Studies of Nuclear Hazards and Constitutional Law

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18
~~15~~ January 2006

Dr. Carl J. Paperiello,
Mr. Jim Wiggins, and
Mr. Norm Lauben, Ralph Myer,
Steve Borjack,Den Boglewebe, and
Harold Scott
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Rockville, Md.
by telefax, 301-415-5153

Dear Gentlemen:

Subject: Second Postscript for Notes of Tele-conference 9 January 2006 -- Three Mile Island Reactor Accident:

The Significance of the large Temperature Difference between the inlet and outlet Reactor Coolant of the TMI-2 Reactor at 18 Hours into the Accident; and

the Inadequacies of the Post-Accident Reactor Examination and the official Analysis of what happened in the Accident.

The Large Temperature Difference

In the Conference of January 9th, I also mentioned the anomaly of the indicated large temperature different of about 55 degrees Fahrenheit between the hot-leg temperature and the cold leg temperature (measured near the suction of the coolant circulation pump that was running (1A) at 18 hours into the accident, as plotted in the graph of Plot of System Parameters of the Rogovin report -- the color plots. The Rogovin Report, Vol. II, Part 2, page 693, give a value of the coolant flow of 28 million pounds per hour through the reactor ("reactor coolant flow"), which is roughly one fourth of the design reactor flow of 138 lbs./hr with four pumps running (138/4=34.5). Assuming 28 million lbs/hr and a heat capacity of water at 1 cal/gm/Oc, and a decay heat rate of 12.9 MW, as is stated in the Rogovin report (same page), then the delta-T would be 1.6 deg F; not 55 degrees as indicated in the Plot of System Parameters. The calculation is as follows:

$$P = W \times C \times \Delta T \text{; hence}$$

$$\Delta T = \frac{P}{W \times C}$$

$$= \frac{12.9 \cdot 10^6 \text{ joules/sec}}{4.186 \times 28 \cdot 10^6 \times 453.6/3600}$$

$$= 0.87\,^\circ\text{C} \times 9/5 = 1.6\,^\circ\text{F} \neq 55\,^\circ\text{F} \ .$$

The director of the Pennsylvania Bureau of Radiation Protection at the time of the TMI accident, Thomas Gerusky, told me in a phone discussion in Harrisburg in 1999 that the NRC officers assured him on the evening of the accident that the incident is "not serious." Assuming that the NRC engineers (as well as the GPU and B&W engineers had this data on the cold leg and hot leg temperatures, should that have signified to them that the reactor is in a wholly abnormal condition with respect to the thermal/hydraulics?

Moreover, the temperatures do not make a sense, unless there was a hole in the core barrel. From the *Plot of System Parameters* I measured the following temperature values at 18 hours into the TMI-2 accident:

Location in Reactor Coolant System	Status of Pump	Temperature °F
Hot Leg, B Loop	—	325
Hot Leg, A Loop	—	325
Cold Leg, A Loop, Pump 1 Inlet	running	270
Cold Leg, A Loop, Pump 2 Inlet	shutdown	330
Cold Leg, B Loop (unspecified as to which pump)	both pumps shutdown	250

The A-Loop cold legs drew their water from the plenum of the A-Loop Steam Generator, and yet the temperature of the 2A leg is higher, and much higher, than the leg 1A. I assume that there is a back flow through the 2A pump, since it was not running. So, I think that there must have been a hole in the core barrel such that the coolant flow that went up into the core, coming from the discharge of the 1A pump that was running, divided into two branches: one branch flowed up and out of the core, being heated in the process, to explain the 325 °F hot leg temperatures; while the other branch exited the postulated hole, to enter the inlet nozzle for the 2A leg. The 2nd branch of core flow formed a part of the back flow through the 2A pump. Having flowed through much of the core region, that back flow was heated by the core decay heat. The Rogovin Report, page 490, gives a schematic drawing of the TMI-2 reactor coolant system, and that shows that the reactor vessel inlet nozzle from the 2A cold leg is almost diametrically opposite from

the inlet nozzle of the 1A cold leg; and indeed, the drawing of the "end-state configuration" of the TMI reactor core and vessel internals given in the August 1989 Nuclear Technology article on "A Scenario ..." by Broughton and others, reprinted in Nuclear Safety, Vol. 35, No. 2, shows a hold in the "baffle plate" at the 2B inlet nozzle side of the vessel; though no hold through the core barrel. Perhaps the flows were very circuitous in the core region, due to a possible massive destruction by then. (This analysis goes further to prove the necessity of leaving a main coolant pump running, and not switch it off.)

