February 8, 1985

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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

THREE MILE ISLAND ALERT'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW ON DIECKAMP MAILGRAM ISSUE

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TMIA 2/8/85

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I INTRODUCTION

1. At the time of the Unit 2 accident on March 28, 1979, TMI Unit 1 had been shut down for refueling. On July 2, 1979, the Commission directed that TMI-1 be maintained in a shutdown condition, and determined that the public interest would best be served if hearings preceded any restart of TMI-1. The Commission based its actions on a conclusion that

> [i]n view of the variety of issues raised by the accident at the Three Mile Island Unit No. 2 facility, the Commission presently lacks the requisite reasonable assurance that the same licensee's Three Mile Island

Unit No. 1 facility, a nuclear power reactor of similar design, can be operated without endangering the health and safety of the public.

This Licensing Board was established to hold hearings on TMI-1's restart by the Commission Order and Notice of Hearing dated August 9, 1979, Metropolitan Edison Company (Three Mile Island Nuclear Station Unit No. 1), CLI-79-8, 10 NRC 141 (1981).

2. "Managerial capability and resources" was explicitly identified as an unresolved issue by the Commission in its August 9 Order, 10 NRC 141 at 144-145 (1979). The Commission's Order of March 6, 1980, CLI-80-5, 11 NRC 408 further delineated certain "management issues" which it deemed pertinent to a study of management capability. Among these issues are:

> (10) whether the actions of Metropolitan Edison's corporate or plant management (or any part or individual member thereof) in connection with the accident at Unit 2 reveal deficiencies in the corporate or plant management that must be corrected before Unit 1 can be operated safely.

3. This Board[1] presided over hearings concerning issues raised by Board Issue 10, as well as all other issues directed for review by the Commission in its August 9 and March 6 Order, 1980, resulting in an August 27, 1981 "Partial Initial Decision (Procedural Background and Management Issues)," 14 NRC 281 (1981). ("PID"),

4. In resolving Board Issue 10, we focused our inquiry

> ... in determining whether any particular actions on the part of Licensee reflected positively or negatively

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[1] The original Licensing Board members included Dr. Walter H. Jordan and Dr. Linda W. Little. These members were replaced by current Board members Sheldon J. Wolfe, Esq., and Dr. Gustave A. Linenberger, Jr. Ivan W. Smith, Esq. has served as Board Chairman since the formation of the original Licensing Board.

> on Licensee's management competence, and whether any of the witnesses considered there to be more subtle factors, such as management attitude, which were deficient in Licensee's management during the events following the accident. Included in this latter inquiry was our interest in Licensee's responses to external stimuli, such as the Staff's inspections, as well as Licensee's internal reactions to the TMI-2 accident, such as whether Licensee evaluated and, if so, in what manner, the performance of individuals in the company during the accident.

PID, Paragraph 463.

5. We devoted particular attention to the issue of information flow during the accident. We considered crucial to a full examination of the issue the management implications of a mailgram sent by GPU President Herman Dieckamp, to Congressman Morris K. Udall, Chairman of the House Committee on Interior and Insular Affairs which has NRC oversight jurisdiction, on May 9, 1979, with copies to at least two NRC Commissioners. See, Joint Mailgram Exhibit 1-C Item (142)[2], Appendix B, at 117-1 to 117-2; JME 29 at 190-191. The central question was whether Dieckamp deliberately or negligently made false and inaccurate statements in the mailgram.

6. 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.

Ibid.

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[2] Joint Mailgram Exhibit 1 includes Part A, the Joint Mailgram Stipulation to which Licensee, Three Mile Island Alert and the NRC Staff stipulated; Part B which is an index of all exhibits contained in this appendix; and Part C which contains 144 separate exhibits or items. These exhibits will be cited as JME 1-C(1), 1-C(2), etc.

7. In our August 1981 PID, we reached an overall conclusion resolving all "information flow" questions, including the implications of the "Dieckamp Mailgram", favorable to the Licensee. PID at paragraph 506.

8. Intervenor Three Mile Alert ("TMIA") appealed our conclusions on, inter alia, Board Issue 10. On May 24, 1984, the Appeal Board issued a decision which, inter alia, agreed with TMIA that this Board had not adequately developed a record on either the overall question of information flow, or on the specific issue of the "Dieckamp Mailgram," ALAB-772, slip op. at pp. 121-134, ultimately finding the record incomplete on both the competence and integrity of current Licensee management. ALAB-772 at 158.[3]

9. The Appeal Board determined that to properly resolve the mangement issues directed for consideration by the Commission, further development of the record on the "Dieckamp Mailgram" issue was necessary due to the fact that Mr. Dieckamp was and continues to play a critical role in managing the affairs of Licensee. The Appeal Board noted,

> ...Dieckamp is still a high level "presence" at GPU Nuclear. Although he was recently replaced as Chairman and Chief Executive Officer of GPUN, he remains a Director there and thus will continue to participate in the management of GPUN, albeit to a far lesser extent. Notice to the Commission, et al. (February 6, 1984). It is not unreasonable to expect that, as a former Chairman and CEO, Dieckamp will have a more commanding voice in directing the affairs of GPUN than many of his

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[3] The Appeal Board chose not to remand on the broader issue of reporting failures only because two principal figures, Gary Miller and John Herbein, had left Licensee's organization to take positions in GPU's non-nuclear operations. See, generally, ALAB-772 at 121-127.

> fellow members of the Board. Moreover, he sent the mailgram to Congressman Udall in his capacity as President of the parent firm, GPU -- a position he still holds (along with Chief Operating Officer and Director).

ALAB-772 at 133. Thus, our direction from the Appeal Board was to consider the implications of Mr. Dieckamp's actions in terms of the influence he has in the overall management of the corporation.

10. The Appeal Board agreed with our initial determination that the "Dieckamp Mailgram" issue is important to an overall evaluation of management competence and intergrity. In addition, we believe that Licensee's current position that Mr. Dieckamp's mailgram is correct and accurate and that Mr. Dieckamp had no duty at any time to correct it are additional reflections on the integrity of GPUN's current management. See, generally, Licensee's Proposed Findings of Fact and Conclusions of Law in the Form of a Partial Initial Decision on the Dieckamp Mailgram Issue.

11. The Appeal Board directed us to focus on the following two issues:

> 1) whether anyone interpreted the presure spike and containment spray, at the time, in terms of core damage; and
> 2) the sources of the information which Mr. Dieckamp conveyed in his mailgram.

12. In a July 9, 1984 Prehearing Conference Order, we elaborated on the scope of this issue. We rephrased the issue to whether Mr. Dieckamp's mailgram was false or inaccurate; whether he knew or should have known at the time he sent it that it was false or inaccurate; whether he expected the mailgram to be

relied upon in the regulatory process; and whether he had any duty to correct the mailgram upon learning of its misstatements. Memorandum and Order Following Prehearing Conference (July 9, 1984) at 8.

13. TMIA was the lead intervenor on the remanded issue of the Dieckamp Mailgram. Also participating in the remanded proceeding were the licensee, the NRC Staff and the Commonwealth of Pennsylvania.

14. The hearings on this issue were held on 17 days from November 14, 1984 through December 14, 1984 and on January 9, 1985. Twenty-four witnesses testfied. The parties stipulated into evidence 144 prior interviews, depositions and portions or complete reports as Joint Mailgram Exhibit 1-C. See, note 2, supra.

II IS THE DIECKAMP MAILGRAM FALSE OR INACCURATE?

A. Control Room Operators and Management Understood the Significance of the Spike at the Time It Occurred

15. As we explained in our earlier decision,

> The pressure spike referred to [in the mailgram] was a sudden increase in containment pressure from about 3 to 28 psig, followed by a rapid decrease to 4 psig, at about 1:50 p.m. on March 28, 1979. It was caused by a sudden burning or explosion of hydrogen, which would be symptomatic of core damage.

PID paragraph 499.

16. The Board first examined the question whether at or near the time of the pressure spike, which was reflected on pressure records in the control room, anyone understood that it was caused by a combustion or burn of hydrogen produced as a product of a zirconium-steam or zirconium-water reaction. This reaction occurs only at temperatures greater than 2000 degrees F when the zirconium cladding and other elements react with steam to produce hydrogen and zirconium oxide. The reaction is an authocatalytic exothermic zircalloy-steam reaction. Stipulation of Parties on Mailgram Evidence, JME 1-A.

17. The pressure spike occurred about 10 hours after the trip of the reactor at 4:00 a.m. This pressure spike actuated containment building sprays, which operate under a logic of actuation only when two of three independent sensors detect high pressure. JME 1-C (142) at 22. Coincident with these events, some individuals in the Unit 2 control room at the time of the spike heard a loud thud or noise. See, e.g., JME 1-C (122) at 112. One person in the control room described it as "shock waves." JME 1-C (8) at 5. Additionally, an ES or Engineering

Safeguards signal was received at that time and many visual and some audio alarms were actuated. See, e.g., Tr. 29,476 (Mehler); JME 1-C (142) at 22; (143) at 54.

18. At the time of the spike's occurence, operating personnel were also aware of incore temperatures in the range of 2500 degrees F, which indicated that ECCS criteria had been exceeded and that temperatures had reached the point where the zirconium cladding was reacting with steam to produce significanct amounts of hydrogen. Stipulation of Parties on Mailgram Evidence. JME 1-A; See, e.g., JME 1-C (67) at 39. Expert witnesses testified that flammable hydrogen is reached when hydrogen reaches a volume of four percent of the total containment building, and that the only method by which this amount of hydrogen could be produced within 10 hours of the accident's initiation is through a zirconium-steam reaction. Tr. 28,200 (Lowe); Tr. 28,200 (Linenberger/Lowe); Zebroski, ff. Tr. 28,441 at 7; Tr. 28,530 (Zebroski). See also, JME 1-C (6) at 195.

19. The Board finds that the operators awareness of these temperatures led them to an analysis of the condition of the reactor as one in which hydrogen could be produced up to and beyond flammable limits. Therefore, we believe that TMI-2 operational staff's awareness of incore temperatures beyond 2200 degrees aided them in analyzing the pressure spike correctly as a hydrogen burn or explosion at the time it occurred.[4] See, also, JME 1-C (4) at 59-68, 73-74, 130.

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[4] The ignition of the hydrogen is more correctly termed a rapid burn than an explosion.

20. In sum, the Board finds that control room operators and management not only understood the significance of the pressure spike at the time it occurred, but as a result of their analysis of the pressure spike, changed the mode they had been using to cool the reactor. Although no one at the time was able to develop a complex analysis of the degree of core damage demonstrated by the spike or hydrogen burn, it is clear that operating personnel viewed the spike as an indication that their efforts to cool the reactor had been hindered and were unsuccessful.

1. General Awareness of Pressure Spike and Related Events by TMI Personnel

21. The following individuals in or near the TMI-2 control room at the time of the spike, or in communication with those onsite, testified in early interviews of an awareness of the pressure spike, the thud or explosive sound caused by the hydrogen burn, the actuation of the containment sprays or the receipt of an ES signal: John Flint, at JME-1-C (11) at 7; JME-1-C (109) at 39-40; Craig Faust, JME 1-C (2) at 11; Ed Frederick, JME 1-C (71) at 10-11; JME 1-C (132) at 2-5; Joe Logan, JME 1-C (136) at 53-54; Fred Scheimann, JME 1-C (134) at 4; NRC Inspector J. Higgins, JME 1-C (19) at 24; JME 1-C (129) at 25-26; Adam Miller, (137) at 4; Gary Miller, JME 1-C (23) at 20, 26; JME 1-C (83) at 31-32; JME 1-C (85) at 25-26; JME 1-C (93) at 28-29; JME 1-C (122) at 112, 114-115, 117-118, 125-127; JME 1-C (138) at 100-104. Michael Ross, JME 1-C (33) at 3-4; JME 1-C (124) at 5; JME 1-C (81) at 42, 43; JME 1-C (124) at 54, 56-57; George Kunder JME 1-C (37) at 51-52; JME 1-C (72) at 27; Michael Benson, JME 1-C (126)

at 4-11; Donald Berry, JME 1-C (13) at 17; (JME 1-C (114); JME 1-C (113) at 6-9; Lynn Wright, JME 1-C (24) at 25-26; JME 1-C (116) at 4-7, 11, 20; Lee Rogers, JME 1-C (100) at 49-51; Walter Marshall, JME 1-C (92) at 11-13; JME 1-C (31) at 17, 23-25; Hugh McGovern, JME 1-C (111) at 3-4. See also, JME 114; JME 1-C (5) at 143-145, 193-194; JME 1-C (143) at 54-92; JME 1-C (108) at 138-139; JME 1-C (107) at 48, 66.

22. Those coming on shift later in the day after the spike also recall learning about it that day. See, e.g., Ted Illjes, JME 1-C (36) at 2-7; Charles Mell, JME 1-C (60) at 6-7.

23. In addition, the following individuals answered "Yes" to a question on a questionnaire distributed to present and past GPU System and B&W employees during discovery in this proceeding, which asked whether on March 28, they were aware or informed of the pressure spike, the "thud" or noise indicating the hydrogen burn: Donald A. Berry, Guilford E. Stambaugh, Jr., George T. Steuerwald, William H. Zewe, Daryl L. Wilt, G.M. Olds, Mark S. Coleman, Michael S. Richards, Howard C. Crawford, Beverly A. Good, Charles E. Rippon, Dale J. Laudermilch, Michael L. Kuhns, Walter J. Marshall, Brian A. Mehler, Adam W. Miller, M.J. Ross, George K. Wandling, Daniel M. Shovlin, J.B. Logan. TMIA Ex. 32A.

24. There is also evidence that knowledge of the spike may have reached corporate headquarters in Parsipanny, New Jersey on March 28, although the individual who has so testified attempts in the same interview to deny knowledge. Cronenberger, JME 41, at 12-13.

25. The Board finds that the pressure spike and associated events were general knowledge at the site on March 28.

2. Interpretation of the Pressure Spike by Joseph Chwastyk and Brian Mehler.

26. There is considerable evidence that core uncovery and significant core damage was a major concern during the early hours of the accident.[5] This concern was evident early on March 28, providing the context within which to evaluate whether key personnel understood the significance of the pressure spike at the

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5 The following individuals have testified in early interviews that core uncovery and significant core damage was recognized early in the accident, including the day of March 28: B&W representatives John Flint, JME 1-C (11) at 7, JME 1-C (14) at 29, 33, JME 1-C (56) at 24-25, JME 1-C (55) at 21-25, 27-28; and Lee Rogers, JME 1-C (87) at 35-38, JME 1-C (100) at 12-17, 35-37; William Marshall, JME 1-C (92) at 13-14; ; NRC Inspectors Higgins, JME 1-C (79) at 44; and Karl Plumlee, JME 1-C (140) at 142; Instrument Technician Nelson Bennett, JME 1-C (53) at 13, 17-18; Operator Ed Frederick, JME 1-C (71) at 14-15; George Kunder, JME 1-C (18) at 29, 45, JME 1-C (37) at 52-53, JME 1-C (72) at 17-18, JME 1-C (80) at 59, JME 1-C (118) at 45-46; Gary Miller, JME 1-C (10) at 17, JME 1-C (23) at 22, 23 (Tapes 159 and 160) at 60, JME 1-C (83) at 17-20, 25, JME 1-C (93) at 11-12, JME 1-C (122) at 144, JME 1-C (138) at 97; John Herbein, JME 1-C (27) at 28, JME 1-C (61) at 16, 21-23, 25; , Mike Ross, JME 1-C (81) at 18, 28, 44, JME 1-C (124) at 9, 14-16; Gary Broughton, JME 1-C (48) at 6; Robert Arnold, JME 1-C (26) at 19-20, 25; JME 1-C (84) at 21, 14-15, 17, 46, JME 1-C (.21) at 4-5; Herman Dieckamp, JME 1-C (66) at 129, JME 1-C (86) at 4, 7-9, 18, 21; JME 1-C (123) at 9-10. See also, JME 1-C (5) at 4-6, 8, 12-13, 114, 140, 157, 185, 189, 195;, JME 1-C (6) at 299, 306-307; JME 1-C (143) at 35-54, 95-96, 117-118; JME 1-C (108) at 116.

In particular, in-core temperatures were considered accurate, and believed to be an indicator of core temperatures and possible core uncovery on March 28. See, Miller, JME 1-C (23) (Tapes 159 and 160) at 55-56; JME 1-C (85) at 25, 32, 34-37, JME 1-C (122) at 67; Flint, JME 1-C (11) at 10, JME 1-C (14) at 4-8, 19-20, 25; JME 1-C (56) at 2-3, 25-27, 33-40, JME 1-C (55) at 20-21, JME 1-C (109) at 4-10, 16-17, 21-32; Zewe, JME 1-C (119) at 33; Instrumentman Tom Wright, JME 1-C (52) at 11-14; Instrumentman William Yeager, JME 1-C (54) at 17-19; Instrumentman Gilbert JME 1-C (91) at 12, JME 1-C (112) at 5, 28, 29. See also, JME 1-C (5) at 12-14, 186; JME 1-C (6) at 185; JME 1-C (143) at 17, 22-38, 94-95. The concern over core damage and high in-core temperatures also reached corporate headquarters in Parsipanny. See, Creitz, JME 1-C (94) at 6; Hilbish, JME 1-C (74) at 37-38. See, Paragraphs 87 to 95 infra, for a more detailed discussion of the accuracy of in-core thermocouple temperature readings.

time of the event in terms of core damage.

27. Brian Mehler, a shift supervisor at Unit 2, arrived in the Unit 2 Control Room at about 6:00 a.m. on March 28. Tr. 29,428-29,429 (Mehler). He testified that he concluded in the morning period that there had been some core damage. Tr. 29,430 (Mehler). In testimony to the Hart Committee investigating the accident Mehler stated that after radiation alarms were received during the morning of March 28 he determined that there was "fuel damage" and that perhaps one-third of the core had been uncovered. JME 1-C (68) at 7; Tr. 29,431-432 (Mehler).

28. Joseph Chwastyk, a shift supervisor in Units 1 and 2, started work around noon on March 28, 1979. Tr. 29,108; Tr. 29, 110. (Chwastyk). On that day he supervised operators Theodore Illjes, Joseph Kidwell, and Charles Mell. Tr. 29,109 (Chwastyk). Chwastyk testified that shortly after his arrival at work he recalls being briefed on specific temperatures, pressures, and radiation levels. Tr. 29,112. (Chwastyk). He recalls also that upon his arrival at Unit 2 the hot-leg temperatures were pegged at 720 degrees. Tr. 29,112-113, 29,114 (Chwastyk). He testified that he discussed the possibility of core damage with other operational personnel near the time of his arrival and that based on the information available to him at that time he concluded that Unit 2 had suffered some core damage. Tr. 29,113 (Chwastyk). He based his conclusion on the hot-leg temperatures and the radiation release which he characterized as "pretty significant". Tr. 29,113, 29,190 (Chwastyk).

29. Chwastyk relieved William Zewe, a third shift supervisor, at the console after his briefing on the status of TMI-2.

Tr. 29,114 (Chwastyk). He basically directed operations and reported directly to Station Manager and Emergency Director Gary Miller. Tr. 29,118 (Chwastyk). Chwastyk stated that he stationed himself in front of the consoles and within the area labeled "operators base line" in licensee's figure of the control room. Tr. 29,116-118 (Chwastyk); Lic. Mailgram Exh. 1 at 1. He situated himself in the Control Room, and from that vantage point, he could easily see the reactor building wide-range and narrow-range pressure recorder strip chart. Tr. 29,124 (Chwastyk).

30. Mehler was located in the same area at the time of the pressure spike at 1:50 p.m. Tr. 29,476-79 (Mehler). He testified that the Shift Supervisors' office, where Miller is said to have been, was located about 35 to 40 feet from the panels in the control room but easily within hearing distance of the alarms received at the time of the spike. Tr. 29,477-478 (Mehler).

31. Chwastyk stated that since he was standing near the console he saw the pressure recorder move "straight up" and then fall rapidly. Tr. 29,124 (Chwastyk). He testified that he assumed the alarms which were actuated at the time of the spike caused him to look at the console. Chwastyk said it took only "a couple of heartbeats" for the spike to rise and fall. Tr. at 29,124-29,125 (Chwastyk).

32. Mehler testified that he became aware of the pressure spike when the alarms were actuated, and an ES signal was received. He stated that Ross and an NRC inspector in the control room were aware of the ES signal. He testified further that operators, including Lynne Wright, were securing equipment. He saw the

reactor building pressure recorder jump, and he then became aware of the actuation of the containment sprays. Tr. 29,476-479 (Mehler).

33. Marshall testified that he was aware of the pressure spike, the alarms and the actuation of the containment sprays. Walter Marshall, JME 1-C (92) at 11-13; JME 1-C (31) at 17, 23-25. He testified in a more recent deposition taken in the course of discovery in this proceeding that he believed Miller was in the control room at the time of the spike and aware of the thud or explosive sound caused by the hydrogen burn from remarks made by Miller at the time. Furthermore, he stated that he believed Miller was aware of the actuation of the containment sprays from his position in the back of the console at the time of the spike and actuation of the sprays. TMIA Exh. 32G at 1, 4-5

34. McGovern in an interview with Marshall at about 3:00 a.m. on March 29 told Marshall that at 2:00 p.m. the following occurred:

> ...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 &BX-VPS,DH-V8's) isolation and cooling. Someone secured spray pumps, shut BS-Vi's and DH-V's (Hugh did) and unisolated equipment for building.

JME 1-C (1).

35. Other pressure indicators, including the steam generator pressures and the reactor coolant system pressures indicated a coincident spike downward at the time of the pressure pulse. JME 1-C (143) at 56; JME 1-C (63) at Appendix TH.

36. Chwastyk said that at the time of the spike he saw the containment sprays become energized and begin spraying sodium

hydroxide in the reactor building. He said he made the assumption that everybody in the control room was aware of the spike simply because it was a "major variance" from what had been taking place previously. Tr. 29,126 (Chwastyk). Mehler agreed that everyone in the control room knew about the sprays and believed that Miller knew about the spike as well. Tr. 29,482-483 (Mehler); JME 1-C (89) at 29. He stated that both he and Chwastyk were "highly concerned and a little scared" by the high pressure. JME 1-C (98) at 11. Tr. 29,484 (Mehler). Chwastyk has stated, "it scared the hell out of me." JME 1-C (99) at 20-21.

37. Chwastyk and Mehler discussed the fact that actuation of the containmnet sprays indicated that the pressure spike was a real pressure excursion since at least two out of three independent sensors needed to record pressure to 28 psi to activate the sprays. Tr. 29,103 (Chwastyk); 29,480, 29,487 (Mehler). Chwastyk testified that his conversation with Mehler further convinced him that the spike was real. Tr. 29,317 (Chwastyk).

38. Chwastyk also immediately sent someone back to inform Gary Miller that they had "some sort of problem." Tr. 29,131 (Chwastyk).

39. Chwastyk then directed the operators to secure the containment sprays after the pressure dropped. Tr. 29,127, 29,227-228 (Chwastyk). See, JME 1-C (32) at 30; JME 1-C (35) at 9, 10; JME 1-C (117) at 9-10. He also ordered certain checks be made to verify containment integrity and to determine other parameters. Tr. 29,127-128 (Chwastyk); JME 1-C (117) at 32-36. Mehler confirmed that an order was given to check to determine if the containment was breached by the pressure spike. Tr. 29,486

(Mehler). See, also, JME 1-C (126) at 11-13.

40. A radiation check was conducted at about 2:05 p.m. on March 28 "around the Unit 2 reactor building". The radiation check was recorded on a log by radiation technician Beverly Good, whose reponsibility it was to record such checks. TMIA Exh. 32B; Tr. 31,337-339. Thomas Mulleavy, who at the time of the accident was Radiation Protection Supervisor, testified that radiation checks were performed by his group on orders from the operations personnel. Tr. 31,332-333. A statement by Leland Rogers, the Babcock & Wilcox site representative, indicates that this radiation check was conducted in response to the pressure spike. JME 1-C (51) at 22.

41. Some individuals in the control room recall an explosion at or near the time of the spike. Operator Craig Faust described the spike in the following way in an April 6, 1979 interview with company investigators: "We probably had some sort of explosion because that's what it looked like; shock waves. JME 1-C (8) at 5. See also, JME 1-C (2) at 11.

42. Within minutes after the spike, after the equipment was secured, Chwastyk himself went back into the shift supervisor's office to speak to Miller about the spike. He testified that he told Miller that he believed the spike was a real pressure increase, based primarily on the fact that the spray pumps had activated. He also told Miller about Fred Scheimann's cycling of the electromatic valve with the spike, and the loud noise reported to him, leading to the conclusion that there had been some kind of explosion in the containment building. Tr. 29,131-132 (Chwastyk); JME 1-C (99) at 8-17.

43. Chwastyk explained to Miller his analysis of the pressure spike in a "moving conversation" which took the two of them from the shift supervisor's office into the control room, in front of the reactor building pressure and secondary side plant parameters. Tr. 29,147; 29,279-280 (Chwastyk). It appears that Miller was looking at parameters in order to verify what Chwastyk was telling him about the pressure spike or explosion in the reactor building. Tr. 29,170; 29,322 (Chwastyk).

44. Chwastyk testified that he did not remember discussing explicitly with Miller that the spike was caused by a hydrogen burn because he assumed that Miller understood that to be the case. Tr. 29,154 (Chwastyk). He stated that he knew of no other cause for the burn or explosion other than a buildup and combustion of hydrogen. Tr. 29,141 (Chwastyk).

45. Mehler recalls discussing with Chwastyk whether the explosion or spike might have been caused by some sort of "chemical reaction". Tr. 29,488 (Mehler); JME 1-C (89) at 13-15. One prior interview also indicates that he may have discussed hydrogen with Chwastyk. JME 1-C (68) at 12. Chwastyk recalled discussing a chemical reaction. Tr. at 29,166, 29,317. (Chwastyk).

46. Mehler has testified that he understood that someone had correlated cycling of the EMOV (which caused a spark) with the pressure spike. Tr. 29,499-504 (Mehler); JME 1-C (68) at 8; JME 1-C (89) at 15. He understood this from an instruction which was given shortly after the pressure spike that no equipment be activated in the reactor building for fear of creating another spark and causing a second explosion or combustion. Tr. 29,503-504 (Mehler) JME 1-C-(89) at 15.

47. In his first interview with the Special Inquiry Group, Mehler was very certain that the date of this instruction was March 28. In this first interview, Mehler even offerred to take a lie detector test to demonstrate his sincerity. JME 1-C (89) at 25. After a New York Times article appeared on the subject of Mehler's testimony, Mehler became less certain and stated that he had changed his mind about the date of the instruction after having spoken to a number of others who were in the control room on March 28, including Chwastyk. TMIA Ex. 17; JME 1-C (98) at 15-17. Chwastyk, however, denied that he told Mehler that the instruction was given on any day other than March 28 since he in fact believed that it was given on March 28, and tries to explain how Mehler may have gotten the wrong impression. JME 1-C (117) at 36-42.

48. Mehler definetely connects the instruction not to activate equipment in the reactor building with his operating or directing the operation of lift and backstop pumps, activated in preparation for operating a reactor coolant pump. Although he currently can not recall the date on which this occurred, he does maintain that the only time during the accident on which he specifically recalls activating these pumps is the evening of March 28, shortly before the starting of the reactor coolant pump around 7:20 p.m. Tr. 29,528-30, 29,534 (Mehler); TMIA Ex. 16 at p. 2 [of Exhibit]. Mehler testified that normally the starting of the backstop or lift pumps would be listed in the control room log. Tr. 29,528 (Mehler).

49. Operator Theodore Illjes, who reported to Unit 2 sometime in the late afternoon of March 28 also recalls a discussion

in which the cycling of the EMOV was correlated with the spike. JME 1-C (36) p. 2-7; JME 1-C (126) at 4-5.

50. Chwastyk clearly remembers three different occasions early in the accident, on which an instruction was given not to operate equipment in the reactor building for fear of causing a spark which might ignite hydrogen which had built up in the reactor building. Chwastyk gave the first instruction, after authorization from Miller, soon after the pressure spike. He gave the order because he had determined that the spike was an explosion caused by a spark of hydrogen in the reactor building. Cycling of the EMOV had caused the spark. Tr. 29,152-153 (Chwastyk); JME 1-C (35) at 18. See also, JME 1-C (119) at 46, 47-48; JME 1-C (124) at 66-67; JME 1-C (95) at 22, 23, 29-30.

51. Chwastyk remembers that the second time the instruction was given was also on March 28, shortly prior to starting of the reactor coolant pump at 7:20 p.m. He remembers that the instruction was given not to start equipment in the reactor buiilding and Mehler stated "don't worry about it because I have been running those pumps in there and nothing happened." Tr. 29,155 (Chwastyk). This corresponds closely to Mehler's memory of a conversation he held when Miller gave such an instruction. Tr. 29,509-511 (Mehler); JME 1-C (89) at 16; JME 1-C (115) at 30-32; JME 1-C (117) at 14-18;

52. It is obvious that by stating "nothing happened," Mehler must have meant that his operation of equipment caused no explosion, so that the hydrogen must have burned off. This was Chwastyk's understanding at the time. Tr. 29,155-156 (Chwastyk).

See, also, JME 1-C (143) at 77-88. Further, others have testified that an instruction was given after acknowledgment of the hydrogen burn. See, e.g., JME 1-C (119) at 46, 47-48; JME 1-C (124) at 66-67. The Board finds that an instruction was given not to start equipment, authorized by Miller, in response to the pressure spike, in acknowledgment of the hydrogen burn.

53. Chwastyk testified that he understood that the pressure spike was caused by a hydrogen burn or explosion. He further testified that he believed that the hydrogen had been generated by a zirconium-water or zirconium-steam reaction which occurs when the zirconium cladding reacts at high core temperatures. Tr. 29,141; 29,374 (Chwastyk). Chwastyk credibly explained the thought process by which he eliminated other possible causes of the pressure spike and explosion. Tr. 29,372-377 (Chwastyk). He also explained that he was trained on the zirconium-water reaction at TMI and perhaps in the Nuclear Navy as well. Tr. at 29,283-284; 29,310 (Chwastyk).

