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RELATED CORRESPONDENCE

TMIA - 10/22/84

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

DOCKETED
USNRC

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

'84 OCT 23 P2:34

OFFICE OF SECRETARY

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

THREE MILE ISLAND ALERT'S MOTION TO EXTEND DISCOVERY PERIOD FOR SPECIFIC, NEWLY-DISCOVERED EVIDENCE

In a conference call on Wednesday, October 17, 1984, Chairman Ivan Smith, of this Atomic Safety and Licensing Board ("Licensing Board") indicated that discovery on narrow matters disclosed late in the discovery period would be permitted by the Board upon an adequate showing by TMIA of the importance of these matters.

Pursuant to Judge Smith's direction, TMIA requests that this Board grant it the right to limited discovery beyond the allowed period concerning the following:

1) Robert Keaten's notes dated March 29 and March 30, 1979, whose inspection in their original form was permitted only last Monday, October 15, 1984 in Harrisburg;

2) The reactor building pressure strip chart, identified as SCA-0015, which contains the narrow-range and wide-range recording of the pressure spike, whose inspection in its original form was permitted only last Monday, October 15, in Harrisburg;

3) A meeting which took place on the afternoon of March 29, 1979, in which George Kunder briefed the then newly-formed GPU Task Force about the production of hydrogen in the containment beyond design limits of four percent. TMIA learned of this discus-

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sion through the October 15, 1984 deposition testimony of Julien Abramovici, a GPU Service Corporation engineer who arrived at TMI on March 28, 1979.

4) Ivan Porter, chief instrument engineer at TMI-2 on March 28, 1979 is reported to have taken a complete set of incore thermocouple temperatures on that date. TMIA learned of this fact for the first time through the deposition testimony of Richard Lentz, a GPU Service Corporation engineer at the TMI site beginning March 28, 1979. Mr. Porter has always denied that he knew about the so-called second set of complete incore thermocouple temperature readings taken on March 28, 1979. This second set of data indicated temperatures in excess of normal temperatures for up to 40 percent of the core points measured.

5) The notes of Mike Morrell, a GPU Service Corporation Nuclear Systems Engineer, who was located at the GPUSC offices in Parsippany on March 28 and March 29, 1979. His notes, which were produced to TMIA only last Thursday, October 18, indicate that Mr. Morrell knew of the actuation of the containment sprays on March 28, containment isolation and possibly the pressure spike.

I BACKGROUND

This Licensing Board set October 15, 1984, as the cutoff date for discovery after a prehearing conference held on September 17, 1984. TMIA's request for a longer discovery period was at that time denied.

TMIA has attempted, given the shorter than requested discovery period, to utilize all discovery opportunities available to it on the Dieckamp Mailgram issue. It filed its First Set of Interrogatories and First Request for Production on July 31, 1984. GPU failed to make any response or produce any responsive

documents until September 4, 1984. At that time GPU failed to file a complete response and successively over the next six weeks has supplemented its original response.[1]

On September 4, 1984, TMIA filed a third set of interrogatories and third request for production. On September 24, 1984, TMIA filed a Fourth set of interrogatories and Request for Production, based in large part on the Board's ruling on September 17, 1984, that it would permit inquiry into incore thermocouple temperatures and further based on the so-called "Moore Notes" which indicated GPU Service Corporation engineers sent to the site on March 28 learned of incore temperatures in excess of 2500 degrees on that date. On October 1, 1984, TMIA filed its Fifth Set of Interrogatories.

GPU failed to answer the bulk of interrogatories posed by TMIA in its Fourth Set of Interrogatories and Request for Production on the ground the Board had not permitted inquiry into incore temperatures. See Licensee Response to TMIA's Fourth Set of Interrogatories (received October 10, 1984). TMIA counsel held a discovery conference with GPU counsel on October 16, 1984. Even after the discovery conference, GPU counsel refused to agree to supplement its response to include the requested information about incore thermocouple temperatures even though it was clearly within the scope of the Board's ruling on September 17, 1984. TMIA was, therefore, forced to file a motion to compel licensee to respond to the bulk of the interrogatories included in TMIA's

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[1] GPU, in its latest response to TMIA's Fifth Set of Interrogatories requesting any supplementation of its prior response, made three corrections or modifications to its prior responses to TMIA's First Set of Interrogatories. See Licensee Response to TMIA's Fifth Set of Interrogatories (October 15, 1984).

Fourth Set of Interrogatories.

TMIA has held depositions in Harrisburg on September 25 to 28; October 2 to 5, 10, and 15; and in Washington on October 12 and 19. Other depositions are currently scheduled for October 23 (Bradford), October 29 (Creitz), and November 13 (Zebrowski).

TMIA's discovery has further uncovered a great deal of previously undisclosed information concerning licensee's knowledge on March 28 and March 29, 1979 of the pressure spike, the production and combustion of hydrogen, the actuation of containment sprays and incore thermocouple temperatures of 2500 degrees. At least a portion of this information, as described below, indicates that Mr. Dieckamp was informed early on March 29, 1979 that there had been an explosion in the containment on March 28. Further, other information disclosed in the course of discovery demonstrates that licensee personnel, including GPUSC personnel sent to the site on the afternoon of March 28, 1979, licensee consultant William Lowe, and George Kunder, Unit 2 Superintendent, Technical Support, discussed the pressure spike the production of hydrogen beyond containment design limits of four percent, and core damage at a 3:30 p.m., March 29, 1979 meeting -- about eight hours prior to the time GPU contends it first determined that significant amounts of hydrogen had been produced in the TMI-2 containment the first day of the accident.

TMIA requests by this motion limited additional discovery concerning matters discovered in the last few days of the discovery period in accordance with Judge Smith's October 17, 1984 direction.

II HAVING PROCEEDED EXPEDITIOUSLY TO USE ALL AVAILABLE OPPORTUNITIES FOR DISCOVERY WITHIN THE PERMITTED PERIOD, TMIA HAS A RIGHT TO LIMITED ADDITIONAL DISCOVERY ON NEWLY-DISCOVERED MATERIAL EVIDENCE

Within the last few days of the discovery period GPU has disclosed significant new information which requires limited additional discovery. Outlined below are the five new matters only recently disclosed to TMIA for which TMIA requests an extension of the discovery period:

(1) The Keaten Notes

Robert Keaten held the position of GPUSC Manager of Systems Engineering on March 28, 1979. On that date Mr. Keaten convened a meeting of GPUSC's top technical personnel to discuss the TMI accident or transient. At that meeting individuals were assigned certain tasks to analyze particular discrete portions of the accident. A decision was made at that meeting to send five GPUSC engineers to the site. The group included:

a) T. Gary Broughton, GPUSC Control and Safety Manager, who headed GPUSC's transient and accident analysis group;

b) James Moore, GPUSC Mechanical Components Manager;

c) Richard Lentz, GPUSC I & C Engineer;

d) Julien Abramovici, GPUSC Systems Engineer; and

e) G. Lehmann, GPUSC Systems Engineer.

One of the group has testified that Mr. Broughton reported directly to Mr. Keaten who reported directly to Richard Wilson, GPUSC Director of Technical Functions, who later headed the GPU Task Force set up to analyze the accident. Both Mr. Keaten and Mr. Wilson remained in Parsippany on March 28, 1979. Mr. Keaten remained in Parsippany on March 29 and March 30 as well.

The five engineers arrived at the TMI Observation Center

at times varying from about 2:00 p.m. until 5:20 p.m. on March 28. All remained at the Observation Center throughout the evening of March 28, and some throughout the early morning hours of March 29, 1979. Two of the GPUSC group have testified that they received a briefing at about 5:00 p.m. on March 28 from an electrical engineer identified as Richard Bensel, who told them incore temperatures in excess of 2500 degrees had been measured. In addition, Mr. Lentz spent several hours the evening of March 28, 1979, collecting data from the Unit 2 Control Room, to bring back to the Observation Center for the GPUSC personnel to analyze.

