SEP 10 1979

Mr. Vincent L. Johnson
Director, Technical Staff
President's Commission on the Accident at TMI
2100 M Street, N.W.
Washington, D.C. 20037

Dear Mr. Johnson:

Reference 1: Transcript of Closed Commission Meeting for Friday, March 30, 1979.

Reference 2: USNRC Office of Public Affairs Press Release dated March 30, 1979.

Reference 3: TMI-2 Event Tree Analysis for Core Melt Down and Recommended Evacuation Procedures dated April 1, 1979.

Your letter of July 23, 1979, requests the NRC's understanding of the public news media attention to the question of fuel melting and core meltdown, the hypothetical consequences of such a development, how it developed, and why it persisted so long following the accident at Three Mile Island, Unit 2.

It is difficult to pinpoint the primary mechanism(s) that caused this concern since the press was communicating with NRC personnel and industry personnel through many channels. It is possible that the initial public reaction to the TMI-2 accident results from an impression of assumed nuclear catastrophes involving the melt-down China syndrome sequence of postulated events. Although little credence is ascribed to this rapid, imminent, and unaltered scenario, it is a commonly held misconception which quite naturally could result in intense and persistent interest from members of the public.

Consideration of fuel melt started during the first days after the accident where evidence of severe core damage at the Three Mile Island, Unit 2, facility was inferred from high in-core thermocouple temperature readings and primary coolant sample analysis results. Also, a bubble of noncondensable gases had collected in the reactor vessel upper head which led to anxiety over the outcome of the event. One important operational objective was to reduce and finally eliminate the bubble. One method explored for eliminating these noncondensable gases include rapid depressurization of the reactor coolant system which involved the consideration of possible gas (bubble) expansion and initiation of low-pressure injection. Even though this course of action was not taken, we think that discussions of possible consequences of this sequence helped bring on the melt-down concern because expansion of the bubble in the reactor vessel could deter penetration of the water flow required to cool the core and result in a fuel melt. The potential for hydrogen explosion in the reactor vessel was also of concern until it was concluded that there was no significant oxygen being generated in the reactor coolant system by radiolysis. If an explosion were to occur, the

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POOR ORIGINAL

pressure vessel would likely not rupture (Reference 3), but the operation of valves and other components in the reactor coolant system could not be assured.

The above concerns were highlighted during the closed Commission meetings on Friday, March 30, 1979. The transcript of this meeting (Reference 1) shows that the possibility of core meltdown related to bubble expansion had been relayed to the news media by a press briefing. Subsequent misinterpretation of this information and related press releases appear to have caused the public alarm of a core meltdown. Following the March 30, 1979, Commission meetings, an NRC press release (Reference 2) was forwarded to the public media addressing the concern of core meltdown. The enclosed Reference 2 states there was no imminent danger of a core melt at the Three Mile Island Nuclear Plant.

With regard to the probability of a core melt and its hypothetical consequences, some staff work was done on March 30-31, 1979 (see enclosed Reference 3). Only relative probabilities (high, low, medium) were used to determine core meltdown assuming trip of the operating reactor coolant pump as the initiating event. The event tree focused more on the sequences which could lead to a core melt than the actual probabilities involved. Core cooling from natural circulation was not assumed in this event tree. The overall probability of a core melt appeared to be relatively low. Reference 3 also provides the sequence of major events following a postulated core meltdown. The fission product releases would be similar to those of the Reactor Safety Study (WASH-1400). Evacuation scenarios relating to other postulated events following the accident are also presented in Reference 3.

We have discussed this with Mr. William Stratton and understand that this information is responsive to your request.

Sincerely,

Original signed by,
E. G. Case

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosures:
1. USNRC Office of Public Affairs Press Release dated March 30, 1979
2. TMI-2 Event Tree Analysis for Core Meltdown and Recommended Evacuation Procedures dated April 1, 1979

Distribution Copies:
Docket No. 50-320
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SMiner
SNewberry
RMattson
WBesaw, DDC
MRogovin, Director
NRC/TMI Special Inquiry Grp.
Arlington Blvd.

