A PERSPECTIVE

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The papers in this issue of *Nuclear Technology* are related to what is perhaps the most provocative question of light water reactor public risk. Has the nuclear technical community included so many conservatisms in the modeling of the consequences of nuclear reactor accidents that we are describing a mythical catastrophe that cannot happen?

The issue is not one of can accidents happen, nor one of major plant damage, nor even one of can a meltdown and melt-through occur. The question is, even if the worst accident postulated did occur, would the actual result be a public catastrophe? Are there risks beyond that of other accepted public risks? Is there a real probability that tens of thousands or hundreds of thousands of people could be killed by a nuclear power plant accident?

This concern was recognized as one of substance during 1980. The U.S. Nuclear Regulatory Commission (NRC) held hearings on November 18 and the Presidential Nuclear Oversite Committee (chaired by Gov. Bruce Babbitt of Arizona) invited testimony on December 16. The latter hearings, which included testimony from some of the authors of the papers in this issue, resulted in a letter to President Jimmy Carter stating that this is a matter of substance that should be addressed.

The papers included in this issue are based on seven given at a special session and one given at a plenary session of the American Nuclear Society/European Nuclear Society 1980 International Conference. The Campbell et al. and Levenson and Rahn papers were presented at both the NRC and Oversite hearings and the Bunz et al. paper was presented at the NRC hearing.

The current overestimates of accident consequences and public risk can probably be traced to two separate issues. The first is the incomplete assessment of chemical and/or physical chemical processes and the natural attenuation in release fraction they provide.

The paper by Campbell et al. covers the iodine chemistry in some detail. The papers by Bunz et al. and Hilliard and Postma address the conservatisms inherent in previous treatment of aerosols. The paper by Mendoza et al. indicates that current analysis overpredicts the actual release from the SL-1 accident by more than two orders of magnitude. The papers by Parker and Creek and by Smith discuss specifics of past experience and experiments and the papers by Levenson and Rahn and by Morewitz discuss the general issue in some detail. The Levenson and Rahn paper also discusses the impact on emergency planning.

The second cause of the overestimate has not been directly addressed in any of the papers and I would like to take this opportunity to raise it. In addition to the chemical effects and phenomena, we seem to have inadequately treated the phenomena called TIME. Some of our analyses have been done nonmechanistically so as to make sure we haven't overlooked some accident sequence or another. This is quite proper and important but has led in some cases to the overlooking of the obvious. There are many such cases. A few typical ones follow.

1. Unless there has been a major loss of water from the primary system—whether by pipe break, open relief or safety valve, failed primary pump seal, or whatever—there will be no fuel melting—and probably no major fuel failure. Thus, the containment space will always be wet and steamy (*by the TIME*) when and if fuel failure occurs.

2. Fuel melting releases the bulk of the gases and volatile fission products. Fuel melting must precede (*by the TIME*) molten fuel penetration of the pressure vessel. Thus, any possible molten fuel-concrete reactions will not release significant fractions of either gaseous or volatile fission products. These would have been released when the fuel melted. Much of the aerosol agglomeration and iodine reactions discussed in these papers will have occurred *by the TIME* the fuel reaches the concrete.

3. The fission product and fuel aerosols are not generated in the dome of a containment building nor in the pressure suppression area of a boiling water reactor. If they are generated when the fuel

melts, they *must* be generated inside the pressure vessel. This means that their density for interaction or agglomeration in the critical early times is set by the free volume of a pressure vessel—perhaps a few thousand cubic feet at most, rather than the million or so cubic feet of containment volume. And *by the TIME* the aerosols actually exit into any compartment they are substantially reduced in quantity. *By the TIME* they exit from a compartment and are diluted by total containment volume, additional reduction has occurred.

4. Since fuel will not melt until after (*by the TIME*) the loss of most of the water from the primary system, it is not appropriate to use the high velocity of the escaping steam or water in a large loss-of-coolant accident to calculate fission product transport into containment. Fuel melting, if it occurs, will not start until the fast blowdown stage is over. Any aerosols swept out of the primary system into containment will be swept only by steam from residual water (or added water), by hydrogen from the reaction of zirconium and water, or by a steam/hydrogen mixture. Steam and hydrogen reactions with fission products should not be ignored since one or the other or both are always present at the *TIME* of exit from the primary system.

As you read these papers, remember that a factor of only 20 reduction in iodine and aerosol release makes very substantial changes in the public risk and in what is the optimum emergency response. An exposure of 500 R to 1000 people may result in 500 acute deaths, but an exposure of 25 R to the same 1000 people will almost certainly result in no acute deaths. A reduction of a few orders of magnitude in ground deposition due to aerosol fallout completely changes the long-term problems of chronic exposure.

I believe that the review of past accidents and past experiments represented in this volume is only the tip of the iceberg. I encourage all readers to participate in this provocative issue by taking a look at their past experience, their past experiments, and their past accidents to help us define what it is that can really happen.