54. Chwastyk has consistently testified that immediately after the pressure spike he requested and received permission from Miller to draw a bubble in the pressurizer. Tr. at 29,142; 29,288; 29,322; 29,363 (Chwastyk); JME 1-C (88) at 18; JME 1-C (117) at 24-27; 62, 67, 69-71, 105-106. He testified in a deposition in this proceeding that he did this in order to "flood the core" . Tr. 29,143-145; 29,294 (Chwastyk). He defined his objective as getting the reactor coolant system into a status in which he and other operations personnel would have a better idea of what was occurring with the reactor itself and the reactor coolant system. Tr. 29,145 (Chwastyk). In particular, Chwastyk

explained that by establishing a level in the pressurizer by drawing the bubble, there would be better indication as to the water level in the primary coolant system. Tr. 29,322-324; Tr. 29,147 (Chwastyk).

55. Chwastyk described the evolution of drawing a bubble as: closing the block valve, turning on the pressurizer heaters, initiating high pressure injection, each step of which was accomplished a short time after he received permission to draw a bubble in the pressurizer. These were all the necesessary steps to repressurizing the reactor coolant system from its previous state, Chwastyk explained. Tr. 29,148; 29,151; 29,382-383 (Chwastyk).

56. Chwastyk stated that these steps to draw a bubble in the pressurizer, or repressurize, were part of their overall goal that day to stabilize the system. Such steps were only contemplated completed on March 28, 1979 with consideration and forethought since drawing a bubble at that time was a serious departure from the previous way in which they had attempted to stabilize the reactor. Tr. 29,381-383 (Chwastyk).

57. The Nuclear Safety Analysis Center ("NSAC") study of the TMI-2 accident corroborates Chwastyk's testimony about the evolution or operating mode employed by plant personnel to stabilize the reactor after the pressure spike. This study, based entirely on objective data, divided the accident into six major phases, that is "into intervals representing various operating modes that occurred during the accident." JME 1-C (63) at App. TH-2. NSAC defined "Phase 6" as starting with the closure of the

relief block valve began at 3:08 p.m. and ending at 7:50 p.m. with the successful starting of one of the reactor coolant pumps. JME 1-C (63) at App. TH 85 et seq. See, Tr. 28,691-693 (Dieckamp).

58. Mehler's prior testimony is consistent. Mehler confirms that the primary concern of site personnel after the pressure spike was recovering from a damaged core. JME 1-C (68) at 10-11; Tr. 29506-507. He also testified previously that he believed that the decision to repressurize the reactor during the afternoon of March 28 was made sometime during the period of 2:00 to 4:00 p.m. JME 1-C (68) at 11; Tr. 29,505 (Mehler).

59. Contrary to this evidence, Mr. Dieckamp testified that he has seen no evidence which would indicate that site personnel understood the significance of the pressure spike and changed the mode or strategy for cooling the reactor as a result of their interpretation. Dieckamp ff Tr. 28,316 at 12. Dieckamp testified at the hearing that he did not interpret Chwastyk's testimony that he received permission to draw a bubble in the pressurizer, to indicate he had received permission to take one step in an ultimate repressurization evolution. Tr. 28,720 (Dieckamp). He further testified that he did not believe actions to close the block valve at 3:08 p.m., over an hour after the pressure spike, demonstrated a response to or understanding of the pressure spike. Tr. 28,719 (Dieckamp).[6] Dieckamp finally suggests that

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[6] Dieckamp, however, agrees with Chwastyk that it would take

repressurization began at or around 5:20 p.m. when the high pressure injection was started, apparently on orders transmitted from Jack Herbein. Tr. 28,411 (Dieckamp).

60. This Board finds Mr. Dieckamp's criticisms of Mr. Chwastyk's testimony unsubstantiated and easily refuted. First, Chwastyk testified that he may have directed that the heaters be turned on prior to closing of the block valve in order to prepare the heaters. Tr. 29,291 (Chwastyk). Other site personnel have testified that there were serious problems with the pressurizer heaters on the day of the accident. Tr. 29,628-630 (Illjes); JME 1-C (58) at 21-23; JME 1-C (20) at 22; JME 1-C (50) at 5; JME 1-C (6) at 299; JME 1-C (60) at 24-27. In fact notes of the General Public Utilities Service Company engineers sent to the site on the first day of the accident indicate that they were briefed by site personnel about these problems. TMIA Ex. 15 at 8 [of exhibit]; TMIA 28 at 4 [of exhibit].

61. Secondly, it is not clear that a bubble was <u>not</u> drawn in the pressurizer at the time the site personnel attempted to do so. Illjes remembers that sometime during the afternoon or evening of March 28 a bubble was drawn in the pressurizer. Tr. 29,744-745 (Illjes). Moreover, the training materials on the

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intentional operator actions to repressurize the reactor and to close the block valve under the conditions existing at TMI-2 on March 28, 1979. Further, he agreed that whatever repressurization occurred on March 28, described in the NSAC Report as Phase 6, "Repressurization and Recovery", was the result of intentional operator action directed by operators' supervision. Tr. 28,734-736 (Dieckamp).

Dieckamp also agreed with TMIA that he understands the term "phase" into which the accident is divided by NSAC, to mean the strategy then being employed by site personnel to bring the reactor to a cold shutdown. Tr. 28,725 (Dieckamp).

TMI-2 accident indicate that the evolution of closing the block valve and starting the pressurizer heaters did in fact lead to creation of a bubble in the pressurizer. TMIA Ex. 13 at 4; Tr. 28,715 (Dieckamp). The NSAC chart indicates that in fact the pressurizer level began to drop after the closing of the block valve at 3:08 p.m., which is what would result if a bubble were drawn. JME 1-C (63) (Equipment and System Action Matrix).

62. Third, contrary to Dieckamp's statement as to when repressurization began, site personnel besides Chwastyk have placed the time of repressurization sometime prior to orders from Herbein to begin this evolution. Ross clearly testified in a deposition taken in this proceeding that site personnel took steps to repressurize prior to the orders from Herbin. TMIA Ex. 32J. Herbein did not successfully refute or provide any alternative explanation to Chwastyk's and Ross' testimony. Thus, the Board remains unconvinced that repressurization began when Herbein gave the order to do so late in the afternoon, rather than at the time the block valve was closed shortly after the pressure spike. Tr. 30,394, 30,396-398 (Herbein).

63. Finally, Chwastyk himself offers a plausible explanation of why they were not successful in drawing a bubble in the pressurizer during the afternoon of March 28. He states that he believes that they did not have an adequate volume in the pressurizer to fill the reactor coolant system because the inventory was so low in the system. Tr. 29,150-151; 29,322 (Chwastyk).

64. In summary, it is clear that Chwastyk and his direct supervisor Miller understood the significance of the pressure spike and responded, first by immediately securing equipment, and

them by beginning a repressurization evolution by permitting Chwastyk to draw a bubble in the pressurizer. Moreover, that strategy was partially successful in that the pressure in the reactor coolant system began to rise and the bubble in the A-loop was collapsed. Tr. 29,363-39,364 (Chwastyk).

65. From this conclusion, and additional evidence, it is clear that Chwastyk and Mehler both interpreted the pressure spike to indicate that there was greater core damage than they had previously believed. Mehler alluded to this in discussing the need to recover from a damaged core. See paragraph 58 supra.

66. Chwastyk stated explicitly at this hearing, and in earlier interviews with the NRC, that after the spike, he understood that a zirconium-water reaction had taken place, indicating more serious core damage than he had originally conceived. Tr. 29,158-159; 29,293-294; 29,326-328; 29,331; 29,351 (Chwastyk). Chwastyk defined "core damage" as a loss of some amount of cladding material, but more importantly that the core damage may be continuing. Tr. 29,175; 29, 179;29,293-294; 29,326-327; 29,331; 29,346 (Chwastyk). He also testified that his immediate concern after the spike was to ensure that the core was covered. He stated that after the event, he could not look at the indicators previously available to him with the same confidence that the core was being adequately cooled. Tr. 29,326-329 (Chwastyk).

67. Chwastyk has in less detail in previous interviews testified to substantially the same evaluation of the status of the reactor after the pressure spike. JME 1-C (99) at 20-21; JME 1-C (117) at 24, 32.

68. Corroborating Chwastyk and Mehler's testimony about their interpretation of the pressure spike, and its relation to core damage, is the testimony of Ted Illjes, whom Chwastyk briefed along with the other operators coming on shift after the spike. Chwastyk told the operators about the pressure spike and hydrogen burn to ensure they would understand the steps being taken for the "recovery". Tr. 29,167; 29,308-309 (Chwastyk). Illjes testified that he remembered a briefing about the pressure spike on March 28 and additionally a discussion about hydrogen, and recalled discussion on the evening of March 28 in which the occurrence of the pressure spike was correlated with recycling of the EMOV. Tr. 29,595-598, 29,600 (Illjes); Illjes, JME 1-C (36) at 3-6; JME 1-C (127) at 4-9. Illjes testified at two different times to the NRC that he remembered discussions about a hydrogen or noncondesnable bubble in the reactor vessel head. Tr. 29601-2; JME 1-C (36), (127),supra. While Illjes's memory had failed regarding these events by the time of the hearing, he did acknowledge that his early testimony about such discussions was consistent. Tr. 29,610 (Illjes).

69. Operator Chuck Mell, one of those briefed by Chwastyk along with Illjes, has also testified in earlier interviews that he recalled a conversation about a noncondensable bubble on the evening of March 28 after the reactor coolant pump was started. Tr. 29,616 (Illjes); JME 1-C (69) at 17, 23. Illjes had similar recollections. JME 1-C (36) at 9-11; JME 1-C (127) at 6-10. And Ed Frederick, on duty from the beginning of the accident, recalled non-condensables on March 28. JME 1-C (71) at 13-14. And NRC Inspector Plumlee recalled a definite awareness of hydro-

gen on March 28. See, JME 1-C (140) at 3, 59-75, 95-101, 1-6-112, 118-122, 147, 199-200, 203, 205-206. See also, JME 1-C (139).

70. Illjes testified in this hearing that he tends to remember events by correlating them to evolutions which occurred at the plant. In fact we find, as TMIA brought out at the hearing, that Illjes in his prior testimony to the NRC correlated discussions about hydrogen, the pressure spike or noncondensible gas with specific evolutions taking place on March 28. Therefore we find his prior testimony, especially in light of his current lack of memory, to be credible. Tr. 29,573-29,757 (Illjes).[7]

3. Interpretation of the Spike by Gary Miller and John Herbein

71. Station Superintendent Gary Miller was not only aware of the pressure spike, but his knowledge of plant conditions including an awareness of superheated temperatures enabled him to understand that a hydrogen explosion was the cause.

72. First, Miller acknowledges that he heard the "thud" in the control room at the time of the spike, and recalls some discussion about a ventilation damper shifting. Tr. 30,186-187. (Miller). See, also, JME 1-C (83) at 31. The Board finds

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[7] Illjes testified that he came to believe that his testimony in two interviews with the NRC was inaccurate after speaking to and individual named Steve Pogi. The Board attaches no weight to Illjes' change in testimony given the fact that he has provided no credible basis for his acceptance of Pogi's view of the pressures spike and hydrogen burn over his own, when Pogi was not a first-hand observer at the site on March 28 and had less access to information than Illjes during the first days of the accident. Tr. 29,657-658;29,757; 29,763; 29,772.

credible the testimony of Chwastyk and Mehler, that they spoke to Miller about the pressure spike and that he appeared to understand that the pressure spike, actuation of containment sprays, cycling of the EMOV, and the loud noise or thud, had all occurred simultaneously.

73. Chwastyk testified that in the course of a "moving conversation" with Miller as Miller prepared to leave the plant for the Lt. Governor's office (see, infra), Miller said to him something like "let's not get everybody all excited about it." This indicated to Chwastyk that Miller not only was aware of the spike, but wanted to investigate the matter, and make a determination about what had in fact happened. Tr. 29,159; 29,281 (Chwastyk)

74. Chwastyk further testified that Ross was present at the time of this conversation with Miller, and agreed with Miller's advice. Chwastyk also believed that Ross understood the significance of the information which Chwastyk was relating to Miller, as well as Miller's reasoning for ensuring that others in the control room not get excited. Tr. 29,424-426 (Chwastyk).

75. Mehler has also testified that Miller was aware of the pressure spike. JME 1-C (89) at 29; Tr. 29,483 (Mehler).

76. Other operators in the control room agreed with Chwastyk and Mehler that Miller was aware of the pressure spike, or one of the events accompanying the pressure spike, such as actuation of the containment sprays, the alarms or ES signal, in addition to the "thud." For example, Marshall assumed Miller was aware of actuation of the containment sprays from his position in the control room. TMIA Ex.32G, supra. Zewe has stated that he

believed no one in the control room could have missed the spike or the actuation of the sprays, including Miller. JME 1-C (75) at 257, 260. NRC Inspector J. Higgins testified that he believed Miller told him that he knew of the pressure spike on March 28. JME 1-C (19) at 24.

77. Further, Miller prepared a statement on April 14, 1979, in order to provide a composite picture of the first day of the accident from the perspective of the on-site emergency command team or "think tank" group.[8] This statement was intended to be as complete a sequence of events as the group could reconstruct at that time. JME 1-C (10) at 1. In that statement Miller states that at the time of the spike, he was aware not only of a thud, but actuation of the containment sprays at the time of the pressure spike. Id. at 24. Despite the plain language of this document, Miller denies personal knowledge of the spray acutation. We find unconvincing his explanation that although he used the pronoun "I" throughout the document, he meant to convey knowledge of the group, instead. Tr. 30,191-192 (Miller).

78. Despite evidence to the contrary, Miller also claims that he was unaware of both the alarms and the ES signal at the time of the pressure spike. Tr. 30,195-196; 30,198-199 (Miller). See, also,, JME 1-C (33) at 3-4, JME 1-C (124) at 54, JME 1-C (81) at 41-43 (Ross). Miller's position is particularly incredible, given that there were a large number of alarms which were actuated at the time of the pressure spike. Tr. 29,476 (Mehler);

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[8] For a description of "think tank", see, JME 1-C (143) at 4-5.

TMIA Ex. 21; Broughton, ff. Tr. 31,225; Tr. 31,228-232, 31,234 (Broughton). Moreover, as Miller himself acknowlwedges receipt of an ES signal is a significant event. JME 1-C (122) at 125.

79. As Chwastyk and Ross have testified, Miller gave orders prior to leaving for the control room in the 2:00 to 2:30 p.m. time frame, that no one was to change plant status without his permission. Tr. 30,208 (Miller). JME 1-C (81) at 39 (Ross); JME 1-C (88) at 17 (Chwastyk). The fact that by the time he left, Miller had already authorized Chwastyk to draw a bubble in the pressurizer representing a major change in the manner in which site personnel were attempting to stabilize the reactor, demonstrated that Miller understood the significance of the pressure spike before he left. See, also, Tr. 29,382-383 (Chwastyk). Indeed, Miller admits that shutting the block valve at 3:08 p.m. would lead to the kind of change in status which he expected to authorize, supporting that he did in fact authorize the action before he left. Tr. 30,202-208 (Miller). Miller's repeated denials that he gave permission for that action are simply not credible.

80. Similarly incredible is Miller's denial that he gave an instruction not to activate equipment in the reactor building for fear of causing a spark on March 28. The instruction could not have been given on March 29, as some have theorized, because the March 29 instruction as noted in Seelinger's notes, was discussed at 9:30 p.m. Miller agrees that he left the site at about 7:00 or 8:00 p.m. that day, the 29th. See, Tr. 30,209-210 (Miller); TMIA Ex. 2 at 7 [of Exhibit].; JME 1-C (95) at 23. The Board therefore concludes that Chwastyk and Mehler's testimony that

Miller gave the instruction on March 28 is correct, and that Miller is wrong.

81. The Board also finds that Station Manager and Emergency Director Miller was informed of a complete set of 51 incore thermocouple temperature readings which were taken on March 28. From these readings, the Board finds that Miller, as he should have, properly interpreted the pressure spike as a hydrogen burn at the time it occurred.

82. Early on March 28, operations personnel printed out temperature data for incore temperatures. The temperatures appeared as temperatures less than 700 degrees F and question marks. John Flint testified that the question marks which appeared on the computer printout indicated temperatures greater than 700 degrees F. JME 1-C (11) at 5. He further testified that if the thermocouples had failed, they would print out "bad" and not question marks. JME 1-C (14) at 8.

83. Miller reqeusted that Porter provide him with the incore temperature readings shortly after 7:00 a.m. Porter reported the results, including temperature readings greater than 700 degrees to Miller. Miller then requested that Porter obtain readings from the thermocouples prior to penetration or input into the computer by measuring the voltages directly. Miller did this based on his experience with thermocouples in the Nuclear Navy. Tr. 30,138-139 (Miller). Miller requested the readings almost immediately after he arrived at TMI-2. Tr. 30,133 (Miller).

84. Thermocouple readings were taken under Porter's direc-

tion. See, JME 1-C (53) at 4-19; JME 1-C (10) at 15; JME 1-C (23) at 55-60; JME 1-C (59) at 12-13; JME 1-C (83) at 14-17; JME 1-C (85) at 11-17; JME 1-C (93) at 23; JME 1-C (95) at 4-5; JME 1-C (122_ at 37-38, 61, 64-65, 67-69, 73, 75-79. TMIA Ex. 32 D. Upon obtaining superheated readings, one of the instrument technician exclaimed, "Christ, this thing's melting down." TMIA Ex. 32 D at 36. This individual clearly felt the core was damaged, or was in the process of getting worse. Id at 45

85. Miller concedes that Porter reported to him readings in a range of 0 to 2400 or 2500 degrees. Tr. 30,144 (Miller); JME 1-C (23) at 55-56. However, he states that Porter told him that because of the range of temperatures the readings were not reliable and perhaps the thermocouples had melted and formed new junctions. Tr. 30,151 (Miller).

86. Miller has stated, however, in early interviews to the NRC that he relied on even these few incore temperature readings in his assessment of the condition of the reactor on March 28. He used the 2500 degree figure as a "gross indicator," of superheated conditions. JME 1-C (23) at 56. Miller stated to the NRC, "...the bottom line here was that they're hot, they were hot enough that they scared you," and "...we just knew we didn't have a control, we were out of control." Ibid. He also stated that he requested the readings, "... because they were the only indicator [of] what was going on in the core I had that was direct." Id. at 75.

87. Ross too stated that he believed Miller interpreted the incore thermocouple temperatures to indicate "the bottom line ...the core is hot, or it is at least hot." JME 1-C (33) at 42.

These were Miller's evaluations which he drew from a small set of approximately five to 10 readings.

88. Prior to and during this hearing, licensee had insisted that Miller and Ivan Porter, chief instrumentation and control engineer reporting to Miller, were not aware of the complete set of incore thermocouple temperatures, six of which showed temperatures over 2200 degrees F, the ECCS limit. Tr. 30,140; 30,143-144 (Miller); Tr. 31,469-471 (Porter); JME 1-C (125) at 12; JME 1-C (85) at 14-15; JME 1-C (93) at 24; JME 1-C (95) at 4-5; JME 1-C (23) at $ $. Licensee claims that a second complete set of 51 readings were taken by instrumentmen but never passed up to Porter or Miller for use in assessing the status of the reactor. JME 1-C (125) at 7, 12; JME 1-C (143) at 23-32; JME 1-C (97) at 16-18; JME 1-C (57) at 11-12; JME 1-C (70) at 10-11.

89. This complete set of incore temperature readings contained six readings which were above 2200 degrees F which indicated ECCS criteria were exceeded and there was no assurance that the ECCS would function so as to safely cool the reactor. 10 CFR 50.46. JME 1-C (143) at 31; TMIA Ex. 32C. More importantly for the Board's focus, these temperatures indicated that not only was the core uncovered but the zirconium cladding was reacting with steam to produce hydrogen and zirconium oxide.

90. But in addition, the Board has concluded from testimony introduced in this hearing that Porter and Miller were aware, despite their protestations to the contrary, of the full set of 51 incore thermocouple data taken on March 28. This data confirmed the original high readings in the range of 2400 degrees.

Richard Lentz, a GPUSC engineer sent to the site on the first day of the accident who had previously worked at TMI-2, testified that Porter had shown him a complete set of 51 readings which Porter had taken on the first day of the accident. Lentz claims that Porter showed him this complete set of 51 readings in handwritten form a few days after March 28. Lentz had worked with Porter at TMI-2 prior to the accident. Lentz stated that the temperatures readings which Porter showed him at that time corresponded to the range of readings which have been previously identified by Porter and licensee to be the complete set of readings taken on March 28 but not turned over to the NRC until May 7. Moreover, Lentz stated that Porter told him he had shown this complete set of 51 readings to Miller on March 28. TMIA Ex. 32 C and 32 I.

91. William Yeager, an instrumentman whom Porter directed on March 28 to take some incore temperature readings prior to input into the computer testified that he and his partner Thomas Wright took only two sets of readings, neither of which was a complete set. He stated that the first set of readings was taken with a fluke thermometer and the second set of readings of seven to ten readings of the same points in the core were taken with a millivolt reader to confirm the first set. He stated positively that he had never seen and never taken the complete set of 51 readings. TMIA Ex. 32 D; TMIA Ex. 32 C.

92. The testimony of Yeager and Lentz together undermine Porter's claim that the instrumentmen including Yeager and Wright took the complete set of readings without consulting him and without informing him of the results. It appears from their

testimony that Porter was concerned enough about the temperatures, undoubtedly in consultation with Miller, that he took the complete set of data and conveyed it to Miller on March 28. See also, JME 1-C (136) at 19.

93. Therefore, Miller had available the full set of data which would certainly confirm that core temperatures exceeded 2200 degrees F such that the cladding was oxidizing to produce significant amounts of hydrogen. Miller has never denied that he knew temperatures greater than 2200 degrees F exceeded ECCS criteria and would influence his actions if he had known them. Tr. 30,168; 30,171-172 (Miller).

94. Also supporting our conclusion that Miller knew of incore temperature readings greater than 2200 degrees, which he believed to be a reliable indicator of core temperatures, is George Kunder's prior testimony that he knew Porter had relayed such temperatures to Miller on March 28. JME 1-C (30) at 44, Tr. 30,056, 30,061; JME 1-C (59), Tr. 30,067. Kunder was responsible for the lead engineers on March 28 and for collecting hard information about the transient for Miller and him to take to the briefing of the Lieutenant Governor.

95. There is additional evidence that these temperatures were know within the "think tank," and were in fact communicated to Miller. See, JME 1-C (81) at 23, JME 1-C (124) at 46; JME 1-C (100) at 63-65; JME 1-C (6) at 297; JME 1-C (91) at 12; JME 1-C (20) at 10; JME 1-C (87) at 29-30; JME 1-C (1?) at 49-50; JME 1-C (23) at 37, 75; JME 1-C (30) at 44; JME 1-C (37) at 52-53; JME 1-C (59) at 10-11; JME 1-C (61) at 15-16; JME 1-C (72) at 21-22;

JME 1-C (73) at 15; JME 1-C (82) at 17-18; JME 1-C (95) at 8, 17, 34, 49-50; JME 1-C (118) at 28; JME 1-C (122) at 77; JME 1-C (138) at 147-149.

96. The Board has also concluded that John Herbein was informed of thermocouple temperatures which indicated core temperatures in excess of 2400 degrees F and find his current testimony denying such knowledge incredible. Tr. 30,305. First, Herbein's past testimony clearly indicates that he was told of incore temperatures as high as 2400 degrees F. JME 1-C (61) at 15. Tr. 30,304. Second, it appears that GPUSC personnel stationed at the Observation Center during the afternoon of March 28 were told in a 5:00 p.m. briefing that site personnel had measured incore thermocouple temperatures in excess of 2500 degrees F. TMIA Ex. 15 at 7. TMIA Ex. 32K at 102-103. This briefing apparently was given by Richard Bensel, the lead electrical engineer at TMI-2 on March 28. JME 1-C (50) at 4-5.

97. It is inconceivable to us that Herbein would not have known of these temperatures if site personnel had transmitted them to Miller and to GPUSC technical support personnel sent to the site to analyze the data.

98. Further, Herbein has stated that he would have wanted Miller to transmit to him any information Miller had on the pressure spike, the hydrogen burn, actuation of containment sprays or incore thermocouple temperature readings greater than 2200 degrees F. Tr. 30,337-338; 30,435-436 (Herbein). We believe that Miller did inform Herbein of all these occurrences.

99. We conclude that given Miller's awareness of the incore thermocouple temperatures, including the striking full set of 51,

led him to an understanding that a zirc-water reaction had taken place so as to produce substantial amounts of hydrogen. In that light we find the extensive testimony that Miller was aware of the pressure spike (Chwastyk and Mehler); containment sprays (Ross, Marshall, Zewe); and the noise (Miller, Ross), to indicate that despite his claim to the contrary he did know of the pressure spike and its significance. See also JME 1-C (107) at 48, 66; Tr. 30,284.

100. We give substantial weight to Chwastyk and Mehler's testimony which would indicate not only that Miller knew about the pressure spike, but that he properly analyzed it to be caused by a hydrogen burn and took responsible steps to change the mode of shutting down the reactor in response to his understanding. This included his authorizing Chwastyk to draw a bubble in the pressurizer as the first step in repressurizing the reactor coolant system and giving a direction to Mehler and other operations personnel not to activate equipment in the reactor building for fear of another hydrogen spark.

101. We find that Miller would be expected to, and did, pass on this information to Herbein. Herbein was located in the Observation Center, overseeing operations personnel who were attempting to deal with the accident. Herbein was a central figure, apparently involved in discussions with Robert Arnold throughout the day after he arrived at the Observation Center. He discussed with Arnold the need to start a reactor coolant pump, and according to all accounts, gave the order in the 5:00 to 5:30 p.m. time frame on March 28 to increase high pressure

injection. Tr. 28,411 (Dieckamp); 29,161-163 (Chwastyk); JME 1-C (120) at 61; JME 1-C (88) at 43; JME 1-C (99) at 24. Chwastyk has testified that Herbein at the time he gave this order appeared to understand the conditions and events taking place at TMI-2, explaining why Chwastyk felt no need to explain the pressure spike or hydrogen burn. Tr. 29,263; 29,400 (Chwastyk).[9]

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[9] Chwastyk resisted going to full high pressure injection at the time Herbein gave this order because he felt there had been a definite change in the plant parameters such that it was not necessary. Tr. 29,363-364 (Chwastyk). Chwastyk, apparently as many of the other operational personnel, were trained not to take the plant solid under any condition. Tr. 30,444 (Chwastyk).

4. The Pressure Spike and Hydrogen Burn was Common Knowledge Among Site Personnel on March 28

102. During discovery in this proceeding, TMIA propounded a number of interrogatories to GPUN concerning operational personnel and management's awareness on March 28, 1979 of the hydrogen burn or explosion. Licensee chose to answer these interrogatories by distributing a questionnaire to present and former GPU and B&W employees and managers involved in some manner in the accident. TMIA Ex. 32A at 1-2. These questionnaires were distributed with a cover letter from GPUN Licensing Manager Jack Thorpe which stated that answers to the questionnaires would be used in the restart hearings for TMI-1. Id. at Att. 2.

103. Twenty-one persons answered "yes" when the questionnaire asked whether they were aware or informed on Wednesday, March 28, 1979, of the hydrogen explosion or combustion which occurred in the TMI-2 containment building. Most of these individuals later retracted their affirmative answers, after being contacted by licensee attorney Richard Lloyd. These retractions are for the most part short statements composed by Thorpe, which state without explanation that the individual misread or did not understand the questionnaire at the time he or she was completing it. TMIA Ex. 32A at 3; Attachment 3. The Board gives little credibility to these retractions, which were made only _after_ consultations with licensee's counsel. Rather, the Board finds that the majority of the individuals who originally answered affirmatively that they were aware of the hydrogen burn, answered candidly and truthfully.

104. The Board heard testimony from six of these individuals. The first, Thomas Mulleavy, testified that he learned of an explosion in the containment building at 1:50 p.m. on March 28, and in contradiction to his original questionnaire answer, claims that he did not identify the explosion as a hydrogen burn at the time. Mulleavy, who was a radiation protection supervisor, was in the Unit 2 control room at the time of the explosion. He learned of the pressure spike when he heard a noise which sounded like an oil burner going on. Tr. 31,324 (Mulleavy).

105. He testified, further, that someone told him that it sounded like an explosion in the reactor building, and then called his attention to the pressure spike strip recorder. He viewed the spike which rose rapidly and then returned straight back down. Ibid. Mulleavy stated that he did not report the explosion to anyone because he believed the operations personnel in the control room, about 15 or so, were trained individuals who he had confidence could handle the problem. Tr. 31,326-328 (Mulleavy). He confirmed, however, that it seemed a significant event at the time it occurred. Tr. 31,328 The Board believes that Mulleavy, as well as the operations personnel whom he observed, understood the hydrogen burn to be a significant event and took steps to deal with it.

106. Although Mulleavy denied taking any actions in response to the spike, he did state that he told Beverly Good about the explosion. 31,336-337 (Mulleavy). It is interesting to note that Good is the individual who recorded the results of the radiation check done around the Unit 2 reactor building which appears to have been done in response to the spike. TMIA Ex. 32

B. See, paragraph $ $, supra.

107. Moreover, the Board finds it significant that a number of other individuals who originally answered their questionnaires by indicating that they learned on March 28 of the hydrogen burn, were in fact working under Mulleavy's supervision in the Health Physics group. These include Joseph DeMan; Lorraine Beeman and Richard Benner. Tr. 31,320-321 (Mulleavy) TMIA Ex. 32A at 3. It is reasonable to suspect that if Mulleavy were aware of the hydrogen burn, others in his Health Physics group would also have become aware, which would explain the initial, candid questionnaire answers by DeMan, Beeman and Benner. As discussed infra, the inconsistencies in DeMan's testimony and his poor demeanor have lead this Board to give no credence to Deman's subsequent repudiation of his questionnaire answers.

