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**STP Units 3 and 4  
Combined License Adjudication**

**Docket Nos. 52-012-COL 52-013-COL**

**Response of Dr. Arjun Makhijani to the NRC Staff's position on Contention 17 regarding the use of the LADTAP II model**

**22 May 2009**

The NRC Staff states that I did not provide requisite materials for review as being among the reasons for rejecting Contention 17 regarding the use of LADTAP II.<sup>1</sup> STP states that “[t]he LADTAP II program implements the radiological exposure models described in Regulatory Guide 1.109, Revision 1” and that while “it is not dispositive” the NRC “has stated that ‘it is entitled to special weight.’”<sup>2</sup>

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 the LADTAP II model and a larger number of its other regulations and models are based on obsolete science.<sup>3</sup> 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

<sup>1</sup> NRC Staff 2009, p. 65 *NRC Staff's Answer to Petition for Intervention and Request for Hearing*, by Sara B. Kirkwood, James P. Biggins, and Jessica A. Beilecki, Counsel for the NRC Staff. Before the Atomic Safety and Licensing Board Panel. In the Matter of STP Nuclear Operating Company, South Texas Project, Units 3 & 4), Docket Nos. 52-012-COL and 52-013-COL, Rockville, MD, May 18, 2009

<sup>2</sup> STP 2009, p. 65 *STP Nuclear Operating Company's Answer to Opposing Petition for intervention and Request for Hearing*, Steven Frantz et. al., Counsel for the STP Operating Company, Before the Atomic Safety and Licensing Board Panel. In the Matter of STP Nuclear Operating Company, South Texas Project, Units 3 & 4), Docket Nos. 52-012-COL and 52-013-COL, Washington, D.C, May 18, 2009, p. 76.

<sup>3</sup> 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>)

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.

*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.<sup>4</sup> [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.<sup>5</sup>

Further the NRC Staff paper makes specific reference to Regulatory Guide 1.109 as being among the guidance documents that are being revised and that are based on ICRP 1 and 2.

The concern with existing regulations and guidance is that they are based on dosimetry concepts issued in 1959 under the recommendations of the International Commission on Radiological Protection (ICRP) in ICRP 2. This approach was consistent with the prior version of Part 20, but is no longer consistent with current Part 20. As revised in 1991, Part 20 changed the methodology by implementing dosimetry concepts of ICRP 26 and ICRP 30. However, Appendix I and guidance documents (e.g., Regulatory Guide 1.109 and

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<sup>4</sup> NRC Staff 2008, p. 2,

<sup>5</sup> NRC Staff 2008, Enclosure 4, p. 3

others) were not changed, and therefore are still based on ICRP 2 dosimetry concepts.<sup>6</sup>

And further:

In implementing ALARA requirements of Appendix I, the U.S. Nuclear Regulatory Commission (NRC) published a series of regulatory guides to provide guidance on how to demonstrate compliance with design objectives. The regulatory guides address methods for estimating gaseous and liquid effluent releases, dispersion of effluents in the atmosphere and water bodies, and calculating potential radiation doses to offsite members of the public. The main guidance document is Regulatory Guide 1.109.<sup>7</sup>

And more:

The proposed revision would consider updating key regulatory guides and determine whether other supporting documents need to be revised as well. The revised guidance would retain the current numerical dose criteria of Appendix I, but would redefine the dose criteria as ED or TED. Also, the adjustments made to the dose calculation methodology would be consistent with the dosimetry concepts of ICRP 103 recommendations, as adopted in the revision to Part 20. For the purpose of this discussion, the focus is on Regulatory Guide 1.109, but it should be recognized that the revision would require, by necessity, the review of other regulatory guides, supporting NUREGs, computer codes, etc., given their complex interlocking relationships in supporting the implementation of Appendix I.<sup>8</sup>

The NRC Staff paper also lists the guidance documents and models being revised and Regulatory Guide 1.109 and LADTAP II are among them.<sup>9</sup> This establishes the basic point in the contention that the model and related guidance in question are obsolete. Moreover, since the NRC Staff is aware of their obsolescence and have recommended a process by which a revision would take place, provision of proof of the same by an intervener is superfluous.

In view of the fact that the NRC Staff itself has found the Regulatory Guide 1.109 and LADTAP II, among others, as out of date, the putative “special weight” that these documents may have had prior to the NRC Staff’s own findings, cannot and should not be allowed to stand.

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 states explicitly 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

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<sup>6</sup> NRC Staff, p. 1.

<sup>7</sup> NRC Staff 2008, p. 2.

<sup>8</sup> NRC Staff 2008, pp. 5-6.

<sup>9</sup> NRC Staff 2008, 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, p. 2 and p. 3.

represent a **typical or average adult** who is exposed occupationally.<sup>10</sup> [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**.<sup>11</sup> [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.

While STP Operating Company may have used dose conversion factors in some cases specific to teenagers or children does not change the fact that the underlying models and the associated guidance documents are obsolete, being based on ICRP 1 and 2, and need to be revised to provide the necessary framework for evaluating whether there is compliance with the regulations, including the ALARA aspects of the regulations. There can be no definitive finding that the Applicant meets the requirements of dose limits until the calculations are actually done using updated and validated models using the latest dose conversion factors. How rapidly this can be done is up to the NRC’s own process of making the needed revisions. But the fact that it needs to be done has been established.

In sum, we reiterate that LADTAP II and the associated regulations and guidance documents are obsolete. Moreover, the NRC Staff and the Commission itself are aware of this fact and has admitted it. It is unsupportable that the use of such obsolete models should be allowed in some cases, while more recent science is used in others. As noted above, the NRC Staff has itself admitted that “three different generations of recommendations (ICRP Publications 1, 26, and 60), and corresponding methodologies for calculating radiation doses.”<sup>12</sup> In the case of reactor licensing the oldest and most obsolete publications and regulatory guidance are being used.

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<sup>10</sup> 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)

<sup>11</sup> ICRP 2 1959, p. 2

<sup>12</sup> NRC Staff 2008, p. 2.

The Applicant's ER needs to be 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 and in accordance with guidance that reflects the best and most recent science.

A handwritten signature in black ink, reading "Arjun Makhijani". The signature is written in a cursive style with a large initial 'A' and 'M'.

Arjun Makhijani, Ph.D.  
President, Institute for Energy and Environmental Research