UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

June 6, 1979

The Honorable Morris K. Udall, Chairman
Subcommittee on Energy and the Environment
Committee on Interior and Insular Affairs
United States House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

Attached is a copy of Chairman Hendrie's response to your questions of May 21 concerning Three Mile Island.

Sincerely,

Carlton Kammerer, Director
Office of Congressional Affairs

Enclosure:
As stated

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1-1 QUESTION 1

Are you inquiring into why Mr. Michelson's analysis was not acted upon by Babcock & Wilcox? What have you determined regarding the circumstances surrounding NRC staff being given the Michelson analysis and the staff's response thereto?

ANSWER 1

Yes we are looking into the matter of Mr. Michelson's analysis and the actions of TVA, B&W, and the NRC, both from the standpoint of our Part 21 regulations on the requirements for making safety-related information known to NRC and as part of the NRC's Three Mile Island investigation.

Until I was informed at the May 21st hearing (by Dr. Mattson) that an NRC staff member had received a handwritten version of the Michelson analysis over a year ago from an ACRS member, I had thought that NRC's first knowledge of it was after TMI, from Mr. Michelson himself. These matters are all under investigation.

1-2 QUESTION 2

Could you explain to us what was done to make sure that the Three Mile Island management was informed fully of the incidents at other B&W plants?

ANSWER 2

TMI management, like all licensees, receive copies of Licensee Event Report summaries and regular "current events" reports prepared by the NRC staff. The pertinent B&W reactor events, notably the Davis-Besse and Rancho Seco events would have been covered in those reports.

1-3 & 1-4 QUESTIONS 3 AND 4

Do you know whether the TMI management was ever explicitly warned that water in the pressurizer was an indication of a full pressure vessel only under conditions where the temperature was below the boiling point everywhere in the primary but the pressurizer itself?

Were operators instructed as to when they should believe that the pressurizer water level was indeed indicative of a full primary system?

ANS AND 4

I do not know if TMI management was warned of the possibility that the pressurizer level might not correctly reflect the water level in the reactor vessel, nor do I know if the operators at TMI were properly instructed about this matter.

(Q. 1-5) QUESTION 5

Were operators at TMI and elsewhere trained as to how to deal with situations where steam bubbles might develop at the top of the pressure vessel or at the top of the primary side of the steam generators?

ANSWER 5

I do not know if the TMI operators, or other operators, were trained to deal with steam bubble formation in the primary system.

(Q. 1-6) QUESTION 6

Could you explain to us why there never has been a requirement for devices that would provide a direct measurement of water level in the pressure vessel?

ANSWER 6

I agree with Commissioner Gilinsky that there is not a satisfactory explanation, other than that the pressurizer level indication was thought to be sufficient, and that the pressurizer tank is easier to instrument for level indication than the heavily shielded reactor vessel in PWR's.

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2-1 & 2-2 QUESTION 1 AND 2

What briefly is the status of your inquiry? What is the status of transcription of tapes of telephone conversations at the incident response center? When did transcription of these tapes begin? When will it be completed?

ANSWER 1 AND 2

I agree with Commissioner Gilinsky's answers to both questions.

2-3 QUESTION 3

Have you appointed a permanent director? If not, when will this be done?

ANSWER 3

A permanent director has not yet been appointed. We will appoint a permanent director as soon as possible. In the meantime, the investigation is going on under Dr. Cornell.

2-4, 2-5, 2-6 QUESTIONS 4, 5, AND 6

Is your inquiry seeking to determine why the Commission did not receive on the first day information indicating that there was a hydrogen fire explosion some 9 hours and 50 minutes after the turbine trip?

Will the inquiry seek to determine why Babcock & Wilcox did not notify its customers of Michelson's analysis indicating that there might be problems in the event of small break loss of coolant accidents? Will the inquiry seek to determine whether the B&W reactor operators had been sufficiently well-informed of significance and implications of the transients at Rancho Seco and Davis Besse?

ANSWERS 4., 5., AND 6

The answer is yes to all three questions. These are all important questions in our investigation.

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3-1 QUESTION 1

Do you believe a significant cause of the core damage was the fact that the auxiliary feed water valves were closed (apparently in violation of NRC technical specifications) during the first 8 minutes following the generator trip?

ANSWER 1

No, not from what I know at present of the accident sequence. The auxiliary feedwater valves were apparently opened soon enough (at the 8-minute point) so that there should have been no core damage if the operators had recognized that the pressurizer relief valve was stuck open and had immediately closed the block valve in the relief line. Even failing that recognition, it appears at present that there would have been a much reduced level of core damage, or no damage, if the operators had left the high pressure injection system in operation to keep the primary system pressure above the saturation point. A determination on these current views, of course, must await of the investigation.

QUESTION 1a.

