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September 12, 2002

Dr. William Schull, Chair

"Review of the CDC-NIH-Feasibility Study of the Health Consequences to the American Population from Nuclear Weapons Tests," Project Number BRER-K-01-02-A
National Academy of Sciences

Dear Dr. Schull:

We are submitting comments and observations for the Committee's consideration as you review *A Feasibility Study of the Health Consequences to the American Population from Nuclear Weapons Tests conducted by the United States and other Nations* (hereafter, "Study") which was prepared by the Centers for Disease Control and Prevention (CDC) and the National Cancer Institute (NCI).

The Institute for Energy and Environmental Research (IEER) has studied and been concerned about the health and environmental effects of nuclear weapons production and testing since its inception in 1987. IEER has published a number of books, reports and articles on the subject, including *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and Its Health and Environmental Effects* and *Radioactive Heaven and Earth: The health and environmental effects of nuclear weapons testing in, on, and above the earth*.

We are pleased that the U.S. government has over the past decade, after a long and damaging period of denial, begun to face the health and environmental legacy of the Cold War. The Study you are reviewing, which examines several aspects of the health consequences to people in the contiguous United States from radioactive fallout from most atmospheric nuclear testing, is part of that examination.

Our review of this work concludes that it will be well worth the effort to actually complete the Study. The methodology will need to be refined and made more transparent, however. We have several concerns about the details in the Study that we hope you will address in your review. We also hope that you will make specific recommendations about the public health measures that must be taken now, so that the public is not waiting in limbo forever while scientists carry out prolonged and complex studies. We also believe that the full study should be conducted expeditiously and released in a timely fashion, unlike the 1997 NCI report on the effects of iodine-131 fallout. Delays in publishing data and analyses are fundamentally unfair to people who have diseases that may be related to fallout and who need information and help.

Our specific comments on the Study, organized according to section of the report, and our comments on outreach are as follows:

Volume 1

1. The assumption that red bone marrow dose and thyroid dose due to external radiation are the same (p. 54) is questionable and may cause a significant underestimation of bone marrow dose. Since most of the red bone marrow in the body is closer to the ground than the thyroid, and since dose varies as the inverse square of the distance for the source, the bone marrow dose may be several times the effective dose. The methodology in Appendix D does not make clear how the single radiation dose rate for all organs was set in the matter of height. While equation 3.1 in the main report indicates that a w_T factor is taken into account for each organ, it appears not to have been done. See comments below relating to Appendix D.
2. External doses are assumed to be age independent. Does that mean that adult w_T factors were used for children as well? If so, this could systematically underestimate doses to children (due to the same inverse r-squared dependence of gamma dose discussed above), with the underestimation being greater for farm children spending much of their time outdoors. The Committee should inquire whether adult w_T factors were used for children and if so recommend an examination of the implications.
3. Based on the discussion in chapter 3 on external doses, it appears that people who spent most of their time outdoors, such as the shepherds, ranchers, farmers, farm workers, and their families would have had doses several times the average for the county (pp. 55-57). Thus in high fallout areas, external doses could be an order of magnitude greater than the national average for the farming and ranching population. Doses to farm families, with people spending a lot of time outdoors in heavy work, would seem to be a factor of five or ten greater than the average for the county. There may be a high differentiation by ethnicity, since occupation, living structure characteristics, and food habits varied by ethnicity. For instance, some Mormon farm families raised goats. Children drinking goat's milk on such farms would have received very high doses to the thyroid (on the order of 1,000 rem or even more in high fallout areas). Shepherds in Utah and Idaho were disproportionately of Basque origin and hence this population would also have been disproportionately affected. Did the CDC take into account that meat in such areas would be much more highly contaminated and the disproportionate effect that consumption of such meat would have on farming and ranching families? (Note that farm animals, such as sheep dogs and outdoor-grazing animals [cattle, goats, sheep, and horses] would also have been disproportionately affected, with potentially serious economic impact in some cases. The Study does not address such issues.) Doses to farm families, specifically exposures in-utero and exposures of children, should be explicitly calculated and presented. Doses to people, especially those on farms, drinking goat's milk should also be explicitly assessed.
4. Only adults have been considered for internal dose in the Study (p. 62). The age dependence of diet is acknowledged to be great (p. 62). Hence we might expect that the doses to children would be substantially different. Given the special significance of childhood leukemia in the Study, at least some computations of bone marrow dose to children would have been important. The greater importance of milk in the childhood diet would affect this dose significantly, since the milk pathway is important for strontium-90.
5. In-utero carbon-14 and tritium doses were not calculated. Doses to children were not calculated. Doses to ova in formation in females in-utero were not calculated. Not one of

these issues is even mentioned in the report, though they may raise the risk of cancer and non-cancer effects, including birth defects and miscarriages. See the 1999 IEER-initiated letter to the BEIR VII committee of the NAS, [attached](#).

