

**Studies of Nuclear Hazards
and Constitutional Law**

Richard E. Webb, Ph.D.
American Scientist (Physics)
Raiffeisenstraße 1
86868 Mittelneufnach
Bayern (Bavaria), Germany
Telephone: 49-8262-960236
(within Germany 08262-960236)
e-mail: richard.webb@t-online.de
www.technidigm.org/webb

13 January 2006

Revised Letter

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: Conference 9 January 2006, by Telephone.
Topics: Three Mile Island Accident, especially about In-Core Thermocouples Data and Measurements for Plutonium, Computer Models of Emergency Core Cooling System (ECCS) Performance in Loss of Coolant Accidents (LOCA), Reactivity Accidents (Runaway Fission Chain Reactions) in a BWR — LOCA without Scram, and other Matters.

Thank you very much for conferring with me on Monday. By this present letter I offer some notes and comments on the remarks of the those of you who participated in the conference — remarks in response to several particular questions, requests for documentations, and concerns which I asserted.

1. Mr. Lauben has informed me that the NRC has in your files and on microfiche all of the measurement data of the TMI-2 reactor in-core thermocouples — measurements taken in the course of the Three Mile Island accident. He has offered that I may obtain a copy of that documentation. I do have a microfiche reader; but if it is not expensive, I would prefer the printed form. However, if making a photocopy would be difficult or expensive, a copy of the microfiche form of the T/C data might suffice.

2. I mentioned the NRC analysis of the "Long Term Cooling" of the TMI-2 reactor that was made in 1979. The draft or original version of the report/analysis was given to me in my meeting with Dr. Mattson and Carl Berlinger on April 26, 1979, in my meeting with them in Mattson's office in Bethesda. I have since read a reference to the published final form of that analysis, which I am very interested

- 2 -

to obtain for my study. Therefore, I request a copy of the final report. Also, before our meeting I have requested your NRC Public Document Room to search for a document with the words "Long Term Cooling" and Three Mile Island in the title. So far, I have not received any information from the PDR as to whether their search has found that document. But I am sure that it was issued. My copy of the original version is in storage in America, and is not accessible to me until I return to my home country. However, I need to write my manuscripts now.

3. In our conference I have proposed and recommended that the NRC acquire a copy of all of the records of the reactor system data (manual measurements, graph recordings, &c.) and actions performed on the reactor system during the accident (recorded in logs books and perhaps in approved written procedures or instructions). As I asserted in the conference, the time period after the first 16 hours of the accident, until a month after the reactor coolant circulation pump that was running on April 26, 1979, was switched off on April 27, or whenever it was switched off, is of special importance. I have found in the official literature of the TMI accident that little is discussed about what were the actions taken in that period of time, and how the reactor and instruments responded or behaved in that period, including what thermocouples had stopped giving electrical voltage signals indicative of possible temperature values, and when.

a. Did any significant events occur in that period of time? Any sudden changes in-core thermocouple readings, reactor pressure, water level in the pressurizer; and if so, when, and the values?

b. As you well know, the NRC's Harold Denton went to the TMI site on March 30, and as you said, the many trailers did not begin arriving until that day. After that there appeared to be much activity among the NRC personnel there and the many experts of the private industry and universities. Yet, there does not seem to be a published account of what reactor operations, engineering-wise, was done in those critical times of March 29 to, say, May 30th of 1979. The only thing mentioned in the published official accounts of that period seems to be about an alleged unfounded scare about a hydrogen bubble explosion. In my judgment, however, the danger that certainly existed during that time period was a possible reactor eruption due to melting, re-melting, or a further melting, of reactor core material followed by an FCI (fuel-coolant interaction), either in the form of a steam explosion, or an over-pressurization of the reactor vessel, and a consequent vessel rupture in either case, or a rupture of the reactor vessel by a weakening of the vessel during a thermal attack of molten core material pouring down onto the vessel bottom and settling there, or a combination of a weakened vessel and an FCI pressure surge.

I propose and recommend that the NRC re-investigate the TMI accident with the object of producing a scientific and engineering account of the entire process of regaining control of the reactor after the first 16th hours to the point of a certain safe state, which I define as a state in which the fission

CO2

- 3 -

product heat could not produce any fuel melting or any further zirconium steam reaction, or weakening of the reactor vessel, and also, a state of the reactor materials such that no possible fission chain reaction could occur. The Rogovin report, although informative of lots of things, does not provide a scientific engineering analysis of what happened in the TMI accident. And what happened is not confined to the first 16 hours.

