Draft White Paper

SC&A REVIEW OF LAWRENCE BERKELEY NATIONAL LABORATORY SITE PROFILE MATRIX ISSUE #3

Contract No. 200-2009-28555

Prepared by
Joyce Lipsztein
S. Cohen & Associates
1608 Spring Hill Road, Suite 400
Vienna, Virginia 22182

Saliant, Inc.
5579 Catholic Church Road
Jefferson, Maryland 21755

September 2012

S. COHEN & ASSOCIATES: ***Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program***	Document No.: White Paper – SC&A Review of LBNL Issue #3 Effective Date: Draft – September 5, 2012 Revision No. 0 – (Draft)
SC&A REVIEW OF LAWRENCE BERKELEY NATIONAL LABORATORY SITE PROFILE MATRIX ISSUE #3	Page 2 of 5
Task Manager: _____ Date:_____ Joseph Fitzgerald	Supersedes: N/A
Project Manager: _____ Date:_____ John Stiver, CHP	Reviewer(s): John Stiver

Record of Revisions

Revision Number	Effective Date	Description of Revision
0 (Draft)	09/05/2012	Initial issue
	09/07/2012	Privacy Act-cleared version includes minor revisions to the figure titles for clarificatio0n purposes.

SC&A REVIEW OF LAWRENCE BERKELEY NATIONAL LABORATORY SITE PROFILE MATRIX ISSUE #3

SC&A reviewed the NIOSH response to Issue 3, in relation to the solubility of uranium and thorium compounds in the lung.

SC&A agrees with the NIOSH response that solubility Type S, as provided by the Human Respiratory Model described in ICRP 66 (ICRP 1994), adequately bounds the behavior of "high-fired" uranium. The same applies to thorium compounds.

In general, for insoluble material (Class Y or Type S), the ICRP 66 model describes a more tenacious retention in the thoracic region than does the ICRP 30 (ICRP 1979) model. For times remote from inhalation, the content of the lungs as predicted by the updated model is several times greater than that predicted by ICRP 30. Compared with the ICRP 30 lung model, the ICRP 66 model generally predicts lower absorption from the respiratory tract to blood for a given particle size, at least for particle sizes commonly encountered in the work place or environment. For 1-µm particles, predicted total absorption is about four times greater for Class Y than Type S (ORNL 2003).

As a consequence of the differences in the kinetics of the two models, the predicted excretion rates are not the same. In addition, the ICRP 30 systemic models have been updated. Current uranium and thorium models are described in ICRP Publication 78 (ICRP 1977).

Figures 1 and 2 below illustrate the differences in the predicted urine excretion rates of U-238, AMAD 1µm, using the ICRP 30 lung model and systemic models (labeled as class Y) and using the updated ICRP 66 lung model and ICRP 78 systemic model (labeled as Type S).

Figure 1: Comparison of Urinary Excretion Rates of U-238: Class Y and Type S versus Time After Intake, AMAD = 1µm, at Early Times after Intake

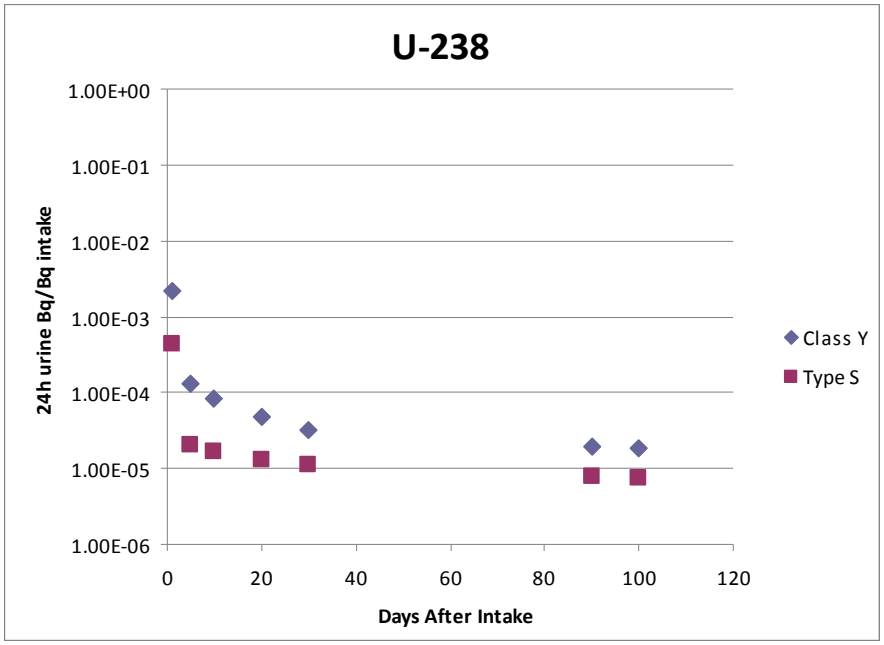
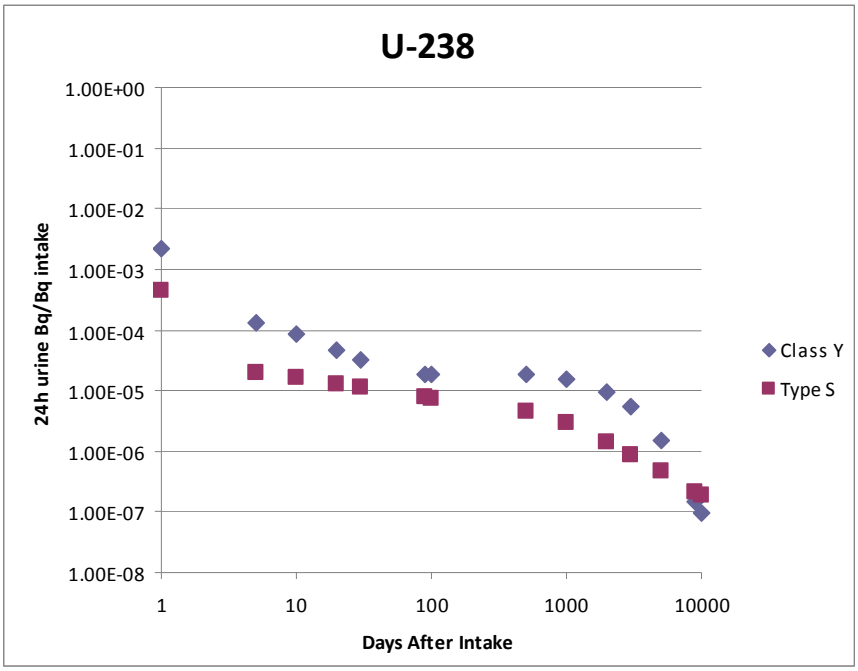


