

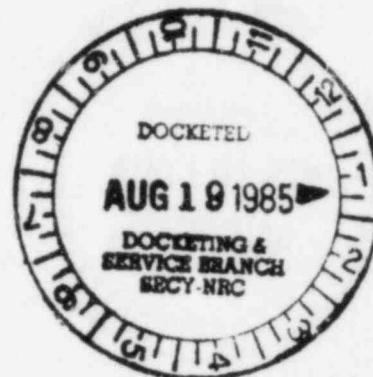
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:
Ivan W. Smith, Chairman
Sheldon J. Wolfe
Gustave A. Linenberger, Jr.



SERVED AUG 19 1985

In the Matter of
METROPOLITAN EDISON COMPANY
(Three Mile Island Nuclear
Station, Unit No. 1)

Docket No. 50-289-SP
[ASLBP 79-429-09-SP]

(Restart Remand on
Management)

PARTIAL INITIAL DECISION
ON THE REMANDED ISSUE
OF THE DIECKAMP MAILGRAM

August 19, 1985

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Appearances

On behalf of the Metropolitan Edison Company, Licensee:
Ernest L. Blake, Jr., Esq., and David R. Lewis, Esq.

On behalf of the United States Nuclear Regulatory Commission:
Jack R. Goldberg, Esq., and Lois R. Finkelstein, Esq.

On behalf of Three Mile Island Alert, Intervenor:
Lynne Bernabei, Esq., and Joanne Doroshow, Esq.

On behalf of the Commonwealth of Pennsylvania:
Thomas Y. Au, Esq.

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PARTIAL INITIAL DECISION
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I. Introduction

This partial initial decision disposes of the so-called "Dieckamp mailgram issue," a matter remanded by the Appeal Board to the Licensing Board for further proceedings in ALAB-772, 19 NRC 1193 (1984). The remanding order pertained to the Licensing Board's respective partial initial decision dated August 27, 1981. LBP-81-32, 14 NRC 381, 555-56.

On March 28, 1979, the day of the accident at Three Mile Island Unit 2, at 1:50 p.m. (approximately 10 hours after the initiation of the accident), there occurred a detonation of hydrogen in the TMI-2 containment building. It was later determined that the hydrogen had been produced by an interaction of zirconium alloy fuel cladding with steam in the reactor core, a phenomenon resulting from core temperatures greater than 2000° F. The core had necessarily been severely damaged by that time.

The hydrogen combustion produced a containment pressure "spike" or excursion recorded to be from about 3 to 28 psig, followed by an immediate decrease in pressure to 4 psig. The spike was recorded on both channels of the containment building pressure recorder strip chart which showed a sharp "spike" at the time. The pressure spike started the containment building spray pumps. Each pump required for starting that two out of three pressure sensors detect pressures of about 30 psig. Simultaneously a sound was heard described by some as a "thud" or

a "whoomp," which was later determined to be water hammer in the containment spray system. The containment isolated on an engineered safety feature. Some alarms actuated. A few minutes after the pressure spike, the spray pumps were secured and the operators directed their attention to other matters. The hydrogen detonation was not reported by the Licensee until March 30. This is a matter of significance, because an earlier appreciation that the core was severely damaged would have been important to emergency actions in the vicinity of Three Mile Island.

On May 7, 1979, Congressman Morris K. Udall, Chairman of the Subcommittee on Energy and the Environment of the House Committee on Interior and Insular Affairs, other Congressmen, and NRC Commissioner Victor Gilinsky toured Three Mile Island. Mr. James Floyd, then TMI-2 supervisor of operations, conducted the tour. Mr. Herman Dieckamp, then and now President and Chief Executive Officer of General Public Utilities Corporation, participated in the tour. Mr. Floyd mentioned the pressure spike and initiation of containment building spray. He identified the containment building pressure recorder and discussed the conclusion that the pressure spike was not a spurious electrical signal because spray initiation required coincidence of at least two pressure indicators. Mr. Floyd also stated that the pressure spike was in full view of an NRC inspector.

The tour was reported in the New York Times on the next day, May 8, 1979. The article was entitled "Lag in Reporting Reactor Damage Laid to Experts" and stated in its lead sentence:

A technician from Three Mile Island nuclear plant told Congressmen today that control room personnel and Federal inspectors knew the plant's fuel core was seriously damaged two days before the damage was formally reported and the seriousness of the accident made public.

The pressure spike was cited as the basis for this statement.

Mr. Dieckamp later explained that he was disturbed by the article because he believed that there was an actual delayed recognition of the pressure spike significance and of the severity of core damage that had occurred during the accident. On May 9 he sent a mailgram to Congressman Udall with a copy to Commissioner Gilinsky and other NRC Commissioners. The mailgram stated in pertinent part:

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.

In March 1980 NRC Chairman John Ahearne directed the Office of Inspection and Enforcement to conduct an investigation into suspected information-flow deficiencies during the accident. Included was the reportability of the pressure spike. The result of that investigation was published in NUREG-0760 (January 1981). NUREG-0760 reported that Shift Supervisor Joseph Chwastyk had stated that he was aware on March 28 that the pressure spike was real, that it was caused by hydrogen, generated by a zirconium/water reaction in the hot core, and that he had reported that information on March 28 to the TMI Station Manager and Emergency Director, Gary Miller.

NUREG-0760 also reported that another shift supervisor, Brian Mehler, had stated that hydrogen was discussed on March 28. This was in

the context that electrical equipment should not be operated in the containment in order to prevent ignition. Theodore Illjes, a control room operator, made a similar statement, also reported in NUREG-0760. These statements by Messrs. Chwastyk, Mehler, and Illjes, were largely discounted in NUREG-0760. But, even if the statements were not accurate, they could impugn Mr. Dieckamp's mailgram statement that no such evidence existed.

Then, turning their attention to Mr. Dieckamp's mailgram, the Staff investigators concluded that it did not constitute a false material statement because it was not a statement required to be made under the Atomic Energy Act.

The Licensing Board was then conducting hearings on Licensee's management, including integrity aspects, and, on March 18, 1981, Mr. Norman C. Moseley, the lead investigator in the information-flow inquiry, appeared as a Staff witness. We could not accept the Staff's simple test for "false material statement" under the statute, because our inquiry was a broader one into the integrity of Licensee's management. No party pursued the matter, however, and after brief questioning of Mr. Moseley, we allowed the matter to rest on NUREG-0760 and on Mr. Moseley's stated conclusion that Mr. Dieckamp had believed the mailgram to be true when sent.

The issue was appealed and the Appeal Board remanded the matter to the Licensing Board for further proceedings. The Appeal Board explained that our reliance upon NUREG-0760 and Mr. Moseley's testimony was misplaced. We erred primarily because that report was too summary;

because our questioning of Mr. Moseley on the point was insufficiently penetrating; because there was then no firm record evidence that Mr. Dieckamp was ever interviewed on the matter; and because we should have examined Mr. Dieckamp on our own. ALAB-772, 19 NRC at 1266-67 (1984).

The Appeal Board defined the issues on remand as follows:

(1) whether anyone interpreted the pressure spike and containment spray, at the time, in terms of core damage, and (2) who or what was the source of the information that Mr. Dieckamp conveyed in the mailgram. The Appeal Board also defined the first issue as "was there evidence that anyone interpreted the pressure spike in terms of core damage at the time of the spike, and was such information withheld." The Appeal Board characterized the scope of this inquiry as "relatively limited." ALAB-772, 19 NRC at 1267 n.103, 1268.

The Licensing Board added a third facet: whether, when, and how any such interpretation was communicated to Mr. Dieckamp. The Board also accepted as subissues: (1) whether Mr. Dieckamp took steps to correct any misstatement upon learning the facts; (2) did Mr. Dieckamp expect the mailgram to be relied upon and to be important to the regulatory process; and (3) should Mr. Dieckamp have known the facts and did he make any effort to discover them. Memorandum and Order Following Prehearing Conference (July 9, 1984) (unpublished), at 8. However, the Board ruled that corporate agency and imputed scienter were not issues in this proceeding. Rather, the key subissue is whether anyone actually interpreted the pressure spike and spray initiation in terms of core

damage, not whether anyone should have made that determination. With respect to whether Mr. Dieckamp should have known the facts, the Board ruled that the appropriate standard was whether he acted with careless disregard for the accuracy of the mailgram. Memorandum and Order Ruling on First GPU-TMIA Discovery Dispute (August 13, 1984) (unpublished), at 3-4.

In addition to the Licensee and NRC Staff, Intervenor Three Mile Island Alert (TMIA) and the Commonwealth of Pennsylvania (Commonwealth) participated in the remanded proceeding. The Commonwealth, however, elected not to file post-hearing proposals. There was extensive prehearing discovery.

Twenty-four witnesses testified at the hearing.¹ The parties also stipulated into evidence 144 prior interviews, depositions, and reports; and portions of a number of the TMIA depositions were admitted in lieu of live testimony.²

¹ Appendix A is a list of witnesses and transcript citations to their testimony, as well as a list of documentary material bound into the transcripts.

² Appendix B is a list of exhibits offered or received in this proceeding. The 144 prior interviews, depositions, and reports which were stipulated into evidence were marked as 144 items in Part C of Joint Exhibit 1. However, for simplicity we have cited the items in Part C of Exhibit 1 as prime exhibit numbers; e.g., the Joint Ex. marked as 1(c)(35) is cited as "Joint Ex. 35." Appendix C lists the principal participants in the activities related to the mailgram issue and briefly describes the role of each.

II. Summary and Comments

Mr. Dieckamp came to the hearing to avow that he believed that the mailgram was true. We believe him. It was not until March 30, 1979, two days after the accident, that he learned about core temperature readings exceeding 2000° F, the zirconium/water reaction, the combustion of hydrogen, and core damage beyond local failed fuel. In fact, the evidence establishes that Mr. Dieckamp did not even know about the pressure spike until March 30. The real question was whether, in the following weeks and before his mailgram, he learned that others may have possessed that information on March 28. The issue of whether Mr. Dieckamp may have acted with careless disregard for the facts in sending the mailgram evaporated early in the hearing, because, beginning on March 31, he worked at Three Mile Island and was deeply involved in the recovery efforts.

Central to Licensee's case was its explanation of how GPU management, and Mr. Dieckamp, became aware of the significance of the pressure spike and containment spray actuation. Several individuals in the control room were aware of the pressure spike tracing and even more heard the noise. Most thought that the spike was an electrical anomaly if they had any perception at all. Two, however, Messrs. Chwastyk and Mehler, appreciated the fact that the spike was real because of the simultaneous initiation of containment sprays. The spike did not seem to have any lasting effect upon plant status at the time, and there were other matters to attend to. The incident seemed to pass from the

operators' thoughts. But later, on evening of March 29, Richard Bense1, TMI-2 lead electrical engineer, and Ivan Porter, TMI-2 lead instrumentation engineer, and perhaps others, began to collect photocopies of plant parameter strip charts to begin the accident analysis. Mr. Bense1 noted the pressure spike tracing, learned that the containment spray had actuated, and he too then realized that the spike was real. In the meantime, Mr. William Lowe, a highly respected nuclear engineer, and Chairman of the engineering firm of Pickard, Lowe and Garrick, was working with the recovery planning group of the GPU Accident Events Analysis and Recovery Planning Team. Mr. Bense1 brought his information to Mr. Lowe.

Mr. Lowe's extensive background in nuclear engineering and chemistry enabled him to recognize that the spike might have been the result of a hydrogen ignition, in part, from the shape of the tracing. Other factors, subatmospheric containment pressure, for example, reinforced his analysis. He suspected immediately that there had been a zirconium/water reaction. Subsequent calculations that night confirmed his analysis. Mr. Dieckamp learned about Mr. Lowe's discovery the following day, March 30.

The Board found Mr. Lowe's testimony to be especially convincing -- in part because of his demeanor, but more importantly, because the inherent logic of his account. He had not been at the island on the 28th but had been in consultation since the early hours of that day. He arrived there in the early afternoon of the 29th. He had extensive communications with other members of the analysis and recovery task

force and plant personnel. He believes that he was the first to identify the pressure spike as a hydrogen burn. He believes, as we do, that it is inconceivable that that information could have been concealed earlier.

But Joseph Chwastyk, TMI-2 Shift Supervisor, actually saw the pressure chart tracings rise and fall. He knew that the sprays had actuated and he shared with Brian Mehler an early understanding that the pressure spike was real -- not an electrical anomaly. In October 1979 Mr. Chwastyk told the Special Inquiry Group that he knew on March 28 that there had been a hydrogen explosion. In September 1980 he told the special NRC team investigating information flow that, not only did he know on the 28th that there had been a hydrogen explosion, but that he knew on the 28th that there had been core damage and heat sufficient to produce a zirconium/water reaction. He said that he promptly reported this information to the Station Manager and Emergency Director, Gary Miller, and imparted it to others that day.

The Board listened to Mr. Chwastyk over two days. We have read every relevant statement reported on his memory of March 28, 1979. Mr. Chwastyk simply is not to be believed on this subject. His memory became increasingly accurate over time, but then faltered at the hearing. There was no corroboration of his statements that he told others about hydrogen and zirconium/water reaction. His actions were not consistent with his asserted awareness of severe core failure. He had sharply varying accounts of his understanding of hydrogen and his reporting of it. In the findings below we explain that these

conclusions are not intended to disparage Mr. Chwastyk's candor. He, more than any other witness to the events of March 28, has been confused by after-acquired information. He makes no allegations. He is, himself, concerned about his memory. He feels that his statements have been over-analyzed and that his meanings have not been fully and accurately understood.

Brian Mehler, on duty as a shift supervisor with Mr. Chwastyk at the time of the spike, was interviewed in August and October 1979. He stated with emphatic assuredness that an order was given on the evening of March 28 not to start electrical equipment in order to avoid igniting hydrogen. Subsequently, however, investigators pointed out to Mr. Mehler that his memory was at odds with log entries and the accounts of other participants. Mr. Mehler consulted the logs; compared his memory with others, including Mr. Chwastyk; engaged in some introspection; and came to the conclusion that it is more likely that the order not to operate electrical equipment was given on the 29th. He later explained that the days of the accident seemed to run together and that it was hard to recall what he remembered, compared to what he was told and what he read.

Mr. Theodore Illjes, a control room operator, stated on May 23, 1979 that, in the evening of March 28, a hydrogen explosion had been discussed as a possible cause of the pressure spike. As with Mr. Chwastyk, we came to the conclusion that Mr. Illjes' memory has been influenced by information acquired after the 28th. The most significant example of this was that Mr. Illjes recalled a concern about a "hard"

noncondensable bubble in the reactor vessel head on March 28. It is beyond any dispute that the existence of the noncondensable hydrogen bubble in the reactor vessel head did not become a matter of concern until Messrs. Lowe, Crimmins, and Moore calculated the volume of hydrogen in the reactor vessel very late on March 29 and in the early morning hours of March 30. Mr. Illjes also believed that the containment pressure record tracings were photocopied on March 28, but the better evidence is that it was on the 29th that this was done. Mr. Illjes' testimony at the hearing demonstrated that he had a very unreliable memory.

It is also significant that, of the three individuals who stated that, on March 28, they were aware of hydrogen, only Mr. Mehler had been interviewed before Mr. Dieckamp sent his mailgram on May 9, 1979. In an April 25, 1979 interview, Mr. Mehler alluded to the pressure spike but made no reference to his later recollection that hydrogen ignition was a concern on March 28. Whatever the validity of the statements by Messrs. Chwastyk, Mehler, and Illjes, there is no reason to believe that Mr. Dieckamp had any evidence on May 9 that any of them knew about hydrogen on March 28.

The Board has pored over the statements of seventeen others who were in the control room at one time or another on March 28th (including two NRC inspectors) who, because of their duties, would probably have been aware that the pressure spike was recognized as a hydrogen explosion if such were the case. About half of them did not even know on March 28 that a pressure spike had been identified on the strip

chart. The other half, those aware of the tracing on the 28th, were about evenly divided among those who thought it was an electrical anomaly, and those who simply did not understand it.

As noted, the Board discounts entirely the statements of Messrs. Chwastyk, Mehler, and Illjes to the effect that a hydrogen detonation was identified on March 28. With that, the case against Mr. Dieckamp becomes inconsequential. When considered with the additional fact that virtually no one else in the control room realized the spike was real, let alone a zirconium/water-hydrogen combustion, the case against Mr. Dieckamp vanishes.

We are left, then, to ponder how it could have been that an event of such significance was not appreciated at the time. In the first place, the pressure spike appeared on the pressure recorder at a time when operating and analysis personnel had their hands full trying to understand the conditions they were dealing with so that they could proceed with confidence to recover from the accident. The pressure trace rose and fell back almost to normal very quickly, with seemingly minimal consequences to indicate any substantive change to the puzzling situation being confronted. It seems to be a normal response for the persons concerned to have concentrated on the puzzle-solving task before them, particularly since there was little appreciation that the spike actually represented a true pressure transient.

In the second place, for the significance of such an event to have been appreciated would have required a somewhat complex conceptual analysis involving such questions as (a) what substance (gas or steam ?)

could be available to raise the pressure of so large a volume to the value seen from the trace?; (b) what mechanism could account for the rapid return of the pressure to a near normal value?; and (c) what mechanism could have provided the source of such a substance whose behavior would be consistent with observations at the time? The passage of time has seen answers to these questions evolve. But at the time, the persons involved could not cope with such questions. The operational personnel of TMI-2 were not schooled in the chemical and thermodynamic properties of zirconium in a high temperature steam environment, or the exothermic and autocatalytic nature of reactions that might result therefrom. It was known that hydrogen could be one of the reaction products. The Final Safety Analysis Report for TMI-2 analyzed hydrogen production following a postulated loss of coolant accident in terms of months before the flammability range would be reached. Two very experienced operations persons, Messrs. Michael Ross and William Zewe, on the day of the occurrence did not see how such a large buildup of hydrogen in the containment building (approximately 2 million cubic feet volume) could occur so rapidly. Mr. Moseley, who led the team that performed the information-flow investigation, testified:

I concluded that on March 28, 1979, it was beyond the range of credible operator knowledge to infer that amounts of hydrogen sufficient to reach a flammable concentration in a two million cubic foot containment might exist at 10 hours after the initiation of the event.

In addition to resolving the mailgram issue on our own, it was also our duty to hear and decide the cases presented by the Commonwealth and

the Intervenor TMIA. The Commonwealth had no position. TMIA's case against Mr. Dieckamp rests on two theories. First, there is a very large body of data consisting of interviews, testimony, investigation reports and other records. From this pool of information, TMIA would have us believe only the small and unreliable portion indicating an awareness on March 28 of hydrogen. TMIA would have us disregard all evidence to the contrary. TMIA's selection from Mr. Chwastyk's varying accounts of the relevant events is a refinement of this strategy.

TMIA's other theory of the case is that there has been a criminal perjury and subornation-of-perjury scheme afoot in this proceeding. By our count TMIA, either directly or by strong implication, accuses fifteen of the 24 witnesses who testified before us of lying and invites an inference of perjury by even more witnesses. TMIA accuses GPU lawyers of pressuring company witnesses called by TMIA to lie, and suggests that the NRC Staff investigations have been deliberately restrained. In our decision below we have alluded to TMIA's charges as disruptive, unfounded, and professionally reckless.

But TMIA's perjury theory is not merely reckless -- it is logically absurd. The theory would have to depend upon a massive conspiracy to conceal a discovery on March 28th of the hydrogen detonation and its implications. Such a conspiracy would, of necessity, have been formed instantly among about 20 people present at the time, with either the acquiescence or the ignorance of NRC inspectors. The conspiracy would need to be expanded quickly to as many as a hundred individuals, perhaps even more. It would have to include, or be skillfully hidden from, the

many engineers, scientists and the managers from other utilities who came to Three Mile Island following the accident to aid in the accident recovery and analysis. The conspiracy would have to escape the penetrating investigations of the Senate, the House of Representatives, the Kemeny Commission, the Special Inquiry Group, the multiple NRC inquiries, and our own proceedings with its thorough discovery opportunities. Finally, this conspiracy would have to be incredibly stable over six years.

In this remanded proceeding, and during the entire TMI-1 restart proceeding, this Board has not seen any evidence of even the slightest reliability to suggest that Mr. Dieckamp lied in his mailgram or evidence that in any way impugns his integrity.

FINDINGS OF FACT

III. On What Information Was The Mailgram Based

A. Licensee's Case on Dieckamp's Knowledge

1. Introduction

1. Mr. Dieckamp came to the hearing to explain what he meant by the mailgram and how he arrived at the conclusions stated in it. He was supported in his testimony by those who were most intimately involved in the recognition and interpretation of the pressure spike. Mr. Dieckamp and those reporting to him, together with their records, were subject to very penetrating and thorough prehearing discovery authorized by the Board. The cross-examination of those individuals reflected that discovery.

2. By way of background, Mr. Dieckamp explained that in using the term "core damage" in the mailgram, he was referring to the kind of significant damage that would be consistent with a major fraction of the zirconium having reacted with water or steam. Tr. 28,345 (Dieckamp). His frame of reference was the New York Times article, which he believed suggested that knowledge of the meaning of the pressure spike in terms of core damage could have influenced the decision to evacuate the populace from around Three Mile Island. For this reason, Mr. Dieckamp was referring to the degree of core damage sufficient to have cast doubt on the ability to cool the core with confidence. Tr. 28,948 (Dieckamp).

3. Mr. Dieckamp believed that, at the time he sent the mailgram, the pressure spike and its meaning were not understood on the day of the accident, and consistent with that belief, that no one made a conscious decision to withhold information about the spike. Dieckamp, ff. Tr. 28,316, at 18. The mailgram reflected Mr. Dieckamp's own understanding of the positive discovery and interpretation of the pressure spike -- of the first recognition of its meaning on the night of March 29. Id. at 5, 9. Mr. Dieckamp first became aware of core damage beyond local failed fuel when he was informed of the pressure spike, the postulated mechanism of a hydrogen "explosion," and the reaction of zirconium and water as the source of the hydrogen. This information came to Mr. Dieckamp sometime on Friday, March 30, 1979.

4. His chronology of the events leading to this awareness began with a coincidence in that, on Wednesday, March 28, 1979 the day of the accident, Mr. Dieckamp had been in Harrisburg, Pennsylvania, attending a Pennsylvania Public Utility Commission meeting unrelated to TMI. Mr. Dieckamp had spoken with Walter Creitz (then Met Ed's President, who was in Reading, Pennsylvania) and with Robert Arnold (GPU Service Corp.'s Vice President of Generation, who was in Parsippany, N. J.) on the morning of March 28. In the early afternoon of March 28, he had a very brief conversation on the steps of the Pennsylvania State Capitol with John Herbein (then Met Ed Vice President of Generation), Gary Miller (then TMI Station Manager), and George Kunder (then Supervisor of Technical Support - TMI-2), who were on their way to brief the Lieutenant Governor. Later on Wednesday evening after returning to his

home in New Jersey where GPU's corporate offices are located, Mr. Dieckamp again spoke to Robert Arnold. On Thursday morning, March 29, he met briefly with Mr. Arnold in order to review and sign a memorandum establishing a "Task Force" to investigate and analyze what was then thought to have been a severe plant transient. On Thursday afternoon, he attended a briefing for a group of Congressmen at the TMI visitor's center; and at this time, he spoke with R. Vollmer of the NRC and with some members of the Task Force. On Thursday evening, Mr. Dieckamp again spoke to Mr. Arnold. Mr. Dieckamp testified that at no time on March 28 or March 29 did anyone mention to him core temperatures in excess of 2000° F, the pressure spike, zirconium/water reaction, hydrogen, or core damage beyond failed fuel. Id. at 5-9. No witness suggested otherwise. TMIA, however, argues that Mr. Dieckamp had all of this information earlier in the accident.

2. The Task Force Investigation

5. On Thursday, March 29, 1979, the Task Force -- designated the "Events Analysis and Recovery Planning Team" -- met at the TMI site. The team members met at about 3:30 p.m. in the TMI supervisors' conference room and were assigned to either an Events Analysis group or a Recovery Planning group. Mr. William Lowe, founder and Board Chairman of the consulting firm of Pickard, Lowe and Garrick, was one of the team members and was assigned to the Recovery Planning Group. Lowe, ff. Tr. 28,151, at 3-4. As will be seen below, it was Mr. Lowe who first

interpreted the pressure spike in terms of zirconium/water reaction and hydrogen combustion -- a point very much in dispute in this proceeding. Other team members present were Messrs. Richard Wilson (the Chairman), Edward Wallace, Donald Reppert, Gary Broughton, George Kunder, James Moore, Lee Rogers, Ron Williams, Thomas Crimmins, and Robert Long. With the exception of Mr. Rogers, who was B&W's representative, all these individuals were engineers or managers from GPU system companies. TMIA Ex. 18, at 3.