The deposition testimony of Mr. Broughton in this proceeding and the testimony of Mr. Lentz given to the NRC on June 1, 1979 indicate that Mr. Lentz brought back to the group of the GPUSC engineers in the Observation Center on the evening of March 28, 1979, the day's alarm printouts. Other technical personnel in this proceeding and during depositions have stated that from the alarm printout for the time period around 1:50 p.m. on March 28, 1979, one could determine that there had been a hydrogen combustion or explosion in the containment.

Mr. Lentz has testified that in the late evening of March 28 Mr. Broughton, his superior, returned to the hotel before the other GPUSC engineers in order to report back to Mr. Keaten because it was hard to get through on the phones in the Observation Center. Mr. Keaten's notes for this period of time had been disclosed to TMIA in the course of discovery in this proceeding. The original Keaten notes were made available in Harrisburg only last Monday, October 15.

The portion of Mr. Keaten's notes on which TMIA requests further discovery are attached and incorporated herein as Exhibit 1. The entry is labeled in the upper-right hand corner "TGB call 3/29/79?/3/30", indicating that the notes which followed were taken on either March 29 or March 30. It appears from the notes that Mr. Broughton had communicated to Mr. Keaten the information which follows this notation. This information includes a sequence of events for March 28, 1979 and a section labeled "Present Status" which includes a notation about "explosion in containment".

Mr. Keaten has testified to the NRC that after receiving this information he (Keaten) immediately transmitted the information to Mr. Dieckamp. See NRC Keaten Interview, June 1, 1979, attached and incorporated herein as Exhibit 2, at 7. Thus, the critical question is whether the notes were taken on March 29 or March 30, as the photocopy is not clear.

Mr. Keaten has testified that the conversation with Mr. Dieckamp transmitting this information too, place on March 30, and does not mention that his notes contain the "March 29" notation, as well as "March 30." However, the information contained on the first two pages under this entry, Exhibit 1 at 2-3, concerns Mr. Dieckamp's activities on March 29, 1979 and would tend to indicate that the notes were written on March 29. They include his flight time from Parsippany to TMI on March 29 and his scheduled briefing of a congressional delegation in the afternoon of March 29.

TMIA's examination of the original Keaten notes was permitted on October 15. At that time TMIA discovered that only the

3/29/79 date is written in the same ink as the notes themselves. The additional notation of a question mark beside the 3/29 and the 3/30 date are in red ink and appear to have been added at a later time and perhaps by someone other than Mr. Keaten. Thus, it appears from TMIA's examination of the original of Mr. Keaten's notes that at least the first three pages of the entry under the 3/29/79 date were taken down by Mr. Keaten on March 29 and transmitted to him by Mr. Broughton on that date.

In addition, it appears that Mr. Broughton had sufficient data available to him on the evening of March 28, 1979 to conclude that there had been a hydrogen explosion in the Unit 2 containment at 1:50 p.m., specifically the alarm printout for that date. Mr. Keaten's notes indicate, then, that Mr. Broughton called him on the morning of March 29 to report what the GPUSC group had found. At that time, Mr. Broughton apparently told Mr. Keaten that there had been an explosion in the containment the prior day. According to Mr. Keaten's prior testimony, although he places the conversation on March 30, he immediately told Mr. Dieckamp what he had learned from Mr. Broughton about the status of the plant.

TMIA requests additional discovery from Mr. Keaten concerning his notes taken on March 29, in which he indicates Mr. Broughton told him of an explosion in the containment occuring on March 28. In addition, TMIA requests additional discovery from licensee concerning the maintenance of Mr. Keaten's notes in the period since the time of the TMI Accident.

This discovery will be probative of the date on which Mr. Keaten took the notes and any subsequent conversations he may have had with Mr. Dieckamp concerning the information transmitted by

Mr. Broughton that an explosion had occurred in the Unit 2 containment.

(2) Strip chart SCA-0015, which recorded the pressure spike is ut at about 10:00 p.m. on March 28, 1979. It has subsequently been taped back together. TMIA discovered this cutting of the strip chart only upon its examination of the original strip chart, which was permitted last Monday, October 15.

TMIA requests that it and its technical expert be permitted to inspect the original of strip chart, SCA-0015, in Washington, D.C., in order to determine if a careful examination of the strip chart will disclose the precise time at which the early portion of the strip chart was cut off from the recording drum.

(3) Mr. Abramovici testified during his deposition on October 15 that he attended a meeting of the GPU Task Force in the afternoon of March 29, 1979, at which George Kunder briefed the group about his concern that hydrogen over the containment design limit of four percent had been produced. He further testified that Mr. Wilson, who headed up the Task Force and convened the meeting, stated his belief at the meeting that the core was completely gone. In addition, Mr. Abramovici testified that Mr. Lowe was present at the meeting.

Mr. Lowe, at his deposition on October 19, 1984, stated that he could not recall any discussion of hydrogen although he stated that he did recall a conversation about the pressure spike and the fact that it was considered spurious.

GPU's position has always been that Mr. Lowe was the first to examine the pressure spike chart around 11:00 p.m. on March 29, 1979, and through his examination, determined that there had been a hydrogen explosion or burn the previous day.

Evidence that hydrogen production in excess of containment design limits was discussed eight hours prior to 11:00 p.m. casts doubt on the position that Mr. Lowe was the first to discover the hydrogen burn.

In addition, TMIA has recently reviewed the questionnaire returned by Thomas Crimmins, who served in the same technical group as Mr. Lowe, in the days following the accident. Mr. Crimmins stated in his questionnaire that he believed the first discussions of the pressure spike, hydrogen explosion or combustion, and actuation of the containment sprays began in the March 29 afternoon briefing of the GPU Task Force by George Kunder. See Crimmins questionnaire, at 10-12, attached and incorporated herein as Exhibit 3.

Therefore, TMIA requests limited discovery of the other individuals present at the March 29, 1979, afternoon meeting at which hydrogen was discussed. TMIA requests this discovery of Richard Wilson, who convened the meeting; Mr. Crimmins who attended the meeting; Mr. Kunder who played a key role in briefing the attendees of the meeting; and all other known attendees.

(4) Mr. Lentz testified at his deposition on October 15 that he had learned within a few days after the accident that Ivan Porter had taken a complete set of 51 or so in-core thermocouple temperatures on the first day of the accident. Mr. Lentz stated that he later saw these recordings which appeared as two columns of handwritten millivolt readings on notebook paper. Mr. Lentz, in reviewing the set of in-core data which has become known as the second set of temperature data, stated that the

readings accorded with his recollection of Mr. Porter's double column of millivolt readings.

This second set of data indicated that fully 40 percent of the core points were reading higher than normal, and many over the 2200 degree emergency core cooling system limits set out in 10 CFR 50.46. This second set of readings indicated that hydrogen had been produced in significant quantities and that the core had suffered damage. Based on these readings, Mr. Miller should have known by the morning of March 28 that the core had suffered serious damage and that hydrogen had been produced in amounts above containment design limits.

Prior to discovery in this proceeding, it was always assumed that the group of instrumentmen who took the first group of in-core readings also took the second set of 51 readings. However, William Yeager, deposed by TMIA on October 10, testified that he had never seen the second set and that he and the other three instrumentmen could not have taken the second set because they did not spend sufficient time to take 51 readings. His group, Yeager testified, had time to take about nine readings on March 28. If Mr. Porter, the instrumentmen's superior, who would have directly reported to Miller, in fact took these additional readings personally, without involving his subordinates, it is reasonable to assume that the in-core data was accorded considerably more importance than has been previously argued by GPU.

TMIA requests limited discovery concerning this second set of data which has now been identified for the first time to have been taken by Ivan Porter. TMIA wishes to question Mr. Porter, Mr. Miller, Mr. Kunder, and Mr. Bensel, concerning their

knowledge of this second set of in-core data now that Mr. Porter has been positively identified as the individual who took the data. In addition, TMIA wishes to pose questions of the licensee as to the location of the original handwritten list of the millivolt readings taken by Mr. Porter on March 28, 1979.

