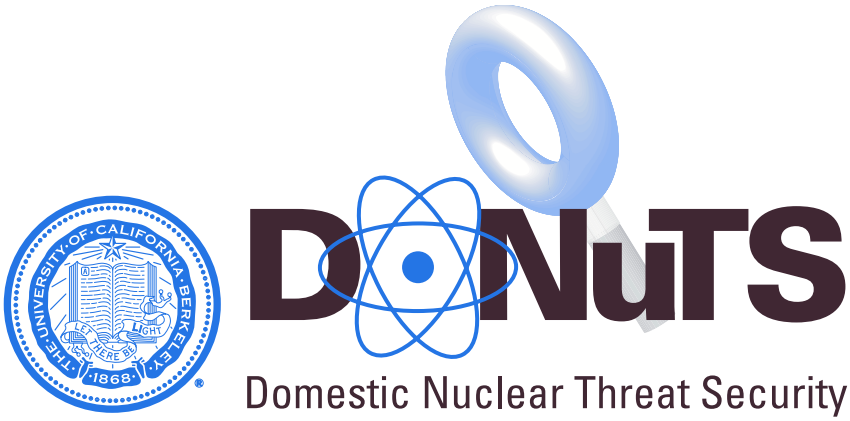

DoNuTS Technical Meeting

Time: **1600 Wednesday, 11 February 2009**

Place: **NE Conference Room, 1106 Etcheverry**

Speaker: **Charles Yeamans, UCB Nuclear Engineering**

Subject: **Synthesis of Uranium Fluorides from Uranium Dioxide with Ammonium Bifluoride and Ammonolysis of Uranium Fluorides to Uranium Nitrides**

Actinide nitrides, in particular uranium mononitride (UN), are being considered as fuel types for advanced reactor systems. Here we demonstrate a low-temperature synthesis route on uranium that could be developed into a commercial fabrication process for UN and mixed actinide nitride fuels. UN was successfully synthesized from UO_2 by first reacting with NH_4HF_2 in a ball mill at 20 °C to form tetravalent ammonium uranium fluorides. The fluorination reaction progresses though β-NH_4UF_5, δ-$(NH_4)_2UF_6$, and γ-$(NH_4)_2UF_6$ intermediate phases before finally forming $(NH_4)_4UF_8$, and is also shown to occur between solid uranium dioxide at the surface of the particles and ammonium fluoride vapor. Then the reaction of $(NH_4)_4UF_8$ with ammonia gas at 800 °C forms an α-U_2N_3/UN_2 solid solution product with a composition of $UN_{1.83}$. The x-ray powder diffraction pattern is the fcc pattern commonly referenced as that of UN_2 and this intermediate product contained 1 wt % UO_2 as an impurity. The final product, UN, was obtained by decomposing the intermediate uranium nitride at 1150 °C under argon to produce UN with a 9 wt % UO_2 impurity. Surface area increased by a factor of ten during ammonolysis, consistent with the action of a hydriding agent.