108. DeMan, currently a training department instructor, indicated on his questionnaire that on March 28, 1979, he was informed of the pressure spike and the hydrogen burn. TMIA Ex. 33 B. DeMan was, on March 28, a radiological control foreman whose duty it was to direct the activity of health physics technicians. He reported to Unit 2 sometime in the morning of March 28. Tr. 31,343-345 (DeMan).

109. At the time of his testimony before this Board, DeMan not only could not remember whether or not he remained in the Unit 2 control room through the time of the pressure spike at 2:00 p.m, ibid. but claimed that he became aware of the hydrogen burn from "reading various reports" sometime prior to his deposition taken by TMIA on October 5, 1984. Moreover, DeMan said he

came to believe he answered the questionnaire incorrectly after speaking to company attorney Lloyd. Tr. 31,350-351 (DeMan). Additionally, DeMan disavowed his deposition testimony of October 5, 1984 in which he stated that he did not know whether the hydrogen burn or explosion occurred before or after the accident. Tr. 31,352 (DeMan).

110. Deman's various testimony changes throughout this proceeding undermine his credibility. DeMan testified in an earlier deposition, and confirmed before this Board that he learned of the pressure spike between 1979 and 1981, from an individual who mentioned it "in passing." Tr. 31,354-356 (DeMan). DeMan also testified at the time of his deposition taken by TMIA that he learned about the spike sometime before moving to the training department. Tr. 31,355 (DeMan). His current testimony is further impeached by the fact that he testified to the Senate Committee investigating the TMI-2 accident on October 16, 1979, that he learned about the pressure spike in the March 28 to March 30,1979 time period. Tr. 31,356 (DeMan).

111. DeMan provides no plausible reason for his varying, inconsistent, and incredible explanations for his mistakes in answering the questionnaire. His only attempt to explain -- that he psychologically blocked the date of the hydrogen burn from his memory -- is insulting to the intelligence of this Board. Tr. 31,357 (DeMan). We find that DeMan's noncredible testimony and entire demeanor, as reflected in his deposition and in this hearing, indicate that his prior affirmative answer to question 3(a), is correct. We find, further, that he appears to have changed his answer only after pressure from GPUN attorney

Lloyd.

112. The third witness who answered affirmatively on his questioning that he was aware on March 28 of the hydrogen burn, was Curtis Conrad. Conrad, currently a layout man with Met-Ed in Redding, was at the time of the accident an auxiliary operator C assigned to Unit 2. Tr. 31,362 (Conrad). He stated the following in his questionnaire:

> 1) On March 28 he was informed of the pressure spike through "information ...relayed [to him] by [his] foreman";
>
> 2) He was not aware of a thud or thump caused by the explosion although he was in the vicinity of TMI-2 at that time;
>
> 3) He was informed on March 29 at 9:00 a.m. by his foreman of the hydrogen burn which occurred on March 28 in the Unit 2 reactor building;
>
> 4) He was informed on March 28 of the acutation of the containment sprays;
>
> 5) He was aware on March 28 of the alarms actuated by the pressure spike or hydrogen burn.

TMIA Ex. 33 D.

113. At the hearing, Conrad's testimony changed completely. He stated that he was at the Observation Center at the time of the spike, which to this Board's mind is not "in the vicinity of TMI-2". Tr. 31,367 (Conrad). In other words, Conrad now claims he was in an entirely different location than where he claims he was located at the time he responded to the questionnaire.

114. During the hearing, Conrad also asserted that he does not know if he ever learned of the particular pressure spike in question. But at his deposition he testified that he learned of the pressure spike one to two weeks after the accident. Tr.

31,372-31,373 (Conrad). Further, at the time of the hearing Conrad said that he came to believe after speaking to Lloyd that he did not learn of the March 28 hydrogen burn or explosion in the containment building occurring on March 28 but instead only learned at some later time of a hydrogen burn in the reactor vessel. Tr. 31,378-31,380 (Conrad).

115. Moreover, Conrad now says that he learned about this hydrogen burn through the newspapers and not through a foreman. Tr. 31,381 (Conrad). As is apparent from the Board's having to call a bench conference in the midst of Conrad's testimony to comment on Conrad's demeanor. We find Conrad's current testimony totally non-credible. Tr. 31,377; 31,379 (Conrad). Conrad's consistent answers in his questionnaire to questions 1(a) and 3(a) about the pressure spike and hydrogen burn seem much closer to the truth.

116. Further, we believe it reflects poorly on licensee that its attorney would try to pressure lower-level employees such as Conrad to present incredible testimony on a central point before this Board. We think it is clear that Conrad is currently not testifying truthfully and that his testimony was formulated after conversations with Lloyd. Tr. 31,379; 31,385-386. Moreover, it reflects poorly on licensee that its current and former employees would alter these credible, consistent answers and present such inconsistent and non-credible testimony before this Board.

117. The fourth witness was David Zeiter, currently a Radiation Chemistry Supervisor, TMI-1, and at the time of the accident a radiation chemistry technician. Tr. 31,392 (Zeiter).

Zeiter answered as follows to the GPUN questionnaire:

> 1) He was informed on March 28 by other workers of the spike at the time the spike occurred;
>
> 2) He was aware on March 28 of the hydrogen burn;
>
> 3) He learned on March 28 of the actuation of the containment sprays; and
>
> 4) he was aware on March 28 of an instruction given not to activate electrical equipment in the reactor building for fear of causing a spark or hydrogen explosion. TMIA Mailgram Exhibit 33D.

118. While Zeiter claims that he filled out the questionnaire with care, Tr. 31,399 (Zeiter), he testified that he answerred each of the above questions incorrectly. Tr. 31,400-406 (Zeiter). As with DeMan and Conrad, almost all of Zeiter's current testimony is noncredible. He claims that he learned of the pressure spike only a few weeks ago from a company attorney. Tr. 31,402-403 (Zeiter).

119. He claims he learned of the hydrogen explosion in the containment building only within the last few weeks, through conversations with company attornies and other employees. Tr. 31,407-408 (Zeiter). Zeiter's only explanation for his supposedly erroneous questionnaire answers was an alleged confusion between the spike and hydrogen explosion on the one hand, and the clearly distinct hydrogen <u>bubble</u>.

120. The Board finds that Zeiter's current testimony is not credible, and that as with the other witnesses, he changed his previous, credible answers to the questionnaire after apparent

pressure from company attorneys to do so.[11]

121. A fifth witness who originally answered that he had learned of the hydrogen burn on March 28, was A.P. Rochino. He was the Engineering Mechanics Manager at the time of the TMI-2 accident. In July, 1979, he participated in the containment shock wave study which focused on the temperature effects of the pressure spike and/or hydrogen burn. TMIA Exs. 35 and 36. As such, he reviewed the hydrogen burn and pressure spike event in some depth. Moreover, he reviewed a draft report on the actuation of containment sprays at the time of the spike. TMIA Ex. 37; Tr. 31,420; 31,422-424 (Rochino).

122. In his questionnaire Rochino answered the following:

> 1) He was informed at 8:00 p.m. on March 28 of the pressure spike by means of "telephone communications which [were] continously [sic] going on between TMI-1 and Mountain Lakes Bldg...";
>
> 2) He was informed of the hydrogen explosion or combustion on March 28, 1979 at 8:00 p.m. "by telephone ...", apparently by means of open lines between TMI-1 and Mountain Lakes;
>
> 3) He did not remember whether or not he was informed or aware of actuation of the containment sprays or an instruction not to activate equipment in the reactor building for fear of causing a spark or hydrogen burn. TMIA Mailgram Exh. 33E.

123. At the time of this hearing, Rochino testified that he

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11 Zeiter claims that he became aware of some mistakes on his questionnaire immediately after filling it out and learned of other inaccuracies after speaking to Lloyd. However, it appears from the September 14, 1984 letter to Zeiter from Lloyd that his first awareness, or at least manifested awareness of mistakes on the questionnaire, was after the company questioned him. Moreover, Zeiter's confirmation to the September 14, 1984 Thorpe letter that he learned about the hydrogen explosion on March 30 and not March 28 contradicts not only his questionnaire but his current testimony as well. TMIA Ex. 32A at Att. 3.

was not at work at 8:00 p.m. on March 28 but instead only worked his usual 8:00 to 5:00 work day on March 28 and 29. Tr. 31,426-427 (Rochino). He testified that he meant to say that he learned of the pressure spike and hydrogen burn on March 30 when Wilson set up a group to maintain a nightly vigil by means of a squawk box or speaker phone. Tr. 31,427; 31,432; 31,439 (Rochino). Further, he testified that he had mistakenly characterized the telephone communications as between Unit 1 and Mountain Lakes, when in fact those communications were between Mountain Lakes and the TMI site. Tr. 31,432 (Rochino).

124. The Board finds Rochino's current testimony incredible for a number of reasons. First, Rochino is an engineer who is in a fairly high position in the GPUSC/GPUN hierarchy. By his own admission, he is a careful and precise engineer, and would be expected to complete the questionnaire carefully at the time he received it. It is simply absurd to suggest that Rochino made so many different mistakes throughout the questionnaire when he himself states that he took the questionnaire seriously. Tr. 31,428-429; 31,431 (Rochino).

125. Moreover, it is clear that Rochino was intimately familiar with the subject matter of the questionnaire. It is not credible that Rochino would have reviewed and perhaps commented on detailed papers on the effects of the spike and hydrogen burn, and then been unable to answer a question about the date on which he became aware of the spike and hydrogen burn. The Board finds it more likely that his original answers were correct, given the appearance of the questionnaire, Rochino's precision and care in his work generally and in preparing the questionnaire, and his

familiarity with the events on which he was questioned.[12]

126. Furthermore, the answers to questions 1 and 3 are identical, demonstrating to the Board some certainty in Rochino's mind about awareness of the pressure spike and hydrogen burn on March 28. Tr. 31,430 (Rochino); TMIA Ex. 33 E.

127. Therefore, we find that Rochino's original answer that he was aware on March 28, 1979 of the hydrogen burn, was in fact correct, and that he changed this answer only after being convinced to do so by Licensee's attorneys. Tr. 31,445-446; 31,451; 31,453-454 (Rochino).[13]

128. The final witness on this subject was Robert Boyer, currently a TMI-1 shift supervisor, and at the time of the accident, a Unit 1 control room operator. Tr. 31,548-549 (Boyer). He resonded to the questionnaire as follows:

> 1) He learned of the pressure spike when he returned to work on March 29 after being off work the 28th, and was informed by operational personnel of TMI-2 conditions;
>
> 2) He was informed about the hydrogen burn when he returned to work on March 29 for his regularly-scheduled shift and was briefed by operations; and
>
> 3) He recalls a briefing by operations personnel about the pressure spike, the actuation of the containment spray and the hydrogen burn when he returned to work on March 29. TMIA Mailgram Exh. 33F.

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[12] Rochino's thoroughness is further evidenced by his explanation of why his questionaire was turned in late. He explained to Licensing Manager J. Thorpe, who sent him the questionnaire, that he turned it in late because he had been on vacation.

[13] Rochino testified that he, on his own, had confirmed Mr. Thorpe's representation in his letter to Rochino of September 14, 1984 was patently untrue, since licensee attorneys stated at the hearing that they had requested that he and other employees verify Thorpe's letters. Tr. 31,454-455; 31,457-458; TMIA Ex. 32 A at Att. 3.

129. After being contacted by company attorney Lloyd, Mr. Boyer changed his story. Since then, he has had other conversations with licensee attorneys to prepare for his deposition and this hearing. Tr. 31,561-562 (Boyer). By the time of the hearing, he had little memory about any of these events. Tr. 31,557-560 (Boyer). The Board observes that it required three different licensee attorneys to prepare Boyer for this hearing.

130. At the hearing Boyer could not remember whether, at the time he was briefed on March 29 of TMI-2 conditions, whether he was informed about the pressure spike, actuation of containment spray or the hydrogen burn. He could not remember how or when he learned of the pressure spike, or how or when he learned of the hydrogen burn. And he has simply no memory now of the pressure spike or related events. Tr. 31,551-552; 31,556-558; 31,560 (Boyer).

131. Moreover, Boyer denied that licensee attorneys had attempted to obtain confirmation of his retraction of his original questionnaire answers. Instead Boyer insisted that he had confirmed his retraction entirely at his own initiative. Tr. 31,563 (Boyer). As other testimony confirmed, supra, licensee attorneys requested these confirmations. Boyer's attempt to make the confirmation appear as his original idea drastically reduces any credibility the Board would otherwise attach to his testimony.

132. For the reasons stated above, the Board finds Boyer's original question response, that he was informed about the hydrogen burn on March 29 when he reported to work, accurate, and

his current testimony non-credible.

133. We find, in summary, that the answers given by the six individuals on their questionnaires indicate that they knew about the hydrogen burn on March 28, or were informed upon arrival at the plant early the next morning, to be substantiated by the preponderance of the evidence before us. We find the partial or complete retractions of all these individuals non-credible.

134. The quality of these six individuals' testimony is so poor that we have no choice but to find that they were pressured by company attorneys to change their testimony for purposes of these hearings. We find the fact that licensee attorneys would pressure employees to change their testimony on a critical issue before this Board, that is, whether anyone was aware of the hydrogen burn on the first day of the accident, reflects poorly on licensee management.

135. Moreover, the Board believes these six individuals are a representative sample of individuals who answered that they were aware of the hydrogen burn on the first day of the accident. Given the extremely poor quality of these six individuals' testimony, we believe that their retractions, under apparent pressure from company attorneys, are simply not credible. Therefore, we find that the majority of the other individuals who answered yes to question 3(a) on licensee's questionnaire were aware of the hydrogen burn on March 28, 1979. These include the following individuals:

Richard Benner;

James L. Hetrick;

Ronald D. Natale;

George L. Civijic;

Margaret Pelen

Richard R. Umberger;

David A. Kemble;

Thomas Riggenbach;

Donald E. Smith;

Juanita A. Gingrich;

J. K. Lionarons;

Lorraine Beeman;

Edward D. Hahn;

Matthew Joyce; and

David E. Reich.

136. The Board therefore concludes that it was general knowledge at the site on the afternoon of March 28 that a hydrogen burn or explosion occurred in the Unit 2 reactor building.

5. Awareness of GPUSC Engineers of Pressure Spike and Hydrogen Burn on March 28 and 29, 1979

137. The Board finds that the GPUSC group of engineers sent to the site on the first day of the accident learned on March 28 or early on March 29 of the pressure spike and an explosion in the containment. They also learned through analysis of the hard data made available to them of the hydrogen or noncondensible gases in the primary reactor coolant system and of temperatures greater than 2500 degrees F which would lead to the production of hydrogen. Therefore, just as the TMI-2 operational personnel, they properly interpreted the pressure spike in terms of generation of substantial amounts of hydrogen and core damage.

138. About 9:30 a.m., March 28, Richard Wilson called Robert Keaten out of a meeting and told him to return to the office because of an accident or incident at TMI-2. Tr. 31,238 (Keaten); JME 1-C (45) at 4. Upon Keaten's return to his office Wilson told him to make arrangements to send a group of engineers to the site. Keaten specifically recalls sending Gary Broughton, who was then Control and Safety Analysis Manager and responsible for transient and accident analysis at GPU's nuclear plants, and his subordinate Lentz. Tr. 31,238-239; 31,071 (Keaten). See, JME 1-C (45) at 4-5; JME 1-C (44) at 4-6; JME 1-C (47) at 11; JME 1-C (26) at 13-15; JME 1-C (95) at 46; JME 1-C (121) at 17, 45; JME 1-C (86) at 33; JME 1-C (7) at 11, 27-28; JME 1-C (82) at 58-58; JME 1-C (43) at 5-7; JME 1-C (49) at 2-3, 8; JME 1-C (48) at 2-5; JME 1-C (41) at 4-6.

a. Awareness of Incore Thermocouple Temperature Readings Greater Than 2500 degrees F.

139. James Moore, another GPUSC engineer sent to the site kept detailed notes of the meeting at which Keaten made these arrangements. These notes indicate that both Moore and Broughton were given assignments. Broughton was given responsibilty for obtaining data from the plant, to put together a sequence of events and to address the question of whether the core was uncovered. TMIA Ex. 15 at 5; Tr. 31.075-078 (Broughton). Lentz's notes of that same meeting indicate that Broughton and he were to collect the following types of hard data in order to compile a sequence of events and eventually complete a computer RETRAN analysis of the transient or accident. TMIA Ex. 8 at 1; Tr. 31,078-081 (Broughton). The types of hard data which Broughton and Lentz were to collect included the sequence of events monitor; the post-trip monitor; reactimeter data; ICS record data; alarm printer data; and utility printer data. Broughton acknowledged that they "might" collect strip chart recordings to evaluate the transient. Tr. 31,078-081 (Broughton).

140. Broughton, as head of the unit, was sent personally to the site in order that he might do an anaylsis of the accident or transient as quickly as possible. Tr. 31,082 (Broughton). Although Broughton denied that Keaten emphasized the urgency of his task, Wilson testified during a previous interview that he understood early in the morning that the incident at TMI was serious and that GPUSC engineers needed to travel quickly to the site and report back immediately to GPUSC headquarters. Tr. 31,083-084; JME 1-C (45) at 5-6.

141. Lentz was sent to the site because he had previously worked at TMI-2 and was familiar with the site and site personnel. Tr. 31,083 (Broughton).

142. Moore was the first of the five GPUSC technical personnel to arrive at TMI. He stationed himself at the Observation Center after his entry into the Unit 2 Control Room was barred. TMIA Ex. 32 K at 5. He was briefed at about 5:00 p.m. by Bensel and informed in the course of that briefing of incore thermocouple temperature readings greater than 2500 degrees F. TMIA Exh. 32 K at 87, 102-103 See also, JMR 1-C (50) at 4-5. Moore stated that after being briefed about termperatures greater than 2500 degrees F he understood that there was some core damage. Id at 126.[14] Moore stated clearly that at "whatever time it was that I got the information on 2500, that that would have influenced my opinion or at least firmed up my opinion that there had been at least some core damage." Id. at 151.

143. Moore further testified that sometime after Broughton arrived at the Observation Center he briefed Broughton on what he had learned up to that time. Id. at 71.[15] He said that he believed that he gave Broughton all the relevant information he had gathered to date including the incore thermocouple temperature readings greater than 2500 degrees F. Tr. at 31,102-103; 31,107.

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[14] Moore also stated that a high dome reading of 1000 R, also recorded in his notes indicated to him that the reactor had suffered potential core damage. TMIA Ex. 32 K at 126.

[15] Broughton has testified and his notes would reflect that he arrived at the Observation Center at about 5:20 p.m. Tr. 31,084; TMIA Ex. 28 at 3.

144. Broughton has stated that that although he does not recall such a briefing by Moore, he has "no way of disagreeing with Jim Moore's memory." Tr. 31,092 (Broughton). Additionally, he stated that if he had received the information he would have passed it on to his management. Tr. 31,105 (Broughton).

145. Further, Broughton admits that he was aware on March 28, 1979, that temperatures greater than 2200 degrees indicated a zirc-water reaction would occur to produce hydrogen and that production of hydrogen caused by one percent oxidation of the zirconium cladding would lead to a concern as to whether the ECCS would, from a design standpoint, operate adequately to cool the reactor. Tr. 31,092-093 (Broughton). He also indicated that at temperatures greater than 2200 degrees, one knows that the ECCS had failed to provide adequate coolant and failed to perform in accordance with ECCS criteria. Tr. 31,177-178. (Broughton)[16]

146. It is clear to the Board that Broughton was aware of superheated temperatures, and thus he knew on the evening of March 28 that the TMI-2 core had seriously overheated. GPUSC engineers were also aware that a significant amount of hydrogen had been produced by a zirconium-steam reaction. This knowledge is important in understanding how Broughton and the other GPUSC engineers interpreted the data which was made available to them that evening, and during the early morning of March 29.

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[16] Broughton testified that he did not believe that these temperatures or one percent oxidation of the zirconium cladding would lead one to believe that there was no assurance that the ECCS would work to adequately cool the reactor. Tr, 31,180 (Broughton). We believe that it is clear that the ECCS criteria provide for no more than one percent oxidation of the cladding. 10 CFR 50 46. See, TMIA Appendix A; Tr. 31,180 (Broughton).

b. Awareness of Pressure Spike, Explosion in Containment Building, and Actuation of Containment Sprays.

147. Included in the data available to them was information from George Kunder. Kunder briefed Broughton, Moore and Lentz at about 6:00 p.m. on March 28 about the status of the reactor. Moore and Broughton took notes of that briefing. TMIA Ex. 15 at 10; TMIA Ex. 28 at 6. JME 1-C (49) at 5; JME 1-C (48) at 5, 6; JME 1-C (50) at 5.

148. After that briefing Lentz returned with Kunder to the Unit 2 control room in order to gather data for the GPUSC group to review and analyze. Tr. 31,114-115; 31,118 (Broughton); 32,986 (Lentz). Lentz left to go into the control room around 7:00 or 7:30 p.m. Tr. 31,118 (Broughton). Lentz stayed until about midnigh in the Unit 2 control room. JME 1-C (47) at 9: Tr. 31,119 (Broughton). Lentz recalls staying until around 11:00 p.m. Tr.32,996 (Lentz)

149. Lentz testified to the NRC in 1979 that he gathered together and xeroxed 12 hours of alarm printout. JME 1-C (47) at 7. However, at a deposition taken by TMIA on October 15, 1984, Lentz denied gathering together <u>any</u> of the alarm printout. He made this denial even though only one month prior to this deposition he had told licensee attorneys, who had provided this information to TMIA in a discovery response, that he had collected four hours of alarm printout. Lic. Mailgram Exh. 2 at 51-52, 54-57; 60-63; Lic. Mailgram Exh. 3. <u>See also</u>, JME 1-C (47) at 6-9; JME 1-C (47) at 16-17.

150. Further, at the time he testified before this Board on

January 9, 1985, he again changed his testimony, stating that he brought back some portion of the alarm printout, but not 12 hours worth. Lentz conceded this point only after being confronted with notes taken by Julien Abramovici on March 28, 1979, which indicated that a portion of the alarm printout from 8:09 to 11:17 a.m. on March 28 was available to Abramovici on that date. See, Tr. 33,025-026.

151. Because Lentz shifted position at least three times in the course of these proceedings, we have no choice but to credit his earliest testimony to the NRC, closest in time to the events and thus objectively most reliable, which indicates he brought back 12 hours of alarm printout to the Observation Center. We also assume that included in such a stack was the critical 1:50 p.m. portion showing the alarms actuating at the time of the pressure spike.

152. Moreover, we believe that Lentz photocopied the reactor building pressure strip chart while in the control room during the evening of March 28. Illjes' early testimony confirms that he believed someone photocopied the strip chart during the late evening of March 28 and his testimony suggests that it was xeroxed by a GPUSC engineer. JME 1-C (36) at 9; JME 1-C (127) at 6-10, See also, Tr. 29,624 (Illjes). See also, JME 1-C (60) at 9-11.

153. It appears to the Board that if, as Illjes testified close in time to the accident, a photocopy was made of the pressure spike strip recorder, it must have been Lentz who made the photocopy. Lentz was the only individual, with appropriate corporate authority to do so, who was actively involved during the

evening of March 28 in photocopying hard data from the Unit 2 control room.

154. Dieckamp testified that he did not believe Illjes' testimony that the strip chart was xeroxed on the evening of March 28, because "the physical evidence demonstrates the chart was not removed " until March 29. Dieckamp ff Tr.28,316 at 14. Dieckamp based his conclusion on an analysis similar to one found in the so-called "Frampton Memorandum" JME 1-C (107) which concluded that the strip chart could not be removed from the recording machine without disrupting the recording trace. Frampton also determined that the strip chart appeared to have been removed at noon on March 29. See, JME 1-C (107) at 56-62.

155. However, the testimony from both Richard Brill, a lead instrument and control engineer and expert witness for Licensee, and Lentz, who was familiar with the strip chart recorder at TMI-2, demonstrates that the reactor building pressure strip chart could have been removed during the evening of March 28 without causing more than a minor disruption of the recording trace. Lentz Dep. ff. Tr. 29,708; Brill ff. Tr. 31,610.

156. Moreoever, Brill testified that it was possible to remove a portion of the chart and tape the chart back together in a manner so that it would continue to move onto the take-up roll. Id. at 4.

157. Upon questioning from TMIA counsel he identified a slight dip at or around midnight on both the wide-range and narrow-range recordings on strip chart B, TMIA Ex. 41; Tr. 31,625 (Brill). Brill found no similar corresponding dip at that same

time around the midnight time period on strip chart A, TMIA Ex. 42. Tr. 31,626 (Brill). The Board members observed the same anomalies in the originals copies of the two charts as did Brill. Tr. 31,629-630 A. Brill seemed to agree that if there were a dip on one chart but not on the other, it might indicate that the anomalies on the first chart were caused by some disturbance other than a pressure excursion. Tr. 31,614 (Brill).

158. Further, Brill testified that the pressure strip recorder was cut in three pieces prior to the time it was microfilmed on May 2, 1979. Tr. 31,636 (Brill). Since licensee has provided no reason whatsoever for the cutting of the pressure spike strip chart, it is a reasonable inference that the chart was cut at some time before the strip chart paper ran out at about noon on March 29. If the strip chart were in fact removed at noon on March 29 there would be no reason to cut and mutilate this particularly valuable piece of evidence, especially prior to its microfilming on May 2.

159. We give no weight to Brill's speculation that the chart was not cut and taped together, prior to the time of the taping for microfilm on May 2. Brill ff. Tr. 31,610 at 4. As TMIA pointed out during questioning of Brill, extra tape appeared on the back side of the chart which does not currently hold the chart together, Tr. 31,646; certain portions of the strip chart are folded over at the point where the chart is taped at the 2:00 a.m. taping, Tr. 31,642-643 (Brill); and portions of the wheel runs are torn and disturbed between 10:00 p.m. and 2:00 a.m. to a much greater degree than the portion of the chart after 2:00 a.m. Tr. 31,643. Brill also admitted that in the ordinary course of

business these strip charts are not cut. Tr. 31,651 (Brill).

160. The Board therefore concludes that the strip chart was removed sometime before the paper ran out at noon on March 29, and was taped back together prior to microfilming on May 2. Further, it was most likely removed and photocopied by Lentz or at his direction on the evening of March 28.

161. The Board finds added support for this conclusion in the fact that Lentz was responsible for preserving analog data, including the strip charts on March 28. JME 1-C (47) at 14. We are unconvinced by Lentz's current attempts to deny that he held such responsibility on March 28. Tr. 32,997-002 (Lentz). Finally, we find other indications that the GPUSC engineers in the Observation Center on the evening of March 28 and early morning of March 29 had available to them information about plant conditions at 1:50 p.m., which could only have come from the alarm printout and the strip chart. As stated earlier, Abramovici's notes indicate that he reviewed a portion of the alarm printout for the middle time period of the transient. Tr. 33,025 (Lentz).

162. In addition, Broughton made certain plots of data during the evening of March 28 or early morning of March 29 from the "hard data" which Lentz brought back. One of the plots indicates that although the majority of data was taken from the post-trip monitor, certain data indicating the time of the ES signal had to be taken from the alarm printout. Tr. 31,121-123 (Broughton); TMIA Ex. 28 at 8.[17] See also, JME 1-C (49) at 3; JME 1-C (50) at 8; JME 1-C (48) at 7, 10.

163. Finally, Abramovici answered during discovery in this

proceeding that on March 28 he became aware of actuation of containment sprays. TMIA Ex. 32A at 4. Abramovici was located in the Observation Center and had access to the hard data which Lentz brought back from the Observation Center.

164. Moreover, Mike Morrell, located in Parsippany, who served as interface for those GPUSC engineers on the site and management in Parsippany stated that on March 28, 1979, he was aware of actuation of the containment sprays. Ibid.; JME 1-C (42) at 6-7. The Board believes that it could only be from transmission of this information from those GPUSC engineers at the Observation Center that Morrell could have learned about the spray actuation. Therefore, we find that Abramovici and Morrell must have had access to the pressure spike's alarm printout and learned that the containment sprays were activated.

165. We also find it inconceivable that if the GPUSC engineers reviewed the alarm printout for the time around the pressure spike at 1:50 p.m., they would not have learned of the ES signal and the wide range of alarms which became actuated at that time. Moreover, we believe they had at least the same depth of knowledge to analyze the alarm printout as Richard Bensel, who was able to understand the significance of the spike upon seeing this data. TMIA Ex. 32 E at 4.

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[17] The Board finds Broughton's deposition testimony that the ES actuation time came from the alarm printout more convincing than his testimony during the hearing that it may have come from the SOE monitor.

166. Indeed, notes taken by Robert Keaten during a conversation with Broughton, apparently on the morning of March 29, in which there is the notation "explosion in containment," confirms this hypothesis. TMIA Ex. 10 at 13.

c. Conclusion

167. The Board concludes that the group of GPUSC engineers sent to the site early on March 28 in order to analyze the accident and provide technical support learned of the explosion in the reactor building sometime during the evening of March 28 or early morning of March 29, and interpreted it to indicate the release of hydrogen or noncondensible gas into the primary reactor coolant system. This supports our finding that the hydrogen burn was common knowledge at the TMI site on March 28, and was interpreted to signify core damage at the time it occurred.

B. Conclusion Concerning False Statements in the "Dieckamp Mailgram"

168. It is clear that the significance of the pressure spike was understood at the time of its occurrence on the afternoon of March 28. GPUSC engineer Gary Broughton stated that operators coming off-site for debriefings in the Observation Center[18] spoke of the hydrogen explosion. JME 1-C (48) at 19. Similarly, Shift Supervisor Zewe testified that hydrogen was discussed as the cause of the spike by early morning, March 29 -- significantly before the Licensee acknowledges such recognition. JME 1-C (119)

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[18] The operator debriefings are explained at JME 1-C (49) at 5; JME 1-C (31) at 4; JME 1-C (48) at 11; JME 1-C (121) at 46.

at 42-43; JME 1-C (4) at 59-68, 73-74, 130; JME 1-C (5) at 6-9, 73, 147, 194-195; JME 1-C (143) at 1-2, 54-92, 96-97.

