the chart recorder had indicated that there had been a real pressure pulse in the containment building rather than an electrical noise signal. Prior to October 30, 1979 Mehler recalled the instruction not to start equipment in the containment building. (Id., p. 78.) While Mehler said on October 30, 1979 and subsequently that he was unsure as to whether this instruction had been issued on March 28, the testimony on balance indicates that Miller gave the instruction (or it was given in his presence) to Mehler and Chwastyk in the shift supervisor's office late in the day on March 28. (Id., pp. 78, 82, 83.) Theodore Illjes, a TMI operator stated that on March 28 the pressure pulse and a possible hydrogen explosion were discussed. (Id., p. 88.) Miller admits having heard a noise at the time the pressure pulse occurred, but he has denied having been aware on March 28 of a pressure pulse having been recorded, of the containment sprays having initiated or of an engineered safeguards systems actuation.

In sum, of those senior personnel present in the control room on March 28, most recollect the pressure pulse and actuation of containment sprays; Illjes said that on March 28 there was speculation about hydrogen; Mehler and Chwastyk believed on March 28 that the reactor building pressure chart had shown a real increase in pressure; Chwastyk recalled that he told Miller that the pressure pulse was "an explosion and probably caused by a hydrogen explosion"; Mehler and Chwastyk recall that someone (the evidence indicates Miller) instructed that equipment in the containment building not be started, the record indicating this being out of concern that a spark would cause an explosion of hydrogen; and Miller states that he heard a noise but was unaware of the pressure pulse and the possibility of hydrogen ignition being the source of the pressure pulse until two days later, on March 30.

On balance, consideration of statements describing the situation at the time the ignition occurred and in the following hours leads to the conclusion that it is likely that Miller's recollection of not having been aware of the pressure pulse and its significance is erroneous.

IV. Reporting Requirements

The requirements that utility managers fully inform State and Federal officials of conditions, such as those existing at TMI–2 following declaration of a site emergency at 6:56 a.m. and a general emergency at 7:24 a.m. on March 28, derive generally from several requirements of the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, and Title 10, Parts 20 and 50 of the Code of Federal Regulations.

10 CFR 50.10 states that no utilization facility shall be used except as authorized by a license issued by the Commission; that is section 50.10 of the NRC regulations states, in effect, that conditions specified in a nuclear power reactor operating license are binding upon the licensee. 10 CFR 55.31 stipulates that licensed operators shall observe the Commission's regulations. The TMI–2 operating license included a requirement that technical specifications be incorporated into the license, and that, "Metropolitan Edison Company shall operate the facility in accordance with the technical specifications, except where specifically excepted. . . ." Section 6.8.1 of the TMI–2 technical specifications requires that in the event of an emergency, the requirements specified in the TMI–2 emergency plan, (prepared pursuant to 10 CFR 50.34(b) (6) (v)) shall be satisfied. Therefore, failure to satisfy the emergency plan requirements would represent a failure to adhere to the requirements of the license and this failure would constitute violation of 10 CFR 50.10 and 10 CFR 55.31 of the NRC regulations.

Among the emergency plan's requirements are the following:

> Section 3 (subsection 2.5) of the Three Mile Island emergency plan titled "State/Met-Ed Radiation Emergency Interface Plan" requires that, in the event of a radiation emergency, the station superintendent, assistant superintendent or his (sic) designee provide information to the Pennsylvania Bureau of Radiological Health with regard to the "status of consequence mitigation features . . ." and ". . . the possible need for protective action." [Among the information to be provided is that concerning plant status, i.e. whether it is at "Hot Standby," Hot Shutdown, Cooling Down, etc.]
>
> Radiation Emergency Procedure 1670.2 (Site Emergency Plan Procedure) contains an implicit requirement (1670.2.4.I.8) that the NRC and Pennsylvania Bureau of Radiological Protection be informed of plant conditions.
>
> Radiation Emergency Procedure 1670.3 (General Emergency Procedure) requires that the "Station Superintendent/Assistant Superintendent/Shift Supervisor take certain actions including providing information to various Federal and State organizations. (1670.3.4.I.4.) Note (1) to 1670.3.4 states that:

> It shall be the responsibility of all the above [i.e. station superintendent and other responsible officials] to provide maximum assistance and information possible to the various off-site groups, i.e. AEC, State of Pennsylvania Bureau of Radiological Health, State Police, and Coast Guard.

10 CFR 20.403 states that a licensee shall immediately notify the NRC of any incident involving source, byproduct or special nuclear material that threatens to cause radiation exposure in excess of certain specified amounts or which threatens to cause damage in excess of $200,000 or a loss of 1 working week or more at any of the affected facilities. *While section 20.403 does not contain specific reporting requirements, it does contain, by implication, a requirement that the notification be made in a manner that conveys a full and accurate description of the incident as is reasonably practicable.*

Section 206 of the Energy Reorganization Act of 1974 requires that a responsible officer of a firm operating a facility licensed pursuant to the Atomic Energy Act of 1954, as amended shall notify the Commission immediately of any noncompliance with NRC regulations at the facility or any defect in the facility or its basic components that could create a substantial safety hazard. 10 CFR 21 establishes procedures and requirements for implementation of section 206. Because 10 CFR 21.21 states that initial notification of the existence of a defect shall be made within 2 days following the responsible officer receiving information regarding that defect, it is unclear whether the enforcement provisions of Part 21 are applicable with regard to information not provided the Commission during the 48-hour period following initiation of the accident. *Since no section of the NRC regulations.* other than Part 21, establishes procedures for implementation of section 206 of the Energy Reorganization Act, it is unclear whether section 206 is applicable with regard to immediate reporting of defects or noncompliance with NRC regulations during the first 48 hours of the accident.

Understanding of Reporting Requirements as of March 28, 1979

In an interview conducted by I&E on September 24, 1980, Shift Supervisor Mike Ross was asked several questions with regard to information that should have been reported to the NRC on March 28, 1979:

> Q. Was the information passed on to the NRC on March 28th, to the best of your knowledge, that this valve had been open for a period of time much in excess of what people expected?
>
> A. To my knowledge, I don't have any knowledge of it being passed on or not being passed on. I can't answer.
>
> Q. Okay. Again the related questions, prior to March 28th, would you believe—did you believe this to be something that would be reportable to the NRC?
>
> A. Reportable to the NRC? Once we got into the emergency plan, quite clearly it's reportable, even prior to March 28th. (Ross, I&E, 9/24/80, p. 24.)

> Q. Were the hotleg temperatures or the implications thereof reported to the NRC in the morning of March 28th, to the best of your knowledge?

A. That I can't say. They were reported into the think tank, and the information was being called across the control room. It was freely open. Whether or not they got it, I can't say.

Q. Again, in your opinion on or prior to March 28, should this have been reported?

A. My answer is pretty much the same. Once you get into the emergency plan, it clearly should be reported, anything in the emergency plan. (Ross, I&E, 9/24/80, p. 31.)

Q. Was the count rate behavior and the potential for recriticality passed on to the NRC on March 28, to the best of your knowledge?

A. To my knowledge, I don't have any knowledge of it being passed on. I did not.

Q. And I'll ask you the same related question as before, about what your opinion was of the reportability of this on March 28th, and subsequently.

A. Pretty much the same. Once we had instituted the emergency plan, we reported everything we saw in the plant. (Ross, I&E, 9/24/80, p. 38.)

On October 16, 1980, Joseph Logan, former TMI-2 superintendent engaged in the following dialog with I&E investigators concerning information that should have been reported to the NRC on March 28:

By Mr. CRAIG.

Q. To the best of your knowledge, was the core exit thermocouple information passed on to the NRC on 3-28-79?

A. I don't know.

Q. Did you discuss with anyone the need to communicate the possibility of such high temperatures to the NRC?

A. Did I discuss it?

Q. Yes.

A. No.

Q. Were there any discussions that you know of concerning the need to communicate the possibility of these kinds of temperatures?

A. I know of no conversation that took place.

Q. In your opinion, should the temperature have been reported to the NRC?

A. I think the indications that we had should have, and I would be surprised if they were not. I think, at the same time, if we felt they were suspect, that information—that impression would have been conveyed also.

Q. And—okay.

To your knowledge, was this information withheld from the NRC on 3-28-79?

A. Not to my knowledge.

By Mr. MOSELEY.

Q. You just answered a question, when you responded on reporting. Is this what you would have said if we would have asked you on March 27, or has it changed?

A. No, my feelings are that any information that we had should be provided. If any information wasn't given, I'm

sure it was either hindsight or it was felt that it wasn't germane. (Logan, I&E, 10/16/80, pp. 44–45.)

In an interview conducted by I&E on September 4, 1980, Shift Supervisor William Zewe was asked several questions concerning his view with regard to information that should have been reported to the NRC on March 28, 1979:

Mr. CRAIG. The information concerning the system response to shutting the block valve to increase primary system pressure and decrease containment pressure.

Mr. FIDELL. Do you understand the question, Bill?

The WITNESS. Yes, I do, but I have no knowledge of what exact information was passed on to the NRC at any particular point in time.

By Mr. CRAIG.

Q. In your opinion now, should it have been passed on to the NRC?

A. I think that the status of the plant in its condition, yes, information such as that should be passed on, yes. (Zewe, I&E, 9/4/80, p. 13.)

Q. In your opinion, should the hot-leg temperatures have been reported to the NRC earlier than they were, given that they were not reported until sometime later in the afternoon?

Mr. GEPHART. You want his opinion as of today?

Mr. CRAIG. Yes, as of today.

The WITNESS. I will answer that in two parts then.

First, yes, I feel that they should have been reported. All right. But on the second part, I have no knowledge of what information was given to the NRC or when. (Zewe, I&E, 9/4/80, p. 22.)

Q. Excuse me. Just one question here. In your opinion, should the—should the plant condition relative to inventory, plant status relative to inventory, should information for the plant status, inventory status—should that information have been passed on to the NRC?

A. Yes. (Zewe, I&E, 9/4/80, pp. 28–29.)

Q. Is it your belief now that information concerning the core exit thermocouples should have been passed on to the NRC on the day of the accident?

A. Yes, I do. (Zewe, I&E, 9/4/80, p. 33.)

Q. Concerning the containment pressure spike, is it your belief today that this information should have been passed to the NRC on the day of the accident?

Mr. MCBRIDE.[17] Which information?

Mr. CRAIG. Concerning the pressure spike that had occurred.

Mr. MCBRIDE. That the instrument itself had spiked high?

Mr. CRAIG. Whatever his knowledge was. And you said you

[17] Attorney representing Mr. Zewe.

didn't believe it was real, but you were aware of the instrumentation.

By Mr. CRAIG:

Q. Should that have been reported to the NRC?

A. Yes, it should have, even though, if I may just clarify that somewhat, there were NRC personnel present, onsite, and even in the Unit 2 control room.

(Zewe, I&E, 9/4/80, p. 45.)

In an interview conducted by I&E on September 4, 1980 Shift Supervisor Joe Chwastyk was asked about reporting of the pressure spike:

> Mr. MCBRIDE. Another question is, after your conversation with Mr. Miller about the pressure spike, the fact that you believed that an explosion had taken place, did you make any assumption with respect to whether Mr. Miller had passed along that information either to his superiors or to the NRC?
>
> The WITNESS. I assumed—He was their emergency director, and he would pass that information along up our chain, and also making the necessary NRC notification.
>
> (Supra, p. 72.)