Do you believe that if the auxiliary feed water valves had been opened when the trip occurred, and that the pressurizer relief valve had stuck in the open positon, that things might have been worse? [There is a theory that if the valves had been opened the primary system would have contracted, thereby emptying the pressurizer, which might have made things worse.]

ANSWER 1a.

No, I don't believe so, on the basis of what I know now of the accident sequence. With the auxiliary feedwater valves open, as they should have been, there would have been increased energy transfer to the secondary system and, as the question notes, a more rapid contraction in the primary water volume due to a more rapid primary water temperature decrease. This would presumably have triggered the high pressure injection system at an earlier time. If the primary water contraction had emptied the pressurizer, the operators would probably have let the HPI system run long enough to recover the level indication, as they did in the actual case. Again, operator action to close the block valve in the pressurizer relief line would have saved the situation, or failing this, leaving the HPI on would have at least much reduced the core damage. As before, I would note that a final determination on this question will come out of the investigation.

3-2 QUESTION 2

Do you believe that the operators had adequate reason to believe that the pressurizer relief valve was stuck open? That is, given the information available to the operators, do you believe they should have known the valve was open earlier than they did find this to be the case? Please explain.

ANSWER 2

Yes, as I currently understand the accident sequence and the instrument readings that were available, I believe that the primary system pressure readings should have indicated to the operators that there was an opening in the primary system and a loss of water going on. Further, the quench tank conditions (the open relief valve vented to this tank) should have confirmed that the valve was open. There were also temperature readings from the relief valve tail pipe, although I am not sure how unambiguous these were. These comments are made with the caveat that I have not examined the control room instruments, nor have I examined the instrument records. All of these points will be covered in detail in the investigation.

3-3 QUESTION 3

Are you aware that one reason given for the operators having shut down the reactor coolant pumps was their concern that the pumps might thereby be damaged to the point where they could no longer be used? Do you believe this was an appropriate action given the information then available to the operators?

ANSWER 3

Yes, I am aware of that reason being given for shutting down the main coolant pumps. I do not yet have enough detailed information from the investigation to judge whether it was an appropriate action at the time.

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4-1 QUESTION 1

When did you become aware that there were voids in the primary cooling system?

ANSWER 1

Friday morning (March 30th) I had discussions with the staff about their conclusions that there was substantial core damage, that there had been a large metal-water reaction, and that some of the hydrogen from that reaction was still in the primary system in one or more bubbles. This was my first knowledge of what turned out to be the actual core condition. I do not recall discussing steam bubbles (voids) earlier than March 30th, although steam voids in hot portions of the primary system were obviously one possible explanation for the large hot leg - cold leg temperature differences that I recall being reported before March 30th.

4-2 QUESTION 2

When did you become aware that on the morning of March 28, probably between 7 and 8 a.m., Mr. Miller had directed that thermocouple measurements be made on the wires coming out of the reactor?

When did you become aware that temperatures in excess of 2000 degrees may have been measured on March 28?

What would a measurement of 2400 degrees have meant to you?

ANSWER 2

On March 30th, during discussions with the staff in the morning, I recall being told that there had been some attempts to get temperature readings from several of the in-core thermocouples sometime earlier. I do not recall dates or times for these measurements, which had to be made by potentiometer readings on the thermocouple leads. I recall the results as being mixed -- that is, one or more high readings and some low ones. I do not recall the high temperatures, except that they were well above the normal recording range of the normally-connected readouts. By this time, March 30th, the staff was pretty well convinced that the thermocouples were reading correctly and there had been very high temperatures at the thermocouple locations, as contrasted to an early

view that the off-scale readings of the thermocouples reflected a failure in this non-safety grade set of instruments. A temperature of 2400°F at one of these locations would have indicated to me substantial overheating and damage in the core.

4-3 QUESTION 3

How did you interpret the fact that there was a substantial difference in temperature between hot and cold legs during the first day?

ANSWER 3

I can recall asking about the hot leg and cold leg temperatures, but am not sure it was on March 28th. I was at Washington Hospital Center that day, with a daughter who was having surgery. I called my office and the NRC Response Center periodically for reports on TMI, and it may have been during one of those calls that I asked about the hot leg - cold leg temperatures. The answer was that there was a large temperature difference, but the information seemed to be uncertain -- that is, not clearly established at that time. I could not tell if the temperature difference was the result of an incorrect report, instrument difficulties, or reflected steaming in the core and voided hot legs. The staff briefing of the Commission on the morning of March 29th did not, to my recollection, mention the hot leg - cold leg temperatures.

4-4 QUESTION 4

On March 28, did you suspect based on the information provided you that day, that the core might have been uncovered?

ANSWER 4

No, although the release of some fission product activity to the primary coolant (and subsequent external releases) indicated to me that there had been some fuel rod cladding cracks. These could have resulted from large and abrupt temperature changes in the coolant. This seemed the most likely explanation for the activity in view of the overall conditions at the plant as reported on March 28th and at the Commission briefing on the 29th.