I offer a sketch of my idea of a hold in the core barrel; but it represents also a more circuitous path through the core region to the inlet nozzle of 2A. By the way, I assume that the electrical power to the running coolant pump was 6.7 MW, which is about half of the core decay heat; and the rise in temperature of the coolant due to that electric power would be about 0.5 degrees Fahrenheit, if the flow were 28 million pounds per hour, which I doubt. I am wondering what basis the Rogovin commission asserted that flow value?

So, something is not explained about the temperatures. I do not recall any analysis in the official TMI reports of what could explain those temperatures values given in the Plot of System Parameters.

I offer the above analysis, since I raised the question in the conference. I think Norm Lauben asserted the assumption has been that the high delta-T of 55 degrees F was due to "flow blockage," as he called it. That statement seems to contradict the Rogovin report's value of the reactor coolant flow of 28 million lbs/hr. A flow blockage would certainly be serious — indicative that the TMI-2 mishap as of its state in the evening of the 28th was indeed serious, contrary to what Gerusky alleged as what the NRC assured him that evening, to wit, that the mishap is not serious. I think the temperature data compiled above ought to have signalled the NRC engineers that the reactor was not under control in the evening of the 28th.

Has these data ever been analyzed for their significance? This is another question that I posed in the conference. I recommend that your office investigate this matter among the others matters which I raised in the conference and my letters. Naturally, I would like to be informed of the results of whatever analysis you might make.

Post-Accident Reactor Examination and Analysis

In the conference, and in my follow-on letters, I mentioned the fact that the EG&G laboratory in Idaho, who was contracted by the DOE, NRC, and GPU, jointly, to analyze the recorded data of the TMI-2 reactor accident and the findings of the post-accident inspection of the TMI-2 reactor internals, did not look at the data for the time period beyond the first sixteen hours of the accident. I ought to mentioned an important fact that relates to that fact.

When I was participating in a British Court of Inquiry in 1988-1989 that was held to investigate the British Government's plan to construct additional PWR reactors — a modified Westinghouse design — I telephoned the EG&G, sometime prior to March 16, 1989 (the day of my testimony), and probably in February, or maybe January 1989, to inquire into what they have discovered so far about the end-state of the reactor, and what analyses they have made to figure out what happened, how much of the core material melted, its re-distribution, and any strong fuel-coolant interactions, and other like questions. I made two phone calls, a day apart.

In the first call I conferred with D. Golden of EG&G, who was very helpful and cooperative; for his company promptly sent me a set of reports of their work, including an EG&G report of a Scenario for the Accident. In that first call Golden answered one of my queries about what happened after the first sixteen hours of the accident. It was then he informed me that the EG&G company has not analyzed that post-16 hours data, and indeed, they have not even "looked" at the data. My immediate thought was that their work of analyzing the data for the pre-16 hour period was enough of a difficult research work that had occupied them fully up to that time, being a very complex record of data that had to be analyzed.

On that same day I had telephoned the U.S. Department of Energy, or was it then ERDA, to inquire into the TMI-2 accident analysis and reactor inspection. In that telephone call I may have learned that EG&G was the organization performing the TMI accident analysis research, and then got the telephone information on how to contact that organization, in order to inquiry further into what analyses have been made, and what was discovered in the reactor inspection, and so forth; or I may have telephoned the DOE (or ERDA) after I conferred with EG&G's Golden, to make queries following on the information Golden gave me. I cannot recall now the order of my calls.

But on the next day, I contacted Golden once more, or the EG&G office in Idaho, to confer with Golden, to ask additional questions, or to request further information; and it was in that second call to the EG&G that I was informed that the entire project of the TMI accident analysis work in which EG&G had been engaged up to the time of my first call (the day before), was cancelled suddenly — extremely abruptly. In that telephone call I was informed that the group of persons who performed the work of that project had been immediately "disbanded" and reassigned to other departments of the EG&G. I have assumed that the U.S. Government/ERDA (or was it DOE by then?) reacted to my queries, knowing that I was participating in the on-going British Court of Inquiry, and promptly cancelled the EG&G TMI accident analysis project, in order to prevent any further release of information or data about the accident, and especially about the time period after the first sixteen hours of the accident. I think that that motive for the sudden cancellation of the EG&G project is likely; for the work was "cancelled," connoting that it was ended prior to a completion, and that obviously a project for analyzing the TMI accident data ought to examine and analyze the accident data for the entire time periods of the accident, including the period beyond the first sixteen hours, and

including the periods of time prior to and after the coolant circulation pump was switched off on April 27 (1979).