Appendix D

1. External exposures in high fallout areas close to the Nevada Test Site (NTS) are "underestimated in this report." These estimates may be "up to 50% too low" (p. 14). These are areas where the fallout cloud would have passed less than 12 hours after the test. Depending on the test, this may affect areas a few tens to a couple of hundred miles from the NTS. These problems should be corrected.
2. A relaxation length of 0.1 cm is used for soil for the first 20 days of deposition. It is not clear that this is a conservative assumption for farming and ranching families in arid areas.
3. What was the distance from the ground for bone marrow as an organ? How does it compare with the effective radius? Was the effective radius weighted appropriately for the non-linearity of gamma dose variation with distance? If the effective height of the person for the external effective dose equivalent (EDE) calculation is about 3 feet, then this would seem to underestimate bone marrow dose, since most of the marrow is below the waist. It would underestimate it even more for children, perhaps by a factor of several fold. The effective height should be closer to a foot or a foot-and-a-half.
4. The discussion on p. 54 does not make clear what EDE factor was actually used for external radiation. In Appendix D, it states that a factor of 0.66 rem/R was used. It is unclear whether a higher factor for children - a 30% higher factor is indicated - was used (p. 15). Based on the statement on p. 16, it appears that none of the factors that would increase dose, including the higher dose conversion factor have been used. "In this report, all calculations of dose are based on the average exposure given above and estimates for any individual should be adjusted up or down based on the above discussion." (p. 16). Children's external doses would seem to be underestimated due to use of the adult EDE factor of 0.66 rem/R.
5. Table A4 on p. 16 indicates that a single factor for mR/hour has been used for external dose estimates. The height at which this radiation dose rate is measured is not specified. The estimation of bone marrow dose in particular, both to adults and children may be considerably affected by this method of calculation. Depending on the height at which the dose rate is specified, it may affect the external radiation dose estimate to the bone marrow by several fold.

Appendix E

1. Inhalation doses have not been directly calculated but estimated as fractions of the ingestion dose (pp. 42-44). Equation 3.2 on p. 59 applies only to ingestion dose. This indicates that inhalation doses were entirely omitted. Not even a single example calculation has been done even though air concentration data are available and even though this is the most important pathway for plutonium dose. The only radionuclide for which inhalation doses are estimated to be greater than ingestion is Pu-239/240. The factor estimated is 2.6. This is about a factor of 120 larger than the estimated ratio for I-

131, which is soluble, and a factor of 240 greater than Sr-90. This seems strange, since the uptake of plutonium from the gut is only 1 in 10,000. Based on this the inhalation to ingestion ratio for plutonium-239/240 should be approximately 200 or more. It is surprising that the Study does not appear to have done even a small number of calculations using air concentration data to validate its factor of 2.6 for the inhalation to ingestion dose ratio for plutonium. Indeed, no actual results for inhalation dose have been provided. Also note that the inhalation calculation assumes 80 percent of the time spent indoors. The plutonium inhalation doses may have been underestimated due to these assumptions. Were any verification calculations done with air concentrations to see if the inhalation to ingestion dose ratio seemed reasonable in the case of hot spot areas - such as areas where people actually remember fallout settling on laundry hanging out to dry?

2. Special factors may enhance inhalation doses considerably for some populations. It would appear that inhalation doses, including possibly inhalation doses from plutonium, may be important for ranching and farming families in hot spot areas. This does not appear to have been taken into account. (Note: the term farming and ranching families includes farm workers and ranch-hands and their children who may have been outdoors with them much of the time.) In high fallout, high dry deposition areas, such as those in Nevada, Utah, Arizona, Wyoming, Montana, Colorado, and Idaho, there is ample anecdotal evidence that there was considerable deposition of fallout on laundry hanging outdoors to dry. Women handling this laundry may have therefore received considerable re-suspension doses. These have not been discussed at all, much less estimated.
3. The chart for integrated intake used for Cs-137 shows enormous variation in the May-September period, with a steep drop and then a somewhat steep rise (p. 17). What is the basis for this?
4. Why did the Study redo the I-131 doses with constant value for retention of I-131 by vegetation instead of the rainfall dependent and presumably more accurate retention used in the 1997 NCI study? This assumption resulted in a reduction in population thyroid dose estimate by a factor of 2 (p. 74).

