



IEER Memorandum on Tritium

To: Joseph and Cynthia Sauer

From: Arjun Makhijani

Subject: Review of Braidwood Generating Station Groundwater Issue: Frequently Asked Questions (Last Updated March 1, 2006) by Exelon Nuclear

Date: 20 March 2006

You asked me to take a look at *Braidwood Generating Station Groundwater Issue: Frequently Asked Questions (Last Updated March 1, 2006)* by Exelon Nuclear, which is on the web at www.braidwoodtritium.info/images/FAQ_-_3-1-06.pdf. I downloaded it from the Braidwood website on 18 March 2006. Here is my review.

Factual situation: Exelon's FAQ acknowledges that leaks from its discharge pipe that occurred at various times since 1996 have contaminated groundwater in the vicinity of the plant and on site. Exelon states that it is storing Braidwood tritiated water in tanks. The FAQ does not define the term "as needed" so that it is not clear how long this storage will continue and what is driving the need, given the company's position that 20,000 picocuries per liter of [tritium](#) is "safe."

I found the Exelon FAQ deficient, even troubling, on some key issues. Here is my analysis.

1. The Exelon FAQ asserts, among other things, that the Environmental Protection Agency's (EPA) limit of 20,000 picocuries per liter for water contamination is "safe." It also asserts that the EPA has set this standard according to what is "safe to drink" Both of these assertions are wrong and, coming AFTER the scandal, egregious. These assertions indicate (i) ignorance of the scientific basis of risk assessment for radiation (most importantly the BEIR series of studies by the National Academy of Sciences, of which BEIR VII is the latest and most recent evaluation of the state of the science) and of how EPA defines "safe," or (ii) a deliberate intent to mislead having knowledge of these things. I hardly know which is worse.
2. The established science is, and has been for some time, that there is no threshold for cancer risk of radiation and therefore no level of exposure is "safe." While it is true that we all are exposed to natural background radiation, this does not mean that natural background radiation is "safe." By the same reasoning one could imply that exposure to an influenza virus is safe because the virus is natural. Worse, it is analogous to implying that exposure to the virus on a long airplane ride is natural and hence safe (analogy to indoor radon, which is an artifact of construction). It is transparent that these are nonsense arguments. Cellular level research indicates that small exposures to radiation cause damage that could become the locus of later development of cancer. Further, most of the annual exposure of 300 to 350 millirem (mrem) that the FAQ write-up mentions is from indoor radon. The EPA does not say that this poses no risk. On the contrary, exposure to radon and its decay products is well-known to increase lung cancer risk.
3. Using risk factors published by the EPA (in a CD, Federal Guidance Report 13, also called FGR 13) in 2002 for mortality from cancer, I estimate that ingestion of tritiated water at the rate of 1.5 liters per day at 20,000 picocuries per liter (pCi/L) over a lifetime of 70 years would cause a fatal cancer risk of about 4 in 100,000. The morbidity rate (incidence risk) is higher by about 30 percent (about 5.7 in 100,000), also according to coefficients in FGR 13 for tritiated water intake.



I used 1.5 liters per day for water intake, less than the usual standard assumption of 2 liters per day for adults, since intake by children is averaged with intake by adults. No account is taken of organically-bound [tritium](#) in this calculation.

4. The EPA defines safe as zero known risk. Therefore it not only sets Maximum Contaminant Levels (MCLs) but also Maximum Contaminant Level Goals (MCLGs). The latter are the levels considered safe. MCLGs for all radionuclides are zero. See www.epa.gov/OGWDW/mcl.html. The company should know this. The EPA defines MCLG as

“The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. Maximum contaminant level goals are nonenforceable health goals.” (http://iaspub.epa.gov/trs/trs_proc_qry.navigate_term?p_term_id=1085423&p_term_cd=TERMDIS)

In the case of radiation, the EPA, Nuclear Regulatory Commission (NRC), National Academy of Sciences, and the National Commission on Radiation Protection and Measurements have all concluded that the hypothesis that best fits the facts is that there is some risk from exposure to radiation, no matter how small the exposure and that, for solid cancers, the risk is proportional to the level of exposure (this is the linear, no threshold hypothesis). For radiation, therefore, an MCLG of zero has no margin of safety in it. Above zero exposure, there is a positive, non-zero risk. That is the science on which radiation protection regulations are based.