V. INFORMATION PROVIDED TO STATE AND FEDERAL OFFICIALS

At approximately 7:02 a.m.[18] Shift Supervisor Bill Zewe informed Clarence Deller of the Pennsylvania Emergency Management Agency (PEMA) that a site emergency had been declared and that there was high radiation in the containment building but there had been no offsite releases. (Senate, p. 245.) At approximately 7:10 a.m. TMI engineer Richard Bensel called NRC Region I and left with the Region I answering service a message to return his call. The message was passed on to the Region I secretary at about 7:45 a.m. At approximately 7:12 a.m. William Dornsife (7:07 a.m. according to Dornsife's notes[19]) of the Pennsylvania Bureau of Radiological protection attempted to call the TMI site but was not able to get through to the control room. (*Ibid.*, p. 248.) At approximately 7:15 a.m. (at approximately 7:10 according to Dornsife's notes) TMI Supervisor Bill Zewe returned Dornsife's call wherein the latter recollected that:

> Shift supervisor called back to my home number. He told me the plant had suffered a transient and R.B. [reactor building] radiation-level was high initiating the site emergency—things sounded very confused at this point in time—I tried to get a status of important safeguards without very much success—they did tell me that reactor was shut down and RB pressure was about 1 or 2 psi—SI had been initiated and was cooling core—they informed me that they had sent out monitoring teams and there was no detectable radiation levels outside the plant. I then—heard in background the announcement to evacuate the Unit 2 fuel handling and auxiliary buildings. At this point a health physics type got on the phone and things sounded extremely confused and finally he hung up saying he would call back. [From Dornsife's notes prepared some weeks after the accident based on notes made contemporaneous with the accident. See appendix B.]

At approximately 7:24 a.m., Station Superintendent Gary Miller declared a general emergency and at 7:25 a.m. he notified the Pennsylvania Bureau of Radiological Protection of this development. At about 7:35 a.m. the DOE was informed of the general emergency. At about 7:37 Metropolitan Edison official George Troffer left a message with the Region I answering service asking that his call be returned. At about 7:41 a.m. TMI engineer Richard Bensel left a message with the Region I answering service stating that a general emergency had been declared, and that there was a primary to secondary steam generator leak and an offsite radiological release.

At approximately 7:50 a.m. an open telephone line was established between the TMI–2 control room and NRC Region I in King of

[18] Unless otherwise noted times are from Senate report.
[19] See appendix B.

Prussia, Pa. At approximately 8 a.m., Region I notified John Davis in Bethesda.

(Davis was then Acting Director of NRC's Office of Inspection and Enforcement.) At approximately 8 a.m., Region I was notified by TMI that the radiation detector in the containment dome was reading 200 R/hour.

[Since this detector was shielded by 2 inches of lead which attenuated the radiation field approximately 100 fold, it is unclear whether the 200 R/hr was the radiation level within the containment atmosphere or whether it was the level seen by the meter after attenuation by the lead. In the latter case the level in the containment atmosphere would have been on the order of 20,000 R/hr. Miller said the dome monitor was indicating on the order of 50,000 R/hr. at about 7 a.m.; see footnote at p. 35.]

At approximately 8:15 a.m. TMI Superintendent of Technical Support George Kunder advised the commanding officer of the Pennsylvania State Police that a general emergency existed, that there had been no outside radiological release, and the problem was contained within TMI-2. (Senate, p. 262.) At approximatelv 8:20 a.m., Region I was informed that the dome was reading 600 R/hour. At approximately 8:23 a.m. the NRC Incident Response Center in Bethesda was informed by Region I that there were indications of failed fuel. that primary pressure was 1,500 psi, and the average of hot- and cold-leg temperatures was 571 degrees. (Note the absence of indication of hot-leg temperatures which were an indication that the core was or had been uncovered, that the hot-legs were steam bound, and that whatever cooling was being achieved was probably via the bleed and feed method, which was not an approved or practiced procedure.)

At approximately 8:30 a.m. the NRC Incident Response Center informed the NRC Office of Reactor Regulation that they had, "Pulled a bubble in the reactor vessel," and that the, "Reactor is okay, but they have a release." (Ibid., p. 265.) At approximately 8:33 a.m., Davis informed NRC Executive Director Lee Gossick that:

> JOHN DAVIS. There was a loss of pressurizer level and apparently a BUBBLE pulled in the vessel (phonetic). There's about a one pound pressure in the containment. Now what this lead people to believe that there has been some LOSS OF COOLANT. We do not know whether the situation was an OFF-SITE RELEASE, and we do not know whether the situation has been terminated.
>
> LEE GOSSICK. Okay, I'll be right over. (Ibid.)

Between 8:45 a.m. and 9:15 a.m. Region I informed the Incident Response Center of the following:

1. Radiation Monitors
   (a) Outer monitors (305' elevation) reading 100 mr/hr;
   (b) Containment dome monitors went from 200 to 1000 R.
2. Core is not being cooled, no flow, they're having trouble cooling the core because they think that the primary system is vapor bound.
3. Containment pressure is now at one pound, down from a maximum of two pounds. (Ibid., p. 268.)

At approximately 8:52 a.m., John Davis briefed Commissioner Kennedy on the status as he knew it at the time:

> Rapid cooldown of primary cooling system, HPI occurred, loss of pressurizer level, and a bubble pulled into the vessel.
>
> One psi inside containment, leading to a resulting loss of coolant but the primary coolant system is intact.
>
> (Ibid., p. 270.)

At approximately 8:57 a.m. Davis told Commissioner Ahearne approximately what he had just told Kennedy. (Ibid., p. 271.)

At approximately 8:59, Region I was informed by TMI that the HPI flow was 250 gallons per minute and primary pressure was 1,400 psi. At approximately 9 a.m. TMI informed Region I that the containment dome monitor was reading 6,000 R/hour. (Ibid.)

William Dornsife of the Pennsylvania Bureau of Radiological Protection told Interior Committee staff on November 12, 1980 and January 21, 1981 that to the best of his knowledge, based partly on notes and partly on memory, Miller had told him on March 28, 1979 in a phone conversation at approximately 9 a.m. that the stuck open PORV had been the cause of a loss of coolant accident, that there were voids in the system and that there might have been a release of gap activity as a result of some fuel failure. In this conversation there had been no discussion of throttling of high pressure injection; and it was Dornsife's impression that emergency systems had functioned in accordance with procedures. There was no mention as to possible core uncovery and Dornsife's impression was that everything was under control. Dornsife's notes, prepared some weeks after the accident, and based on notes made during the accident, are as follows:

> At this point (about 0900) Gary Miller, plant superintendent, came on the line and briefed me on what had occurred. His briefing was as follows (based partly on notes and partly on recollection):
>
> > At 4 a.m. a turbine trip from 98 percent power occurred—reactor shutdown automatically—violation of tech specs in that aux feed was valved out temporarily (S/G may have boiled dry)—electromechanical relief valve lifted but did not reseat—indication in control room (elec signal to valve) indicated that it had reseated—block valve is now closed—High pressure safety injection was initiated—all safeguards systems operated—diagnosed—pressurizer may have voided and low pressure in primary probably caused flashing and bubbles in primary—may have temporarily lost main coolant circulation—currently stabilized and cooling normally on A S/G—possible primary to secondary leak in B S/G—B/SG has been isolated—100 ppm Boron in primary—may have been diluted by secondary to primary feedback then (sic) tube leakage—there has probably been a slight amount of failed fuel; no speculation as to amount—R. B. dome monitor reading 600 R/hr—RB pressure $\sim$ 1 psig—fence post show $<$ 1 mrem/hr—wind blowing to west currently sending monitoring team to Goldsboro. (Dornsife Notes. See App. B.)

On October 1, 1980, Dornsife engaged in the following dialog with I&E investigators with regard to what he had believed about plant conditions after his conversation with Miller:

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By Mr. CRAIG.

Q. Did you believe the plant was stable when you got that report?

A. Yeah. I guess so. That was what I told everybody. I didn't really question, I didn't have time to question that much the information he was giving. We were relying on their information at that point.

(Dornsife, I&E, 10/1/80, pp. 14–15.)

In a telephone conversation with Met-Ed's Troffer, at approximately 9:30 a.m., Miller said he had not described certain aspects of the situation in his earlier 9 a.m. conversation with a nuclear engineer, presumably Dornsife. While it is unclear from the transcript [20] which particular aspects of the situation Miller was referring to when he said, "I didn't say this to them," he left the engineer, presumably Dornsife, with the impression that the plant was stable 30 minutes before presenting Troffer a more pessimistic assessment: "See, the situation we're in is a delicate one because we actually have plant integrity. If we had a leak we'd be all right." On October 1, 1980, I&E investigators asked Dornsife about the impression conveyed by Miller:

By Mr. HOEFLING.

Q. The impression that Gary left with you after that phone call was that the plant was stable?

A. Yes.[21]

Q. That there was cooling path——

A. Yes.

Q. ——working?

A. Right.

Q. And that failed fuel was limited to some gap activity as a result of the transient?

A. Right. And the radiation levels they were seeing in the plant was a result of that activity.

(Dornsife, I&E, 10/1/80, p. 36.)

Following his discussion with Miller, Dornsife reported to Lieutenant Governor Scranton who issued a press release at approximately 10:55 a.m. stating that:

> The Metropolitan Edison Company has informed us that there has been an incident at Three Mile Island Unit #2. Everything is under control. There is and was no danger to public health and safety. The incident occurred due to a malfunction in the turbine system. There was a small release of radiation to the environment. All safety equipment functioned properly . . . The civil defense has alerted all counties in the vicinity although there is no need for evacuation. (See App. C.)

Meanwhile at approximately 9 a.m., NRC's Deputy Director for Reactor Regulation, Edson Case had explained to Commissioner Ahearne that sufficient primary coolant had been lost to cause an uncovering of part of the core, and increased radiation was probably due to popping of some fuel elements. (Senate report, p. 273.)

[20] See appendix A.

[21] Miller has questioned the validity of Dornsife's recollection and notes in this regard. (Miller, I&E, 11/10/80, pp. 135–139.)

At approximately 9:26 a.m. George Kunder (TMI–2 Superintendent of Technical Support) was asked by Donald Haverkamp, of NRC Region I, to explain what had happened earlier in the morning. The Senate report quotes from Kunder's response:

> . . . The pressure came . . . all the way down to about 1,000 pounds and that was roughly over a 15 minute span. I think it was during that condition that we . . . got a bubble [or] some such through apparently the heating in the core up in the loops and . . . it apparently had an effect of vapor locking . . . It looks to me [like] we had that vapor locking effect being fed by the heat in the core . . . The problem [then was] trying to get the pressure down low enough so we are sure that the flow is going down into the reactor vessel annulus and up into the core. Vapor lock is apparently preventing that from occurring. (Id., p. 127.)

Kunder apparently did not inform Region I that the PORV had been open from shortly after 4 a.m. until about 6:20 a.m. and that during this period the high pressure injection flow had been severely throttled. Also there is no record that Kunder mentioned hot-keg temperature reaadings approaching 800 degrees, or that the in-core thermocouple sensors were indicating temperatures in excess of 2,000 degrees although there was doubt as to the accuracy of these measurements. (It is unclear, however, whether Kunder knew about the in-core temperature sensor data.)

At approximately 9:35 a.m., Kunder informed Haverkamp that the pressure transient had probably caused lifting of the safety valves on the steam generators. (Id. p. 281.) (That these valves might have opened is not discussed elsewhere, and it is not clear whether this communication might have been garbled.) At about 10:15 a.m. Kunder reported to Haverkamp, "Still injecting" and that level was dropping in the borated water storage tank. (Id. p. 286.) The Senate report contains the following excerpt from the 10:15 a.m. conversation in which Kunder appeared to ask TMI Supervisor Mike Ross for information as he spoke to Haverkamp in Region I:

> KUNDER (to Mike Ross in Unit 2 control room). Mike, how does the core look?
>
> KUNDER (to Haverkamp). [I'm] talking to Mike Ross—— he's looking at the indications; his assessment is that he's surely . . . got the core covered and we are getting water . . . into the core. The only thing though is that the T_h [hotleg temperatures] are still high and that's what bothers us; the pressure, and getting control of it, and . . .
>
> HAVERKAMP. What is your pressure and temperature now?
>
> KUNDER. The pressure is still up around what I told you, it's holding there, okay: We got a bubble in the pressurizer . . . But he is still baffled by the T hot [hot-leg temperatures]; *we are really trying to access that. T hot right* now is reading 571 degrees F but, again, I am not sure how real a number that is. (Senate report, June 1980, p. 132). [At this hour, the hot-leg A temperature was about 730 degrees and hot-leg B was about 780 degrees, both temperatures indicating superheated conditions. It is not clear why Kunder

reported that T hot was 571 degrees which, at the prevailing pressures would have implied water rather than superheated steam in the hot-legs.]