4-5 QUESTION 5

If you had seen the pressure spike at the same time you opened the pressurizer valve, and that this pressure spike was accompanied by turning on of the containment sprays, indication of high temperature at the reactor coolant pump inlet, a thump heard by some people, what would you have made of all this?

ANSWER 5

The containment pressure spike had to be due to either hydrogen burning or electrical instrument malfunction. The only other thing that would give a high-scale reading would be a sizeable loss of coolant accident, which would pressurize the containment but would not give a "spike" indication -- the pressure would stay high. The containment spray actuation is on high containment pressure and is thus not an independent event, but follows from the pressure indication. The pump air inlet temperatures would have been confirming indications of hydrogen burning or a steam-filled containment. I don't know whether the "thump" was apparent to people in the control room.

I would have been concerned that the spike was due to hydrogen burning, but really cannot tell whether I would have concluded it was that or was due to crossed electrical circuits as the operators did. I understand the operators were in respirators at that point and busy with assorted other operations. It is really impossible to know which conclusion I would have drawn.

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5-1 QUESTION 1

When did you first become aware that people in the control room knew of the pressure spike in the containment at the time it occurred?

ANSWER 1

Commissioner Gilinsky informed me of this fact upon his return from the tour with the Subcommittee on May 7th.

5-2 QUESTION 2

We have a statement indicating that somewhere between five and ten people in the control room were aware of the pressure spike and some or all of the phenomena which occurred immediately following venting of pressurizer in the containment These events include initiation of containment sprays, triggering of high temperature alarms at the air inlets for two of the reactor coolant pumps, and detection of high temperature in the pressurizer discharge pipe.

Would you care to speculate as to why this event seems not to have been considered sufficiently important for you to have been informed about it?

ANSWER 2

I just don't know why NRC was not informed earlier, and look to the investigation to develop the reasons.

5-3 QUESTION 3

Would you yourself have considered these events significant?

ANSWER 3

Yes. (Please see my answer to Question 5, Page 4.)

5-4 QUESTION 4

Would the fact of a hydrogen explosion suggest the possibility of deformations in the core that might block flow of cooling water?

ANSWER 4

Yes, clearly. A flammable hydrogen concentration in the containment could only have resulted from substantial zirconium-water reaction, and that would have meant core overheating and substantial damage to fuel cladding that could cause flow blockage.

5-5 QUESTION 5

Would it not be important that you know of such deformation in order that you could develop appropriate plans for dealing with the situation?

ANSWER 5

Yes, very important: lack of this knowledge at the time it occurred delayed our understanding of the actual condition of the reactor for almost two days.

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6-1 QUESTION 1

How close do you believe we came to having a core meltdown?

ANSWER 1

I cannot tell at this point. It was a possibility, but I think considerable analysis will have to be done to make a reasonable estimate as to how close it was.

6-2 QUESTION 2

What would have happened if the pressurizer heater power supply had failed on that first day? Are you aware of any intermittent failings during the first few days of part or all of the pressurizer heater power supply?

ANSWER 2

The primary system would have had to be brought "solid" and system pressure maintained with the high pressure injection pumps. This is a feasible mode of maintaining system inventory and pressure. If it had been used early and the pressure kept above about 1600 psig, there probably would have been much less core damage.

There were several intermittent power failures on the various pressurizer heater groups during the first day, at least. These were probably due to moisture in the containment atmosphere causing electrical trips.

6-3 QUESTION 3

What could have caused the pressurizer heater power supply to fail?

ANSWER 3

As noted above, excessive moisture from steam in the containment atmosphere was a probable cause of some of the heater groups tripping out intermittently. Other conditions that could have caused heater failure are power loss from all off-site electrical supplies, damage to the electrical connections from the hydrogen burning, and burning out of the heaters if the pressurizer had emptied with the heaters remaining energized.

6-4 QUESTION 4

Are there back-up power supply systems for the pressurizer heater power supply?

ANSWER 4

There are back-up supplies in the sense that any off-site supply could be connected to the heater groups. However, the heaters were not connected to the emergency diesel generators at the time of the accident.

6-5 QUESTION 5

Were you concerned that the environment in the reactor building might become such (either because of high water levels, humidity, or radiation damage) that you would lose vital equipment or instruments? Please explain.

ANSWER 5

Yes. Much of the instrumentation and electrical equipment inside containment that was being used to cool the core and monitor reactor and containment conditions was not designed to operate for extended periods in the very high radiation field that was present. There was concern that insulating materials in these components would deteriorate in the radiation field and cause failures of the equipment and instruments. Moisture was of less, but still some concern. Later, with the continued accumulation of water in the base of the containment, there was concern that some instrument components, and some pump motors and valve operators mounted low in the containment might be submerged and rendered inoperable.