Comments on the report,
"Radiation Exposure Due to Venting TMI-2
Reactor Building Atmosphere," by
B. Frank and D. Teufel, Institute
for Energy and Environmental Research,
Heidelberg, June 12, 1980

by

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(Dr. Beyea performed the dose calculations for the Union of Concerned Scientists (UCS) in their report, "Decontamination of Krypton-85 from Three Mile Island Nuclear Plant," May 15, 1980.)

The Heidelberg group has suggested that doses from isotopes other than Krypton-85 could dominate the radiation doses following venting of the atmosphere of the Three Mile Island #2 reactor containment building. In particular, they calculate that as much as 8 curies of Cesium 137 could be released if, at the time of release, the airborne concentration of Cesium 137 should equal the maximum concentration of radiocesium measured over the last year. Although I do not expect an 8 curie release of Cesium-137 to occur during venting,[1] I would agree that such a release would produce a much larger cumulative radiation dose than would release of 57,000 curies of Krypton-85.[2,3] I would not expect, however, any cancers to necessarily result from such a release.[4,5]

Although I do not expect a significant release of non-gaseous fission products to occur, I conclude that an "early warning" monitoring program at the release point would be an appropriate response to the concerns raised by the Heidelberg group. Such a program could be instituted relatively quickly.

As an example of a suitable monitoring program, I have considered the addition of an extra particulate filter, of known efficiency, to the venting stack -- a filter which could be checked periodically during the release for the presence of radiocesium. My preliminary analysis of this method suggests that it would be possible to use data taken early in the venting period to estimate the total number of curies of cesium 137 likely to be released over the entire period.[6] In this way, it could be determined whether or not the total release of cesium 137 would exceed, say, .01 curies -- an amount which would, by my calculations, bring the cumulative cesium dose below the gamma dose from Krypton-85 and well below the skin dose from Krypton-85.[7]

Anxiety over the Heidelberg report could then be relieved by a very simple procedure: a promise that the release would not be allowed to proceed if, at any time, the projected cesium release exceeded a stated threshold.

Notes and References

1. Before it is possible to estimate the quantity of non-gaseous elements which might be released during venting, it is necessary to interpret the enormous fluctuations found on different occasions in the measurements of non-gaseous fission products contained in the atmosphere. If the fluctuations were caused by sampling errors, then the average concentration value is the appropriate value to use. If, on the other hand, the measurements reflect a real variation in the airborne concentration, then simple probability arguments suggest that it is unlikely that the high values will occur throughout the whole period of the venting.

   It was on the basis of arguments such as these that I concluded in my analysis for the UCS report that Krypton was the most important isotope. However, the Heidelberg group has suggested that the venting process itself might perturb the situation, leading to high concentrations of airborne particulates. Since such a conjecture does not seem unreasonable to me, I recommend as discussed in the text, that the release be monitored for early signs of radiocesium and other radioisotopes.

2. The dose from cesium-137 would not occur instantaneously, but would occur over many decades. In my calculations, the dominant contribution to the cumulative dose would arise from the long-term "groundshine" gamma dose produced by radiocesium deposited on the ground. 8 curies of cesium 137 and the accompanying cesium 134 would produce, over the next 50 years, a whole-body population dose out to 1000 miles of about 200 person rem. (Based on calculations in Ref. 3.)

   (For a release of short duration, with the winds blowing preferentially towards Harrisburg or New York City, the population dose might be 600 person-rem.)

   Note that the Heidelberg group finds a higher population dose (2200 person rem) through the food pathway. However, their numbers are based on their own food-chain calculations which predict doses about an order of magnitude higher for cesium than would be predicted using conventional methods. Since I have not myself independently reviewed the Heidelberg food-chain analysis, I am not in a position to accept or reject the Heidelberg population dose calculations for cesium.

3. Jan Beyea, "Some Long-Term Consequences of Hypothetical Major Releases of Radioactivity to the Atmosphere from Three Mile Island," Report to the Council on Environmental Quality, September 1979.

4. The number of health effects calculated to result from a given population dose depends on the value of the "dose-effects" coefficient which is assumed. This coefficient--the number of cancers produced per million whole body rem--is an uncertain number. In my calculations, I generally use a range for this number which varies from 150 to 1500 non-fatal cancers per

million person rem. Thus, a 200 person-rem population dose (see Note 2) would lead, at most, to a one in three chance of a cancer occurring.

However, should the Heidelberg food-pathway methodology be accepted, an 8 curie release of cesium might lead to a few cancers developing years later in the exposed population.

5. I do not find elements other than cesium (and krypton) to be of major importance: In all of my calculations of reactor accidents, the Cesium isotopes and radioiodines dominate the health consequences following a release of radioactive aerosols. By now, the short-lived radioiodines have decayed to low concentration levels--leaving the radiocesiums the major concern from a release of particulates. It should be noted, however, that my calculations do not extend beyond 75 years in the future. I have not checked whether or not other isotopes with very long lifetimes could make an appreciable contribution over the next 1000 or more years to the total dose.

6. I expect that radiocesium would be easily detectable in the absence of krypton. Thus, the flow of vented air could be halted periodically, and gamma readings taken by a spectrometer kept in place near the monitoring filter.

7. Even if the Heidelberg food-chains coefficients are used, the population doses would be very small--suggesting that no health effects would result from a .01 curie release.