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COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

31 March 1980

U.S. NUCLEAR REG. COMM.
ADVISORY COMMITTEE ON
REACTOR SAFEGUARDS

Prof. Milton Plesset
Mechanical Engineering Department
California Institute of Technology
Pasadena, CA

Dear Prof. Plesset:

This letter is in response to your request for our reflections on the ACRS/ECCS subcommittee meeting on Tuesday, March 25th, 1980.

It is painfully clear to me that I presently have less intimate knowledge of the nuclear hardware that is in question than the other consultants do. Perhaps I can first turn that weakness to a strength by addressing certain features of the meeting that were doubly difficult for me.

Presentation: The standards of presentation of the difficult technical material were not uniformly high. By talking rapidly about the mechanics of a process and moving quickly to results, speakers frequently dared the committee people to expose their ignorance publically by asking questions. Only when questioning began did it become clear that there was not a general understanding of the processes. I have asked Andy Bates to equip me with pictures to alleviate my own problems in the future. But I also think you might greatly improve the situation for all concerned if you could lay some requirements on speakers:

first: Require that the material they circulate include the relevant schematic diagrams of the insides of systems.

second: Require a higher standard of graphical work generally. One picture is really worth 10,000 words and the points of dissention almost always turn, either on questions about how fluids can and do move in complex passages, or on what is meant by certain graphs of system performance.

third: There is a great deal of downright illiterate presentation. And confused ideas lurk close behind confused language. (There is probably little you can do about this.)

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Physical Processes: At issue in the upper head injection process are one of two questions: 1.) Are the proposed analytical descriptions reasonably correct or do they stray modestly from the physical process? 2.) Do the proposed analytical descriptions overlook major problems of two-phase instability

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that could cause them to fail radically?

A key need is to learn which is the case, and I see three routes by which to decide, short of testing the real system: The last of the three is to attempt a very complete three-dimensional modeling. This would be virtually impossible because the boundary conditions are irremountably complex and because no one has yet made a proper accounting of liquid superheating in a computer program.

The second route is that of experimental modeling. You all tell me from your greater experience -- which I take right seriously -- that it can't be done. Yet I don't believe you. The right sequencing of graded experiments could surely be used to isolate and eliminate some variables, while tampering with the liquid could make it possible to deal with others.

But the remaining route is far more modest. It amounts to no more than altering the meeting format to make full use of the rather large expertise around the table. By providing adequate blackboard space, and placing it so we all had ready access to it, you could vastly increase the substance of the conversation. You, for example, raised a very telling question about whether liquid drainage from the upper plate might be sustained by the fact that, once it is established, all vapor below might be condensed on the liquid stream coming through. This is a subtle notion because it depends on opposing process rates and driving forces. Without a blackboard, I think none of us fully perceived it. Certainly no one was able to argue its merits with you.

To pull the consultants into this kind of dissection of the physical processes might vastly extend what we could finally say about the strategies being set before us. However, it would defy transcription, and thus thwart the sunshine law.

Dimensionless Groups: It would be very helpful for me if I could go back and relive last Tuesday's discussion armed with key values of appropriately defined Weber, Reynolds, Froude, Rayleigh, Bond, Biot, and/or Jakob numbers in the PWR system. Certain ideas about physical behavior could then be immediately eliminated and others brought into focus.

Do you think it would be fruitful in shaping NRC's understanding, as well as in guiding ours, to ask for some such information in the future.

Thanks for your help and patience during my first encounters with these still slightly mysterious transactions. I look forward to the April meeting.

Very truly yours,



John H. Lienhard
Professor

JHL/bc