This evidence is probative of the knowledge of control room personnel on March 28, 1979 of temperatures in excess of 2200 degrees F which would indicate the generation of significant amounts of hydrogen and significant core damage. It would provide control room personnel with sufficient knowledge of core temperatures to interpret properly the pressure spike which occurred at 1:50 p.m. as a hydrogen burn or explosion.[2]

(5) Michael Morrell was a nuclear systems engineer located in Parsippany on March 28, 1979. Notes he took on March 28, 1979, indicate that he learned of a 4 PSI pressure spike in the reactor building at that date; actuation of the containment sprays; and containment isolation on the SFAS. See Morrell Notes, attached and incorporated herein as Exhibit 4.

These notes indicate that Mr. Morrell was informed on March 28 of actuation of the containment sprays which he knew demonstrated 30 PSI in the reactor building or 1600 PSI in the reactor coolant system. This information should have informed Mr. Morrell that a pressure spike of 30 PSI had occurred in the containment

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[2]The core remained within the range of temperatures recorded in the second set only during the morning of March 28, 1979. After that time, the core cooled down. Therefore, Mr. Porter must have recorded those readings during the morning of March 28. If he recorded these temperatures at that time, it is likely that he transmitted information about these readings to Gary Miller shortly after he took them.

on that date and that this spike was caused by a real increase in pressure and not a spurious electrical signal because of actuation of the containment sprays.

Together with other information transferred to Parsippany from the on-site group of GPUSC engineers, especially the in-core temperatures greater than 2500 degrees, he may well have interpreted the pressure spike as an indication of the production or combustion of hydrogen on March 28.

TMIA wishes to depose Mr. Morrell concerning his notes and the information he received about the TMI accident on March 28 and early March 29.

TMIA did not receive the Morrell Notes until October 18, 1984, when TMIA counsel conducted a review of all documents produced in response to TMIA's First Request for Production. These notes were evidently added to GPU's response since the last review of these documents conducted by TMIA counsel on October 8, 1984.[3] Therefore, TMIA requests an extension of the discovery period to depose Mr. Morrell concerning his notes.

III CONCLUSION

In consideration of the above, TMIA requests an extension of the discovery period to and including November 8, 1984, in which to conduct discovery on the five limited items listed above. TMIA has taken advantage of every discovery opportunity presented it at an earlier time. The evidence GPU has disclosed during the last week is critical to the issue before the Board and constitutes good cause for extension of the discovery period.

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[3]These notes were produced as First Set, D-8(71) in licensee's Document Room.

Respectfully submitted,

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Attorneys for Three Mile Island
Alert

Dated: October 17, 1984

Exhibit 1

R W Keaton

From 2/15/79 To 1/24/80

Steno Notebook

80 SHEETS EYE-EASE® PAPER • GREGG RULED

BOOK NO. _____ FROM Feb 15 79 TO _____

NATIONAL BLANK BOOK COMPANY, INC. • HOLYOKE, MA. 01040 NATIONAL 36-746 Made in USA

Broughton X 4

IGB 3/29/79
3/30

① SD at 10[45] Airport

② 1[00] Senators - Briefing

③ S.C.E.

Condensate Pump Trip - electrical disturbance

Then C-2 BFP Trips - loss of FW

Turbine Trip.

7 sec - ΔP primary - opened EM - no indication that safety valve

9 sec Scram H. P (expected)

Letdown secured ~ 1 min & 1700-1800

Pri P did not stabilize but continued to drop

may have been EM valve leak

2-2½ min HPI

Prz level up but pressure dropped still

Tave -5° (ok) rise constant or slightly increasing - pressure decr.

~4½ min - P at Psat HL

Pressurizer level ~ top, secured HPI

level still increased started to let down

Never got rid of bubble

Pressurizer off-scale for 4½ hrs

Bubble degraded pump performance/oscillation

(100-60%) - shut off pumps. [Closed valve to relief valve.]

In min pressure turned

TH > TC reassuring that heat removal

HPI secured ~5 min

No Nat Circ. - bubble too big
Secondary - started Emer Fw pumps (3)
all Motor operated valves closed (should be)
took 15-20 min to find
dryed out both St. gen — restored
flow to both — B behaved abnormally
after shock — no evidence of A leak
(identical trip transient on both)

Fuel — no decay heat, vessel continued to
heat up - eleven detectors 700+
and coverage - damaged
May have been inventory reduction
Nuclear instrument readings (X11)
at some time - may have been time
that core was uncovered.

Finally 7-8 pm
— had good vacuum, hi level in 17,
pump started

Present status

Bubble in reactor

Non-condensables in Pressurizer

-lots-

Explosion in containment

2000 ft³ @ 1000 psi 260°F 280°

Could be 100,000 ft³

Ed Wallace

(1) Courtney Smythe | Sheraton 2-days
Louisa Smith

Ward Barker

944-4041 X 319, 284, 385

Unit

(2) Courtney call Ted Meyer at Toledo Ed.

Data on Sept 77 trip - send to Ed at M.I.T.

Exhibit 2

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:

IE TMI INVESTIGATION INTERVIEW

of Mr. Robert W. Keaton
Manager of Systems Engineering - GPU

Trailer #203
NRC Investigation Site
TMI Nuclear Power Plant
Middletown, Pennsylvania

June 1, 1979
(Date of Interview)

July 6, 1979
(Date Transcript Typed)

297
(Tape Number(s))

NRC PERSONNEL:

Mr. Robert Marsh
Mr. Anthony N. Fasano

MARSH: The time is 1:27 p.m. It's June 1, 1979 and My name is Bob Marsh. I'm an investigator with the U. S. Nuclear Regulatory Commission assigned to Region III, Chicago, Illinois. This afternoon we are located at the corporate headquarters of the GPU Service Corporation at 260 Cherry Hill Road in Mountain Lakes, New Jersey. We have with us at this time Robert W. Keaton who is Manager of Systems Engineering with GPU. At this time I'd like the other individuals present in the room to identify themselves, spell their last name, and identify their position.

FASANO: Anthony N. Fasano, Inspection Specialist, NRC.

KEATON: Robert W. Keaton, Manager of Systems Engineering for GPU Service Corporation.

HOBER: J. G. Hober, Manager of Generation Division Support.

MARSH: Thank you. Mr. Keaton before we turned the tape on, I discussed briefly with you this two-page memo which you have in front of you. As I indicated the memo discusses the purpose of NRC's investigation, the authority under which it is being conducted and the scope of the investigation. It also goes into the rights of the person being interviewed. And on the second page there's several questions which I have requested your response to. The first question reads "Do you understand the above?"

KEATON: Yes, I do.

MARSH: And secondly "Do we have your permission to tape this interview?"

KEATON: Yes, you do.

MARSH: And thirdly "Would you like a copy of the tape and transcript?"

KEATON: Yes, please.

MARSH: They will be provided.

MARSH: There is a fourth question, although it's not called out specifically at the end of the letter, it is included in the body of the letter regarding your right if you so desire to have a company representative present and it's my understanding that this is the capacity in which Mr. Hober is currently in the room?

KEATON: That's correct.

MARSH: Fine. Thank you.

MARSH: Mr. Keaton, to begin with could you give us a brief resume of your experience in the nuclear field and a description of your duties with GPU and then following that if you would we'd like to discuss and get in your

own words your recollection of your activities in connection with the March 28th incident at Three Mile Island starting with your initial notification, how you found out about it, and what the sequence of events were for the first several days.

