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Comanche Peak Units 3 and 4 Combined License Adjudication **Docket Nos. 52-034, 52-035**

Response of Dr. Arjun Makhijani to the NRC Staff's position on Contention 9 regarding the use of the LADTAP II model

8 May 2009

The NRC Staff states that I take "issue only with the ability of LADTAP II to estimate doses from *commercial fish* and *saltwater invertebrates*"[1] . This is incorrect. I cited the examples of commercial fish and salt water invertebrates to illustrate that LADTAP II underestimated doses. My specific objection was a general objection to the use of a model that systematically underestimates dose. I stated:

> While the specifics of this [commercial fish and salt water invertebrates] comparison study relate to the Savannah River Site, *the systematic underestimation of doses is inherent in the model*, since the doses are calculated for the same source term for each case and each radionuclide.[2] [emphasis added]

The NRC staff has essentially ignored my statement that the underestimation of doses in LADTAP II is (i) systematic, and (ii) inherent in the model.

The NRC staff further claims that the underestimation of doses by the model is irrelevant because "neither commercial fishing nor commercial harvest of invertebrates occurs in Squaw Creek, the Brazos River below the Paluxy River, or the Whitney Reservoir."[3] Whether the fish are in

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[1] NRC Staff 2009, p. 35 (U.S. Nuclear Regulatory Commission. *NRC Staff's Answer to Petition for Intervention and Request for Hearing*, by James P. Biggins, Susan H. Vrahoretis, Marcia J. Simon, Counsel for the NRC Staff. Before the Atomic Safety and Licensing Board Panel. In the Matter of Luminant Generation Co. LLC (Comanche Peak Nuclear Power Plant, Units 3 & 4), Docket Nos. 52-034 & 52-035, NRC, Rockville, MD, May 1, 2009)

[2] Arjun Makhijani, *LADTAPP II Model Declaration of Dr. Arjun Makhijani*, [Re:] Comanche Peak Uits 3 and 4, Combined License Adjudication, Docket Nos. 52-034, 52-035, Institute for Energy and Environmental Research, Takoma Park, MD, [April 3, 2009]. ML090970367

[3] NRC Staff 2009, p. 35

commercial nets or at the end of an individual's fishing line is irrelevant. The fish that take in the radioactivity from that discharged to the water do not know that they are going to be caught or how they may be caught. The people who consume the fish get just the same doses from a given fish, independent of whether it was caught as part of commercial fishing or recreational fishing. The critical point in this regard is whether any fishing occurs in the stated water bodies, including the water body where the highest contamination concentration is to be expected – Squaw Creek reservoir – because that is the location where the discharges take place.

And in fact, the many members of the public do have access to Squaw Creek Reservoir for recreational purposes, as the applicant has stated in its Environmental Report:

> Water from SCR is not utilized in any way for public consumption. Access to SCR is through Squaw Creek Park for recreational activity and is limited to company employees and their families. *The activity is limited to specific hours and specific days of the week with the restriction of shoreline fishing only.* Public groups can arrange for access to participate in shoreline fishing only with specific permission from CPNPP Public Relations Department personnel.
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> The discharge from SCR is Squaw Creek, a freshwater stream that converges with the Paluxy and Brazos Rivers approximately 4.3 mi south of the reservoir (Figure 5.4-1). There are no other sources of dilution in Squaw Creek; therefore, the most limiting location for aquatic food and recreation for an individual in an unrestricted area is along Squaw Creek. From its confluence with the Paluxy River, the Brazos River flows approximately 60 stream mi south to Whitney Reservoir.[4] [emphasis added]

Members of the families of workers are not workers; they are members of the public. By Luminant's own admission, they are allowed routine access to Squaw Creek Reservoir for recreational activities, including fishing. Further, members of the public other than members of the families are also allowed access to Squaw Creek Reservoir, though with permission from Comanche Peak's Public Relations Department.

