U.S. URANIUM SUPPLY TO THE RESEARCH AND TEST REACTOR COMMUNITY

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ABSTRACT

From the 1950s through the early 1990s, the U.S. Department of Energy (DOE) was the primary supplier of low enriched uranium (LEU) and highly enriched uranium (HEU) to research and test reactors worldwide. The formerly called Y-12 Plant in Oak Ridge, Tennessee, was put into operational stand down in 1994 due to inadequate safety documentation. This paper will discuss the re-start of the Y-12 Plant and its current capabilities.

Additionally, the paper will address recent changes within the DOE, with the creation of the National Nuclear Security Administration (NNSA). It will show how the change to NNSA and an organizational re-alignment has improved efficiencies. NNSA is committed to operate its sales program so that it is complementary to, and in support of, the Reduced Enrichment for Research and Test Reactors (RERTR) and Foreign Research Reactor Spent Nuclear Fuel (FRR SNF) Return Programs. The NNSA is committed to provide an assurance of competitively-priced, high-quality uranium supply to the research and test reactor community under long-term contracts. This paper will discuss some of NNSA's recent successes in long-term contracting and meeting deliveries.

1. Operational History and Current Status of the Y-12 National Security Complex (Y-12) in Oak Ridge, Tennessee

DOE was the primary supplier of LEU (19.75 wt. % ^{235}U) and HEU (93 wt. % ^{235}U) to research and test reactors from the 1950s. In the early 1990s, two major events impacted DOE's ability to supply uranium to the market. The first event was passage of the Schumer Amendment of the Energy Policy Act of 1992, which limited sales of HEU to foreign research reactors. Passage of this legislation limited HEU sales to only research reactors in which: (1) no fuel design with <20% enrichment is available; (2) the recipient of the HEU commits to use LEU whenever the design is available; and, 3) the U.S. government is actively developing an LEU fuel design that can be used in that reactor.

The second event impacting the United States' ability to supply uranium to the research and test reactor community was the operational stand down at Y-12 from 1994-1999. This resulted in a halt of all shipments of uranium to research reactors until partial resumption of activities in 1998. The operational stand down was caused by the lack of formal safety documentation for stacking containers. During the 1994-1999 timeframe, a plant-wide review was completed on all procedures and safety documentation, and all deficiencies were corrected. The uranium metal production capabilities at Y-12 are now fully operational, and capabilities for oxide production have partially resumed. Y-12 is now producing and shipping uranium around the world.

2. Formation of the National Nuclear Security Administration (NNSA)

Another recent change, which has had a positive impact on U.S. supply of LEU and HEU to foreign research and test reactors, was the formation of the NNSA. The National Nuclear Security Administration Act of 1999 created the NNSA as a separately organized agency within the DOE. Y-12 is managed by the NNSA Y-12 Site Office (YSO). The three primary missions of the NNSA are: (1) nuclear security and nonproliferation programs, including the final disposition of the Department's surplus fissile materials; (2) management of the U.S. nuclear defense; and, (3) supplying the naval nuclear propulsion programs. This NNSA uranium sales program falls under the nonproliferation mission.

Previously, DOE's Oak Ridge Operations was the contractor for uranium sales to research reactors; however, since the formation of NNSA, Y-12's supply to the research and test reactor market became a primary mission and therefore transferred entirely to YSO. Current contracts are signed by the NNSA YSO Manager. Due to the increased priority of the uranium sales activity and in order to provide better service to customers, YSO authorized the formation of the Reactor Supply Program at BWXT Y-12, L.L.C., the DOE contractor at Y-12. The Reactor Supply Program manages daily operations of the program for NNSA. Note that BWXT Y-12 is independent from the BWX Technologies in Lynchburg, Virginia.

3. Uranium Contracting with NNSA

As a matter of policy and as a point of law, [Section 3112(d) and (e) of theUnited States Enrichment Corporation Privatization Act of 1996 (P.L. 104-134)], the NNSA only sells uranium "to any State…or nonprofit, charitable, or educational institution for use other than the generation of electricity for commercial use." In other words, NNSA will sell uranium to the research reactors directly, or to another entity if such entity has legal power of attorney from the end user to purchase on its behalf. This means that NNSA will not sell uranium to third parties such as fabricators, brokers, etc.

