LETTERS TO THE EDITOR

COMMENT ON "CONTRIBUTION OF ACTIVATION PRODUCTS TO FUSION ACCIDENT RISK: PART I. A PRELIMINARY INVESTIGATION"

In the first issue of *Nuclear Technology/Fusion*, Holdren[1] assessed conceivable radioactivity releases from a fusion power plant under severe accident conditions. These conceivable releases were estimated to be 20% of the total radioactivity in the stainless steel first wall and blanket of the reference design, UWMAK-I.

As noted at the end of the paper, ongoing work at Massachusetts Institute of Technology has addressed the problem of the potential for accidental release of structural activation products. In doing so, we have examined the temperatures that may be realistically generated as a consequence of a lithium fire.[2,3] As expected, the theoretical maximum (adiabatic) flame temperature of 2400 K was found extraconservative. Because of the inevitable radiation cooling and the limitations on the rate at which oxygen may reach the flame, the maximum temperature of the flame under severe accident conditions was found limited to ~1400 K, not enough to melt the structural materials. Further, the gas temperature in a containment with no provision for emergency cooling was predicted to be limited to a maximum of 1000 K. These findings by our model even appear conservative when compared with scoping experiments in lithium fires performed at Hanford Engineering Development Laboratory.[3]

Thus the mobility of 20% of the structural activity by melting or vaporization seems to be arbitrarily high. Our estimate for the maximum fraction that may be mobilized for UWMAK-I amounts to 0.2% of the total structural radioactivity.[4] We share the opinion that strategies that will further reduce the potential for activation product accidental release should be pursued. However, the inherent limitations on the activation product release should not be underestimated.

Mujid S. Kazimi

Massachusetts Institute of Technology
Department of Nuclear Engineering
138 Albany Street
Cambridge, Massachusetts 02139

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REPLY TO "COMMENT ON 'CONTRIBUTION OF ACTIVATION PRODUCTS TO FUSION ACCIDENT RISK: PART I. A PRELIMINARY INVESTIGATION' "

Kazimi[1] describes accumulating evidence that the temperatures experienced in actual lithium fires could be very much lower than the adiabatic flame temperature used in my article[2] and in some earlier work[3] on fusion reactor accidents. His results are encouraging. If they stand up under the needed further experimental investigation of the full range of conditions that could be encountered in severe accidents, then the maximum release fractions from stainless steel structure in such accidents will indeed be smaller than the 20% I used as a "worst case" for the most mobile isotopes. (The assumed release fractions from stainless steel for the less mobile isotopes were stated in the article to be 4%.)

How *much* smaller depends not only on what the actual temperatures turn out to be, but also, as my article emphasized, on the effectiveness of formation and mobilization of volatile oxides from structural material at temperatures below its melting point. (An ameliorating factor is the fraction of mobilized material that would plate out or fall out before reaching potential victims, which I stated I was neglecting for low-melting-point materials, and which some experts think was likewise underestimated in the Rasmussen report's analysis of light water reactor accidents.[4]) Kazimi's estimates of possible mobilization fractions do account for oxidation from solid as well as from molten material, but I think he would have to agree that making these estimates required quantitative characterization of physical phenomena that are poorly understood theoretically and very scantily investigated experimentally.

In this situation, the associated uncertainties are bound to be large, and the question of how to define the "worst case" becomes not only a matter of technical judgment but also of philosophy. The history of technology assessment and regulation of nuclear fission reveals *both* a tendency to place on the technology's proponents a substantial burden