TMI-2 Task Force | D/DSS
SNewberry | RMattson
8/ /79 | 9/4/79

per RJM changes included

9-10-79

OFFICE	TMI-2 Task Force	D/TMI-2	NRR ELD	NRR	NRR	PA
SURNAME	AIgnatonis,DSS/jm	RVollmer		ECase	HDenton	
DATE	8/16/79	8/20/79	8/21/79	9/4/79	9/7/79	9/2/79

Mr. Vincent L. Johnson
Director, Technical Staff
President's Commission on the Accident at TMI
2100 M Street, N.W.
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It is difficult to determine the exact mechanism(s) that caused this concern since the press was communicating with NRC personnel and industry personnel through many channels. Consideration of fuel melt started during the first days after the accident where evidence of severe core damage at the Three Mile Island, Unit 2, facility was inferred from high in-core thermocouple temperature readings and primary coolant sample analysis results. Also, a bubble of noncondensable gases had collected in the reactor vessel upper head. One important operational objective was to reduce and finally eliminate the bubble. One method explored for eliminating these noncondensable gases included rapid depressurization of the reactor coolant system which involved the consideration of possible gas (bubble) expansion and initiation of high-pressure injection. Even though this course of action was not taken, we think that discussions of possible consequences of this sequence brought on the meltdown concern because expansion of the bubble in the reactor vessel could deter penetration of the water flow required to cool the core and result in a fuel melt. The potential for hydrogen explosion in the reactor vessel was also of concern until it was concluded that there was no significant oxygen being generated in the reactor coolant system by radiolysis. If an explosion were to occur, the pressure vessel would likely not rupture (Reference 3), but the operation of valves and other components in the reactor coolant system could not be assured.

The above concerns were highlighted during the closed Commission meetings on Friday, March 30, 1979. The transcript of this meeting (Reference 1) shows that the possibility of core meltdown related to bubble expansion had been relayed to the news media by a press briefing. Subsequent misinterpretation of this information and related press releases appear to have caused the public alarm of a core meltdown. Following the March 30, 1979, Commission meetings, an NRC press release (Reference 2) was forwarded to the public media addressing

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To develop a complete response to your request regarding our understanding of why the public media's attention to core melt persisted for so long is difficult in the time frame available. More research of news accounts and many interviews would be necessary.

We have discussed this with Mr. William Stratton and understand that this information is responsive to your request.

Sincerely,

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosures:
1. USNRC Office of Public Affairs Press Release dated March 30, 1979
2. TMI-2 Event Tree Analysis for Core Melt Down and Recommended Evacuation Procedures dated April 1, 1979

cc: William Stratton

OFFICE						
SURNAME						
DATE						

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF PUBLIC AFFAIRS
WASHINGTON, D.C. 20555

No. 79-67
Tel. 492-7715

FOR IMMEDIATE RELEASE
(Friday, March 30, 1979)

NOTE TO EDITORS: The following was telephoned to the media at 6:30 p.m. EST on Friday, March 30.

The Chairman of the Nuclear Regulatory Commission Joseph M. Hendrie said this afternoon that there is no imminent danger of a core melt at the Three Mile Island Nuclear Plant.

Additional technical experts from the Commission staff headed by the Director of the Office of Nuclear Reactor Regulation Mr. Harold Denton reached the site early this afternoon. At the direction of the President, they have been provided with augmented communication facilities. The NRC team at the site is working closely with the utility personnel and experts from other federal agencies and the State of Pennsylvania. Close contact is being maintained with Governor Thornburgh.

Efforts to reduce the temperatures of the reactor fuel are continuing. These temperatures have been coming down slowly and the final depressurization of the reactor vessel has been delayed. There is evidence of severe damage to the nuclear fuel. Samples of primary coolant containing high-levels of radioiodine and instruments in the core indicate high fuel temperatures in some of the fuel bundles, and the presence of a large bubble of non-condensible gases in the top of the reactor vessel.

Because of these non-condensible gases, the possibility exists of interupting primary coolant flow within the reactor should the pressure be further decreased and the contained gases allowed to expand. In the unlikely event that this were to occur some of the fuel would fail to cool and further damage to that fuel could occur. Several options to reach a final safe state for the fuel are under consideration. In the meantime, the reactor is being maintained in a stable condition.