5. The Exelon FAQ does not provide data for the levels of routine discharge and drinking water contamination. It does allude to the fact that tritium is discharged into the river. The Braidwood plant does pollute the drinking water of some people in the area. Even though the level is well below the EPA MCL, it is above natural background and above the EPA MCLG. This should not be described as “safe”. Besides meeting the drinking water limits, the company is required to conform to ALARA — keeping exposures as low as reasonably achievable. It is not clear to me that the company is doing that. At this stage, the burden should be on the company that there is no reasonable alternative to these discharges and on the NRC to enforce its regulations.
6. As I have noted, tritiated water and organically-bound tritium has other effects, including contributing to the risk of birth defects, genetic defects, and miscarriages. This is not mentioned in the Exelon FAQ.
7. The Exelon FAQ assertion that 20,000 pCi/l is “safe” is in direct contradiction to the EPA Fact sheet on tritium to which the company provides a link. That fact sheet says: that tritium is one of the “least dangerous radionuclides” but also reminds that “As with all ionizing radiation, exposure to tritium increases the risk of developing cancer.” (www.braidwoodtritium.info/images/US_EPA_Facts_About_Tritium.pdf) Note that my risk estimate (4 fatal cancers in 100,000) is within the EPA target risk range of 1 in 10,000 to 1 in a million range. I used EPA risk coefficients. (I do not agree with the “least dangerous” characterization of tritium since the EPA rule does not take into account non-cancer risks, such as birth defects and miscarriages, or the risks of in utero exposure. The EPA’s statement characterizing tritium is therefore rather too narrowly based.)

You might want to ask the company for those instances of Cs-137 and Co-60 measurements. According to the Exelon FAQ, some of the measurements above the detection limit. It would also be useful to know that what Exelon’s detection limit is.



Recommendations

1. I think letters to the EPA and the company from the community pointing out the problems and the commendable things in the Exelon FAQ might be useful. You might want to ask Exelon to stop tritium discharges from its other nuclear plants also.
2. A second letter to the NRC demanding a suspension of power generation at Braidwood may also be considered in view of the continued and what appears to be studied ignorance of the company to the elementary basis of regulations of radionuclides in water, including in the EPA fact sheet cited by the company itself, as well as ALARA rules. That suspension might continue until all Exelon senior executives and all the PR people responsible for fact sheets, FAQs, etc. demonstrate knowledge that they understand the risks of radiation and the basis of regulations. This might encourage some rapid learning on radiation science and regulations that has not taken place so far. As President Truman is said to have remarked (perhaps apocryphal), “the most sensitive nerve in the human anatomy runs through the pocketbook.”
3. Exelon needs to fix the FAQ, of course. It should also continue its zero tritium discharge approach and make that independently verifiable. It should include discussion of routine contamination of surface water and what Exelon is doing to meet its obligations under the ALARA rule – which is the regulation that obliges them to keep [radioactivity](#) releases “as low as reasonably achievable.”
4. I might preface my final recommendation with a quote from President John F. Kennedy’s speech to the people of the United States on July 26, 1963 announcing the atmospheric test ban treaty, which goes to the issue of involuntary vs. natural radiation exposure, among other things:

...the number of children and grandchildren with cancer in their bones, with leukemia in their blood, or with poison in their lungs [due to radioactive fallout from atmospheric nuclear testing] might seem statistically small to some, in comparison with natural health hazards. But this is not a natural health hazard — and it is not a statistical issue. The loss of even one human life, or the malformation of even one baby — who may be born long after we are gone — should be of concern to us all. Our children and grandchildren are not merely statistics toward which we can be indifferent.

In view of the widespread tendency in the nuclear industry to sidestep or misrepresent the risks of low level radiation, I suggest the following:

Every nuclear power plant and nuclear weapons plant operation should have two things inscribed in the front of every training manual and in every company report to shareholders, in the hope that they will get it even if the management does not: (i) the above quote by President Kennedy, and (ii) a clear statement of the BEIR VII report’s conclusions. (I offer to supply such a statement as a public service, free of charge, to the nuclear industry.)