6. The information available to those attending the Thursday afternoon Task Force meeting is an important issue in this proceeding. TMIA generally argues that the full significance of the accident, particularly the pressure spike and hydrogen combustion was understood and discussed. The reactor building pressure recorder strip chart was available to the Task Force and general knowledge of plant status and accident progression was excellent according to TMIA. See Section III.B, infra.

7. Mr. Lowe had a recollection, imprecise as to time, that at some time on March 29th the containment pressure spike was mentioned in his presence and said to be a spurious indication -- a voltage anomaly in instrumentation. Mr. Lowe remembers being skeptical of the explanation. Mr. Lowe, however, did not see the strip chart during the afternoon meeting and does not recall anyone analyzing or exhibiting recognition of the significance of the containment pressure spike. Lowe, ff. Tr. 28,151, at 10; Tr. 28,177-78 (Lowe).

8. However, Mr. Thomas Crimmins (a GPU system engineer who attended the meeting) has stated that he remembers seeing the pressure trace during the meeting, but he too states it was assessed to have been a spurious instrument problem. Mr. Crimmins remembers no mention of hydrogen. TMIA Ex. 32F.

9. Mr. Kunder recalls a side discussion during or after the Thursday afternoon meeting in which he was shown the strip chart or a representation of the strip chart. He thinks Gary Broughton showed the chart to him. Tr. 30,001 (Kunder). He believes that hydrogen, along with instrument malfunction, were offered as possible explanations -- possibilities that needed to be examined. Mr. Kunder, however, remembers no discussion of the pressure spike during the main meeting. Tr. 30,005 (Kunder).³ Nor does he remember any discussion or concern about a zirconium/water reaction. Tr. 30,016-17, 30,074 (Kunder). Mr. Kunder does believe he mentioned long-term hydrogen generation at the meeting, but merely as a topic for subsequent recovery planning and without discussion. Tr. 30,007-08 (Kunder).

10. Mr. Gary Broughton, GPU Service Corp. manager, remembers no discussion of the pressure spike or a hydrogen explosion at the meeting and no observation of the strip chart. Tr. 31,159 (Broughton). His

³ Licensee points out that Mr. Kunder exhibited uncertainty in his recollection as to what was said about the pressure spike, by whom, and when, citing his May 23, 1979 IE interview. Joint Ex. 37, at 50-51; see also Joint Ex. 80, at 74-75.

recollection was corroborated by Mr. Richard Wilson. Tr. 31,530-31 (Wilson). Mr. Broughton does not remember that conversation concerning the pressure spike recalled by Mr. Kunder on March 29th. Mr. Broughton remembers in detail that he first learned that there had been a hydrogen explosion on Friday morning, March 30. Tr. 31,166, 31,198-201 (Broughton). Moreover, Mr. Broughton stated that when informed on Friday of the pressure spike, he at first did not understand that the pressure spike had not just occurred. Tr. 31,199.

11. In sum, it is unclear whether there was discussion of the spike or of hydrogen during the afternoon Task Force meeting on March 29. Hydrogen may have been mentioned and a record of the pressure spike may have been available.

12. It is probable that Mr. Kunder's memory associating the pressure spike record with hydrogen is imprecise on that point. It is more likely that hydrogen was discussed as one of the many aspects of the transient which should be explored. The subissue has grown out of proportion to its importance, because, even if the pressure spike had been recognized as real, and, even if it had been attributed to hydrogen, those facts would not undercut the accuracy of the mailgram or the spirit of the mailgram. The only relevance is one argued by TMIA, i.e., that the evidence that it was Mr. Lowe who first identified the spike and hydrogen later that day is incredible -- a matter we address below in Section III.B.

13. Later that evening (March 29) the Recovery Planning group reassembled and Mr. Lowe told Mr. Herbein that the basic problem was

18. Shortly before 4:00 a.m. (on March 30), Mr. Lowe attempted to calculate the amount of zirconium that would have had to react with steam in order to account for the burned hydrogen in the containment plus the then existing amount of hydrogen in the reactor vessel above the core. This led him to conclude that a large part or perhaps all of the zirconium had reacted and hence the core was seriously damaged. After discussions with Messrs. Crimmins and Moore, Mr. Lowe then recommended an approach toward removal of hydrogen from the reactor vessel while maintaining sufficient pressurization so as not to impede core cooling. Removal of the hydrogen from the reactor vessel was subsequently accomplished and confirmed, as was Mr. Lowe's interpretation of its significance. Id. at 13-14.

Mr. Dieckamp's Awareness of Core Damage

19. On Friday, March 30, and continuing for the next several days, Mr. Dieckamp gained an explicit understanding of this first recognition of the meaning of the pressure spike, the confirmation of hydrogen, and a rough quantification of the degree of core damage suggested by analysis of the zirconium/water reaction. Mr. Dieckamp recalls that his awareness of core damage increased abruptly on Friday, March 30, when he was informed of the pressure spike. In telephone conversations with personnel at the site, most likely Robert Arnold, Mr. Dieckamp was told of the pressure spike recording being brought to the attention of the GPU Task Force during the night of March 29. Dieckamp, ff. Tr. 28,316, at 9; Tr. 28,348 (Dieckamp). Mr. Dieckamp also talked to Mr. Lowe by

telephone several times near midnight on Friday, March 30. Lowe, ff. Tr. 28,151, at 15; Joint Ex. 86, at 22-23.⁴

20. Mr. Dieckamp learned that the Task Force had postulated a zirconium/water reaction as the source of the hydrogen and that the presence of hydrogen was recognized as being consistent with the abnormal pressure-volume behavior in the primary system. The postulate caused the plant staff to take steps to take a containment building gas sample and to take steps to permit operation of the hydrogen recombiner. Dieckamp, ff. Tr. 28,316, at 5, 9-10.

21. Mr. Dieckamp moved to the site on the afternoon of Saturday, March 31. He then became aware of the confirmation of hydrogen through analysis of the containment building gas sample, and thus the first quantitative indicator of the degree of core damage. Id. at 10.

22. During the first few weeks of April, Mr. Dieckamp remained at the site. He availed himself of early GPU interviews of operators, sat in on preliminary reviews of the sequence of events, participated in status reviews with the onsite NRC staff, coordinated the activities of the Industry Advisory Group, and generally participated in managing the response to the accident. Id. at 10-11; Van Witbeck, ff. Tr. 28,261, at 2-3; Zebroski, ff. Tr. 28,441, at 11-12.

⁴

Mr. Dieckamp was also briefed on Friday by Robert Keaten, who had that morning obtained from Gary Broughton a sequence of events and update on the current status of the reactor. The update contained information on the explosion in containment and the bubble in the
(Footnote Continued)

23. During the third week in April, Mr. Dieckamp assembled testimony for presentation to the Nuclear Regulation Subcommittee of the Senate Committee on Environment and Public Works (Hart Committee). Dieckamp, ff. Tr. 28,316, at 11.

24. Mr. Dieckamp did not conduct or cause to be conducted any additional inquiry into the facts beyond his own knowledge before sending the mailgram, nor does he remember consulting with anyone. He had neither heard nor seen any indication that on March 28 the pressure spike had been properly diagnosed as the product of a zirconium/water reaction or that the pressure spike caused the plant staff to change or adopt a strategy for bringing the plant to cold shutdown that recognized the presence of hydrogen or noncondensable gas. His examination of operator interviews and his involvement in development of the sequence of events revealed nothing to indicate that anyone had on the 28th identified the meaning of the spike and taken actions in response. Id. at 12.

25. Mr. Dieckamp believes that had operators and plant management correctly interpreted the pressure spike, they would have immediately turned on the high pressure injection pumps and left them on. However, this action was not taken until around 5:30 p.m. -- several hours after the pressure spike at the direction of management that was unaware of

(Footnote Continued)

reactor. Joint Ex. 45, at 7; Tr. 31,247-49 (Keaten); TMIA Ex. 10, at 10-12. Mr. Dieckamp no longer remembers this briefing. Tr. 28,646 (Dieckamp).

the pressure spike and for reasons unrelated to the pressure spike. Tr. 28,901 (Dieckamp); Tr. 28,542-44 (Zebroski). See also Tr. 30,324-26 (Herbein) (referring to Joint Ex. 82, at 38-40); Joint Ex. 63, at 7 (NSAC-1 (July 1979)). In addition, they should not have left the block valve open, as it was, for more than an hour after the pressure spike. Tr. 28,842 (Dieckamp). Finally, Mr. Dieckamp believes that had the pressure spike been understood, Gary Miller and Jack Herbein would not have left the plant to brief the Lieutenant Governor. Tr. 28,906 (Dieckamp). This belief was confirmed by Mr. Miller in this proceeding. Tr. 30,239-42 (Miller).

B. TMIA's Case on Dieckamp's Knowledge

1. Introduction

26. TMIA attacks Licensee's position on the basis for the mailgram on four grounds. See generally TMIA proposed finding 241. (1) TMIA first argues that Dieckamp's belief that William Lowe was the first to interpret the pressure spike the night of March 29th/30th was not reasonable. (2) Second, TMIA argues that Dieckamp knew better because Herbein and Miller briefed him on plant status on March 28th, including the fact that a hydrogen burn had occurred. (3) Third, TMIA contends that Robert Keaten, on the basis of information obtained from Gary Broughton at the site the morning of March 29th, briefed Dieckamp on plant status and informed Dieckamp at that time of the hydrogen burn. (4) Finally, TMIA argues that Dieckamp's understanding of the degree of

core damage on the 28th or early on the 29th implied that he was aware of the hydrogen burn at that time.

2. Mr. Lowe's Discovery

27. TMIA asserts that Mr. Lowe's testimony contains many contradictions. Its first example of such derives from a comparison of Mr. Lowe's testimony, regarding his being the first to understand the significance of the pressure spike, with the information contained in a memo of December 4, 1979 written by Mr. Lewis Battist of the NRC/TMI Special Inquiry Group, Group #3. This memo states that during a telephone conversation (date not documented) with Mr. Lowe, the latter stated that he did not know that he was the first to have understood the spike's significance. TMIA proposed finding 287; Joint Ex. 104. We find no contradiction between Mr. Lowe's telling Mr. Battist that he did not know that he was the first such person and his testimony that he has no evidence to indicate otherwise. As Licensee points out:

Lowe was not present at TMI on March 28th and does not claim to know what people believed on that day. He did testify, however, that he "believed" he was the first to recognize its significance. Tr. 28,154-55 (Lowe). See also, Tr. 28,216-17 (Lowe). This testimony presents no contradiction. As he testified, "I find it inconceivable that if anyone had known hydrogen was present in containment and had ignited, they would have concealed that knowledge from peers or managers and that the on-site technical support team would not have been told of it." Lowe, ff Tr. 28,151, at 14. [Underlining added]

Licensee reply finding 14.

28. On March 28, 1979, Mr. Lowe documented by memo a telephone conversation between himself and Mr. Jack Thorpe, at TMI, that took

place at about 4:20 p.m. that day. The memo stated that Mr. Thorpe told Mr. Lowe: "Plant thinks core is recovered, but proof not yet established." TMIA Ex. 1. In his testimony, Mr. Lowe stated that: "He [Thorpe] reported the plant thinks core cooling is recovered." Lowe, ff. Tr. 28,151, at 3. TMIA interprets this as a misleading contradiction indicating in reality that Mr. Lowe knew on March 28 that the core had earlier been uncovered and subsequently covered again. Thus, reasons TMIA, Mr. Lowe knew of the seriousness of the accident on that date. TMIA proposed findings 288, 289.

29. Upon being questioned about this, Mr. Lowe testified that the term "recovered" is commonly used to mean that core cooling has been returned to some understandable state; and that it was much later when he made the shocking discovery that the core may have been uncovered. Tr. 28,161, 28,163 (Lowe). We find no basis in this situation to impugn Mr. Lowe's credibility. TMIA is making too much of a play on the word "recovered." Granting for sake of argument that both Messrs. Thorpe and Lowe had been thinking in terms of a core previously uncovered by coolant, there is no evidence to negate the conclusion that it was not until near midnight on March 29 and during the early morning hours on March 30 that Mr. Lowe's analysis of the pressure spike trace led him to conclude that the core had been seriously damaged.

30. TMIA also opines that Mr. Lowe's testimony is incredible because it appears that there were general discussions about the pressure spike and hydrogen buildup during the afternoon meeting of the Task Force on March 29 well before Mr. Lowe's analysis of their

significance. According to TMIA, Mr. Richard Wilson (GPU Service Corporation):

opened the meeting by stating that the company had assumed there had been core damage in the range of \$20 to \$30 million, and that a one-year outage was anticipated. Although different individuals attending the meeting have differing recollections about the meeting, what is striking is that the pressure spike, hydrogen burn, or production of hydrogen to flammable limits was discussed in some manner.

TMIA proposed findings 290, 291.

31. However, Mr. Wilson's one page of prefiled testimony and his answers to many questions subsequent thereto indicate that he based his core damage concept solely upon his awareness of radiation and that that concept was of several or perhaps many failed fuel pins in the core. It was in that context that the dollar and downtime estimates were made and discussed with the Task Force. Wilson, ff. Tr. 31,504; Tr. 31,505-44, passim (Wilson); see also Licensee reply findings at 16, 17. We find nothing to support TMIA's statement that the significance of the pressure spike, hydrogen burn, or production of hydrogen to flammable limits were recognized or discussed during the Thursday Task Force meeting.

32. TMIA refers to statements by Mr. J. D. Abramovici (GPU Service Corporation) that there was concern expressed about hydrogen building up to a four percent concentration and a discussion of hooking up a hydrogen recombiner, both occurring during the afternoon Task Force meeting on March 29. TMIA reasons that such a magnitude of hydrogen buildup in so short a time since accident initiation could only have derived from a zirconium/water reaction and, hence, at the subject

meeting, there had to have been a recognition that a zirconium/water reaction had occurred. TMIA proposed findings 292-93.

33. However, Mr. Abramovici stated that George Kunder raised the concern about hydrogen but that Abramovici did not recall a discussion of how the hydrogen originated. Mr. Abramovici thought that Mr. Kunder had the results of a containment atmosphere sample. TMIA Ex. 32H, at 43-44. But such a sample was not taken until March 31, and showed 1.7% hydrogen. Lowe, ff. Tr. 28,151, at 13; see also Dieckamp, ff. Tr. 28,316, at 10. Mr. Kunder testified that he did not have any knowledge of hydrogen concentration until the weekend following accident initiation; and that his concept of hydrogen formation was in terms of a long-term effect rather than a short-term zirconium/water reaction. Tr. 30,011, 30,016 (Kunder). Attempts to contact Atomic International personnel to assist in setting up recombiners did not occur until Friday, March 30. Tr. 31,010-11, 30,018-19 (Henrie). Thus, any discussion on March 29 about setting up a hydrogen recombiner was not in reference to a zirconium/water reaction source of hydrogen.

34. TMIA references two written comments by Mr. Crimmins (from Jersey Central Power and Light) for the proposition that the containment building pressure recorder spike was viewed and discussed at the Task Force meeting on the afternoon of March 29, and that Lowe should have immediately recognized its significance. TMIA proposed findings 294-96. Our own review of Crimmins' comments reveals his saying that: "The assessment at that time was that it must have been a spurious instrumentation problem." Mr. Crimmins did not recall any mention of

hydrogen until late evening of the 29th or early morning of the 30th.

TMIA Ex. 32F.

35. Finally, making references to notes, depositions and testimony, TMIA states that information derived from Messrs. Abramovici, Broughton, Kunder, and J. E. Henrie (Rockwell Hanford) supports TMIA's thesis that a hydrogen burn was discussed at the afternoon Task Force meeting on March 29, 1979, that spark-generating equipment was ordered not to be started because of the hydrogen concern, and that efforts to set up and operate hydrogen recombiners were initiated because of an awareness of a serious hydrogen problem. TMIA proposed findings 297-302. The Board has carefully reviewed the citations in TMIA's proposed findings and concludes that they do not support a finding that a consideration of the possible presence of hydrogen by any of the named individuals was in the context of a large amount of hydrogen deriving from the interaction of significant amounts of zirconium fuel cladding with water. This is consistent with Mr. Henrie's testimony that three successive inquiries (on March 28, 29 and 30, 1979) by Atomic International to GPU regarding the need to set up the recombiners met with negative responses. Tr. 31,011 (Henrie). Thus, we cannot accept TMIA's assertion that Mr. Lowe's testimony is not credible on that account.

36. Mr. Lowe's closing comments regarding this matter deserve special attention:

To recapitulate, no recognition of or even speculation about the significance of the pressure spike was expressed or implied in all of the extensive and intensive communica-

tions I heard or was party to from early morning of 28 March until the spike's significance was recognized at about 2300 on 29 March as I have described. These communications were with both senior and junior engineers, operators and managers, probably more than 50 in all. Nor did I hear about any such prior recognition from the hundreds of people I dealt with subsequently while on duty at TMI for nearly a month. Furthermore, the people I know and dealt with would not have deliberately concealed such knowledge. And I state that judgment with emphasis and without qualification.

Lowe, ff. Tr. 28,151, at 15. When asked during the hearing whether he presently knows that he was the first person to recognize the significance of the pressure spike, Mr. Lowe testified that "all the evidence I've got so indicates." Tr. 28,217 (Lowe).

3. Mr. Dieckamp's Information from Miller and Herbein

37. As we noted at the outset, on Wednesday, March 28, Mr. Dieckamp was in Harrisburg for a meeting with the Pennsylvania Public Utility Commission unrelated to TMI-2. At about 2:30 p.m. on the steps of the Pennsylvania State Capitol, Mr. Dieckamp encountered Messrs. Herbein, Miller, and Kunder, who were on their way to a briefing of the Lieutenant Governor. Mr. Dieckamp had been excluded from that briefing session. Their conversation was very brief -- Mr. Dieckamp expressed his concern about senior personnel being absent from the plant. Mr. Dieckamp testified that he could not recall any detailed discussion of plant parameters or conditions but that he gained the impression that the plant was stable. Dieckamp, ff. Tr. 28,316, at 5, 7. Mr. Herbein only recalls in pertinent part that Mr. Dieckamp asked who was "minding the store" at TMI-2. Tr. 30,378 (Herbein). Like

Mr. Herbein, Mr. Miller could only recall Mr. Dieckamp's question about "who is minding the store." Tr. 30,214 (Miller). Mr. Kunder recalls a sense of urgency on the part of Mr. Dieckamp that they should promptly proceed to brief the Lieutenant Governor. Tr. 30,071 (Kunder).

38. Having gained the impression from these three men that the plant was stable, Mr. Dieckamp felt no need to contact either these men or other personnel at the site on March 28th after the briefing of the Lieutenant Governor. Tr. 28,403-05 (Dieckamp).

39. TMIA asserts that it is not credible that none of the four participants during the course of the encounter on the steps of the State Capitol could remember anything other than an off-hand remark by Mr. Dieckamp. It argues that it is reasonable to conclude that Messrs. Herbein and Miller briefed Mr. Dieckamp on the status of the reactor at some time during the afternoon of March 28, and that this briefing necessarily would include informing him of incore thermocouple temperature readings greater than 2200° F, the pressure spike, and the hydrogen burn. TMIA's proposed findings 195-202.

40. In Section IV below, we discuss at considerable length the evidentiary record that establishes that neither Mr. Miller, Mr. Herbein, nor Mr. Kunder were aware of the pressure spike on March 28. We also find there that, while Mr. Miller and Mr. Herbein were informed about preliminary incore thermocouple readings exceeding 2200° F on March 28, they did not regard those readings as reliable because of their improbable scatter. Mr. Kunder testified that he did not even know about incore temperatures in that range until weeks after

the accident. Therefore it would have been impossible for any of those individuals to impart information about the pressure spike and its significance to Mr. Dieckamp during the encounter on the State Capitol steps.⁵

4. Mr. Dieckamp's Information from Keaten

41. On the morning of March 28, Mr. Robert Keaten, then Manager of Systems Engineering, GPU Service Corporation, located in Parsippany, sent Mr. Gary Broughton, then Control and Safety Analysis Manager, as well as a group of other engineers to investigate what had occurred at TMI-2.⁶ Tr. 31,238-39 (Keaten). On Friday morning, March 30th, Mr. Keaten telephoned Mr. Richard Wilson, then Director of Technical Functions, GPUSC, who had been at the plant site for over twelve hours. This was the first time that Mr. Keaten heard about a hydroger bubble in

⁵ It is by design, not oversight, that we have not followed TMIA's theory about the so-called "time gap." In essence TMIA argues that Messrs. Miller, Herbein and Kunder cannot account for their time between the briefing at the State House and their return to Three Mile Island and that Mr. Dieckamp cannot recall details of his trip back to New Jersey. TMIA proposed findings 187-88, 200-02. It is not as clear as TMIA would have us find, that there was a time gap in the return trip to the Island. But that is not the important point. We can find no basis to infer, from the void of information about the return trips, that any such time was used to inform Mr. Dieckamp about conditions back at the plant. Having found that Messrs. Herbein, Miller and Kunder did not have the information in the first place, it is pointless to unscramble TMIA's involved analysis.

⁶ See Section IV.I, infra, re: GPUSC Engineers' Knowledge.

the reactor. Later that morning, pursuant to a prior arrangement that Mr. Keaten in turn would brief Mr. Dieckamp, Mr. Broughton telephonically briefed Mr. Keaten. Tr. 31,131-32; 31,149 (Broughton); Tr. 31,246; 31,248-49; 31,255; (Keaten); Joint Ex. 45, at 7. Prior to placing this telephone call, on the morning of March 30th, Mr. Broughton was told for the first time by one of GPUSC's Task Force interviewers, Mr. Robert Long, that there had been a hydrogen explosion or burn on March 28th. Tr. 31,147; 31,170-71 (Broughton).

42. The notes made by Mr. Keaten, to record the information obtained from Mr. Broughton on the morning of March 30th, were set forth in five pages of a notebook. TMIA Ex. 10, unnumbered pp. 11-15; Tr. 31,263 (Keaten). These notes reflect inter alia that Mr. Broughton spoke about the sequence of events which had taken place on March 28th. Thereafter, under a separate heading, "Present Status," the following appears in the notebook:

Bubble in reactor

Non-condensibles in Pressurizer

-lots-

Explosion in containment

1000 ft.³ at 1000 psi 280 degrees F260-280

Could be 100,000 ft.³

TMIA Ex. 10, at 13.

43. On the basis of his earlier conversation with Mr. Wilson and the subsequent one with Mr. Broughton, Mr. Keaten for the first time became fully aware on March 30th that the transient had been very severe

in terms of damage to the reactor, that there was still a hydrogen bubble, that the plant was not in a stable configuration and that a lot of work remained to be done. Joint Ex. 45, at 7, 8; Tr. 31,292 (Keaten).

44. Shortly after the briefing by Mr. Broughton, at about 10:45 a.m., Mr. Keaten contacted and personally briefed Mr. Dieckamp at Parsippany. Tr. 31,248; 31,624 (Keaten). Mr. Dieckamp has no recollection of the content of the briefing but his notes indicate that he talked to Mr. Keaten on March 30th. Tr. 28,645-46 (Dieckamp).

45. TMIA contends that the Broughton-Keaten telephone conversation took place on the morning of March 29th because of the following:

(a) The reporting procedures had been changed in that, as of the time Mr. Wilson arrived at the site during the afternoon of March 29th, Mr. Broughton was to report directly to Mr. Wilson, and thus Mr. Broughton's phone call to Mr. Keaten must have taken place on the morning of March 29th rather than on the morning of March 30th. TMIA proposed findings 207-10. However, we are convinced that the Broughton-to-Keaten phone call was held on the morning of March 30th because, as found above, there was in place a prior arrangement that Broughton would contact Keaten and because we have found that both men were credible witnesses. Moreover, we are persuaded by the fact that as early as June 1, 1979, during the course of an interview with NRC personnel, Mr. Keaten stated that the phone conversation had been on Friday morning, the 30th (Joint Ex. 45, at 7).

(b) The first of the pages of Mr. Keaten's notebook recording the conversation with Mr. Broughton bore the date of "3/29/79" but, sometime prior to October 19, 1979 when a copy of his notes was turned over to NRC investigators, Mr. Keaten inserted in red ink both a question mark after the date of "3/29/79" and a date of "3/30" below the date of "3/29/79." TMIA urges that the date of "3/29/79" was correct because it was written initially, and because the first two entries related to Mr. Dieckamp's activities on March 29th and thus would not have been reported by Broughton or recorded by Keaten on March 30th. TMIA proposed findings 214-15, 222-23. Again we found Mr. Keaten to be a credible witness when he testified that he inserted the question mark and the date of 3/30 because he deemed the date of 3/29/79 to have been an error (TMIA Ex. 10, at 11; Tr. 31,260-61, 31,271) and we see nothing unusual about Mr. Broughton fulfilling his duties by making a complete report upon Mr. Dieckamp's previous day's activities. (In passing, absent more, we cannot but conclude that Mr. Broughton erred in reporting that a Congressional briefing had taken place at 1:00 p.m. on March 29th when, in fact, it began at 2:30 p.m.) Finally, we are persuaded that the Broughton-Keaten telephone call took place on the morning of March 30th because Mr. Keaten's recording in his notes reflecting that a specific primary core coolant sample and its reading had been taken "last night" (TMIA Ex. 10, at 14) was confirmed subsequently in NUREG-0600 as having been conducted at 4:15 p.m. on March 29, 1979. Joint Ex. 62, App. II A, at II-A-59.