The British Court of Inquiry, as I have mentioned, was named the Hinkley Point C Inquiry, as it was set up to investigate and judge the British government nuclear company's plan (and application for a permit) to build more PWR reactor stations in Britain. The first of those additional PWRs was to be built at the Hinkley Point nuclear power station in west England, near Bridgwater. At the Hinkley Point station there was then operating two Magnox gas-cooled reactors, comprising the "A" station, and two AGRs (Advanced Gas-Cooled Reactor) comprising the "B" station. The PWR that was proposed would be for the "C" station, hence the name "Hinkley Point C Inquiry." I determined from the site drawings that the C station could fit up to six PWRs; and indeed, the PWR project officer for the British Government declined to exclude the possibility that additional PWRs would be build at the C station following the construction of one PWR, and without having to obtain another permit for the additional construction. (The Gravelines station in France has six PWRs side by side, a few feet apart from each other.) And further, three other sites in England were planned for additional PWRs, to follow the Hinkley Point construction. Therefore, the full plan was a potential for about sixteen more PWRs in Britain. Thus, there was an enormous interest, I think, to prevent any more work of the EG&G that might discover more about what happened in the TMI accident that could interfere with the industrial and government plans for developing nuclear power in the world.

In my judgement the EG&G group was making vitally important scientific work that ought not to have been stopped. Therefore, I recommend and urge that all of the EG&G data records of the accident, and their records of their work, as well as the original data be acquired and that EG&G be commissioned to make a full comprehensive analysis of the TMI accident.