At 10:17 a.m. Kunder informed Region I that TMI–2 personnel were having to don respirators, and that they were using steam generator A for cooling. Kunder said staff believed natural circulation was working. (Id., p. 288.) (If Kunder said this, it is unclear what the basis was for such a statement since this was about the time that TMI managers were uncertain as to whether the core was being cooled adequately by the bleed and feed procedure that was being employed.)

At about 10:55 a.m., NRC inspectors, who had arrived at the site about 10 minutes earlier reported to region I that it appeared attempts were being made to cool the reactor using the "A" steam generator and the atmospheric dump valves. (Id., p. 295.) At about 11 a.m. Greg Hitz (a TMI shift supervisor) told Haverkamp at Region I that they were still feeding the "A" steam generator, implying that cooling was being achieved by this means. (Id., p. 295.)

At about 11:15 a.m. Region I reported to NRC's Wilber in Bethesda that Region I had still not received any word on hot-leg temperatures (Id., p. 298.) The basis for Region I saying this is unclear because 1 hour earlier Kunder had given Haverkamp in Region I a hot-leg temperature reading, although this reading was incorrect. (See above.) The transcript of the conversation (01–023–CH 2/20–10) between Region I and Bethesda at approximately 11:15 a.m. indicates, in addition to stating ignorance of hot-leg temperatures, Bethesda was seeking confirmation that heat was being removed via steam generator A. (In actuality, at that time, apparently unbeknownst to the NRC, the principal path for heat removal was via the pressurizer relief valve.) In this discussion, an NRC official in Bethesda (unidentified on the transcript, but probably Wilber) asks three times for confirmation that cooling was via the steam generator. (Id., pp. 10, 12, 13.) The transcript also indicates that both Bethesda and Region I believed the control room personnel were themselves uncertain as to the hot-leg temperatures. (Id. p. 12.) (In actuality control room personnel had set up a special instrument to facilitate their monitoring of the hot-leg data which they seem to have believed. (See supra at p. 19.))

At approximately 11:45 a.m. Harry Kister of Region I provided temperature and pressure data to Mike Wilber in Bethesda. Kister informed Wilber that the hot-leg temperature was 620 degrees and that the primary system pressure was 2,000 psi. (01–024–CH2/20–9.) The combination of pressure and temperature, would have implied water rather than steam in the hot-legs. Actually the 620 degree temperature data was obtained from a data source which could not indicate temperatures in excess of 620 degrees. Other instruments in the control room, capable of displaying higher temperatures, showed the hot-leg temperature to be about 700 degrees, a temperature which, for the prevailing pressure of 2,000 psi, was indicative of steam in the system. The 620 degree temperature was also inconsistent with other information provided by Kister that the reactor coolant pumps were vapor bound, i.e. if the temperature and pressure data were accurate, the pumps would not have been in this condition.

At approximately 12:20 p.m., NRC inspector Walter Baunack reported to Don Caphton in Region I that he believed bubbles to exist in the hot-legs. (Senate report, June 1980, p. 305.) At approximately 12:20 p.m., NRC staff in Bethesda requested in-core thermocouple data (NUREG–0600, P. I–A–79, 80, Item 456) which was not provided to Bethesda until approximately 4:10 p.m., and then it was reported incorrectly. (See supra, pp. 32–33.)

At approximately 1:15 p.m. NRC inspectors at TMI informed Region I of the depressurization strategy. The inspectors at the site did not report at this time temperature data indicating superheated conditions in the hot-legs and in the pressure vessel above the fuel bundles. At this hour, the inspectors were probably unaware of the in-core thermocouples that would have indicated temperatures above the fuel bundles. It is unclear whether they were aware of the two instruments displaying hot-leg temperatures in excess of 700 degrees.

At approximately 1:15 p.m., Metropolitan Edison Vice President J. G. Herbein met with members of the press at the TMI observation center. Herbein explained the apparent cause of the reactor trip and that high radiation levels in the containment building were first measured at 6:50 a.m. Herbein apparently did not inform the press of the several manifestations of core uncovery and severe fuel damage. The March 29 New York Times quoted Herbein as having said that the series of events in the accident "was not the normal evolution" and that there had been "some minor fuel failure."

At approximately 1:55 p.m. NRC Inspector Gallina reported to Region I from TMI–1 that unit 1 control room personnel were still in respirators. (Senate report, June 1980, p. 317.) At this time, Gallina made no mention of the pressure pulse and safeguards systems actuation that occurred at about 1:50 p.m. as a result of combustion of hydrogen gas in the containment building. At about 2:15 p.m. NRC inspectors at the site reported to Region I that there was suspicion of a bubble in the hot- and cold-leg pipes connecting the reactor pressure vessel to the steam generators. It is unclear why the report indicated that there was only a suspicion of a bubble since it had been recognized since early in the morning that steam in the hot- and cold-legs prevented use of the reactor coolant pumps for purposes of cooling the core. Again (at 2:15 p.m.) no mention was made of the pressure pulse and associated actuation of safeguards systems that had occurred 25 minutes earlier.

At approximately 2 p.m., Herbein, Miller, and Kunder left the site and drove to the office of Lieutenant Governor Scranton. The meeting began at about 2:30 p.m. and, according to NUREG 0600 lasted 30 to 45 minutes. (NUREG 0600, p. I–A–89, Item 505.) (NUREG 0600 states on page I–A–103, Item 577, that Miller and Kunder returned to the TMI–2 control room at approximately 4:30 p.m.) [If these times are correct, and the travel time between the site and the Lieutenant Governor's office is approximately 30 minutes, there is a period of at least 45 minutes during which the whereabouts of Herbein, Miller, and Kunder has not been explained, since NUREG 0600, Item 577, states that Miller, the station superintendent, and Kunder, the superintendent for technical support, had been away from the site for 2½ hours.]

There appears to exist no contemporaneous written record of the meeting in the Lieutenant Governor's office. The following is an October 1, 1980 dialog between I&E investigators and Thomas Gerusky, Director of the Pennsylvania Bureau of Radiological Protection in which Gerusky presents his recollection as to what transpired at the meeting:

Q. Let me go back and ask you again, we are talking about the electromatic relief valve, or the PORV, as it is sometimes called. Now should the fact that this had been open for a period in excess of two hours been passed on to the state?

A. Yeah, it—I think that's an item that would indicate—would have indicated to everybody what was happening during that two-hour period, why it was happening during the two-hour period, why they were having problems, and where the water was coming from that was coming out of the primary system.

Q. Do you feel this information was withheld? Again, this is a——

A. I don't know if—I can't recall very much—I can't recall anything, really, it's weird, of the meeting in the Lieutenant Governor's office a little bit later with the people from the plant. I was there, and they went through an engineering discussion of what was happening at the plant, and I don't have any notes on it, and I can't remember what they said. I just came out of that meeting knowing that I was mad about their attitude. But that information may have been passed along at that time, I don't know.

Q. We have some questions on that.

A. But if there was more information that I obtained, that would have been obtained at that time. I don't think I received it from NRC at any time during that first day.

Q. Okay. Again trying to look at assessments you might have of why the information was not passed on, do you feel the utility did not recognize or adequately evaluate this?

A. I don't know.

Q. Do you have a feel that they may have felt that there wasn't any need to pass this information on to you?

A. Yes, probably, during that first couple of days the utility did not—had an attitude that they could handle the situation and did not need to give us every little detail as to what was happening at the plant. And it was obvious at that meeting in the Lieutenant Governor's office, and that's why I was concerned. Their attitude was, "Don't bug us. We know what's going on and we can handle it," and that same—I'm sure that same attitude prevailed on giving us information concerning what was happening at the plant.

On the radiation levels, I think we were very well satisfied with the information we were getting from their field monitors and so forth. But from the actual control room or the operators or whoever was in charge at the moment at the plant, we were not getting very much information. I don't think they felt we needed it, or were competent to understand it.

Q. Let's go to the briefing then. And recognizing what you have already said, let me just ask you to consider some specific things and see what your recollection is.

First off, before we get into that, do you have any notes or any recollections or reports that were written about or anything you could refer to about what went on in that briefing.

A. No.

Q. To your knowledge, was any tape recording made or were others who might have made—like a secretary who may have been there to take notes, or make a transcript?

A. I don't think so. I don't remember who all was there. I know the Lieutenant Governor was there, at least two people from Met Ed, myself, and then from that point on, it's blank. I don't know who else was there. We had so many people that were involved in the Lieutenant Governor's office and Governor's office the first three or four days, and faces didn't mean anything to me right away, because I had never met a lot of the people before.

By Mr. GAMBLE.

Q. Do you know who some of the other people represented, the agencies?

A. No, I don't remember.

Q. Doesn't the Lieutenant Governor typically have someone take minutes at meetings like this?

A. I don't think there were any minutes taken. There may have been notes taken. There were many notes taken later, but I am not sure on that first meeting how many notes were taken. In meetings in the Governor's office later, there was always someone taking notes, and writing up a report, which I have never seen. I know that there is a report available. It's possible that Paul Critchlow was there. He's the Governor's press secretary. Because the Lieutenant Governor had scheduled a press conference for that day, and he was planning on going after the meeting for another update. But it's possible that Paul Critchlow was there, and he and his staff had taken some very good notes of all the meetings.

By Mr. MOSELEY.

Q. But you are not sure that was done, you are just suggesting that's a possibility?

A. No, I don't know.

By Mr. HOEFLING.

Q. Who was there for the utility?

A. Gary Miller.

By Mr. MOSELEY.

Q. Herbein?

A. Yeah, Jack Herbein. There may have been a third person, but I don't recall who it was, or if there was a third person. It seemed to me there was another person there.

Q. There was a third person. It was George Kunder. Do you know George?

A. Yeah. Okay. Yeah, I know of him. I don't know him that close. I don't think he said very much.

By Mr. HOEFLING.

Q. Who did most of the talking?

A. Herbein. Herbein did most of the talking.

Q. Did Miller have an active role or not?

A. Yes, but not as much as Herbein.

By Mr. MOSELEY.

Q. Was Miller—was his participation one—well, let me phrase it more in a question.

What was Miller's participation? Would you characterize it as introductory remarks about plant status?

A. Well, Miller, I think, gave more information concerning the actual plant status than Herbein did. Herbein talked more about the general features of what was happening down there, rather than the details of the accident. I don't remember. I don't remember. I really don't. I'm sorry. It's just so long ago. I didn't remember the next day, to be honest with you, on that one, because we were getting so much—they said there had been no releases from the plant. We knew there were—I was arguing with them about the releases from the plant, and—because we had just received word from their staff that they had detected and we had detected radiation levels in the field, and they said, "Oh, no, there's nothing in the environment." So they weren't up to date on what was even happening at their own—you know, outside.

That's what I was concerned with, was the offsite details.

Q. Do you recall Miller leaving the briefing at some point in time?

A. No.

By Mr. HOEFLING.

Q. When you were saying they were saying there were no releases, can you differentiate between Miller and Herbein?

A. I think it was Herbein.

Q. Herbein.

By Mr. MOSELEY.

Q. Bear with us a little bit, in trying to shake your memory a little bit, if we might.

Q. During the briefing, I'm going to ask you a series of things and see if you recall whether it was discussed or not. Core uncovery or its possibility.

A. I don't know.

Q. Superheat?

A. I don't know.

Q. Plant stability?

A. Yeah, I think they gave the impression that they had things under control. They may not have said so directly. I don't know if that's what you meant by plant stability.

Q. Yes, it is. It is.

Did you get the impression from this that there was any temporary nature to the stability, or that it was permanently stable or temporarily stable?