(c) There were discussions among the GPUSC engineers on March 28th indicating that they suspected a bubble somewhere in the system and discussions on March 29th indicating that the bubble was non-condensable gas rather than steam. TMIA alleges that the references to a bubble in the reactor and to non-condensibles in Mr. Keaten's notes evidence that the telephone conversation with Mr. Broughton took place on March 29th. TMIA proposed findings 220-21. However, TMIA's citations to the record do not show that Mr. Keaten had been informed prior to March 30th about a hydrogen bubble in the reactor.

(d) The 1000 ft.³ calculation in the notes was an earlier, rougher calculation than the 1500 ft.³ calculation made by Messrs. Lowe and Moore on the night of March 29th. TMIA proposed finding 221, n.3. This is erroneous. Mr. Lowe initially calculated a bubble size of 1568 ft.³ at 2:45 a.m. on March 30th and thereafter, at 3:30 a.m. on March 30th, calculated a bubble size of 1100 ft.³ Lowe, ff. Tr. 28,151, at 12. It appears that Mr. Keaten's notes reflected a rounding off of this second calculation.

(e) The primary system pressure and temperatures recorded in Mr. Keaten's notes were measured at 6:30 p.m. on March 29th as is evidenced by TMIA Ex. 2 at 5. TMIA proposed finding 221, n.23. However, as the Licensee points out, no evidence was adduced showing that these temperatures were unique to March 29th and did not exist also on March 30th as well.

46. We conclude that the probative evidence establishes that

Mr. Broughton briefed Mr. Keaten on the information contained in the latter's notes on the morning of March 30, 1979 and that Mr. Keaten relayed this information to Mr. Dieckamp that same morning.

5. Mr. Dieckamp's Understanding of Core Damage

47. We are convinced from the findings of this Section, supra, and Section IV, infra, that Mr. William Lowe was the first person to recognize the significance of the March 28, 1979 containment building pressure spike; and that that recognition occurred during the late evening of March 29 and the early morning hours of March 30, 1979.⁷ But TMIA argues that Mr. Dieckamp's awareness of core damage on March 28 and 29, 1979 demonstrates his early awareness of a hydrogen burn in the containment building. TMIA proposed findings 228-36.

48. Mr. Dieckamp testified that he met with Mr. Arnold on the morning of March 29 for the purpose of formally establishing the Task Force to investigate the TMI-2 event of the previous day. Dieckamp, ff. Tr. 28,316, at 8. TMIA characterizes that meeting as one in which Dieckamp advised Arnold of serious core damage. TMIA proposed finding 228. Mr. Arnold substantiated that such a meeting and discussion took place, but with respect to serious core damage stated:

7

In Section IV.B, infra, we find incredible Mr. Chwastyk's statement of September 4, 1980 to the effect that on March 28 he quickly identified the pressure spike as a hydrogen explosion produced by a zirconium/water reaction. See Joint Ex. 117, at 27.

"If someone wanted me to quantify it, I would say half a percent or a percent failed fuel type situation." Joint Ex. 84, at 25. The Board finds this to be far short of the extent of awareness on the part of Messrs. Arnold and Dieckamp alleged by TMIA.

49. TMIA refers to the briefing given to the Task Force on the afternoon of March 29, 1979 by Mr. Wilson, in which Wilson tells the Task Force of core damage to the extent of \$30 million. Since the chain of command was Wilson to Arnold to Dieckamp, TMIA concludes that Mr. Wilson's knowledge could only have come from Messrs. Dieckamp and Arnold. Hence, according to TMIA, Mr. Dieckamp must have been aware of the true seriousness of the core damage. TMIA proposed finding 231. We have previously dealt with each of these communication scenarios. We conclude that they are not supportive of TMIA's position regarding Mr. Dieckamp's awareness.

50. Finally, TMIA asserts further corroboration that Mr. Dieckamp understood the serious nature of the accident on March 28, 1979 from the contents of a memorandum written to Dieckamp on March 29 by Mr. B. H. Cherry, who was then Vice President for Planning of the GPU Service Corporation, and who reported directly to Dieckamp. TMIA proposed findings 232-35. Licensee points out that the Cherry memorandum (TMIA Ex. 5) focuses primarily upon Mr. Cherry's perception of communication inadequacies on the day of the accident. Licensee's reply findings 55 and 56. We agree.

51. The Cherry memorandum stated that the communication difficulty persisted "until I spoke to you and got your view of the state of the

reactor, etc. I think it was really only at that point that I had the full understanding of the situation and the condition of the plant." TMIA Ex. 5, at 2. TMIA would have us conclude from this statement of Mr. Cherry that: "This would be true only if Dieckamp were in fact informed of the high in core temperature readings and the hydrogen burn which would lead him to the correct assessment that TMI-2 had suffered serious core damage." [Footnote omitted] TMIA proposed finding 235. The most that the Board can conclude from this is that Mr. Cherry believed that Mr. Dieckamp had provided Cherry the best account that Cherry had been able to obtain by the time the memorandum was written. We can find no probative evidence here or elsewhere to establish that the Dieckamp-to-Cherry communication reflected an awareness on Mr. Dieckamp's part of the true and actual extent of core damage on March 28, 1979. In fact, Mr. Dieckamp's own account of his awareness of core damage, as of March 29, concludes with the statement: "I certainly had no sense at all of massive reaction of zirconium with the water, oxidation and scalding, falling apart." Tr. 28,344 (Dieckamp). We find nothing that impugns the credibility of that statement and we accept it as fact.

IV. Whether Anyone on March 28, 1979 Interpreted the
Pressure Spike and Containment Spray Actuation
In Terms of Reactor Core Damage

A. Introduction

52. In this section we deal with the second prong of TMIA's case which, in effect, alleges that the significance of the pressure spike and the initiation of the containment spray pumps was well understood at the time of the spike and throughout the day on March 28, and that this understanding was widespread among the people gathered on the island that day. Here too we comply with the Appeal Board mandate to determine "whether anyone interpreted the pressure spike and containment spray, at the time, in terms of core damage [emphasis in original]" and "whether any such information was withheld." ALAB-772, 19 NRC 1267 n.103, 1268.

53. Our emphasis is on those who were working in the control room at the time of the pressure spike at 1:50 p.m. and during the following hours. We focus on four persons in particular whose early statements or role in the accident, more than any other factors, gave rise to the issue of whether Mr. Dieckamp was truthful in his mailgram: (1) Joseph Chwastyk, a shift supervisor, who once stated that, on March 28, he interpreted the pressure spike and spray actuation in terms of hydrogen combustion, zirconium/water reaction and core damage; (2) Brian Mehler, another shift supervisor, who realized that the pressure spike was real soon after it occurred, and who once stated that, on March 28, an order was given to avoid starting electrical equipment to prevent the ignition of any combustible gas (presumably hydrogen); (3) Theodore

Illjes, a control room operator, who once stated that a hydrogen explosion had been discussed on March 28; and (4) Gary Miller, TMI Station Manager and Emergency Director at the time of the spike, to whom any such information might be imputed, and who was in direct communication with Mr. Dieckamp within an hour after the pressure spike.

54. We conclude below that Mr. Chwastyk's memory has been hopelessly influenced by after-acquired information; that Mr. Mehler, after careful reflection, came to the conclusion that the order to avoid ignition of hydrogen was not issued on the 28th; that Mr. Illjes has a very poor memory of the timing of events; and that there is no reliable evidence that Mr. Miller was even aware of the pressure spike, let alone its significance on March 28.

B. Joseph J. Chwastyk

55. Mr. Joseph J. Chwastyk is very important to the resolution of the mailgram issue. A TMI-2 shift supervisor with ten years TMI experience in 1979, Mr. Chwastyk was present in the control room at 1:50 p.m. on March 28 and actually observed the rise and fall of the containment pressure strip chart recorder pen at the time of the pressure spike. Mr. Chwastyk is the only person to claim that on March 28, 1979 he knew that the pressure spike and containment spray actuation was caused by hydrogen combustion and that the hydrogen was generated by a zirconium/water reaction and that the zirconium/water reaction meant damaged zirconium cladding and core damage. Moreover, Mr. Chwastyk states that he imparted a substantial amount of this

information to Station Manager Gary Miller soon after the pressure spike. If Mr. Chwastyk's account of these events is correct -- or more precisely, if TMIA's selection of Mr. Chwastyk's several accounts, is correct -- it would be likely that Mr. Dieckamp had knowledge of some evidence that the pressure spike and containment spray actuation was, on March 28, 1979, thought to be indicative of core damage. Mr. Chwastyk's various accounts of the pressure spike and its implications cover virtually every area of dispute about the knowledge possessed by those in the control room on March 28.

56. By way of background to the findings in the following paragraphs, Mr. Chwastyk testified that he saw the actual pressure recorder going straight up, but that initially he did not know what was happening. He noted that the containment spray pumps came on. The pressure came back down and looked like it was staying there, so he ordered the spray pumps secured. Then he ordered an external check of the reactor building and ordered the control room operators to verify containment integrity. He testified that "eventually" he came to the conclusion that the pressure spike did in fact indicate a real increase in pressure after discussing the cause of the spike with Brian Mehler. He then discussed the pressure spike with Station Manager Gary Miller. He testified that he told Mr. Miller that he thought there had been a real pressure increase. He does not now recall mentioning hydrogen or core damage to Mr. Miller and is uncertain whether he mentioned that there had been an explosion. Nevertheless, Mr. Chwastyk testified that at the time of his conversation with Mr. Miller, Mr. Chwastyk's

understanding of the pressure spike was that it was caused by a hydrogen buildup from zirconium/water reaction in the core. According to Mr. Chwastyk, he asked and shortly thereafter received permission from Mr. Miller to "draw a bubble" in the pressurizer. Mr. Chwastyk also testified that, to avoid sparks, he ordered that the electrically operated pressurizer relief valve not be operated and testified that a similar but general order was given later in the evening. Mr. Chwastyk also testified that he discussed the pressure spike with an NRC representative, but cannot recall if he told him that there had been a hydrogen explosion. He stated that he discussed the pressure spike with operators who later came on shift. He believes he told them the pressure spike indicated a real increase in pressure and may have discussed hydrogen and zirconium/water reaction with them.

Before the Pressure Spike

57. On March 28, 1979 Mr. Chwastyk was a shift supervisor licensed on both units and was scheduled for the three-to-eleven shift at TMI-2. He came to the station early, about noon, because he had heard about the accident. He received an informal briefing when he reported to the Unit 2 control room sometime before 1:00 p.m. His testimony is vague on the point, but he believes that the prevailing impression at that time was that there was some "sort of core damage" based upon temperature and radiation readings. Tr. 29,112-13 (Chwastyk). Mr. Chwastyk, himself, did not know "for a fact" that there was core damage, but believed that

there had been. Tr. 29,189 (Chwastyk);⁸ see also Tr. 29,325-26 (Chwastyk).

58. In any event, Mr. Chwastyk did not think in terms of zirconium/water reaction prior to the pressure spike (Tr. 29,346 (Chwastyk)).

59. Mr. Zewe was the shift supervisor on duty at the time of the accident that morning and was still on duty when Mr. Chwastyk arrived at Unit 2. Mr. Chwastyk saw that Mr. Zewe was very busy on other matters, so Mr. Chwastyk took over the actual direction of the operators. Mr. Gary Miller was in overall charge of Unit 2. Mr. Chwastyk could not describe the direct reporting line, but there was a standing order that Mr. Miller was to approve any changes in operation. Tr. 29,118 (Chwastyk). There were no existing procedures to govern the plant status. Tr. 29,124 (Chwastyk).

The Pressure Spike

60. Something, perhaps alarms, alerted Mr. Chwastyk and he happened to be standing near the reactor building pressure recorder at

⁸ Later in his testimony, Mr. Chwastyk was much more explicit about his appreciation of core damage before the pressure spike. He specifically recalled radiation levels, specifically in the reactor building; water that had flooded into the auxiliary building was radioactively "hot;" and that there had been a loss of the reactor coolant pumps. Those signs, and others, according to his later testimony, indicated to Mr. Chwastyk that "in fact there was core damage" prior to the spike. Tr. 29,366 (Chwastyk).

1:50 p.m., the time of the spike. He saw the recorder indicator go straight up and then down again. Some alarms went off, but Mr. Chwastyk cannot recall which. He does, however, recall that the reactor building spray pumps came on. Tr. 29,124-26 (Chwastyk). Prior to the spike everything had been fairly quiet, but with the alarms and operator actions connected with the spike, Mr. Chwastyk assumed that everyone (as many as twenty people) in the control room was aware of the pressure spike. Tr. 29,124-27, Tr. 29,174 (Chwastyk). One or two others may have actually seen the strip-chart pen rise and fall. Tr. 29,175 (Chwastyk). Mr. Chwastyk did not hear the "thud" heard by others at the time of the hydrogen detonation. Tr. 29,132 (Chwastyk).

61. The timing of the awareness that there had been a real rise in the reactor building pressure (as compared to signal anomalies) at the time of the strip chart indication and the spray pump initiation is the first of several events giving rise to the question about the accuracy of Mr. Chwastyk's memory of the relevant episodes. Those who doubt Mr. Chwastyk's accounts suggest that his memory has become suspiciously and increasingly sharper with the passing of time.

62. At the time of his first interview on May 21, 1979, there was not the same focus on the pressure spike and its significance as there was after the issue of information flow had surfaced. At the beginning, Mr. Chwastyk stated that he did not know initially whether the spike existed in the sensors or in the building itself. He recognized, however, that the spray pumps had come on. Since he did not know what caused the spike indication, he delayed securing equipment, particularly

the spray pumps. Joint Ex. 35, at 9. During the May 21 interview he did not state how long after the spike before he came to the realization that it was real.

63. Interviewed again on the point on October 11, 1979, Mr. Chwastyk stated again that he did not know at the time that the spike was an explosion.⁹ It was not until "sometime later" but on the same shift, that he associated the noise heard by others with the pressure spike on the strip chart recorder. Then he knew there had been some "kind of explosion in the building." Joint Ex. 88, at 19. And, consistently, on October 30, 1979, he told the Special Inquiry Group that he initially did not attribute the spike to a real pressure excursion and that he had considered the possibility of an electrical malfunction. Joint Ex. 117, at 5. Again, Mr. Chwastyk believed he became aware that the spike was real "sometime later." As between afternoon or evening, it was, he thought, "before the evening" when he "put it together." Id. at 11.

64. At the hearing, Mr. Chwastyk testified that he "eventually" came to the conclusion that the spike was real. But he said that, in terms of "real time," it was not very long after the event that he

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Mr. Chwastyk has used the terms "detonation," "explosion," and "combustion" interchangeably since he first began discussing the matter. We see no significance in the varying use of the terms, and we differ with Licensee on that score. Mr. Chwastyk is not certain whether the term "explosion" was ever used on March 28. Joint Ex. 117, at 105-06.

appreciated that it was an actual pressure spike. Tr. 29,130 (Chwastyk). Later, on cross-examination, Mr. Chwastyk explained that he became aware that the spike was real apparently sometime during the six minutes he allowed the containment sprays to operate. He reported to Mr. Miller just after securing the spray pumps. Tr. 29,318-19 (Chwastyk).

65. The Board has difficulty reconciling Mr. Chwastyk's use of the term "sometime later" in his October 11, 1979 interview, his October 30, 1979 recollection that it was "sometime later" but "before the evening," and his testimony that he "eventually" realized the spike was real, with his final testimony that the realization came within a few minutes after the strip-chart indication. Even allowing for a distortion of time perception because of excitement, his earlier statements are inconsistent with his final testimony at the hearing.

66. We have even greater difficulty reconciling Mr. Chwastyk's final testimony that, not only did he know the spike was real within a few minutes, but he also knew it was a zirconium/water, hydrogen explosion that early (Tr. 29,372 (Chwastyk)), as we discuss below.

67. The Board noted other inadequacies in Mr. Chwastyk's memory as to how he became aware that the spike was real. His early memory, on October 11, 1979, was that he "put two and two together," i.e., the pressure spike and the noise, and then he realized there had been a detonation. He also believed that the detonation correlated with the

actuation of one of the valves, which valve he could not then specify.¹⁰ Joint Ex. 88, at 19. At the hearing, he initially, and for the first time, explained that the actuation of the spray system and its "two-out-of-three" logic (two of three pressure sensors are required to actuate each pump) convinced him that the spike was real. Tr. 29,130 (Chwastyk). The sensor-logic explanation materialized in a conversation with Mr. Mehler. Tr. 29,317 (Chwastyk).

68. Later in his testimony he believed that it was the combination of the noise and the actuation of the EMOV or its block valve, that led him to the conclusion that the spike was real. Tr. 29,319, 29,331 (Chwastyk).

69. The varying accounts of how Mr. Chwastyk concluded that the pressure spike was in fact some sort of detonation are confusing, but an explanation could be that the seemingly different accounts are each incomplete. Our greater concern is that, in his four interviews and in

¹⁰ Even though, on October 11, 1979, Mr. Chwastyk could not identify the valve he thought corresponded to the detonation, earlier, on May 21, he referred to it as an "electromagnetic relief valve." Mr. Chwastyk has frequently referred to the now-famous pilot operated relief valve (PORV) as an "electromagnetic relief valve" or "EMOV." Others have referred to the same valve (operated by a solenoid) as an "electromatic operated valve" (also "EMOV") or "motor-operated valve" ("MOV"). Tr. 29,334. We have generally used the somewhat redundant term "EMOV valve." This valve has a down-stream block valve. We interpret Mr. Chwastyk's October 11 statement to mean that he did not know whether it was the actuation of the EMOV or its block valve which corresponded to the detonation. At other times, he was more confident that it was the EMOV valve.

his hearing testimony, Mr. Chwastyk may have accepted incomplete and not fully accurate statements of the events put to him by his questioners.

Identification of Hydrogen and Core Damage

May 21, 1979 Interview

70. In his May 21, 1979 interview by the NRC, Mr. Chwastyk made no mention of hydrogen. Joint Ex. 35. He later explained that he simply was not asked about hydrogen then. This is true. However, he was asked to express himself about any observations from his experience which might be helpful to other plants. He had nothing to say. Joint Ex. 35, at 54-55. The Board has carefully read Mr. Chwastyk's May 21 statement. If, as Mr. Chwastyk later testified, he fully understood the implications of the failed fuel-cladding, zirconium/water reaction on March 28, 1979, that understanding should have been apparent on May 21. In fact, one cannot determine from his May 21 statement that Mr. Chwastyk inferred anything at all about core damage from the pressure spike. But the question never came up.

71. On the other hand, by that time Mr. Chwastyk probably knew, as did many people, that there had been a hydrogen detonation and that the hydrogen had been produced by failed zirconium cladding in the core. Therefore, at least as of May 21, 1979, Mr. Chwastyk's memory did not seem to be influenced by any after-acquired knowledge.

72. Mr. Chwastyk's May 21, 1979 interview is significant to the Board in several respects:

(a) Although not beyond belief, it is unlikely that, if on March 28, 1979, Mr. Chwastyk possessed all of the information concerning zirconium/water reaction and hydrogen buildup to the extent that he later recalled, some of that information should have appeared in the May 21 interview;

(b) Assuming that Mr. Chwastyk did in fact possess such knowledge, it is unlikely that he had communicated it to the extent he later recalled because, by May 21, 1979, the NRC had already interviewed most of those present in the control room on March 28 (e.g., Joint Ex. 12 -- 33). Yet the three NRC inspectors who interviewed Mr. Chwastyk on May 21, 1979 did not allude to the very important information that Mr. Chwastyk today believes he possessed and communicated on March 28.

(c) The first recorded statement by Mr. Chwastyk was made after the mailgram and even then it provided no information inconsistent with the mailgram.

73. We believe that it is also significant that, on May 21, Mr. Chwastyk provided no more information about his report to Station Manager Gary Miller, other than Mr. Chwastyk's suggestion to Mr. Miller that the "electromagnetic relief valve" not be cycled. Joint Ex. 35, at 18.

October 11, 1979 Interview

74. Mr. Chwastyk was interviewed by four members of the Special Inquiry Group on October 11, 1979. For the first time Mr. Chwastyk

alluded to "the hydrogen detonation or combustion." He referred to the phenomenon in a context which assumes that the interviewers already were familiar with it; not in the context that on March 28 Mr. Chwastyk had been aware of hydrogen combustion. Joint Ex. 88, at 6.

75. Later in the October 11 interview, Mr. Chwastyk stated that "I again went to Gary Miller and explained what I thought had happened as far as hydrogen detonation and the simultaneous opening of the valve. . . ." Id. at 18. This suggests that, on October 11, Mr. Chwastyk recalled that, on March 28, he informed Mr. Miller about Chwastyk's awareness of a hydrogen detonation. However, immediately after that statement, Mr. Chwastyk stated that he "just can't remember" whether he related to Mr. Miller his thoughts at the time about correlating the pressure spike with the valve operation. Id. at 22.

76. Mr. Chwastyk explained during the October 11 interview that he was "not that well acquainted with hydrogen or any other gases for that matter" and that, because he had seen the initial spike, he was nervous about hydrogen gases. Id. at 36. Indeed, we cannot discern from the October 11 interview that Mr. Chwastyk understood the zirconium/water reaction at that time let alone on March 28. He does not refer to it.

77. The Board has compared Mr. Chwastyk's statement on October 11, 1979 to the effect that he had explained his thoughts about hydrogen detonation to Mr. Miller on March 28 with other portions of his statement that day and with his testimony later. We believe that the most logical explanation is that, by October 11, 1979, Mr. Chwastyk had

begun referring retrospectively to the pressure spike as the "hydrogen detonation" or "hydrogen explosion."

October 30, 1979 Interview

78. The Special Inquiry Group interviewed Mr. Chwastyk again on October 30, 1979 after having reviewed his October 11 statement. This time there was no question about Mr. Chwastyk's assertion. In response to specific questions, he stated in certain terms that he knew there had been a hydrogen explosion on March 28 before he reported his concerns about the pressure spike to Gary Miller. Joint Ex. 99, at 14-15. Mr. Chwastyk felt sure that he had discussed hydrogen with Brian Mehler on March 28 but doesn't remember the conversation. Id. at 17. He recalled on October 30 that he mentioned "some sort of explosion" to Gary Miller at the time but was not sure that he attributed it to hydrogen. Id.

79. Then the Special Inquiry Group, apparently aware of the special importance of Mr. Chwastyk's statement about hydrogen, came directly to the point. The interviewer explained to Mr. Chwastyk that the Group had not discovered any general appreciation on Wednesday, March 28, of hydrogen, and that the general appreciation did not materialize until Thursday afternoon or night or Friday morning. Id. at 17-19. In fact the Special Inquiry Group apparently had not found anyone with an understanding on March 28 of the fact that there had been any sort of explosion, let alone one produced by hydrogen. Yet, as the interviewer pointedly explained, Mr. Chwastyk seemed to have arrived at

the hydrogen conclusion on Wednesday afternoon. The interviewer further observed that Mr. Chwastyk had stated that others about him probably knew about the hydrogen then. Id.

80. Mr. Chwastyk conceded that he may not have told Mr. Miller about the hydrogen explosion or any explosion at the time of his report to Miller on the 28th. Id. at 20, 28. Mr. Chwastyk nevertheless insisted that he told others in the control room about it -- probably counterparts to Chwastyk himself. Id. at 20. He also stated that he had reported to someone from the NRC that day that there had been some sort of explosion. Id. at 21. He was not however, able to state the names of those with whom he discussed hydrogen or the explosion (Joint Ex. 99, passim) with the possible exception of Brian Mehler (e.g., Id. at 17, 19).

September 4, 1980 Interview

81. At the direction of NRC Chairman Ahearne, the Office of Inspection and Enforcement (IE) began an investigation into questions about the adequacy of information transfer between the Licensee and the NRC following the accident. NUREG-0760. The IE team, headed by Mr. Norman Moseley, interviewed Mr. Chwastyk on September 4, 1980. Joint Ex. 117. The IE team focused sharply on Mr. Chwastyk's asserted knowledge on March 28 of a hydrogen explosion.