KEATON: Well, with respect to my resume, I have a degree in physics from Yale University which I received in 1957. The first two years after graduation I worked for the Dupont Company at the Savannah River Plant on the use of the nuclear facilities there, this was classified work. I then went in 1959 to Atomics International. From 1959 to 1965 I was at the sodium reactor experiment, initially as a Senior Physicist and later as the Manager of the Engineering Section at that reactor. From 1965 to 1968 I was the American representative to the Halden Reactor Project in Halden, Norway, where I was engaged in research in fuel irradiation, instrumentation development, and computer applications to nuclear reactors. On my return from Norway in 1968, I became Manager of Safety and Analysis at Atomics International as part of the fast breeder reactor program there. I subsequently held other positions, management level positions, associated with the Clinch River Breeder Reactor Project, and finally as Manager of the LMFBR Technology Programs. Last year I left Atomics International and came to GPU Service Corporation. My present position as Manager of Systems Engineering is to oversee the activities which we perform that are of a broad systems type basis such as the nuclear analysis for the reload of reactor cores, the applications of on line computers to reactors, the safety analysis of present and new reactor facilities, and the preliminary engineering of new plants.

MARSH: Fine, thank you. Could we take your recollections now of the March 28th incident?

KEATON: Yes. On March 28th, which was a wednesday morning, I was initially in a meeting at a motel down the street from here reviewing certain administration procedures that had been suggested. John Hober, who is in the room here, was the one who had arranged that meeting. To the best of my memory it was along about 9:00 or 9:30 that I was summoned to the telephone in the motel and my superior, Dick Wilson, asked me to leave that meeting and come here to the offices because there had been some sort of an incident at TMI Unit 2, with not much more detail given than that. I immediately came over here and we sat down and started to discuss what had occurred. At that point in time we had little conception of what had really gone on at the island. We knew that there had been a transient, we knew the reactor had gone through a turbine trip, and subsequently a reactor trip, we knew that the situation had not been normal, that there had been a high pressure injection, and I don't think we knew a whole lot more than that. I remember distinctly being told originally that there had not been any release of radiation and so that was the information that we had. The reason for the meeting early in the morning was to identify a team of people from here to be sent out to the island to investigate the incident to find out what had happened and to serve as support to the Met Ed people in getting the unit restarted. We identified a group of people, I think five if I remember correctly, to go and I subsequently, later in the morning, met with them and with a couple of the other managers here to discuss what

their duties would be and when they were going out. Our intention was to send them out right after lunch. It was along about 11:00 I think that Dick Wilson again came down to that meeting and pulled me aside and indicated that the information that was being received was the incident was more serious than we had originally known. Although even then I don't think we had any real understanding of what we were facing, and emphasized the importance of getting that team on the road very quickly, so we stopped our deliberations and the people very shortly thereafter left. The rest of the day is a little bit fuzzy frankly. But we became aware and I think in the morning both Dick Wilson and I became aware of the fact that the main coolant pumps had been turned off and both of us, because of our background with sodium reactors I think in part, were very concerned about the fact that the pumps were not running and it was I think in the early afternoon that we met in Mr. Arnold's office down at the end of the building and he got the plant people on the telephone on his squawk box in his office and we started having conversations with them with respect to what was going on. In some cases I believe we were talking to the people in the control room. I remember for example I think a couple of times that we were talking to the control room, although I'm not completely sure about that. And there were other times that I know that we were talking to Jack Herbein, who is the Vice President of Met Ed, who was located in the Visitor's Center across the river from the island. And he was in turn on the telephone with the control room and we were getting updates of the plant status, discussing with them what they were trying to do, what the plant condition was, and I believe it is a true statement that it was largely as a result

of the recommendation from here that late in the afternoon there was a high priority placed on trying to reestablish the system pressure to reestablish vacuum in the condenser and then to start a coolant pump which was finally done late afternoon or early evening I guess. I think we were here until about 9:00 that night if I remember correctly. I think at that time although we knew there... by then we knew that there had been some radiation releases, the releases really were small and I think that we left here on wednesday evening without even then any real understanding of what we were facing. On thursday we prepared to set up analysis in support of the island...started getting activities organized here. I remember holding meetings with several different groups in which I told them what I knew of what had happened on the previous days and we started talking about the kind of support that we might provide them. At that time to the best of my memory our thoughts were directed toward restart. Dick Wilson and one or two others I think left late thursday morning to go to the site. But we were basically I think thinking of the type of team that would need to be set up for recovery and the actions that would be taken, there again indicating that we really didn't realize even at that point in time how really serious the situation was. I remember meeting with Bob Arnold on thursday afternoon and having some discussions that he had instigated about the possible organization, the recovery work, and so forth. I know as a fact that I did not work particularly late thursday evening and friday morning I had gotten up early and appeared at the Morristown airport at 7:00 to take a flying lesson, again indicating that at this time we thought that the worst of it was behind us and ran into Bob Arnold at the airport who said he felt like

the situation was more serious than we had realized and he was on the way to the island. So I came back friday morning and got on the telephone with Dick Wilson who by then had been out at TMI for what, 12 hours or so or maybe a little more than 12 hours, and that was the first time that I really got an understanding of the fact that our problems were not over. That's the first that I really heard about the hydrogen bubble that was in the reactor and we realized that the plant wasn't at that point safely shut down. Later on on Friday morning I had a long discussion with Gary Broughton who reports to me as Manager of the Control and Safety Analysis Group. Gary had been one of the original team that had gone out on wednesday and had had a chance during thursday to inspect some of the data and I have here in front of me the notes that I took in the telephone call with him on friday morning and this was the first time that we got a really good rundown of what had happened. He had managed to have gone through the data enough so that he could talk through the sequence of events and then give me an update on the current status of the reactor. And in looking back over this yesterday, in preparation for the discussions this morning, I noticed that the report that I got from him on friday morning is substantially correct as we know it today. And shortly after that conversation, I got on the phone and later went and talked to in person, Mr. DieckKamp, who is President of GPU, and went through with him what the entire understanding of the situation was. So it was at that point on friday morning that I at least became fully aware of the fact that: (1) the transient had been very severe in terms of its damage to the reactor; and (2) that there was still a hydrogen bubble, that the plant was not in a stable con. guration,

and that we had a lot of work to do. We ... on Friday then set up here an organization to support the work at Three Mile Island. During the initial phases of the effort we were the only contact with the architect engineer, Burns and Rowe, so that all requests for information from Burns and Rowe from the site went through us. This changed later on but initially this was the way it was run. In addition, we were carrying out a series of analytical and design tests here in support of a request from the site. By friday afternoon we had made arrangements to have an around the clock operation here and in fact did so starting on Friday. We had made arrangements to keep a line...a telephone line open between us and the site, to keep telephone operators on duty over here around the clock and so forth. So that we were basically then set up in the mode that persisted for a couple of weeks in supporting the site activities. I was...I suppose more or less the Manager of these activities and in fact my office was set up as the command station for the activities here. I worked very late Friday night and came in again saturday morning. Then on saturday afternoon I...Mr. Dieckamp called me over and asked me to be prepared to go to the site first thing Sunday morning to serve as the coordinator and liaison for the industry advisory group which he was setting up. So I made arrangements to have one of the other managers here take over the role that I'd been playing here. Sunday morning I went to the site and spent most of Sunday meeting with the members of the industry advisory group, bringing them up to date on what had happened, what the situation was, explaining to them the type of activities that we were hoping they could help us with, and then for the next few days I was the liaison with the industry advisory group.

FASANO: Thank you. Maybe we could...this is Fasano speaking. We can go back to the first day, wednesday, the 28th. Did you have information with respect to the temperature in the reactor vessel, the hot leg temperatures, or the pressure, or the incore temperatures?

KEATON: Yes, we did, but not of the incore temperatures. We did not see any data from the incore thermocouples until much later. We did have data on the hot leg and the cold leg readings or at least we had data that they were offscale and in some cases they were offscale high and in some cases offscale low. I don't remember with any degree of certainty exactly when during the day we first had that data. I believe that we had some indication of temperatures on Wednesday morning. I am certain that we had them Wednesday afternoon when we were meeting in Bob Arnold's office because I remember us constructing tables on his blackboard.

FASANO: How 'bout pressure?

KEATON: Yes. We also...again I'm not sure when we first had it but certainly by Wednesday afternoon at least we had pressure data.