A. No, it was—the accident was over, in effect, and now all it was, was clean-up. That was the impression I got. There would be no more releases to the environment. It was over,

and, "Ha, ha, ha." And, "I don't know what you people are interested for, and we ought to be down at the plant making sure things are going smoothly."

Q. Primary system inventory or loss of coolant, the extent of that, the severity?

A. I'm not sure when we—when I learned of the details of what really happened at the accident. I'm sorry, but I just can't—you know, I can't remember.

Q. I can certainly appreciate that, and understand it, but bear with us, if you would, just a minute more.

A. Okay.

Q. The extent of core damage?

A. I think that they told us that they believed there was some—some damage, minor damage to the cladding, but that was it. There was no—you know, no severe core damage. I'm sure they did not say there was no—that there was severe core damage. There may have been some cladding failures is what they told us.

Q. So was the discussion about core damage related sort of to the release of gap activity or something of that nature?

A. Yes.

Q. And was there discussion of what caused the gap activity to be released? Overheating, pressure decrease?

A. It would have been overheating, but overheating is a nice—I think they may have missed possible voids in the system, but I don't—I'm not positive.

Q. You're not positive if they mentioned the cause?

A. No.

Q. Okay.

A. They must have, but what it was, I don't remember. I would have asked. It's not something that you don't——

Q. I believe Mr. Dornsife has related it more to the pressure, the rapid pressure decrease, but whatever your recollection is, is what your recollection is.

A. I don't know. And I'm sure that I took some kind of notes in that meeting, but I have no idea what I did with them, and even two or three days later when I was looking for them, I couldn't find them. Our desks were piled sky-high with pieces of paper.

Q. Was the pressure spike discussed, instance of pressure spike in containment?

A. No. I didn't know about that until Friday, late Thursday night or Friday.

Q. Was the potential for the situation to deteriorate—I think you covered that in a previous answer, but you may want to address it again.

A. No, as a matter of fact, in every meeting we had with either the utility or the NRC onsite inspectors, until Joe Hendrie came up, Joe Hendrie and Harold Denton came up on Friday, the impression was that things were—were over and getting better, and that the releases would be over shortly, as soon as they cleaned up some water on the floor, and that kind of thing, and everything was under control.

Q. Did you feel the briefing was complete and necessary information was provided? You have, I think, addressed this somewhere along the way, but maybe you'll want to summarize it.

A. Before I had gone to the briefing, I had received information from the plant and from our people in the field concerning what was happening offsite. And when they came in and described the situation to us, they indicated there weren't any problems offsite, and I said, "That's not true," and that caused some minor problems between the—among the people. And so they didn't—we felt we were more—we had more of an update of what was happening offsite than they did, which was very possible, in retrospect, knowing what they were going through inside the control room at the time, that this information may not have gotten to them.

Q. Was this information that was available to you and to them at an earlier time, or—that is earlier in the morning?

A. Yes.

Q. Could it have been information that only became available in the time period when these people left the site?

A. No, I doubt it, because I think it was about 10:00 o'clock or so in the morning when we were first told that they had detected some slight increases offsite, and then our people went out to cross-check. They should have known, there was adequate time.

Q. Did you have the feeling that the information that was being presented was colored or being put in its best light, or some——

A. No. I was very disgusted, that it was a typical utility trying to play down a nuclear power plant problem. That was my impression of what the discussion in the Lieutenant Governor's office, that they were acting in the Lieutenant Governor's office the same way they were apparently acting with the press outside. You know, trying to say that there was not a problem, and that everybody was making a big deal out of nothing.

Q. Do you believe this was despite the fact they knew that there was a problem of more serious proportions than they were discussing?

A. I don't know. I think they were very disturbed that they had to be in the Lieutenant Governor's office, rather than being at the plant. They didn't want to be there, they wanted to get out in a hurry, and they were trying to tell us in effect, "We are going to handle it, it's none of your business. The NRC is down there. Don't worry."

By Mr. HOEFLING.

Q. What led you to believe that they were downplaying their presentation?

A. Because of—I thought I had more information than they were giving me, than they gave us in the overview of what was happening, about what was happening at the plant. We already knew that they had some failed fuel from 7:30 or 8:00 o'clock telephone call, or some voids in the system, and so forth, and that we were still—we were getting releases at the time they were talking to us, we were measuring radioactivity, our people were measuring radioactivity in the area, and they were saying there weren't any releases. And I just couldn't believe that they didn't know that.

Q. So was the key element in your feeling that they were downplaying this, was their——

A. I think it was more of an attitude than anything else. It was the way they phrased the words and the way they talked down to the people in the office, rather than trying to lay it out—lay their cards on the table. They really were.

Q. So it wasn't so much of what they presented, but how they presented it?

A. Yeah, I think so. It turned us all off. I mean it was everybody in the office. When they left, everybody shook their head and we said, "We don't trust them," just from the way they presented the information, and that's, I believe, why the Lieutenant Governor went down the next day himself to see what was going on. I didn't know he was going down until after he came back.

Now, later when NRC came along that evening and started to fill us in, there wasn't that much difference, you know. They indeed told us about the offsite releases, but they didn't have much more information to present to us, I don't think, than what we got earlier.

Q. Could this perspective on your part be a result of an individual's personality, just an individual's attitude, as opposed to a company attitude?

A. No, we had good relationships with Metropolitan Edison. I hadn't met Gary Miller except for one or two times before, so that wasn't—you know, Jack Herbein and I had talked many, many times before. I expected Herbein, I think, to be more honest than he was. It looked like he was still out talking to the press instead of talking in a private room with the people who needed to know. It just didn't seem like it was a good—a good give-and-take.

Q. Is your perception on that day based mostly on Herbein's approach?

A. Yeah, I think it was. It may have been both Herbein and Miller.

Q. Clearly it was Herbein and it may have been Miller; is that the way you would size it up?

A. Yeah, I think. Again it's awful hard to remember, but I know I came out of that meeting disgusted and felt that we needed a lot more information. I think we went to a press conference right afterwards, and we had decided that we would not ask them to attend the press conference.

By Mr. MOSELEY.

Q. When you say you needed more information and then——

A. We felt there was more information available than they were telling us.

Q. Operational type status?
A. Yeah.
Q. Everything?
A. Well, even a general overview of what was happening at the plant, we didn't get, and there was again no information on offsite problems, as far as I recall. Now, again, you know, that meeting is—there were so many subsequent meetings. I didn't even remember—I'm not sure where it even took place, in rethinking it for other inquiries. I assumed that they always took place in the Governor's office, and I guess that one took place in the Lieutenant Governor's office, and I've been in the Lieutenant Governor's office prior to that, so it wasn't—you know, it wasn't a new place to me, so I guess that's why I didn't—it didn't ring a bell that it was the Lieutenant Governor, and it was the Lieutenant Governor's meeting, but I just assumed it was in the Governor's office for some reason.

By Mr. HOEFLING.

Q. Do you recall how long the meeting ran, approximately?
A. I believe it was less than an hour, but I don't know.
Q. And the bulk of that time was Herbein?
A. I think it was Herbein. It was both of them. Miller explaining what they were doing at the plant then, Herbein, I think, explaining that it wasn't—you know, trying to play down the accident situation.
Q. Were there a lot of questions directed to them?
A. I don't remember. I seem to recall that there weren't very many technical people in the room except me. I think I was the only one there—may have been the only one there that was acquainted—that was acquainted with nuclear power reactors or with reactors at all. I don't know how many—and I would have had to have asked the questions, and I don't remember how many questions I asked.

By Mr. HARPSTER.

Q. Aside from the specifics, was there any time that day where you felt they communicated concerns that we now know existed in the control room over potential for further deterioration of the situation?
A. No. (Gerusky, I&E, 10/1/80, pp. 13–27.)

In sum, Gerusky's recollection seems best summarized with his statements to the effect that limited information was passed on, that the overall impression conveyed was that the accident was over and ". . . everything was under control," and that the general attitude displayed by Herbein and Miller was one of, "Don't bug us. We know what's going on and we can handle it."

Following the meeting, beginning at approximately 4:30 p.m. and continuing until about 5:30 p.m., Lieutenant Governor Scranton held a press conference at which he released a statement saying:

> The situation is more complex than the company first led us to believe. We are taking more tests. And at this point we believe there is still no danger to public health. Metropolitan Edison has given you and us conflicting information. We just concluded a meeting with company officials and hope this briefing will clear up your questions.
> (Lt. Gov. Scranton, 4:30 p.m., 3/28/79, press release.)

The statement then went on to describe radiological releases, which were relatively minor. The statement said little about the condition of the plant or the likelihood of deterioration leading to a major radiological release. The press conference transcript indicates that Lieutenant Governor Scranton, and BRP's Dornsife and Gerusky were under the impression that plant personnel had believed the reactor systems had functioned normally until 6:40 a.m. Lieutenant Governor Scranton said:

> The company is saying that the indications were normal up to that time (i.e. until 6:40 a.m.) that the normal safety functions were occurring and they didn't begin to see radiation until about that time. That is what they are saying, we have no way to verify that or not.

The plant was in fact not in a normal condition until 6:40 a.m. which is approximately the hour at which the last of the reactor coolant pumps had to be shut down as a result of steam in the system.

At approximately 2:45 p.m. NRC in Bethesda repeated a request (originally made at 2 p.m.) for information concerning the basis for the utility's belief that the depressurization strategy, as then being pursued, would be successful. The Senate report on page 319 suggests that General Public Utilities Vice President Robert Arnold had also expressed skepticism at about 2 p.m. as to whether the core was covered and he recommended that maximum high pressure injection flow should be maintained, a strategy which if followed would have been opposite to the depressurization strategy then being employed.

By mid-afternoon, NRC staff in Bethesda had begun to infer that the core had been uncovered. In a recorded conversation between Edson Case and Harold Denton (Senate report, p. 324; also IRACT tape, 01-222-Ch6/24—9, 10) Case told Denton that it was fair speculation that potential existed for the core being uncovered; that, "The problem is they've still got these (sic) large delta T between T hot and T cold." Case and Denton then discussed the cause of the situation with Denton (apparently) saying:

> Well the scenario that we've talked ourselves into a possibility that was the feedwater tramped (tripped?) and analyzed in the FSAR with the pressure release (relief?) valve staying stuck—And that would lead you into much—a lot of this kind of thing.

Case (apparently) then said:

> Well apparently ECCS came on, but at some point they turned it off, and I think that was probably the wrong thing to do, but I think that's maybe how they got the bubble in there.

Case and Denton then agreed that the ECCS should have been left on.

At approximately 4:10 p.m. Met Ed Supervisor Hitz reported to Region I (in response to NRC's request for in-core thermocouple data which was initially asked for at about 12:20 p.m.) that the in-cores were not available, that they were printing out question marks. As noted above (supra at 32–33), it was not the case that all thermocouples were printing question marks which were an indication of either the thermocouples being defective or temperatures in excess of 700; com-

puter printouts indicated two of the thermocouples were measuring temperatures less than 700 degrees at about the time the NRC was being informed that they were all question marks.

The transcripts of a telephone conversation at about 4:14 p.m. (apparently between Stello and Eisenhut in Bethesda, Senate, p. 335) indicates concern that there was a steam bubble in the core, and that B&W itself ". . . just said they don't have enough information to straighten it out either, and they just got their information second-hand, of course, from their guy at the site, too." (IRACT tape, 01–225–CH6/24–12.)

At about 4:31 p.m., Stello told Eisenhut (Senate, p. 339) that, "There ain't no way you can get those conditions (i.e. the prevailing combination of temperature and pressure) without superheat." (IRACT tape, 01–226–CH6/24, 3.)

At approximately 4:35 p.m. Stello told Gilinsky, that if they really had the hot leg temperature as they had indicated, the only plausible explanation was superheat, and:

> If there's a bubble on the top of the core, the top of the core can be uncovered and as the stuff comes up through the core, it gets to the top of the core, which would be uncovered, and this is a scenario. I'm not sure that this is what they've got, but I want to tell you how you can get superheat . . . Through the top of the core that's uncovered and when you get the steam up there—because they've got a steam bubble, that superheats to whatever the temperature in equilibrium with the rods will be, and that, in turn, will go over into the steam line. (IRACT Tape, 01–226–CH6/24–6, 7.)