NNSA's policy is to encourage long-term contracts. Typically, contracts range from three to seven years in length. By signing long-term contracts, the customer is guaranteed assurance of supply at a competitive price and Y-12 is able to better schedule and plan use of its resources, which results in improved efficiencies for both parties. Pricing is determined by several factors. NNSA must recover all costs for producing the uranium requested by the customer and it must recover the current market value of the uranium itself. Consideration is also made for the

duration of contract and amount of uranium the customer is willing to commit to purchase. Typically, such commitment is based on the actual requirements of the reactor under contract.

4. Quantity and Quality of Uranium Available from NNSA

As a result of the end of the Cold War, President Clinton announced on March 1, 1995, that approximately 200 metric tons of fissile material was excess to national security needs. In a subsequent announcement on February 6, 1996, the Secretary of Energy declared that approximately 174 metric tons of the excess fissile material was in the form of HEU, with the remaining excess fissile material in the form of plutonium. In order to provide LEU to research and test reactor customers, Y-12 blends this excess HEU metal, with clean depleted uranium metal (See Figure I). As a result, NNSA customers receive high quality, non-reprocessed, commercial-grade broken metal (See Figure II).

Figure I. Induction Furnace

Figure II. Tray of broken metal and hollow cylinder

Table 1 shows the comparison of NNSA's typical LEU product with the ASTM-C-1462-00, the standard specification of uranium metal enriched to more than 15% and less than 20% ^{235}U. As indicated in Table 1, NNSA's typical LEU product meets and/or exceeds the ASTM specification.

Table 1. Comparison of NNSA's Typical LEU Product with the ASTM-C-1462-00

Element	Units	Typical NNSA LEU Metal	ASTM C1462-00
Uranium	Wt%	99.85%	99.85%
U-232	μg/gU	0.00020	0.00200
U-234	Wt%	0.220%	1.000%
U-235	Wt%	19.750%	20.000%

Element	Units	Typical NNSA LEU Metal	ASTM C1462-00
Trans-U (Alpha)	Bq/gU	50	250.0
Fission Products	Bq/gU	<<600	600
Aluminum	µg/gU	100	150
Beryllium	µg/gU	10	10
Boron	µg/gU	1	1
Cadmium	µg/gU	0.5	1
Calcium	µg/gU	25	100
Carbon	µg/gU	400	800
Chromium	µg/gU	30	50
Cobalt	µg/gU	10	10
Copper	µg/gU	40	50
Dysprosium	µg/gU	0.5	Sum<3
Europium	µg/gU	0.5	Sum<3
Gadolinium	µg/gU	1	Sum<3
Iron	µg/gU	200	250
Lead	µg/gU	10	10
Lithium	µg/gU	10	10
Magnesium	µg/gU	10	50
Manganese	µg/gU	50	50
Molybdenum	µg/gU	100	100
Nickel	µg/gU	50	100
Phosphorus	µg/gU	100	100
Samarium	µg/gU	1	Sum<3
Silicon	µg/gU	250	250
Sodium	µg/gU	10	25
Tin	µg/gU	10	100
Tungsten	µg/gU	100	100
Vanadium	µg/gU	2	30
Zirconium	µg/gU	100	250
EQUIVALENT BORON CONTENT (EBC)		4.00	4.00

5. Recent Successes of NNSA Sales

Because NNSA is committed to supporting the RERTR and FRR SNF Programs, and the nonproliferation benefits to down blending HEU, it plans to be in this business for the long-term. During the past two years, NNSA has entered into three new long-term LEU contracts and is in

active negotiations with three additional LEU customers and expects to be entering into negotiations with two additional LEU customers in the near future.

NNSA has had several successful deliveries of LEU and HEU during 2000-2002, with additional deliveries planned under existing long-term contracts. By providing high quality uranium, assurance of supply, and competitive pricing, it is expected that NNSA will again be the primary supplier of uranium to research and test reactors worldwide.