FASANO: Was there a correlation made between your TH possibilities and your tem...and your pressure?

KEATON: On Wednesday afternoon very definitely because we quickly ... as soon as we got the data grabbed the steam table and looked to see if the

conditions were saturated in the hot leg and they were and this was one of the reasons that we expressed back to the site what we felt was the importance of trying to elevate the system pressure and get a pump started again.

FASANO: Okay then this goes back to probably late in the afternoon, you made a suggestion?

KEATON: The first time that I remember for sure that that was done was middle to late afternoon, yes.

FASANO: At that time do you recall what the status of the reactor was or what the site people were doing? Did you have information on that point?

KEATON: Our first contacts with the site...the amount of information we got was a little confusing which is I don't think very surprising...that the atmosphere in the control room at that time was fairly hectic and our understanding sort of grew as a result of telephone calls in the afternoon. I can't say honestly that we instantaneously had all of this information but rather that it grew as we managed to understand what was going on.

FASANO: Were you in contact at all with Babcock and Wilcox, B&W?

KEATON. I was not personally and I don't remember for sure whether there was anyone that contacted B&W at Lynchburg. We did have some discussions either directly or second party discussions with Lee Rodgers who is the B&W representative at the site.

FASANO: Did you have any information early in the day on the boron analysis that was made in the early morning?

KEATON: To the best of my memory I did not see any boron analysis until I was...until much later.

FASANO: Also the source range or the intermediate range activity as it was going up early in the morning?

KEATON: Not in the morning, no.

FASANO: Specifically, it was reactor coolant pumps that you had information on?

KEATON: It was...the first thing that we had information on was the temperature and pressures in the hot leg and cold leg, that's right.

FASANO: And the reactor coolant pump?

KEATON: And the fact that the pumps were turned off, yes.

FASANO: You say that you were quite concerned on the turning off of the reactor coolant pumps. Was this early in the morning that you originally had this concern or was it later on?

KEATON: The first time that we heard that they were off, the comment that I made at the time was that if I were out there I would be trying to restart the pumps. I believe that was in the morning. I might comment that we later found out...we did not know at that time but we later found out that in fact they were trying to restart the pumps and had been unsuccessful. We didn't know that at that time.

FASANO: Why would you be so concerned on having the reactor coolant pumps restarted? I mean what was the basis that you had? I mean you mentioned you were on the sodium loop type?

KEATON: Yes.

FASANO: How did you make that correlation to the pressurized water reactor?

KEATON: Simply that the temperature conditions in the loops were such that we didn't feel like ... that you could guarantee that you could cool the core by natural circulation and therefore some form of force cooling would seem to be indicated.

FASANO: Okay. So did you have enough information to evaluate whether natural circulation was in effect or not?

KEATON: No. Certainly we did not have that We had enough information to make us nervous and that's all I can really honestly say.

FASANO: So in that situation you'd rather have it.

KEATON: That's right, that's right.

FASANO: Okay. You mentioned that you were concerned about vacuum pressure in the condenser or that the establishment of vacuum in the condenser. What was the basis for this concern?

KEATON: This in fact was a reflection of what we had learned from the plant that they were trying to get the condenser vacuum reestablished and they felt that was part of what they needed to do in order to reestablish the force cooling in the primary loop and so in my comment I'm really reflecting what the plant told us that they felt was an important thing. And we agreed with them in the sense that that would be a good heat sink.

FASANO: Would there be any concern here... were you concerned about these were knowledgeable of the steam generator possibility of having shocked the steam generator? Did you have any information? Do you recall?

KEATON: That's a good question. I honestly do not remember. I certainly got the information on friday morning and I'm not sure whether I had it before then or not.

FASANO: Okay.

KEATON: I sort of doubt it. The best of memory is that I was surprised when I heard about it later on.

FASANO: Uh huh. Now, you mentioned the high pressure safety injection is not normal on the...so that raised a concern also in your mind. Did you know that ECCS seems to get actuated...at least high pressure safety injection seems to get actuated when you have a feedwater initiated trip at the TMI 2? At least in the earlier year of 1978 I think you had a number of high pressure injections. Are you familiar with this?

KEATON: Yes I am and in fact I think in part my initial reaction was associated with the fact that I was very familiar with what had happened last year at the time when we had a transient in which the main safety valves had stuck open and resulted in overcooling the primary system, depressurization and a high pressure injection and that particular incident. Although it turned out to be fairly severe economically, was not severe at all in terms of damage to the core or anything like that. Our initial reaction I think on Wednesday morning, when we heard about the TMI transient that it had a high pressure injection was that it was probably another one of the same type of thing that the reactor was alright but that we were going to have to do a lot of analysis in order to really understand what had happened and so that was our original reaction. The people that we selected to go out to the site on wednesday were based upon that type of

thing. Well, okay let's go out and help them analyze the transient. It wasn't with the thought that we had massive core damage or something like that. We didn't suspect that until much later.

FASANO: The point I think I'm really getting at is then you were knowledgeable that there had been at least two, maybe three, maybe four high pressure injections in 1978?

KEATON: Yes, we aware of that and at least in the case of the one which had resulted from the safety valves being stuck open. We had done very detailed analysis of that transient.

FASANO: Yeah, one would consider that abnormal?

KEATON: Yes, sir. And as you know I think the plant was shut down for several months and we had to change all the safety valves as a result of that.

FASANO: Yeah, the more normal, trip where you have a run back and your run back doesn't hold apparently...you did get some high pressure injection. So in a way this plant seems to be designed to have an easy high pressure injection on a related trip to the turbine reactor. Would you say this is true?

KEATON: I don't believe so although I will tell you honestly that I haven't studied it real carefully, but I believe that it's true that normally we would expect to ride out a turbine trip in fact I'm a little more sure of my ground then I'm sounding. Our analysis and B&W's analysis would indicate that we should be able to ride out simply a turbine trip without even tripping the reactor. If the initiating event is a loss of feedwater flow, then our analysis would indicate that we would expect the reactor to trip but we would not expect to get high pressure injection.

FASANO: Uh huh.

KEATON: And in fact we have very recently, in the of course of the last two or three weeks done some additional analysis which confirms that statement. That we should be able to ride out a simple loss of feedwater flow without getting a high pressure injection.

FASANO: Even with what you said ... 2205 or 2255?

KEATON: Wait a minute. I'm talking about high pressure injection.

FASANO: Yeah, but I'm thinking of you usually use your electromotive valve to ah...

KEATON: That's right.

FASANO: ...in conjunction with this runback?

KEATON: That's correct. And I'm talking about the case where that valve functions properly, that is that is opens but then it also closes when it's supposed to and in that case the pressure comes down and levels out in the range of about 2000 psi well above the HPI injection setpoint of 1600 psi.

FASANO: Uh huh. Have you in your service... as a service function here, have you analyzed the transients? Has your group analyzed the transients for the 1978 events?

KEATON: For the 1978 event?

FASANO: Yes.

KEATON: The only one that we analyzed in real detail was the case where the safety valves stuck open.

FASANO: The other ones I guess happened...one was in March. I guess the one in April is the one you are talking about.

KEATON: The one that I'm talking about is in April. That's correct.

FASANO: And again there was one in November and then another in December.

KEATON: That could be correct. I understand that the relationship between our analytical people and the operating utilities has been that we would get in and analyze those events only if we were requested to by the operating utility. In the case of the April event, where the safety valves stuck open, Met Ed requested us to come in and help them. In the other cases they did not.

FASANO: I see. Do you actually...well in doing this do you...in doing your analysis do you get information from other like plants such as the Davis Besse?

KEATON: Yes, we do where it's available. We'd look at Davis Besse, Crystal river SMUD or Arkansas.

FASANO: Had you seen the...I guess it was the 77 transient that Davis Besse had?

KEATON: Only after the fact not before the fact.

FASANO: Okay, so as far as the following days, the two following days, do you get involved at all with the environmental concerns or health physics concerns or...