The foregoing statements indicate Stello's concern that portions of the core might be uncovered.

Thus, by late afternoon on March 28, NRC officials, including Stello and Case, suspected that the core was uncovered, that portions of it might not be adequately cooled, and that fuel had been damaged as a result of overheating. Because they had not been provided significant information, and because the information they did have was in some cases misleading, NRC officials in Bethesda were unable to make an accurate assessment of the situation, particularly with regard to the extent of the core damage and the presence and quantity of hydrogen in the primary coolant system. It was not until March 30 [22] when these officials learned of the pressure pulse that had occurred in the containment building on March 28, and the high radiation level in the reactor coolant water, that concern developed that there might be further deterioration requiring evacuation of persons living in the plant's vicinity.

On September 24, 1980, Mike Ross engaged in the following dialog concerning information transmitted to the State on March 28:

> Q. You stated to the Senate in October that, through the day, information on major changes was fed to Unit 1 for pass-on to the state. Who decided what information to pass on?
>
> A. That varied. I don't think anybody decided this was an official chain, this was our chain of notifying the state. It varied. Normally I communicated with Jim Seelinger much of the time, and he communicated back through.
>
> Q. Then the information that was passed on was not selected because of its potential interest to the state, or passed on specifically for further pass-on to the state; is that right?
>
> A. No. that's not right. The information selected was significant information that was to be disseminated to all personnel, including Unit 1 personnel, the State, anybody else they had on the phone over there.
>
> Q. Let me ask you a few specific things, were they included in the pass-on.
>
> Was core uncovery or the possibility of core uncovery passed on through that channel?
>
> A. I don't remember if it was or not.
>
> Q. Was plant stability or the perception of plant stability passed on?
>
> A. Yes. I can't say a hundred percent, but every time we changed something, we passed on.
>
> Q. But this is a change in status rather than a projection of where the equipment may be in the future; is that correct?
>
> A. Yeah. Projections were kind of tough to make that day, yes, sir. I would think that would be correct.
>
> Q. Was the fact of inventory deficiency passed along?
>
> A. To my knowledge, no.
>
> Q. Pressure spike?
>
> A. I can't say for sure. I kind of have the feeling it was passed on, that we had a spike.
>
> Q. What gives you that feeling?
>
> A. I don't know. It may have been something I read later, and that's a problem.
>
> Q. Was the potential for the situation deteriorating passed on?
>
> A. Yes and no. The status was passed on. The fact that we were concerned we were running out of water was passed on. The fact that we were concerned we didn't have forced cooling was passed on. In that light, yes.
>
> Q. What about the lack of effective heat removal through ATWS circulation?
>
> A. I can't say for sure it was passed on.
>
> Q. Was the ineffectiveness or—let me rephrase it. Was the fear of bypassing of the core with HPCI flow, was that passed on through that channel?
>
> A. I don't know. It was discussed on our side.
>
> Q. I'm sorry?
>
> A. It was discussed on our side. Whether it was discussed on the Unit 1 side, I don't know.
>
> Q. Or whether it was passed along the communications channel. (Ross, I&E, 9/24/80, pp. 67–69.)

In sum, the record cited above indicates critical information was not provided on March 28 to State and Federal officials. The latter were not told on March 28 that there was reason to believe the PORV had been open for some 2 hours and 20 minutes during which time the

[22] See app. H.

high pressure injection had been throttled and letdown flow had been maintained at a high level. Prior to arrival of NRC inspectors at the site at approximately 10 a.m., the NRC was not informed of hot-leg temperature data and in-core thermocouple computer data indicating temperatures in excess of 700 degrees. It remains unclear as to the hour at which the NRC inspectors were informed of such data and the time at which such data was reported to Bethesda. The record indicates that on March 28 the State was not informed of the hot-leg temperatures and the in-core computer data or of the significance of either. Neither the NRC nor State was informed on March 28 of the direct measurements of the in-core thermocouple voltages indicating temperatures in excess of 2,000 degrees.

The State was not informed on March 28 of the containment building pressure spike nor of some TMI supervisors' interpretation of it. NRC officials in Bethesda were unaware on March 28 of the pressure spike and other manifestations of a hydrogen burn. (The record contains contradictory statements with regard to whether the NRC inspectors at the site were aware of the pressure spike on March 28.) The record indicates that the overall assessment of the situation presented on March 28 to State and Federal officials by TMI managers was inconsistent with the managers' own perception of the severity of the accident and the prognosis for bringing the reactor to a stable condition. The lack of critical information in State and Federal hands is manifest in Lieutenant Governor Scranton's statements released at 10:55 a.m. and at 4:30 p.m. and in the NRC's PNO's 79–67 and 79–67A describing the situation as the NRC perceived it to exist respectively at 10:45 a.m. and 3:30 p.m. (Mr. Scranton's statements are included as appendixes C and D and the PNO's as appendixes E and F.)

VI. Conclusion

The record indicates that in reporting to State and Federal officials on March 28, 1979, TMI managers did not communicate information in their possession that they understood to be related to the severity of the situation. The lack of such information prevented State and Federal officials from accurately assessing the condition of the plant. In addition, the record indicates that TMI managers presented State and Federal officials misleading statements (i.e. statements that were inaccurate and incomplete) that conveyed the impression the accident was substantially less severe and the situation more under control than what the managers themselves believed and what was in fact the case.

APPENDIX A

THE MILLER-TROFFER CONVERSATION

Transcript of phone call from Gary Miller at TMI about 9:30 A.M., March 28, 1979, to George Troffer, Reading, to assist in providing help for Met-Ed communications Services staff by reporting on what he said to Lt. Governor Scranton.

MILLER) Lt. Governor - - I had no choice but to talk to him.
) What I said and its probably not in very good verbage is that this morning very early we experienced a turbine trip. Two problems were in the secondary plant not the nuclear plant. When the unit trips from 100 percent, the reactor sometimes trips from 100 percent and it did. There was very high power. That's not a problem and not unexpected. When the reactor trips due to high pressure, its one of the parameters that normally trips the reactor. At the same time it was in the reactor building and due to the high pressure we had some relief valve lift which released some reactor coolant to the building floor. This was not a break or a leak or anything that was designed to relieve at a high pressure. Obviously not enough reactor trips that doesn't occur. But it did on this one. That gave us indication of reactor building radioactivity because of the reactor coolant being released to the floor of the building. Okay It's got radioactivity in it.

Right now In addition to this the plant obviously experienced a pressure and temperature change fairly fast. I didn't say this to them -- I'm just saying it to the group. And I was on the phone with a nuclear engineer over there so he knows about fuel pins. I said yes we may have had some fuel pin leakage. I don't know that right now. That's part of long term assessment on this thing and that's economic. He asked if I had any melting on fuel. I said I don't have any indication of melted fuel, but I may have had some fuel pin leakage which is not abnormal in the industry. Now I didn't say any of that to the press but I did say that we had reactor coolant released in the building which was giving radioactivity on the monitor.

When we get that, I said our emergency plan mandates that when I see it in the reactor building I assume it's getting out. Therefore, I go into the general emergency. I fully gear-up like I already got an

-2-

emergency in the public. That means that I put people on [redacted], I closed the gates, I get the State Police, I [redacted] all the phone calls and I say subsequent to doing everything in the plant we have had confirmation very rapidly the number I. (?) From the time the incident started we have had no release to the environment especially above background. We have had no indication of a millirem an hour that I know of. We know where the wind is moving -- it is moving slowly to the west. We have people at the west site boundary. We had a helicopter fly over to Goldsboro. We had the meters taken out at York Haven -- if I have to go back I will. Never had any indication. We have been in communications with Molloy in the State for most of the [redacted]. We had no action level by the plan for the public.

We do not expect any additional or any release. We are in the process of taking the plant to a cold shutdown to evaluate the situation and that evaluation is probably more economically damaging than anything else -- from the [redacted] standpoint.

Is Troffer there?

TROFFER: Yes.

MILLER: I don't expect any effect on the public. That's what I had said to people. I didn't have any time to think about it.

TROFFER: That sounds good. Did anybody have an overdose?

MILLER: Nobody had one. Nobody had an overdose or an overexposure. We have surveyed all the areas internally and roped the appropriate areas off.

We had nobody, as a result of the incident, that got any overexposure. We have taken reactor coolant samples afterwards. We may have used up a lot of quarterly doses of some people. I had nothing at the time of the incident. I may have had some exposures of people during the action

we needed to take in the correction of this thing in the plant. We have some people that I'm not totally sure of but I don't believe that we have anybody overexposed. And we didn't overexpose anybody at the time of the incident due to anything. For example, I have a chemist [redacted] that went into a room to get a sample for us, he may have gotten a fairly good dose. I wouldn't expect that he exceeded his limit.

OK, George. When I come back and re-assess this thing I may find some doses higher than I expect right now because I've had people doing things that must be done. I've got full dosimetry on anybody out there -- full body count and everything else. That's too much detail but that's just so you know. I will say I've had nobody overexposed. And I will say that we will have to fully evaluate that as a result of the incident when we can collect all the people from this thing. It will effect nobody inadvertently, George.

TROFFER: OK. Do you know when we will be able to decide when people should come to work -- I think we are thinking about the Observation Center overcrowding.

MILLER: The best thing is that I am keeping them here now. I guess I wanted to be damn sure I had total control of the cooldown before I worried about that. I have had some people come to work. I've got one guy in charge of the Observation Center.

I believe that it's Gary Hahn. I have had Shovlin bring in whoever he needed. I've sent the contractors that didn't get there home.

TROFFER: No we did not do that. We did not call of the contractors and send them home.

MILLER: I didn't call them off. There were some on-site but the ones that went to the center I probably sent home. We did send them home. We made that

decision. It's just been too hard to worry about them. They probably went home anyway. I've been here since 7:00 in the morning, and I've been up since 4:00 and I don't think I'll worry about the economic consequences of the contractors. To get them out of our way to be honest with you. If anybody was on-site I kept them to use them.

KLINGAMAN: We did not send our people home though, right Gary.

MILLER: We've got them on hold at the Observation Center. I put Gary Hahn in charge to be sure that they didn't go home or wander around like what happened to me in August. I have brought on those people that Shovlin needs. Through him. I've got to go back and assess the people right now. Quite frankly, up to now its been Jack, Lee Rodgers and the plant -- I've haven't had a shot at that. Jim Seelinger's in charge of that and he's pretty aware of what we're doing.

I just talked to the State and I gave them the scenerio that I just gave you, but not with that kind of detail. So they're going to release something whether I like it or not probably.

I did talk to Maggie (DER) and Dornsife which I had known personally. I'm pretty sure I know them well enough that they will release something that will help. I told Maggie that if she has any problems getting us she should call Jack's office and he'll talk to her. I think you should tell Norene that she shouldn't treat Maggie as someone she doesn't know -- if she doesn't know her -- in case I need something. She's probably going to get a lot of questions from management over at the Governor's office.

TROFFER: I think we ought to go ahead cancel this Friday tour now.

MILLER: Yeah, I love that idea. George, I'll tell you what. I'm not sure that I'll be working here Friday. Just kidding. If there's anything else that you need I'll be in the Unit #2 Control Room. You can get me through that. I think you ought to release something. I think we should.

KLINGAMAN: I think I better verify one thing. There are rumors going back and forth as to what we have. My understanding is that what we have is a general emergency declared sometime this morning. And it's still an official general emergency.

MILLER: The emergency was declared sometime around 7:00. I guess I could be off a little bit.

KLINGAMAN: Yes, I got a call around 7:15.

MILLER: We did declare a general emergency here -- that's true.

TROFFER: The sooner we get back properly from a general to a site, the better.