There have been intermittent releases of radioactivity into the atmosphere from the primary coolant system. The licensee is attempting to stop the intermittent gaseous releases by transferring the radioactive coolant water into the primary containment building. The levels of radioactivity being measured have been as high as 20 to 25 millirem per hour in the immediate vicinity of the site at ground level. Off-site levels were a few millirem per hour.

#

Confirm receipt at site with Gossick or Cas

NRC PROCEDURES FOR DECISION TO RECOMMEND EVACUATION

Who Decides

1. Combination of consequences and times require immediate initiation of evacuation: Senior NRC Official on site recommends to Governor.

2. Unplanned event with substantial risk takes place or is imminent or situation judged excessively risky but there is time for consultation. Senior NRC Official notifies Governor and NRC HQ. Chairman makes recommendation to Governor after consulting with Commissioners if possible.

3. Planned event involving significant additional risk. Chairman and Commissioners makes recommendation.

Chmn. Hendrie

H. Denton –

Van (Site)

Rcvd on site by Chmn 1625 hrs. April 1, 79

Unplanned Events

EVENT	EXPECTED PLANT RESPONSE	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO
1. Loss of vital function or unplanned leaks.	Restore function within 1 hour	No significant change		Possible precautionary evac 2 mi; stay inside 5 mi
Examples Reactor Coolant Pump Trip;	Switch to Alternate Function involving Primary Coolant in Auxiliary Building	Small leak less than 1 gal/hour		possible precautionary evac 2 mi; stay inside 5 mi
Loss of offsite power;		Large leak 50 gal/min	2 hour	Evac 2 miles Stay Inside 5 miles
Loss of feedwater; Depressurization to go on RHR; Leak in Auxiliary Building	Serious possibility of failure to restore a vital function See 2			

These tables include a number of assumptions about activity and weather, chosen realistically — conservative. In an actual release, the release rate and weather should be evaluated as they are at the time, and the decision based on those values.

(2)

	EVENT	EXPECTED PLANT RESPONSE	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO
2.	Sequence leading to Core Melt	Maintain Containment Integrity (likely) with Containment Cooling	Design Containment Leak Rate	4 hour	Precautionary Evac 2 mi all around and 5 mi, 90° sector stay inside 10 mi
		Containment expected to Breach	Significant release of core fission products	24 hour (time for containment failure)	Evac 5 mi all around and 10 mile, 90° sector, stay inside 15 mi
3.	Hydrogen flame or explosion possible inside reactor vessel	Mixture in flammable range			Precautionary 2 mi (?) + 5 mi 90° sector 10 mi stay inside
		Explosion; major damage Core Melt See 2			
4.	Evacuate or Lose Control Room	Loss of Control Treat like major release			Precautionary (?) 2 mi Evac 5 mi all around and 10 mi 90° sector, stay inside 15 miles

W

EVENT	EXPECTED PLANT RESPONSE	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO
Planned Manuever	Probability of losing vital function	See releases under loss of vital function	Timing of maneuver can be set to provide as much time as necessary	Precautionary evacuation 2 miles, stay inside 5 miles PLUS See outcomes under loss of vital function.

Action Guidelines

a. Notify evacuation authorities two hours in advance (if possible) to standby for a possible evacuation.

b. Projected doses of 1 rem whole body or 5 rems thyroid stay inside.

c. Projected doses of 5 rems whole body or 25 rems thyroid mandatory evacuation of all persons.

Assumes general warning already that some form of evacuation may become necessary.

Weather

The table is based on a realistic prediction of the weather for the next few days, based on the April 1 forecast which would result in high doses at a given distance. At the approach to decision time for evacuation, the appropriate meterological condition will be factored into the dose estimates to determine the evacuation time, sectors, and distances for the evacuation.

NRC is predicting the dispersion characteristics of the region for the currently measured meteorology as the incident progresses. Rain could lead to higher local radioactivity levels.

Heat Generation

The reactor core is now quite cool compared to the conventional design-basis calculations.

1. The reactor is new, so no fuel has more than 3 months equivalent operation, compared to 1-2 years average for other plants.

2. The neutron chain reaction has been shut down for over 4 days.

It should also be noted that the concrete basemat of this plant is unusually thick.

As a result of the above differences, calculations for this plant at this time predict that the core will not melt its way through the containment.