82. Mr. Chwastyk's memory of the event appeared to be sharper than ever before, especially respecting his understanding on March 28 of the significance of the pressure spike. He stated that, after the

explosion, it dawned on him that "we did, in fact, have some core damage in there because zirconium/water reaction created the hydrogen." This is the first mention by Mr. Chwastyk of the zirconium/water reaction. He recalled that it made him nervous. Id. at 24. Mr. Chwastyk said he knew on the afternoon of March 28 that the core had heated up enough to cause the zirconium/water reaction. Id. He knew also that the hydrogen came from one place -- the zirconium/water reaction in the core. Mr. Chwastyk imputed to Gary Miller a serious attitude about the matter based upon Chwastyk's report to Miller. Id. at 26. Most importantly, Mr. Chwastyk told the IE team:

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.

Id. at 27.

Testimony at the Hearing

83. At the hearing, Mr. Chwastyk was examined extensively by the parties about what he knew on March 28, 1979 about the pressure spike, hydrogen, zirconium/water reaction and core damage; at what time he knew about them and to whom he imparted this information. He testified over two days. He had not read the transcripts of his previous interviews before his testimony on the first day. After the Board had concluded that his unaided memory of the events on March 28, 1979 had been tested sufficiently, we requested that he review the transcripts over the

recess before appearing for the second day. He reported that his memory had been refreshed by his reading. Tr. 29,286 (Chwastyk).

84. Consistent with his September 4, 1980 statement to the IE team, Mr. Chwastyk stated that he understood when he reported to Mr. Miller that the spike or explosion had been caused by a hydrogen buildup; that he knew there had been core damage; that the core damage produced a zirconium/water reaction in which hydrogen is freed. Tr. 29,141 (Chwastyk).

85. Mr. Chwastyk provided his final version of how thoroughly on March 28 he appreciated the significance of the pressure spike near the end of his testimony. He was queried by Licensee's counsel as to whether the combusted hydrogen could have been thought to be from a source such as the hydrogen used to scavenge oxygen in the reactor coolant water, Mr. Chwastyk immediately discounted that possibility by pointing out that the makeup tank, where scavenging hydrogen could be found, was in the auxiliary building, not in the reactor building where the detonation occurred. Tr. 29,372 (Chwastyk).

86. Then Mr. Chwastyk explained once again his version that he knew there was an explosion when the pressure spike indication happened simultaneously with the operation of the EMOV or block valve. Id. Simultaneously with that realization, Mr. Chwastyk knew that the explosion was from hydrogen, and, once he knew that it was a hydrogen explosion, he knew that it had to be from the zirconium/water reaction and not from the makeup tank. Id. If the Board were to accept this version of Mr. Chwastyk's account, we would then have to impute to

Mr. Chwastyk a very thorough appreciation of the zirconium/water reaction and core damage within a few minutes after the pressure spike.

87. Mr. Chwastyk also testified that the zirconium/water reaction was an indication to him on March 28 that the core was damaged more than he thought was the case before the spike. Tr. 29,354-55 (Chwastyk).

Report to Gary Miller

88. With his analysis that there had been a zirconium/water reaction, a hydrogen explosion, and core damage fresh in his mind, Mr. Chwastyk reported to Station Manager Gary Miller.

89. As is well recognized, Mr. Chwastyk's report to Miller about the pressure spike would be the closest link connecting Mr. Chwastyk's March 28 understanding of hydrogen and core damage on that day to Mr. Dieckamp. Mr. Miller encountered Mr. Dieckamp soon after that report. There are two aspects to Mr. Chwastyk's testimony on this issue: (1) If, in fact, Mr. Chwastyk made any report to Mr. Miller, what does his report tell us about Chwastyk's understanding of the pressure spike; and (2) what did Mr. Miller understand from Mr. Chwastyk's report?

90. To revisit the sequence of events: The pressure spike happened at 1:50 p.m. Mr. Chwastyk allowed the containment spray pumps to run until he was satisfied that they should be secured. The time of securing the pumps has been established as five to six minutes after the spike by the Nuclear Safety Analysis Center. Joint Ex. 63, at 44, 45. Then Mr. Chwastyk discussed the two-out-of-three logic for spray pump

actuation with Mr. Mehler. E.g., Tr. 29,166 (Chwastyk). It was during this conversation that Mr. Chwastyk, in one of his accounts, came to the conclusion that the spike was real. Tr. 29,130, 29,317 (Chwastyk). Mr. Chwastyk then reported to Mr. Miller, who had to leave shortly thereafter to brief the Lieutenant Governor. Tr. 29,159 (Chwastyk).

91. The Special Inquiry Group estimated from the State log entry of his 2:30 p.m. arrival at the Lieutenant Governor's office that Mr. Miller left for the 30-minute trip soon after the spike. Joint Ex. 106, at 906. Mr. Miller believes he left the Unit at about 1:55 p.m. (Tr. 30,246 (Miller)), and Mr. Herbein believes he may have left (from offsite) with Mr. Miller at 2:00 p.m. (Tr. 30,343 (Herbein)). Mr. Chwastyk believes that Mr. Miller left 15 minutes to a half-hour, perhaps less, after the spike. Joint Ex. 117, at 27.

92. By any account, Mr. Chwastyk's report to Mr. Miller was necessarily a short one. Mr. Miller does not remember Mr. Chwastyk's report. Tr. 30,204 (Miller). The report to Mr. Miller, according to Mr. Chwastyk, was after Chwastyk made a "bee line" to Miller's office. He followed Miller back to the control room in what has become known as the "moving conversation." E.g., Tr. 29,170, 29,320 (Chwastyk).

93. Mr. Chwastyk testified that he told Mr. Miller that the spike was real and that it was primarily the spray pumps that supported that conclusion. Curiously, contrary to his repeated testimony at other times, he stated that he did not report the noise or thud heard simultaneously with the spike to Mr. Miller. Tr. 29,131 (Chwastyk). Nor did Mr. Chwastyk, during the account just cited, testify to his

oft-repeated statement that he reported to Mr. Miller his view that the simultaneous operation of the EMOV or its block valve provided the basis for believing the spike was real. Id.

94. Contrary to his important September 4, 1980 deposition, Mr. Chwastyk testified that he could not recall whether he told Miller about his understanding that there had been a hydrogen explosion (Tr. 29,141, 29,358), nor any explosion (Tr. 29,153 (Chwastyk)). But see Tr. 29,358 (Chwastyk). Mr. Chwastyk may not even have mentioned "hydrogen" to Miller, relying on the assumption that both he and Miller understood the presence of hydrogen. Tr. 29,154 (Chwastyk). But Mr. Miller said nothing to Chwastyk to indicate that he, Miller, understood that the spike was caused by a hydrogen burn. Tr. 29,281 (Chwastyk). Mr. Chwastyk testified that he could not recall telling Mr. Miller about core damage during his report and doesn't believe that he did. Tr. 29,180, 29,281 (Chwastyk).

95. According to Mr. Chwastyk, whatever it was that he reported to Mr. Miller, it was not serious enough to distract Mr. Miller from other thoughts. Miller, getting ready to report to the Lieutenant Governor, was very busy. He responded to Mr. Chwastyk with the advice that they should not get excited. Tr. 29,159 (Chwastyk).

96. As noted, Mr. Miller said nothing to indicate an appreciation that the pressure spike was caused by hydrogen or that it indicated core damage. Tr. 29,281 (Chwastyk). In fact, Mr. Chwastyk never received any acknowledgment from Mr. Miller that Miller believed the pressure spike was real. Tr. 29,282 (Chwastyk). When questioned whether

Mr. Chwastyk believed Mr. Miller was absorbing Chwastyk's report, or whether Miller may have been preoccupied with other things, Mr. Chwastyk explained that Mr. Miller was preoccupied and that Chwastyk was sure that Miller was thinking about other things. Tr. 29,321 (Chwastyk).

Chwastyk's Communication with Others

97. Mr. Brian Mehler, another shift supervisor at TMI-2, was also on duty at the unit at the time of the pressure spike. His account of the events is covered below in the next section. Here we are concerned with whether Mr. Chwastyk communicated to Mehler his understanding on March 28 of the hydrogen explosion and zirconium/water reaction.

98. Mr. Mehler was in the shift supervisor's office at the time of the spike, but left to go to the control console when he became aware of the increased activity and alarms. Tr. 29,475-76 (Mehler). In the important minutes that followed the spike, Mr. Mehler had a close working relationship with Mr. Chwastyk. As we noted above, it was Chwastyk's conversation with Mehler that, in one of Chwastyk's versions, led Chwastyk to realize the spike was real because of the two-out-of-three sensor logic for the containment spray pumps. E.g., Tr. 29,166-67 (Chwastyk).

99. When interviewed on October 30, 1979, Mr. Chwastyk could not remember having a conversation on March 28 with Mr. Mehler about the causes of the spike, i.e., whether it could have been caused by a chemical explosion or by hydrogen. He believed then that he may have

had such a conversation, and that, because Mehler was present, they probably did confer. Joint Ex. 99, at 7-8, 17.

100. By the time Mr. Chwastyk was interviewed by the IE team on September 4, 1980, he recalled definitely that, after the spray pumps were secured and matters had returned to a relatively normal state, he discussed the pressure spike with Mehler and that Mehler agreed with Chwastyk that there had been an explosion. Joint Ex. 117, at 6, 9-10, 26. There was, however, no reference to hydrogen or zirconium/water reaction in Chwastyk's 1980 account of his conversation with Mehler. Id.

101. At the hearing, Mr. Chwastyk testified again that he believed on March 28 that Mr. Mehler understood that there had been a real pressure spike. And again Mr. Chwastyk could not recall any discussion about hydrogen with Mehler. Tr. 29,167, 29,317 (Chwastyk).

102. In his testimony at the hearing, Mr. Mehler recalled a conversation of a few words with Mr. Chwastyk right after the spike. He corroborates Mr. Chwastyk's statement that he, Mehler, soon knew that the spike was real but does not recall that it was described as an "explosion." Mr. Mehler was quite specific in his belief that hydrogen was not discussed with Chwastyk on that date. In fact, Mr. Mehler recalls that he first learned about hydrogen in the newspaper. They discussed a possible chemical reaction but could not identify any source. Tr. 29,486-87 (Mehler). Nor was a zirconium/water reaction discussed at that time. Tr. 29,566 (Mehler).

103. Mr. Chwastyk testified that he discussed the pressure spike with members of the oncoming shift the afternoon or evening of March 28. These were Theodore Illjes, John Kidwell, and Chuck Mell.¹¹ While he cannot recall specifically, he thinks that he discussed hydrogen. Tr. 29,167-68, 29,337-38 (Chwastyk); see also Tr. 29,349-51 (Chwastyk). He may also have discussed the zirconium/water reaction with them. Tr. 29,356 (Chwastyk). Messrs. Illjes, Mell, and Kidwell have also been interviewed.

104. On July 14, 1979 Mr. Charles Mell stated that during the shift turnover they were shown the spikes and told that both building spray pumps had come on. He stated, however, "at that time they . . . hadn't really postulated why they had come on yet. No one really had the time to think about it." Joint Ex. 60, at 7. Mell stated that there was no discussion of hydrogen burn the first night and that it was not until the next day or night that someone postulated one. Id. at 11-12; Joint Ex. 69, at 17-18.

105. In a May 23, 1979 NRC interview, Mr. Theodore Illjes stated,
 . . . when it [the shift] was turned over it was mentioned
 that we did have a pressure spike, when we turned over. That
 was the only thing that was mentioned, and that they had
 recovered from a reactor building isolation.

Joint Ex. 36, at 8. Mr. Illjes, who testified, could not remember

¹¹ Mr. Chwastyk also indicated that either Bill Conaway or Carl Guthrie also came on shift with Illjes, Kidwell and Mell. Tr. 29,167 (Chwastyk). Mr. Conaway came on duty at 11 p.m. on
(Footnote Continued)

Mr. Chwastyk's briefing. Tr. 29,644-46, 29,653-54 (Illjes).

106. Mr. John Kidwell was interviewed by the Special Inquiry Group. The SIG report, March 4, 1980, indicates that Kidwell's memory of Wednesday, Thursday, and Friday was blurred. Mr. Kidwell recalled that there was discussion late one night about the pressure spike and what caused it, but he did not know which day. Joint Ex. 107, at 61.

107. In his September 4, 1980 deposition, Mr. Chwastyk identified Donald R. Neely as the NRC inspector whom he had told the spike was real. He could not recall Neely earlier. Joint Ex. 117, at 104-05; see also Tr. 29,166 (Chwastyk). Mr. Neely, however, is certain that he was not informed of the pressure spike. Joint Ex. 130, at 8-13.

Draw a Bubble

108. Since as early as his October 11, 1979 interview, Mr. Chwastyk has maintained that, immediately after the pressure spike, and as a result of his understanding of it, he sought and received permission from Mr. Miller to "draw a bubble" in the pressurizer. Joint Ex. 88, at 7, 18. As Mr. Chwastyk later explained, drawing or establishing a bubble in the pressurizer would mean closing the pressurizer EMOV valve or block valve so that the water would not escape and by turning on the pressurizer heaters so that a steam bubble would form. Makeup flow

(Footnote Continued)

March 28. We do not know when Mr. Guthrie came on duty.

Mr. Chwastyk is probably mistaken about Conaway and Guthrie.

would be increased. The purpose, according to Mr. Chwastyk, was to establish a familiar mode; to know with confidence from the pressurizer level what the coolant level in the system was; and to assure that the core was covered. This mode was contrasted by Mr. Chwastyk with cycling the EMOV or block valve, allowing water (or steam) to escape, thus not allowing a bubble to form in the pressurizer. Tr. 29,142-50, 29,288 (Chwastyk).

109. Drawing a bubble is not the same as the so-called "repressurization strategy" (Tr. 29,291 (Chwastyk)), a theory of the case much favored by TMIA. Mr. Chwastyk's request to draw a bubble, and Mr. Chwastyk's statement that Mr. Miller authorized that tactic is advanced by TMIA as evidence that the significance of the pressure spike was fully appreciated by Chwastyk, Miller, and, in general, by others on March 28.

110. The difficulty with the theory is that no special relationship between drawing a bubble and the pressure spike has been demonstrated. Moreover, as Mr. Chwastyk himself concedes, he had requested permission to draw a bubble before the pressure spike and could not explain why the request after the spike differed from earlier requests except that he perceived a more pronounced need. Tr. 29,322-25 (Chwastyk). Also, as Licensee points out, at the time of the pressure spike, people were already working on the pressurizer trying to draw a bubble and to establish a level. Joint Ex. 2, at 11 (Faust); Joint Ex. 24, at 12-13 (Wright).

Chwastyk Prevents Sparks

111. At least one order, perhaps more, was given following the accident not to operate electrical equipment in the containment in order to prevent sparks which could ignite combustible gas. TMIA argues that the first order was given on March 28 soon after the pressure spike and that, therefore, there must have been an appreciation of hydrogen at that time. We discuss the spark-prevention strategy in greater detail in the section below on Mr. Mehler's testimony (where we find that the first order was given on March 29). In the following paragraphs we address Mr. Chwastyk's memory of the first spark-prevention order.

112. Beginning with his very first interview on May 21, 1979, Mr. Chwastyk alluded to his idea of the relationship between the "electromagnetic relief valve" (EMOV) and his assumption that there had been an explosion. Mr. Chwastyk stated then that he suggested to Miller that the valve no longer be cycled. Joint Ex. 35, at 18. During his second interview, October 11, 1979, the interviewers pressed Mr. Chwastyk to be careful about whether he told Miller that he, Chwastyk, thought that opening the valve had caused an explosion. Mr. Chwastyk responded that while he was sure that he had that cause and that effect in mind at the time, upon thinking about the matter, he could not remember telling Miller about his theory. Mr. Chwastyk may have stated to Miller only another request to draw a bubble. Joint Ex. 88, at 21-22.

113. A few weeks later, during his third interview, Mr. Chwastyk was again requested to state his best recollection about what he told Mr. Miller about his spark theory during that report. On this occasion, Mr. Chwastyk stated that he had thought about that matter, and that he did go to Mr. Miller with his thoughts about the sparks and the valve operation. Joint Ex. 99, at 13-14.

114. The question arose again during the September 4, 1980 interview by the IE team where the team alluded to Mr. Chwastyk's first testimony on May 21, 1979 (when Chwastyk had recommended that the EMOV not be operated). The interviewers wanted to know why Mr. Chwastyk's recommendation was limited to the EMOV. Mr. Chwastyk responded that in fact there had been an order put out not to operate other equipment and that he "sort of kicked" himself "for not thinking of it." Joint Ex. 117, at 15-16.

115. At the hearing, Mr. Chwastyk testified, for the first time, that the first order not to operate equipment was issued by Chwastyk himself after a discussion with Mr. Miller and that the order pertained to the EMOV or block valve. Tr. 29,152-53, 29,285 (Chwastyk); see also Tr. 29,332 (Chwastyk). He explained also that his "kicked myself" statement was not inconsistent with his current testimony. According to Mr. Chwastyk, his first order was limited to the EMOV because that was the only item being operated. Tr. 29,332 (Chwastyk). When the later order covering all electrical equipment came out, Mr. Chwastyk realized that he should have anticipated that other equipment might be used. Therefore, he "sort of kicked myself." Tr. 29,344-45.

116. The Board disagrees with Licensee's proposed findings on this point. Licensee reply findings 92, 93. Mr. Chwastyk's explanation about overlooking other electrical equipment, thinking only about the EMOV, is consistent with his earlier interviews as he explained during the IE interview of September 4, 1980. Joint Ex. 117, at 15-16, supra.

117. We are however troubled by the recurring phenomenon of Mr. Chwastyk's memory improving over time. From no early mention of the fact that he, Chwastyk, had given the order not to cycle the EMOV, and uncertainty whether he had even discussed the matter with Mr. Miller, Mr. Chwastyk came to the hearing confident that the order was issued by Chwastyk himself after consultation with Mr. Miller.

118. When deposed before the hearing on September 24, 1984, Mr. Chwastyk stated that it was Mr. Miller, not Chwastyk, who gave the order not to operate the EMOV. Tr. 29,284-87 (Chwastyk) (deposition not in evidence). But having since refreshed his memory by reviewing all of the depositions (at the Board's request), Mr. Chwastyk arrived at his present view that the order was given by Chwastyk after consultation with Mr. Miller. Yet, as we have recounted above, Mr. Chwastyk's earlier depositions and interviews were much less specific on the matter than is the memory they refreshed. And of course, we must consider the fact that no one else has ever mentioned Chwastyk's order not to operate

the EMOV or block valve. Mr. Miller does not recall any discussion of Mr. Chwastyk's account. Tr. 30,204 (Miller).¹²

Board Conclusions on Mr. Chwastyk's Testimony

119. The Board concludes that, on March 28, 1979, Mr. Chwastyk did not interpret the pressure spike and the actuation of the containment spray pumps in terms of hydrogen combustion and core damage. His testimony and previous statements to that effect are not reliable. We also conclude that Mr. Chwastyk's testimony is probably consistent with his understanding of the truth. But his memory of events has been influenced by after-acquired information.

120. Mr. Chwastyk probably understood on March 28 that the pressure spike was real. Mr. Mehler corroborates this. As of May 21, 1979, his first statement on the matter, he had already associated in his memory the cycling of the EMOV (or the block valve) with the pressure spike. Therefore, by that time, he may have had a memory that on March 28 he knew that there had been an explosion or detonation. But the record is

¹² In two early interviews, Mr. Mehler stated that "either the same day or two days later" there was a discussion of the source of ignition. First he thought it had been the pressurizer vent valve (Joint Ex. 32, at 32) and later the pressurizer block valve (Joint Ex. 68, at 8). But Mr. Mehler has never mentioned Mr. Chwastyk's order not to cycle the EMOV or block valve in his several statements about when the first order not to operate electrical equipment was issued. See the discussion of operating electrical equipment in connection with Mr. Mehler's testimony below; see also Joint Ex. 36, at 9-10 (Illjes).

not reliable on that point, because he refers solely to the simultaneity of the spike and the valve cycling without reference to sparks.

121. The Board was influenced by the fact that, as a trend, Mr. Chwastyk's memory seemed to improve over time. But this was not always the case. For example, he was less certain about what he had reported to Mr. Miller and to the oncoming shift in his hearing testimony than in some earlier statements. Nevertheless, there were too many inconsistencies in Mr. Chwastyk's accounts of the relevant episodes for the Board to accept any of the various versions over any other. His account that he understood on March 28 that there was a hydrogen combustion which derived from a damaged core and degraded zirconium cladding and that he communicated the essence of this information to others is not corroborated by those to whom he believes he spoke. Nor is it corroborated by the record of events.

122. In sum, we find that on March 28, 1979, Mr. Chwastyk did not believe as an interpretation of the pressure spike and spray actuation, that there was core damage (more severe than believed before the spike), nor did he believe that any such core damage produced hydrogen by a zirconium/water reaction, nor did he then believe that the pressure spike was a hydrogen combustion. Nor did he communicate any such information to anyone on March 28. Since we do not find that any of those links occurred, the possibility that they all occurred is extremely remote.

123. Moreover, even if we were to believe that Mr. Chwastyk appreciated the full significance of the pressure spike, and, assuming

further, that he spoke about some or all of this information to Mr. Miller, Mr. Chwastyk's testimony was that Mr. Miller was not paying attention to Mr. Chwastyk during the report. Indeed, Mr. Miller's immediate departure to brief the Lieutenant Governor after Chwastyk's report is a strong indication that Mr. Miller had not received any such information from Chwastyk.

124. It is not necessary that we understand why Mr. Chwastyk made statements inconsistent with the reliable evidence. However, since those statements constitute the main collection of accusations -- by others, not Chwastyk -- against Mr. Dieckamp, some additional observations about Mr. Chwastyk might be helpful.

125. He was not a volunteer. He appeared under subpoena. He carries no brief against Mr. Dieckamp. He stated that he is sure that Mr. Dieckamp did not know what Chwastyk knew during the accident. Tr. 29,421 (Chwastyk).

126. The Board and the parties have had the opportunity to ponder deliberately the transcripts of Mr. Chwastyk's testimony, and various statements. We have read exquisite analyses of virtually every subtlety and nuance in the differing accounts. Yet, Mr. Chwastyk's testimony and depositions have been on-the-spot oral answers months and years after the events.

127. As Mr. Chwastyk explained, there has been an overanalysis of his answers. He does not have the verbal skills of the lawyers who have questioned him. His meanings have not always been accurately understood by his questioners. Tr. 29,420-21 (Chwastyk). He points out that

information is missed in transcribing the depositions; the tone of the question; some possible facial expressions. Tr. 29,420 (Chwastyk). We are sympathetic to that observation. As we noted during the hearing, his demeanor was frequently consistent with uncertainty -- a shrug of the shoulders for example. Tr. 29,190-91. Yet this uncertainty may not be evident in the raw language of the transcripts.

128. Mr. Chwastyk acknowledged that he has learned a lot since the accident and doesn't know how much of that information could have become confused with his memory of events. Tr. 29,314 (Chwastyk). He also acknowledged that he probably had less confidence in his understanding of the events on the day of the accident than he did during his testimony. Tr. 29,352-53 (Chwastyk).

129. He appeared to be cooperative with all participants regardless of their positions on the issues. He tried to provide information as best he could. This we see as a possible part of the problem -- a willingness to provide information even though uncertain about it. All in all, we thought his summary advice to the Board was very constructive. He is not sure that five and a half years after the accident anyone can make total sense out of the events of March 28, 1979. Tr. 29,420 (Chwastyk).

C. Brian Mehler

130. As noted above Mr. Brian Mehler was, with Mr. Chwastyk, also a TMI-2 shift supervisor on duty at the time of the pressure spike.

Noticing increased activity and the actuation of some alarms, Mr. Mehler went to the console. Tr. 29,475-76 (Mehler). The pressure recorder looked to him as if there had been an electrical fault, but shortly thereafter he saw that both containment spray pumps were running. Based upon the two-out-of-three sensor logic for the pumps (and an engineered safeguard (ES) signal), Mr. Mehler realized the spike was real. Tr. 29,479 (Mehler). After the equipment was secured, Mr. Mehler and Mr. Chwastyk "looked at each other" and mutually agreed that there had been a spike. They didn't know the cause -- perhaps a chemical reaction. It was over, and there was no more that could be done about it. They went on with their work. Tr. 29,562-63 (Mehler); see also Tr. 29,487 (Mehler).

131. Mr. Mehler was examined thoroughly at the hearing about whether he appreciated or discussed the fact that there had been a hydrogen explosion on the 28th and he was quite specific that neither hydrogen nor explosion was understood or discussed on March 28th. Tr. 29,487, 29,563-66. Nor, of course, was zirconium/water reaction. Tr. 29,566 (Mehler).