MILLER: The reason we have not, and you're right George, is because to be honest with you we've been assessing the plant. [Troffer: That's fine.] We don't know where the hell the plant was going. See the situation we're in is a delicate one because we actually have plant integrity. [Troffer: OK.] If we had a leak we'd be all right -- as far as we'd have a lot more economic consequences. We've been trying to figure out how to cool down in the most expeditous fashion without releasing and without damaging too much. That's taking a pretty hard assessment. I'll work on getting out of the emergency right now.

[Troffer: Excellent Miller. O.K.] ?

Something about Herbert?

[Troffer: I understand

APPENDIX B

Dornsife Notes

Dornsife notes from 3/78

~ 0705 - Received call from C. Daller, PEMA duty officer advising that TMI had a site emergency and to call plant to get details

~ 0706 - Called Maggie to inform her and verify number to call at plant site - only number we had was plant switchboard 944-4041

~ 0707 - Called plant site - had difficulty getting through switchboard to Unit 2 control room - finally gave switchboard my home number to have control room directly call me

~ 0710 - Shift supervisor called back to my home number. He told me the plant had suffered a transient and RB radiation level was high initially the site emergency - Things sounded very confused at this point in time - I tried to get a status of important safeguards without any such success - they did tell me that reactor was shutdown and RB pressure was about 1 or 2 psi - SI had been initiated and was cooling core - They informed me that they had sent out monitoring teams and there was no detectable radiation levels outside the plant.

I think I heard in background the announcement to evacuate the Unit 2 fuel handling and auxiliary buildings. At this point a health physics type got on the phone and things sounded extremely confused and finally he hung up saying he would call back.

~ 0720 - Called office - talked to Dianne - told her briefly about what was happening and I was on my way in to the office - told her first technical type who arrives in office should call Unit 2 control room immediately.

I arrived in office about 0750. Ten was there with open line established to plant-control unit. Plant had declared a general emergency about 0730 due to high radiation levels in the reactor building. There still were no releases outside plant. Met Ed monitoring teams were out and around. I talked to [illegible] radiation, and I recall, they said the were [illegible] with makeup pumps and [illegible] and there was pressurizer electromechanical relief valve. From the information that I was getting it sounded as if plant conditions were stabilized (in reality the core was probably being uncovered at this time and fuel damage was continuing) For the next hour or so we kept getting plant status reports periodically. (The open line was not manned continuously by Met Ed. They would come to the phone when ready to report) Things seemed to remain the same with still no releases occurring.

At about 0900 I was called by Middletown at Dauphin to go brief the Lt Gov and attend a press briefing that was scheduled for about 1000. I called back to plant to get more details on what had initiated accident and what the present status was in order to brief Lt Gov & Gov.

At this point Gary Miller, plant superintendent, came on the line and briefed me on what had occurred. His briefing was as follows (based partly on notes and partly on recollection):

At 4:00AM a turbine trip from 98% power occurred - reactor shutdown automatically - isolation of tech spec in that aux feed was valved out temporarily S/G my have blocked by - electromechanical relief valve lifted but did not reseat - indication in control room (also signal to valve) indicated that it had reseated - block valve system in was closed - High pressure safety injection was initiated - all safeguard system operated as designed - pressurizer may have gone solid and lost pressure in primary probably caused flashing and bubble in primary - may have temporarily lost min natural circulation - currently stabilized and cooling normally on A S/G - possible primary to secondary leak on C S/G - B S/G has been isolated - 100 ppm Boron in primary - may have been diluted by secondary to primary backhead thru tube leakage - There has probably been a slight amount of failed fuel no speculation as to amount - R.B. dose monitor reading 600 R/hr - RB pressure ~1 psig - fence post dose < 1 mrem/hr - wind blowing to west currently sending monitoring team to Goldsboro

APPENDIX C

10:55 A.M. STATEMENT BY LT. GOV. SCRANTON

FOR IMMEDIATE RELEASE
321-D79

GOVERNOR'S PRESS OFFICE
CONTACT: Paul Critchlow
Press Secretary
(717) 783-1116

TRANSCRIPTION
PRESS CONFERENCE
LIEUTENANT GOVERNOR WILLIAM W. SCRANTON, 3d
INCIDENT AT THREE-MILE ISLAND
MARCH 28, 1979 10:55A

Following is Lt. Governor Scranton's opening statement:

THE METROPOLITAN EDISON COMPANY HAS INFORMED US THAT THERE HAS BEEN AN INCIDENT AT THREE-MILE ISLAND, UNIT #2. EVERYTHING IS UNDER CONTROL. THERE IS AND WAS NO DANGER TO PUBLIC HEALTH AND SAFETY.

THE INCIDENT OCCURRED DUE TO A MALFUNCTION IN THE TURBINE SYSTEM. THERE WAS A SMALL RELEASE OF RADIATION TO THE ENVIRONMENT.

ALL SAFETY EQUIPMENT FUNCTIONED PROPERLY.

METROPOLITAN EDISON HAS BEEN MONITORING THE AIR IN THE VICINITY OF THE PLANT CONSTANTLY SINCE THE INCIDENT. NO INCREASE IN NORMAL RADIATION LEVELS HAS BEEN DETECTED. A STATE POLICE HELICOPTER IS ALSO AT THE SCENE TO MONITOR THE AIR.

THE CIVIL DEFENSE HAS ALERTED ALL COUNTIES IN THE VICINITY ALTHOUGH THERE IS NO NEED FOR EVACUATION. THERE IS ALSO A TEAM FROM THE FEDERAL GOVERNMENT ON THE WAY TO INVESTIGATE.

Answering questions with Lt. Governor Scranton are:

William Dornsife, Nuclear Engineer, Bureau of Radiation Protection, DER
Colonel Oran Henderson, Director, Civil Defense
Senator Jim Ross, member, Emergency Management Council
Bob Laughlin, Governor's Science Advisory Committee
Ray Holst, Energy Liaison Officer

APPENDIX D

4:30 P.M. STATEMENT BY LT. GOV. SCRANTON

FOR IMMEDIATE RELEASE
322-D

GOVERNOR'S PRESS OFFICE
CONTACT: Paul Critchlow
Press Secretary
(717) 783-1116

TRANSCRIPTION
PRESS CONFERENCE
LIEUTENANT GOVERNOR WILLIAM W. SCRANTON, 3d
INCIDENT AT THREE-MILE ISLAND
MARCH 28, 1979
4:30 P.M.

Following is Lt. Governor Scranton's opening statement:

Answering questions with Lt. Governor Scranton are:

William Dornsife, Nuclear Engineer, Bureau of Radiation Protection, DER
Colonel Oran Henderson, Director, Civil Defense
Thomas Gerusky, Director of DER's bureau of radiological protection

THIS IS AN UPDATE ON THE INCIDENT AT THREE MILE ISLAND NUCLEAR POWER PLANT TODAY.

THIS SITUATION IS MORE COMPLEX THAN THE COMPANY FIRST LED US TO BELIEVE. WE ARE TAKING MORE TESTS. AND AT THIS POINT, WE BELIEVE THERE IS STILL NO DANGER TO PUBLIC HEALTH.

METROPOLITAN EDISON HAS GIVEN YOU AND US CONFLICTING INFORMATION. WE JUST CONCLUDED A MEETING WITH COMPANY OFFICIALS AND HOPE THIS BRIEFING WILL CLEAR UP MOST OF YOUR QUESTIONS.

THERE HAS BEEN A RELEASE OF RADIOACTIVITY INTO THE ENVIRONMENT. THE MAGNITUDE OF THE RELEASE IS STILL BEING DETERMINED, BUT THERE IS NO EVIDENCE YET THAT IT HAS RESULTED IN THE PRESENCE OF DANGEROUS LEVELS.

THE COMPANY HAS INFORMED US THAT FROM ABOUT 11 A.M. UNTIL ABOUT 1:30 P.M., THREE MILE ISLAND DISCHARGED INTO THE AIR, STEAM THAT CONTAINED DETECTABLE AMOUNTS OF RADIATION.

THE DISCHARGE WAS A PART OF THE NORMAL REACTOR EMERGENCY COOLING PROCESS. IT WAS DONE TO RELIEVE POTENTIALLY DANGEROUS PRESSURE IN THE REACTOR CHAMBER.

BECAUSE OF AN APPARENT LEAK IN THE PRIMARY COOLING SYSTEM, RADIOACTIVE MATERIAL WAS DISCHARGED INTO THE AIR ALONG WITH THE STEAM.

THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES WAS NOT NOTIFIED OF THE RELEASE UNTIL ABOUT THE TIME THAT IT WAS HALTED.

THE COMPANY HAS SAID THAT FURTHER DISCHARGES MAY BE NECESSARY AND HAS PROMISED TO NOTIFY US IN THAT EVENT.

THE LEVELS THAT WERE DETECTED WERE BELOW ANY EXISTING OR PROPOSED EMERGENCY ACTION LEVELS. BUT WE ARE CONCERNED BECAUSE ANY INCREASED EXPOSURE CARRIES WITH IT SOME INCREASED HEALTH RISKS.

THE FULL IMPACT ON PUBLIC HEALTH IS BEING EVALUATED AS ENVIRONMENTAL SAMPLES ARE ANALYZED. WE ARE CONCERNED MOST ABOUT RADIOACTIVE IODINE, WHICH CAN ACCUMULATE IN THE THYROID, EITHER THROUGH BREATHING OR THROUGH DRINKING MILK. FORTUNATELY, WE DON'T BELIEVE THE RISK IS SIGNIFICANT BECAUSE MOST DAIRY COWS ARE ON STORED FEED AT THIS TIME OF YEAR.

TEAMS FROM THE DEPARTMENT OF ENVIRONMENTAL RESOURCES, THE NUCLEAR REGULATORY COMMISSION, AND THE DEPARTMENT OF ENERGY ARE IN THE AREA CONDUCTING TESTS.

THE MOST RECENT REPORTS INDICATE THAT THE LEVELS HAVE BEEN DECREASING THROUGHOUT THE AFTERNOON.

WE WILL KEEP YOU ADVISED OF ANY FURTHER IMPORTANT DEVELOPMENTS.

APPENDIX E

NRC PNO 79-67

IE Bulletin 79-05
Enclosure 1
PN No. 79-67 and Subsequent Revisions

PRELIMINARY NOTIFICATION

March 28, 1979

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-79-67

This preliminary notification constitutes EARLY notice of event of POSSIBLE safety or public interest significance. The information presented is as initially received without verification or evaluation and is basically all that is known by IE staff on this date.

Facility: Three Mile Island Unit 2
Middletown, Pennsylvania
(Docket No. 50-320)

Subject: REACTOR SCRAM FOLLOWED BY A SAFETY INJECTION AT THREE MILE ISLAND - UNIT 2

The licensee notified Region I at approximately 7:45 AM of an incident at Three Mile Island Unit 2 (TMI-2) which occurred at approximately 4:00 AM at 98% power when the secondary feed pumps tripped due to a feedwater polishing system problem. This resulted in a turbine trip and subsequent reactor trip on High Reactor Coolant Pressure. A combination of Feed Pump Operation and Pressurizer Relief - Steam Generator relief valve operation caused a Reactor Coolant System (RCS) cooldown. At 1600 psig, Emergency Safeguards Actuation occurred. All ECCS components started and operated properly. Water level increased in the Pressurizer and Safety Injection was secured manually approximately 5 minutes after actuation. It was subsequently resumed. The Reactor Coolant Pumps were secured when low net positive suction head limits were approached.

About 7:00 AM, high activity was noted in the RCS Coolant Sample Lines (approximately 600 mr/hr contact readings). A Site Emergency was then declared. At approximately 7:30 AM, a General Emergency was declared based on High Radiation levels in the Reactor Building. At 8:30 AM site boundary radiation levels were reported to not be significant (less than 1 mr/hr). The source of activity was stated to be failed fuel as a result of the transient, and due to a known previous primary to secondary leak in Steam Generator B.

The Region I Incident Response Center was activated at 8:10 AM and direct communications with the licensee and IE:Headquarters was established. The Response Team was dispatched at 8:45 AM and arrived at the site at 10:05 AM.