Also, the information in the report is not reliable. For instance, the report states that a chart recording of an area radiation monitor in the auxiliary building (HP-R-3236) is usable for estimating the amount of noble gas radioactivity that was released to the atmosphere in the accident. The report states that that area monitor remained on-scale throughout the accident. But the article on the pathways for release of radioactive fission products by Langer, et al., in the August 1989 edition of *Nuclear Technology*, gives a reproduction of the chart recording graph of that monitor (HP-R-3236); and that graph shows that the monitor rose off-scale for three times during the afternoon of the first day, and also a two-hour gap in the recording concurrent with the first off-scale event. Also, the official account of the start of the accident has the PORV opening automatically before the high pressure reactor scram occurred. But I have it recorded on audio tape Jack Herbein's explanation of what happened, given in the afternoon on the first day; and he said that the reactor scrambled on "high pressure," and then said immediately after that statement: "Following that high-pressure" scram, "we opened the electromatic relief valve" — hence, the PORV opening after the scram, and being opened manually. Also, the section of the TMI-2 Final Safety Analysis Report (FSAR) for the design basis loss of main feedwater accident in the TMI-2 reactor plant has the PORV set to open well above the scram setpoint; so that the DBA analysis assumed no pressure relief valves opening in the Design Basis Loss-of-Feedwater Accident (loss of main feed water pumps). The Rogovin report does not provide a reprint of the FSAR sections, especially the DBA analysis of the design-basis LOFWA! That is a fundamental omission!

The NRC contracted its TMI accident investigation to a law firm, instead of commissioning a company of reactor engineering experts, such as the Bettis laboratory, and the Idaho organizations which have specialized in making reactor disruptive experiments and analyses. The Rogovin report seems more concerned about how certain organizations, especially the NRC, responded to that TMI accident (e.g., Who knew what, and who went where, and when?), and determining on proposed deficiencies in the plant equipment, procedures, and operations, with the object of reducing the chances of a similar accident occurring again in the future, than about establishing what happened in the accident, and what were the dangers that existed. Although the analysis given in the Rogovin report is important, of course, I judge that the report lacks an adequate scientific and engineering analysis of the progress of the accident, including the actions which were taken to achieve a final safe state without a reactor eruption or containment vessel burst, and the response of the reactor

- 4 -

system to those actions, starting with the first disturbance at 4:00 a.m. March 28th.

c. Is it a fact that the coolant circulation pump that was running on April 26th was switched off on April 27th? I ought to ask for a verification. Also, why was it switched? It was said by Mr. Lauben that he never heard that the pump was switched off because of a loss of water level indication for the Pressurizer. Of course, there were so many things happening, that such a fact and cause for the switch to natural circulation might not have been widely mentioned. However, inasmuch as much as Mr. Lauben expressed no knowledge that the last water level instrumentation expired, nor that any water level gauges had expired, I request that the records of the accident be examined to find out and establish just what happened? By records, I do not mean to include the Kemeny report or the Rogovin report.

1. Was the pump switched off on April 27th?
2. Did the reactor operators lose the last water level indication on that day? Did a water level gauge "fail" on that day?

4. In the conference it was recommended to me, as Dr. Paperiello has done in his letter to me dated November 29th (which, by the way, I did not received from the post delivery until January 6 or so), that I study the NUREG-1230 report, "Compendium of ECCS Research for Realistic LOCA," as a starter for learning what documents describe the ECCS models used by the NRC staff. Therefore, I request a copy of that report.

5. *BWR LOCA without Scram.* I inquired about whether any modelling calculations were ever made of the design-basis loss of coolant accident in a Boiling Water Reactor (BWR) with the added assumption of the failure of the control rods to be driven up into the core — a failure to scram — and with various sizes of pipe rupture and location, and initial power levels. After some discussion, Mr. Harold Scott was consulted, who then joined in the conference. If my notes and recollection are correct, Mr. Scott stated that he is not aware of any such calculations having been made. So, it seems likely that this particular accident possibility has never been investigated by a suitable mathematical/computer calculations. I request that your office consider my question further, and determine whether in fact such calculations have been done or not, and inform me so. Of course, if such calculations have been done, I would request that you provide me with a detailed report of them.