132. Mr. Mehler has been interviewed or deposed at least six times since the accident.¹³ His earlier statements contain many references to

¹³ These statements are in evidence: Joint Ex. 17, Met Ed interview (April 25, 1979); Joint Ex. 32, NRC Interview (May 17, 1979); Joint Ex. 68, Hart Committee interview (August 22, 1979); Joint Ex. 89, NRC deposition (October 11, 1979); Joint Ex. 98, NRC deposition (Footnote Continued)

the hydrogen explosion and other core damage indicators on March 28. Mr. Mehler has repeatedly explained that these references are products of knowledge gained after March 28. Tr. 29,488, 29,490, 29,514, 29,564, 29,581 (Mehler). The Board has examined these statements, particularly the portions cited by the parties. With one exception, we find nothing inconsistent with Mr. Mehler's assertion that, on March 28, 1979, he did not know that the pressure spike and containment spray actuation was caused by a zirconium/water reaction, hydrogen explosion, or that anyone interpreted the spike or spray actuation in terms of core damage on that day.¹⁴

133. The exception we allude to is Mr. Mehler's prior statements concerning timing of an order not to actuate electrical equipment.

(Footnote Continued)

(October 30, 1979); and Joint Ex. 115, NRC interview (September 3, 1980).

14 TMIA points to Mr. Mehler's August 22, 1979 interview by the Hart Committee (Joint Ex. 68, at 12) for a proposed finding that Mr. Mehler had indicated that he may have discussed hydrogen with Mr. Chwastyk. TMIA proposed finding 45. In that interview, Mr. Mehler stated "we were concerned but we couldn't determine if it was hydrogen or maybe we had some kind of chemical reaction that time." Joint Ex. 68, at 12. The entire discussion however indicates that hydrogen was not, as might be inferred, discussed as a possible source of the spike. Mr. Mehler stated in that same interview that no one realized that there could have been so much hydrogen; and that neither he nor anyone else had any idea at the time that the temperatures were high enough to produce a zirconium/water reaction. Id.

Electrical Equipment

134. There is no dispute that, once hydrogen or an explosion was identified as the cause of the pressure spike, an order was given not to operate electrical equipment to prevent ignition by sparking. To support the theory that zirconium/water reaction, hydrogen and core damage were understood on March 28 TMIA cites statements by Mr. Mehler that the order not to operate electrical equipment was issued on March 28. We consider the entire subissue in the context of Mr. Mehler's statements.

135. When interviewed on August 22, 1979 by the Hart Committee, Mr. Mehler was asked if he heard anyone express any concern about energizing the block valve just prior to the pressure spike. He replied:

No. After the pressure -- don't know exactly what the time element was after that. Since we did have an explosion, it needed a source of ignition. We assumed the ignition source could have been the block valve. If it was that same day or two days later I can't tell. I know it was discussed at some time or another.

Joint Ex. 68, at 8.

136. Mr. Mehler was again interviewed about the spark potential by the Special Inquiry Group on October 11, 1979:

Q What I'm trying to do is key in to some events on 3/28.

A Yes, you are trying to figure out if they told us not to operate [lift pumps] why we did.

Q Not really, I'm trying to figure out if someone told you not to operate electrical equipment in the containment, was that on 3/28 or 3/29?

- A That was 3/28.
- Q Why are you so sure?
- A Because it was prior to the reactor cooling pump starting and we started that at 3/28 in the evening.
- Q So that was contrary to the instruction that was issued?
- A It was after the hydrogen burn and we had to get some kind of pump running, you know, you had the lesser of two evils.
- Q Okay, well, I admit it has been six months ago since this occurred, but the last question on this is, is that in the control room log, it was on the three to eleven shift on the 29th, on swing shift around 2114 [9:14 p.m.] when the entry was made to place the pumps in the off position (minimize spark potential at reactor building). And as I understood, that in your memory, that is about when that instruction was given to you. So do you see why I have the question?
- A I understand and I can say for a fact and I will go under oath and I will take a lie detector test, prior to running the reactor core pumps, someone did tell us not to start anything and I remember telling Gary, it's too late now I have already started them. And that was after the hydrogen spike.
- Q Now the reason why you were not to start anything --
- A Was a spark in case we did have hydrogen in there.
- Q Okay. And you did not know who advised you of that?
- A No, I don't.
- Q Where did they think the hydrogen came from at that point in time?
- A I don't know.

Id. at 24-25.

137. We have considered the possibility that, in the passage just cited, Mr. Mehler was attempting to explain that the order not to start electrical equipment came after the spike rather than before it, and that he was thinking of the starting of the reactor coolant pumps rather

than the date. But other portions of the October 11 interview support the conclusion that Mr. Mehler then believed that, in fact, the order was given on the 28th. See Id. at 15, 16.

138. On October 30, 1979 Mr. Mehler was interviewed again by the Special Inquiry Group about the order not to start electrical equipment. This time Mr. Mehler believed that the order was given by Mr. Miller from his office, but that he, Mehler, did not know what day the order was given. He recalled that the order followed Mr. Mehler's testing of the lift and backstop pumps, a step necessary before actuating the reactor coolant pumps. The comment was made to the effect that since those pumps had been started (already sparked) there would not be any hydrogen left. Joint Ex. 98, at 11-12.

139. Referring back to the October 11 interview, Mr. Mehler was asked about what had made him then believe that the order was given on March 28. He responded that "because I remember starting the lift pumps and backstop pumps on March 28." However, he recalled starting those pumps also on the 29th. Id. at 13-14. Mr. Mehler explained that since the earlier interview, upon "thinking back upon it" he had become less certain that the order had been given on the 28th. He had talked to Messrs. Miller, Ross, Zewe, and Chwastyk, none of whom recalled the instruction being given on the 28th. He stated that Mr. Chwastyk in particular recalled the instruction being given on the 29th. Id. at

15-16.¹⁵ Mr. Mehler summarized the matter by stating that his own memory standing alone had been that the instruction was given on the 28th but that, in talking to the others, it is more likely to have been given on the 29th. Id. at 16-17.

140. On November 1, 1979, Mr. Mehler provided to the Special Inquiry Group transcript corrections to his October 11, 1979 deposition in a cover letter informing the Group that he was unable to state that the instruction not to operate electrical equipment occurred on March 28, 1979 or at some later date. Joint Ex. 89 (cover page).

141. Mr. Mehler was interviewed for the last time by the IE team on September 3, 1980. Mr. Mehler stated that the change in his opinion concerning the instruction not to operate electrical equipment was the result of having talked to people, having had the chance to review logs, and having had a chance to sit down, talk to his wife, and figure out where he was. Joint Ex. 115, at 23. He stated that, after six months, the 28th, 29th and 30th ran together. Id. at 21.

¹⁵ Mr. Chwastyk remembered the conversation. He stated that he didn't want to talk to Mr. Mehler about it. He thinks that he may have made a comment to Mr. Mehler that he, Chwastyk, didn't think it happened on the 29th (in one answer) and that it didn't happen on the 28th (in another answer), but Mr. Chwastyk could not remember either way. Joint Ex. 117, at 38. Mr. Chwastyk was willing to defer to Messrs. Zewe and Miller on the point. Id. at 41. In an earlier interview, Mr. Chwastyk stated that he didn't believe that the order not to operate electrical equipment, particularly the lift pumps, was given on March 28th. Moreover he provided his reasons for tending to think the order was given later than the 28th. Joint Ex. 99, at 15-17.

142. The control-room log tends to support the position that the order not to activate electrical equipment remembered by Mr. Mehler and others was given on March 29. TMIA Ex. 16. The entry for 2114 hours (9:14 p.m.) on March 29 noted "Placed RCP [reactor coolant pumps] lift pumps in off [position] (minimize sparking potential in RB)." TMIA Ex. 16, at 87. This entry indicated to Mr. Mehler that the lift pumps had been started in case it became necessary to start a reactor coolant pump. Tr. 29,531-33 (Mehler). Mr. Mehler acknowledged that this could have been the event that occasioned the instruction he remembered, though he is not certain. Tr. 29,578 (Mehler). No similar entry can be found in the log for March 28th. TMIA Ex. 16.

143. Mr. Mehler's testimony at the hearing was not very helpful, but, in general, it was consistent with his last two interviews. Tr. 29,507-34, 29,567-79 (Mehler). As he explained:

As time goes on, you know, from March 28th, it became harder to recall what actually I remembered, and what I was told about, read about, or found out about. It is very hard to differentiate between them.

144. Others who had a good opportunity to hear about any spark prevention strategy recalled either that it took place after the 28th or could not recall that it happened on the 28th.

145. Mr. Kunder testified that he gave such an order -- to de-energize unnecessary equipment in the reactor building -- to Mr. Bensei after the Thursday meeting. Tr. 30,028-33 (Kunder); Joint Ex. 118, at 51-53. Mr. Zewe specifically recalled that the order was given sometime on the 29th. Joint Ex. 119, at 46. Mr. Ross stated that

he was sure that the order was not given on the 28th; it was given either on the 29th or 30th. Joint Ex. 124, at 66-67.

146. NRC Inspector, Mr. Neely, present on March 28, did not hear any such order that day and it was not until much later that he heard about it. Joint Ex. 130, at 9-10. Similarly, NRC Inspector, Mr. Higgins, also present, did not learn about the spark prevention strategy until much later. Joint Ex. 129, at 30. Mr. Faust guessed that any such order would have been given on the 29th. Joint Ex. 133, at 17-18. Mr. Porter does not recall such a discussion on the 28th, but recalls that preventing sparks was a consideration later. Joint Ex. 70, at 19-20. Mr. Logan recalls such an order but cannot recall whether it was given on the 28th. Joint Ex. 136, at 47. Shift foreman Adam Miller, when asked if he recalled whether there was a concern about sparking on the 28th replied: "No, not on the 28th." Joint Ex. 137, at 13. Mr. Frederick seems unable to recall anything about such an order on any date. Joint Ex. 132, at 8. Nor does Mr. Illjes. Joint Ex. 127, at 10-11.¹⁶ Nor does Mr. Conaway. Joint Ex. 136, at 47.

Conclusions On Mr. Mehler's Testimony

147. Even though Mr. Mehler realized rather promptly that the pressure spike on March 28 was a real pressure increase, he has never

¹⁶ But Mr. Illjes stated on May 23, 1979 that there had been a discussion of the arcing potential of the EMOV which could ignite
(Footnote Continued)

wavered in his belief that there was no appreciation or discussion of hydrogen or hydrogen explosion on that date. The only thing remarkable about Mr. Mehler's testimony is the firmness of his initial belief that the instruction not to operate electrical equipment came on March 28 just prior to operating the reactor coolant pumps that evening.

148. It is not clear that Mr. Mehler "retracted" his earlier statement to that effect as Licensee suggests. Licensee reply finding 8. A better interpretation is that he deferred to what he regarded as better evidence that the order came on the 29th and that Mr. Mehler recognized that his earlier statements were probably wrong. Mr. Mehler's revised opinion was not a simple change of mind, he came to the conclusion that the order was probably given on the 29th only after a thoughtful approach to the matter -- studying the log, talking to his colleagues and thinking it over. He does not claim that his memory was refreshed by those steps, a restraint that enhanced his credibility.

149. In any event, we cannot accept TMIA's argument (not without its logic) that Mr. Mehler's earlier statements, closer to the events, should be accepted over his later statements. Mr. Mehler himself lost confidence in the earlier statements. Given the large amount of reliable evidence that the order not to operate electrical equipment came after March 28, and no reliable evidence that it came on the 28th,

(Footnote Continued)

hydrogen, but he could not say that it was discussed on March 28. Joint Ex. 36, at 9-10.

we accept Mr. Mehler's revised opinion. The order was not issued on March 28. It was issued first on March 29.

150. Mr. Mehler's interview with Mr. O'Connor of Metropolitan Edison took place on April 25, 1979 -- before the mailgram. Joint Ex. 17. It reflects Mr. Mehler's awareness then that the spike was real -- a point not in dispute. Id. at 8. Other than the pressure spike itself and the reference to the actuation of the containment sprays, the April 25 interview provided no information that would have alerted Mr. Dieckamp to any possibility that anyone appreciated a hydrogen detonation on March 28. In fact, Mr. Mehler's April 25 interview and others conducted before May 9, 1979 are interesting in that the pressure spike seems to have a rather low priority in the discussions. Even weeks after the accident the importance of the spike was not apparent in the interviews.

D. Theodore Illjes

151. Mr. Theodore Illjes was a control-room operator working the three-to-eleven shift under Mr. Chwastyk on March 28. By the time he was briefed and made other preparations it was not until about 6:30 p.m. that he began working at the console. Joint Ex. 36, at 2-5. Mr. Illjes was interviewed twice before the hearing. In the first interview, by the NRC on May 23, 1979, Mr. Illjes stated that, upon initial briefing, he was told that there had been a spike and containment isolation. Later in the evening a "hydrogen explosion" was discussed as a possible cause. Id. at 6.

152. Pressed as to when the hydrogen explosion was discussed, Mr. Illjes explained:

If I want to relate it, I would say it was after we drew the bubble in the pressurizer which we did after that. As far as what time that was mentioned, as far as we discussed it, I know it was discussed when we turned over [shift change], when we came in, but we didn't make any bones about it because we were interested in getting flow through the reactor and the bubble in the pressurizer and so. They had recovered from the building isolation high pressure injection. They had recovered from that situation, and our concern was cooling the reactor and insuring it had flow. Later on when we had things stabilized, we had a bubble in the pressurizer and had a reactor coolant pump running and that term area, we were discussing with, I can't remember if it was one of our engineers. But we did have a pressure spike. We pulled it out and I don't know who wanted a copy but we made a couple copies of the chart. [Underlining added]

Id. at 7.

153. Mr. Illjes had recalled clearly that when the shift "was turned over" he learned only that there had been a pressure spike and the unit had recovered from containment isolation, with no mention of hydrogen at that time. Id. at 6, 8-9. Therefore, we posit from the passage just cited that Mr. Illjes on May 23 had begun retrospectively to refer to the pressure spike as the hydrogen explosion, and vice versa, as we have noted in accounts by other commenters.

154. The NRC interviewer may also have fallen into the same pattern as the following exchange indicates:

FASANO: So a pressure spike was discussed at the turn over, when you first came in, about 3:45. And then somewhere about 8:00 further discussion and also xerox copies [of the containment pressure strip chart recorder]?

ILLJES: Right.

FASANO: And apparently. . .

ILLJES: I think we remembered the xerox machine wasn't working too good.

FASANO: At this time you discussed what and with whom, if you can remember?

ILLJES: We talked, I talked about it with the trainee on our shift, who was Chuck Mell. And the person that asked for the information, and I don't remember who that was, whether it was an NRC inspector or a B&W representative.

FASANO: Was any discussion related to this? Was the hydrogen burn or was a real spike or was this discussed as an electrical spurious signal possibly?

ILLJES: This was discussed that evening but we also talked about it several times after that and I cannot separate the two different discussions but as far as I remember we related it to a cycling of the electromatic relief isolation, which is a DC operated valve I believe and that has a contact in there which will cause arcing which possibly could ignite the hydrogen. That was discussed, but I can't say we discussed it that night. We didn't really have that much time to do a lot of discussion, but we talked about it and when I walked away from the panel, the guy that wanted the copy, you know, he wanted it now, and I had to walk away from the panel to make sure that the other guy, my shift supervisor, was there while I walked away so. . .

FASANO: On the first evening, can you recall if on that first evening you were discussing after 8:00 that it was possibly a hydrogen burn?

ILLJES: As far as I know that possibility was discussed that evening.

Id. at 9-10.

155. From the foregoing one could, and perhaps should, conclude that as of May 23, 1979 Mr. Illjes' best memory was that a hydrogen explosion was discussed as the cause of the pressure spike the evening of March 28. But as the interview continued, Mr. Illjes introduced a new factor into his memory of the events:

ILLJES: It was also that night, you know, that we determined that we had a hard bubble and what that bubble was, you know, we had talked about that too, you know. . . What is the gas and is it hydrogen or other and all that water that went through the reactor and out into the RC drain tank and out into the reactor building. [Underlining added]

Id. at 10.

156. The "hard bubble" comment was not pursued on May 23. The question would arise again as to whether the "hard bubble" to which Mr. Illjes refers was related to a real pressure spike on March 28 or to the widely publicized concern of some days later that there was a hydrogen bubble trapped in the head of the reactor vessel.

157. Mr. Illjes was interviewed again on September 24, 1980 by the special IE team investigating the information-transfer matter. Joint Ex. 127. The team was very interested in Mr. Illjes' earlier statements about hydrogen:

Q Is it still your recollection that hydrogen was discussed on March 28th, 1979, as a possible cause of the pressure spike?

A To my recollection, we discussed the pressure spike.

Q Do you recall who you discussed it with?

A The other two men in the control room at the time, and Joe Chwastyk was sitting behind us, or in the near vicinity. I don't remember if he was in the conversation or not. But the other two men on the shift --

Q That would be Mell and Kidwell?

A Yes.

BY MR. HOEFLING:

Q Was hydrogen a part of those discussions, do you recall?

A I don't remember.

Q When you said "pressure spike," you used that intentionally? You were talking about the pressure spike?

A Yes.

Q And not necessarily hydrogen?

A It's hard for me to separate all the discussion that was made on that night. I can't really say, because it was discussed how many times thereafter, and that far apart I can't relate the difference.

Id. at 6-7.

158. This passage suggests again that Mr. Illjes had begun retrospectively and generically equating hydrogen with pressure spike.

159. The IE team also attempted to resolve with Mr. Illjes his memory on May 23, 1979 that there had been a "hard bubble" determined on March 28:

Q . . . The other investigations to date have concluded that it was not until subsequent to March 28th, 1979 -- either late Thursday evening or early Friday morning sometime -- that a realization took place that a hydrogen bubble existed in the primary system in the reactor vessel head, this noncondensable bubble.

You have previously testified that the reason you recall that you knew of the spike on March 28th, the evening of March 28th, was that that same evening you became aware that there was a hard bubble of hydrogen -- using your words there -- which was in the reactor vessel head.

The discrepancy which I'm trying to resolve is the contradiction in when you knew of the hydrogen bubble and when the other investigations have concluded that there became general knowledge of the fact that a hydrogen bubble, or noncondensable gases still existed in that reactor system.

Can you explain the discrepancy between that?

A No.

Q Is it still your recollection that you were aware of a bubble of hydrogen, or noncondensable gases, which remained in the reactor vessel head on March 28th, 1979?

A I can remember the bubble and the problem that we had which we were trying to resolve at the time. I can remember the bubble being in the "noncondensable bubble," so to put it. I do remember that.

Joint Ex. 127, at 8-9.

160. When pressed on the point he remained of the opinion that the "hard bubble" was identified on the 28th because he associated it with trying to establish a bubble in the pressurizer. Id. at 9. Mr. Illjes also consistently remembered in both interviews that the pressure spike had been xeroxed on the 28th, a point we return to later. Joint Ex. 36, at 7-8; Joint Ex. 127, at 5-6.

161. At the hearing Mr. Illjes had almost no recollection of conversations on the day of the accident. To the best of his recollection, he does not remember a discussion of hydrogen on the evening of the 28th. Tr. 29,595 (Illjes). He could not recall discussing the pressure spike with Messrs. Chwastyk, Mell and Kidwell that evening. Tr. 29,597 (Illjes). He does not recall any discussion correlating the spike with the operation of the relief valve. Tr. 29,600 (Illjes). He could not recall any discussion about hydrogen in the reactor vessel. Tr. 29,610 (Illjes). He had no recollection of being told by Mr. Chwastyk that the pressure spike was real, that it represented an explosion, that the explosion was due to hydrogen, or that the source of the hydrogen was a zirconium/water reaction in the reactor core. Tr. 29,652-53 (Illjes). He didn't seem to recall his

previous interviews. He simply acknowledged that the transcripts say what they say. E.g., Tr. 29,607 (Illjes).

162. Mr. Illjes tried to be helpful by his analyses of the log and knowledge of procedures. On that basis, Mr. Illjes believes now that the realization that a hydrogen burn had actually occurred was later, probably Friday, March 30. He believes that if the pressure spike had been attributed to a hydrogen burn or hydrogen explosion on Wednesday, March 28, there would have been corrective measures taken and perhaps a log entry made. Tr. 29,650-51, 29,745 (Illjes).

163. Mr. Illjes also testified that he remembers Steve Pogi as one of the engineers who was present when the spike was attributed to hydrogen. Mr. Illjes recalls that Mr. Pogi was not present on the day of the accident. Tr. 29,657-59 (Illjes). Mr. Pogi was a Penelec Former GPUSC startup engineer who arrived at TMI on Friday, March 30, 1979. TMIA Ex. 11, at 2.

164. The Board has no reason to believe that Mr. Illjes' loss of memory was simply a convenience. He was no more helpful with his memory to counsel for Licensee than he was when cross-examined by Intervenors. E.g., Tr. 29,642 (Illjes, Blake). We conclude that Mr. Illjes simply does not have a good memory. By the time of his first interview, May 23, 1979, he had already begun to show signs that his memory was influenced and confused by after-acquired information. His recollection of a "hard bubble" of hydrogen in the head of the reactor vessel on March 28 is a very good example of this. Today he acknowledges that,

during his earlier interviews, he had difficulty keeping his days straight. Tr. 29,637 (Illjes).

165. In sum, and without disparagement to Mr. Illjes, we conclude that the better course is to give little weight to Mr. Illjes' testimony from memory at the hearing or in earlier interviews. His analyses of the log and procedures, however, are credible. In any event, Mr. Illjes' first interview, on May 23, occurred well after the May 9 mailgram.

E. Gary P. Miller.

166. On March 28, 1979 Mr. Gary P. Miller^b was the TMI station manager in charge of both units through their respective superintendents. He arrived at the station at about 7:00 a.m. on March 28 and, because of radiation indications, he soon became aware of the need to initiate the emergency plan. Mr. Miller served as emergency director. He assembled his senior and most qualified people into what was later labeled the "think tank." He placed Mr. Michael Ross, operations superintendent of TMI-1, in charge of operations (Mr. James Floyd, operations superintendent of TMI-2 was away on a training assignment). Mr. George Kunder, TMI-2 Technical Support Superintendent, was placed in charge of engineers. As we have noted throughout, SRO shift supervisors Chwastyk, Mehler, and Zewe, and perhaps other shift supervisors, were also present during much of the day and at the time of the pressure spike.

167. Mr. Miller testified from a mixture of his own memory and his understanding of events from transcripts of his previous statements. He testified that, on March 28, he heard a "thud" which was subsequently correlated to the time of the spike; that he asked others in the control room what the sound was; and that he was told something to the effect that it was the ventilation damper.¹⁷ Tr. 30,186-87 (Miller).

168. Mr. Miller testified further that today he cannot recall that he was aware on March 28 of either the pressure spike or the actuation of spray pumps. Tr. 30,190, 30,200 (Miller). He seemed to place greater reliance on previous statements to the effect that he was not aware of those events on March 28 than on his present memory. Id.

169. On April 14, 1979 Mr. Miller organized a taped, group discussion with key personnel on his own initiative to discuss and record the events of March 28. Mr. Miller prepared a statement from the transcript of that discussion. Joint Ex. 10.

170. Subsequently Mr. Miller was interviewed or deposed seven times, by our count, ending with the September 5, 1980 interview by the IE team investigating information flow. The Board has reviewed each passage cited to us by the parties (and two identified by the Board)

¹⁷ The Special Inquiry Group reported on the nature of this sound. It has also been referred to as "a thump " "a bump," "a whoomp" and the "popping" shut of the ventilation damper. The SIG states that the sound was most likely water hammer in the reactor building spray system piping. We are not aware of any other reliable explanation. Joint Ex. 106, at 42; (SIG Report, Volume i).

relevant to whether on March 28th Mr. Miller was aware of the pressure spike and the containment spray actuation.¹⁸

171. On the whole his statements support his present testimony that he cannot recall being aware on March 28 of the pressure spike and the actuation of the spray pumps. Each of the statements are consistent with that position, but two of them raise questions about the matter. First, TMIA points to Mr. Miller's report of the group discussion of April 14, 1979 where he stated:

It should be noted that at approximately 1400 I heard a loud deep noise and at that time the Reactor Building spray pumps started and subsequent to the events of this day I learned that this was a 30 lb. pressure spike which occurred in the Reactor Building due to hydrogen. [Underlining added]

Joint Ex. 10, at 21-22.

172. Licensee responded by noting that Mr. Miller stated only that he heard a noise, not that he became aware of the spray. Licensee also asserts that Mr. Miller used the pronoun "I" throughout the group report, when in fact the report undertakes to record the knowledge of the entire group. We agree that Mr. Miller misused "I" in the report

¹⁸ Joint Ex. 10, at 21-22 (April 14, 1979); Joint Ex. 23, at 26, 70-71 (May 7, 1979); Joint Ex. 39, at 57-58, 63 (May 31, 1979); Joint Ex. 83, at 31-32 (September 20, 1979); Joint Ex. 85, at 25 (September 28, 1979); Joint Ex. 93, at 28-29 (October 18, 1979); Joint Ex. 95, at 18-22 (October 29, 1979); and Joint Ex. 122, at 26, 111-23 (September 5, 1980).

where he seems to have embodied the entire TMI-2 emergency team into his own person. See Licensee reply finding 77, n.46 for examples.¹⁹

173. When questioned on September 5, 1980 about the cited portion of his April 14, 1979 report, Mr. Miller explained that the statement in question was the result of the meeting with his key people. Joint Ex. 122, at 114. At the hearing Mr. Miller testified that he had intended the April taping to record the combined recollections of all the participants for Mr. Miller's own use in the investigations which were then just beginning. Tr. 30,261 (Miller).