MAJOR EVENTS AND TIMING IN EVENT OF CORE MELTDOWN

Event 1 - Sprays and Coolers Operative

Time=0 Flow stops, core and water start heat-up

Time=100 min Core starts to uncover

Time=150 min Core begins to melt

Time=200 min Molten core is in lower head of reactor vessel, pressure is 2500 psia

Time=210 min Reactor vessel fails, containment pressure goes to 25 psia

Time=210 min Hydrogen burns, containment pressure goes to 67 psia
Steam explosion possibility - minor consequence

<u>CONTAINMENT SURVIVES</u> (Failure assumed 130 psia)

Time=10 hours Molten core has melted about 1 meter into basemat

Time=days Major problem - handle hydrogen, oxygen - maintain containment integrity

CAUTION:
- Keep sprays running
- Keep water many feet over molten debris
- WITHOUT RECOMBINERS Hydrogen continues to build up

<u>BASEMAT SURVIVES</u>

Event 1 Conclusion: This event should not produce major releases

Event 2 - Sprays and Coolers Failed Before Flow Stops

Time=0 to Time=210 min Same as Event 1 - containment pressure is 25 psia

Time=810 min Containment pressure is 70 psia

Time=1 day Containment fails due to steam (mostly) overpressure - about 135 psia

<u>CONTAINMENT FAILS</u>

Event 2 Conclusion: This event leads to major releases.

APR 1 1979

This table includes a number of assumptions ab ut activity and weather. These assumptions have been chosen conservativ y. In an actual release, the release rate and weather should be evaluated as they are at the time, and the decision based on those values.

Event - Spontaneous failure or decision to perform a potentially risky maneuver Find out what actually happened and what is functioning. Predict what could result - different likelihoods Predict release rate	In tables
Determine present weather and forecast	Assumed constant in table
Dose Prediction	In table
Action Guidelines	Per Appendix 7

	EVENT	EXPECTED PLANT RESPONSE (RANGE?)	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO	WHO DECIDES
1.	Loss of vital function or decision to perform a potentially risky maneuver. Examples 1. Reactor Coolant Pump Trip. 2. Leak in Aux Building. 3. Loss of off-site power 4. Loss of feed water 5. Depressurization to go on RHR.	Restore Function Within 1 hour	No significant change		None*	
		Switch to Alternate Function involving Pri Coolant in Aux Building	Small leak less than 1 gal/hour		None*	
			Large leak in Aux Building 50 gal/min	2 hour	Evac 2 miles Stay Inside 5 min	
		Failure to restore vital function	Core melt; see item 2 below & Appendix 1			

*For sufficiently risky maneuver, do precautionary evac 2 mi and stay inside 5 mi; whether to do this or not depends on details of maneuver and plant situation.

	EVENT	EXPECTED PLANT RESPONSE (RANGE?)	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO	WHO DECIDES
2.	Core Melt	Maintain Containment Integrity (likely) with Containment Cooling	Tech Spec Containment Leak Rate	4 hour	Precautionary Evac 2 mi all around and 5 mi sector; stay inside 10 mi	
		Containment Beached	Reactor Safety Study Categories PWR 4 - See Appendix 1	24 hour	Evac 5 mi all around and 10 mi sector, stay inside 15 mi	
3.	Hydrogen Explosion Inside Reactor Vessel	No significart change in reactor or primary system	No significant change		None	
		Core Crushed (unlikely)	Core melt See Item 2 & Appendix 1			

APPENDIX 1 MAJOR SEQUENCES OF EVENTS

Major sequences evaluated here are tied to the loss of forced circulation in the RCS. The loss of flow from the reactor coolant pump (RCP) is the generalized initiating event from which other initiating events such as loss of offsite power can develop.

