Follow-up Memo to NRC Chairman Allison Macfarlane

To: Dr. Allison Macfarlane, Chairman, NRC
From: Arjun Makhijani
Subject: Some notes and references regarding our meeting on November 13, 2012
Date: November 14, 2012
Sent by email to Mary Woollen: Mary.Woollen@nrc.gov
cc: office@ieer.org

Thank you very much for having taken the time to meet with me yesterday. This is to follow up and provide you with some notes and some URLs for reference to make it easier for you and your staff to pursue any of these points in more detail, should you wish to do so. My recommendations are in bold.

Our meeting covered three topics:

1. Pilot epi studies: Some issues relating to the pilot epidemiological studies that the NRC authorized a National Academies panel to pursue following the publication of the panel's feasibility study and recommendations earlier this year.
2. Radiation risk communication by the NRC.
3. 10 CFR 61: Some concerns that I have regarding the way that the NRC has been handling some scientific issues relating to low-level waste, including the potential revision of 10 CFR 61.

1. Pilot epi studies

I really appreciate that the NRC has decided to fund the pilot studies. However, IEER recommended that only the case control study should be done. This option was not discussed in the NRC's memorandum authorizing the studies dated October 5, 2012 (SECY-12-0136). My comments on the feasibility study are at:

http://ieer.org/resource/testimony/ieer-analysis-cancer-risks-populations/

I am not asking for a revision of the NRC mandate to proceed with both the case control and the ecologic pilot studies. However, it would be useful, and may help avoid the controversies that are very likely to attend upon the ecologic study, **if the panel were to pursue and publish its work in two parts – the children's case control study first and then the ecologic study, with due attention to the lessons learned from the case control study.**

It is important for the pilot study to consider the effects of more than one nuclear power plant if people are living in the shadow of more than one. Specifically, Dresden and Braidwood should be considered together, because there are people affected by both – like the Sauer family. Sarah Sauer had brain cancer at the age of 7; she was operated on and lives with severe aftereffects. Her father, a medical doctor, has done an important *preliminary* analysis of childhood cancer data in the area, despite facing many obstacles. He presented his work to the National Academies panel. His slides are at:

http://dels.nas.edu/resources/static-assets/nrsb/miscellaneous/Sauer_morning_present.pdf

I know he would be happy to discuss his findings and experience with you. He can be reached by email and by phone. Sarah's mother, his wife Cindy Sauer, has reviewed the above information.

Tritium is likely to be a critical radionuclide for estimating fetal dose from nuclear power plant operation. IEER concluded some time ago that the ICRP's method of attributing the mother's uterine wall dose from tritium (and from alpha-emitting radionuclides) to the embryo during the first eight weeks of pregnancy is incorrect. Though I have not yet looked at it specifically, it seems to me that the problem also extends to carbon-14, which was also identified as a key radionuclide in the feasibility study. The issue of a scientifically defensible approach for fetal dose estimation, especially during the early part of pregnancy, needs to be addressed because it is very important for a credible children's case control study that is geared (rightly so, in my opinion) to the mother's place of residence at the time of the birth of the child. IEER's report, *Science for the Vulnerable*, which briefly covers this issue can be downloaded from the following URL:

http://ieer.org/resource/reports/science-vulnerable-setting-radiation/ (please see p. 73 and p. 85)

I recommend that the NRC request the EPA's Science Advisory Board or the National Academies Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation to provide it with scientific advice as expeditiously as possible on how fetal doses, including in the first eight weeks, from alpha emitters and relatively low-energy beta emitters, particularly tritium and carbon-14, should be calculated. This problem should also be addressed by the National Academies pilot study in the course of its work. I intend to bring it up in my initial comments when the panel starts its work.

A related data problem is that the NRC does not require monitoring of tritium in rainwater, though this is recognized as a potential issue by at least some in industry. This could be a crucial exposure pathway especially during pregnancy, notably for people with private wells. In 2006, Ken Sejkora of Entergy Nuclear Northeast (Pilgrim Station) estimated that under adverse weather conditions, episodic releases could result in concentrations as high as 36 million pCi/L – 180 times the drinking water limit close to the stack (probably onsite, though this is not explicitly stated). Sejkora used a source term of 1 Ci/day. While this choice is on the higher side of routine releases (for one sample year, 2004) I have looked at, even higher tritium source terms releases from US nuclear power plants have been measured. For instance, the Palo Verde plant reported 2,123 curies of tritium releases to the atmosphere in 2004 (all three reactors). The Sejkora reference is:

Ken Sejkora, *Atmospheric Sources of Tritium and Potential Implications to Surface and Groundwater Monitoring Efforts*, Entergy Nuclear Northeast – Pilgrim Station, presented at the 16th annual RETS-REMP Workshop, Mashantucket, CT, 26-28 June 2006. The link is at http://www.docstoc.com/docs/114828734/Atmospheric-Sources-of-Tritium-and-Potential-Implications-to
.

I recommend that the NRC require routine monitoring of rainwater around commercial nuclear reactors. The NRC should also encourage nuclear power plant owners to consider making funds voluntarily available to private well owners nearby in case the well-owners want to have their water tested for tritium and other radionuclides emitted from nuclear power plants.