174. A similar ambiguity appears in the transcript of Mr. Miller's May 7, 1979 interview with the NRC:

The containment, we felt, was stable. The reasoning there would be that, up till 2 o'clock, and I'm aware we had a hydrogen excursion, I was aware at 2 o'clock we had an excursion, but up till that point, we had not seen anything above 4 - 5 pounds in the building. . . .
[Underlining added.]

Joint Ex. 23, at 26.

175. Later, on September 5, 1980, when the IE team was specifically concentrating on information flow, Mr. Miller's May 7, 1979 statement was brought up. Joint Ex. 122, at 119. Mr. Miller explained that he

¹⁹ The Board noticed this tendency at the hearing, too. E.g., Tr. 30,256, lines 18-20 (Miller). We also noticed several occasions when Mr. Miller awkwardly used the third person, "Gary Miller" where one would normally say "I," "me," "we" or "us." E.g., Tr. 30,133; 30,147; 30,152; 30,153; 30,192; 30,195; 30,254; 30,263 (Miller). Mr. Miller does not have the communication skills that might be expected in a person with his background.

had not intended to state on May 7, 1979 that on Wednesday, March 28 he was aware that there had been an excursion. He did not gain that awareness until Thursday or Friday, and the passage in question simply reflected that after-acquired knowledge. Id. at 120. In another portion of the same May 7, 1979 interview, Mr. Miller clearly indicated that he did not have knowledge on March 28 that the spike was real. Joint Ex. 23, at 71. The statement in question could easily be the result of a transcribing error or a misstatement by Mr. Miller. When considered in light of the many other statements made by Mr. Miller on the matter, we conclude that it is of no importance.

176. We have already discussed Mr. Chwastyk's communication -- or non-communication -- with Mr. Miller about the pressure spike. TMIA states that Mr. Mehler also testified that Mr. Miller was aware of the pressure spike on March 28. TMIA proposed finding 75, citing Joint Ex. 89, at 29 (Mehler) and Tr. 29,483 (Mehler). However, Mr. Mehler testified only that he assumed that Mr. Miller knew of the spike because he, Mehler, assumed that everyone in the control room knew about it, particularly those who were up at the console. Tr. 29,483 (Mehler). Moreover, Mr. Mehler had no recollection of discussing the pressure spike with Mr. Miller. Joint Ex. 115, at 14 (Mehler).

177. Mr. Marshall also assumed that Mr. Miller would be aware of actuation of the spray pumps from his position in the control room. TMIA Ex. 32G, at 10, 15-16. Mr. Zewe stated that he had found it hard to believe that anyone who was in the control room observing anything

would have missed the spike, the turning off of the pumps, or the discussions. Joint Ex. 75, at 260.

178. TMIA also states that NRC Inspector James Higgins "testified that he believed Miller told him that he knew of the pressure spike on March 28." TMIA proposed finding 76. However, Inspector Higgins' statement (on June 21, 1979) was not that clear:

And, on Friday, people, I guess, were going over the charts and were looking at that and I started, picked it up and started to discuss it with plant management and came out and talked to Gary Miller about it and at that point he said that, in discussing at that point, he realized that he had heard it and that he had recognized it on Wednesday but that was the first time he had thought of it since then, that he had completely forgotten about it in the whole rush of events that occurred, and he stated at that point he remembered, clearly saying to the operators what was that, and looking over and the operators securing the building spray pumps and it was at that point on Friday that I believe, that plant management really realized that they had that pressure spike.

Joint Ex. 19, at 24-25.

179. In later interviews, Mr. Higgins stated that he believed that Mr. Miller had become aware of the spike either on Friday morning or a couple of hours before then. Joint Ex. 79, at 50-51 (Higgins). In any event, the impression Mr. Higgins gained was that Mr. Miller had heard something on March 28; it had registered momentarily on his mind; but that it was past history seconds later; and that it wasn't until Friday that Mr. Miller, looking back, understood its significance. Joint Ex. 199, at 23-24 (Higgins).

180. TMIA also mounts a circumstantial argument that Mr. Miller had been informed of a complete set of 51 incore thermocouple temperature readings taken on March 28 from which Mr. Miller properly interpreted

the pressure spike as a hydrogen burn at the time it occurred. TMIA proposed finding 81.

181. Incore thermocouples were installed at TMI-2 to support the startup and test program. Although they were neither utilized by plant operating personnel nor relied upon in any procedures, incore thermocouple temperatures could be printed out on the control room alarm computer printout. The computer's range was limited to 700° F. Readings in excess of 700° F were printed out as question marks. Joint Ex. 106, at 898 (SIG Report). Mr. Miller, however, did not understand the significance of question marks on March 28. Tr. 30,133 (Miller).

182. Soon after he began the initial assessment of the plant's status, Mr. Miller directed Mr. Ivan Porter, the lead instrument engineer, to take incore thermocouple readings at a point at or before the computer inputs. Tr. 30,133 (Miller). This tactic was based in part upon Mr. Miller's experience from the Navy and the TMI test program. Tr. 30,138-39 (Miller). Mr. Porter reported back to Mr. Miller after the first set of readings were taken. At the hearing, Mr. Miller's memory of the report was poor. Tr. 30,143 (Miller). In an early interview, May 7, 1979, he stated that:

[T]he other thing is that I had Ivan Porter read out the thermocouples on the in-cores which are not a device that are extremely accurate, but they are an indicator, it came out question mark on the computer. He sent an instrument tech down, the 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're hot, they were hot enough that they scared you, as far as what you're looking for. It

told me the reason the computer was off scale at 700 degrees. So I came in at 15 after 7, T₁ was pegging high, T₂ was pegged low. The in-cores were reading anywhere from 2500^C 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. Our goal was to maintain HP injection, maintain steaming, core cooling and attempt to go solid. I know that we were super heated and all that sort of thing, I don't think we tumbled to that kind of [logic] but we just knew 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.

Joint Ex. 23, at 55-56.

183. Despite his poor present memory of the thermocouple results, Mr. Miller seemed positive in his testimony that on March 28 he regarded the results as unreliable. Tr. 30,144-45, 30,151, 30,152 (Miller).

184. Mr. Porter testified that from his knowledge of the condition of the thermocouples since the accident he would not agree that the millivolt readings from the thermocouples (the method used by his technicians) would represent actual temperatures. His particular concern on the 28th was that the temperature readings should have been very close to each other, but that he recalled readings scattered from 200 to 2200° F and that 200° F was unreasonable for that time. Tr. 31,484-86 (Porter).

185. Mr. Miller stated that he did not have the complete set of 51 thermocouple readings (with six readings exceeding 2200° F) available to him until a matter of weeks after the accident. Tr. 30,171 (Miller). But TMIA imputes knowledge on March 28 of all 51 thermocouple readings to Messrs. Porter and Miller based upon the deposition of Mr. Richard Lentz, a General Public Utility Service Corporation (GPUSC) engineer. TMIA Ex. 32. The Lentz deposition does not support TMIA. In fact, it

appears that the opposite is true; the complete sets of readings did not become available until after March 28. Id. at 118-22.

186. TMIA also asserts that Mr. George Kunder's prior testimony indicates he knew that Mr. Porter had relayed incore temperature readings greater than 2200° F to Miller on March 28. TMIA proposed finding 94. Mr. Kunder testified in this proceeding, however, that he was not aware of incore temperature readings in that range until weeks after the accident. Tr. 30,060 (Kunder). Mr. Kunder testified that his knowledge concerning what information Porter had relayed to Mr. Miller was derived from having heard testimony on this point in hearings before the Kemeny Commission. Joint Ex. 59, at 13 (Kunder); see also Tr. 30,065-68 (Kunder). Mr. Kunder recalled that the temperatures data available to Mr. Miller on March 28 were not useful in diagnosing what was going on in the plant. Tr. 30,067 (Kunder).

187. Mr. Ross, deposed by the Special Inquiry Group, stated that the thermocouple readings provided to Mr. Miller, because of their very wide range, were not taken in a "serious vein." Joint Ex. 81, at 23-24; see also Joint Ex. 124, at 45-46 (Ross). Mr. Leland Rogers made a similar statement. Joint Ex. 87, at 29-30 (Rogers). TMIA cited a string of some twenty citations to the effect that temperatures greater than 2200° F were known in the "think tank" on March 28 and communicated to Mr. Miller. TMIA proposed finding 95. We checked each of the citations and could find none to the effect that readings of

temperatures greater than 2200° F were believed to be reliable on March 28.²⁰

188. Finally, TMIA argues that Mr. Miller's earlier statements that he was unaware of the alarms and the engineered safeguards (ES) signal at the time of the spike are not credible. TMIA proposed finding 75. Mr. Miller's testimony was that he cannot recall the alarms. Tr. 30,199 (Miller). Apparently the ES signal correlated to the pressure spike was the third ES signal of the day (Tr. 30,195 (Miller)), and there had been many alarms throughout the day (Joint Ex. 136, at 53-54). We cannot find either way whether Mr. Miller heard the alarms and was aware of the ES signal at the time of the spike.

Board Conclusions on Mr. Miller

189. Mr. Miller's testimony at the hearing was not very instructive to the Board. We have relied more upon his previous statements, the statements of others, and the circumstances in our effort to determine whether on March 28 Mr. Miller interpreted the pressure spike and containment spray actuation in terms of hydrogen combustion and core damage.

²⁰ However it is clear that the instrument technicians actually measuring the incore signals believed at the time that the high readings accurately indicated high temperatures. Mr. Yeager stated "Christ, this thing is melting down!" Both Mr. Yeager and Instrumentman Wright believed that the core was uncovered. TMIA Ex. 32(c) (Yeager).

190. The question of whether Mr. Miller, on March 28, knew about the pressure spike and the containment spray actuation is a legitimate one. There are several circumstantial factors indicating that he should have been aware of those events. Others, similarly situated, were aware of the spike. There were alarms and the relatively rare engineered safeguard (ES) signal. There was increased activity among the operators. Mr. Miller heard the noise, which was remarkable enough to prompt him to ask about it. He was actually in the process of gathering data for the impending report to the Lieutenant Governor, thus, presumably, he was sensitive to changes in plant status.

191. On the other hand, we place little significance in the early reports of incore thermocouple readings exceeding 2200° F. These readings were not then believed. In any event high incore thermocouple readings would not tell Mr. Miller that the pressure spike was real if he did not even know about the pressure spike. Those who knew the spike was real, Mr. Mehler for example, did not dwell on it, and immediately went to other tasks. Mr. Chwastyk was rather certain that Mr. Miller was preoccupied with his preparation for the trip to the State Capitol. His departure for the State Capitol is inconsistent with an appreciation that there had just been a real pressure spike sufficient to actuate the spray pumps.

192. As improbable in retrospect as it might seem that a containment pressure spike of some thirty pounds would not be noticed by Mr. Miller, it is no more improbable -- again in retrospect -- than the fact that other severe plant conditions were not understood on March 28.

Finally, in his early statements on the matter he has consistently and believably asserted that he did not know about the pressure spike on March 28.

193. The preponderance of the evidence is that Mr. Miller did not know about the spike or spray actuation on March 28. The most we could find from the evidence is the possibility, averred to by NRC Inspector Higgins, that Mr. Miller, on March 28, may have recognized a pressure spike (perhaps the securing of spray pumps); put it out of his mind until the morning of March 30; then recalled it when the hydrogen burn was understood. In any event, there is no reliable evidence that on March 28, 1979 Mr. Miller interpreted the pressure spike and containment spray actuation in terms of hydrogen combustion and core damage.

F. John G. Herbein

194. Mr. John G. Herbein was Vice President of Generation, Metropolitan Edison Company, at the time of the accident. He arrived at the observation center (also known as the "Visitors' Center") near Three Mile Island at about 11:45 a.m. on March 28 and remained at the observation center. He was in radio contact with the TMI-2 control room throughout the day. His primary contact was with his subordinate, Gary Miller. Mr. Herbein testified that he was not aware on March 28 of incore thermocouple temperature readings in the range of 2400° F. Tr. 30,299-301 (Herbein). Nor was he aware on March 28 of a pressure spike, having become aware of it through Mr. Lowe on the 30th or 31st of March. Tr. 30,418 (Herbein).

195. TMIA alleges that Mr. Herbein's testimony is incredible because Mr. Miller passed such information on to Mr. Herbein. TMIA proposed findings 96, 100, 101. Since we find that Mr. Miller did not know about the pressure spike and hydrogen burn on March 28, we cannot, of course, find that he passed this information on to Mr. Herbein. However, as we noted above, Mr. Miller and others had the early thermocouple readings and they could have passed this information to Mr. Herbein. TMIA proposed findings 96-98.

196. Mr. Herbein testified before the Kemeny Commission on July 29, 1979 that the high incore temperature readings were relayed to him on March 28, but because of the question marks, zero readings and some readings as high as 2400° F, the readings looked as though they were "woefully inaccurate." Joint Ex. 61, at 15 (Herbein). At the hearing, however, Mr. Herbein testified that he had not intended to tell the Kemeny Commission that on March 28 he had information to the effect that incore readings were as high as 2400° F. Tr. 30,304 (Herbein). He stated that he has been asked that question "again and again" but nowhere did he indicate that he had that knowledge on March 28. Id. Contrary to his testimony, however, the Board can identify only one other statement by Mr. Herbein on the incore temperature readings -- his deposition to the Special Inquiry Group on September 19, 1979. Joint Ex. 82, at 17-18 (Herbein). There his testimony was much the same as to the Kemeny Commission. He thought that he had had a conversation with the control room on March 28 about Mr. Miller seeing a few incore thermocouple readings -- some question marks, some zeros, some high, and

some very low. The range of data and missing points indicated to Mr. Herbein that the data was basically unreliable and inconclusive.

Id.

197. The Board concludes that Mr. Herbein's testimony that he did not know about the early high incore temperature readings is, as alleged by TMIA, not credible, in light of his two earlier statements. While we do not understand how Mr. Herbein could have been so positive about the matter in his testimony (Tr. 30,304-05), the matter is not important and does not reflect upon his candor. His earlier statements were about the same as every other informed person, i.e., the scatter of thermocouple readings was illogical and the readings were thought to be unreliable.

198. The preponderance of the evidence establishes that Mr. Herbein did not know about the pressure spike on March 28, much less that he correlated it with hydrogen burn and core damage. He possessed about the same information as did Gary Miller about the early incore thermocouple readings.

G. Knowledge of Other Individuals

199. Virtually every individual in a position to have relatively direct knowledge of the pressure spike and containment spray actuation has been interviewed, some many times, since the accident. As far as we can determine statements from each of them have been received into evidence. There has been almost an open-ended opportunity for the parties in this proceeding to discover and to present such information.

200. Mr. Hugh McGovern, a control room operator, dictated a chronology of events to Mr. Marshall, operations engineer, at about 3:00 p.m. on March 28th. As relevant, he noted:

1400 Had a [loss] of 2-32A and 2-42A[,] loss of radiation area monitors and an RX building pressure spike that went off scale on narrow range meter--definite spike straight up, straight back down . . . had full Rx building (spray pumps and [BS-VI's], DH-V8's) isolation and cooling. Someone secured spray pumps, shut BS-VI's and DH-V8's (Hugh did) and unisolated equipment for building.

Joint Ex. 1, at 2, 5. Licensee correctly notes that this statement indicates only an awareness that the spike had occurred; it attributes no significance to the spike.

201. In a May 4, 1979 Met Ed interview, Mr. McGovern explained the appreciation that he and others had of the significance of the spike:

[I]t was exactly when we had the reactor building pressure spike. At the time I don't think anybody thought it was an explosion. We thought that we just lost a bus. . . . At the time we thought the spike on the recorder was an electrical spike and not an actual pressure spike.

Joint Ex. 21, at 7-8.

202. The best inference to be drawn from Mr. McGovern's statements is that he regarded the spike at the time of its occurrence to be a signal anomaly.²¹

²¹ Licensee offered into evidence portions of a TMIA deposition of Mr. McGovern tending to corroborate the statement that the spike was regarded as electrical, but the Board Chairman vaguely "accepted" the deposition as compared to receiving it into evidence. Tr. 29,542. TMIA now objects to Licensee's citation to the deposition on that basis. We see no need to enter that fray.
(Footnote Continued)

203. Mr. Craig Faust, a control room operator, stated in an April 6, 1979 interview with Met Ed:

Q What about the reactor containment building spike?

A We probably had some sort of explosion because that's what it looked like; shock waves.

Q Did you hear anything?

A No I didn't.

* * * *

Q The spray pumps came on automatically?

A Right.

Joint Ex. 8, at 5-6.

204. Licensee argued that Mr. Faust's statement that they probably had "some sort of explosion" should be read as a retrospective observation, and that it provides no basis for a belief that Mr. Faust understood the spike to represent hydrogen generation or zirconium/water reaction. This reading is probably correct because, in an NRC interview of Mr. Faust on April 21, 1979, he stated:

The only other thing we had was this spike in the building, which I believe we are now interpreting possibly to a hydrogen explosion. [Underlining added.]

Joint Ex. 12, at 82-83.

(Footnote Continued)

The problem with both the deposition and the May 4, 1979 statement is that neither indicates when Mr. McGovern later became aware that the spike was real.

205. The best inference to be drawn from Mr. Faust's statements is that on March 28 he understood that there was an actual pressure spike and containment spray actuation but that he did not then understand the significance of those events. See Joint Ex. 2, at 11 (Faust); but see Joint Ex. 28, at 145; Joint Ex. 133, at 7 (Faust alludes to instrumentation problem).

206. On April 21, 1979, Mr. Donald Berry, an engineer who was maintaining a log of events in the control room at the time of the pressure spike, was interviewed by the NRC:

A People didn't really, I don't think, understand at that point [spike] what happened. I didn't understand at that point what happened. Sprays came on. We know that and then they, as I logged there, they turned the sprays off, you know, the pressure had spiked up and came back down.

Q Why did they stop the sprays?

A The pressure was back down to normal or close to normal level and they turned the spray off. So at that point I don't think anyone really realized and it wasn't until we were reading about the spike in the paper that there was a possible hydrogen, and I am going back things through my mind, when it could happen, I was there from 7:00 in the morning until 6 o'clock the next morning and then it dawned on me that we had the building spike. And that was the only way I could see that people must have later realized and that is what they tied it to. [Underlining added.]

Joint Ex. 13, at 17-18.

207. Mr. John Flint, a B&W employee who was in the control room throughout the 28th, in an April 23, 1979 NRC interview, stated:

In this range of time, heard a double thump, and at the time we had been in and out of respirators. I assumed that the sound I heard was just a ventilation cycling at this time.

There appears to be a correlation with this and the reported hydrogen detonation in the building at that time.
[Underlining added.]

Joint Ex. 14, at 6.

208. In an April 23, 1979 NRC interview, Shift Supervisor William Zewe stated:

I was right on the recorders themselves and they just went (whistle) up and right down. And I said, "What the heck was that." . . . And he said, "Bill, we've started the buildings spray pumps." And I said, "What?" And so I looked over, and they were running and I pondered that for about 30 seconds. I guess, because I thought, there just must have been some electrical fault surge from the electromatic, that caused the building spray pumps to come on.

Joint Ex. 15, at 33. Mr. Zewe left no doubt as to his understanding of the pressure spike indications:

I was convinced at that time it was just a false electrical signal.

* * * *

It never entered my mind that it was a hydrogen explosion, at that time at all.

Id. at 38. He stated that he discussed the spike with Joseph Chwastyk and Michael Ross, and they also concluded it was some sort of electrical transient. Joint Ex. 75, at 256-59. See also Joint Ex. 119, at 42-44.

209. In a May 9, 1979 NRC interview, Mr. Joseph Logan, the TMI-2 Superintendent, stated that although he was in the control room at the time, he did not recall a report that reactor building sprays had activated. He did hear a noise, asked what it was, and someone reported it was the ventilation system. Joint Ex. 25, at 72-73; Joint Ex. 77, at 14-15. Mr. Ivan Porter, lead instrumentation engineer, stated he was

not aware of the pressure spike on March 28, 1979. Joint Ex. 70, at 12-14. Mr. George Kunder, in charge of technical assistance, testified in this proceeding and has previously stated that he was not aware of the pressure spike on the 28th. Mr. Kunder, who also went to the State Capitol with Mr. Miller, was collecting data for that purpose at the time of the spike. Tr. 29,994 (Kunder); Joint Ex. 72, at 25-27.

210. Mr. Leland Rogers, B&W's site operations manager, stated that he was not aware of the pressure spike. He did hear a "bang" but was told it was ventilation dampers. Joint Ex. 87, at 47-48; Joint Ex. 100, at 49-50.

211. Two NRC inspectors who were in the control room -- James Higgins and Donald Neely -- were not aware of the pressure spike on the 28th. Joint Ex. 79, at 51 (Higgins); Joint Ex. 129, at 22-24 (Higgins); Joint Ex. 90, at 16-17 (Neely); Joint Ex. 130, at 8-9 (Neely).

212. Control room operators Edward Frederick and Lynn Wright were aware of the pressure spike, but did not understand it. They attributed it to an electrical or instrument problem. Joint Ex. 28, at 143-47 (Frederick); Joint Ex. 71, at 11-13 (Frederick); Joint Ex. 75, at 264-65 (Frederick); Joint Ex. 111, at 3-7; Joint Ex. 116, at 7-13 (Wright).

213. Mr. Adam Miller, a shift foreman in the control room, was also aware of the pressure spike but did not understand it. He believed it was due to a sudden escape of steam when the EMOV was opened. Joint Ex. 137, at 4-5.

214. Mr. Walter Marshall, an operations engineer in the control room at the time of the spike, was aware of the spike. He stated that

they could not come up with any reason for the pressure spike other than an electrical system or instrument fault. Joint Ex. 31, at 23.

215. Mr. Michael Ross, the TMI-1 Supervisor of Operations who was in the Unit 2 control room providing assistance, and near the console at the time, was also aware of the pressure spike, but he attributed it to an instrument problem. Joint Ex. 33, at 3-5; Joint Ex. 81, at 42-44; Joint Ex. 124, at 47-48.

H. Questionnaire Responses

216. In order to respond to many of TMIA's first set of interrogatories, Licensee prepared a thirteen-page questionnaire which was distributed to 456 individuals. Those receiving the questionnaire were present and past GPU System and B&W employees who might be in a position to have information about the pressure spike, spray actuation, the noise heard coincident with the spike, and any realization of hydrogen combustion and core damage inferred from the pressure spike. TMIA Ex. 32(a), at 1.

217. Question 3(a) of the questionnaire asked:

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

Twenty-one individuals answered "yes" to question 3(a). Affirmative answers to question 3(a) would, if correct, be contrary to Licensee's avowed understanding of the facts. Therefore, Licensee contacted all 21 persons who responded "yes." In all but one instance (one person, an ex-employee, could not be reached), Licensee discussed with each person

his or her response to question 3(a). Licensee's discussion with each person amounted to asking each person whether he or she understood question 3(a). Each of the twenty reported that his or her response to question 3(a) was in error; that in fact each had no information about hydrogen on March 28, or that each could not recall when each first learned about hydrogen. Several were quite specific as to the time and circumstances of their learning about hydrogen on another date. As a result, Licensee prepared and sent a letter to each individual confirming Licensee's understanding of the conversation. Subsequently Licensee sought acknowledgment of its letter from each person contacted (except one who is not currently an employee of the GPU System Companies). TMIA Ex. 32(a), Attachment 3.

218. The Board authorized TMIA to depose and to call as witnesses any six of the twenty respondents. TMIA called Thomas Mulleavy, Joseph DeMan, Curtis Conrad, David Zeiter, A. P. Rochino, and Robert Boyer. Counsel for TMIA cross-examined all six extensively concerning their responses and their discussions with Licensee's attorneys. As might be expected, as a group, the six witnesses called by TMIA had the weakest and most questionable comments on Licensee's follow up. TMIA Ex. 32(a), Attachment 3. Each of the six, however, explained in his testimony that his original response to the questionnaire was as the result of misunderstanding. As perceived by the Board, there was plain carelessness in reading. Tr. 31,334 (Mulleavy); Tr. 31,357 (DeMan); Tr. 31,387 (Conrad); Tr. 31,403-04 (Zeiter); Tr. 31,430, 31,432-33 (Rochino); and Tr. 31,558 (Boyer).