At 10:45 AM the Reactor Coolant System Pressure was being held at 1950 psig with temperature at 220°F in the cold leg. By 10:45 AM, radiation levels of 3 mr/hr had been detected 500 yards offsite.

There is significant media interest at the present time because of concern about potential offsite radiation/contamination. The Commonwealth of Pennsylvania and EPA have been informed. Press contacts are being made by the licensee and NRC.

Contact: GKlingler, IE x28019 FNolan, IE x28019 SEBryan, IE x28019

Distribution: Transmitted H St 3:45 3:35

Chairman Hendrie	Commissioner Bradford	S. J. Chilk, SECY
Commissioner Kennedy	Commissioner Ahearne	C. C. Kammerer, CA
Commissioner Gilinsky		(For Distribution)
Transmitted: MNBB 3:50	P. Bldg 3:40	J. G. Davis, IE
L. V. Gossick, EDO	H. R. Denton, NRR	Region F 3:55
H. L. Ornstein, EDO	R. C. DeYoung, NRR	
J. J. Fouchard, PA	R. J. Mattson, NRR	
N. M. Haller, MPA	V. Stello, NRR	(MAIL)
R. G. Ryan, OSP	R. S. Boyd, NRR	J. J. Cummings, OIA
H. K. Shapar, ELD	SS Bldg 3:52	R. Minogue, SD
	W. J. Dircks, NMSS	

APPENDIX F

NRC PNO 79-67a

PRELIMINARY NOTIFICATION

March 29, 1979

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-79-67A

This preliminary notification constitutes EARLY notice of event of POSSIBLE safety or public interest significance. The information presented is as initially received without verification or evaluation and is basically all that is known by IE staff on this date.

Facility: Three Mile Island Unit 2
Middletown, Pennsylvania (DN 50-320)

Subject: NUCLEAR INCIDENT AT THREE MILE ISLAND - UNIT 2

This supplements PNO-79-67 dated March 28, 1979.

As of 3:30 p.m., on March 28, 1979, the plant was being slowly cooled down with Reactor Coolant System (RCS) pressure at 450 psi, using normal letdown and makeup flow paths. The bubble has been collapsed in the A Reactor Coolant Loop hot leg, and some natural circulation cooling has been established. Pressurizer level has been decreased to the high range of visible indication, and some heaters are in operation. The secondary plant was being aligned to draw a vacuum in the main condenser and use the A Steam Generator for heat removal. The facility plans to continue a slow (3°F/hr) cooldown, until the Decay Heat Removal System can be placed in operation at 350 psi RCS pressure, 350°F RCS temperature in 15-18 hours.

As of 3:30 p.m., a plume approximately ½ mile wide and reading generally 1 mr/hr was moving to the north of the plant. The ARM's helicopter is being used to define the length of the plume. Airborne iodine levels of up to 1×10^{-8} uCi/ml have been detected in Middletown, Pennsylvania, which is located north of the site.

Media interest is continuing. The Commonwealth of Pennsylvania is being kept informed by plant personnel.

Contact: GKlingler, IE x28019 FNolan, IE x28019 SEBryan, IE x28019

Distribution: Transmitted H St Mar 23 '0:30

Chairman Hendrie	Commissioner Bradford	S. J. Chilk, SECY
Commissioner Kennedy	Commissioner Ahearne	C. C. Kammerer, CA
Commissioner Gilinsky	10:32	(For Distribution)
Transmitted: MNBB 10:25	P. Bldg Mar 23	J. G. Davis, IE
L. V. Gossick, EDO	H. R. Denton, NRR	Region 1 10:33
H. L. Ornstein, EDO	R. C. DeYoung, NRR	
J. J. Fouchard, PA	R. J. Mattson, NRR	
N. M. Haller, MPA	V. Stello, NRR	(MAIL)
R. G. Ryan, OSP	R. S. Boyd, NRR	J. J. Cummings, OIA
H. K. Shapar, ELD	SS Bldg 10:28	R. Minogue, SD
	W. J. Dircks, NMSS	

PRELIMINARY NOTIFICATION

March 30, 1979

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-79-678

This preliminary notification constitutes EARLY notice of event of POSSIBLE safety or public interest significance. The information presented is as initially received without verification or evaluation and is basically all that is known by IE staff on this date.

Facility: Three Mile Island Unit 2
Middletown, Pennsylvania (DN 50-320)

Subject: Nuclear Incident at Three Mile Island

Plant Status

Three Mile Island Unit 2 is continuing to remove decay heat through A-loop steam generator using one reactor coolant pump in that loop for coolant circulation. The reactor coolant pressure and temperature were stable and under control throughout the night of March 29. There has been some difficulty in maintaining coolant letdown flow due to resistance in the purification filters. The licensee notified IE at about 11:00 p.m. on March 29 that they expected to remain in this cooling mode for at least 24 hours.

The licensee's engineering staff was requested by NRR to obtain a better estimate of the volume of the noncondensible "bubbles" in the reactor coolant system. There are apparently two such bubbles, one in the pressurizer that has been intentionally established for control of pressure and level, and one in the reactor vessel head caused by the accumulation of noncondensible gases from failed fuel and radiolytic decomposition of water. The estimate is to be obtained by correlating pressurizer pressure and level indications over the past hours of stable operation. The volume of the bubble in the reactor vessel is of interest in assuring that sufficient volume remains in the upper head for collection of more noncondensible gases arising from continued operation in the present cooling mode as well as to assess the potential for movement of the bubble during a switchover to decay heat removal operation.

The licensee believes it is prudent to remain in the present cooling mode due to the potential for leakage of highly radioactive coolant from the decay heat removal system into the auxiliary building, movement of noncondensible gases into the reactor coolant loop, and boiling in the core when the reactor coolant pump is shut down.

APPENDIX G

MAILGRAM: MR. HERMAN DIECKAMP TO CHAIRMAN MORRIS K. UDALL

MAILGRAM SERVICE CENTER
MIDDLETOWN, VA. 22645

western union Mailgram

4-020522E129 05/09/79 ICS IPHMTZZ CSP WSHB
8145368859 MGM TDMT JOHNSTOWN PA 933 05-09 1151A EST

MAY 10 1979

THE HONORABLE MORRIS K UDALL
WASHINGTON DC 20515

THE STORY IN THE NEW YORK TIMES OF MAY 8 1979 REPORTING ON THE VISIT OF YOUR SUBCOMMITTEE TO THE THREE MILE ISLAND PLANT IS GROSSLY IN ERROR.

THE "PRESSURE SPIKE" WAS NOT IN THE REACTOR VESSEL. THE PRESSURE GAGE WHICH SHOWED A SPIKE AT ABOUT 150PM ON THE DAY OF THE ACCIDENT READS PRESSURE WITHIN THE REACTOR CONTAINMENT BUILDING.

THE PRESSURE SPIKE DID INITIATE CONTAINMENT BUILDNG SPRAY WHICH IS DESIGNED TO COOL THE STEAM RELEASED INTO THE CONTAINMENT BUILDING AND TO SCRUB ANTICIPATED IODINE IN THE DESIGN BASIS ACCIDENT. SINCE BUILDING PRESSURE DID NOT INDICATE THE CONTINUING NEED FOR BUILDING SPRAY, THE OPERATOR TURNED OFF THE SPRAY PUMPS. IT WAS THIS ACTION AND THE BUILDING PRESSURE RECORDER THAT HR FLOYD REFERRED TO AS BEING IN VIEW OF THE NRC INSPECTORS IN THE CONTROL ROOM AT THE TIME.

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.

ON THE EVENING OF THURSDAY MARCH 29 WHEN THE TECHNICAL STAFF SENT TO THE SITE TO INVESTIGATE THE ACCIDENT WAS REVIEWING AND CORRELATING PLANT DATA FROM THE NUMEROUS SOURCES, THE SPIKE WAS NOTED AND POSTULATED TO BE THE RESULT OF A HYDROGEN OXYGEN EXPLOSION WITHIN THE CONTAINMENT BUILDING. THE TECHNICAL STAFF RECOGNIZED THAT THE PROBABLE SOURCE OF ANY HYDROGEN WAS A ZIRCONIUM WATER REACTION IN THE REACTOR CORE. THE PRESENCE OF HYDROGEN WOULD INDICATE THAT HIGH TEMPERATURE CONDITIONS MUST HAVE EXISTED IN ORDER TO RESULT IN SIGNIFICANT REACTION AND HYDROGEN PRODUCTION. THIS RECOGNITION LED TO MEASUREMENTS TO DEDUCE THE EXTENT OF A HYDROGEN BUBBLE WITHIN THE PRIMARY REACTOR COOLING LOOP. THE RESULTS OF THESE MEASUREMENTS WERE PROMPTLY REPORTED TO THE NRC ON FRIDAY MARCH 30. IN ADDITION THE FIRST GAS SAMPLE FROM THE CONTAINMENT BUILDING ATMOSPHERE TAKEN AT 4AM ON MARCH 31 REVEALED THE PRESENCE OF HYDROGEN GAS AND A REDUCED OXYGEN LEVEL WHICH WERE SUPPORTIVE OF THE PREVIOUS POSTULATE.

I REGRET THAT THIS ASPECT OF THE ACCIDENT HAS BEEN MISUNDERSTOOD AND INACCURATELY REPORTED. I THINK THE FULL UNDERSTANDING OF THE THREE MILE ISLAND ACCIDENT IS OF SUCH VITAL IMPORTANCE TO THE NATION THAT THE WORK OF YOUR COMMITTEE AND THE OTHER BODIES THAT WILL BE INVESTIGATING THE ACCIDENT SHOULD NOT BE DEFLICTED BY INACCURATE REPORTING FOUNDED ON PRESUMPTIONS OF DUPLICITY. SINCERELY

H DIECKAMP, PRESIDENT
GENERAL PUBLIC UTILITIES CORP
1001 BROAD ST
JOHNSTOWN PA 15907

11:51 EST

MGMCOMP MGM

APPENDIX H

Excerpts From Commission Discussion re Discovery of Pressure Pulse

A transcript of a March 30 Commission meeting shows Dr. Roger Mattson of the NRC staff reporting the occurence of the pressure pulse to the Commissioners.

"My bestguess is that the core uncovered, stayed uncovered for a long period of time, we saw failure modes, the likes of which has never been analyzed. It isn't like a LOCA. Some kind of swelling, rupture, oxidation near the top of the quarter center of the assembly.

We just learned -- I don't know -- three hours ago, that on the afternoon of the first day, some 10 hours into the transient, there was a 28 pound containment pressure spike. We are guessing that may have been a hydrogen explosion. They, for some reason, never reported it here until this morning. That would have given us a clue hours ago that the termo-couples were right and we had a partially disassembled core." (Tr, NRC Commission meeting, 3/30/79, pp. 60-61.)

A few minutes later in a discussion with Commissioner Gilinsky, Mattson elaborated on the discovery of the pressure pulse. This discussion occured prior to concern that oxygen might build to a concentration where it would combine chemically with hydrogen to the pressure vessel, causing a fire or explosion in the vessel.

COMM. GILINSKY: Can you estimate anything with the amount of hydrogen there?

DR. MATTSON: Well, we have got a problem there. The thing that really tripped, you know, Vic Stello was involved for the first two days over here and was trying to convince people to start thinking a severely damaged core. He had a hunch at the start, and when the temperature measurements started to go in there was some anomalies in them. He said start thinking severely damaged core. Believe the instruments. We had some trouble getting people to believe it, not necessarily inside, because our people turned to and started working pretty hard on that aspect.

We had some trouble with B&W wanting to believe it. Finally, they began to believe it about midnight last night, and by 4:00 o'clock this morning they were agreeing with us. I think the thing that tripped them was this sample of hot coolant having this 1000 R at contact.

Then a second thing happened this morning, I don't know, it must have been mid-morning, 9:00 - 10:00 o'clock. Just in the midst of taking some temperature data from the I&E guy, he says, you know, I have just heard in the control room that a guy was reading the strip chart recorder and says he's got a funny blip in the containment that nobody saw before, 28 psi pressure blip in the containment at 1350 hours Wednesday.