6. In the conference I mentioned the evident reason why the control room operators of the TMI-2 reactor switched off the ECCS injection early in the event — to avoid going water solid in the pressurizer (hence in the reactor system), and asked whether there exists any engineering analysis for the PWR reactors, including the B&W design of the TMI-2 reactor, of the possible consequences of going water solid — whether there was ever made and reported in a technical report a demonstration of just what is the danger, or are the dangers, of the reactor coolant

ML053490333
ML053620415

003

- 5 -

system, including the pressurizer in a PWR, going water solid. By this note I request your office to investigate this question, and provide me with whatever reports which may have been made that provide such an analysis and demonstration.

7. I neglected in the conference to raise for a discussion my concern for a reactivity accident in the a PWR in which un-borated water is injected into the reactor coolant system from the ECCS water tanks, called "accumulators" as I recall, when the reactor is open for a refuelling, or in any other state in which the reactor is depressurized? May I request Ralph Myer to telephone me to discuss that concern, and to send me a letter to provide me with whatever analysis and calculations of that accident possibility that may have been made?

8. Ralph Myer mentioned the Anticipated Transients without Scram (ATWS) in a BWR. He, I think, alluded to a steam valve closure without scram. I am indeed interested in that accident possibility as well, including also the extended case in which the recirculation pumps are not promptly shut down upon a failure to scram. Has the NRC engineers of your office made computer modelling calculations of such accident possibilities?

- a. Also, I assume that the NRC has issued an analysis of the hazards of possible unstable power oscillations in the BWR. I request a copy of whatever analyses which the NRC engineers have made.

9. Norm Lauben mentioned the 1972 ECCS hearings in which he and I met. I recall, as I said, that Dr. Steven Hanauer headed a panel of AEC officers which together presented the AEC testimony at those hearings. As I said, I questioned that panel. And as I said in our conference, one particular question which I put to Dr. Hanauer was: Has there ever occurred a failure to scram in a reactor upon an emergency signal for a scram? (I am re-stating the question from an uncertain memory; so the words might not be exact, but the substance is.) As I certainly recall, he did not seem to know the answer to the question, for he then promptly consulted his colleagues on the panel, and from them he obtain a definite answer, "Yes". (Or he knew of one case, and needed to check with his colleagues to find out if there were other instances.) He might have stated the instance of such a failure to scram, or I asked a follow up question for it; but he declared that there was one instance of a failure-to-scram, and cited that as having occurred in the "N" Reactor at Hanford. Mr. Lauben, I am curious. Did you, by any chance, disclose that fact? Or who on the panel did? Do you recall the names of the other members of the panel?

10. About the ECCS models for calculating the progress of a LOCA in either a BWR or a PWR. Has the NRC confirmed the validity of the models, by checking the mathematics and the physics (thermal/hydraulic equations, etc.), and checking the computer program to confirm that the program does correctly implement the mathematical equations and logic of the model?

C04

- 6 -

I am interested very much to have for study whatever NRC staff analysis and evaluation of the RELAP and TRAC models that were made that formed the basis for the NRC's reliance on those models for calculating the progress of a LOCA in a PWR and BWR. I think it likely that such information is mentioned or given in the Compendium report, NUREG-1230?

11. I inquired into whether or not any measurements for the plutonium concentrations in the TMI-2 reactor system had been made and reported? I mentioned my estimate that about 43 kilograms of plutonium was produced in the approximately 90 effective full power days of reactor power operations before the accident occurred. I think it was Ralph Myer who responded to my query, and stated that he does not know of any measurements for plutonium in the TMI-2 reactor system. May I request the your office to investigate this question, and inform me of whether or not any measurements were made, and if so, of course, to provide me with whatever documentation there is of such measurements?