219. Messrs. Mulleavy (Tr. 31,334), DeMan (Tr. 31,350-51), and Rochino (Tr. 31,427, 31,434-36, 31,449) testified that it was after the 28th that they learned about the hydrogen burn. Mr. Boyer could not recall when he learned about it. Tr. 31,556-58 (Boyer). Mr. Conrad learned about the hydrogen combustion in the containment building at the hearing during cross-examination, apparently believing that the combustion under discussion was one he thought to be in the reactor vessel itself. Tr. 31,378-80 (Conrad).

220. Similarly, Mr. Zeiter thought that the hydrogen bubble in the reactor vessel, a matter of concern several days after the accident, was the same phenomenon as the pressure spike on March 28 until a couple of weeks before his testimony in this proceeding. Tr. 31,402 (Zeiter).

221. TMIA meets this testimony quite simply: The Board should accept the initial responses to the questionnaire as accurate and regard the testimony of each of them in this proceeding as non-credible. TMIA proposed finding 133. We are urged to find that the quality of the testimony by TMIA's six witnesses is so poor that we must "find they were pressured by company attorneys to change their testimony for purposes of these hearings." TMIA proposed finding 134. In essence, counsel for TMIA charges the six witnesses with perjury and the company attorneys with subornation of perjury. See also TMIA proposed findings 103, 111, 116, 120, 127, and 129. The charge is disruptive, unfounded, and professionally reckless. TMIA's analysis of the record based upon its perjury/subornation-of-perjury theory is frivolous and we decline to evaluate it. The Board itself, however, is satisfied that none of the

six witnesses knew on March 28, 1979 that there was a hydrogen combustion in the containment. Their testimony to that effect is representative of the twenty-one witnesses who originally answered "yes" to question 3(a).

I. Knowledge of GPU Service Corporation (GPUSC) Engineers

222. On the day of the TMI-2 accident (March 28, 1979), Mr. Richard Wilson, Director of Technical Functions, GPUSC, informed Mr. Robert Keaten (GPUSC) of the event and directed Mr. Keaten to arrange to send some of the GPUSC engineers to the Three Mile Island facility for an investigation of what had happened.²² TMIA would have the Board find that these engineers interpreted the pressure spike in terms of the generation of substantial amounts of hydrogen and serious core damage from information they learned on March 28 or early on March 29, thus, we presume, undercutting the credibility of the Dieckamp mailgram. TMIA proposed findings 137-166.

223. TMIA states that Mr. Gary Broughton, who was GPUSC's Control and Safety Analysis Manager, was given the responsibility to obtain data to put together a sequence of events and to address the question of

²² At our hearing, Mr. Keaten could only remember specifically having arranged for Messrs. Gary Broughton and Richard Lentz to go, but said there may have been others. Tr. 31,237-39 (Keaten). Licensee lists the following GPUSC engineering personnel who went to Three Mile Island on March 28: Messrs. Julien Abramovici, Gary Broughton, George Lehmann, Richard Lentz, and James Moore. Licensee proposed findings, Appendix C.

whether the core was uncovered. TMIA proposed findings 138-139. Mr. Broughton testified, however, that he did not know whether the question "was the core covered" was a specific assignment. Rather, he suggested that it was the type of question that they would have been able to answer after the data were collected and subsequently analyzed.

Tr. 31,708 (Broughton).

224. While TMIA points to Mr. Broughton's testimony that "they might collect strip chart recordings to evaluate the transient" (TMIA proposed finding 139), that statement alone creates a false impression of the materiality of strip charts to GPUSC engineers. Mr. Broughton testified: "[g]enerally when we looked at a transient like this we didn't rely on strip charts.... In some cases we had to fall back on the strip charts because that information wasn't available through some other source." Tr. 31,081 (Broughton).

225. TMIA attributes generally to the GPUSC engineers knowledge of incore thermocouple temperatures greater than 2500° F. TMIA proposed finding 137. Notes taken by the first GPUSC engineer to arrive at TMI -- James Moore -- indicate that Mr. Moore was told at approximately 5 p.m. on March 28 by Richard Bensei about incore thermocouple readings greater than 2500° F. TMIA Ex. 32K, deposition Ex. 2, at 6. TMIA continues, however, claiming that "Mr. Moore stated that after being briefed about temperatures greater than 2500° F he understood that there had been some core damage." TMIA proposed finding 142, citing TMIA Ex. 32K, at 126. However, the citation indicates that Mr. Moore concluded that there was core damage based on a 1,000 R/hr. dome reading

-- information also provided to Mr. Moore by Mr. Bense1 at 5 p.m. Mr. Moore's statement only indicates he reached a conclusion regarding core damage after the 5 p.m. briefing, and does not indicate that he based his conclusion on high incore thermocouple readings as TMIA suggests. Mr. Moore, in fact, testified that he did not know that core temperatures in excess of 2200° F would indicate that a zirconium-water reaction would occur or that hydrogen would be produced. TMIA Ex. 32K, at 87-88 (Moore).

226. TMIA asserts that Mr. Moore has stated that he subsequently informed Mr. Broughton of all relevant information including the incore thermocouple temperature readings greater than 2500° F. TMIA proposed findings 143. Not one of TMIA's citations, however, supports this claim. Mr. Broughton, as early as in a June 11, 1979 NRC IE interview, stated that he did not have any knowledge of incore thermocouple readings on the 28th. The only affirmative piece of evidence before the Board -- Mr. Broughton's IE interview -- indicates that Mr. Broughton was not informed of incore thermocouple temperatures. Joint Ex. 48, at 29 (Broughton). The Board also rejects TMIA's claim that "GPUSC engineers were also aware that a significant amount of hydrogen had been produced by a zirconium-steam reaction." TMIA proposed finding 146. TMIA cites no evidence to support this.

227. TMIA attributes to the GPUSC engineers knowledge of the pressure spike. TMIA first refers to a briefing of the engineers by George Kunder at about 6 p.m., but TMIA does not claim that any mention was made of the pressure spike. TMIA proposed finding 147.

228. TMIA claims that Mr. Lentz photocopied the strip chart on the evening of March 28. TMIA proposed finding 152. TMIA ignores Mr. Lentz's present testimony and prior statement to the effect that he did not obtain a photocopy of the pressure spike on that day. Lentz, ff. Tr. 32,972, at 2. Mr. Lentz previously stated in an NRC interview on June 1, 1979 that he photocopied no analog output on March 28. Joint Ex. 47, at 9 (Lentz). TMIA claims that Mr. Lentz "was responsible for preserving analog data, including strip charts on March 28." TMIA proposed finding 161. But Lentz testified that this responsibility was not assigned to him until a day or two after the accident. Tr. 32,997 (Lentz).

229. TMIA cites no evidence indicating that Mr. Lentz photocopied the strip chart. Instead, TMIA refers to Theodore Illjes' NRC IE interview (TMIA proposed finding 152), in which Mr. Illjes stated that on March 28 someone (whom Illjes could not remember) asked for a copy of the strip chart. See Joint Ex. 36, at 9 (Illjes). Mr. Illjes stated that he could not remember if the person was an NRC inspector or a B&W representative. Id. Even if the Board were to accept Illjes' statement in his IE interview, the Board could not accept TMIA's assertion that "it must have been Lentz who made the photocopy." TMIA proposed findings 153.

230. Mr. Illjes' NRC IE interview cannot, however, be accepted at face value -- particularly with regard to whether the strip chart was photocopied on the 28th. We have previously noted that Mr. Illjes' memory has been consistently very poor. Section IV.D., supra.

Mr. Illjes' statement has been widely discredited. The possibility that the strip chart was photocopied on March 28 was examined and rejected in NUREG-0600 and in the SIG Report. Mr. Illjes now believes that the discussion of hydrogen, which he remembered in conjunction with the chart being photocopied, occurred on Friday, March 30. Tr. 29,595, 29,651 (Illjes). In addition, other testimony and physical evidence strongly indicates that the pressure chart was not removed on the 28th. Joint Ex. 60, at 9-12; Joint Ex. 107, at 61; Tr. 29,407-409 (Chwastyk).

231. TMIA's last point is that Mr. Keaten's notes "confirm this hypothesis" that GPUSC engineers understood the pressure spike. TMIA proposed finding 166. This point rests on the premise that Mr. Keaten's notes were written on March 29. We have found elsewhere, however, that they were written on March 30. Section III.A.4, supra.

232. There may be some evidentiary ambiguity as to who copied the pressure spike portion of the reactor building pressure recorder strip chart and when the copies were made. We have not attempted to resolve this previously, pending a determination as to its relevancy to the state of knowledge of the GPUSC engineers. The Board concludes that the question of who and when is in no way a pivotal or relevant issue with respect to the depth of understanding about the TMI-2 accident acquired by the GPUSC engineers on the 28th or 29th of March.

233. The Board finds that the GPUSC engineers first sent to TMI on March 28 did not gain an awareness of the significance of the pressure spike on the 28th or early on the 29th of March 1979.

V. Whether, in the NRC Staff's View, Mr. Dieckamp
Believed the Statements in the Mailgram Were True

234. The Licensing Board originally disposed of its concern about the Dieckamp mailgram based upon the report of the NRC Staff's investigation into information flow, NUREG-0760,²³ and the testimony of the lead Staff investigator, Mr. Norman C. Moseley. In its remand opinion, the Appeal Board explained that our reliance upon NUREG-0760 and Mr. Moseley's testimony was misplaced. We erred primarily because that report was too summary; because our questioning of Mr. Moseley on the point was insufficiently penetrating; because there was then no firm record evidence that Mr. Dieckamp was ever interviewed on the matter; and because we should have examined Mr. Dieckamp on our own. ALAB-772, 19 NRC at 1266-67.

235. Whether NUREG-0760 is an adequate report of the IE investigation, whether Mr. Moseley's views on the Dieckamp matter are sound and, in fact, whether the investigation was complete have, to a large extent, become moot. With the aid of the parties, we have explored the issues as carefully as we know how and have not relied upon the conclusions of NUREG-0760 or those of Mr. Moseley in his early testimony.

236. The Board has not used NUREG-0760 for disputed factual findings. We have purposely avoided referring to the report except to

²³ Staff Ex. 5 in the main hearing.

determine whether we have left unexplored avenues of inquiry suggesting that the mailgram was false.

237. When Mr. Moseley previously appeared before the Board on February 18, 1981, he testified that, based upon his September 12, 1980 interview with Mr. Dieckamp, Mr. Moseley believed that Mr. Dieckamp's intent in sending the mailgram was to tell the truth, and that in fact Mr. Dieckamp believed the mailgram was true. Tr. 13,063-64 (Moseley).

238. Even though we do not depend upon Mr. Moseley's conclusions as to whether Mr. Dieckamp believed his mailgram was accurate, it was appropriate and useful, in a negative sense, to hear from Mr. Moseley in the remanded proceeding. That is, in view of the Appeal Board's concern, our duty was to determine whether Mr. Moseley and the IE investigating team possessed information tending to incriminate Mr. Dieckamp.

239. Mr. Moseley, now employed by the Institute of Nuclear Power Operations, testified for the Staff in the hearing on remand. He still believes that Mr. Dieckamp believed the mailgram was true. Moseley, ff. Tr. 29,816, at 4. He explained that he and Terry Harpster of the NRC Staff interviewed Mr. Dieckamp under oath and on the record on September 12, 1980 and believed then that he was sincere. Id. As noted, it is now our task, not Mr. Moseley's, to judge Mr. Dieckamp's credibility. However, Mr. Moseley also added objective reasons for his opinion. He believes that it was beyond the range of credible operator knowledge to infer that amounts of hydrogen sufficient to reach a flammable concentration in a two million ft.³ containment would exist at

ten hours after the initiation of the event. Mr. Moseley also asserted his belief that no one present in the control room had concluded on March 28 that hydrogen caused the pressure spike. Id.

240. Mr. Moseley made himself available for extensive cross-examination, and in our view nothing inconsistent with his opinion was developed. He was a credible witness. Tr. 29,817, et seq. (Moseley). We listened to his testimony carefully and have since read many of the depositions conducted by him and the IE team in September 1980. We are satisfied that Mr. Moseley was well informed and had a basis for his opinion.

241. TMIA presented the testimony of David H. Gamble, who, during the relevant period had been employed as a criminal investigator by the NRC Office of Inspector and Auditor. He had been assigned to participate in the investigation directed by Mr. Moseley. The purpose of Mr. Gamble's testimony was to disparage the methods and results of the investigation. Gamble, ff. Tr. 30,522 (passim).

242. Mr. Gamble was not a very convincing witness and did not seem to understand the investigatory scheme used by the IE team. For example, Mr. Gamble makes the superficially shocking charge that Mr. Moseley directed that portions of the report of the investigation be drafted before the interviews. Id. at 2. Mr. Gamble felt that writing sections of the report based upon prior interviews and previously gathered documents tended to predetermine the conclusions. Id. at 4. But Mr. Gamble scarcely acknowledged the fact that the order from Mr. Victor Stello to Mr. Moseley establishing the information-flow task

force, expressly and prudently directed the team to rely on available interview transcripts and testimony "to the maximum extent possible" and to conduct additional interviews only when necessary. Staff Ex. 2, at 2. There was a very large body of carefully developed pre-existing information. Even so, the IE team conducted many additional interviews which formed an important part of the conclusions of NUREG-0760.

243. As is evident throughout this decision, the Board has cited to many of the interviews conducted by task force members Messrs. Moseley, Harpster, Craig, Hoefling, and Gamble in carrying out Mr. Stello's order to investigate the flow of information following the accident. One of Mr. Gamble's allegations is that Mr. Moseley placed unwarranted restrictions on the questioning of witnesses during the information-flow depositions. If true, the quality of the interviews would be diminished.

244. As Mr. Gamble explained, Mr. Moseley (1) established the scope of the questioning; (2) required that questions be prepared before the interview based upon available information; (3) required that one principal questioner at a time ask questions, that other questioners defer their questions until the end of the interview or slip the question to the principal questioner at the time; (4) at the end of the planned interview, Mr. Moseley would, off the record, organize and approve follow-up questioning. Tr. 30,560-73 (Gamble). Mr. Gamble could not recall Mr. Moseley prohibiting any questions in any interview attended by Mr. Gamble. Tr. 30,665.

245. If Mr. Gamble had been in charge of the investigation, he would not have prepared word-for-word questions in advance and would have permitted all five of the interviewers to ask questions whenever each felt like it. E.g., Tr. 30,561, 30,567. Mr. Gamble was free to ask any questions whenever he chose. E.g., Tr. 30,562.

246. The Board has read the relevant portions of most, perhaps all, of the pertinent information-flow interviews. We find no sign that the questioners were frustrated. There were many follow-up questions. Mr. Moseley's ground rules for the interviews were logical and conducive to order, accuracy and thoroughness -- not to mention fairness to witnesses. Our only criticism might be that he should not have exempted Mr. Gamble from following the protocol, but as it turned out, Mr. Gamble asked relatively few questions.

247. In sum, while the Board did not rely upon the conclusions of NUREG-0760 in this proceeding, we relied upon its underlying interviews. We find no fault with the Staff's information-flow investigation as it pertains to the Dieckamp mailgram issue.²⁴

²⁴ The Board has not addressed all of Mr. Gamble's criticisms of the NUREG-0760 investigation (TMIA proposed findings 273-83). We agree with the Staff that they are inconsequential. Moreover, they have turned out to be irrelevant. The Staff's proposed findings on Mr. Gamble's testimony accurately reflect our views. Staff proposed findings 57E-57P.

VI. Conclusions of Law

248. The pressure spike and the actuation of the containment building spray system was first interpreted in terms of a hydrogen combustion at about 11:00 p.m. on March 29, 1979 by Mr. William Lowe. At that time he also concluded that the hydrogen was produced by a zirconium and water reaction in the reactor core. Several hours later he concluded that the core had been extensively damaged.

249. Mr. Dieckamp learned of Mr. Lowe's discovery on March 30, 1979.

250. The statements by Joseph Chwastyk that, on March 28, 1979 he knew the pressure spike was real are accurate. Mr. Chwastyk's statements that, on March 28, he knew that the pressure spike was caused by a hydrogen explosion are not accurate. His statements that on March 28 he knew that there had been a zirconium/water reaction also are not accurate.

251. The statement by Brian Mehler that he knew that on March 28, 1979 an order was given not to operate electrical equipment in order to avoid igniting hydrogen is not accurate, nor does Mr. Mehler believe his statement is accurate.

252. The statement by Theodore Illjes that on March 28, 1979 there was a discussion that a hydrogen combustion caused the pressure spike is not accurate, nor does Mr. Illjes believe it is accurate.

253. No statement by any participant to the effect that on March 28, 1979 he knew that there had been a hydrogen combustion is accurate. No one knew on March 28, 1979 that there had been a hydrogen

combustion in the containment of TMI Unit 2, or that there had been a zirconium/water reaction in the reactor core.

254. On May 9, 1979, when Mr. Dieckamp sent his mailgram to Congressman Udall, he believed that it was accurate. At that time there was no evidence to the contrary. Subsequent information to the contrary is not accurate.

255. Mr. Dieckamp was deeply involved in the recovery of the accident at TMI-2. He had gathered information to present to Senator Hart's Subcommittee about the accident several weeks before the mailgram. He had a reasonable basis to believe that the mailgram was accurate and did not act in careless disregard of the facts in sending the mailgram.

256. Subsequently, when the statements of Messrs. Chwastyk, Mehler, and Illjes came to light, and when other information became available to Mr. Dieckamp that there was some evidence that someone on March 28, 1979 had interpreted the pressure spike and containment spray actuation in terms of reactor core damage or hydrogen, it would have been functionally pointless to formally notify the NRC of this information. The NRC was either the developer of that information or was receiving it simultaneously with Mr. Dieckamp. We do not reach the question as to whether Mr. Dieckamp, in the narrow legal sense, had a duty to formally notify the NRC of such information because that question is unrelated to any question of integrity.

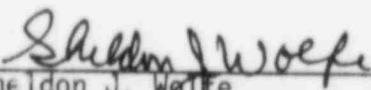
257. From the foregoing conclusions, it necessarily follows that no relevant information was withheld.

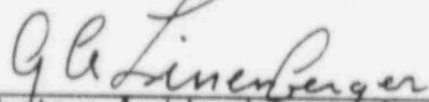
258. This aspect of the remanded proceeding is decided without reservation or condition in favor of the Licensee.

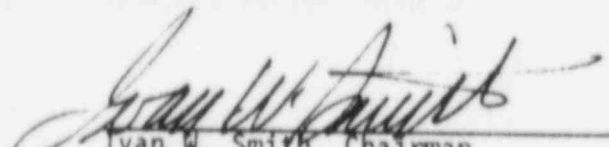
VII. Appeals

Any party may take an appeal from this decision by filing a Notice of Appeal within ten days after service of this partial initial decision. Each appellant must file a brief supporting its position on appeal within thirty days after filing its Notice of Appeal (forty days if the Staff is the appellant). Within thirty days after the period has expired for the filing and service of the briefs of all appellants (forty days in the case of the Staff), a party who is not an appellant may file a brief in support of or in opposition to the appeal of any other party. A responding party shall file a single, responsive brief only regardless of the number of appellants' briefs filed. See 10 CFR § 2.762.

ATOMIC SAFETY AND LICENSING BOARD


Sheldon J. Wolfe
ADMINISTRATIVE JUDGE


Gustave A. Linenberger, Jr.
ADMINISTRATIVE JUDGE


Ivan W. Smith, Chairman
ADMINISTRATIVE LAW JUDGE

Bethesda, Maryland

August 19, 1985

APPENDIX A

List of Witnesses and Testimony

<u>Witness</u>	<u>Written Testimony</u>	<u>Oral Testimony</u>
Boyer, Robert E.		31,544 to 31,567
Brill, Richard A.	ff Tr. 31,610	31,593 to 31,665
Broughton, T. Gary	ff Tr. 31,235	31,070 to 30,234
Chwastyk, Joseph J.		29,107 to 29,426
Conrad, Curtis A.		31,361 to 31,391
Deman, Joseph H.		31,343 to 31,358
Dieckamp, Herman M.	ff Tr. 28,316	28,302 to 28,970
Gamble, David H.	ff Tr. 30,522	30,459 to 30,822
Henrie, James O.		31,007 to 31,044
Herbein, John G.		30,298 to 30,458
Illjes, Theodore F.		29,585 to 29,782
Keaten, Robert W.		31,236 to 31,299
Kunder, George A.		29,989 to 30,103
Lentz, Richard	ff Tr. 32,972	32,971 to 33,032
Lowe, William W.	ff Tr. 28,151	28,138 to 28,246
Mehler, Brian G.		29,427 to 29,584
Miller, Gary P.		30,123 to 30,294
Moseley, Norman C.	ff Tr. 29,816	29,784 to 29,977
Mulleavy, Thomas L.		31,318 to 31,343
Porter, Ivan D., Jr.	ff Tr. 31,462	31,461 to 31,496
Rochino, A. P.		31,417 to 31,458
Van Witbeck, Thomas L.	ff Tr. 28,261	28,259 to 28,295

Wilson, Richard F.	ff Tr. 31,504	31,503 to 31,544
Zebroski, Edwin L.	ff Tr. 28,441	28,439 to 28,571
Zeiter, David E.		31,392 to 31,413

Documentary Material Bound
into the Transcript

<u>Description</u>	<u>Following Transcript Page</u>
Curriculum Vitae of William W. Lowe	28,151
Mailgram from H. Dieckamp to Rep. Udall (May 9, 1979)	28,316
N.Y. Times "Lag in Reporting Reactor Damage Laid to Experts" (May 8, 1979)	28,316
Memorandum from B. Cherry to H. Dieckamp (March 29, 1979) (re TMI #2 Accident)	28,418
TMIA Deposition of Herman Dieckamp (Oct. 3, 1984) (page 121 to page 122 line 6)	28,632
TMIA Deposition of Robert Arnold (Oct. 4, 1984) (page 24 line 23 to page 26 line 4)	28,635
TMIA Deposition of Richard Lentz (Oct. 15, 1984) (page 105 line 7 to page 109 line 1)	29,708
TMIA Deposition of Walter Creitz (Oct. 29, 1984) (page 20 line 15 to page 30 line 5)	29,708
Notification by Licensee of Intended Joint Mailgram Exhibit References and Deposition Stipulations (Nov. 27, 1984)	30,105
Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Nov. 28, 1984) (re external check of containment)	30,105

Curriculum Vitae of David H. Gamble	30,522
Memorandum from Victor Stello to Norman Mosely (April 1, 1980) (re Completion of IE Investigation of Information Flow at TMI During March 1979 Accident)	30,522
Draft of NUREG-0760 Section Entitled "High Core Exit Temperatures"	30,522
Draft of NUREG-0760 Section Entitled "Reportability of a Predicted Offsite Exposure Rate"	30,522
Revised Draft of NUREG-0760 Section Entitled "Reportability of a Predicted Offsite Exposure Rate"	30,522
Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Nov. 28, 1984) (re knowledge of hydrogen burn)	30,823
Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Nov. 28, 1984) (re instruction not to operate electrical equipment)	30,823
Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Nov. 29, 1984) (re Illjes' prior statements)	30,823
Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Nov. 29, 1984) (re Chwastyk's communi- cations)	30,823
Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Dec. 5, 1984) (re discussion of hydrogen during meeting on March 29, 1979)	30,823
Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Dec. 5, 1984) (re incore thermocouples)	30,823

Notification by Licensee of Intended Joint Mailgram Exhibit 1 References (Dec. 5, 1984) (re investigative reports)	30,823
Open Lines of Inquiry into IE Inspectors' Alleged Failure to Report Information Re March 28, 1979, Hydrogen Explosion at TMI-2 (Enclosure 2 to TMIA Mailgram Exh. 22)	30,862
Notification by Licensee of Intended References to Joint Mailgram Exhibit 1 (Dec. 7, 1984) (re repressurization)	31,303
Notification by Licensee of Intended References to Joint Mailgram Exhibit 1 (Dec. 7, 1984) (re Mr. Arnold's knowledge of the pressure spike and incore thermo- couple temperatures)	31,303
Notification by Licensee of Intended References to Joint Mailgram Exhibit 1 (Dec. 7, 1984) (re time at which Miller departed TMI to brief the Lt. Governor)	31,303
Notification by Licensee of Intended References to Joint Mailgram Exhibit 1 (Dec. 7, 1984) (re thud attributed to ventilation dampers)	31,303
Notification by Licensee of Intended References to Joint Mailgram Exhibit 1 (Dec. 11, 1984) (re NSAC Report)	31,303
Notification by Licensee of Intended References to Joint Mailgram Exhibit 1 (Dec. 11, 1984) (re Inspector Higgins' impression of G. Miller's awareness of the pressure spike)	31,303
Notification by Licensee of Intended References to Joint Mailgram Exhibit 1 (Dec. 12, 1984) (re information gathered by GPUSC engineers)	31,582
Instruction Manual for Reactor Building Pressure Recorder	31,610

