CT-1340

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May 26, 1981

Dr. William Kerr, Chairman
Subcommittee on Class 9 Accidents
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
1718 H Street, N.W. 10th Floor
Washington, D.C. 20555

Dear Bill:

I am writing this letter to give you my impressions of the May 21-22, 1981 Class 9 Accident Subcommittee Meeting for discussion the MARCH Code. Overall I found the meeting to be very educational in giving me a feeling of what the MARCH code and associated codes are designed to accomplish.

I believe that the use of codes like MARCH or improved derivatives of it will increase and will become an essential part of reactor accident evaluation. It is, however, important that users of this code be constantly skeptical and suspicious of the results. As brought out in the discussion, there are cases where MARCH produces obviously erroneous results which violate the basic laws of mass and energy conservation. The dangerous cases are those where results are in error even though basic conservation principles are not violated. Thus it is important to develop check calculations of key variables which are independent of MARCH wherever possible, and this has apparently been done in some cases.

The question of hand calculation vs. the use of a code is a frequent subject of discussion. In some ways this is a false issue brought about by the way the MARCH code is sometimes used. Historically the MARCH code started out as a series of hand calculations describing various phases of an accident sequence. These hand calculations then were programmed for a computer. (One of the most significant features of the continuing computer revolution is the ability to store a computational sequence so that it is immediately accessible.) The complication arises when many of these small relatively simple sub-calculations are tied together into one comprehensive overall computational scheme. Even when individual subroutines provide valid results, systems instabilities may then lead to erroneous overall results. An overall hand calculation would be subject to the same difficulties. It is when the MARCH code is used without full understanding of the content of the subroutines, and without sufficient

skepticism that the results are subject to doubt and suspicion. Part of the difficulty appears to be one of semantics. The use of the work "code" somehow implies an entity intimately related to computers and completely different from any other type of calculation. Really, MARCH is an approximate calculational scheme which has been programmed for machine calculation to save time and money.

The subject of sensitivity analysis arose frequently during the course of the meeting and there seems to be some confusion as to the meaning of this term. I believe there are at least two distinct definitions:

1) There is for instance, the sensitivity of the containment pressure and temperature to various postulated accident sequences.

2) There is the sensitivity of the containment response for a fixed accident sequence to various limiting values of fundamental parameters or models used in the MARCH subroutines. For example: how does the maximum containment pressure vary for different assumed values of the heat transfer coefficient or the radiant absorptivity, etc.

The latter type of sensitivity analysis should provide an upper and lower bound to the final results of a MARCH computational sequence. The possibility of carrying out such an analysis, which will be difficult, should be explored.

There is also the interesting question of how much detail is needed to evaluate the effects of a LOCA. This question, which arose particularly with respect to core-concrete interactions, is closely tied to the sensitivity problem. It may be that for some aspects of a LOCA sequence a relatively simple go-no go result will provide enough information to determine upper and lower bounds for containment pressure. This question of required detail appears worthy of further study.

Validation is another subject which frequently arose during the discussions. The key problem is that MARCH attempts to model a phenomenon which can never be fully reproduced experimentally. The situation is akin to medical research where it also is impossible to carry out experiments to demonstrate the lethal effects of some agent or disease. However, I do feel that some of the individual subcalculations can, as brought out in the discussion, be checked with suitable experiments. Wherever possible experimental studies related to LOCA should be tied into MARCH, and MARCH should be continuously brought into conformance with new (or old) experimental results.

There were a number of areas in which the MARCH code appeared unnecessarily deficient. The incorrect choice of heat transfer coefficients (pointed out by Dr. Etherington), and the approximate gas constant used in calculating primary system pressure (pointed out by Dr. Zudans) are examples. I also believe that the hydrogen burning models could be improved, and there appears to be considerable uncertainity about the hydrogen generation rate. I believe it is important to improve these and other basic aspects of subroutines which currently constitute MARCH.

The results from MARCH depend crucially on the input options chosen by the code operator. In a similar way, it appears that the progression of the LOCA depends upon actions taken by the power plant operators. This suggests the possibility of incorporating the MARCH code into a reactor simulator to simulate a LOCA and to produce responses dependent on operator action. Such a combination might ultimately provide an interesting research and possibly training tool. The MARCH code probably requires further development before the above suggestion can be implemented.

I would like to conclude with the following overall suggestions:

1. MARCH code users should clearly indicate all input option, whether external or default, which have been used (e.g., discussion of G. Thomas, EPRI).

2. MARCH code results should always be treated with healthy skepticism. The outputs should be recognized for what they are--the results of a sequence of predictive calculations only partially verified by experiment (e.g., discussion of P. Cybulskis, BCL).

3. A continuing program of MARCH improvement and modification should be conducted by investigators who are intimately acquainted with all aspects of the code. Such a study differs from the use of MARCH to evaluate a particular power plant design. (Some work of this nature was reported at the meeting.)

Sincerely yours,

Martin Sichel
Professor

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cc: G. R. Quittschreiber
J. C. Mark