APPENDIX 1.a SEQUENCES OF POSSIBLE SYSTEMS FAILURES

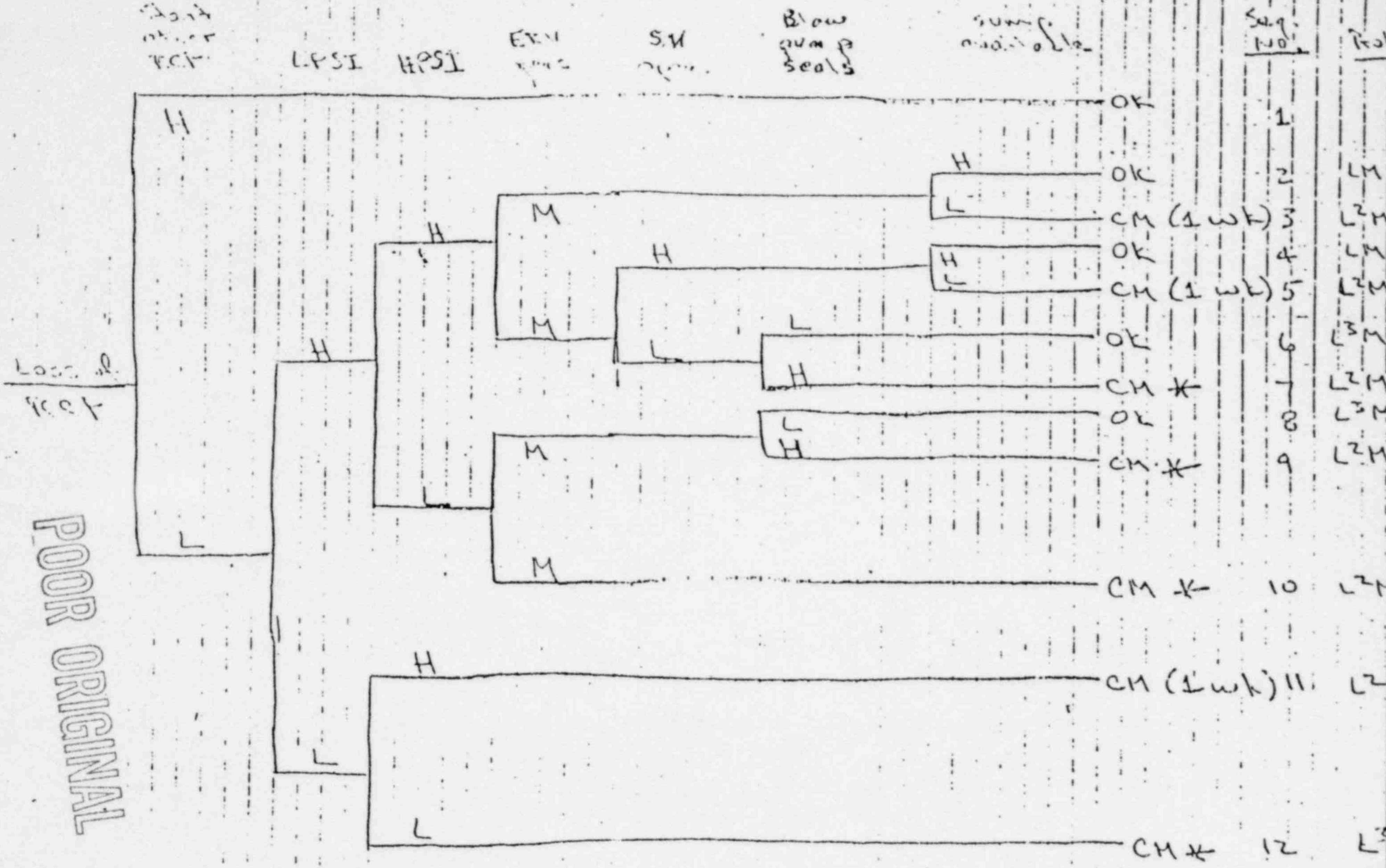
Figure 1.b-1 shows the loss of RCP event tree. This tree shows the various options available given the loss of the RCP, and indicates which combinations of events or failures would lead to core meltdown (CM). The sequences denoted with an asterisk are those which would be expected to follow the core meltdown progression discussed below, leading to the variety of atmospheric radioactive releases and consequences discussed later. Some core meltdowns could be expected to be delayed for roughly a week because of the availability of ECC injection over that period. This method of core cooling, however, is not expected to be adequate to prevent core melt; as such a core meltdown is assessed to occur at roughly a week. A rough measure of relative probabilities of the various outcomes is indicated by the notation of L, M, H (low, medium, high). The column on the right-hand side of the page indicates the relative probabilities of the sequences, with "LM" as the highest probability and L^3M as the lowest.