169. We find that both the site operations personnel operating TMI-2 on March 28, licensee personnel generally present at TMI-2 on March 28, GPU Service Corporation managers in Parsippany, and those sent to the site to analyze the accident, interpreted the pressure spike which occurred in the TMI-2 containment building at 1:50 p.m. to indicate a hydrogen burn, and some core damage. Therefore, we find that Dieckamp's mailgram, which contains the statement that no one interprreted the pressure spike or containment sprays in terms of core damage, is inaccurate and false.

170. We also conclude that Dieckamp's statement that no one withheld any information concerning these events, is inaccurate and false. NRC officials at NRC headquarters in Washington and in Bethesda did not become aware of the hydrogen detonation until March 30. JME 1-C (4) at 60-61. Commonwealth of Pennsylvania officials, including Lieutenant Governor William Scranton, Jr., who were briefed in Harrisburg one hour after the detonation, were not informed of the hydrogen burn until March 30. JME-1 C (143) at 57; JME 1-C (142) at 44.[19] Thus, we find the mailgram to contain significant, false information.

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[19] The significance of this withholding of information can not be overstated. Both Commisioners and the NRC Staff manning the Emergency Response Center indicated that they would have ordered an evacuation if they had been informed of the hydrogen burn at the time it occurred. JME 1-C (4) at 110. On the basis of less serious indications about the reactor's status, the Commission did move to recommend a precautionary evacuation on March 30. JME 1-C (4) at 68-70, 82-84, 110; JME 1-C (143) at 1 n.2; JME 1-C (107) at 55-56.

III DIECKAMP KNEW AT THE TIME HE SENT THE MAILGRAM ON MAY 9, 1979 THAT THE MAILGRAM WAS INACCURATE AND CONTAINED MATERIAL FALSE STATEMENTS.

A. The Purpose of the Mailgram

171. On May 7, 1979, a congressional delegation visited TMI-2. In the course of this site visit, James Floyd, Supervisor of Operations for Unit 2, pointed out to members of the delegation, which included members of Congress, staff of the House Committee on the Interior and Insular Affairs, and NRC Commissioner Victor Gilinsky, that the reactor building pressure strip chart which recorded the pressure spike was in view of control room personnel at the time the spike occurred. Mr. Floyd stated that NRC inspectors in the control room at the time viewed the spike. He stated further that the actuation of the containment sprays indicated the spike was real because at least two independent pressure sensors were required to cause its initiation.

172. On May 8, 1979, the New York Times printed an article describing Floyd's briefing and stating that although control room personnel and NRC inspectors were aware from the spike that the core was seriously damaged they did not report the damage for two days to the NRC. Dieckamp ff. Tr. 28,316, at 28,316-U.

173. Dieckamp wrote a mailgram the next day to Congressman Morris Udall, Chairman of the House Committee on the Interior and Insular Affairs, with copies to NRC Commissioners Gilinsky and Richard Kennedy. Id. at 28,316-V; JME 1-C (29) at 190-191. According to Dieckamp, he wrote the mailgram to correct what he perceived as "misinformation in the New York Times article." Id. at 12.

174. During the hearings, Dieckamp claimed that the mailgram was not intended to have any official regulatory purpose. Tr. 28,752 (Dieckamp). We reject this testimony. Dieckamp sent the mailgram to Commissioner Gilinsky who was on the site tour, and to Commissioner Kennedy, who used it at a later time to answer certain questions posed by the House oversight committee. JME 1-C (29) at 190-191.

175. Dieckamp denied sending the mailgram to any Commissioner other than Gilinsky, until confronted with the copy he sent to Commissioner Kennedy. Tr. 28,962-964 (Dieckamp). Moreover, a draft of Dieckamp's mailgram indicates that he intended to send it to all NRC Commissioners. TMIA Ex. 14; Tr. 28,752-754 (Dieckamp).

176. The Board finds, therefore, that Dieckamp intended to use the mailgram to convince at least two Commissioners that the licensee did not withhold information about the spike and hydrogen burn from the Commission for two days. We have determined that this statement by Dieckamp is a material false statement. See, Section II, supra. Moreover, it appears that Dieckamp sent it to Commissioner Gilinsky because of discussions he held with Gilinsky on the site tour during which Gilinsky expressed concern that licensee had not reported information about the accident to the NRC in a timely fashion. Tr. 28,755 (Dieckamp).

177. Moreover, it was clear to Dieckamp that the NRC considered the mailgram to be submitted to the agency for regulatory purposes when, during a Commission meeting held on October 14, 1981, Commissioners questioned him on the mailgram and its inac-

curacies. Additionally, the NRC Staff included it as an issue to be investigated in its information flow investigation. Finally, if Dieckamp had any doubt that the Commission considered or relied on the mailgram, that doubt should have been erased when this Board included it as an item necessary for resolution of Board Issue 10. See Section I, supra.

178. We conclude that the Dieckamp mailgram was intended to be, and was in fact treated as, a statement by licensee to the NRC to convince agency officials that licensee had not withheld information about the single most significant event occurring on the first day of the accident.

B. Dieckamp's Knowledge of the Interpretation of the Pressure Spike by Plant and Corporate Staff

1. Miller-Herbein Discussions With Dieckamp

179. Dieckamp was in Harrisburg on March 28, 1979, for a meeting with the Pennsylvania Public Utilities Commission ("PUC") on business unrelated to TMI-2. He admitted to only a few conversations during the morning of March 28 about the then ongoing accident or transient at TMI-2. Dieckamp, Tr. ff. 28,316 at 5-7. On cross-examination Dieckamp explained that during his first conversations with Walter Creitz and Robert Arnold around 9:00 a.m. on March 28 he learned generally about certain parameters of the reactor which he described in previous interviews. Tr. 28,381-383; TMIA Ex. 3; JME 1-C (66) at 122; JME 1-C (86) at 3-5.

180. It appears to this Board that Dieckamp was informed in his conversations with Arnold and Creitz of the possibility of offsite radiation releases. Moreover, his testimony that he did

not understand how radiation releases could occur if the emergency core cooling system ("ECCS") had operated properly, indicates that he was aware of the significance of this information. JME 1-C (66) at 123; JME 1-C (86) at 4.

181. At about 11:00 a.m. Dieckamp attended a briefing by the Lieutenant Governor at which a generally optimistic picture was given of TMI-2. A short time after that briefing he spoke with either Creitz or Arnold. Dieckamp testified that he does not know whether in this conversation he learned of offsite releases above background levels. Tr. 28,389-390 (Dieckamp). He insisted that he did not learn at any time of specific reactor parameters on the first day of the accident, nor of the strategies being used to stabilize the reactor that day. Tr. 28,402 (Dieckamp).

182. Dieckamp further testified that he attempted to attend licensee's briefing of the Lieutenant Governor scheduled for about 2:30 p.m. because he wished to learn about the plant's status. When state officials did not permit him to attend, he testified that he merely greeted Met-Ed officials Herbein, Miller and Kunder on the steps of the State Capitol and a short time later continued on his way back to Parsippany. Dieckamp testified that he made no other attempt to contact site personnel to determine the status of the plant.[20]

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[20] Dieckamp did admit on cross-examination that apparently he had a conversation with Arnold around 3:00 p.m. since Arnold previously testified to that fact. Tr. 28,405-406 (Dieckamp);JME 1-C (26) at 28. Dieckamp continues to argue, however, that Arnold in this conversation, did not convey any knowledge of information to him about specific parameters of the troubled reactor. Tr. 28,406 (Dieckamp).

183. Dieckamp testified that he returned by car to Parsippany, although he testified on at least one prior occasion that he did not remember whether he had driven or flown back to his home in New Jersey. Tr. 28,406; JME 1-C (66) at 13; JME 1-C (86) at 13.

184. He also testified that he remembers that he returned to his home alone, although the company informed him, in preparation for this hearing, that two other individuals accompanied from Harrisburg to New Jersey. Tr. 28,406-407.

185. Dieckamp stated that the only thing he remembers about the time after he left the State Capitol, and before he arrived home in New Jersey that evening, was a radio communication in which Lieutenant Governor Scranton stated that the TMI-2 accident was more serious than the company had previously indicated. Dieckamp understood that Scranton meant the Company had misled the Commonwealth, and was shocked when he heard this news. Yet, according to his testimony, he made no attempt to investigate or inquire into the situation, but "continued on [his] way home." Tr. 28,408-410 (Dieckamp).

186. Dieckamp claimed that he had no direct recollection of any of his actions from 2:30 p.m. in the afternoon until he returned home, a period he described as a "time gap." Tr. 28,892 (Dieckamp).

187. Dieckamp testified that he spoke to Arnold in the evening, after returning home, and learned that site personnel had taken the plant solid and started a reactor coolant pump. Remarkably, Dieckamp claimed that he had not discussed any specific plant conditions with Arnold at that time. Tr. 28,410

(Dieckamp).

188. The Board finds this testimony to be non-credible, especially when juxtaposed with the testimony of Herbein, Miller and Kunder who have similar "time gaps" concerning the afternoon of March 28. See, infra.

189. Dieckamp was extremely involved in TMI-2 prior to the time of the accident and more than usually knowledgeable about the plant for a corporate executive at his level. Tr. 30,380-381 (Herbein); 28,612-615 (Dieckamp). Dieckamp directly supervised Arnold and William Verrochi when they headed the design and construction group building TMI. During the construction of TMI Dieckamp kept himself informed about problems which occurred and attended meetings on specific programs and contracts with major contractors. Because of his background and interest in the technical issues which arose during the construction of TMI, Dieckamp often communicated with Herbein directly even though he was not Herbein's supervisor. Tr. 28,613-615 (Dieckamp).

190. Prior to coming to GPU, Dieckamp worked for over 20 years at Rockwell International (or its predecessor North American Aviation), serving for three years as President of Atomics International, a Division of Rockwell. Dieckamp ff Tr. 28,316 at 2.

191. The Board finds incredible Dieckamp's professed lack of interest in the ongoing accident at TMI-2, in light of his extensive experience in nuclear technology, his special interest in TMI since 1973, his involvement in bringing outside technical support to assist in the "recovery efforts," and his extensive testimony about the accident to state and national governmental bodies concerned with the accident. Moreover, we cannot believe

that Dieckamp, who was so disturbed about the May 8, 1979 New York Times article that he wrote a mailgram to both Congressman Udall and two NRC Commissioners, would sit by calmly while the Lieutenant Governor told a national audience that Metropolitan Edison had misled the public about the seriousness of the TMI-2 accident.

192. Fyrthermore, the testimony of Walter Creitz, former Met-Ed President, indicates Dieckamp was informed of off-site radiation above background levels and later misrepresented to the PUC that there were no such measurements. The Board finds that Dieckamp's misrepresentation to the PUC about the seriousness of the accident seriously damages his credibility. Specifically, Creitz stated that he so informed Dieckamp in a conversation prior to noon on March 28, 1979. This was the second meeting he held with Dieckamp that morning, of offsite releases above background levels. Creitz believes that he probably mentioned a reading of 3 MR/hour. Creitz Dep. ff. 29,708 at 25-29. Dieckamp's notes for March 28 indicate that he was told of the 3 MR/hour reading by Creitz since this figure appears immediately to the right of Creitz' phone numbers. TMIA Mailgram Exh. 3 at 2. See also, TMIA Ex. 9, at 5-6.

193. In addition, it appears that the NRC, in a Preliminary Notification issued on March 28, stated that at 10:45 a.m. radiation levels of 3 MR/hr had been detected 500 yards offsite. JME 1-C (143) at App. F. Therefore, site personnel did have information which they passed to the NRC of offsite releases of 3 MR/hour. measured at 10:45 a.m. The Board finds credible Creitz'

testimony that he informed Dieckamp sometime prior to Dieckamp's second statement to the PUC around 11:30 a.m. of offsite releases. Dieckamp told the PUC at 11:30 a.m., after speaking to Creitz, the following: "There is no evidence of any radiation that is detectable above the background levels in the area." TMIA Ex. 4 at 2; Tr. 28,398 (Dieckamp). It is clear to the Board that Dieckamp had available to him information indicating offsite releases above background. Yet he told the PUC without qualification that there were no such releases.[21]

194. We find Dieckamp's misstatements to the PUC during the morning of March 28, 1979, weigh heavily in our decision not to credit his testimony about discussions between himself and site personnel later that day. Dieckamp claims he met Herbein, Miller and Kunder on the steps of the State Capitol around 2:30 p.m., after he was excluded from the briefing of the Lieutenant Governor. Although he testified that he spoke to the three gentlemen, his only memories of that conversation are that he expressed concern about the absence of senior people from the site, and gained an impresion that the plant was in a stable condition. Dieckamp ff Tr. 28,316 at 7.

195. Herbein and Miller, in almost identical language,

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[21] Dieckamp's first statement to the PUC at 9:00 a.m. omits information about the seriousness of the TMI transient. Although he did know of some off-normal radiation releases and had some question about the proper functioning of the ECCS, he stated: "All the indications that we have are that the plant is safely shut down. I am unaware of any impact or release which would have an interaction with the general public in the environ to the plant." TMIA Mailgram Exh. 4 at 2.

describe their conversation with Dieckamp on the steps of the State Capitol. Herbein says all he remembers about the conversation is "Mr. Dieckamp asking who was back at the Island minding the store. And, in addition he indicated that they wanted to talk to me during the briefing, that apparently they didn't want to talk to him." Tr. 30,378 (Herbein).

196. Miller stated that he could not remember any of the conversation he held with Kunder and Herbein on the way to the State Capitol, and all he could remember about the brief discussion with Dieckamp was that Dieckamp "asked me who is minding the store..." Tr. 30,214 (Miller). Kunder has no recollection of this encounter other than "a sense of urgency or promptness on the part of Mr. Dieckamp to have us go in and brief the Governor..." Tr. 30,071 (Kunder).

197. It is not credible that all four participants in this discussion, including the three Met-Ed officials with the best understanding of the TMI-2 accident, would remember nothing about the conversation except an off-hand remark by Dieckamp. Further, we do not credit Dieckamp's testimony that he did not ask questions about the status of the reactor, and that Herbein or Miller did not tell him about the specific plant parameters. Tr. 28,402 (Dieckamp); 30,215 (Miller); 30,378-379 (Herbein); 30,070-071 (Kunder).

198. Not only was Dieckamp particularly interested in TMI, he would likely be one of the GPU officials kept most completely informed about an incident of this magnitude. Given his deep involvment in TMI after the accident, including his admitted

involvment in bringing offsite technical support to the site, we do not believe Dieckamp would adopt such a nonchalant attitude toward the on-going accident while he was in Harrisburg. Dieckamp ff Tr. 28316 at 9-11.

199. Dieckamp stated that he wanted to attend the briefing of the Lieutenant Governor scheduled for 2:30 p.m. because he wanted to learn about the incident. Yet he made no efforts, according to his testimony, to obtain the information first-hand, either from Herbein, Miller and Kunder after they completed their briefing of the Lieutenant Governor, or from other site personnel. Tr. 28,403-405 (Dieckamp). The Board does not believe Dieckamp would attempt to obtain information about the status of the reactor from a briefing of Commonwealth officials rather than directly from those within his company, nor that he would simply give up his attempt to obtain the information once excluded from the Commonwealth briefing.

200. Equally striking to the Board is the "time gap" which appears to exist in the recollections of Dieckamp, Herbein, Miller and Kunder. Dieckamp stated that other than hearing the radio commentary from the Lieutenant Governor he has a "time gap" from 2:30 p.m. until Wednesday evening when he returned home to New Jersey. Tr. 28,892 (Dieckamp). Herbein said he does not remember much about the trip back from the briefing to the site. He assumed Miller managed to go back to TMI and to the control room, and he to the Observation Center -- and he could not remember whether Miller and Kunder stopped at the Observation Center on the return. Tr. 30,382-383 (Dieckamp). Miller testified that he had absolutely no memory of the time when he left the State

House until the time he returned to the site other than getting out of the car at the processing center. Miller stated that he could not remember anything about the ride back including whether Herbein and Kunder returned with him. Tr. 30,220 (Miller) Kunder testified that the time period after he left the Lieutenant Governor's briefing was "somewhat of a blank. You are talking about an hour or two or three that I don't specifically recall my, you know, exactly what I did." He also stated that he did not have "any recollection of just where I went, but I do know I returned back to the TMI area, probably into the plant, but I can't recall that particular time period with any degree of clarity." Tr. 30,072-073 (Kunder).

201. The Board does not believe that Herbein, Miller and Kunder have no better memory of the one and one-half to two hours from the time they completed the briefing until the time they returned to the site. Their testimony is especially incredible if one believes that Miller protested leaving the site in the first place. Moreover, an hour and one-half would be an unusually long period of time for the ride back to the site. It is not credible that Dieckamp would have a similar "time gap" during which he cannot remember whom he was with, whether he drove or flew back to New Jersey, or anything to do with the event other than one radio news brief which he allegedly ignored.

202. The evidence brought before us about Dieckamp's deep involvement in TMI both before and after the accident lead us to conclude that Herbein and Miller briefed Dieckamp on the status of the reactor at some time during the afternoon of March 28.

This briefing necessarily would include informing him of incore thermocouple temperature readings greater than 2200 degrees F, and the hydrogen burn which had occurred only a short time prior to Miller's departure from the site.

203. We also find that Herbein misrepresented information to the Lieutenant Governor during the afternoon briefing. This further discredits his and other Met-Ed officials' testimony that they did not know about the pressure spike at the time of the briefing and did not convey that information to Dieckamp.

204. Herbein stated in this briefing that Met-Ed had measured no offsite radiation releases even though he and Met-Ed officials knew that such measurements had been made. JME 1-C (142) at 42. Herbein testified in this hearing that if he had known of offsite releases he would have told the Lieutenant Governor, but that he was not sure that Met-Ed knew of such releases. Tr. 30,374-375 (Herbein) However, as discussed above, Creitz testified that sometime before noon he was informed by Unit 2 control room personnel of offiste releases which he reported to Dieckamp. Creitz Dep. ff. Tr. 29,708 at 24.

205. Moreover, the NRC's preliminary notification confirmed that such measurements had been made at 10:45 a.m. Therefore, the Board believes that Herbein and Miller knew of these measurements and misrepresented the situation to Commonwealth officials by denying such offsite releases.

206. If, as we believe, Herbein and Miller told Dieckamp about the pressure spike and hydrogen burn on March 28 he intentionally made false statements in his mailgram when he stated that no one understood the significance of the pressure spike and

containment sprays on March 28.

C. Broughton-Keaten Communication with Dieckamp

207. Even if we find that Dieckamp was not informed of the hydrogen burn and incore temperatures exceeding 2500 degrees F by Herbein and Miller on March 28, we believe the GPUSC engineers who were sent to the site informed Dieckamp through Robert Keaten early on March 2, of the hydrogen burn in the containment building, and of the hydrogen or noncondensible gases present in the pressurizer. Therefore, Dieckamp knew on March 29 that GPUSC engineers sent to the site had interpreted the pressure spike to be a burn or explosion of hydrogen produced from the zirc-water reaction.

208. It is necessary first to establish the reporting relationships which existed between the GPU Service Corporation group sent to the site on March 28 and GPU headquarters in Parsippany. According to Broughton he continued to report to his immediate supervisor Keaten until Richard Wilson came to the site to set up a formal organization. At that time he began reporting to Wilson. Tr. 31,128 (Broughton); TMIA Ex. 31 at 93-94.

209. Wilson arrived on site during the afternoon of March 29 and chaired the first meeting of the Task Force held at 3:30 p.m. in the Processing Center. TMIA Ex. 18 at 3. Therefore, we assume that Broughton maintained his usual reporting relationship to Keaten until Wilson arrived on site during the afternoon of March 29 to set up the formal Task Force group, directed by Dieckamp.[22]

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[22] Broughton contends that when he spoke about a formal organization in his deposition he was talking about the formal organization set up on March 30 to provide direct support for plant operations. Tr. 31,139 (Broughton). However, it is clear

210. The Board finds, therefore, that Broughton maintained a formal reporting relationship to Keaten only through the morning of March 29, and beginning that afternoon, reported directly to Wilson who arrived at the TMI site to set up the Task Force.

211. As stated in Section II (A)(4), supra, Broughton was aware of incore thermocouple temperature readings greater than 2200 degrees F which would lead him to believe that a zirc-water reaction had produced significant amounts of hydrogen, and that the 28 psi pressure spike recorded in the reactor building was caused by the combustion of that hydrogen. As explained below, we believe that Broughton reported these findings to Keaten who in turn reported them to Dieckamp on the morning of March 29.

1. Broughton Reported to Keaten

212. Broughton has testified that he cannot remember whether he reported to Keaten anytime on March 28 or March 29. Tr. 31,125-126 (Broughton). However, Broughton admits that as a matter of routine he would have reported back daily to his management. Tr. 31,127; 31,132; 31,204. Given Broughton's explanation in his deposition that he reported to Keaten through the morning of March 29 and thereafter to Wilson, we conclude

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that there was no such organization formed on March 30, and what Broughton was referring to both in his deposition and in his testimony in this hearing was the Task Force which Wilson headed which was divided up into two sections: Events Analysis and Recovery Planning. TMIA Ex. 18 at 3. In fact, Broughton states this explicitly later in his testimony when he testified his function did not change much with the more formal organization since he was merely assigned to work in the Events Analysis section. Tr. 31,158 (Broughton). He also mentions that at the time the more formal organization was set up "we planned to begin interviewing operators..." Ibid. This decision was made at the Task Force meeting during the afternoon of March 28.

that any reports made to Keaten would have occurred prior to the first meeting of the Task Force at the TMI site at 3:30 p.m. on March 29.

213. Keaten's notebook contains one set of notes with the following notation at the top of the page: "TGB call 3/29/79?/3/30I". The original of these notes indicates that "TGB call 3/29/79" appears in the same color blue ink as the notes themselves. The rest of the notation, including the question mark and the second date 3/30, appear in red ink. Keaten testified that "TGB call 3/29/79" was written at the same time as the notes themselves for that entry. He further testified that he added the second date in red ink some time prior to turning the notes over to NRC investigators because he believed that he had placed the wrong date on the notes when he originally wrote them. TMIA Ex. 10 at 11; Tr. 31,260-31,261; 31-271 (Keaten).

214. Keaten further testified that he wrote the first three pages of these notes to record information he obtained from a telephone call from Broughton. Tr. 31,262;31,265 (Broughton). The first notation states "HD at 10:45 Airport". This apparently refers to Dieckamp's arrival at the Harrisburg airport. Tr. 31,133 (Broughton) The second entry is "1:00 Senators-briefing". According to Broughton, this refers to the congressional briefing which was conducted in part by Dieckamp during the afternoon of March 29. Tr. 31,139 (Broughton).

215. The Congressional briefing which was conducted during the afternoon of March 29 took place around 2:30 p.m. according to the Rogovin Report. Tr. 31,310 (Keaten); JME 1-C (106) at 841.

216. The third entry, which continues onto the following page, is "S.O.E." which means Sequence of Events. Following this title is chronology of the major events occurring on March 28, ending with the notation "Finally 7-8 p.m. ...pump started". On the next page, immediately following is an entry which appears to follow the sequence of events, "Present Status". Under present status the following appears:

> Bubble in reactor
> Non-condensables in Pressurizer
> --lots-
> Explosion in containment
> 1000 ft3 [at] 1000psi   280 degrees F 260-280
> Could be 100,000 ft3

TMIA Mailgram Exh. 10 at 11-13.

B217. roughton has testified that on March 29 he was aware of all the information which appears under the section Sequence of Events, but not the information which appears under "present status". Tr. 31,141 (Broughton); TMIA Ex. 31 at 70-71.

218. We find that the preponderance of the evidence indicates that Broughton and the other GPUSC engineers at the Observation Center on March 28 and through the early morning of March 29, obtained data sufficient to compile the Sequence of Events as well as the evaluation of the present status which appears in Keaten's notes under the March 29 entry.

219. For example, it appears likely that through the hard data brought by Lentz back to the Observation Center, Broughton's group learned of the pressure spike and hydrogen burn in the containment building at about 1:50 p.m. This data included the alarm printout and copies of the pressure spike strip chart. See Section II (a)(4), supra.

220. Prior testimony also indicates that there were discussions among the Broughton group engineers about the possibility of a bubble in the reactor vessel. JME 1-C (48) at 6 (Broughton); JME 1-C (47) at 14-15 (Lertz).

221. Finally, we believe that the information available to the GPUSC engineers would lead them to believe that any bubbles which remained in the primary reactor coolant system by the morning of March 29, 1979, and which had not been collapsed after a reactor coolant pump was started on the evening of March 28, were composed of hydrogen or non-condensible gas. Therefore we believe that they knew by the morning of March 29 that the bubbles which remained in the system, including those in the pressurizer, were noncondensible gas and not steam. Tr. 28,472-478 (Zebroski).[23]

222. The Board concludes that pages 11 through 13 of the Keaten notes are notes of a conversation Keaten held with Broughton on the morning of March 29. The most compelling evidence supporting this conclusion is the fact that Keaten wrote down the date of March 29 at the time he wrote down the notes. Second, we believe that Broughton and others in his group had obtained all

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[23] There are two other indications from Keaten's notes that they were written on March 29 and not on March 30. First, the calculation of the volume of gas in the primary system, either 1000 or 2000 cubic feet, is a much rougher calculation than that made by William Lowe and Moore during the night of March 29. See TMIA Ex. 7 at 1, which contains a notation that there had been 1500 cubic feet of noncondensable gas calculated in the pressure vessel and pressurizer; Lowe, ff. tr. 28,151 at 12.

Secondly, the primary system pressure and temperatures which are noted under "Present Status" are those which were measured at least as early as 1:30 p.m. on March 29, and probably during the early morning of March 29. TMIA Ex.2 at 5; Tr. 31,148 (Broughton).

the information in these notes by Thursday morning. Third, it appears that the purpose of Broughton briefing Keaten was to assist in preparing Dieckamp to travel to TMI on Thursday.

223. Clearly the first two items record Dieckamp's schedule for March 29. Tr. 28,643 (Dieckamp). There could be no conceivable reason for Keaten to record on March 30 Dieckamp's schedule for the prior day. Moreover, the timing of the congressional briefing is incorrect, since the briefing took place around 2:30 p.m. and not 1:00 p.m. If Broughton informed Keaten of the time of the briefing after the fact he would have stated the correct time, whereas the time of the briefing might be misstated prior to the time of its occurrence. Tr. 28,643 (Dieckamp). Finally, we believe that Broughton did not report to Keaten but to Wilson after the morning of March 29. Therefore, we find these notes record Broughton's briefing of Keaten on March 29.

2. Keaten Reported to Dieckamp

224. Keaten has testified to the NRC that after taking these notes, including the section entitled "sequence of events" and "present status" he met with Dieckamp to convey to him the information contained in the notes. JME 1-C (45) at 7. Keaten testified at the hearing that "It had been prearranged that I would get a telephone call from Mr. Broughton, that he would give me a rundown on what they had learned and then it had been arranged that I would go and brief Mr. Dieckamp on what I had learned." Tr. 31,248 (Keaten).

225. Keaten currently, and at the time of his original NRC interview in 1979, stated that he received a briefing from Broughton and in turn briefed Mr. Dieckamp on March 30, 1979. JME

1-C (45) at 7; Tr. 31,392 (Keaten).

226. We find that Keaten did in fact brief Dieckamp on what he had learned from Broughton, but did so on the morning of March 29 when he first received this information from Broughton. It is reasonable to infer that Keaten's notes under the 3/29 date were written to prepare Dieckamp to travel to the TMI site on the morning of March 29.

227. If Dieckamp were briefed by Keaten of information Keaten obtained from the Broughton group on the morning of March 29, Dieckamp knew at that time that site personnel and GPUSC technical personnel had already understood the pressure spike to be caused by a hydrogen burn in the containment which indicated core damage.

3. Dieckamp's Awareness of Core Damage on March 28 and March 29, 1979 Demonstrates His Awareness of the Hydrogen Burn.

228. On the morning of March 29, Dieckamp signed a memorandum authorizing the formation of a Task Force to analyze the accident and assist in a recovery operation, after discussing with Arnold the severity of the accident. Arnold has testified that Dieckamp spoke to him about significant core damage in this discussion. JME 1-C (84) at 24-26, ff Tr. 28,635; Tr. 28,640. Although Dieckamp claimed that "significant core damage" meant little more than "cracked fuel, failed fuel pins such that they lost their integrity as far as containing gas, radioactive gas," we find that Dieckamp meant core damage caused by a zirc-water reaction. Dieckamp ff Tr. 28,316.[24]

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[24] It appears that Dieckamp was informed by Arnold on the morning of March 29 that HPI had been throttled the previous day. JME 1-

229. Further, Wilson briefed the Task Force at the beginning of its first meeting at 3:30 p.m. on March 29, 1979. He stated the following, according to GPUSC engineer Julien Abramovici:

> "...we assume that the core is damaged...a financial loss ...that you lost a core, that that's equal to X amount of dollars...In other words, we're not looking to restart the reactor in the immediate future because of this potential core damage."

TMIA Ex. 20 at 49-50.

230. Notes taken by Broughton and Abramovici of the meeting corroborate that Wilson gave this assessment at the beginning of the meeting. Abramovici's notes read: "Assumptions: 1 year outage; 30 million core lost; 20-30 million". TMIA Ex. 38 at 2. Broughton's notes of the meeting state as a goal of the meeting "Detailed assessment of core damage". Tr. 31,542-543 (Wilson); TMIA Ex. 39. The notes also state "one year, 30 million core and $20 -$30 million cleanup" Ibid.; Tr. 31,541-542 (Wilson).

231. The Board believes that Wilson could make this assessment of serious core damage only if the Broughton group at the site had transmitted to GPU Parsipanny headquarters hard information about the accident, including the high incore temperatures and hydrogen burn. Moreover, Wilson's assessment of the seriousness of the accident could only be derived from his immediate superior Arnold, or from Dieckamp who signed the memorandum establishing the Task Force. It is unlikely that Arnold, in discussing with Dieckamp on the morning of March 29 would have withheld from him any information concerning the status of the

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C (84) at 27. This would lead Dieckamp to the conclusion that there had been some core damage beyond failed fuel or cracked fuel pins.

reactor or the degree of core damage. Therefore, we believe Wilson's assessment of the accident and the degree of core damage suffered at TMI-2 are evidence supporting our conclusion that Dieckamp was aware of the hydrogen burn on the morning of March 29, and of TMI-2 had serious core damage.