In addition, the quote above makes clear that the contamination can be expected to be present in downstream water bodies (Paluxy and Brazos Rivers and the Whitney Reservoir), though with considerable dilution. The dilution is not disputed here. What is at issue is whether the dose calculations are systematic underestimates whatever the level of contamination might be. For a given person, radionuclide, and intake pathway, the dose is directly proportional to the intake of radioactivity. Because of this, the use of the LADTAP II model will underestimate doses in the same proportion, independent of the level of intake and hence the level of dilution.

The NRC Staff states that I did "not identify the source of the information he relies on or provide the document for the Board to review."[5] LADTAP II is a model approved for use by the NRC. A minimum of due diligence would require that the NRC Staff and Board be current on the state of the model in assessing doses and updates to that model. Moreover, the NRC is itself aware that

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[4] ER, Section 5.4.1 (Luminant, *Comanche Peak Nuclear Power Plant Units 3 and 4. COL Application, Part 3, Environmental Report*, Rev. 0 (Non-Proprietary Version), Chapter 05 - Environmental Impacts of Operation, ML082680609, 2008-09-19)

[5] NRC Staff 2009, p. 35

the LADTAP II model and a larger number of its other regulations and models are based on obsolete science.[6] According to SECY-08-0197:

> 10 CFR Part 20 provides the fundamental radiological protection regulatory requirements for NRC licensees. Through the existing compatibility criteria, the Agreement States have certain requirements that are essentially identical to 10 CFR Part 20 for their licensees. The most recent rulemaking to incorporate the recommendations of the ICRP into 10 CFR Part 20 was completed in 1991, and was based primarily on the 1977 recommendations contained in ICRP Publication 26, and the public dose limit later reflected in the 1990 recommendations contained in ICRP Publication 60. Not all the recommendations contained in ICRP Publication 60 were incorporated into 10 CFR Part 20 in 1991 because those recommendations were not available during the public comment period for the proposed rule.
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> *In 1991, some other portions of the regulatory framework (e.g. 10 CFR Parts 32, 50, 51, 61, and 72) were not considered or updated along with 10 CFR Part 20.* ***Those portions not updated*** *were primarily those in which explicit dose criteria were provided, rather than a cross-reference to 10 CFR Part 20. Consequently, the use of radiation protection concepts based on the 1958 recommendations contained in ICRP Publication 1, and the maximum permissible concentrations of radionuclides from ICRP Publication 2 (1959) are still required for some licensed activities. This is* ***particularly the case for 10 CFR Part 50, Appendix I, dealing with effluents for operating power plants, current new reactor applications and early-site permits, and the next generation of nuclear plants****.* On the other hand, the NRC fuel cycle licensees requested and were authorized, on a case-by-case basis, to conduct licensed activities using the dose methodologies that have been revised by the ICRP since 1990. *As a result there are* ***three different generations of recommendations*** *(ICRP Publications 1, 26, and 60), and corresponding methodologies for calculating radiation doses, that comprise various aspects of NRC's regulatory guidance and licensing programs* ***that are in use today by various licensees****.* The staff notes that this situation is similar for other U.S. Federal agencies and the Agreement States where a similar spectrum of requirements exists.[7] [italics and bolding added]

I should not be required to provide NRC's own publications to the NRC staff; nor should I have to provide updates to the models that NRC allows when it is aware that these models are obsolete. This is clearly the case with LADTAP II. NRC Staff 2008 lists LADTAP II as among the models that are being revised. Indeed, they are part of the list of programs that the NRC itself is updating. NRC Staff 2008 has a whole Enclosure devoted to "Listing of NRC Guidance Potentially Subject for Update in support of the revision of 10 CFR Part 50 and Appendix I Regulations for Light Water-Cooled Nuclear Power Reactors". LADTAP II and the guidance for the use of LADTAP II are among the models and guidance documents being revised.[8]

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[6] NRC Staff 2008 (R. W. Borchardt (Executive Director for Operations, NRC), *Options to Revise Radiation Protection Regulations and Guidance with Respect to the 2007 Recommendations of the International Commission on Radiological Protection*, prepared for the Commissioners of the NRC, Policy Issue, SECY-08-0197, December 18, 2008, at http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2008/secy2008-0197/2008-0197scy.pdf)