Appendix F

1. Little or no continuous data exist for fallout prior to 1958. There was gummed film data since 1952 but this appears not to have been used.
2. The essence of the approach has been to use meteorological data as well as soil and deposition data for Sr-90 to develop a model of geographical variation in Sr-90 deposition. This was then used as a template for all other radionuclides (pp. 9 and 10). This means that the geographical variation due to emissions from nuclear weapons facilities has not been taken into account. Possible emissions of Sr-90 are from reactors and reprocessing plants (Hanford, Savannah River Site, Idaho National Engineering Laboratory, Oak Ridge, West Valley in New York [commercial reprocessing]) as well as places that may have processed or separated Sr-90 as such. The latter sites would include Hanford (where Sr-90 was separated from high-level waste) as well as those sites at which Sr-90 thermoelectric generators may have been made. This should be done in follow up work.
3. Note that this model results in serious underestimates for areas with low rainfall and high dry deposition. ("There are also large differences for countries in very arid locales where

the model's neglect of dry fallout resulted in a significant underestimate of Sr-90 deposition density." p. 15.) These are precisely the areas with high NTS fallout. Some of these are also areas with large farming and ranching populations. Hence a variety of assumptions and simplifications in this report has created a systematic underestimation of doses to farming and ranching families. Some of these factors have been given a quantitative estimate (as for instance in relation to time spent outdoors), but others such as the omission of dry fallout have not.

Methodology

One important overall issue is that the methodology appendices do not appear to contain a specific method of separating doses due to radionuclide releases from nuclear weapons plants from those attributable to nuclear weapons tests so far as the deposition of radionuclides is concerned. In the case of radionuclides where the total is estimated from weapon explosion megatonnage, notably carbon-14 and tritium, this is not an issue. But it would appear to be an issue for deposition data.

Public Health Outreach

We have believed since the 1997 NCI study was published that three health measures are of the utmost importance, both for public health and for democracy and trust in government:

1. People who were in the most affected areas during testing should be sought out and informed about the exposures, circumstances and risks. This should include intensive outreach in all high fallout areas with special attention being given to farming and ranching families.
2. Physicians, nurses and other medical personnel throughout the country should be trained to recognize the symptoms of thyroid abnormalities and other radiogenic diseases and to inquire of their patients the geography and circumstances of their upbringing in case of suspicious symptoms or history of residence in a high fallout area.
3. The governments of the United States and other nuclear weapon states have an obligation to assess the damage their nuclear weapons testing and development programs have inflicted upon people in non-nuclear countries. Scientists working in the United States, the country that has done more than any other to assess such damage, should take the lead in urging their counterparts in other countries to examine the harm done by their nuclear weapons programs as well. We would appreciate a statement from the NAS to its counterparts in other countries to that effect.

Outreach by the Committee

Finally, we would like to express our disappointment with the Committee's lack of proper outreach regarding its formation and activities. We learned of the Committee's establishment only through a cold call to NAS in late May 2002, about a month after the Committee's first meeting. When I spoke with the Study Director, she implied there was not much public interest in the first meeting. When I replied that is likely because no one knew about it, she responded: it was on the web site.

This is not acceptable. It is disingenuous, to say the least, for the Committee to assume the public is informed and involved by simply making a posting to the very large and somewhat complex NAS web site. There is not even any indication on the CDC fallout study web site, the original web site containing information on the Study, that the NAS had begun its review of it (www.cdc.gov/nceh/radiation/fallout/). Moreover, the fact that IEER has long been concerned about the health effects of nuclear testing is widely known; it is even documented in newspaper articles and press releases on the Committee's reading list. We are particularly aggrieved and dismayed that the NAS review committee took a pro-forma and completely ineffective approach to notifying the public on an issue of obvious public health importance.

If it were not for our cold call, we and many other concerned people and organizations may not have learned of or had opportunity to comment on the review until release of the Committee's final report. The Committee may benefit from our, and others', involvement. We hope the Committee, and the NAS, will be more open and inclusive of the public in the future.

Thank you for considering these comments. We look forward to the Committee's detailed and specific response to them.

Sincerely,

Arjun Makhijani, Ph.D.
President

Lisa Ledwidge
Outreach Director, U.S., and Editor of *Science for Democratic Action*

cc:

Dr. Isaf Al-Nabulsi, Study Director
Committee Members Present at September 12, 2002 Meeting in Des Moines, Iowa

Attached:

[Letter to BEIR VII Committee from IEER and others, September 3, 1999 \(signatures updated December 20, 1999\)](#)