232. Finally, we find further corroboration that Dieckamp understood the serious nature of the accident on March 28 from a memorandum written to him on March 29 from Bud Cherry. TMIA Ex. 5. Cherry was Vice President of Planning for GPUSC at the time of the accident. He reported directly to Dieckamp. He is one of the individuals whom Dieckamp asked to assist him in gathering together outside technical support in the aftermath of the accident. Cherry had an extensive nuclear background. Tr. 28,413-28,414 (Dieckamp).

233. Cherry in this confidential memorandum to Dieckamp described communication problems during the first day of the accident. In doing so, he described the individuals within Met Ed and GPUSC who were informed and had hard data and information about TMI-2 on the first day of the accident.

234. Cherry stated that he believed Arnold was the only one to whom he spoke during the day, who appeared to have hard information about the condition of the reactor. He stated that Met-Ed headquarters personnel were "not up to speed" on the accident and at least one, and perhaps two press releases underplayed the seriousness of the accident. Id. at 1-2. At one point Cherry told Creitz to contact Arnold "to get an update" on the situation. Finally, Cherry stated that problems in obtaining and communicating hard information about the accident persisted

throughout the early afternoon until he talked to Dieckamp and got "his view of the status of the reactor." Cherry wrote, "I think it was really only at that point that I had the full understanding of the situation and the condition of the plant." Id. at 2.

235. In light of Cherry's nuclear background and the subject matter of this confidential memorandum, it appears that Cherry credited Dieckamp with having the best hard information on the status and condition of the reactor on the first day of the accident. This would be true only if Dieckamp were in fact informed of the high incore temperature readings and the hydrogen burn which would lead him to the correct assessment that TMI-2 had suffered serious core damage.[25]

236. We conclude, therefore, that Dieckamp's underestanding by the morning of March 29 that TMI-2 had suffered serious core damage, demonstrates his awareness of the hydrogen burn occurring at 1:50 p.m. on March 28.[26]

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[25] The circumstances under which this memorandum was produced in discovery in this proceeding also demonstrates its reliability. Apparently Dieckamp produced the original of this confidential memorandum for the first time at his deposition. It was not produced to the NRC in the course of any prior investigation. Given that the memorandum speaks frankly of the communication problems within the GPU and Met-Ed organizations on March 28, the Board gives it great weight.

[26] Dieckamp testified that he did not learn of the pressure spike until Arnold informed him sometime on March 30. According to Dieckamp Arnold told him of the Task Force's analysis of the pressure spike recording during the night in terms of a zirconium-water reaction which led to production of hydrogen to

D. Conclusion

237. The Board finds that Dieckamp knew that the statements in his mailgram, that no one interpreted the pressure spike in terms of core damage at the time it occurred and that no one withheld information, were false at the time he wrote them.

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flammable limits. Dieckamp, ff Tr. 28,316 at 9.

Moreover, Dieckamp testified that he cannot remember any briefing by Keaten concerning the information contained under the entry "TGB call 3/29/79". Tr. 28,646-647 (Dieckamp).

Dieckamp's notes for March 30, 1979 do not reflect either the conversation he describes with Arnold about the pressure spike or the conversation Keaten describes with Dieckamp. TMIA Ex. 3.

Dieckamp currently possesses no notes for March 28 other than two pages taken during the morning of March 28 and no notes for March 29. Tr. 28,622-623 (Dieckamp). He has no explanation of why no such notes exist. Ibid.

The Board finds, further, that Dieckamp's notes of March 30 lack any record of a conversation with Keaten. The Board finds that this supports an inference that Keaten's briefing occurred on March 29, and not March 30.

IV. ASSUMING THAT DIECKAMP DID NOT KNOW THE STATEMENTS IN HIS MAILGRAM WERE FALSE AT THE TIME HE SENT THE MAILGRAM HE SHOULD HAVE KNOWN THEY WERE FALSE.

238. This Board finds that Dieckamp should have known that statements he made in his mailgram were false at the time he made them. A minimal investigation on his part would have demonstrated that there was in fact "some evidence" that on March 28 licensee and GPUSC personnel properly interpreted the pressure spike to indicate a hydrogen burn and core damage.

239. Dieckamp cannot sustain his current position that the "thrust" of his mailgram is accurate. He uses the standard of whether there is "absolute proof" that operations personnel properly understood that the pressure spike was caused by a hydrogen burn and indicated core damage. Dieckamp ff Tr. 28,316 at 15. This is a distortion of the issue before the Board.

240. The issue is whether there is any evidence of a proper interpretation of the spike and whether licensee improperly withheld information from the Commission about the spike or hydrogen burn. It is not Dieckamp's or the Licensee's responsibility to determine what information "passes muster" and needs to be turned over to the NRC. Clearly, all potentially useful information about critical reactor parameters was required to be disclosed to the agency during the accident.

241. We believe that Licensee's four arguments in support of Dieckamp's position, have eroded under close scrutiny during this hearing. Licensee's four arguments are:

> 1) A complex analysis, beyond the training and capabilities of TMI-2 operators was required to determine the pressure spike was caused by a hydrogen burn and demonstrated core damage;

2) Prior Chwastyk, Mehler and Illjes' interviews do not provide "absolute proof" that they properly interpreted the pressure spike as caused by combustion of hydrogen produced through a zirconium-water reaction;

3) The conclusion in NUREG-0760 that on March 28, 1979 no one in the control room at Unit 2 properly interpreted the pressure spike supports Dieckamp's mailgram statements; and

4) GPU consultant William Lowe was the first person to discover the significance of the pressure spike at 11:00 p.m. on March 29, 1979.

242. As explained below, we find the information available to Dieckamp on May 9, including operator interviews, provided him with adequate information to conclude that some individuals appreciated the significance of the pressure spike on the first day of the accident.

A. Dieckamp's Unduly Restrictive Definition of the Issue Before this Board.

243. Dieckamp testified that prior to sending the mailgram on May 9 he reviewed Miller's reconstruction of the events of March 28, transcribed from a taped conversation of a number of key TMI personnel, JME 1-C(10). Miller prepared this statement to help Dieckamp prepare testimony for the Nuclear Regulation Subcommittee of the Senate Committee on the Environment and Public Works (Hart Committee). Dieckamp ff Tr. 28,316 at 11. Dieckamp also reviewed virtually all early Met Ed operators' interviews; sat in on discussions concerning preliminary reviews of sequence of events; and ccoordinated the activities of the Industry Advisory Group ("IAG"). Dieckamp ff Tr. 28,316 at 11.[27]

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[27] Licensee presented testimony from Edwin Zebroski and Thomas Van Witbeck that Dieckamp was intimately involved in analysis of the

244. Dieckamp was also involved in reviewing reports from operator interviews, including those interviews conducted by Robert Long and Donald Reppert. Dieckamp apparently gave an order early in the interview process that no report was to be issued prior to his review and approval. The language he uses in instructing Long in this regard demonstrates an intent to suppress information which would be unfavorable to the company. According to the transcription of a group interviee conducted by Long, Dieckamp gave him the following instructions:

> Here's the status of this thing here: We start a review with the VP's and Herman last night; they said, "Hey, you got some conjectures in there." We're gonna have to, but they said, "Take that out and only give us stuff that you can actually document, either from the control room logs or from an interview; not something you inferred" and when we're to have that to them tomorrow afternoon and then its to go on the street as soon as they've said OK. And that's what we're working toward. And I've just got direct orders from Dieckamp that says I've got to keep that contained and not give it to anybody until we get their approval.

TMIA Mailgram Exh. 12 at 4.

245. The Board finds that Dieckamp's instructions regarding operator interviews show that he personally wished to maintain tight control over the interviews and restrict disclosure of information about the accident to only "documented information. Dieckamp's attitude toward the Long investigation parallels his attitude in addressing the question before this Board, that is, whether anyone interpreted the pressure spike in terms of core

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accident in the period immediately after the accident, beginning on March 30, 1979. Zebroski ff Tr. 28,441 at 12; Van Witbeck ff Tr. 28,261 at 3-4.

damage.

246. Certainly, one of Dieckamp's main responsiblities in the post-accident period has been to to ensure that all relevant information is disclosed to the Commission. Therefore, it is particularly disturbing that in sending the mailgram, and continuing to defend its clearly erroneous content, Dieckamp has signaled to this Board that his concern is not with whether or not the company withheld potentially useful information about the pressure spike and hydrogen burn during the accident, but rather with whether or not anyone completed a detailed technical analysis of core damage which under NRC requirements was required to be disclosed.

247. Dieckamp's narrow view of licensee's responsibility to disclose information to the NRC reflects poorly on his integrity and capabilities.

B. A Complex Technical Analysis Is Needed To Determine the Pressure Spike Was Caused by a Hydrogen Burn.

248. Licensee contends that a complex technical analysis was required to understand the significance of the spike, and that Met-Ed operators were not technically trained or capable of making such an analysis. In support of this position, Licensee presented the testimony of Tom Van Witbeck. Van Witbeck testified that he only appreciated the pressure spike as an indicator of core damage in the April 2 to 4, 1979 time period. This testimony is unconvincing.

249. Van Witbeck admits that he failed to even speak to site personnel explicitly about whether they interpreted the pressure spike correctly at the time, or whether they had with-

held information about the spike or hydrogen burn from the NRC or the public. Tr. 28,265-266 (Van Witbeck). Further, he did not speak to Dieckamp about this issue at any time during 1979 or 1980, to his knowledge. Tr. 28,264 (Van Witbeck). Therefore the Board finds it difficult to understand what he knows about site personnel's awareness of the hydrogen burn on March 28 or Dieckamp's investigation into that matter.

250. The reliability of Van Witbeck's testimony on this issue is further questionable, given his past focus on accident related events. The Sequence of Events which Van Witbeck's Accident Assessment Group prepared included only events which could be proven or demonstrated from direct plant indicators and does not include events which must be drawn from "inferences or conclusions" from direct indicators. Tr. 28,290-291 (Van Witbeck). Therefore Van Witbeck's work on the Sequence of Events did not include a description of operators' interpretation of the pressure spike at the time it occurred and would provided no guidance to Dieckamp on this matter. Tr. 28,291 (Van Witbeck).

251. Similarly unreliable was the testimony of Licensee witness Zebroski, who arrived at the site on March 31. His assignment at that time was to assess core damage. Later in May, he became Director of the Nuclear Safety Analysis Center which conducted a study of the accident based on "detailed analysis of instrument records". The NSAC studies avoided reliance on recollections of plant personnel. Therefore Zebroski did not focus at any time on the issue of whether licensee personnel properly interpreted the pressure spike at the time it occurred to indicate core damage or a hydrogen burn. Zebroski ff Tr. 28,441 at

3-4, 10; 28,463; 28,526 (Zebroski). Zebroski's testimony clearly does not support a conclusion that through conversations with the NSAC analysts, Dieckamp made a diligent effort to inquire into whether site personnel properly interpreted the pressure spike at the time it occurred.

252. Licensee suggested during the hearing that it took weeks or months for experts such as Zebroski and Witbeck to understand and analyze the extent of core damage at TMI, even after it was recognized that the spike was caused by combustion of hydrogen produced by a zirconium-water reaction. Tr. 28,264 (Van Witbeck); Zebroski ff. Tr. 28,441 at 5-9-11; 28,522. The inference licensee suggests we make is that given the difficulty of this analysis, site personnel could not have properly interpreted the spike at the time it occurred. See also Lowe ff. Tr. 28,151 at 8-11.

253. However this Board rejects Licensee's interpretation of the issue. The Board is not concerned with the issue of whether site personnel on March 28 made a detailed technical analysis of the extent of core damage from their observations of the spike, but rather whether they understood, in general terms, that the spike indicated a burn of hydrogen produced by a zirconium-water reaction. As Chwastyk emphasized during his testimony before this Board on March 28, 1979 site personnel were most interested in stabilizing the reactor and not in making fine analyses of the amount of core damage. Tr. 29,180 (Chwastyk)

254. By the early morning of March 30, Dieckamp had told

top EPRI officials, whose assistance he was seeking, that the accident at TMI was very serious and that "significant core damage]was] apparent". Tr. 28,452-453 (Dieckamp); TMIA Mailgram Exh. 6 at 4. Moreover, in an introductory IAG meeting on March 31, which Dieckamp attended, the general working assumption was that there was a minimum of 15 percent core damage. 28,480-485. (Zebroski).

255. Clearly by March 30 and 31, licensee officials, including Dieckamp, had already assessed the core damage at TMI as very serious. This was apparently based on a proper analysis of the pressure spike, which Dieckamp himself characterized as the Rosetta stone of deducing the degrees of core damage. Tr. 28,364 (Dieckamp).

256. Because it required a complex analysis, we reject licensee's argument tha: site personnel could not have properly interpreted the pressure spike in terms of core damage because it required a complex analysis.

C. Dieckamp's Analysis of Chwastyk, Mehler and Illjes' Interviews.

257. Dieckamp's argues that although Chwastyk, Mehler and Illjes' interviews constitute "some evidence", they do not constitute sufficient evidence to convince him that Chwastyk, Mehler and Illjes properly understood the pressure spike. Tr. 28,757 (Dieckamp); Dieckamp ff Tr. 28,316 at 13-15. We find Dieckamp's analysis of these interviews in his testimony to be misleading.

258. For example, Dieckamp states that Mehler is uncertain about the timing of equipment limitations. Dieckamp ff Tr. 28316 at 13. However, it is clear that a fair reading of Mehler's

interviews would indicate that he was absolutely certain that March 28 was the date he was given an instruction not to activate equipment in the reactor buildidng until a New York Times article appeared discussing his testimony to this effect before the Special Inquiry Group. JME 1-C (89) at 13,14; JME 1-C (68) at 13; TMIA Mailgram Exh. 17. See, discussion, Section II A, supra. Dieckamp's testimony is misleading insofar as it suggests that Mehler has always been uncertain of the date of the instruction. In fact the preponderance of his testimony indicates he remembers the instruction on March 28.

259. Dieckamp also suggests that the basis for Illjes' recollection of an evening discussion on March 28 of the hydrogen explosion, is his connection of the event to the time when the containment pressure recorder chart was removed for photocopying. Dieckamp ff Tr. 28,316 at 13-14; 28,808-811 (Dieckamp); JME 1-C (36) at 6. In fact, in at least two separate statements, Illjes does not link discussion of the hydrogen explosion with xeroxing of the chart in at least two places in his May 23, 1979 NRC interview. See, JME 1-C-36 at 6, 10; Tr. 28,808-810 (Illjes).

260. Moreover, Dieckamp fails to mention that Illjes reaffirmed his early testimony in a September 24, 1980 NRC interview, stating three times that he recalls a discussion of hydrogen or noncondensible gas on March 28. See JME 1-C (127) at 6,9. Indeed, Dieckamp testified to the Board that he was not certain he had read Illjes' second NRC interview. Tr. 28,817 (Dieckamp).

261. Dieckamp also testified that he did not believe that Chwastyk understood the pressure spike to be caused by a combustion of hydrogen caused by a zirconium-water reaction, for the

following reasons:

1) In a May 21, 1979 interview, Chwastyk does not mention hydrogen or core damage. Dieckamp ff Tr. 28,316 at 14;

2) In an October 30, 1979 interview, Chwastyk does not identify it with a specific assessment of core damage although he refers to a hydrogen explosion. Tr. 28,857 (Chwastyk);

3) In a September 4, 1980 interview, while mentioning both a a zirc-water reaction and "some core damage" Dieckamp can establish no "absolute proof" that Chwastyk understood the pressure spike to indicate core damage, Dieckamp ff Tr. 28,316 at 16.

262. Dieckamp has entirely distorted the issue, from whether the Chwastyk interviews indicate "some evidence" to the question whether they constitute "absolute proof." Moreover, we simply cannot understand how Dieckamp reached the conclusion that Chwastyk did not understand the significance of the spike. Simply because Chwastyk did not take the time during the afternoon of March 28, 1979 to complete a complex analysis of core damage is no basis to assume Chwastyk did not understand the hydrogen burn.

263. Further, Chwastyk did not use the words "hydrogen" or "zirconium-water reaction" explicitly in his earlier interviews because specific questions were not asked of him. Chwastyk in fact testified that everyone at that point in time understood that TMI-2 had suffered serious core damage, so there was no need to mention it. Tr. 29,213 (Chwastyk).

264. Dieckamp maintains today that Chwastyk did not understand the pressure spike to indicate core damage or a zirc-water reaction, even though he concedes that Chwastyk appeared to correlate the cycling of the EMOV with the spike. JME 1-C (88) at 19-21; JME 1-C(99) at 14-15; Tr. 28,847; 28,849-853 (Dieckamp).

Further, he was aware of hot leg temperatures greater than 700 degrees, high incore temperature readings and high radiation levels, conditions which together would lead one to consider the possibility of a zirconium-water reaction. Tr. 28,860-865 (Dieckamp).

265. The Board finds that it reflects poorly on Dieckamp's integrity that he refuses to acknolwedge the Chwastyk, Mehler and Illjes' interviews as "some evidence," since they each explicitly state some understanding that the pressure spike indicated a hydrogen burn and core damage.

266. Moreover, Dieckamp's position entirely fails to incorporate the findings of an internal company inquiry into the matter, which indicates that Licensee employees properly interpreted the pressure spike. When confronted with this internal company investigation, Dieckamp testified that it did not change his mind about the accuracy of statements in his mailgram. Tr. 28,888 (Dieckamp).

267. Under cover of a September 17, 1980 memorandum Licensing Manager Ed Wallace transmitted to Arnold all information of which he was then aware regarding the company's understanding of core damage following the TMI-2 accident. One of the attachments to this memorandum is an "Untitled Piece" completed by Bill Behrle, Scott Guilbord and Don Reppert on Arnold's direction. In that attachment, under a heading "Licensee's Knowledge" of "Core Damage/Fuel Uncovering" appears, in relevant part, as follows:

> On Wednesday, Chwastyk (Shift Supervisor) was aware of high incore Thermocouple readings, assumed there was some core damage, realized magnitude of problem when it took 50,000 gallons of HPI to fill the 88,000 gallon RCS, and knew there

was core damage from the explosion in the building.
TMIA Mailgram Exh. 15 at 2, 13..

268. Later in this same attachment under the heading "Licensee' Knowledge" of the "Pressure Spike/Hydrogen" the following is written:

> Two of the licensees employees (Chwastyk and Mehler) who were aware of an actual pressure spike may have believed on Wednesday that it was due to a hydrogen explosion.

Id. at 17.

269. The untitled piece appears to be an analysis of the various NRC and other interviews of licensee employees up to the time of the September 1980 memorandum. Given that Arnold had directed that this analysis be conducted, and given that at least some of the individuals responsible for the analysis also kept close track of employee interviews for the company, (Behrle, Wilson and Reppert) as a part of their regular business duties, the Board attaches great weight to their conclusion that some licensee employees may have understood on the first day of the accident that the spike was caused by a hydrogen explosion and indicated core damage.

270. Since Dieckamp acknowledgee that he performed no such detailed analysis, Dieckamp ff Tr. 28,316 at 12, the Board finds it incredible that he so cavalierly rejects the analysis specifically ordered by Arnold. It appears to the Board that no matter how great the volume of evidence presented to Dieckamp, he would refuse to acknolwedge that licensee employees and managers understood the significance of the pressure spike at the time it occurred.

D. <u>The IE Investigation and Report on Information Flow During the TMI-2 Accident</u>

271. Dieckamp relies on various investigative reports to support the "thrust" of his mailgram that the pressure spike was not understood at the time it occurred. Dieckamp ff Tr. 28,316 at 16-17. However, none of the reports cited, except the NRC investigation into information, flow specifically focused on the issue of whether information, including that concerning the pressure spike, the hydrogen burn and core damage, was withheld from NRC and Commonwealth of Pennsylvania authorities.

272. The NRC Staff presented testimony from Norman Moseley, investigative team leader for the Office of Inspection and Enforcement Investigation entitled "Investigation Into Information Flow During The Accident At Three Mile Island," NUREG-0760 (1981), to support the NRC Staff's position that although Dieckamp's mailgram's was inaccurate, Dieckamp did not intentionally make false statements in the mailgram. Mr. Moseley's testimony was based entirely on information he derived in the course of the NUREG-0760 investigation. Tr. 29,832 (Mosely).

273. TMIA presented testimony from former NRC investigator David Gamble, who participated in the NUREG-0760 investigation. Gamble testified that the NRC inquiry was sharply curtailed and its conclusions pre-determined and not supported by the facts. In light of what we find to be credible and convincing testimony from Gamble we attach no weight to either NUREG-0760 or Moseley's testimony. Therefore, we find that NUREG-0760 provides no support for Dieckamp's position.

274. In essence, Moseley testified that he believed

Dieckamp was sincere when he stated in his mailgram that no one interpreted the pressure spike in terms of core damage. Moseley ff Tr.29,816 at 4. Moseley supported this statement with his observations of Dieckamp in the course of an interview conducted of Dieckamp for the NUREG-0760 investigation; Moseley's conclusion that no one present in the TMI-2 control room understood on March 28, 1979 that the pressure spike was caused by a hydrogen burn; and Moseley's belief 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 cubic foot containment might exist at 10 hours after the initiation of the event." Ibid.

275. Moseley's testimony that the thrust of Dieckamp's mailgram was accurate, was not supported by the facts uncovered in the course of the NUREG-0760 investigation. Mosely stated that Chwastyk, while a credible witness, was inaccurate in his recollec*:on at the time of the spike, he attributed it to a hydrogen burn. Tr. 29,839 (Moseley) Moseley bases this on the fact that Chwastyk, to his mind, had trouble differentiating the time he knew certain events occurred. Tr. 29,969 (Moseley). However, Moseley could not cite a single interview in which Chwastyk demonstrated such confusion Tr. 29,973 (Moseley).

Moreover, the Board knows of none.

276. Moseley also concluded that Chwastyk did not understand that a zirc-water reaction caused the burn and spike. Yet Mosely never questioned Chwastyk about his training on the zirc-water reaction or his understanding of Appendix K; whether he had read any books on the zirc-water reaction; or whether he had

considered sources for the hydrogen other than as a product of the zirc-water reaction. Tr. 29,837-838.[28]

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[28] Similarly, Moseley never looked into training generally at TMI-2 to determine if there was training on the zirconium-water reaction or ECCS criteria. Tr. 29,872 (Moseley). Therefore it is hard to understand how he could assert that it was not within the range of credible operator knowledge that hydrogen could be produced up to flammable limits within 10 hours after an initiating event.

277. Second, Moseley's observations of Dieckamp during his one strike the Board as peculiarly unreliable. First of all, the interview itself provided no opportunity to test Dieckamp's credibility. The questions which Moseley asked Dieckamp were generally conclusory, and asked for opinions not for facts. Tr. 29,898-900. Secondly, Moseley approached the interview, which focused on the mailgram, with an extremely narrow working definition of material false statement -- that is, one submitted to the NRC in some official manner, Moseley knew at the time he interviewed Dieckamp that he would not find the mailgram to be a material false statement. Tr. 29,893-897 (Moseley).

288. Third, the Board observed that Moseley appeared to find the entire issue of the Dieckamp Mailgram beneath his attention. Moseley appeared to be more interested in protecting Dieckamp than in determining whether information about the pressure spike and hydrogen burn had been improperly withheld from the Commission.

289. Although he determined that the mailgram contained inaccurate statements, apparently Moseley never bothered to tell the Commission. Tr. 29,846-847 (MOseley). Further, Moseley testified that he believed Dieckamp should have correted the mailgram. Tr. 29,946. However, he explained that it was a rather minor inaccuracy even though it had consumed great NRC investigative and hearing resources. Tr. 29,946. When asked why he believed Dieckamp should have corrected the mailgram, Moseley explained simely that it would have saved himself a lot of grief. Tr. 29,976 (Moseley). The Board finds that Moseley was not sufficiently concerned in his investigation about the adequate

flow of information to the NRC.

290. On the other hand, we find Gamble's criticisms of the IE investigation and report to be incisive and determinative in our decision not to afford NUREG-0760 or its conclusions any weight. Gamble was an investigator from the NRC's Office of Inspector and Auditor assigned to the investigation to protect the interests of the Department of Justice, to ensure that any information be preserved which might be useful to any future criminal prosecution. Tr. 30,510.

291. He made the following serious criticisms of the investigation:

> 1) Moseley directed that the three major portions of the investigative report be drafted prior to any significant investigation;
>
> 2) Moseley attempted to restrict full and complete questioning of witnesses by imposing a protocol where interviewers could only ask questions on a pre-approved list; follow-up questions by other than the chief interviewer were permitted only at the end and after being approved by Moseley; and in some cases by entering into agreement with corporate counsel whereby the areas of question were restricted. Gamble ff Tr. 30,587 at 3-5; Tr. 30,548; 30,559; 30,561-564; 30,579-580; 30,660 Gamble);
>
> 3) At least one original member of the Task Group, Ronald Haynes, appeared to have a conflict of interest. Tr. 30,729 (Gamble);
>
> 4) Significant information which was already on the public record was never discussed during the course of the investigation and did not appear in the final report. Tr. 30,531;
>
> 5) Moseley did not employ investigative techniques which would have led to a better development of the factual record. Tr. 30,706-711 (Gamble); TMIA Mailgram Exh. 22, Enclosure 2.

292. Gamble's criticisms lead us to find that the conclusions of NUREG-0760 are not supported by the facts. Moreover,

Gamble's criticisms of NUREG-0760 provide further reason for this Board's refusal to credit the conclusions of that report. These include:

> 1) Significant facts were left out of the final report or not fully developed, Tr. 30,532; (Gamble);
>
> 2) The report's characterization of Plumlee's testimony did not give it adequate weight, Tr. 30,714-719 (Gamble);
>
> 3) The Task Group's conclusions were not adequately supported by the facts, including conclusions regarding whether anyone in the Unit 2 control room properly interpreted the pressure spike, Tr. 30,804. (Gamble) See TMIA Mailgram Exh. 24 at 1.

293. We give no weight to NUREG-0760, its conclusions or Moseley's testimony on the issue before us.

E. Lowe's Alleged Discovery of the Significance of the Pressure Spike Late on March 29, 1979.

294. Licensee argues that Dieckamp was entitled to rely in sending his mailgram, on his understanding that William Lowe was the first to correctly interpret the pressure spike to indicate a hydrogen burn and core damage. Dieckamp ff Tr. 28,316. Lowe claims he was the first person to discover the significance of the pressure spike at 11:00 p.m. on March 29, 1979.

295. Lowe testified that on March 29 he followed Unit 2 Superintendent Joseph Logan into the Control Room when operators had lost control of the pressurizer level. At that time Bensel showed him the containment building pressure strip chart trace showing 28 psig at 1:50 p.m. on March 28, 1979. Lowe says that he concluded immediately that the spike was caused by a hydrogen ignition and the hydrogen had been produced from a zircalloy-water reaction. Lowe testified that he asked for a second pres-

sure reading and was pointed to the wide range trace at the bottom of the same chart. He also reviewed building temperature traces which confirmed the spike. Lowe, Thomas Crimmins and Moore then calculated the bubble size and the amount of zirconium cladding which would have to oxidize to produce that amount of hydrogen. Lowe contends that from these calculations they concluded the core was very seriously damaged. Lowe ff Tr. 6-7; 11-13.

296. The Board is not convinced that Lowe was the first person to discover the significance of the pressure spike. We have seen substantial evidence in this proceeding hearings that both Met-Ed operations personnel and GPUSC engineers reviewed and understood the significance of the spike on the first day of the accident.

297. Further, we believe that Lowe's testimony itself contains many contradictions. For example, although Lowe now contends he was the first to correctly analyze the spike, in a conversation in 1979 with a Special Inquiry Group investigator he explained in response to a direct question that in fact he did not know whether he was the first to recognize the significance of the spike. Tr. 28,154-155; 28,157-158 (Lowe); JME 1-C-104.

298. Moreover, his prefiled written testimony is clearly misleading in seriously understating his understanding of the seriousness of the accident on March 28. Lowe states in his testimony that Thorpe informed him at about 4:20 p.m. on March 28 that "core cooling is recovered". Tr. 28,160; Lowe ff Tr. 28,151 at 3. Yet according to a memo Lowe dictated to the file on March 28, Thorpe in fact reported to Lowe at that time, that "Plant

thinks core is recovered, but proof not yet established." TMIA Mailgram Exh. 1.

299. The Board understands Thorpe's statement in this memorandum to indicate that at some time prior to 4:20, Licensee's staff believed the core was uncovered. The language in this memorandum is not susceptible to Lowe's peculiar rephrasing -- that cooling of the core has been restored or reinitiated. Tr. 28,159-163. Lowe's artful phrasing of Thorpe's assessment of the status of the plant at that time downplays the seriousness of the accident and casts doubt generally on Lowe's credibility.

300. The Board also finds Lowe's story incredible because it appears that there were general discussions about the pressure spike, hydrogen burn and hydrogen build-up in the reactor building during the afternoon of March 29, fully eight hours prior to Lowe's alleged revelation. The first meeting of the Task Force was held at 3:30 p.m. on March 29 in the processing center at Unit 1. According to Lowe's calendar of activities for the early days of the TMI-2 accident, the Task Force was divided into two "teams". The Events Analysis Team was composed of the following persons:

Richard Wilson, Chairman
Ed Wallace
Donald Reppert
Gary Broughton
George Kunder
James Moore
Lee Rogers

The Recovery Planning Team was composed of:

Ron Williams, Chairman

Thomas Crimmins

William Lowe

D. Klingeman (not present)

Robert Long

TMIA Mailgram Exh. 18 at 3.

301. As discussed in section III, supra, Wilson 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.

302. Abramovici, for example, stated a concern that there was a hydrogen build-up in the reactor building to four percent which led to a discussion about hooking up a hydrogen recombiner. TMIA Mailgram Exh. 32H; JME 1-C(50) at 12-13. See also JME 1-C (78) at 128 (Floyd); JME 1-C (140) at 76 (Plumlee); JME 1-C(22) at 34 (Warren).