2. NRC's radiation risk communication

The NRC's radiation risk communications with the public leave a lot to be desired. It would be extremely helpful if the NRC's statements to the public on radiation risk clearly stated that the best scientific understanding of low level radiation risk for cancer is that there is no safe level of exposure. Only zero exposure results in zero cancer risk. Instead, of explaining that this is the basis of its own regulations and those of the EPA, the NRC's website states the following:

"In general, a yearly dose of 620 millirem from all radiation sources has not been shown to cause humans any harm." http://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html

The 620 millirem total includes natural background, indoor radon and even medical radiation, the risk of which is now a matter of considerable public concern, despite the benefits that may accrue from it to the person getting the radiation dose. Moreover, an annual US population exposure at this level per person would be associated with over 200,000 excess cancers per year, using an average risk coefficient for cancer incidence of 0.11 cancers per person-Sv. The statement on the NRC's website seriously misleads the public and, in my opinion, negatively affects public confidence in the NRC. **I recommend that it be replaced with a simple statement that reflects radiation risks as presented in the BEIR VII or EPA's Federal Guidance Report 13 (FGR-13). The word "safe" should be not be used in the NRC's public pronouncements about radiation unless the NRC is certain that there has been and will be no public exposure from the situation being discussed; in that case the statement should explicitly specify that the meaning of "safe" is that there has been no radiation exposure to the public due to the problem at hand. Guidance to that effect should be provided to licensees.**

3. 10 CFR 61

I have long thought that waste classification should be made more rational; as you know, it is a widely held view. However, revising the low-level waste rule it should not become an occasion to loosen radiation protection or to make scientifically indefensible calculations.

First, the present Subpart C of 10 CFR 61 limits annual doses to the whole body or to any organ, except the thyroid, to 25 millirem per year; the thyroid dose limit is 75 millirem per year (10 CFR 61.41). In public documents and statements, such as SECY-08-187, the NRC has indicated that the organ dose requirement was not addressed in compliance modeling because using only the total effective dose equivalent (TEDE) is "modern" science. In fact, the most recent science of internal dosimetry is based on committed organ doses – as evidenced in the EPA's FGR-13, which is its current guidance document. The internal dose portion of the TEDE is in fact derived from organ doses by attributing weighting factors to various organs, which have changed from time to time. It is much more sensible and scientific to rely on organ doses for internal doses than on an imputed whole body effective dose. TEDE is a useful concept for regulation, and I am not objecting to its use in compliance assessment, especially since it allows combining external and internal dose into a single number, which enables efficient compliance assessment. However, organ dose limits are central to existing radiation protection standards, especially for radionuclides that have preferred target organs, such as actinides, radioiodines, and strontium-90. By all means let's go from ICRP 2, which dates from the late 1950s, to FGR-13, but the NRC should not use it as an occasion to relax radiation protection. It would be especially offensive if existing radiation

protection were to be relaxed under cover of modernizing the science. **Organ doses as defined in FGR-13 must be included in radiation protection rules, including in any revision of 10 CFR 61 Subpart C. The present numerical limits should be maintained, if not tightened. Since the rule is being revised, it should explicitly define a "member of the public" for purposes of compliance assessment as including males and females and people of all ages from infants on up.**

My comments on SECY-08-0147 are at
http://ieer.org/resource/testimony/depleted-uranium-waste-nrc-wrong/

Second, SECY-08-0147 also has a number of other problems such as million-year performance estimates for shallow land burial and other dubious assumptions, including achievement of the required site stability for the duration. This provides one argument for limiting the period of performance. **But if the period of performance for low-level waste disposal is to be limited (at present there is no limit in Subpart C), then there should be *strict limits on both the concentrations and the total curie amounts of long-lived radionuclides* that can be disposed of in a facility licensed under 10 CFR 61.**

I am taking the liberty of expanding on my comments yesterday on this point. One way to set these limits could be to examine a hypothetical worst-case pulse release of the entire inventory of long-lived radionuclides into the environment in various ways immediately after the end of the period of performance. The limits for long-lived radionuclides could be set so that the dose criteria would not be exceeded with any combination of long-lived radionuclides or release modes. This could allow upper curie limits to be derived in a scientifically reasonable way that would also ensure compliance with dose criteria. **In this context, radionuclides with half-lives of more than ten years should be defined as long-lived. My reasoning is that ten such half-lives is a reasonable period for assuming the existence of institutional controls. All other low-level wastes, including depleted uranium from enrichment plants and Greater-than-Class-C waste as currently defined should be designated for deep geologic disposal.** Two IEER reports on the LES proceeding which contain technical details on DU disposal are on the IEER website at:

http://ieer.org/resource/reports/costs-risks-management-disposal/

These are redacted public versions. The NRC's files on the 2004-2005 LES proceeding should contain the un-redacted versions.

Third, in the course of the LES licensing, both the NRC staff and the company's experts declared a report to be scientifically sound even though it contained a result that would allow the disposal of more U-238 than the weight of the Earth *per gram* of Utah soil. There were also other problem results. The report in question is

D. Baird, M.K. Bollenbacher, E.S. Murphy, R. Shuman, and P.B. Klein, *Evaluation of the Potential Public Health Impacts Associated with Radioactive Waste Disposal at a Site Near Clive, Utah*, Rogers and Associates Engineering Corporation, June 1990 (RAE-9004/2-1).

Please see the uranium-238, thorium-232, plutonium-239, and plutonium-242 results on p. 5-13. The allowable concentrations for these radionuclides were reported at physically impossible levels – all more than 5.0E37 picocuries per gram of soil, implying masses many orders of magnitude larger than a gram. I

also wrote a report that was submitted to Utah's DRC for an IEER client, HEALUtah, that included this point. It can be found at

http://www.radiationcontrol.utah.gov/Rules/docs/2008/appB_com.pdf (please see Table 4)

The NRC should insist on scientific integrity and quality assurance in its own work and that of the agreement states, especially in documents having to do with licensing. That has not happened in this case despite the truly fantastic nature of the errors and the fact that the issue has been raised in several NRC forums, including formal oral testimony, and with the State of Utah, over a period of more than seven years. There has been no substantive response either from the NRC or the Utah Division of Radiation Control – at least none has so far been communicated to me.

Please let me know if I can provide you or your staff on more information, documents, or explanations of any of these matters.