Figure 2: Comparison of Urinary Excretion Rates of U-238: Class Y and Type S versus Time After Intake, AMAD = 1 µm, at Early and Late Times after Intake



Many studies recently have been conducted to determine the solubility of various uranium compounds in the lung and their absorption rates to blood (Hodgson et al. 2000; Ansoborlo et al. 2002; and Stradling et al. 2002). None of those studies have shown lung retention that cannot be bounded by Type S. Studies conducted with uranium dioxides and U_3O_8 (Ansoborlo et al. 2002) have shown compatibility with Type S. The only exception to the general kinetics described by the assignment of Types F, M and S is for uranium aluminide (UAl_x), as described by Leggett et al. (2005). Workers exposed to UAl_x during the fabrication of reactor fuel plates, who were removed from exposure, had urinary excretion rates that increased for a few months, peaked, and then declined at a rate consistent with moderately soluble uranium.

The studies on thorium compounds are not as extensive as those on uranium compounds. Hodgson et al. 2000 and Hodgson et al. 2003 have concluded that the assignment of Type S was compatible with the kinetics of Th-232 dioxide administered to rats by intratracheal instillation.

In conclusion, SC&A agrees with NIOSH on their response to Matrix Issue #3.

REFERENCES

Ansoborlo, E., V. Chazel, M.H. Hengé-Napoli, P. Pihet, A. Rannou, M.R. Bailey, and N. Stradling, 2002. *Determination of the physical and chemical properties, biokinetics, and dose coefficients of uranium compounds handled during nuclear fuel fabrication in France.* Health Phys. 82 (3) 279-289.

Hodgson, A., J.C. Moody, G.N. Stradling, M.R. Bailey, and A. Birchall, 2000. *Application of the ICRP respiratory tract model to uranium compounds produced during the manufacture of nuclear fuel.* Report NRPB-M1156. National Radiological Protection Board, Chilton, United Kingdom.

Hodgson A., G.N. Stradling, T.J. Smith, M.J. Youngman, J.C. Moody, and E. Ansoborlo, 2003. *Biokinetics and assessment of intake of thorium dioxide*. Radiat. Prot. Dosim. 105, 115–118.

ICRP 1979. *Limits for Intakes of Radionuclides by Workers (Part 1)*, ICRP Publication 30, Ann. ICRP 2 (3-4). International Commission on Radiological Protection, Pergamon Press, Oxford, England.

ICRP 1994. *Human Respiratory Tract Model for Radiological Protection*, Publication 66, Ann. ICRP 24 (1-3). International Commission on Radiological Protection, Pergamon Press, Oxford, England.

ICRP 1997. *Individual Monitoring for Internal Exposure of Workers*, Publication 78, Ann. ICRP 27 (3-4). International Commission on Radiological Protection, Pergamon Press, Oxford, England.

Leggett, R.W., K.F. Eckermann, and J.D. Boice, 2005. *A respiratory model for uranium aluminide based on occupational data.* J. Radiol. Prot. 25, 405–416.

ORNL 2003. *Dosimetric Significance of the ICRP's Updated Guidance and Models, 1989–2003, and Implications for U.S. Federal Guidance*, ORNL/TM-2003/207. Authors: R.W. Leggett and K.F. Eckerman. Oak Ridge National Laboratory, Oak Ridge, Tennessee. August 2003.

Stradling, N., A. Hodgson, E. Ansoborlo, P. Berard, G. Etherington, T. Fell, E. Rance, and G. Le Guen, 2002. *Industrial uranium compounds: exposure limits, assessment of intake and toxicity after inhalation*. NRPB-W22, National Radiological Protection Board, Chilton, United Kingdom.