303. It is clear that the only method for hydrogen production up to four percent of the total containment volume in two days is through a zirconium-steam reaction. Tr. 28,198-200 (Lowe). Therefore, the predicate to any discussion about hydrogen build-up in the containment to flammable limits would be an understanding that a zirconium-steam reaction had occurred, leading to oxidation of the zirconium cladding and the production

of significant amounts of hydrogen.

304. Crimmins, in an answer to a TMIA discovery request, stated that he remembered that the reactor building pressure trace was viewed and discussed at the Task Force meeting, but discounted as spurious and due to an instrumentation problem. TMIA Mailgram Exh. 32F. Clearly if the pressure trace had been viewed and discussed at the March 29 afternoon meeting, Lowe, who attended that meeting, should have instantaneously interpreted the spike to indicate a hydrogen burn.[29]

305. Crimmins, in answering a questionnaire about his awareness of communications about the pressure spike, containment sprays and hydrogen burn on the first three days of the accident, stated the following:

> I cannot remember such details. The subjects were initially discussed by me and other technical support personnel (R. Williams, W.W, Lowe & others) on the afternoon of March 29 and into the evening. The discussions were initiated by a briefing by George Kunder on the afternoon of March 29 and were the subject of evaluation and analyses and extensive open discussion with all involved parties (Met Ed, GPU, NRC and others from that time on.

TMIA Mailgram Exh. 19 at 11.

306. Crimmins' answer seems to indicate that by the initial meeting of the Task Force on Thursday afternoon the spike was generally understood to indicate a hydrogen burn and core damage.

307. Kunder also recalls that the pressure spike was discussed at the first meeting of the Task Force. Tr. 29,998-999 (Kunder) In testimony in this hearing, Kunder remembered that in a side discussion Broughton showed him either the original or a copy of the pressure trace and suggested that one possible

cause of the spike was a hydrogen explosion. Tr. 30,001-007; JME 1-C-37 at 50- 51; JME 1-C-80 at 74-75. Kunder testified at a prior time that as a result of these discussions he asked Bensel to de-energize electrical equipment in the reactor building. JME 1-C-118 at 52. This is corroborated by a 9:30 p.m. entry in Seelinger's notes which indicates Bensel carrying out such an instruction. TMIA Mailgram Exh. 2 at 7.

308. In addition, Abramovici testified that because of a concern that hydrogen levels in the reactor building may have reached four percent, the design limit at the time, the group discussed consulting with Atomics International in order to hook up a hydrogen recombiner. TMIA Mailgram Exh. 32H at 44-48. An entry in the Unit 2 control room log verifies that the hydrogen recombiner was started up at 8:55 a.m. TMIA Mailgram Exh. 16 at 6[30]

309. Mr. Henrie's memory of the events seemed very poor. We accept Abramovici's testimony over Henrie's in light of the fact that Abramovici worked for GPUSC and was at the site during the entire period in question. Certainly he would know more about GPU's arrangements to secure and start a hydrogen recombiner than someone who is located on the West Coast and called to TMI-2 as a consultant.

310. Moreover, Dieckamp's notes of March 30, 1979 verify that licensee made efforts to contact Atomics prior to the time Henrie claims. TMIA Mailgram Exh. 27 at 3. See also JME 1-C (78) at 128 (Floyd).

311. Broughton and Wilson [illegible] no discussion about the

pressure spike or hydrogen burn at the Task Force meeting at 3:30 p.m. on March 29. Tr. 31,159 (Broughton); 31,530-531 (Wilson).

312. The Board finds from the testimony of Abramovici, Kunder and Crimmins, that there was discussion of the pressure spike and hydrogen burn at the March 29 afternoon meeting of the Task Force. Further the pressure spike trace may have been reviewed at the meeting. This conclusion is compelled by the consistent testimony of these three central individuals who came from different corporate organizations.. The Board also concludes that the group discussed setting up of a hydrogen recombiner to deal with hydrogen greater than the containment building design limit of four percent. There appeared to be general understanding by members of this group, including Lowe and Kunder, that the only means to produce within two days hydrogen greater than the containment design limit was by means of a zirc-water reaction. Tr. 30,075-077 (Kunder); Tr. 28,197-200 (Lowe). Therefore we find that members of the Task Force, including Lowe, Broughton and Kunder, determined as early as 3:30 p.m. on March 29, that the pressure spike was caused by a zirconium-water reaction which produced build-up of hydrogen to flammable limits.

313. We do not find credible Licensee's claim that Lowe was the first to understand the pressure spike during the late evening of March 29 not credible. We ffind further that that this theory fails to support Dieckamp's claim that the "thrust" of his mailgram is correct.

F. Information Available to Dieckamp Prior to May 9, 1979.

314. The Board finds that several operator interviews available to Dieckamp prior to May 9 indicated that the opera-

tions staff ff interpreted the pressure spike to be an explosion and in response took steps to repressurize the reactor, a serious departure from the strategy they had previously employed. These interviews indicate to the Board "some evidence" that the spike was properly understood to have been caused by a hydrogen burn.[3]

G. CONCLUSION.

320. We find Dieckamp should have known that the statements in his mailgram were, and are today, false. Moreover, with minimal investigation, he would have discovered that licensee personnel properly interpreted the pressure spike as a hydrogen burn and and in response changed to repressurize to stabilize the reactor. The Board finds unconvincing licensee's arguments in support of the "thrust" of Dieckamp's mailgram.

321. Licensee has continued to defend the accuracy of the mailgram. The Board believes that Dieckamp and licensee's intransigence on this point, given the extensive evidence presented of Met Ed and GPU Service Corporation awareness of the significance of the pressure spike on March 28, 1979, reflects poorly on management competence and character.

V DIECKAMP SHOULD HAVE CORRECTED THE MAILGRAM ONCE HE DETERMINED THAT STATEMENTS IN THE MAILGRAM WERE FALSE.

322. Licensee argues in its Proposed Findings that "[g]iven the fact that the mailgram was accurate when sent, that its thrust remains a reasonable conclusion today, and that all subsequently adduced contrary evidence was fully known by all concerned, it was certainly unnecessary for Mr. Dieckamp to inform the mailgram recipients that the prefatory phrase 'there is not evidence' was no longer literal." Licensee's Proposed

Findings of Fact and Conclusions of Law (January 28, 1985), at 94.

323. None of the statements contained in the above conclusion is true. As discussed in Part II, supra, the Board believes Dieckamp did possess evidence, and in fact positive knowledge, that Met-Ed and GPU Service Corporation personnel properly interpreted the pressure spike as a hydrogen burn on the first day of the accident. Therefore Dieckamp knew at the time he sent it that he was making false and inaccurate statements in the mailgram.

324. Even if he did not know on May 9, 1979 the statements were false, the reality is that on May 9, 1979, persons such as Chwastyk, Mehler and Illjes had properly interpreted and responded to the pressure spike at the time it occurred. If Dieckamp had done any investigation he would have discovered this substantial evidence at that time. See Section IV, supra.

325. Moreover, Dieckamp's statement that the "thrust" of the mailgram is correct although the words may be literally false makes no sense to this Licensing Board. Licensee and its top management are obliged to be meticulous in fully disclosing all material information within their possession to the NRC in order for the NRC to carry out its mission to protect the public health and safety. That responsibility cannot be any more important than during an accident. Thus licensee's failure to provide information about the pressure spike and hydrogen burn to the Commission on March 28 seriously compromised the Commission's effectiveness in carrying out that mission. This fact licensee does not appre-

ciate, even today, after multiple investigations, inquiries and hearings on this matter.

VI CONCLUSION.

326. The Board concludes that Dieckamp's mailgram of May 9, 1979 contains false statements since licensee personnel did properly interpret the pressure spike and containment sprays to indicate a hydrogen burn and core damage. Moreover, the highest levels of licensee management, including Dieckamp, were aware of the pressure spike and its significance by early on March 29. Yet licensee failed to disclose this information to the NRC or to Commonwealth of Pennsylvania authorities until March 30. The Board therefore finds false Dieckamp's claim in the mailgram that there was no withholding of information.

327. The Board has also found from the extensive record developed in this hearing, that Dieckamp knew that his mailgram was false at the time he sent it since he was informed during the ffafternoon of March 28 by Herbein, Miller and Kunder of their understanding of the pressure spike, and later on the morning of March 29 through Keaten of the GPUSC group's evaluation of the hydrogen burn.

328. Even if Dieckamp did not know on May 9, 1979 that the statements in his mailgram were false at the time he sent it, he should have known given the extensive information available to the company that licensee employees understood the pressure spike to be a hydrogen burn and responded by changing to a repressurization evolution. A minimal investigation would have uncovered the simple fact that the mailgram contained false statements.

329. We conclude licensee management has demonstrated ex-

tremely poor character in continuing to defend false statements in Dieckamp's mailgram of May 9, 1979. Licensee's refusal to accept reporting responsibilities to the NRC demonstrates a basic lack of integrity which prevents this Board from finding licensee management has adequate integrity and competence to operate TMI-2 safely.

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APPENDIX A

Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors. 39 Fed. Reg. 1,002 (1974) (codified at 10 C.F.R. §50.46); 36 Fed. Reg. 24,082 (interim criteria); 36 Fed. Reg. 12,247 (interim criteria).

temperature of the zircaloy cladding should not exceed 2300°F, is replaced by two criteria, lowering the allowed peak zircaloy temperature to 2200°F and providing a limit on the maximum allowed local oxidation. The other three criteria of the IAC are retained, with some modification of the wording. These three criteria limit the hydrogen generation from metal-water reactions, require maintenance of a coolable core geometry, and provide for long-term cooling of the quenched core.

The most important effect of the changes in the required features of the evaluation models is that swelling and bursting of the cladding must now be taken into consideration when they are calculated to occur, and that the maximum temperature and oxidation criteria must be applied to the region of clad swelling or bursting when the maximum temperature and oxidation are calculated to occur there. Another important change is the requirement that, in the steady state operation just before the postulated accident, the thermal conductance of the gap between the fuel pellets and the cladding should be calculated taking into consideration any increase in gap dimensions resulting from such phenomena as fuel densification, and should also consider the effects of the presence of fission gases. When these effects are taken into consideration a higher stored energy may be calculated. Other changes in the evaluation models are mostly in the direction of replacing previous broad conservative assumptions with more detailed calculations where new experimental information is available or where better calculational methods have been developed.

The wording of the definition of a loss-of-coolant accident has been modified to conform to its long-accepted usage, limiting it to breaks in pipes. The new regulations also require a more complete documentation of the evaluation models that are used.

The Commission believes that the implementation of the new regulations will ensure an adequate margin of performance of the ECCS should a design basis LOCA ever occur. This margin is provided by conservative features of the evaluation models and by the criteria themselves. Some of the major points that contribute to the conservative nature of the evaluations and the criteria are as follows:

(1) *Stored heat.* The assumption of 102 percent of maximum power, highest allowed peaking factor, and highest estimated thermal resistance between the UO_2 and the cladding provides a calculated stored heat that is possible but unlikely to occur at the time of a hypothetical accident. While not necessarily a margin over the extreme condition, it represents at least an assumption that an accident happens at a time which is not typical.

(2) *Blow-down.* The calculation of the heat transfer during blowdown is made in a very conservative manner. There is evidence that more of the stored heat would be removed than calculated, although there is not yet an accepted way of calculating the heat transfer more accurately. It is probable that this represents a conservatism of several hundred degrees F. in stored energy after blowdown, most of which can reasonably be expected to carry over to a reduction in the calculated peak temperature of the zircaloy cladding.

(3) *Rate of heat generation.* It is assumed that the heat generation rate from the decay of fission products is 20 percent greater than the proposed ANS standard. This represents an upper limit to the degree of uncertainty. The assumption that the fission product level is that resulting from operation at 102 percent of rated power for an infinite time represents an improbable situation, with a conservatism that is probably in the range of 5 to 15 percent. The use of the Baker-Just equation for calculating the heat generation from the steam oxidation of zircaloy should also provide some conservatism, but the factor is uncertain.

(4) *The peak temperature criterion.* The limitation of the peak calculated temperature of the cladding to 2200° F and the stipulation that this criterion be applied to the hottest region of the hottest fuel rod provide a substantial degree of conservatism. They ensure that the core would suffer very little damage in the accident.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 552 and 553 of title 5 of the United States Code, the following amendments to Title 10, Chapter I, Code of Federal Regulations, Part 50, are published as a document subject to codification to be effective on February 4, 1974.

1. A new sentence is added to § 50.34 (a)(4) of 10 CFR Part 50 to read as follows:

§ 50.34 Contents of applications: Technical information.

(a) * * *

(4) * * * Analysis and evaluation of ECCS cooling performance following postulated loss-of-coolant accidents shall be performed in accordance with the requirements of § 50.46 for facilities for which construction permits may be issued after December 28, 1974.

* * * * *

2. A new sentence is added to § 50.34 (b)(4) 10 CFR Part 50 to read as follows:

§ 50.34 Contents of applications; technical information.

* * * * *

(b) * * *

(4) * * * Analysis and evaluation of ECCS cooling performance following postulated loss-of-coolant accidents shall be performed in accordance with the requirements of § 50.46 for facilities for which a license to operate may be issued after December 28, 1974.

* * * * *

3. A new § 50.46 is added to 10 CFR Part 50 to read as follows:

§ 50.46 Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors.

(a)(1) Except as provided in paragraph (a)(2) and (3) of this section, each boiling and pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical Zircaloy cladding shall be provided with an emergency core cooling system (ECCS) which shall be designed such that its calculated cooling performance following postulated loss-of-coolant accidents conforms to the criteria set forth in paragraph (b) of this section. ECCS cooling performance shall be calculated in accordance with an acceptable evaluation model, and shall be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the entire spectrum of postulated loss-of-coolant accidents is covered. Appendix K, ECCS Evaluation Models, sets forth certain required and acceptable features of evaluation models. Conformance with the criteria set forth in paragraph (b) of this section with ECCS cooling performance calculated in accordance with an acceptable evaluation model, may require that restrictions be imposed on reactor operation.

(2) With respect to reactors for which operating licenses have previously been issued and for which operating licenses may issue on or before December 28, 1974:

(i) The time within which actions required or permitted under this subparagraph (2) must occur shall begin to run on 30 days after publication of the rule in the FEDERAL REGISTER.

(ii) Within six months following the date specified in paragraph (a)(2)(i) of this section an evaluation in accordance with paragraph (a)(1) of this section shall be submitted to the Director of Regulation. The evaluation shall be accompanied by such proposed changes in technical specifications or license amendments as may be necessary to bring reactor operation in conformity with paragraph (a)(1) of this section.

(iii) Any licensee may request an extension of the six-month period referred to in paragraph (a)(2)(ii) of this section for good cause. Any such request shall be submitted not less than 45 days prior to expiration of the six-month period, and shall be accompanied by affidavits showing precisely why the evaluation is not complete and the minimum time believed necessary to complete it. The Director of Regulation shall cause notice of such a request to be published promptly in the FEDERAL REGISTER; such notice shall provide for the submission of comments by interested persons within a time period to be established by the Director of Regulation. If, upon reviewing the foregoing submissions, the Director of Regulation concludes that good cause has been shown for an extension, he may extend the six-month period for the shortest additional time which in this judgment will be necessary to enable the licensee to furnish the submissions required by paragraph (a)(2)(ii) of this section. Requests for extensions of the six-month period, submitted under this subparagraph, shall be ruled upon by the Director of Regulation prior to expiration of that period.

(iv) Upon submission of the evaluation required by subparagraph (ii) of this subparagraph (2) (or under subparagraph (iii), if the six-month period is extended) the facility shall continue or commence operation only within the limits of both the proposed technical specifications or license amendments submitted in accordance with this subparagraph (2) and all technical specifications or license conditions previously imposed by the Commission, including the requirements of the Interim Policy Statement (June 29, 1971, 36 FR 12248), as amended (December 18, 1971, 36 FR 24082).

(v) Further restrictions on reactor operation will be imposed by the Director of Regulation if he finds that the evaluations submitted under subparagraphs (ii) and (iii) of this subparagraph (2) are not consistent with subparagraph (1) of this paragraph (a) and as a result such restrictions are required to protect the public health and safety.

(vi) Exemptions from the operating requirements of subparagraph (iv) of this subparagraph (2) may be granted by the Commission for good cause. Requests for such exemption shall be submitted not less than 45 days prior to the date upon which the plant would otherwise be required to operate in accordance with the procedures of said subparagraph (iv). Any such request shall be filed with the Secretary of the Commission who shall cause notice of its receipt to be published promptly in the FEDERAL REGISTER; such notice shall provide for the submission of comments by interested persons within 14 days following FEDERAL REGISTER publication. The Director of Regulation shall submit his views as to any requested exemption within five days following expiration of the comment period.

(vii) Any request for an exemption submitted under subparagraph (vi) of this subparagraph (2) must show, with appropriate affidavits and technical submissions, that it would be in the public interest to allow the licensee a specified additional period of time within which to alter the operation of the facility in the manner required by subparagraph (iv) of this subparagraph (2). The request shall also include a discussion of the alternatives available for establishing compliance with the rule.

(3) Construction permits may be issued after December 28, 1973 but before December 28, 1974 subject to any applicable conditions or restrictions imposed pursuant to other regulations in this chapter and the Interim Acceptance Criteria for Emergency Core Cooling Systems published on June 29, 1971 (36 F.R. 12248) as amended (December 18, 1971, 36 F.R. 24082): *Provided, however*, that no operating license shall be issued for facilities constructed in accordance with construction permits issued pursuant to this subparagraph, unless the Commission determines, among other things, that the proposed facility meets the requirements of subparagraph (1) of this paragraph.

(b)(1) *Peak cladding temperature*. The calculated maximum fuel element cladding temperature shall not exceed 2200° F.

(2) *Maximum cladding oxidation*. The calculated total oxidation of the cladding shall nowhere exceed 0.17 times the total cladding thickness before oxidation. As used in this subparagraph total oxidation means the total thickness of cladding metal that would be locally converted to oxide if all the oxygen absorbed by and reacted with the cladding locally were converted to stoichiometric zirconium dioxide. If cladding rupture is calculated to occur, the inside surfaces of the cladding shall be included in the oxidation, beginning at the calculated time of rupture. Cladding thickness before oxidation means the radial distance from inside to outside the cladding, after any calculated rupture or swelling has occurred but before significant oxidation. Where the calculated conditions of transient pressure and temperature lead to a prediction of cladding swelling, with or without cladding rupture, the unoxidized cladding thickness shall be defined as the cladding cross-sectional area, taken at a horizontal plane at the elevation of the rupture, if it occurs, or at the elevation of the highest cladding temperature if no rupture is calculated to occur, divided by the average circumference at that elevation. For ruptured cladding the circumference does not include the rupture opening.

(3) *Maximum hydrogen generation*. The calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam shall not exceed 0.01 times the hypothetical amount that would be generated if all of the metal in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react.

(4) *Coolable geometry*. Calculated changes in core geometry shall be such that the core remains amenable to cooling.

(5) *Long-term cooling*. After any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core.

(c) As used in this section:

(1) Loss-of-coolant accidents (LOCA's) are hypothetical accidents that would result from the loss of reactor coolant, at a rate in excess of the capability of the reactor coolant makeup system, from breaks in pipes in the reactor coolant pressure boundary up to and including a break equivalent in size to the double-ended rupture of the largest pipe in the reactor coolant system.

(2) An evaluation model is the calculational framework for evaluating the behavior of the reactor system during a postulated loss-of-coolant accident (LOCA). It includes one or more computer programs and all other information necessary for application of the calculational framework to a specific LOCA, such as mathematical models used, assumptions included in the programs, procedure for treating the program input and output information, specification of those portions of analysis not included in computer programs, values of parameters, and all other information necessary to specify the calculational procedure.

(d) The requirements of this section are in addition to any other requirements applicable to ECCS set forth in this Part. The criteria set forth in paragraph (b), with cooling performance calculated in accordance with an acceptable evaluation model, are in implementation of the general requirements with respect to ECCS cooling performance design set forth in this Part, including in particular Criterion 35 of Appendix A.

4. A new Appendix K is added to 10 CFR Part 50 to read as follows:

APPENDIX K—ECCS EVALUATION MODELS

I. Required and Acceptable Features of Evaluation Models

II. Required Documentation

I. REQUIRED AND ACCEPTABLE FEATURES OF THE EVALUATION MODELS

A. *Sources of heat during the LOCA*. For the heat sources listed in paragraphs 1 to 4 below it shall be assumed that the reactor has been operating continuously at a power level at least 1.02 times the licensed power level (to allow for such uncertainties as instrumentation error), with the maximum peaking factor allowed by the technical specifications. A range of power distribution shapes and peaking factors representing power distributions that may occur over the core lifetime shall be studied and the one selected should be that which results in the most severe calculated consequences for the spectrum of postulated breaks and single failures analyzed.

1. *The Initial Stored Energy in the Fuel*. The steady-state temperature distribution and stored energy in the fuel before the hypothetical accident shall be calculated for the burn-up that yields the highest calculated cladding temperature (or, optionally, the highest calculated stored energy.) To accomplish this, the thermal conductivity of the UO_2 shall be evaluated as a function of burn-up and temperature, taking into consideration differences in initial density, and the thermal conductance of the gap between the UO_2 and the cladding shall be evaluated as a function of the burn-up, taking into consideration fuel densification and expansion, the composition and pressure of the gases within the fuel rod, the initial cold gap dimension with its tolerances, and cladding creep.

2. *Fission Heat*. Fission heat shall be calculated using reactivity and reactor kinetics. Shutdown reactivities resulting from temperatures and voids shall be given their minimum plausible values, including allowance for uncertainties, for the range of power distribution shapes and peaking factors indicated to be studied above. Rod trip and insertion may be assumed if they are calculated to occur.

3. *Decay of Actinides*. The heat from the radioactive decay of actinides, including neptunium and plutonium generated during operation, as well as isotopes of uranium, shall be calculated in accordance with fuel cycle calculations and known radioactive properties. The actinide decay heat chosen

shall be that appropriate for the time in the fuel cycle that yields the highest calculated fuel temperature during the LOCA.

4. *Fission Product Decay.* The heat generation rates from radioactive decay of fission products shall be assumed to be equal to 1.2 times the values for infinite operating time in the ANS Standard (Proposed American Nuclear Society Standards—"Decay Energy Release Rates Following Shutdown of Uranium-Fueled Thermal Reactors". Approved by Subcommittee ANS-5, ANS Standards Committee, October 1971). The fraction of the locally generated gamma energy that is deposited in the fuel (including the cladding) may be different from 1.0; the value used shall be justified by a suitable calculation.

5. *Metal-Water Reaction Rate.* The rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation (Baker, L., Just, L.C., "Studies of Metal Water Reactions at High Temperatures, III. Experimental and Theoretical Studies of the Zirconium-Water Reaction," ANL-6548, page 7, May 1962). The reaction shall be assumed not to be steam limited. For rods whose cladding is calculated to rupture during the LOCA, the inside of the cladding shall also be assumed to react after the rupture. The calculation of the reaction rate on the inside of the cladding shall also follow the Baker-Just equation, starting at the time when the cladding is calculated to rupture, and extending around the cladding inner circumference and axially no less than 1.5 inches each way from the location of the rupture, with the reaction assumed not to be steam limited.

6. *Reactor Internals Heat Transfer.* Heat transfer from piping, vessel walls, and non-fuel internal hardware shall be taken into account.

7. *Pressurized Water Reactor Primary-to-Secondary Heat Transfer.* Heat transferred between primary and secondary systems through heat exchangers (steam generators) shall be taken into account. (Not applicable to Boiling Water Reactors.)

B. SWELLING AND RUPTURE OF THE CLADDING AND FUEL ROD THERMAL PARAMETERS

Each evaluation model shall include a provision for predicting cladding swelling and rupture from consideration of the axial temperature distribution of the cladding and from the difference in pressure between the inside and outside of the cladding, both as functions of time. To be acceptable the swelling and rupture calculations shall be based on applicable data in such a way that the degree of swelling and incidence of rupture are not underestimated. The degree of swelling and rupture shall be taken into account in calculations of gap conductance, cladding oxidation and embrittlement, and hydrogen generation.

The calculations of fuel and cladding temperatures as a function of time shall use values for gap conductance and other thermal parameters as functions of temperature and other applicable time-dependent variables. The gap conductance shall be varied in accordance with changes in gap dimensions and any other applicable variables.

C. BLOWDOWN PHENOMENA

1. *Break Characteristics and Flow.* a. In analyses of hypothetical loss-of-coolant accidents, a spectrum of possible pipe breaks shall be considered. This spectrum shall include instantaneous double-ended breaks ranging in cross-sectional area up to and including that of the largest pipe in the primary coolant system. The analysis shall also include the effects of longitudinal splits in the largest pipes, with the split area equal to the cross-sectional area of the pipe.

b. *Discharge Model.* For all times after the discharging fluid has been calculated to be two-phase in composition, the discharge rate shall be calculated by use of the Moody model (F. J. Moody, "Maximum Flow Rate of a Single Component, Two-Phase Mixture," *Journal of Heat Transfer, Trans American Society of Mechanical Engineers*, 87, No. 1, February, 1965). The calculation shall be conducted with at least three values of a discharge coefficient applied to the postulated break area, these values spanning the range from 0.6 to 1.0. If the results indicate that the maximum clad temperature for the hypothetical accident is to be found at an even lower value of the discharge coefficient, the range of discharge coefficients shall be extended until the maximum clad temperature calculated by this variation has been achieved.

c. *End of Blowdown.* (Applies Only to Pressurized Water Reactors.) For postulated cold leg breaks, all emergency cooling water injected into the inlet lines or the reactor vessel during the bypass period shall in the calculations be subtracted from the reactor vessel calculated inventory. This may be executed in the calculation during the bypass period, or as an alternative the amount of emergency core cooling water calculated to be injected during the bypass period may be subtracted later in the calculation from the water remaining in the inlet lines, downcomer, and reactor vessel lower plenum after the bypass period. This bypassing shall end in the calculation at a time designated as the "end of bypass," after which the expulsion or entrainment mechanisms responsible for the bypassing are calculated not to be effective. The end-of-bypass definition used in the calculation shall be justified by a suitable combination of analysis and experimental data. Acceptable methods for defining "end of bypass" include, but are not limited to, the following: (1) Prediction of the blowdown calculation of downward flow in the downcomer for the remainder of the blowdown period; (2) Prediction of a threshold for droplet entrainment in the upward velocity, using local fluid conditions and a conservative critical Weber number.

d. *Noding Near the Break and the ECCS Injection Points.* The noding in the vicinity of and including the broken or split sections of pipe and the points of ECCS injection shall be chosen to permit a reliable analysis of the thermodynamic history in these regions during blowdown.

2. *Frictional Pressure Drops.* The frictional losses in pipes and other components including the reactor core shall be calculated using models that include realistic variation of friction factor with Reynolds number, and realistic two-phase friction multipliers that have been adequately verified by comparison with experimental data, or models that prove at least equally conservative with respect to maximum clad temperature calculated during the hypothetical accident. The modified Baroczy correlation (Baroczy, C. J., "A Systematic Correlation for Two-Phase Pressure Drop," *Chem. Enging. Prog. Symp. Series*, No. 64, Vol. 62, 1965) or a combination of the Thom correlation (Thom, J.R.S., "Prediction of Pressure Drop During Forced Circulation Boiling of Water," *Int. J. of Heat & Mass Transfer*, 7, 709–724, 1964) for pressures equal to or greater than 250 psia and the Martinelli-Nelson correlation (Martinelli, R. C. Nelson, D.B., "Prediction of Pressure Drop During Forced Circulation Boiling of Water," *Transactions of ASME*, 695–702, 1948) for pressures lower than 250 psia is acceptable as a basis for calculating realistic two-phase friction multipliers.

3. *Momentum Equation.* The following effects shall be taken into account in the conservation of momentum equation: (1) temporal change of momentum, (2) momentum convection, (3) area change momentum flux, (4) momentum change due to compressibility, (5) pressure loss resulting from wall friction, (6) pressure loss resulting from area change, and (7) gravitational acceleration. Any omission of one or more of these terms under stated circumstances shall be justified by comparative analyses or by experimental data.

4. *Critical Heat Flux.* a. Correlations developed from appropriate steady-state and transient-state experimental data are acceptable for use in predicting the critical heat flux (CHF) during LOCA transients. The computer programs in which these correlations are used shall contain suitable checks to assure that the physical parameters are within the range of parameters specified for use of the correlations by their respective authors.

b. Steady-state CHF correlations acceptable for use in LOCA transients include, but are not limited to, the following:

(1) *W J. L. S. Tong*, "Prediction of Departure from Nucleate Boiling for an Axially Non-uniform Heat Flux Distribution," *Journal of Nuclear Energy*, Vol. 21, 241–248, 1967.

(2) *B&W-2*. J. S. Gellerstedt, R. A. Lee, W. J. Oberjohn, R. H. Wilson, L. J. Stanek, "Correlation of Critical Heat Flux in a Bundle Cooled by Pressurized Water," *Two-Phase Flow and Heat Transfer in Rod Bundles*, ASME, New York, 1969.

(3) *Hench-Levy*. J. M. Healzer, J. E. Hench, E. Janssen, S. Levy "Design Basis for Critical Heat Flux Condition in Boiling Water Reactors," APED-5186, GE Company Private report, July 1966.

(4) *Macbeth*. R. V. Macbeth, "An Appraisal of Forced Convection Burnout Data," *Proceedings of the Institute of Mechanical Engineers*, 1965–1966.

(5) *Barnett*. P. G. Barnett, "A Correlation of Burnout Data for Uniformly Heated Annuli and Its Uses for Predicting Burnout in Uniformly Heated Rod Bundles," AEEW-R 463, 1966.