Murphy – Eisenhut
Ishack
Geleso
Davis

Opinion
most likely outcome right now
Judy

Fig. 1.3-1

Loss of Reactor Coolant Pump



APPENDIX 1.b

MAJOR EVENTS AND TIMING IN EVENT OF CORE MELTDOWN

Event 1 - Sprays and Coolers Operative

Time=0 Flow stops, core and water start heat-up

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Time=210 min Reactor vessel fails, containment pressure goes to 25 psia

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Time=10 hours Molten core has melted about 1 meter into basemat

Time=days Major problem - handle hydrogen, oxygen - maintain containment integrity

CAUTION:
- Keep sprays running
- Keep water many feet over molten debris
- WITHOUT RECOMBINERS Hydrogen continues to build up

<u>BASEMAT SURVIVES</u>

Event 1 Conclusion: This event should not produce major releases

Event 2 - Sprays and Coolers Failed Before Flow Stops

Time=0 to Time=210 min Same as Event 1 - containment pressure is 25 psia

Time=810 min Containment pressure is 70 psia

Time=1 day Containment fails due to steam (mostly) overpressure - about 135 psia

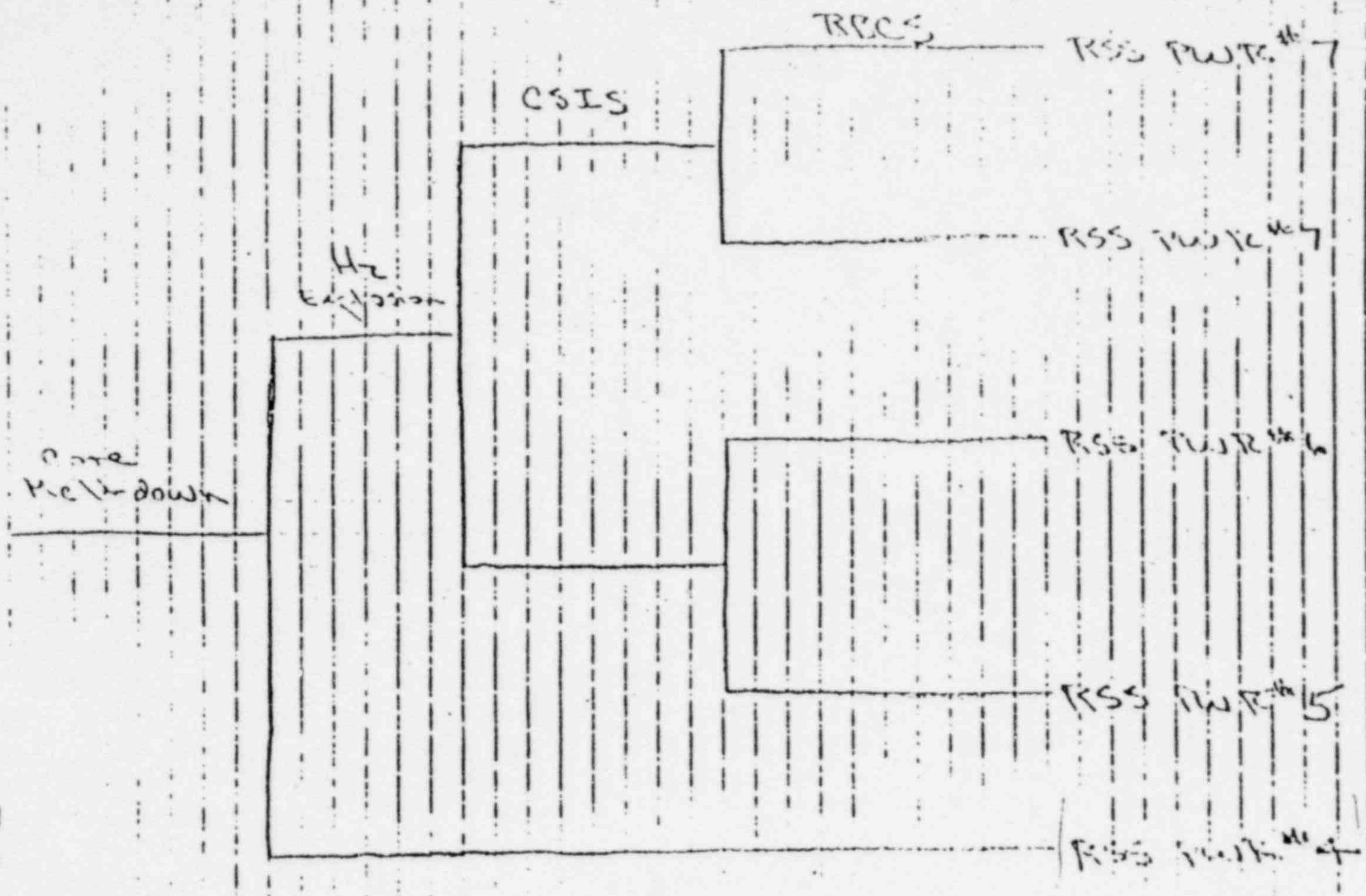
<u>CONTAINMENT FAILS</u>

Event 2 Conclusion: This event leads to major releases.

The event tree for core melt leading to various releases is shown in Figure 1.b.

The following are essential in the event of core melt.

1. Sprays and coolers are required to prevent major releases.
2. Hydrogen must be recombined or otherwise removed from containment.



Core Meltdown
H_2 Explosion
CSIS
RECS
RSS PWR #7
RSS PWR #4
RSS PWR #6
RSS PWR #5
RSS PWR #4

FIGURE 1.b

1c. Large Leak in Auxiliary Building (AB)

The activity level in the reactor coolant is so high that substantial releases can come from small amounts spilled in the AB which requires once through ventilation. A leak of 5 gpm to the AB atmosphere is assumed for the expected level of leakage. A leak of 50 gpm is taken as a large leak to consider a major leak in pump shaft sealing or some similar mishap. Based on the leakage experienced already only the noble gases and no iodine are assumed to evolve. The AB ventilation exhaust is assumed to flow through the charcoal filters.

1d. Hydrogen Explosion in Reactor Pressure Vessel