KEATON: No. We were of course aware of some of the radiation readings and I in particular, occasionally was a transmitter of that information to top management but only as a messenger basically.

FASANO: In your analysis of the transient then in April, I guess you did look at the level of the pressurizer?

KEATON: Yes.

FASANO: ...and I guess it did go below...did at that time go below zero?

KEATON: It went below the indication range, yes. Our analysis indicated that we in fact never did completely void the pressurizer even though it was below the indicated range. The analysis of the April event also indicated in that case we did draw a steam bubble in the reactor dome.

FASANO: In the candy canes or in the reactor?

KEATON: No, in the reactor dome. That transient was somewhat different from this year's transient in that it was a transient resulting from overcooling of the primary system and so the fluid in the steam generators in the candy cane was substantially below the temperature that was left in the top region of the reactor. So in that case the flashing would occur in the reactor first. It's not like the transient of this year where the hot legs were overheated.

FASANO: In your analysis that you said that you did... I guess with B&W where you should remain up around 2000 if the electromatic valve actually operates properly should be able to take at least single feedwater trip and

be able to run back... a double feedwater trip apparently you are not able to take and still remain on...remain on...

KEATON: Oh, excuse me. I may have misread you. I think it's possible that even with a single feedwater trip that we tripped the reactor.

FASANO: Oh really?

KEATON: But I would...my point was that we would not expect to get high pressure injection.

FASANO: I see...so okay. So then it's...you would get your reactor trip. As far as...it seems that the operators usually turn on a second makeup pump, almost automatically close off letdown in anticipation of a...one the increase in pressure and the decrease and in that anticipation to minimize that effect.

KEATON: And also I think in anticipation of a drop in the pressurizer level.

FASANO: Yes.

MARSH: Break in for just a second ____ for a second to turn this tape over, the time being 1:58 reading 475 on the meter.

MARSH: The time is still 1:58 p.m., June 1, excuse me, go ahead.

FASANO: In your analysis did you take this into account? I mean is this...would this be included in your procedure to have this kind of sequence of starting the second pump, opening your 16 valves so that you get flow greater flow and subsidize the mass within the reactor vessel?

KEATON: Yes, it is our intention to include that, in fact we try to include as accurately as we can exactly what we anticipate having happen, yes.

FASANO: Okay. And at least the transients that I've been privileged to look at it appeared that you do still get a dropping. Even with these actions you do get a drop in pressure and it looks like you do hit the high pressure injection point. Now, in your analysis you would stay above it if you stayed at 2000, in actuality though it doesn't appear that that's the case. At least what I've seen maybe because of...maybe special circumstances?

KEATON: It might be, I'm not sure which analysis you are referring to. The analysis that I'm describing that we have done has not been a safety type analysis where you look at everything on the most conservative side, but it's rather been a best guess analysis of what we would most likely anticipate to happen and in that case we would not anticipate going to the high pressure injection even if we have loss of all feedwater. I'm not talking of course about a feedwater line break but simply a loss of the feedwater pumps.

FASANO: I guess there was one when your doing temperature coefficient measurements during the pre-op, the ascention to power testing, where I guess you were I don't know... what 90 percent power...

KEATON: Uh huh.

FASANO: ...and you were at six degrees higher than normal on your...

KEATON: Uh, huh, yes.

FASANO: ...Tavg and there you got I guess a feedwater initiated trip?

KEATON: No. If it's the one that I'm thinking about it was a temperature pressure ratio trip.

FASANO: Okay, that's correct.

KEATON: And that is...your statement is correct with respect to a trip from that. We also analyzed that one, I'm sorry I didn't remember that one when you asked me earlier. We did some analysis on that and our analysis indicated that in the case of a reactor trip with that unbalance between the pressure and the temperature, an unbalance that is sufficient to trip you on a pressure temperature mismatch, that in those cases we would expect to get high pressure injection. That's correct. But the case that I referred to a few minutes ago was where we were...are operating with a normal temperature in pressure and lose feedwater.

FASANO: And then in the incident on March 28th would you then consider the lack of feedwater, emergency feedwater, as being the trigger here or the difference?

KEATON: No, sir. Our analysis indicates that as far as the plant behavior is concerned the fact that we did not have emergency feedwater made no real difference in the transient that occurred. It...of course the behavior of the reactor during the first 8 minutes was a little different from what it would have been with emergency feedwater. But the fact that the emergency feedwater was turned on after 8 minutes...and so the cooling was reestablished in the primary system. After something like about 20 minutes we believed that the reactor conditions were the same as they would have been had the feedwater been initiated when it should have been.

FASANO: So then the dropping pressure, that caused the high pressure injection, then you would evaluate that as being caused by the stuck open valve?

KEATON: Very definitely. Very definitely. In fact, the initial impact of the lack of emergency feedwater was to stop the pressure decrease at a little higher pressure than it would have otherwise.

FASANO: Also the height of the pressurizer? That only went down to 158 inches. Would you think that might have been contributary to keeping that up as well?

KEATON: That's a very good question. I think the answer is that it might have been and I want to look at some analysis that we've recently done to look at that. It's possible that the pressurizer level would have dropped more had the emergency feedwater been initiated when it should have been.

FASANO: How familiar are you with the emergency feedwater system? In particular that is when you have your block valves open and it comes on as you get a trip, I guess with loss of feedwater your emergency feedwater pumps come on...

KEATON: Yes.

FASANO: They come up to pressure and then at 30 inch level, approximately, on the steam generators, you have your integrated control system take over and it's in automatic then these valves would open. Are you familiar with any set leak rate for these particular valves on...so that there is some water coming in immediately?

KEATON: I don't remember the number. I am aware of the fact that there is such a bypass around the valves but I don't remember the values.

FASANO: Okay. What would be the intent of this? Do you have any idea?

KEATON: I'm sorry I really can't ...

FASANO: But you do remember or you do think there is in the back of your mind that there is an automatic starting of water flow even before you get down to the 30 inches?

KEATON: It is the best of my memory that I have been told that that is correct.

FASANO: Okay. I don't think I have anymore questions at this time but maybe you would like to, based on the experience that this has given you and given us, maybe you would like express some ideas or give some advice as to what you think might benefit all of us as far as operating nuclear power plants.

KEATON: Well, I think it is clear that we have learned several lessons. I expect to be testifying before the ACRS next week and answering similar questions. I guess that in retrospect that it's clear that there were several things that contributed to this accident. It appears, I think crystal clear, to us that the stuck open relief valve was the mechanical initiator of the accident. Had that not occurred there is no reason why the plant would not have followed a very normal sequence of events in taking care of itself. It appears to me on the basis of what we have been able to see so far and our investigation is by no means complete, that it appears that the possibility of a loss of coolant in the pressurizer, whether from the stuck open relief valve or broken line or other cause, has not really been adequately considered in terms of defining the expected

behavior of the plant and the actions that we would expect the operators to take in the event of this. And looking at the plant procedures for TMI 2 for example. The procedures really address loss of coolant accidents which are accompanied both by a loss of pressurizer level and a loss of system pressure, which of course is what you would expect to see if the leak is anywhere other than in the pressurizer steam space. So I think perhaps that the industry as a whole had not carefully enough considered the fact that this would appear to be an unusual behavior on the part of the operators. From the standpoint of the operators I think we can say that they did not recognize what was happening to them. They controlled the plant based upon pressurizer level which is what they have done in previous events such as the ones that you described, and which in those cases was the correct thing to do. In this case it was not the correct thing to do and in some of the training that needs to be done I think we will all want to be emphasizing to the operators the importance of controlling the system pressure if it has dropped down to saturation pressure. Another thing that has come out of this is that in circumstances such as this, the operator is presented with a maze of information. All of which is demanding his attention immediately. And at least in the case of TMI 2 it is probably fairly generally true there's nothing in the way that the information is presented that particularly calls the operator's attention to the most critical information. He's left to sort out for himself what is the most critical and what is not the most critical and some of the things that were of great interest to him are things that are not even displayed immediately on the control panels. So, it is putting a heavy load on the operator and so in thinking about this

basically our conclusion in thinking about the lessons are that: (1) we need to make sure that we take any steps that we can to avoid having this particular incident happen again, protection against the stuck open relief valve; (2) I think we need...we feel that we want to make sure that we do everything we possibly can to train the operators in the different types of unusual conditions that might result to make sure that they react as quickly as they can; and (3) I think we need to do everything we can to improve the way that we present information to the operator.