(6) *Hughes*. E. D. Hughes, "A Correlation of Rod Bundle Critical Heat Flux for Water in the Pressure Range 150 to 725 psia," IN-1412, Idaho Nuclear Corporation, July 1970.

c. Correlations of appropriate transient CHF data may be accepted for use in LOCA transient analyses if comparisons between the data and the correlations are provided to demonstrate that the correlations predict values of CHF which allow for uncertainty in the experimental data throughout the range of parameters for which the correlations are to be used. Where appropriate, the comparisons shall use statistical uncertainty analysis of the data to demonstrate the conservatism of the transient correlation.

d. Transient CHF correlations acceptable for use in LOCA transients include, but are not limited to, the following:

(1) *GE transient CHF*. B. C. Slifer, J. E. Hench, "Loss-of-Coolant Accident and Emergency Core Cooling Models for General Electric Boiling Water Reactors," NEDO-10329, General Electric Company, Equation C-32, April 1971.

e. After CHF is first predicted at an axial fuel rod location during blowdown, the calculation shall not use nucleate boiling heat transfer correlations at that location subsequently during the blowdown even if the calculated local fluid and surface conditions would apparently justify the reestablishment of nucleate boiling. Heat transfer assumptions characteristic of return to nucleate boiling (rewetting) shall be permitted when justified by the calculated local fluid and surface conditions during the reflood portion of a LOCA.

5. *Post-CHF Heat Transfer Correlations.* a. Correlations of heat transfer from the fuel cladding to the surrounding fluid in the post-CHF regimes of transition and film boiling shall be compared to applicable steady-state and transient-state data using statistical correlation and uncertainty analyses. Such comparison shall demonstrate that the correlations predict values of heat transfer coefficient equal to or less than the mean value of the applicable experimental heat transfer data throughout the range of parameters for which the correlations are to be used. The comparisons shall quantify the relation of the correlations to the statistical uncertainty of the applicable data.

b. The Groeneveld flow film boiling correlation (equation 5.7 of D.C. Groeneveld, "An Investigation of Heat Transfer in the Liquid Deficient Regime," AECL-3281, revised December 1969), the Dougall-Rohsenow flow film boiling correlation (R. S. Dougall and W. M. Rohsenow, "Film Boiling on the Inside of Vertical Tubes with Upward Flow of the Fluid at Low Qualities," MIT Report Number 9079-26, Cambridge, Massachusetts, September 1963), and the Westinghouse correlation of steady-state transition boiling ("Proprietary Redirect Rebuttal Testimony of Westinghouse Electric Corporation," U.S.A.E.C. Docket RM-50-1, page 25-1, October 26, 1972) are acceptable for use in the post-CHF boiling regimes. In addition the transition boiling correlation of McDonough, Milich, and King (J. B. McDonough, W. Milich, E. C. King, "Partial Film Boiling with Water at 2000 psig in a Round Vertical Tube," MSA Research Corp., Technical Report 62 (NP-6976), (1958)) is suitable for use between nucleate and film boiling. Use of all these correlations shall be restricted as follows:

(1) The Groeneveld correlation shall not be used in the region near its low-pressure singularity,

(2) the first term (nucleate) of the Westinghouse correlation and the entire McDonough, Milich, and King correlation shall not be used during the blowdown after the temperature difference between the clad and the saturated fluid first exceeds 300° F,

(3) transition boiling heat transfer shall not be reapplied for the remainder of the LOCA blowdown, even if the clad superheat returns below 300° F, except for the reflood portion of the LOCA when justified by the calculated local fluid and surface conditions.

6. *Pump Modeling.* The characteristics of rotating primary system pumps (axial flow, turbine, or centrifugal) shall be derived from a dynamic model that includes momentum transfer between the fluid and the rotating member, with variable pump speed as a function of time. The pump model resistance used for analysis should be justified. The pump model for the two-phase region shall be verified by applicable two-phase pump performance data. For BWR's after saturation is calculated at the pump suction, the pump head may be assumed to vary linearly with quality, going to zero for one percent quality at the pump suction, so long as the analysis shows that core flow stops before the quality at pump suction reaches one percent.

7. *Core Flow Distribution During Blowdown.* (Applies only to pressurized water reactors.)

a. The flow rate through the hot region of the core during blowdown shall be calculated as a function of time. For the purpose of these calculations the hot region chosen shall not be greater than the size of one fuel assembly. Calculations of average flow and flow in the hot region shall take into account cross flow between regions and any flow blockage calculated to occur during blowdown as a result of cladding swelling or rupture. The calculated flow shall be smoothed to eliminate any calculated rapid oscillations (period less than 0.1 seconds).

b. A method shall be specified for determining the enthalpy to be used as input data to the hot channel heatup analysis from quantities calculated in the blowdown analysis, consistent with the flow distribution calculations.

D. POST-BLOWDOWN PHENOMENA; HEAT REMOVAL BY THE ECCS

1. *Single Failure Criterion.* An analysis of possible failure modes of ECCS equipment and of their effects on ECCS performance must be made. In carrying out the accident evaluation the combination of ECCS subsystems assumed to be operative shall be those available after the most damaging single failure of ECCS equipment has taken place.

2. *Containment Pressure.* The containment pressure used for evaluating cooling effectiveness during reflood and spray cooling shall not exceed a pressure calculated conservatively for this purpose. The calculation shall include the effects of operation of all installed pressure-reducing systems and processes.

3. *Calculation of Reflood Rate for Pressurized Water Reactors.* The refilling of the reactor vessel and the time and rate of reflooding of the core shall be calculated by an acceptable model that takes into consideration the thermal and hydraulic characteristics of the core and of the reactor system. The primary system coolant pumps shall be assumed to have locked impellers if this assumption leads to the maximum calculated cladding temperature; otherwise the pump rotor shall be assumed to be running free. The ratio of the total fluid flow at the core exit plane to the total liquid flow at the core inlet plane (carryover fraction) shall be used to determine the core exit flow and shall be determined in accordance with applicable experimental data (for example, "PWR FLECHT (Full Length Emergency Cooling Heat Transfer) Final Report," Westinghouse Report WCAP-7665, April 1971; "PWR Full Length Emergency Cooling Heat Transfer (FLECHT) Group I Test Report," Westinghouse Report WCAP-7435, January 1970; "PWR FLECHT (Full Length Emergency Cooling Heat Transfer) Group II Test Report," Westinghouse Report WCAP-7544, September 1970; "PWR FLECHT Final Report Supplement," Westinghouse Report WCAP-7931, October 1972).

The effects on reflooding rate of the compressed gas in the accumulator which is discharged following accumulator water discharge shall also be taken into account.

4. *Steam Interaction with Emergency Core Cooling Water in Pressurized Water Reactors.* The thermal-hydraulic interaction between steam and all emergency core cooling water shall be taken into account in calculating the core reflooding rate. During refill and reflood, the calculated steam flow in unbroken reactor coolant pipes shall be taken to be zero during the time that accumulators are discharging water into those pipes unless experimental evidence is available regarding the realistic thermal-hydraulic interaction between the steam and the liquid. In this case, the experimental data may be used to support an alternate assumption.

5. *Refill and Reflood Heat Transfer for Pressurized Water Reactors.* For reflood rates of one inch per second or higher, reflood heat transfer coefficients shall be based on applicable experimental data for unblocked cores including FLECHT results ("PWR FLECHT (Full Length Emergency Cooling Heat Transfer) Final Report," Westinghouse Report WCAP-7665, April 1971). The use of a correlation derived from FLECHT data shall be demonstrated to be conservative for the transient to which it is applied; presently available FLECHT heat transfer correlations ("PWR Full Length Emergency Cooling Heat Transfer (FLECHT) Group I Test Report," Westinghouse Report WCAP-7544, September 1970; "PWR FLECHT Final Report Supplement," Westinghouse Report WCAP-7931, October 1972) are not acceptable. New correlations or modifications to the FLECHT heat transfer correlations are acceptable only after they are demonstrated to be conservative, by comparison with FLECHT data, for a range of parameters consistent with the transient to which they are applied.

During refill and during reflood when reflood rates are less than one inch per second, heat transfer calculations shall be based on the assumption that cooling is only by steam, and shall take into account any flow blockage calculated to occur as a result of cladding swelling or rupture as such blockage might affect both local steam flow and heat transfer.

6. *Convective Heat Transfer Coefficients for Boiling Water Reactor Fuel Rods Under Spray Cooling.* Following the blowdown period, convective heat transfer shall be calculated using coefficients based on appropriate experimental data. For reactors with jet pumps and having fuel rods in a 7 x 7 fuel assembly array, the following convective coefficients are acceptable:

a. During the period following lower plenum flashing but prior to the core spray reaching rated flow, a convective heat transfer coefficient of zero shall be applied to all fuel rods.

b. During the period after core spray reaches rated flow but prior to reflooding, convective heat transfer coefficients of 3.0, 3.5, 1.5, and 1.5 Btu-hr^{-1}-ft^{-2}-F^{-1} shall be applied to the fuel rods in the outer corners, outer row, next to outer row, and to those remaining in the interior, respectively, of the assembly.

c. After the two-phase reflooding fluid reaches the level under consideration, a convective heat transfer coefficient of 25 Btu-hr^{-1}-ft^{-2}-F^{-1} shall be applied to all fuel rods.

7. *The Boiling Water Reactor Channel Box Under Spray Cooling.* Following the blowdown period, heat transfer from, and wetting of, the channel box shall be based on appropriate experimental data. For reactors with jet pumps and fuel rods in a 7x7 fuel assembly array, the following heat transfer coefficients and wetting time correlation are acceptable.

a. During the period after lower plenum flashing, but prior to core spray reaching rated flow, a convective coefficient of zero shall be applied to the fuel assembly channel box.

b. During the period after core spray reaches rated flow, but prior to wetting of the channel, a convective heat transfer coefficient of 5 Btu-hr^{-1}-ft^{-2}-°F^{-1} shall be applied to both sides of the channel box.

c. Wetting of the channel box shall be assumed to occur 60 seconds after the time determined using the correlation based on the Yamanouchi analysis ("Loss-of-Coolant Accident and Emergency Core Cooling Models for General Electric Boiling Water Reactors," General Electric Company Report NEDO-10329, April 1971).

II. REQUIRED DOCUMENTATION

1. a. A description of each evaluation model shall be furnished. The description shall be sufficiently complete to permit technical review of the analytical approach including the equations used, their approximations in difference form, the assumptions made, and the values of all parameters or the procedure for their selection, as for example, in accordance with a specified physical law or empirical correlation.

b. The description shall be sufficiently detailed and specific to require significant changes in the evaluation model to be specified in amendments of the description. For this purpose, a significant change is a change that would result in a calculated fuel cladding temperature different by more than 20°F from the temperature calculated (as a function of time) for a postulated LOCA using the last previously accepted model.

e. A complete listing of each computer program, in the same form as used in the evaluation model, shall be furnished to the Atomic Energy Commission.

2. For each computer program, solution convergence shall be demonstrated by studies of system modeling or noding and calculational time steps.

3. Appropriate sensitivity studies shall be performed for each evaluation model, to evaluate the effect on the calculated results of variations in noding, phenomena assumed in the calculation to predominate, including pump operation or locking, and values of parameters over their applicable ranges. For items to which results are shown to be sensitive, the choices made shall be justified.

4. To the extent practicable, predictions of the evaluation model, or portions thereof, shall be compared with applicable experimental information.

5. General Standards for Acceptability—Elements of evaluation models reviewed will include technical adequacy of the calculational methods including compliance with required features of Section I of this Appendix K and provision of a level of safety and margin of conservatism comparable to other acceptable evaluation models, taking into account significant differences in the reactors to which they apply.

(Sec. 161, Pub. Law 83-703, 68 Stat. 948, 8? Stat. 36?, 81 Stat. 54, 22 U.S.C. 2201, 5 U.S.C. 552, 553.)

Dated at Washington, D.C. this 28th day of December 1973.

For the Atomic Energy Commission.

PAUL C. BENDER,
Secretary of the Commission.

[FR Doc.74-207 Filed 1-3-74;8:45 am]

Title 12—Banks and Banking

CHAPTER II—FEDERAL RESERVE SYSTEM

SUBCHAPTER A—BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

[Regs. G, T, U]

MAXIMUM LOAN VALUE OF STOCKS

Parts 207, 220 and 221 (Regulations G, T and U) are amended to change from 35 percent to 50 percent the maximum loan value of margin securities. This will have the effect of decreasing the amount of margin required for stock-secured loans and short sales.

PART 207—SECURITIES CREDIT BY PERSONS OTHER THAN BANKS, BROKERS OR DEALERS

1. Effective January 3, 1974, § 207.5(a) (the Supplement to Regulation G) is amended to read as follows:

§ 207.5 Supplement.

(a) *Maximum loan value of margin securities.* For the purpose of § 207.1, the maximum loan value of any margin security, except convertible securities subject to § 207.1(d), shall be 50 percent of its current market value, as determined by any reasonable method.

* * * * *

PART 220—CREDIT BY BROKERS AND DEALERS

2. Effective January 3, 1974, § 220.8 (a) (1) and (d) (the Supplement to Regulation T) is amended to read as follows:

§ 220.8 Supplement.

(a) *Maximum loan value for general accounts.* The maximum loan value of securities in a general account subject to § 220.3 shall be:

(1) Of a registered nonequity security held in the account on March 11, 1968, and continuously thereafter, and of a margin equity security (except as provided in § 220.3(c) and paragraphs (b) and (c) of this section) 50 per cent of the current market value of such securities.

* * * * *

(d) *Margin required for short sales.* The amount to be included in the adjusted debit balance of a general account, pursuant to § 220.3(d)(3), as margin required for short sales of securities (other than exempted securities) shall be 50 per cent of the current market value of each security.

* * * * *

PART 221—CREDIT BY BANKS FOR THE PURPOSE OF PURCHASING OR CARRYING MARGIN STOCKS

3. Effective January 3, 1974, § 221.4(a) (the Supplement to Regulation U) is amended to read as follows:

§ 221.4 Supplement.

(a) *Maximum loan value of stocks.* For the purposes of § 221.1, the maximum loan value of any stock, whether or not registered on a national securities exchange, shall be 50 percent of its current market value, as determined by any reasonable method.

* * * * *

4a. These amendments are issued pursuant to section 7 of the Securities Exchange Act of 1934 (15 U.S.C. 78g).

b. The requirements of 5 U.S.C. section 553 with respect to notice and public participation were not followed in connection with these amendments because following such requirements would be impracticable due to the highly technical nature of the subject matter involved and because it would be contrary to the public interest if this action were not immediately effective. The requirements of 5 U.S.C. section 553 with respect to deferred effective dates were not followed in connection with these amendments because these amendments relieve restrictions previously imposed.

By order of the Board of Governors, January 2, 1974.

[SEAL] CHESTER B. FELDBERG,
Secretary of the Board.

[FR Doc.74-531 Filed 1-2-74;5:04 pm]

CHAPTER V—FEDERAL HOME LOAN BOARD

SUBCHAPTER E—DISTRICT OF COL[illegible] SAVINGS AND LOAN ASSOCIATIONS; BRANCH OFFICES

[No. 73-2084]

PART 582—OFFICES

Satellite Offices of District of Colun[illegible] Savings and Loan Associations

DECEMBER 21, 1[illegible]

The Federal Home Loan Bank [illegible] considers it advisable to amend § 5[illegible] of the Regulations for District of C[illegible]bia Savings and Loan Association[illegible] Branch Offices (12 CFR 582.1-1[illegible] lating to satellite offices, for the pri[illegible] purposes of removing the require[illegible] that (a) a satellite office (other t[illegible] fully automated satellite office) [illegible] cated within a retail sales establis[illegible] such as a department store or supe[illegible] ket and (b) a fully automated sa[illegible] office be located either within a[illegible] retail sales establishment or in a [illegible] ping center, office building or trans[illegible] tion terminal. In addition, the [illegible] considers it advisable to make c[illegible] minor or conforming regulatory ch[illegible] relating to satellite offices.

Accordingly, the Federal Home [illegible] Bank Board hereby amends said § 5[illegible] by revising paragraph (a), sub[illegible] graphs (1) and (8) of paragrap[illegible] subparagraphs (4) and (5) of para[illegible] (g), and the last sentence of para[illegible] (g), to read as set forth below, eff[illegible] January 4, 1974.

Since the above amendments r[illegible] restrictions, the Board hereby find[illegible] notice and public procedure with re[illegible] to said amendments are unnece[illegible] under the provisions of 12 CFR [illegible] and 5 U.S.C. 553(b); and since pu[illegible] tion of said amendments for the 3[illegible] period specified in 12 CFR 508.14[illegible] 5 U.S.C. 553(d) prior to the effective[illegible] of said amendments would in the op[illegible] of the Board likewise be unnecessar[illegible] the same reason, the Board hereby [illegible] vides that said amendments shall be [illegible] effective as hereinbefore set forth.

The amendments set forth below [illegible] the following regulatory changes:

1. Paragraph (a) of § 582.1-1, en[illegible] "Nature of a satellite office", is re[illegible] by adding the following descripti[illegible] a fully automated satellite office: "A [illegible] automated satellite office is one [illegible] is to be operated wholly by machine[illegible] without tellers or other personne[illegible] handle transactions with the public[illegible] is noted that this description is the [illegible] as the description of a fully autom[illegible] satellite office previously in subdiv[illegible] (c)(1)(v) of § 582.1-1, which subdiv[illegible] has been deleted.

2. Subparagraph (c)(1) of § 58[illegible] entitled "Specific provisions", previ[illegible] required a satellite office (other th[illegible] fully automated satellite office) to b[illegible] cated in a retail sales establishment [illegible] required a fully automated satellite o[illegible]

and services of the Department. Coordinates the public information activities of the Department at all levels. Integrates the public affairs communications processes with Department policies and objectives, and establishes and enforces those policies which effect a clear, [illegible]ent, and consistent flow of informa[illegible] to the general public and other audiences about Department programs and activities.

B. The Deputy Assistant Secretary for Public Affairs (Communications) represents the Office of Public Affairs on matters relating to information flow and processing and interface with various publics on substantive matters of Department policies and positions related to: News services, audiovisual and photo services, publications and graphics services, and speakers bureau and speech writing.

C. The Deputy Assistant Secretary for Public Affairs (Operations) represents the Office of Public Affairs on matters relating to management and administration of public affairs activities and interface with pertinent Department publics and organizations related to: Communications planning and evaluation, field services and agency liaison, administrative services, general public services, outside organization liaison, and special information task forces.

Approved: June 22, 1971.

ELLIOT L. RICHARDSON,
Secretary.

[FR Doc.71 9145 Filed 6-28-71;8:48 am]

ATOMIC ENERGY COMMISSION

[Docket No. PRM-36-1]

NEW ENGLAND NUCLEAR CORP.

Filing of Petition

Notice is hereby given that the New England Nuclear Corp., 575 Albany Street, Boston, MA, by letter dated May 26, 1971, has filed with the Atomic Energy Commission a petition for rule making to amend the general license in § 36.24(b) of 10 CFR Part 36 for export of tritium with a specific activity of not more than 10 curies per gram of hydrogen in labeled organic compounds.

The petition requests that the specific activity restriction of "10 curies per gram of hydrogen" be deleted. The petition states further that if the Commission considers that additional controls would be required with deletion of the specific activity restriction, the single shipment restriction of § 36.24(b) could simultaneously be reduced from 10 curies to 1 curie.

A copy of the petition for rule making is available for public inspection in the Commission's Public Document Room at 1717 H Street NW., Washington, D.C.

Dated at Washington, D.C., this 23d day of June 1971.

For the Atomic Energy Commission.

W. B. McCool,
Secretary of the Commission.

[FR Doc. 71-9100 Filed 6-28-71;8:45 am]

CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS FOR LIGHT-WATER POWER REACTORS

Interim Policy Statement

The Atomic Energy Commission has adopted the interim statement of policy set forth below providing interim acceptance criteria for emergency core cooling systems for light-water power reactors.

INTERIM ACCEPTANCE CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS FOR LIGHT-WATER POWER REACTORS

I. GENERAL

The Atomic Energy Commission has recently been reevaluating the theoretical and experimental bases for predicting the performance of emergency core cooling systems, including new information obtained from industry and AEC research programs in this field. As a result of this reevaluation, the interim criteria of section IV of this policy statement have been adopted by the Commission for use in the licensing of light-water power reactors.

II. BACKGROUND

Protection against a highly unlikely loss-of-coolant accident has long been an essential part of the defense-in-depth concept used by the nuclear power industry and the AEC to assure the safety of nuclear power plants. In this concept, the primary assurance of safety is accident prevention by correctly designing, constructing, and operating the reactor. Extensive and systematic quality assurance practices are required and applied at every step to achieve this primary assurance of safety. Nevertheless, deviations from expected behavior are postulated to occur, and protective systems are installed to take corrective action as required in such events. Notwithstanding all this, the occurrence of serious accidents is postulated, in spite of the fact that they are highly unlikely, and engineered safety features are installed to mitigate the consequences of these unlikely events. The loss-of-coolant accident is such a postulated improbable accident; the emergency core cooling system is one of the engineered safety features installed to mitigate its consequences.

Emergency core cooling system design considerations were reviewed in a 1967 report to the AEC by an ad hoc Advisory Task Force on Power Reactor Emergency Core Cooling. The Task Force recommended that additional assurance could and should be obtained that substantial fuel melting can be prevented by emergency core cooling systems. Improvements in primary system integrity, development of improved analytical methods for predicting core cooling performance, and performance of confirmatory experiments were recommended.

Extensive design, analysis, and research programs were initiated by the AEC and the nuclear industry in these areas, and much new information has been developed. Additionally, practices in the design, manufacture, installation, and inspection of power reactor primary systems have been markedly improved.

Later, in 1969, an AEC Internal Study Group recommended greater emphasis on quality assurance, and confirmed the use of postulated unlikely accidents (such as the loss-of-coolant accident) as design bases for reactor safety.

The ongoing industry and AEC programs have produced a large amount of information not available at the time of the earlier reviews. This new information has led to changes in the various emergency core cooling system designs for power reactors, and also in the analytical methods used in the evaluation of system performance. Development by the reactor vendors, and independently by the AEC, of new methods of analysis—computer codes—more complex and sophisticated by far than those formerly in use, gave new insight into the processes, and problems, in predicting emergency core cooling system performance.

The nuclear industry as well as the AEC has sponsored a great deal of confirmatory experimentation in this field. Blowdown experiments performed on nonnuclear simplified models of pressurized systems were used to check and correct the new codes. Some of these experiments in the small LOFT Semiscale Blowdown System at the National Reactor Testing Station in Idaho showed deviations from the predictions of the codes then in use. For example, the emergency core cooling water was ejected from the system during the blowdown. Although there are differences between the small LOFT Semiscale experiments and large power reactors, this experimental result has been taken into account where applicable in the evaluation models of Appendix A by including the conservative assumption that all of the water injected by the accumulators during blowdown is lost.

The process of code development and experimentation using models is expected to continue. The Commission plans to place the necessary additional emphasis on such work in Commission programs and expects the nuclear industry to accelerate its efforts.

In view of the large amount of new information available, the AEC has again conducted a review of the present state of emergency core cooling system technology, and has reevaluated the basis previously used for accepting system designs for current types of light-water reactors.

III. EVALUATION OF EMERGENCY CORE COOLING SYSTEM PERFORMANCE

The course of a loss-of-coolant accident, and the performance of the emergency core cooling system, are evaluated with a sequence of calculations. For calculation, the system is divided into many control volumes ("nodes"). Each volume contains the heat sources and sinks appropriate to the component being modeled. During the entire calculation, temperatures in the core are calculated as function of time. The cooling processes are primary coolant flow during blowdown and flow of emergency core cooling water as it becomes available.

Ideally, one would have available analytical methods capable of detailed realistic prediction of all phenomena known or suspected to occur during a loss-of-coolant accident, supported in every aspect by definitive experiments directly applicable to the accident. In the absence of such perfection, adequate assurance of safety can be obtained from an appropriately conservative analysis based on available experimental information. In areas of incomplete knowledge, conservative assumptions or procedures must be applied. When further experimental information or improved calculational techniques become available, the conservatisms presently imposed will be reevaluated and a more realistic approach will be taken.

Detailed technical reviews have been performed by the AEC of the computer codes currently available for predicting emergency core cooling system performance. The AEC has developed sets of suitably conservative assumptions and procedures which together with the computer codes comprise three appropriately conservative evaluation models to use for evaluation. The codes used in one of these evaluation models (described in Part 1 of Appendix A) are available from the AEC. Codes used in the other two evaluation models (described in Parts 2 and 3 of Appendix A) contain proprietary material, for which summaries are or soon will be publicly available. Other evaluation models are under review by the AEC.

The three acceptable evaluation models presently included in Appendix A are different in many respects, and the sets of conservative assumptions and procedures also differ from one another. These differences arise from two principal causes: (1) Differences in approach and calculational methods of the different analyses, leading to different areas where imperfect knowledge or analysis require conservative treatments, and (2) differences in hardware among the various reactor designs, such as spray vs. flood cooling and hot leg vs. cold leg vs. direct vessel injection.

IV. INTERIM ACCEPTANCE CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS

The criteria for acceptance of emergency core cooling systems have been developed in the context of the defense-in-depth concept, with the primary assurance of safety being accident prevention, achieved by correct design, construction, and operation and by adequate quality assurance. The loss-of-coolant accidents postulated in the criteria thus presuppose a highly unlikely event as a starting point.

These criteria are applicable to all light-water power reactors except as otherwise provided. Improvements are expected in analytical techniques, and experimental programs are expected to provide increased and improved knowledge about ECCS performance. On the basis of such improvements in technology, these criteria will be modified from time to time.

The Commission believes that these criteria for emergency core cooling systems provide reasonable assurance that such systems will be effective in the unlikely event of a loss-of-coolant accident. Nevertheless, in connection with water power reactors yet to be designed and constructed the possibility of accomplishing by changes in design further improvements in the capability of emergency core cooling systems should be considered.

A. *Criteria for all light-water power reactors.* These general requirements have been the basis of AEC safety review for some time. On the basis of today's knowledge, the performance of the emergency core cooling system is judged to be acceptable if the calculated course of the loss-of-coolant accident[1] is limited as follows:

1. The calculated maximum fuel element cladding temperature does not exceed 2,300° F. This limit has been chosen on the basis of available data on embrittlement and possible subsequent shattering of the cladding. The results of further detailed experiments could be the basis for future revision of this limit.

2. The amount of fuel element cladding that reacts chemically with water or steam does not exceed 1 percent of the total amount of cladding in the reactor.

3. The clad temperature transient is terminated at a time when the core geometry is still amenable to cooling, and before the cladding is so embrittled as to fail during or after quenching.

4. The core temperature is reduced and decay heat is removed for an extended period of time, as required by the long-lived radioactivity remaining in the core.

B. *Criteria for specific reactors.* Each reactor shall be evaluated in accordance with the general criteria of section IV.A, and using a suitable evaluation model. Examples of acceptable evaluation models are described in Appendix A.[2] These evaluation models are acceptable to the Commission but their use is not mandatory. Other evaluation models may be proposed by applicants for review in indvidual cases.

C. *Application of criteria to reactor licensing*—1. *Application to operating reactors.* (a) For each reactor holding an operating license on the effective date of these criteria and not covered by paragraph (b) below, an analysis of the performance of the emergency core cooling system presently installed, using methods equivalent to those in Appendix A, shall be submitted to the AEC as soon as practicable, but not later than October 1, 1971. Each such operating reactor shall be shown by that date to be in compliance with the criteria of sections IV A and B.

(b) For reactors granted operating licenses on or before January 1, 1968, compliance with the criteria of sections IV A and B will not be required until July 1, 1974. Each such reactor, to the extent that it is not in compliance with the criteria, shall be subject to the following additional requirements:

(1) An analysis of the performance of the emergency core cooling system presently installed, using methods equivalent to those in Appendix A, shall be submitted to the AEC as soon as practicable, but in no case later than January 1, 1972.

(2) A program of improvements, and a schedule for effecting them before July 1, 1974, together with supporting analysis based on an evaluation model equivalent to those in Appendix A, shall be submitted to the AEC as soon as practicable, but in no case later than July 1, 1972.

The licensee shall make, as soon as practicable, such interim improvements in operating techniques as are practical and worthwhile in improving emergency core cooling system performance or reliability.

(3) An augmented inservice inspection program shall be inaugurated promptly covering those portions of the system piping, pumps, and valves with a nominal diameter of 4 inches or greater and for whose postulated failure the performance of the installed emergency core cooling system would not be in compliance with the criteria. The augmented program shall be based on the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code, section XI, except that the frequency of inspection shall be tripled.

(4) Equipment shall be installed as soon as practical if needed to facilitate detection of primary-system leakage by at least two different methods. The technical specifications regarding allowable rates of identified and unidentified leakage shall be reduced to the lowest practical values.

2. *Variances.* (a) The Commission may authorize variances from these criteria

[1] A loss-of-coolant accident is a postulated accident that results from the loss of reactor coolant at a rate in excess of the capability of the reactor coolant makeup system from breaks in the reactor coolant pressure boundary, up to and including a break equivalent in size to the double-ended rupture of the largest pipe of the reactor coolant system.

[2] Westinghouse Electric Corp. proposals for subatmospheric and ice condenser containments, and proposals from The Babcock and Wilcox Co. and Combustion Engineering, Inc., are under review by the AEC.

where their application is not practicable or for other good cause.

(b) The Commission may also authorize variances from these criteria for a limited period of time to allow completion of testing programs.

(c) The application of these criteria is expected to permit normal electrical power output of all, or almost all, power reactors. However, if a limitation should result, and if an urgent short-term need for additional power occurs because of unusual or peak demand, outage of other equipment, or other similar reasons the Commission may authorize full power operation of the reactor for a limited period.

(d) Any variance authorized hereunder shall be based upon a determination of reasonable assurance that the proposed action will not adversely affect the health and safety of the public.

APPENDIX A—ACCEPTABLE EVALUATION MODELS INCLUDING THEIR CONSERVATIVE ASSUMPTIONS AND PROCEDURES

PART 1—AEC EVALUATION MODEL FOR PRESSURIZED-WATER REACTORS

Analyses should be performed for the entire break spectrum, from 0.5 ft.^{2} up to and including the double-ended severance of the largest pipe of the reactor coolant pressure boundary. The combination of systems used for analysis should be derived from a failure mode and effects analysis, using the single failure criterion.