A detonation of the hydrogen oxygen bubble in the reactor vessel could rupture the vessel and/or crush the core. Rough analysis indicates that the pressure vessel would not rupture. Postulation of the core response is difficult. If the core is crushed, it could effectively prevent core cooling leading directly to the core melt sequence described earlier. It is unlikely that compression would lead to criticality.

Action Alternatives	Evacuation	Stay Inside
1.		2 miles
2.	2 miles	5 miles
3.	2 miles all around 5 miles 90° sector	10 miles
4.	5 miles all around 10 miles 90° sector	15 miles

a. All sector choices governed by wind direction. If shifting, more than one quadrant may be affected.

b. These are initial values; as the release continues measurements may indicate the need for reconsideration of action up to 20 miles.

6. Weather

The table is based on F stability and 1 m/sec wind speed, in view of the April 1-3 forecast. At the approach to decision time for evacuation, the appropriate met. condition will be factored into the dose equations to determine the evacuation time, sectors, and distances for the evacuation.

NRC is predicting X/Q for current meteorology as the incident progresses.

7. Action Guidelines

a. Notify evacuation authorities two hours in advance to standby for a possible evacuation.

b. Predicted doses of 1R whole body or 5R thyroid in 8 hours - mandatory evacuation of children and pregnant women.

c. Predicted doses of 5R whole body or 25R thyroid in 8 hours - mandatory evacuation of all persons.

Assumes general warning already that some form of evacuation may become necessary.

FROM:	ACTION CONTROL	DATES	CONTROL NO.
President's Commission on the Accident at TMI Vincent L. Johnson	COMPL DEADLINE	8/15/79	06933
	ACKNOWLEDGMENT		DATE OF DOCUMENT 7/23/79
	INTERIM REPLY		
TO: Thomas Rehm	FINAL REPLY		PREPARE FOR SIGNATURE OF: ☐ CHAIRMAN ☐ EXECUTIVE DIRECTOR
	FILE LOCATION		OTHER: Denton

DESCRIPTION ☐ LETTER ☐ MEMO ☐ REPORT ☐ OTHER

Req NRC's understanding of how news coverage of the question of fuel melting, core meltdown & xxx hypothetical consequances developed & why it persisted so long

SPECIAL INSTRUCTIONS OR REMARKS

Let the time frame of the suspense dictate the detail of the response

TR

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