a. I have recommended in the conference, as before in a long past discussion with Sandia's Dana Powers, that the possibility of plutonium separating from the Uranium material and concentrating in a critical mass, be investigated; and if it is concluded that a separation is physically impossible, as Mr. Myer (or Dr. Myer) has asserted, with his reference to certain properties of uranium-plutonium mixtures, such a conclusion be demonstrated in a scientific report, and that I be provided a copy of such report. I would like very much to investigate the matter; but I am not competent presently to make any quick conclusive analysis. I am concerned about the complex physical and chemical state of a core melt, with zirconium and other metals present, as well as oxides, and steam, and other chemicals, such as hydrogen, and all at high temperatures, and then with slow and fast cooling possibilities, and so on. I have been informed by Dr. Earl Gulbranson (now deceased), a metallurgist of the University of Pittsburgh who experimented with zirconium-steam reactions, and also with plutonium, that Pu can exist in a gaseous state, PuO, unlike Uranium (UO₂). I recall that he observed that phenomenon himself in experiments which he performed, and that he gave me a scientific paper which he wrote that reported on his experiments with plutonium. He also gave me a scientific reference — some pages of an USAEC Plutonium handbook, if I remember it right. (Most of my research documents are in storage in America, so I cannot now retrieve my notes and documents of that matter.)

I should mention that the question which I have raised was raised by me also in a British Court of Inquiry — the Hinkley Point C Inquiry (1988-1989) — which was conducted to investigate the safety and other concerns about the additional PWRs that were proposed to be built (beyond the Sizewell-B reactor). I gave evidence in that inquiry, which includes a small section on the question. The subject was discussed in the Inquiry: the chief judge was especially interested in the concern which I raised. I would like to offer the NRC a copy of my Evidence. However, it is voluminous report (testimony) — about 110 pages. I am very poor, and have no means presently to make a copy. Nevertheless, if you gentlemen would like a copy, I would find a way to do it. I just can't spend money and time on a work of

C05

- 7 -

such massive photocopying and mailing if the persons to whom I would send the document have not actually expressed a desire to have it for study. With this fax, I am attaching the title page, and the table of contents, and a one page summary, "Summary of Evidence."

12. I recommended and urged in the conference that all of the data of the TMI-2 accident, including chart recordings, logs, manual readings, maps of thermocouple readings, and so forth, held by the GPU, or whatever entity which has taken possession of those records, be acquired by the Government (the NRC), by an impoundment, and preserved, and indeed, copied in such a form so as to be available to the public. I mentioned my knowledge of what data exists, as of at least the year 1995: (1) the holdings of GPU, which were in a "vault", and known by the United States District Court in the official named *TMI Consolidated Proceedings*; and (2) the photograph copies of the original records made by EG&G of the Idaho National Engineering Laboratory.

I mentioned that I did obtain a copy of the *TMI-2 Data Book*, which the EG&G produced. I may have obtained a copy from the NRC's public document room, but it is in my storage in America, and not accessible to me now. May I have a microfiche copy of that report? I assume that that form would not be inexpensive.

I have several more comments to offer, but I shall defer these in order to send this letter without further delay. I have had to work on recovering my computers from a virus attack, which has taken a priority. I have not been able to work on finishing this letter until today for that reason.

I am sending with this fax some sheets of some TMI-2 related calculations:

1. A Loss of Feedwater following Herbein's sequence, but extended to investigate what if the safety valves and the PORV when pressed to pass water stuck closed. I made the math/computer model.

2. Heat conduction calculations (two dimensional: r-z) of a mass of molten UO₂ pouring onto the steel plate bottom of the reactor vessel: both steady state and transient calculations. I calculate that the vessel would probably have ruptured had 19 Metric tons of molten material poured down in one sudden pour. Also, my stead-state calculations give results that the vessel would have ruptured had 19 metric tons settled before ten days — that is, the vessel could not have held up if 19 metric tons laid on it before ten days from the start of the accident. From these calculations I doubt the scenarios of EGG (Nuclear Technology, Aug. 1989), and Beckjord (Nuclear Safety, 1994), that 19 or 20 MTs poured down onto the vessel bottom at 4 to five hours into the accident. Has Sandia ever made calculations "trying to figure out why the vessel did not fail", quoting (paraphrasing) Harold Denton in his March 25, 1999 speech in Middletown?

C06

- 8 -

I also mentioned www.technidigm.org/webb, and promised that I shall send a CD ROM of my later analyses, especially also on the United States Constitution.

This concludes my present letter. I have supplemented it with a second letter, which I shall send separately, instead of incorporating it in the present letter, in order that you can better perceive the revisions of this main letter.

Again, I remind you of my requests for documentations; and again, thank you very much for offering to confer with me about my concerns.

Sincerely yours,



Richard E. Webb

Note: This letter is a revised form of my letter dated January 11, 2006, and telefaxed on January 12. This revised letter corrects for grammar and perspicuity defects of the original letter.