NIOSH response to NIOSH action item on Issue 3 as discussed during the Work Group meeting on Feb. 3, 2012 on Lawrence Berkeley National Laboratory Site Profile.

NIOSH response from issues matrix:
"High-fired uranium is classified as Type S material, which is one of the three dissolution types considered for each dose reconstruction. There is no evidence in the literature to support "Super Type S" behavior for uranium (such behavior is specific to Pu-239), so Type SS uranium is not used for dose reconstructions."

NIOSH action item as listed in the WG issues matrix as updated February 2012:
"Provide additional information to the NIOSH response on this issue on Super S uranium and thorium (scope of the ICRP 66 lung model type S classification compared to the older ICRP 30 class Y model as explained during the WG discussion)"

NIOSH follow up response to this issue:

ICRP 66 states that the default absorption rates in that publication "correspond broadly" to inhalation classes D, W and Y from ICRP 30. However, there are some important differences, particularly in the least soluble category:

Clearance half times for the ICRP 30 respiratory tract model

- D: <10 days;
- W: 10-100 days;
- Y: >100 days

ICRP 66 specifies absorption rates, with approximate half times:

- F: 100% 10 minutes;
- M: 10% 10 minutes and 90% 140 days.
- S: 0.1% 10 minutes and 99.9% 7000 days

The ICRP 30 assignment of uranium oxides (UO_2 and U_3O_8) to class Y is based on a paper [*Morrow, PE, Gibb, FR, Leach, LJ (1966). The clearance of* UO_2 *dust from the lungs following single and multiple inhalation exposures. Health Physics 12, 1217-1223*] that measured lung biological half times of 180 and 340 days in beagles.

ICRP 68 (*Dose Coefficients for Intakes of Radionuclides by Workers*) assigns UO_2 and U_3O_8 to type S.

However, studies of uranium oxide show that these tend to fall at the more soluble end of the type S range, and that high-fired uranium is well within Type S parameters:

- **ICRP Supporting Guidance 3, "Guide for the Practical Application of the ICRP Human Respiratory Tract Model" Annex E:** Illustrative Examples, example E addresses UO_2 at a MOX facility. Experimental studies show that the material is close to the borderline between M and S.
- **DOE Guide of Good Practices for Occupational Radiological Protection in Uranium Facilities**: "Following an accidental release from a nuclear reactor, fission and activation products may be present in fragments of irradiated fuel, of which the matrix is predominately uranium oxide (Devell 1988; Begichev et al. 1989; Toivonen et al. 1992). Studies of the in vitro dissolution of particles released from the Chernobyl accident, seven out of ten of which consisted mainly of uranium (Cuddihy et al. 1989), were consistent in assigning all the gamma-emitting radionuclides to Type M (ICRP 1996)."
- **Inhalation Of U Aerosols From UO_2 Fuel Element Fabrication (Schieferdecker, Dilger, and Doerfel; Health Physics, Vol. 48, No. I (January), pp. 29-48, 1985)** studied 12 workers handling U oxides, including high-fired oxides. The authors calculated a biological half-life of inhaled aerosols in lungs of 109 days.

Given the above studies, as well as the lack of evidence that it is more insoluble, NIOSH feels that solubility type S adequately bounds the behavior of high-fired uranium.

The assignment of insoluble forms of thorium to type S is based on the ICRP assignment of oxides and hydroxides to this class. The NIOSH team has been unable to find citations of thorium forms being retained in the lung more strongly than this. Please provide references or data for the assertion that high-fired thorium would not be adequately bounded by the type S category.