7. M. F. YOUNG, "IFCI: An Integrated Code for Calculation of All Phases of Fuel-Coolant Interactions," NUREG/CR-5084, SAND87-1048, Sandia National Laboratories (1987).

8. M. PILCH, "Comparison of a Dynamic Fragmentation Model with Drop Breakup Data," Draft Report, Sandia National Laboratories (1988) (to be published).

9. V. K. DHIR and G. P. PUROHIT, "Subcooled Film-Boiling Heat Transfer from Spheres," *Proc. Natl. Heat Transfer Conf.*, Atlantic City, New Jersey, August 14–17, 1977.

10. C. C. CHU, "One-Dimensional Transient Fluid Model for Fuel-Coolant Interaction Analysis," PhD Thesis, University of Wisconsin, Madison (1986).

11. D. F. FLETCHER, "Large Scale Mixing Calculations," CLM-R282, Culham Laboratory (1988).

Response to "Comments on the Fuel-Coolant Premixing Debate"

Young's letter[1] contains no technical points, but the following series of formal ones:

1. In his *opinion* we have used a too small melt particle diameter in our calculations, and we were amiss not to have presented parametric calculations on this.

2. In his *opinion* we should have attempted to calculate and compare with Marshall's experiments.

3. He has a code, IFCI, that in his *opinion* is superior to ours because its models "are validated or *are being validated* [emphasis added] against experiment" and in particular "the dynamic breakup has been validated. . . . "

4. After validation "is completed a simulation of large-scale mixing . . . will be done."

Our response to these points is as follows:

1. Our choice of melt particle size and the conservative effect of ignoring additional breakup due to steaming and two-phase turbulence has been explained already (Young's Refs. 1 and 2; see also our response to Corradini in this issue of *Nuclear Science and Engineering*). In addition to particle size, there are several other parameters that need to be varied for a meaningful parametric/sensitivity study. This involves a very significant computational effort. We have only recently been able to complete it, and a paper (Part V of the series) is being prepared for publication. The results from this study, which in reference to this point covers melt particle sizes of 1 to 5 cm, support the premixing quantification given previously.[2]

2. We have stated previously (Young's Ref. 2) why Marshall's experiments cannot be used for testing premixing models. Interestingly enough, these experiments (already more than 3 years old) have not yet appeared in the archival literature, nor have they been used by Young (or anyone else) in the testing of

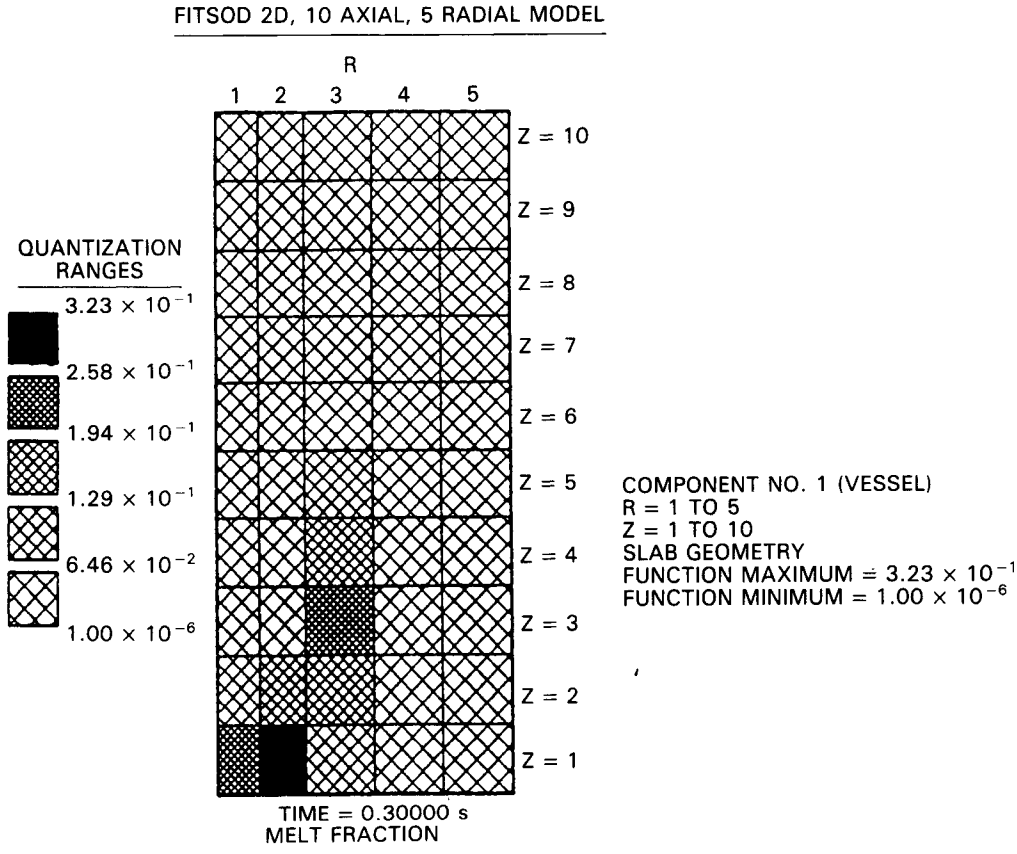

Fig. 1. Melt volume fraction at 0.3 s (reproduced from Young's Ref. 7). The radius is 34.5 cm and the height is 61 cm.

his own code! If this is a code-testing opportunity not to be missed, we hope he can show us how.

3. Regarding IFCI (Young's code), first let us be absolutely clear that the code *has not been documented as yet*, even though by Young's own dates it is 4 years old. The one reference given by Young (his Ref. 7) contains only a *partial* explanation of one aspect of this code, namely, the dynamic fragmentation model. The basis for this model also is not yet available (his Ref. 8). Clearly, verbal descriptions in letters to the editor are not of much use in this debate on premixing, or for any other purpose! Even the results, for the single test calculation presented (Young's Ref. 7), are incomprehensible and at variance with the last paragraph of his letter that is supposed to summarize them. Consider Young's summary given in his Ref. 7: "The melt mass mean diameter decreased during the fall from an initial value of 20 cm to a value of around 15 cm at 0.3 s and showed very little spatial variation" and "a final mixing diameter of 15 cm is quite large compared to experimental measurements of final debris sizes in the 0.5–1 cm range." We let the reader decide what all of this means compared with what he has shown as calculated results (reproduced here as Fig. 1) and with what he states in the last paragraph of his letter.

4. We will be looking forward to these intended computations, and a constructive interaction for a change.

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June 1, 1989

REFERENCES

1. M. F. YOUNG, *Nucl. Sci. Eng.*, **103**, 106 (1989).

2. W. H. AMARASOORIYA and T. G. THEOFANOUS, "Premixing of Steam Explosions: A Three-Fluid Model," *Proc. Natl. Heat Transfer Conf.*, Houston, Texas, July 24–27, 1988, Vol. 3, p. 191, American Nuclear Society (1988).