FASANO: On the...just go back a little...you mentioned if you have a stuck open valve located at the pressurizer or a broken pipe if you like in the upper section of the pressurizer. In that event...now we go back to the reactor coolant pumps, do you think that operating them or not operating them may have had an impact on the actual final condition?

KEATON: This is one of the things that we are trying to analyze and we don't really have a final answer to it yet but it appears likely that in fact had the operators not turned off the coolant pumps when they did that the pumps may have very shortly stopped pumping anyway and so the actual action of turning off the coolant pumps, and again I'm not sure, but I believe that our analysis will show that that actual action of turning off the coolant pumps was not the critical item.

FASANO: Okay. The...did you...well just to get back to that you...then the starvation of the primary system of mass of makeup water...I gather

then might have been the other critical point in this particular situation and how could the operator be more knowledgeable in realizing that he shouldn't turn off his high pressure safety injection or increase his letdown...I think in both...he was doing both at the same time...with a leaking...is this correct?

KEATON: Yes. I think that is exactly correct and I think that what you are mentioning is in fact the critical area as far as the operator's actions are concerned. We believe basically that there are two ways that the core damage could have been avoided. One is to...is for the operators to have realized that they had a system leak, realize that the pressure had dropped to the saturation pressure in the hot leg, and use the high pressure injection flow as a method of controlling system pressure rather than controlling pressurizer level and to have worried about the pressurizer level only once they reestablished a pressure substantially above the saturation pressure in the hot legs. The second thing would have been to have recognized where the leak was and to have stopped the mass loss by closing the blocking valve downstream of the pressurizer relief valve. With respect to your specific question one of the things which we are proposing to do on TMI Unit 1 prior to the time that we suggest it's restart, is to install a monitor and an alarm which compares the current system pressure to the saturation pressure and which will alarm for the operator if the pressure approaches the saturation pressure so that he understands then that his top priority is to work on pressure control and if the pressurizer goes solid well so be it.

FASANO: He's got his safety valves there.

KEATON: That's right.

FASANO: I have no further questions.

MARSH: I have one question...just of interest. Throughout the course of these interviews there has been several comments about the lag time with the alarm printer sometimes running as high as 45 minutes behind in certain events. Has this been addressed at all or is that being studied or looked at or what's GPU's view on that?

KEATON: Our analysis indicates that yes the printer did run substantially late. It's not clear to what extent that influenced the operator's actions but it certainly is a situation that we consider unsatisfactory.

MARSH: I'm not just addressing the incident on the 28th. It appears to be something that has bothered the operators for some time that it ceased to be a useful tool because of the lag in the backlogging of it. I'm just wondering if it has been addressed and if anything were in the mill that might prove there is a corrective action for it?

KEATON: Of course with respect to Unit 2 we are a long ways from thinking about corrective actions of that type but...

MARSH: No, I'm just talking across the board.

KEATON: Across the board. Well, the other place that this arises for us is in Unit 1 and yes we are presently taking action to change that situation in Unit 1. In fact we are taking more than one action. One case is just that they are putting faster printers in, but we are also taking steps to substantially upgrade the entire computer system and make it much more responsive and also have it do a much better job of being able to communicate with the operator in a fashion that we will find useful.

MARSH: Uh huh. I have no other questions then if you...

KEATON: I'm finished.

MARSH: Thank you very much. I would like to say thank you for your time Mr. Keaton and your comments the time being now 2:15 we'll terminate the tape reading 770 on the meter. Thanks again.

Exhibit 3

00173

GPUNC	USE

NAME: THOMAS M CUMMINS JR
(Please Print)

1(a) On Wednesday, March 28, 1979, (the first day of the accident), were you aware or informed of the containment pressure spike which was recorded at approximately 1:50 P.M. on that date at TMI-2?

☐ Yes, I was aware.

☐ Yes, I was informed.

☐ No

☑ I do not remember.

1(b). If your answer to 1(a) is yes, at what time did you become aware or at what time were you informed of the spike?

☐ I became aware or was informed of the spike at about _____ o'clock.

☐ I do not remember.

1(c). If your answer to 1(a) is yes, how were you made aware or did you become informed of the spike?

☐ (State briefly below)

_____

_____

☐ I do not remember.

ATTACH ADDITIONAL SHEETS IF NECESSARY. PLEASE BE SURE TO IDENTIFY FULLY WHAT ITEM NUMBER IS BEING RESPONDED TO ON ANY SUCH ADDITIONAL SHEETS.

(081584)

1(d). If your answer to 1(a) is yes, did you subsequently tell or otherwise communicate with anyone else about the pressure spike? If so, whom did you tell, when, how, and why?

☐ Yes, I told:

NAME	DATE AND TIME	METHOD	PURPOSE (e.g., conversation, report, interview, deposition, testimony, etc.)

☐ No

☐ I do not remember.

1(e). If your answer to 1(a) is yes, describe your experience concerning any electrical malfunctions of equipment that occurred at TMI-2 during the year preceding the accident.

☐ Description: _____

_____

_____

☐ I am not aware of any such malfunction.

☐ I do not remember any such malfunction.

2(a). On Wednesday, March 28, 1979, did you hear a "thud" or "thump" or other noise indicating that hydrogen or some other burn, explosion, or anomaly occurred at or about 1:50 P.M. at TMI-2?

2(a). (Cont'd.)

☐ Yes

☐ No, although I was at or in the vicinity of TMI-2 at that time.

☑ No, I was not at or in the vicinity of TMI-2 at that time.

☐ I do not remember.

2(b). If your answer to 2(a) is yes, what, at the time, did you think caused the noise?

☐ At the time, I thought the noise was caused by:

_____

_____

_____

☐ I did not know.

☐ I do not remember.

2(c). If your answer to 2(a) is yes, did you tell or otherwise communicate with anybody else about the noise at any time on March 28, March 29, or March 30? If so, who did you tell and at what time?

☐ Yes, I told:

NAME	DATE	TIME

2(c). (Cont'd.)

|__| No

|__| I do not remember.

2(d). For any individual identified in your answer to 2(c), state very briefly the substance of your communication:

|__| I told _____ the following:

_____.

_____

_____

|__| I do not remember.

2(e). If your answer to 2(a) is yes, did you take any action in response to the noise? What?

|__| Yes, I took the following action:_____

_____

at about _____ o'clock on _____

|__| No

|__| I do not remember.

2(f). If your answer to 2(a) is yes, were you aware of any action taken by anyone else in response to the noise? What?

|__| Yes, on _____ at about _____ o'clock _____(name) took the following action_____

_____

|__| No

2(f). (Cont'd.)

|__| I do not remember.

2(g). If your answer to 2(a) is yes, did you conclude, either at the time or later, that the noise had been caused by a hydrogen explosion or hydrogen combustion? If so, on what date and at what time?

|__| Yes, on _____ at about _____ o'clock I concluded that the noise had been caused by a hydrogen explosion or combustion.

|__| No

|__| I do not remember.

3(a). On Wednesday, March 28, 1979, were you aware or informed that a hydrogen explosion or combustion had occurred in the TMI-2 containment building?

|__| Yes, I was aware.

|__| Yes, I was informed.

|__| No

|✓| I do not remember.

3(b). If your answer to 3(a) is yes, at what time did you become aware or at what time were you informed of the explosion or combustion?

|__| I became aware or was informed there had been a hydrogen explosion or combustion at about _____ o'clock.

|__| I do not remember.