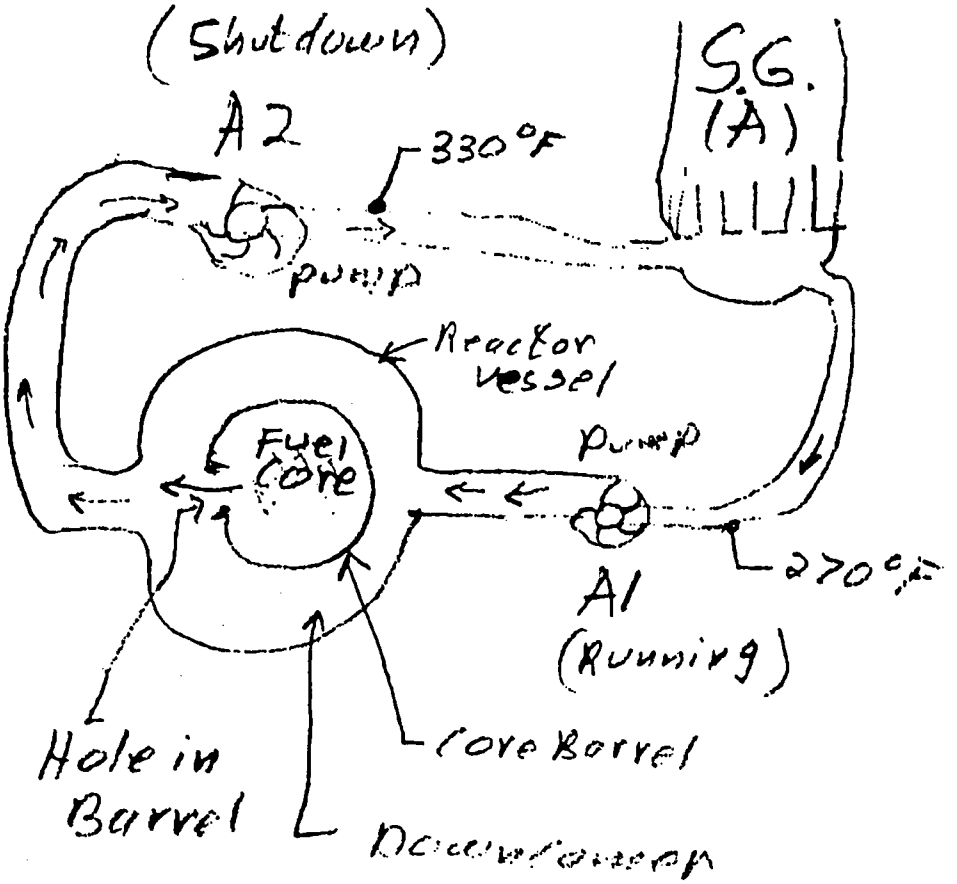
Sincerely yours,

Richard S. Webb

Richard Webb

16 hours

TMI-2 Accident



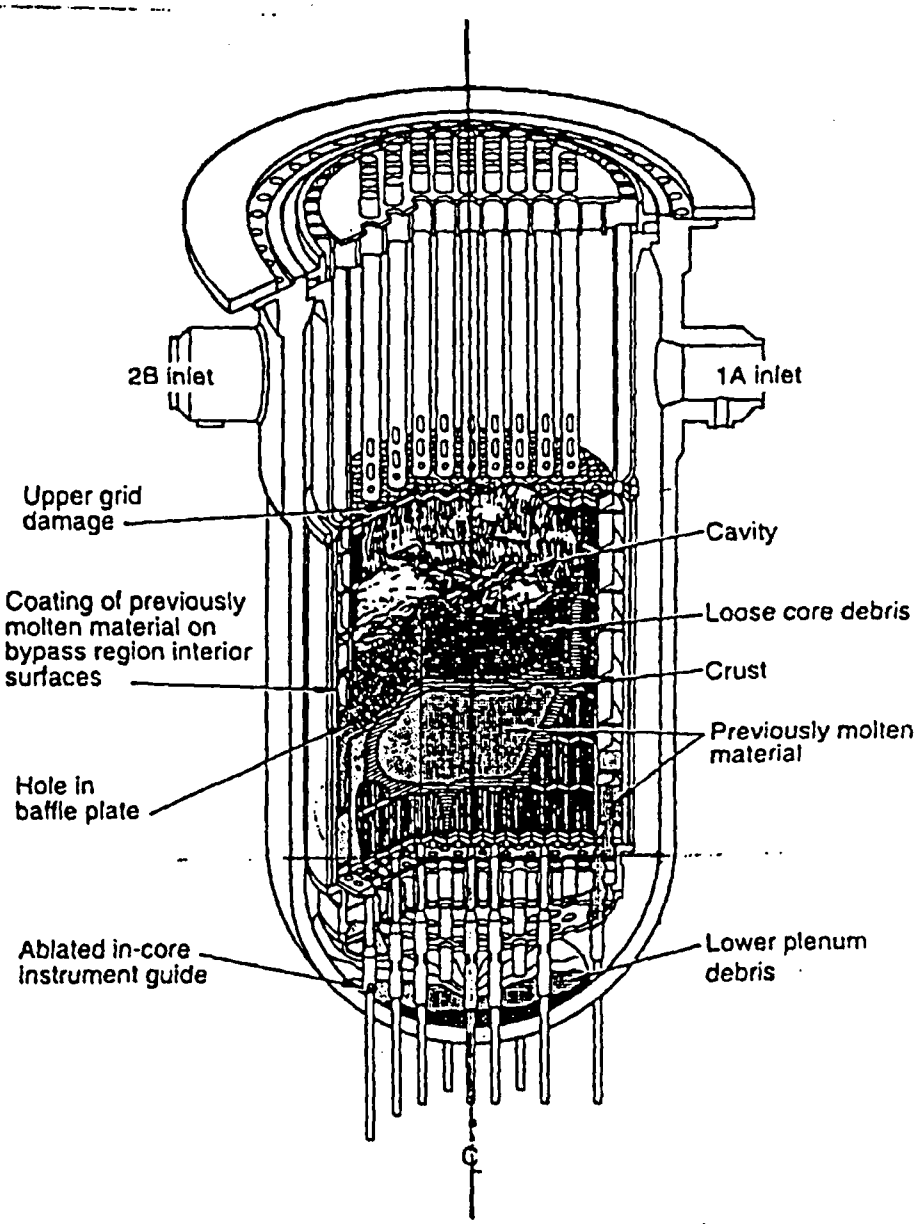


Fig. 1 TMI-2 reactor vessel end-state configuration.