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TO: G. Quittschreiber

FROM: I. Catton

SUBJECT: Class 9 Subcommittee Meeting, Chicago, 9 May 1980

During the opening executive session of the subcommittee meeting Dr. Kerr raised questions about "what should be done" and "how one decides what to do" for Z/IP, near term OLs, and future designs. I have a few ideas and would like to take this opportunity to express them. My thoughts are based on the assumption that a core melt must be accommodated independent of the probability of its occurrence. Risk studies should be pursued independently.

Z/IP. Decisions have to be made too soon to be based on any new information. Two aspects of a core melt need to be addressed in a best estimate or engineering judgment sense. First, the pressure spike that occurs immediately following vessel failure needs to receive a more detailed look as the rate-of-rise of pressure impacts directly on mitigation systems. Second, a best estimate of whether or not an ex-vessel debris bed will dry out needs to be made. If it dries out even with a guaranteed water supply, then a core catcher should receive serious attention. A number of conceptual studies of passive and active core catchers have been made. Some may be useful for Z/IP and should receive consideration. For example the type under consideration for SNR 300 could be retrofit to Z/IP. Third, the benefit of increasing the reliability of the containment spray system should be considered as it could mitigate both the pressure spike, the long term pressure rise and the possibility of a hydrogen burn. The benefits will only accrue if the sprays are properly located. This aspect needs to be determined.

Near Term OLs. Near term OLs still have the flexibility to make minor changes. In determining whether or not design changes should be made, the results of Z/IP class 9 considerations can be brought to bear. The results from the SANDIA fragmentation studies (molten fuel debris in water) can be used to improve our estimates of the pressure spike characteristics as well as better define the debris bed for dry out estimates. Further core catcher design efforts can be completed and, if necessary, retrofit in the reactor cavity. Spray systems can be examined to insure that they are properly placed to optimize their effectiveness. Studies of quenching of hydrogen burning with sprays could be completed within a year (if initiated promptly). A detailed analysis of active and passive core catchers could be made considering a number of different materials.

Future Designs. Studies now underway in Germany to determine how a core melts can be incorporated into a MARCH type analysis so that initial conditions for containment threat are better defined. Debris beds resulting from core melt down will be defined well enough that dryout can be ruled out or accepted as a problem to be dealt with. Conceptual designs of both passive and active core catcher schemes should be developed and tested as a parallel effort so that they can be used if needed. The research program outlined by Mr. Silberberg will answer many of the questions needing resolutuion for future designs.

As noted by Dr. J. Meyer, NRR staff, mitigation devices presently under consideration are FVCS, core retention devices and hydrogen control methods. FVCS design depends strongly on how fast steam is generated during the period immediately following vessel failure. This steam spike is the result of a calculation by the MARCH code. It is not clear that it is the subject of the Integrated Fuel Melt Research Program except for the fragmentation studies. A redirection to give the steam spike attention seems in order. With Z/IP being the center of attention, it is not clear why the IREP has its attention elsewhere.

Dr. Kelber's four year plan will not be very helpful to Z/IP or near term OLs. For example the hydrogen problem will be the subject of rule making in the near future and a lot of decisions need to be made. If core catchers are to be used, some early attention to materials other than MgO is needed. As mentioned above, to answer the steam spike questions requires information about heat transfer, fragmentation and how well water can get to the hot material. Dr. Kelber should be encouraged to re-direct his efforts towards obtaining answers to questions raised by Z/IP. His early study in this regard was very good but needs further refinement in light of the May 7-8 meeting between the staff and the utilities.

Debris bed coolability studies planned at SANDIA are probably not necessary. In that UCLA, ANL, SANDIA and others are in essential agreement about coolability in a given debris bed, attention needs to be focussed mainly on what debris bed to expect. It is clear that in-pile debris bed dry out experiments with water as the coolant are <u>not needed</u>. Fragmentation of core debris in water will yield the needed information about debris beds. Knowledge about how much of the core need be considered will not be obtained in time to be of any use for Z/IP or near term OLs.

There are presently no core retention device studies underway other than the FNP core ladle. NRR will get little help for materials other than MgO. Scoping experiments with other materials should be initiated immediately even if it means stopping the MgO study. In particular actively cooled depleted UO_2 and ThO_2 beds should be studied.

Dr. Kelber should be encouraged to incorporate a study of sprays and containment cooling into his research program. The question to be answered is how to control the core-water interaction steam by condensation and thereby control containment pressure rise. Sprays could also control or eliminate the potential for hydrogen burn if properly placed.

Hydrogen control research seems to be devoted to studies of its production combustion and deformation limits. This is a well studied area. The Germans are doing work in this area under reactor containment conditions. It seems as if questions about where the hydrogen will be, trapping in the top of rooms, where to put detectors and where to put intakes to re-combiners are not a part of anybodies research program. All past work seems to be based on the notion that the hydrogen will be uniformly mixed throughout the containment. Two ongoing programs in Germany are addressing the possibility of hydrogen distribution. This aspect needs more attention as does the use of sprays to quench combustion.

Subjects for consideration at future Class 9 Subcommittee meetings should include the following:

1. A review of past conceptual designs of core catchers and their applicability to LWRs (GE LMFBR concepts, FFTF, CRBR, SNR-300 and others).

2. A state-of-the-art summary of hydrogen control and problems by somebody from NASA or NBS (I can find names of people if you wish).

3. Results of a cost-benefit study of the Integrated Fuel Melt Research Program and how it will be used to re-direct the present program.

4. A description of the KESS system of codes being developed in Germany for use in analyzing Class 9 accidents for comparison with the MARCH/CORRAL package developed in the US.

5. A summary of mitigation devices or systems in existing plants (sprays, etc.).