3(c). If your answer to 3(a) is yes, how were you made aware or did you become informed of the hydrogen explosion or combustion?

|__| (State briefly below)

_____

_____

|__| I do not remember.

3(d). If your answer to 3(a) is yes, did you subsequently tell or otherwise communicate to anyone else about the explosion or combustion? If so, whom did you tell, when, and why?

|__| Yes, I told:

NAME	DATE AND TIME	METHOD	PURPOSE (e.g., conversation, report, interview, deposition, testimony, etc.)

_____

_____

_____

|__| No

|__| I do not remember.

4(a). On Wednesday, March 28, 1979, were you aware or informed of containment spray actuation at TMI-2 at approximately 1:50 P.M. on that date:

|__| Yes, I was aware.

|__| Yes, I was informed.

|__| No

|✓| I do not remember.

4(b). If your answer to 4(a) is yes, did you subsequently tell or otherwise communicate with anyone else about spray actuation?

|__| Yes, I told: _____

|__| No

|__| I do not remember.

5(a). On Wednesday, March 28; Thursday, March 29, or Friday, March 30, 1979, were you aware or informed of any instruction not to activate equipment in the TMI-2 reactor building because it might cause a spark and/or hydrogen explosion?

|__| Yes, I was aware.

|✓| Yes, I was informed.

|__| No

|__| I do not remember.

5(b). If your answer to 5(a) is yes, on what date was the instruction given?

|__| The instruction was given on March ___, 1979.

|✓| I do not remember.

5(c). If your answer to 5(a) is yes, who gave the instruction?

|__| _____ gave the instruction.

|✓| I do not remember.

5(d). If your answer to 5(a) is yes, how did you learn of the instruction?

|__| I heard _____ give the instruction.

5(d). (Cont'd.)

|_| _____ told me about the instruction.

|X| Other (explain) ~~In discussions with~~ operating staff and while on watch as technical support the issue arose and was discussed.

|_| I do not remember.

5(e). If your answer to 5(a) is yes, did you take any specific actions in response to the instruction? What actions?

|X| Yes, I took the following actions: ~~In reviewing~~ planned evolutions in the plant, the issue was addressed. action was taken by the technical support and operations personnel to ~~question~~ the H2 hazard and to mitigate it.

|_| No

|_| No specific action on my part required.

|_| I do not remember.

5(f). Do you know of anyone else who, on March 28, March 29, or March 30, was aware of any instruction not to activate equipment in the reactor building because it might cause a spark and/or hydrogen explosion?

|X| Yes, the following ~~persons~~ were aware of such an instruction: ~~Operating~~ personnel on watch and Technical support personnel.

|_| No

|_| I do not remember.

5(g). If your answer to 5(f) is yes, did the persons identified in your answer take any specific action in response to the instruction?

[☑] Yes, the following persons took the following actions: Actions noted in 5(e).

[ ] No

[ ] I do not remember.

6(a). On March 28, 1979, were you aware at any time of any alarm(s) actuated by the pressure spike or hydrogen explosion?

[ ] Yes

[ ] No

[☑] I do not remember.

6(b). If your answer to 6(a) is yes, which alarm(s)?

[ ] _____

[ ] I do not remember.

6(c). If your answer to 6(a) is yes, what at the time did you think caused the alarm(s)?

[ ] I thought the alarm(s) was caused by: _____

6(c). (Cont'd.)

|__| I did not know.

|__| I do not remember.

6(d). If your answer to 6(a) is yes, did you talk or otherwise communicate with anyone about the alarm(s), either at that time or later?

|__| Yes, I told:

NAME	DATE AND TIME	SUBSTANCE OF THE COMMUNICATION

|__| No

|__| I do not remember.

6(e). If your answer to 6(a) is yes, did you take any action after becoming aware of the alarm(s)?

|__| Yes, I took the following actions:_____

_____

_____

|__| No

|__| I do not remember.

7(a). With respect to the hydrogen burn, pressure spike, or containment spray actuation that occurred at TMI-2 at about 1:50 P.M. on March 28, 1979, did you participate in, overhear, see, or learn of any communication on these subjects between any GPU employee and anybody from B&W, NRC, Commonwealth of Pennsylvania, or any other state agency or office on March 28, March 29, or March 30, 1979?

7(a). (Cont'd.)

[X] Yes

[ ] No

[ ] I do not remember.

7(b). If your answer to 7(a) is yes, for each such communication answer the following: (Utilize corresponding numbered lines in items 7(b)(1) through 7(b)(5) below to identify the specific instance being answered.)

7(b)(1). Identify the subject matter, time, date, and method (e.g., telephone, in person, teletype) in each instance.

	SUBJECT	TIME/DATE	METHOD
I	I could remember such details.		
II	The subjects were initially discussed		
III	by me and other technical support		
IV	personnel (R. Wellons, W.W. Lowe & others)		

7(b)(2). What was the substance of each communication.

I	on the afternoon of March 29 and into the
II	evening. The discussions were initiated
III	by a briefing by George Kunder on the
IV	afternoon of March 29th and were the

7(b)(3). Identify all participants in each communication.

I	subject of evaluation and analysis and
II	extensive open discussion with all
III	involved parties (Met Ed., GPU, NRC
IV	and others from that time on.

7(b)(4). If you were not a participant, did you overhear or see the communication in each instance?

I See above

II

III

IV

7(b)(5). If you did not participate in, overhear, or see the communication, did you learn about the communication from any participant? State from whom you learned and the time, date, method, and reason you were informed.

	NAME	TIME/DATE	METHOD	REASON
I	See above			
II				
III				
IV				

8(a). Do you have documents, including personal notes and files, which relate to one or more of the following?

1. Generation and subsequent combustion of hydrogen on March 28, 1979 at TMI-2;

2. The pressure spike in the TMI-2 reactor building at or about 1:50 P.M. on March 28, 1979;

3. The actuation of the TMI-2 reactor building spray at or about 1:50 P.M. on March 28, 1979;

4. Any instruction on March 28, March 29, or March 30, 1979 not to activate equipment in the TMI-2 reactor building because it might cause a spark and/or hydrogen explosion

5. The "thud" or "thump" or other noise indicating that a hydrogen or some other burn, explosion, or anomaly occurred at or about 1:50 P.M. on March 28, 1979, at TMI-2;

6. Any alarm(s) actuated by the pressure spike or hydrogen explosion on March 28, 1979, at TMI-2; and

8(a). (Cont'd.)

7. Any communications or methods or lines of communication on March 28, 1979, related to generation and subsequent combustion of hydrogen, pressure spike, or containment spray actuation that occurred that date at TMI-2.

[ ] Yes, I do have documents.

[✓] No, I do not have any documents.

8(b). If your answer to 8(a) is yes, please complete the following:

You may contact me at _____ (telephone number), on _____ (date) at _____ (time), to arrange receiving copies of these documents.

August 29, 1984
Date

Leonor M. Caminiti Jr.
Name

0532u

Exhibit 4

March 28

- CS valves open 4 psig in RB
  Spray at 30 psig RB or 1600 psig in RCS
- Cont. Isolation on SFAS
- BWST = 46,788 ft³ =
  Core Flood Tanks = 1410 ft³ =
- Rx trip on Low pressure at 1900 psig
  Rx trip on high pressure at 2355 psig
  Rx trip on high RB pressure at 4 psig
- ~~S/G~~ Pneumatic Reliefs lift at
  S/G Code Safety Relefs lift at
- Pzr Electromatic Relief lift at
  Pzr Relief valves lift at
- EFW pumps start if all RCP's secured or both FP's lost or ~~FW press < 200 psi below steam header~~

- 500 psig
  460°F based on saturation
- RCP's turned off at 1900 psi after trip, 2 pumps off first,
- 1# RB pressure
- 600 ~~cfm~~ at sample sink at 5 A.M
- 14' & 13'
- RCP's only drew 100 amps, no water pumped
- Very low cooldown rate