The following analytical techniques should be used:

1. Thermohydraulic calculation during blowdown—IN-1321, "RELAP 3—A Computer Program for Reactor Blowdown Analysis," June 1970.

2. A suitable refill and reflood calculation from the end of blowdown onward.

3. Fuel element heatup calculation—IN-1445, "THETA 1-B, A Computer Code for Nuclear Reactor Core Thermal Analysis," February 1971. Inputs from 1 and 2 will be used for this calculation.

The user of these codes should assure himself that he has reviewed available "updated memos" and is using the correct versions and choice of options within the code.

The following assumptions and procedures are to be used. Any assumptions not specified should be fully justified.

1. Core and System Noding.

a. RELAP—at least 3 core nodes, at least 7 nodes in the primary side of each steam generator model, and one containment node.

b. THETA—at least 4 radial fuel nodes and one radial cladding node; at least 7 axial fluid nodes.

2. Pump Model—The pump resistance, K, used for analysis should be fully justified. The effect of pump speed upon K should be considered. The more conservative of two assumptions (locked or running) should be used for the pump during the blowdown calculation.

3. Break Characteristics—For large breaks in the range 0.6 to 1 times the total area of the double-ended break of the largest cold-leg pipe, two break models should be used. The first model should be the double-ended severance (guillotine), which assumes that there is break flow from both ends of the broken pipe, but no communication between the broken ends. The second model should assume discharge from a single node (split).

4. A break discharge coefficient (C_D) of 1 should be used for all break sizes.

5. Decay heat—The decay heat curve described in the proposed ANS Standard, with a 20 percent allowance for uncertainty, should be used. The fraction of decay heat generated in the hot rod should be considered to be 100 percent of this value unless a smaller value is justified.

6. Time to departure from nucleate boiling—use any calculated option in the code.

7. Heat transfer after departure from nucleate boiling—use programed transition boiling correlation option.

8. Film boiling heat transfer—use Groeneveld correlation (equation 5.7 of AECL-3281, December 1969).

9. Metal-worker reaction rate—use the Baker-Just equation, with a coefficient of 1.

10. Core flow—use 0.8 x RELAP smoothed flow at the junction which is entering core. If flows are opposed, use zero flow.

11. Enthalpy and pressure—use entering plenum conditions.

12. Accumulator Bypass—For cold leg breaks, all of the water injected by the accumulators prior to end-of-blowdown shall be assumed to be lost. In this context the end-of-blowdown shall be specified as the time at which zero break flow is first computed.

13. Reflood—a calculation for the reflooding heat transfer should be performed. The contaminant back pressure assumed for the analysis should not be higher than the initial pre-break pressure plus 80 percent of the increase in pressure calculated for the accident. The following items should be constraints on the calculation:

a. No steam flow should be permitted in intact loops during the time period that accumulators are injecting.

b. Core exit quality should be calculated from entering mass flow rate and nominal FLECHT heat transfer.

c. Pump resistance, K, should be calculated on the basis of a locked rotor.

d. The effects of the nitrogen gas in the accumulator, which is discharged following accumulator water discharge, should be taken into account in calculating steam flow as a function of time.

e. The pressure drop in the steam generator should be calculated with the existing fluid conditions and associated loss coefficients.

f. All effects of cold injection water, in either a hot or cold leg, on steam flow (and Δ P) should be included in the calculation.

g. The heat transfer coefficient during reflood should be derived from FLECHT data.

PART 2—GENERAL ELECTRIC EVALUATION MODEL

Analyses should be performed for the entire break spectrum, up to and including a double-ended severance of the largest pipe of the reactor collant pressure boundary. The combinations of systems used for analysis should be derived from a failure mode and effects analysis, using the single failure criterion as indicated in Table 2-1 of the topical report "Loss-of-Coolant Accident and Emergency Core Cooling Models for General Electric Boiling Water Reactors," NEDO-10329. The analytical techniques described in NEDO-10329 and its supplement should be used with the following exceptions:

1. During the period of flow coastdown after the minimum critical heat flux ratio at the hot spot is less than one and until the top of the jet pumps uncover, the heat transfer coefficient should be calculated using the D. C. Groeneveld correlation (AECL-3281, equation 5.7).

2. During the period of lower plenum flashing until the core becomes uncovered, the heat transfer coefficient should be calculated using Groeneveld's correlation as in 1 above.

3. The heat transfer coefficients associated with rated core spray flow should correspond to those derived from experimental data, assuming the cladding and channel box emissivity is equal to 0.9.

4. It should be assumed that channel wetting does not occur until 60 seconds following the wetting time calculated using the Yamanouchi analysis.

5. A range of conservatively calculated peaking factors should be studied and the combination selected which results in the most severe thermal transient for the break spectrum and combinations of systems analyzed.

6. The decay heat curve described in the proposed ANS Standard, with a 20 percent allowance for uncertainty, should be used. The fraction of decay heat generated in the hot rod should be considered to be 100 percent of this value unless a smaller value is justified. The effect of voids on reactivity during the blowdown may be taken into account.

PART 3—WESTINGHOUSE EVALUATION MODEL

Analyses should be performed for the entire break spectrum, up to and including the double-ended severance of the largest pipe of the reactor coolant pressure boundary. The combination of systems used for analyses should be derived from a failure mode and effects analysis, using the single-failure criterion.

The analytical techniques to be used are described in the topical report, "Westinghouse PWR Core Behavior Following a Loss-of-Coolant Accident" WCAP-7422-L January 1970 (Proprietary), and a supplementary proprietary Westinghouse report, "Emergency Core Cooling Performance," received June 1, 1971, and in an appropriate nonproprietary report to be furnished by Westinghouse, with the following exceptions:

For breaks greater than 0.5 ft.^{2}—

1. The break discharge coefficient, (C_D), used with the Moody discharge flow model should be equal to 1 for all break sizes.

2. The decay heat curve described in the proposed ANS Standard, with a 20 percent allowance for uncertainty, should be used. The fraction of decay heat generated in the hot rod may be considered to be 95 percent of this value.

3. For large breaks in the range 0.6 to 1 times the total area of the double-ended break of the largest cold-leg pipe, two break models should be used. The first model should be the double-ended severance (Guillotine), which assumes that there is break flow from both ends of the broken pipe, but no communication between the broken ends. The second model should assume discharge from a single node (split).

4. The time after the break for the onset of departure from nucleate boiling at the hot spot should be equal to 0.1 second.

5. For cold leg breaks, all of the water injected by the accumulators prior to end-of-blowdown shall be assumed to be lost. In this context the end-of-blowdown shall be specified as the time at which zero break flow is first computed. The containment back pressure assumed for the blowdown analysis should not be higher than the initial pre-break pressure plus 90 percent of the increase in pressure calculated for the accident under consideration.

6. The pump resistance, K, used for analysis should be fully justified. The effect of pump speed upon K should be considered. The more conservative of two assumptions (locked or running) should be used for the pump during the blowdown calculation.

7. A calculation for the reflooding heat transfer should be performed. The containment back pressure assumed for the analysis should not be higher than the initial pre-break pressure plus 80 percent of the increase

in pressure calculated for the accident under consideration.

The following items should be constraints on the calculation:

a. No steam flow should be permitted in intact loops during the time period that accumulators are injecting.

b. Core exit quality should be calculated from entering mass flow rate and nominal FLECHT heat transfer.

c. Pump resistance should be calculated on the basis of a locked rotor.

d. The effects of the nitrogen gas in the accumulator, which is discharged following accumulator water discharge, should be taken into account in calculating steam flow as a function of time.

e. The pressure drop in the steam generator should be calculated with the existing fluid conditions and associated loss coefficients.

f. All effects of cold injection water, in either a hot or cold leg, on steam flow (and ΔP) should be included in the calculation.

g. The heat transfer coefficient during reflood should be derived from FLECHT data.

In view of the public health and safety considerations discussed above, the Commission has found that the interim acceptance criteria contained herein should be promulgated without delay, that notice of proposed issuance and public procedure thereon are impracticable, and that good cause exists for making the statement of policy effective upon publication in the FEDERAL REGISTER. The Commission invites all interested persons who desire to submit written comments or suggestions for consideration in connection with the statement of policy to send them to the Secretary of the Commission, U.S. Atomic Energy Commission, Washington, D.C. 20545, Attention: Chief, Public Proceedings Branch, within 60 days after publication of this notice in the FEDERAL REGISTER. Copies of comments received may be examined at the Commission's Public Document Room, 1717 H Street, NW., Washington, D.C. The Commission will consider all such comments and suggestions with the view to possible amendments and will issue a report. Additionally, the Commission will consider holding an informal public rule making hearing on this interim policy statement.

(Sec. 161, 68 Stat. 948, 80 Stat. 383, 81 Stat. 54; 42 U.S.C. 2201, 5 U.S.C. 552, 553)

Dated at Washington, D.C., this 25th day of June 1971.

For the Atomic Energy Commission.

W. B. McCOOL,
Secretary of the Commission.

[FR Doc.71-9185 Filed 6-28-71;8:52 am]

CIVIL AERONAUTICS BOARD

[Docket No. 23542; Order 71-6-127]

AIR TRAFFIC CONFERENCE OF AMERICA

Order Instituting Investigation

Adopted by the Civil Aeronautics Board at its office in Washington, D.C., on the 24th day of June 1971.

By Opinion and Order 70-12-165, December 31, 1970, the Board passed upon the provisions of a resolution of the carrier members of the Air Traffic Conference of America (ATC)[1] relating to the establishment of commission rates for travel agent sales of domestic air transportation and providing for certain amendments to the ATC process for the selection and retention of travel agents.[2] During the course that proceeding issues were raised with respect to whether the procedures employed by ATC in adopting the resolution, i.e., ATC's unanimous voting requirement, were contrary to the public interest because such had resulted in an inherently unfair compromise which was reflected by the inadequate level of agent compensation provided for in the resolution.[3]

In response to these allegations we concluded that the substantial issues raised by the unanimous features of ATC's bylaws warranted a general inquiry independent of our concern with the commission resolutions there before us. Consequently, we stated that we would address ourselves to the initiation of an inquiry relative to the unanimity voting procedures at a subsequent date. Order 70-12-165, supra, pages 14-15.

Accordingly, we are herein instituting a general investigation of all the ATC bylaws—not only those which encompass the unanimous voting procedures. We have concluded that the most appropriate avenue of exploring those issues raised by the unanimous voting procedures would be in the context of a thorough and complete investigation into the framework of the conference in which they are employed.

We have concluded that a formal evidentiary hearing is the most satisfactory means of resolving all of the issues raised by the ATC bylaws and would be in the public interest. Our limited experience with the unanimity provisions of the bylaws during the course of the proceedings in Docket 21305 has demonstrated to us that it would be extremely difficult if not essentially impossible to fully explore all of the issues raised by each provision of the bylaws on the basis of written comments alone.

The basic issue to be resolved in the proceeding will be whether the ATC bylaws should be approved or disapproved under section 412 of the Act. Of course, the subsidiary issues are subject to delineation at the prehearing conference. We would expect that such issues include the following: whether the unanimous voting procedures currently employed by ATC should be maintained and if not, whether a representative determination of the conference membership can and should be effected by different voting procedures; whether a carrier which seeks to take action independent of that which the whole conference has decided upon should be allowed to do so pursuant to requirements more flexible than the current ones; whether it is in the public interest to require membership in ATA as a condition to full membership in ATC; and related thereto whether it is in the public interest for ATC to function as part of ATA.[4]

Accordingly, it is ordered, That:

1. An investigation to be known as the "ATC Bylaws Investigation" be initiated for the purpose of determining whether such bylaws or any provisions thereof are adverse to the public interest and whether they should be approved under section 412 of the Act;

2. Said investigation be and it hereby is set for hearing before an examiner of the Board at a place and time to be hereafter designated; and

3. ATA, ATC, all carrier members of ATC, each travel agent and travel agent association participating in the commission proceeding in Docket 21305, and the Departments of Justice and Transportation be served with copies of this order and made parties to the proceeding.

This order will be published in the FEDERAL REGISTER.

By the Civil Aeronautics Board.

[SEAL] HARRY J. ZINK,
Secretary.

[FR Doc.71-9168 Filed 6-28-71;8:50 am]

[1] ATC is one of four conferences of the Air Transport Association of America, the domestic scheduled air carrier industry trade association. The other conferences are: The Airline Finance and Accounting Conference; the Personnel Relations Conference; and the Airline Operations Conference. ATC deals primarily in traffic and sales matter and has a stated purpose of increasing the use and usefulness of air transportation and furthering the interest of the member carriers to deal with their mutual traffic, sales, and advertising problems.

[2] Agreements CAB 5044-A144, Docket 21305.

[3] This allegation was raised initially by by ARTA which was later joined therein by the Department of Justice which argued that the Board consider the unanimous voting procedures either in the commission proceeding or in a subsequent proceeding.

[4] We do not intend in this proceeding to reexamine our approval of any prior resolution adopted by ATC and approved by the Board, since the status of such resolutions under section 412 has already been examined and determined. To the extent the outcome of the investigation affects any extant resolution, we shall consider such matters subsequent to the conclusion of the investigation.

[Docket No. 22118]

HAWAIIAN SERVICE INVESTIGATION

Notice of Postponement of Prehearing Conference

Notice is hereby given that the prehearing conference in the above-entitled investigation is postponed until August 3, 1971, at 10 a.m., e.d.s.t., in Room 503, Universal Building, 1825 Connecticut Avenue NW., Washington, DC, before the undersigned examiner.

The date for filing requests for information and evidence, proposed statements of issues, and procedural dates by counsel for the Bureau of Air Operations is accordingly postponed until July 12, 1971, and the date for similar filings by Aloha and Hawaiian Airlines, and by any other parties, is postponed until July 26, 1971.

application for license dated November 25, 1970 and amendments thereto dated December 30, 1970, March 26, 1971, May 20, 1971, September 30, 1971, October 22, 1971, and November 16, 1971; (2) the proposed facility license with Technical Specifications, and (3) a related Safety Evaluation prepared by the Division of Reactor Licensing, all of which are available for public inspection at the Commission's Public Document Room at 1717 H Street NW., Washington, DC. A copy of each of items (2) and (3) above may be obtained upon request sent to the U.S. Atomic Energy Commission, Washington, D.C. 20545, Attention: Director, Division of Reactor Licensing.

Dated at Bethesda, Md., this 8th day of December 1971.

For the Atomic Energy Commission.

DONALD J. SKOVHOLT,
Assistant Director for Reactor Operations, Division of Reactor Licensing.

[FR Doc.71-18520 Filed 12-17-71;8:47 am]

[Docket No. 50-113]

UNIVERSITY OF ARIZONA

Extension of Completion Date of Construction Permit

The University of Arizona, having filed a request dated November 29, 1971, for extension of the latest completion date specified in Construction Permit No. CPRR-111, which authorizes modification of the existing reactor facility located on the University's campus at Tucson, Ariz.; and

Good cause having been shown for extension of said date, pursuant to section 185 of the Atomic Energy Act of 1954, as amended, and 10 CFR § 50.55 of the Commission's regulations:

It is hereby ordered, That the latest completion date for Construction Permit No. CPRR-111 is extended from December 31, 1971 to September 1, 1972.

Date of issuance: December 8, 1971.

For the Atomic Energy Commission.

PETER A. MORRIS,
Director,
Division of Reactor Licensing.

[FR Doc.71-18521 Filed 12-17-71;8:47 am]

CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS FOR LIGHT-WATER POWER REACTORS

Interim Acceptance

On June 29, 1971, the Atomic Energy Commission published its Interim Policy Statement, "Interim Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Power Reactors." (36 F.R. 12247.) The Statement included, as Appendix A, Parts 1-3, acceptable evaluation models, including conservative assumptions and procedures. Since that time, proposals for evaluation models made by The Babcock and Wilcox Co. and by Combustion Engineering, Inc., have been reviewed by the Commission, together with the conservative assumptions and procedures appropriate to each model. The amendments to the Interim Acceptance Criteria which follow add these acceptable new evaluation models as Parts 4 and 5 of Appendix A. Conforming amendments have been made in the body of the Interim Acceptance Criteria.

1. The third and fourth paragraphs of section III are amended to read as follows:

III. EVALUATION OF EMERGENCY CORE COOLING SYSTEM PERFORMANCE

* * * * *

Detailed technical reviews have been performed by the AEC of the computer codes currently available for predicting emergency core cooling system performance. The AEC has developed sets of suitably conservative assumptions and procedures which together with the computer codes comprise five appropriately conservative evaluation models to use for evaluation. The codes used in one of these evaluation models (described in Part 1 of Appendix A) are available from the AEC. Codes used in the other four evaluation models (described in Parts 2-5 of Appendix A) contain proprietary material, for which summaries are or soon will be publicly available. Other evaluation models are under review by the AEC.

The five acceptable evaluation models presently included in Appendix A are different in many respects, and the sets of conservative assumptions and procedures also differ from one another. These differences arise from two principal causes: (1) Differences in approach and calculational methods of the different analyses, leading to different areas where imperfect knowledge or analysis require conservative treatments, and (2) differences in hardware among the various reactor designs, such as spray vs. flood cooling and hot leg vs cold leg vs. direct vessel injection.

2. New Parts 4 and 5 are added to Appendix A to read as follows:

APPENDIX A—ACCEPTABLE EVALUATION MODELS INCLUDING THEIR CONSERVATIVE ASSUMPTIONS AND PROCEDURES

* * * * *

PART 4—BABCOCK AND WILCOX EVALUATION MODEL [3]

Analyses should be performed for the entire break spectrum, from 0.5 ft.², up to and including the double-ended severance of the largest pipe of the reactor coolant pressure boundary. The combination of systems used for analyses should be derived from a failure mode and effects analysis, using the single failure criterion.

The analytical techniques to be used, with the assumptions and procedures described in §§ 1.1-2.5, are those described in the following topical reports:

1. "CRAFT—Description of Model for Equilibrium LOCA Analysis Program"—Report BAW-10030, October 1971.

2. "REFLOOD—Description of Model for Multinode Core Reflood Analysis"—Report BAW-10031 October 1971.

3. "THETA 1-B, A Computer Code for Nuclear Reactor Core Thermal Analysis," Idaho Nuclear Corporation Report IN-1445, February 1971.

4. "Multinode Analysis of B&W's 2568 MWt Nuclear Plants During A Loss-of-Coolant Accident"—Report BAW-10034, October 1971.

Blowdown Period

1.1 *Core and System Noding.*

1.1.1 CRAFT—At least three core nodes should be used, and at least four steam generator nodes (primary side) should be used. A containment node should be used.

1.1.2 THETA 1-B—At least six radial fuel nodes and two radial clad nodes, in conjunction with at least 10 axial fuel nodes, should be used.

1.2 *Pump Model.*

The pump characteristics, including the effect of pump speed, for analyses should be fully justified. The more conservative of two assumptions (locked or running) should be used for the pump during the blowdown calculation.

1.3 *Break Characteristics.*

For large breaks in the range of 0.6-1.0 times the total area of the double-ended break of the largest cold-leg pipe, two break models should be used. The first model should be the double-ended severance (guillotine) which assumes that there is break flow from both ends of the broken pipe, but no communication between the broken ends. The second model should assume discharge from a single node (split).

1.4 *Discharge Coefficient.*

A break discharge coefficient $C_D = 1.0$ should be used for all break sizes.

1.5 *Decay Heat.*

The decay heat curve described in the proposed ANS standard,[4] increased by a +20 percent allowance for uncertainty, should be used. The fraction of decay heat generated in the hot rod may be considered to be 0.96 times this value.

1.6 *Time to Departure from Nucleate Boiling (DNB).*

The time to DNB should be calculated using any one of the programmed options of the THETA 1-B code.

1.7 *Film Boiling Heat Transfer.*

The Groeneveld correlation (equation 5.7 of AECL-3281, December 1969) should be used in the THETA 1-B code for the film-boiling heat transfer regime.

1.8 *Metal-Water Reaction Rate.*

The metal-water reaction rates should be calculated using the Baker-Just equation with a coefficient of 1.0.

1.9 *Core Flow Rate.*

The smoothed core flow rate at the hot spot location, derived from the CRAFT code and multiplied by 0.8, should be used as input to the THETA 1-B fuel rod heatup calculation.

1.10 *Enthalpy and Pressure.*

The core pressure and the entering plenum enthalpy, derived from the CRAFT code, should be used as input to the THETA 1-B calculations.

1.11 *Core Flooding Tank Bypass.*

For cold leg breaks, all of the water injected by the core flooding tanks prior to the

[3] This evaluation model applies to reactors containing internal vent valves.

[4] "Energy Release Rates Following Shutdown of Uranium-Fuel Thermal Reactors," Subcommittee ANS-5, American Nuclear Society, October 1971. Copies may be obtained from Dr. M. E. Remley, Chairman, Subcommittee ANS-5, Atomics International, Post Office Box 309, Canoga Park, CA 91305. Copies are available for public inspection at the Commission's Public Document Room, 1717 H Street NW., Washington, DC.

end-of-blowdown should be assumed to be lost. In this context the end-of-blowdown should be considered to be the time at which zero break flow is first computed.

Reflood Period

2.1 The core reflood performance should be calculated using the REFLOOD code described in BAW-10031.

2.2 An adiabatic heatup of the core should be assumed from the time of end-of-blowdown until the emergency core cooling fluid reaches the bottom of the core.

2.3 For the reflood calculation, the containment pressure should not exceed the initial prebreak pressure plus 80 percent of the increase in pressure calculated by the methods used for containment design for the accident under consideration.

2.4 The steam flow rate from the core, as it affects the reflood pressure-drop calculations, should be calculated on the basis of core heat transfer coefficients that are equal to or greater than Flecht heat transfer coefficients. The internals vent valves should be the only flow path from the upper plenum.

2.5 The fuel rod temperature transients should be calculated on the basis of heat transfer coefficients derived from flecht.

PART 5—COMBUSTION ENGINEERING EVALUATION MODEL

Analyses should be performed for the entire break spectrum, from 0.5 ft.², up to and including the double-ended severance of the largest pipe of the reactor coolant pressure boundary. The combination of systems used for analyses should be derived from a failure mode and effects analysis, using the single failure criterion.

The analytical techniques to be used, with the assumptions and procedures described in §§ 1.1-2.6, are those described in the following topical reports. Suitable nonproprietary reports are to be submitted.

1. "Description of Loss-of-Coolant Calculational Procedures," CENPD-26, Proprietary Combustion Engineering Report, August, 1971.

2. "Description of Loss-of-Coolant Calculational Procedures," Proprietary Combustion Engineering Report, Supplement 1 to CENPD-26, October, 1971.

3. "Steam Venting Experiments and Their Application to CE Evaluation Model," Proprietary Combustion Engineering Report, Supplement 2 to CENPD-26, November, 1971.

4. "Moisture Carry-over During PWR Post-LOCA Core Refill," informal proprietary Combustion Engineering submittal, November, 1971.

Blowdown Period

1.1 *Discharge Coefficient.*

The break discharge coefficient, (C_D) used with the Moody discharge flow model should be equal to 1.0 for all break sizes.

1.2 *Decay Heat.*

The decay heat curve described in the proposed ANS Standard,[4] increased by a +20 percent allowance for uncertainty, should be used. The fraction of decay heat generated in the hot rod may be considered to be 0.94 times this value unless a smaller value is justified.

1.3 *Break Characteristics.*

For large breaks in the range 0.6 to 1.0 times the total area of the double-ended break of the largest cold-leg pipe, two break models should be used. The first model should be the double-ended severance (guillotine), which assumes that there is break flow from both ends of the broken pipe, but no communication between the broken ends. The second model should assume discharge from a single node (split).

1.4 *Safety Injection Tank Bypass.*

For cold leg breaks, all of the water injected by the safety injection tanks prior to end-of-blowdown should be assumed to be lost. In this context the end-of-blowdown should be considered to be the time at which zero break flow is first computed.

1.5 *Pump Model.*

The pump characteristics, including the effect of pump speed, for analyses should be fully justified. The more conservative of two assumptions (locked or running) should be used for the pump during the blowdown calculation.

Reflood Period

2.1 The reflood sequence of events should be calculated using the analytical methods described in CENPD-26 and its supplements. The containment back pressure assumed for the analysis should not be higher than the initial prebreak pressure plus 80 percent of the increase in pressure calculated by the methods used for containment design for the accident under consideration.

2.2 All effects of cold injection water, in either a hot or cold leg, on steam flow (and ΔP) should be included in the calculation. The steam flow in intact loops during the time period that the safety injection tanks are injecting should be calculated as described in Supplement 2 of CENPD-26. The steam flow rate from the core as it affects the pressure-drop calculations should be calculated on the basis of core heat transfer coefficients that are equal to or greater than FLECHT heat transfer coefficients.

2.3 Pump resistance, K, should be calculated on the basis of a locked rotor.

2.4 The effects of the nitrogen gas in the safety injection tank which is discharged following water discharge, should be taken into account in calculating steam flow as a function of time.

2.5 The pressure drop in the steam generator should be calculated with the existing fluid conditions and associated loss coefficients.

2.6 The heat transfer coefficient for the fuel rod temperature calculations during reflood should be derived from FLECHT data.

In view of the necessity, from the standpoint of public health and safety of providing interim criteria for emergency core cooling systems applicable to all nuclear power reactors, the Commission has found that the amendments contained herein should be promulgated without delay, that notice of proposed issuance and prior public procedure are impracticable, and that good cause exists for making the amendments effective upon publication in the FEDERAL REGISTER. The Commission has issued a notice scheduling a public rule making hearing on the Interim Acceptance Criteria for Emergency Core Cooling Systems for Light Water Cooled Nuclear Power Reactors (36 F.R. 22774). The amendments herein will be considered at that hearing. Interested persons desiring to participate in that hearing should refer to that notice for the procedures available. Interested persons who desire to submit written comments or suggestions for consideration in connection with the amendments should send them to the Secretary of the Commission, U.S. Atomic Energy Commission, Washington, D.C. 20545, Attention Chief, Public Proceedings Branch, within 30 days after publication of this notice in the FEDERAL REGISTER. Copies of comments received may be examined at the Commission's Public Document Room, 1717 H Street NW., Washington, DC.

(Sec. 161, 68 Stat. 948, 80 Stat. 383, 81 Stat. 54; 42 U.S.C. 2201, 5 U.S.C. 552, 553)

Dated at Germantown, Md., this 16th day of December 1971.

For the Atomic Energy Commission.

F. T. HOBBS,
Acting Secretary of the Commission.

[FR Doc.71-18645 Filed 12-17-71;10:26 am]

CIVIL AERONAUTICS BOARD

[Docket No. 22628; Order 71-12-27]

INTERNATIONAL AIR TRANSPORT ASSOCIATION

Order Regarding Passenger Fares

Issued under delegated authority December 7, 1971. Agreement adopted by Traffic Conference 1 of the International Air Transport Association relating to passenger fares, Docket 22628, Agreement CAB 22824.

An agreement has been filed with the Board pursuant to section 412(a) of the Federal Aviation Act of 1958 (the Act) and Part 261 of the Board's economic regulations, between various air carriers, foreign air carriers, and other carriers, embodied in the resolutions of Traffic Conference 1 of the International Air Transport Association (IATA) and adopted by mail vote. The agreement has been assigned the above-designated CAB agreement number.

The agreement would amend an existing resolution governing economy-class fares within the Western Hemisphere by the inclusion of a specified fare reflecting new direct service between Mazatlan and Denver. The proposed fare is $91, one way.

Pursuant to authority duly delegated by the Board in the Board's regulations, 14 CFR 385.14, it is not found, on a tentative basis, that Resolution 100 (Mail 884) 061, which is incorporated in the above-designated agreement, is adverse to the public interest or in violation of the Act.

Accordingly, it is ordered, That:

Action on Agreement CAB 22824 be and hereby is deferred with a view toward eventual approval.

Persons entitled to petition the Board for review of this order, pursuant to the Board's regulations, 14 CFR 385.50, may, within 10 days after the date of service of this order, file such petitions in support of or in opposition to our proposed action herein.

This order will be published in the FEDERAL REGISTER.

[SEAL] PHYLLIS T. KAYLOR,
Acting Secretary.

[FR Doc.71-18547 Filed 12-17-71;8:49 am]

[Docket No. 18257]

SOUTHERN TIER COMPETITIVE NONSTOP INVESTIGATION (HOUSTON-MIAMI PHASE)

Notice of Prehearing Conference

Notice is hereby given that a prehearing conference in the above-entitled matter is assigned to be held on January 18,

[4] See footnote on page 24082.

SUPPLEMENT TO LICENSEE'S APPENDIX B

List of Exhibits

Exhibit Number	Description	Identified at Transcript Page	Admitted at Transcript Page
TMIA Mailgram Exh 20	TMIA Deposition of Julien Abramovici (Oct. 15, 1984) (Page 42 line 19 to page 50 line 13)	30,119	31,697 as TMIA Exh. 32H
TMIA Mailgram Exh 25	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	30,863 Enclosure 2 admitted only
TMIA Mailgram Exh 34	Testimony of David H. Gamble (Nov. 1, 1984)	31,415	Rejected at 31,415
TMIA Mailgram Exh 41	Reactor Building Pressure Strip Chart A (March 28, 1979)	31,606	31,666
TMIA Mailgram Exh 42	Reactor Building Pressure Strip Chart B (March 28, 1979)	31,612	31,666
Reactor Building Pressure Strip Chart (Original)	Licensee will keep custody and be required to produce upon appeal or in any court review. Anamolies between original and duplicates have not been resolved.	31,627	31,628

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.

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.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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

I hereby certify that a copy of the foregoing Three Mile Island Alert's Proposed Findings of Fact and Conclusions of Law on Dieckamp Mailgram Issue has been served this 8th day of February, 1985, by mailing a copy first-class, postage prepaid to the following:

Service List

*Administrative Judge
Ivan W. Smith, Chairman
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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

*Administrative Judge
Sheldon J. Wolfe
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

*Administrative Judge
Gustave A. Linenberger, Jr.
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Docketing and Service Section (3)
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Atomic Safety & Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Atomic Safety & Licensing Appeal Board Panel
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Lynne Bernabei

*Hand Delivered