COMM. GILINSKY: And we have just found out about that now?

DR. MATTSON: We just found out about it, maybe it escaped everybody's notice, because you know, they were sitting there with some super-heated steam coming out the top of the core, they were just then

deciding they had an uncovered core, and they were just then getting instructions on how to get it fixed. So they may not have even noticed it. But that's possibly a hydrogen explosion.

COMM. GILINSKY: That would be the hydrogen that leaked out of the system, out of the primary system?

DR. MATTSON: That's right. And that would be the source of this bubble.

The only thing that could explain this bubble is metal-water reaction. We just ran a calculation on that and it looks like Val Pedisco, he said 10 to 30 percent -- he used a couple of assumptions -- I guess I can't remember -- either 10 or 30 percent water reaction would explain the 1500 cubic feet of hydrogen that is there now, 1000 psi, but if there was a hydrogen explosion in addition to that, there could have been a lot more.

COMM. GILINSKY: Let me ask you may original question which is, what sort of time scale (inaudible) and what should we be concerned about?

DR. MATTSON: Yes, we were asking ourselves that question.

Where we are at now, we are convinced we can stay there indefinitely, because the generation rate of hydrogen is apparently small, and we have got some margin left, indefinitely, I'm sorry, that's too strong. We can stay there on the order of days, I guess if it were 5 days, I would say that's getting a little long. If it were two days, I'd say yes.

COMM. GILINSKY: Is it vulnerable to something failing, say a steam generator?

DR. MATTSON: Prior to the start (inaudible) that is getting to be a real question. If you weren't on the verge of driving this bubble into the hot leg.

Now, we have got early warning signals that tell us when that happens. The first early warning signal would probably be malperformance of the pump that is running. It would start to draw a lot of gas and it would cavitate, vibrate the vibration monitors on the pumps that are working.

COMM. GILINSKY: How long would that give you?

DR. MATTSON: That would tell you you needed to go to either a fast or slow blowdown situation. And you would have hours until you were generating fission products in a core-melt kind of situation through the containment.

COMM. GILINSKY: Let me ask you -- well, let me take you off.

DR. MATTSON: There was one more thing I was going to say. These thermocouples, which is the best thing we have got going for us, would also show a blanketing effect from the gas coming down, penetrating from the upper plenum down into the core. So that would be another early warning signal. That would tell you, no matter how good your procedures are, go with them. Go with your best guess and blow the system down. Either fast or slow, whichever judgment you made at that moment. And people are coupled together ready to make that decision right now. And there are pros and cons both ways and somebody is going to have to call it.

COMM. GILINSKY: Listen, what are the dangers of further hydrogen explosions to bubble through or whatever?

DR. MATTSON: Well, they have got a recombiner and so if you know that it is going on, and at a rate--you see, now they don't even think it is getting to containment. What we would like to do is get to containment, then we burn it. They have got to recombine or they can burn it and control it from exploding.

COMM. GILINSKY: Okay, what if you decide to go with one of these maneuvers, not either if you are forced to by degradation, but deciding that how we want to move the reactor.

DR. MATTSON: If I would rather go with one of these maneuvers right now, I would want you to move people as far as you felt comfortable moving them.

COMM. GILINSKY: And --

DR. MATTSON: I must say to you, I have been recommending move people since about four hours ago.

COMM. GILINSKY: Okay, now that's the next question I want to ask.

What sort of evacuation plans are there, in other words, if someone decides to move right now, are there plans?

DR. MATTSON: Oh, yes. The people would begin to move. The word I had is that some people have moved, that there were children and pregnant women who had been moved.

COMM. GILINSKY: Is John Davis there?

DR. MATTSON: Not right here at the moment.

COMM. GILINSKY: Could you scare him up, please?

DR. MATTSON: Yes.

I may have faulty information, but I only overhear scratches of what went on (inaudible) and I'm trying to work this other problem.

COMM. GILINSKY: Presumably, the evacuation plans are state plans?

DR. MATTSON: Yes, sir.

COMM. GILINSKY: We will get to Davis on that, but why don't let me ask you: What is your principal concern right at this minute?

DR. MATTSON: Well, my principal concern is that we have got an accident that we have never been designed to accommodate, and it's, in the best estimate, deteriorating slowly, and the most pessimistic estimate it is on the threshold of turning bad. And I don't have a reason for not moving people. I don't know what you are protecting by not moving people.

John, I said that I thought children and pregnant women had been moved in some sectors, is that true or false, to the best of your knowledge?

COMM. GILINSKY: Is that John?

DR. MATTSON: It is our understanding that the Governor recommended the moving of pregnant women and children in some sectors, out to five miles. All around? --

COMM. GILINSKY: Well, we recommended that earlier, but on the basis of a different problem.

DR. MATTSON: Yes. You were recommending it on the first problem.

COMM. GILINSKY: That's right.

DR. MATTSON: And hopefully that's under control, but I --

COMM. GILINSKY: The Chairman is going to be back here pretty soon and we are going to figure out what we are going to do.

DR. MATTSON: Yes.

COMM. GILINSKY: But if John Davis is there, I would like to go over the evacuation.

DR. MATTSON: Okay, let me try to find him again, he walked out.

Vic, the hydrogen explosion is a guess at this point, you know, we got it by about third-hand and it would go along with significant metal-water reaction. It would also go along with the failure of some instruments that afternoon, and some equipment failures. (inaudible) -- that you would expect if there were explosions how that would go.

COMM. GILINSKY: Why didn't the recombiners work on that?

DR. MATTSON: I haven't asked that question. That's a good question. I don't know whether they are automatic for this kind of thing, or whether they are only automatic for a loss-of-coolant accident.

COMM. GILINSKY: Is Davis getting scared up?

COMM. AHEARNE: (inaudible) -- how much time (inaudible)

COMM. GILINSKY: All right, while you are trying to get Davis, let me ask you again, suppose we go into this maneuver or one of them, and it turns bad, what sort of time-scales are involved there?

DR. MATTSON: Hours.

COMM. GILINSKY: Hours before what?

DR. MATTSON: Before you had a core melt.

COMM. GILINSKY: Before you had a core melt?

DR. MATTSON: If you lost it and had a core melt, it would be hours before the core was slumping.

COMM. GILINSKY: Are there intermediate --

DR. MATTSON: -- and you would go to things like WASH 1400 to tell you how long you had, depending on what you thought the conditions were.

COMM. GILINSKY: So, okay, but when it went bad, you are saying it takes hours for the core itself to slump internally?

DR. MATTSON: No, I'm extrapolating that from a judgment from the fact that the thing sat there for 15 hours and didn't slump already.

COMM. GILINSKY: Now, it would take some further time, what, another half hour for something to go through the vessel?

DR. MATTSON: Right.

And you wouldn't lose, here, your capability to put water in if it were available. One thing we have got is the capability to put water in, but we don't have the capability to deliver it to the core, if we lost. If that bubble expands and blankets the core.

COMM. GILINSKY: So, okay and --

DR. MATTSON: John is here. Can I give you to him?

COMM. GILINSKY: Yes, please.

MR. DAVIS: Hello.

COMM. GILINSKY: John, what is the status of evaluation plans in this area? I presume these are state plans. Suppose one did say right now that we ought to execute evacuation. Are there plans that would be put into effect or what would happen?

MR. DAVIS: The evacuation is, as we understand it under the control of the state.

COMM. GILINSKY: Sure, but do you know what plans they might be exercising or is it sort of everyone on his own, jumping into his car and clogging the highways?

MR. DAVIS: I will get the (inaudible) Just a minute.

We have copies of the plan here.

(End of Side 1, Tape No. 8)

(Beginning of Side 2, Tape No. 8)

(Tr., NRC Commission meeting, 3/30/79, pp. 79-86.)

APPENDIX I

Concerns That Steam in Hot-Legs Could Not Be Readily Eliminated

After the block valve was closed at approximately 6:20 a.m., Brian Mehler and others were apparently concerned that the steam in the hot-legs could not be condensed merely by increasing system pressure. Mehler recalled plans to enter the containment building for the purpose of venting steam through a valve that had to be operated manually. This plan was abandoned when radiation levels increased in the containment building to the point where entry would have led to unacceptable radiation doses. Mehler engaged in the following discussion with TMI investigators:

> Hunter. . . . let me go back and make a couple of points clear and then I think that will wrap it up. When you came in in the morning, right away, you—it became—you became aware right away that there was steam bubbles in the legs, it was obvious to you that they were there. Was it obvious to the other fellows that were there? Did you discuss it with them at the time?
>
> Mehler. Yeah, it was obvious to Mike. I know Mike knew they were there because we discussed about venting them at that particular time. I didn't really talk to Bill too much.
>
> Hunter. OK. During your discussion with Mike or Bill or Ken Bryan, anybody, did you discuss putting on high pressure injection and taking the system solid at that time?
>
> Mehler. No, we didn't.
>
> Hunter. Can you give me a feeling or give us a feeling of why you wouldn't have considered taking it solid at that time?
>
> Mehler. At that particular time there was no radiation alarms at that time. I, my own opinion (and I did not realize how much water they dumped out the system) was that we just pumped bubbles in the hot legs. We were fairly stable. We finally had pressure recovery and it was just a matter of venting off the hot legs.
>
> Hunter. OK. And once you had established the fact that you had all your pressurizer heaters, did you feel like the pressurizer then would be available to you and there would be any more problems with the pressurizer?
>
> Mehler. I didn't anticipate any more problems with the pressurizer once we, in my own mind we established pressurizer heaters and we were recovering pressure. To me it was just a matter of being able to get in the containment and venting the pressure off the hot legs and thereby reestablishing the bubble in the pressurizer.

(Mehler, I&E, 5/17/79, pp. 39–41.)

Mehler was earlier asked about the proposed entry into the containment building:

HUNTER. Venting the hot legs at the top of the J legs?
MEHLER. Uh-huh.
HUNTER. How do you . . . do you have vent valves installed there to vent? Right at the top of the vent legs, manual valves?
MEHLER. Yeah, manual valves. That would have required a reactor building entry.
HUNTER. All right. Do you know—was this discussed between yourself? Who all was in that discussion?
MEHLER. I think it was . . . basically it was Mike, myself and Bill and Bubba Marshall. Cause I believe I asked Bubba to go make out an RWP so him and I could go in and do it.
HUNTER. OK. So the intent was that if everything went all right you and Marshall would go in?
MEHLER. Well someone had to. (Ibid., p. 19.)

Lee Rogers apparently associated the situation at TMI on March 28 with one that had developed during hot functional testing in September 1977, prior to loading of fuel. This event is described on page 65 of the report of the investigation conducted by the Senate Subcommittee on Nuclear Regulation. In the course of the 1977 event, the TMI staff had encountered considerable difficulty in removing steam that had appeared in the hot-legs. Rogers is apparently referring to this event in the following telephone conversation with Dr. Donald Roy, who was located in the B&W offices in Lynchburg, on March 28, prior to starting of Reactor Coolant Pump 1A at about 7:50 p.m.:

ROY. Won't eventually that steam bubble from the B loop come over into the A loop and get into the pump and aren't you gonna have a lack of water in the complete system eventually?
ROGERS. No, the pressurizer is full of water.
ROY. But will that be enough to fill the B loop when you start the pump?
ROGERS. There is certainly a chance not knowing how much of a steam bubble condition we do have there that we will come up with a saturated condition, yes.
ROY. Aren't you safer to fill the whole system solid?
ROGERS. Cannot fill the whole system! There is no way to fill it! The system is designed to move water in a loca. We haven't had a loca and we can't operate it that way. What we got is . . . We have been in hot functional test. We had a similar condition where we had the hot legs on both loops filled with hotter temperature water than what we had in the system and it took us something like four days to get out of that thing to try and cool it down to where we could get that bubble condition out of there. We've got a similar condition here. The only way we can do it is to force that bubble out of that B loop at this point.
ROY. Then you've got no choice.