APPENDIX B

List of Exhibits

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
Joint Mailgram Exh 1	A. Modified Stipulation of Parties on Mailgram Evidence (Nov. 8, 1984)		
	B. Index of Joint Mailgram Exhibit	28, 131-28, 137	28, 137
	C. 14 Volumes, Containing 144 Documentary Items		
Licensee Mailgram Exh 1	Drawing and four Photographs (lettered A through D) of the TMI-2 Control Room	29, 070	29, 115
Licensee Mailgram Exh 2	TMI-A Deposition of Richard Lentz (Oct. 15, 1984) (page 50 line 25 to page 58 line 25, and page 60 line 12 to page 63 line 7)	31, 666	31, 670
Licensee Mailgram Exh 3	Licensee's Answer to Intervenor Three Mile Island Alert's Fourth Set of Interrogatories to General Public Utilities (Oct 7, 1984) (First four lines of Response 20)	31, 667	31, 670
Licensee Mailgram Exh 4	TMI-A Deposition of Richard Lentz (Oct. 15, 1984) (page 68 line 8 to page 71 line 19)	31, 670	Rejected at 31, 686
Staff Mailgram Exh 1	Memorandum from John Allearne to William Dircks, James Cummings, and Leonard Bickwit (March 21, 1980) (re further investigation of Metropolitan Edison) Attachment: letter from John Allearne to Rep. Morris Udall (March 21, 1980)	29, 916	29, 927

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
Staff Mailgram Exh 2	Memorandum from Victor Stello to Norman Moseley (April 1, 1980) (re Completion of IE Investigation of Information Flow at TMI During March 1979 Accident	29,918	29,930
Staff Mailgram Exh 3	Memorandum from Norman Moseley to David Gamble (Feb. 2, 1981) (re IE Investigation into Information Flow Concerning the TMI Accident)	30,810	30,811
Commonwealth Mailgram Exh 1	Memorandum from William J. Dircks to Chairman Ahearne and Commissioners Gilinsky, Hendrie and Bradford (February 23, 1981) (re Further Information and AEOD Background Paper on TMI Investigation Report) Attachment: Harold L. Ornstein, "Report on the Investigation into Information Flow Concerning the TMI Accident (February 19, 1981)	30,674	rejected at 30,788
TMIA Mailgram Exh 1	Memorandum dictated by William Lowe on March 28, 1979 (re conversation with Jack Thorpe)	28,162	28,168
TMIA Mailgram Exh 2	Notes taken by James Seelinger on March 29, 1979 (Pages 3-13)	28,167	28,586
TMIA Mailgram Exh 3	Notes taken by Herman Dieckamp on March 28, 1979	28,391	28,973

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
TMIA Mailgram Exh 4	Letter from H. Dieckamp to the Pennsylvania PUC (May 21, 1979) Attachment: Transcript of Mr. Dieckamp's comments to the PUC on 3/28/79 concerning the situation at TMI.	28,397	28,974
TMIA Mailgram Exh 5	Memorandum from B. Cherry to H. Dieckamp (March 29, 1979) (re TMI 2 Accident)	28,414	28,980
TMIA Mailgram Exh 6	Handwritten Minutes of March 29, 1979 and March 30, 1979 Meetings of the EPRI Research Advisory Committee	28,451	28,596
TMIA Mailgram Exh 7	First Page of Notes Taken by Edwin Zebroski on March 30, 1979 Concerning Conversation with Robert Keaten	28,462	28,597
TMIA Mailgram Exh 8	Notes Taken by Richard Lentz on March 28, 1979	28,568	28,604
TMIA Mailgram Exh 9	"Task-12" (March 28, 1979)	28,607	28,981
TMIA Mailgram Exh 10	Notes Taken by Robert Keaten from Feb. 15, 1979 to January 24, 1980	28,641	28,983
TMIA Mailgram Exh 11	Preliminary Summary: Technical Manpower Buildup TMI 2 Accident Recovery Team -- March 28 to April 1, 1979	28,653	28,986
TMIA Mailgram Exh 12	Transcript of Conversation between R. Long and D. Dubiel, J. Seelinger, John Hilbish, and Gary Miller on April 12, 1979	28,668	28,990

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
TMIA Mailgram Exh 13	Instructor Notes, TMI II Accident (Rev. 0, 1981)	28,710	28,994
TMIA Mailgram Exh 14	Memorandum to H. Dieckamp (undated) Attachments: Draft of Dieckamp Mailgram and May 8, 1979 New York Times Article	28,752	28,995
TMIA Mailgram Exh 15	Memorandum from E. Wallace to R. Arnold (Sept. 17, 1980) (re Internal Work Related to GPU's Knowledge of Core Damage Following the TMI-2 Accident Attachments: Notes taken by J. Moore on 3/28/79; Untitled piece authored by B. Behrle, S. Guibord, and D. Reppert; Interview Memorandum of Brian Mehler; and Draft TDR-TMI-115	28,879	28,997
TMIA Mailgram Exh 16	TMI-2 Control Room Log (March 28, 1979 to April 1, 1979)	29,385	29,385
TMIA Mailgram Exh 17	New York Times, "3 Mile Island Aides Said to Have Waited to Tell of Hazards" (Oct. 21, 1979)	29,514	29,978
TMIA Mailgram Exh 18	William Lowe's Activi- ties re TMI-2 Accident -- 0830 March 28 to 0730 April 8, 1979	30,000	30,106
TMIA Mailgram Exh 19	Questionnaire Completed by Thomas M. Crimmins, Jr. (Aug. 29, 1984)	30,035	30,107
TMIA Mailgram Exh 20	TMIA Deposition of Julien Abramovici (Oct 15, 1984) (Page 42 line 19 to page 50 line 13)	30,119	

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
TMIA Mailgram Exh 21	Letter from D. Lewis to L. Bernabei (Oct. 18, 1984) Attachments: TMI-2 Control Room Alarm Printout for March 28, 1979 (Pages 71-74); and Licensee's Fourth Supple- mental Response to Three Mile Island Alert's First Set of Interrogatories (Oct. 17, 1984)	30,196	31,235
TMIA Mailgram Exh 22	Memorandum from Roger A. Fortuna to James Cummings (Nov. 6, 1980) (re IE Inspectors' Alleged Failure to Report Information Re March 28, 1979, Hydrogen Explosion at TMI-2) (marked up)	30,709	
TMIA Mailgram Exh 23	Draft Letter from Roger Fortuna to NIS (Dec. 1, 1980) (marked up)	30,711	Rejected 30,823
TMIA Mailgram Exh 24	Memorandum from David Gamble to Norman Moseley (Jan. 26, 1981) (re IE Investigation Into Information Flow Concerning the TMI Accident)	30,713	30,811
TMIA Mailgram Exh 25	OIA Report: IE Inspec- tors' Alleged Failure to Report Information Re March 28, 1979 Hydrogen Explosion at TMI-2 (Jan. 7, 1981)	30,839	30,841
TMIA Mailgram Exh 26	TMIA Deposition of John G. Herbein (Sept. 28, 1984) (Page 28 through page 34 line 14)	30,991	30,991
TMIA Mailgram Exh 27	Notes Taken by H. Dieckamp on March 30, 1979	31,020	31,300

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
TMIA Mailgram Exh 28	Notes Taken by T. Gary Broughton on March 28 and 29, 1979	31,112	31,213
TMIA Mailgram Exh 29	Transcript of Sen. Hart Briefing at TMI Observation Center on March 29, 1979	31,264	31,309
TMIA Mailgram Exh 30	NUREG/CR - 1250 (Rogovin), Volume 11, Part 3, Pages 841-842	31,309	Withdrawn 31,313
TMIA Mailgram Exh 31	TMIA Deposition of T. Gary Broughton (Oct 5, 1984) (Page 70, line 11 to page 71 line 13, and page 93 line 22 to page 94 line 7)	31,312	31,416
TMIA Mailgram Exh 32A	Stipulation on Mailgram Evidence (Dec. 11, 1984) (with attachments noted therein -- questionnaires and followup letters)	31,315 31,697	31,571 31,697
TMIA Mailgram Exh 32B	Page from a Log of Radiation Measurements Taken at about 2 pm on March 28, 1979 Licensee's Response to TMIA'S First Set of Interrogatories and First Request for Production (Sept. 4, 1984)(answer to interrogatory 43(e)) Letter from E. Blake to L. Bernabei (Oct. 12, 1984) (fourth paragraph)	31,337 31,697	31,571 31,697

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
TMIA Mailgram Exh 32C	<p>TMIA Deposition of Ivan D. Porter (Sept. 27 1984) (page 26 to page 33 line 4; and page 55 lines 4 to 25)</p> <p>Attachments: Computer Control System Point Information Listing -- Remote Multiplexer External Connector Listing By Relay Address (Rev. 1, Jan 3, 1978) (Pages 1 to 3 with handwritten numbers entered after the fourth column)</p> <p>Reference Table for Type K Thermocouples</p>	<p>31,467 31,697</p>	<p>31,571 31,697</p>
TMIA Mailgram Exh 32D	<p>TMIA Deposition of William A. Yeager (Oct. 10, 1984) (page 18 line 2 to page 36 line 24; page 45 lines 20 to 24; page 75 line 8 to page 76 line 15; and page 77 line 16 to page 82 line 17)</p>	31,697	31,697
TMIA Mailgram Exh 32E	<p>TMIA Deposition of Richard W. Bensei (page 24 line 16 to page 28 line 25)</p>	31,697	31,697
TMIA Mailgram Exh 32F	<p>Letter from T. Crimmins to J. Thorpe (Nov. 1, 1984)</p>	31,697	31,697
TMIA Mailgram Exh 32G	<p>TMIA Deposition of Walter J. Marshall (Oct. 2, 1984) (page 10 line 2 to page 11; page 15 line 16 to page 17 line 11)</p>	31,697	31,697
TMIA Mailgram Exh 32H	<p>TMIA Deposition of Julien D. Abramovici (Oct. 15, 1984) (page 42 to page 50 line 20)</p>	31,697	31,697

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
TMIA Mailgram Exh 32i	TMIA Deposition of Richard Lentz (Oct. 15, 1984) (page 118 line 21 to page 126 line 8; page 128 line 15 to page 129 line 23)	31,697	31,697
TMIA Mailgram Exh 32j	TMIA Deposition of Michael Ross (pages 17 to 28)	31,697	31,697
TMIA Mailgram Exh 32K	TMIA Deposition of James P. Moore, Jr. (Sept. 26, 1984)	31,697	31,697
TMIA Mailgram Exh 33A	Questionnaire Completed by Thomas A. Mulleavy (Aug. 20, 1984)	31,330	31,569
TMIA Mailgram Exh 33B	Questionnaire Completed by Joseph H. DeMan (Aug. 20, 1984)	31,349	31,569
TMIA Mailgram Exh 33C	Questionnaire Completed by Curtis A. Conrad (Sept. 7, 1984)	31,368	31,569
TMIA Mailgram Exh 33D	Questionnaire Completed by David Zeiter (Aug. 17, 1984)	31,400	31,569
TMIA Mailgram Exh 33E	Questionnaire Completed by A. P. Rochino (Aug. 27, 1984)	31,430	31,569
TMIA Mailgram Exh 33F	Questionnaire Completed by Robert Boyer (Aug. 18, 1984)	31,545	31,569
TMIA Mailgram Exh 34	Testimony of David H. Gamble (Sept. 1, 1984)	31,415	
TMIA Mailgram Exh 35	Memorandum from W. Crandall to D. Croneberger (July 6, 1979) (re TMI Project - Containment Shock Wave Study Reactor Building Ambient Temperature Recorder Charts)	31,420	31,570

<u>Exhibit Number</u>	<u>Description</u>	<u>Identified at Transcript Page</u>	<u>Admitted at Transcript Page</u>
TMIA Mailgram Exh 36	TMI Project - Containment Shock Wave Study - Summary of Key Data	31,421	31,570
TMIA Mailgram Exh 37	Reactor Building Spray Actuation SfAS (Oct. 17, 1979)	31,423	31,570
TMIA Mailgram Exh 38	Notes Taken by Julien Abramovici on March 29, 1979	31,512	31,695
TMIA Mailgram Exh 39	Notes Taken by T. Gary Broughton on March 29, 1979	31,573	31,574 31,695
TMIA Mailgram Exh 40	TMIA Deposition of Ivan D. Porter, Jr. (Sept. 27, 1984) (page 49 last line to page 51 line 11)	31,575	31,576
TMIA Mailgram Exh 41	Reactor Building Pressure Strip Chart A (March 28, 1979)	31,606	
TMIA Mailgram Exh 42	Reactor Building Pressure Strip Chart B (March 28, 1979)	31,612	
TMIA Mailgram Exh 43	Notes Taken by Julien Abramovici on March 28, 1979	33,014	rejected at 30,048

APPENDIX C

Principal Participants in Activity Related to the Dieckamp Mailgram Issue

ABRAMOVICI, JULIEN D.	Engineer II, Mechanical Engineering, GPUSC. Located in Parsippany, N.J. Reported to Gary Capodanno. Arrived at TMI on 3/28/79.
ARNOLD, ROBERT	Vice President for Generation of the GPU Service Corporation. Located in Parsippany, N.J. Reported to Herman Dieckamp. Arrived at TMI on 3/30/79 and directed recovery effort under Herman Dieckamp.
BENNETT, SKIP	Instrumentation Foreman at TMI. Present on the morning of 3/28/79.
BENSEL, RICHARD W.	Lead Electrical Engineer at TMI-2. Arrived at TMI-2 after 6:00 a.m. on 3/28/79.
BENSON, MICHAEL L.	Lead Nuclear Engineer at TMI-2. Arrived at Unit 2 control room at about 7:00 a.m. on 3/28/79.
BERRY, DONALD	Operations Engineer at TMI-2. Arrived at TMI-2 at about 7:00 a.m. on 3/28/79. Was maintaining a log in the Unit 2 control room at the time of the pressure spike.
BROUGHTON, T. GARY	Control & Safety Analysis Manager, GPUSC. Located in Parsippany, N.J. Reported to Robert Keaten. Arrived at TMI on 3/28/79.
CAPODANNO, GARY	Mechanical Design Manager, GPUSC. Located in Parsippany, N.J. Reported to Donald Croneberger.
CHWASTYK, JOSEPH	Shift Supervisor at TMI. Relieved Zewe between 11:00 and 12:00 a.m. on 3/28/79.

CONAWAY, WILLIAM	Shift Foreman at TMI. Came on duty after 11:00 p.m. on 3/28/79.
CREITZ, WALTER	President, Met Ed. Located in Reading, PA.
CRIMMINS, THOMAS	Manager of Engineering, JCP&L. Arrived at TMI on 3/29/79.
CRONEBERGER, DONALD	Manager, Engineering and Design, GPUSC. Located in Parsippany, N.J. Reported to Richard Wilson.
DIECKAMP, HERMAN	President and Chief Executive Officer of GPU and GPUSC.
DUBIEL, RICHARD W.	Supervisor of Radiation Protection and Chemistry at TMI. Arrived at TMI at about 5:45 a.m. on 3/28/79.
FAUST, CRAIG	Control Room Operator at TMI-2. Present in control room when accident began and throughout the day.
FLINT, JOHN	Babcock & Wilcox's Engineer and Start-up Representative at TMI-2. Arrived at TMI-2 about 9:00 a.m. on 3/28/79.
FLOYD, JAMES	Operations Supervisor at TMI-2. Out of town on 3/28/79. Conducted Congressional tour of control room on 5/7/79.
FREDERICK, EDWARD	TMI-2 Control Room Operator. Present in the control room when accident began and throughout the day.
GILBERT, BOB	Instrumentation Technician at TMI-2. Present on the morning of 3/28/79.
GINGRICH, JUANITA	Auxiliary Operator at TMI. On duty when accident began.
HERBEIN, JOHN G.	Vice President for Nuclear Generation, Met Ed. Located in Reading, Pa. Reported to Walter Creitz. Arrived at TMI at about 11:40 a.m. on 3/28/79.

HIGGINS, JAMES	NRC Region I I&E Inspector. Arrived at TMI at about 10:00 a.m. on 3/28/79.
HILBISH, JOHN	Supervisor of Licensing, Met Ed. Located in Reading, Pa. Reported to George Troffer.
HITZ, GREGORY	Shift Supervisor at TMI. Arrived at TMI at about 6:00 a.m. on 3/28/79. Served as intermediary in telephone communications between NRC Response Center and the TMI-2 operators.
ILLJES, THEODORE	Control Room Operator at TMI-2. Came on-shift in the afternoon of 3/28/79.
KEATEN, ROBERT W.	Manager of Systems Engineering GPUSC. Located in Parsippany, N.J. Reported to Richard Wilson. Arrived at TMI on 3/31/79.
KIDWELL, JOHN	Control Room Operator at TMI-2. Came on shift in the afternoon of 3/28/79.
KLINGAMAN, RICHARD	Manager, Generation Engineering, Met Ed. Located in Reading, PA. Reported to John Herbein.
KUNDER, GEORGE	Superintendent of Technical Support at TMI-2 and the on-call Duty Officer at TMI-2 during morning of first day of the accident.
LEHMANN, GEORGE L.	Sr. Engineer, Generation, GPUSC. Located in Parsippany, N.J. Reported to Gary Capodanno. Arrived at TMI on 3/28/79.
LENTZ, RICHARD	Control Systems Engineer, GPUSC. Located in Parsippany, N.J. Reported to T. Gary Broughton. Arrived at TMI on 3/28/79.
LOGAN, JOSEPH B.	Superintendent at TMI-2. Arrived at TMI-2 about 5:45 a.m. on 3/28/79.

LONG, ROBERT	Manager of Generation Productivity, GPUSC. Located in Parsippany, N.J. Reported to the Director of Generation Operations, who in turn reported to Robert Arnold. Arrived at TMI on 3/29/79. Conducted some operator interviews beginning 3/29/79.
LOWE, WILLIAM	Consultant, Pickard, Lowe and Garrick, Washington, D.C. Arrived at TMI on 3/29/79.
MARSHALL, WALTER J.	Operations Engineer at TMI. Arrived at TMI-2 at about 5:35 a.m. on 3/28/79.
MCGOVERN, HUGH	Control Room Operator at TMI-2. Arrived at Unit 2 control room at about 6:55 a.m. on 3/28/79.
MEHLER, BRIAN	Shift Supervisor at TMI. Arrived in TMI-2 control room about 6:00 a.m. on 3/28/79.
MELL, CHARLES	Control Room Operator Trainee at TMI-2. Came on shift in afternoon of 3/28/79.
MILLER, ADAM	Shift Foreman. Arrived in TMI-2 control room at about 6:30 a.m. on 3/28/79.
MILLER, DONALD	Auxiliary Operator at TMI. On duty when accident began.
MILLER, GARY	Station Superintendent at TMI. Arrived in TMI-2 control room shortly after 7:00 a.m. Became Director of Met Ed's Emergency Command Team.
MOORE, JAMES P.	Mechanical Components Engineering Manager, GPUSC. Located in Parsippany, N.J. Reported to Donald Croneberger. Arrived at TMI on 3/28/79.
MULLEAVY, THOMAS	Supervisor, Radiation Protection at TMI.
NEELY, DONALD	NRC Region I I&E Inspector. Arrived at TMI about 10:00 a.m. on 3/28/79.

POGI, STEVEN	Former GPUSC Startup Engineer. Arrived at TMI on 3/30/79.
PORTER, IVAN	Met Ed's Lead Instrumentation Engineer. Arrived at the Unit-2 control room at about 6:30 a.m. on 3/28/79.
RAYMOND, WILLIAM	NRC Region I I&E Inspector. Arrived at TMI in afternoon of 3/28/79.
REPPERT, DONALD	Safety & Licensing Engineer, GPUSC. Located in Parsippany, N.J. Reported to Edward Wallace. Arrived at TMI on 3/29/79. Conducted some operator interviews beginning 3/29/79.
ROGERS, LELAND	Babcock & Wilcox's Site Operations Manager at TMI. Arrived onsite at about 7:00 a.m. on 3/28/79.
ROSS, MIKE	Supervisor of Operations at TMI-1. On duty at TMI-1 when Zewe called him about two hours after the accident started and asked him to go to the TMI-2 control room.
SCHEIMANN, FRED	Shift Foreman at TMI-2. On duty when accident began.
SEELINGER, JAMES	Superintendent at TMI-1. Arrived onsite at about 6:45 a.m. on 3/28/79. Given responsibility for Met Ed's Emergency Control Station in Unit 1 control room.
THORPE, JOHN	Manager of Environmental Affairs, GPUSC. Located in Parsippany, N.J. Reported to Robert Arnold.
TOOLE, RON	Former GPUSC Startup Engineer (TMI-2 Test Superintendent). Present at TMI on 3/29/79.
TROFFER, GEORGE	Manager, Generation Quality Assurance, Met Ed. Located in Reading, PA. Reported to John Herbein.

VAN WITBECK, THOMAS	Consultant, Energy Inc, Idaho Falls, Idaho. Arrived at TMI on 3/31/79. Leader of the Accident Assessment Group. Conducted operator interviews.
WALLACE, EDWARD	Licensing Manager, GPUSC. Located in Parsippany, N.J. Reported to John Thorpe. Arrived at TMI on 3/29/79.
WEAVER, DOUGLAS	Instrumentation Foreman at TMI. Present on the morning of the accident.
WILLIAMS, RON	Senior Consultant, Generation Divison, GPUSC. Located in Parsippany, N.J. Reported to Robert Arnold. Arrived at TMI on 3/29/79.
WILSON, RICHARD F.	Director of Technical Functions, GPUSC. Located in Parsippany, N.J. Reported to Robert Arnold. Arrived at TMI on 3/29/79.
WRIGHT, LYNN	Control Room Operator at TMI-2. Arrived at Unit 2 control room at about 6:45 a.m. on 3/28/79.
WRIGHT, THOMAS	Instrumentation Technician at TMI-2. Present on the morning of the accident.
YEAGER, BILL	Instrumentation Technician at TMI-2. Present on the morning of the accident.
ZEBROSKI, EDWIN	Director, Nuclear Safety Analysis Center, EPRI. Located in Palo Alto, CA. Arrived at TMI on 3/31/79 and assumed role of co-leader of Ad Hoc Industry Advisory Group.
ZEWE, WILLIAM	Shift Supervisor at TMI. On duty when accident began.

References:

NUREG/CR-1250, "Three Mile Island: A Report to the Commissioners and to the Public," Vol. II, Part 3 (Jan. 1980) at 811-816, 914-916.

Report to the United States Senate, "Nuclear Accident and Recovery at Three Mile Island" (June 1980) at 89-91.

JME 1(c) items 9, 12-16, 18-27, 30-38, 40-50, 52-54, and 56-60.

TMIA Mailgram Exh. 11.

SUPPLEMENTAL APPENDIX C

TMIA Adopts Licensee's Appendix C
and Supplements As Follows:

BEEMAN, LORRAINE	Rad Chem Tech Jr., TMI-1.
BENNER, RICHARD L.	Rad Chem Tech Jr., 2nd, TMI-1.
BOYER, ROBERT E.	Control Room Operator. - TMI-1. Reported to work at 2:30 p.m. on 3/29/79.
CVIJIC, GEORGE L.	Auxiliary Operator B, TMI-2.
CONRAD, CURTIS A.	Auxiliary Operator C, TMI-2 on 3/28/79. Reported to work about 7:00 a.m.
DEMAN, JOSEPH H.	Foreman Radiation Protection. Reported to work at Unit 1 about 6:00 or 6:30 a.m. on 3/28/79. Later went to Unit 2 early that morning.
HAHN, EDWARD D.	Utility Construction and Maintenance, 2nd Class, 2nd Yr., TMI-1.
HETRICK, JAMES L.	Maintenance, TMI-2
JOYCE, MATTHEW	Instrumentman 2nd Class, TMI-2.
KEMBLE, DAVID A.	Repairman 1st Cl. (Certified Welder), TMI-1.
LIONARONS, J. K.	Auxiliary Operator A, TMI-2.
NATALE, RONALD D.	Repairman 1st Cl. (Certified Welder), TMI-1
PELEN, MARGARET A.	Rad Chem Tech, TMI-2. Reported to work about 7:00 a.m., 3/28/79 and monitored people, trains, and cars.
REICH, DAVID E.	Instrumentman 1st Class, TMI-1.
RIGGENBACH, THOMAS	Instrumentman 1st Class, TMI-1.

PAGE TWO
SUPPLEMENTAL APPENDIX C

ROCHINO, A. P.

Engineering Mechanics Manager,
GPUSC, New Jersey. Provided
technical assistance at Unit 2
on 3/30/79.

SMITH, DONALD E.

Control Room Operator, TMI-1.

UMBERGER, RICHARD R.

Maint. 2, Mechanical, TMI

ZEITER, DAVID E.

Rad Chem Tech. Reported to
work at Unit 1 about 11:00 p.m.
on 3/27/79. Later went to Unit 2
about 7:00 or 8:00 a.m. on
3/28/79.