[7] NRC Staff 2008, p. 2,

[8] NRC Staff 2008, Enclosure 4, p. 3

Finally, the NRC Staff has stated that the petitioners did not provide support for the part of my declaration that stated that LADTAP II uses adult dose conversion factors. NRC Staff should be aware of this and no documentation other than standard radiological literature and NRC's own literature is required to demonstrate this. As the quote above from NRC Staff 2008 shows, the 10 CFR 50 Appendix I is still based on ICRP 1 and 2, which date back to the 1950s. These are standard guidance documents that underlie the models and calculation methods. ICRP 2 and the contemporaneous National Bureau of Standards handbook NBS 69 state very clearly that it is based on an adult man. ICRP 2 states that it is based on Standard Man quite explicitly:

> **All calculations** are based on a "standard man" and thus do not provide for individual variations….This standard man is designed to represent **a typical or average adult** who is exposed occupationally.[9] [emphasis added]

ICRP 2 further cautions that it neglects differences between children and adults and that this should be kept in mind when using the document:

> The [Maximum Permissible Concentration] values listed for continuous occupational exposure are convenient in obtaining permissible levels for special groups and for the population at large….Because **the continuous exposure values listed neglect several important considerations, particularly differences between children and adults**, it should be emphasized that, even when corrected by the above factors, these can only be regarded as interim values for nonoccupational exposure. It is hoped that the term "continuous occupational exposure values" will emphasize the **provisional nature of their use for other purposes.**[10] [emphasis added]

Hence, ICRP 2 cautioned that it had neglected the differences between children and adults and that its values were "provisional" as far back as 1959. Subsequent research and guidance documents based on later ICRP publications, which have been incorporated into official guidance, including EPA's Federal Guidance Report 13 (1999 and Supplement CD in 2002) show that these differences are routinely substantial. For instance, for a given intake, the dose to an infant's bone surface from strontium-90 is almost 15 times higher than that to an adult. For tritium the value of effective whole body dose from a given intake is about four times higher for an infant compared to an adult. Moreover, the risk as a result of a given dose suffered by infants and children is far higher than that suffered by adults. All of these are well-established facts, which are currently in use in existing federal guidance documents.

In sum, we reiterate that LADTAP II:

- is obsolete,
- uses dose conversion factors based on ICRP 2, which is based on Standard Man, which is another term for Reference Man,
- is known by the NRC Staff to be obsolete because the NRC is in the process of updating it,

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[9] ICRP 2 1959, p. 7 (International Commission on Radiological Protection, *Report of Committee II on Permissible Dose for Internal Radiation (1959)*, Recommendations of the International Commission on Radiological Protection, ICRP Publication 2, Pergamon, New York, Adopted July 1959)
[10] ICRP 2 1959, p. 2

- underestimates doses systematically, especially to infants and children.

Further, the Applicant has admitted that some members of the public routinely have access to Squaw Creek Reservoir several times a week and that the Reservoir empties into other publicly accessible water bodies. The difference between commercial fishing and recreational fishing is irrelevant for individual dose calculations. Moreover, LADTAP II systematically underestimates dose to infants and children, and not only from fish and invertebrates, since it is based on Standard Man and ICRP 2. Indeed, in admitting that three different sets of guidance documents and models are used by different licensees, NRC Staff 2008 is in effect admitting that different members of the public are being protected in materially different ways. This is due to the fact that current science and guidance estimates doses that are much larger for the same environmental conditions. Indeed, since current and new reactors are all being regulated by obsolete models (not only LADTAP II) and guidance, it is not clear that the ALARA guidance that is part and parcel of existing reactor licenses and of new reactor licensing is actually being met by updated methods of calculation. This cannot be determined until dose calculations are done using updated models with dose conversion factors for those members of the public who would receive the highest dose for a given set of circumstances.

I reiterate that the FSAR needs to be completely redone using the most recent validated approaches for estimating dose to the most exposed members of the public, whether they be infants, children, or adults.

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