(S//SI//REL) Trip Report: A Visit to a Nuclear Fuel Plant

FROM: [redacted] and [redacted]
Combating Proliferation (S2G11)
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(S//SI//REL) NSA analysts get to see firsthand how nuclear fuel is produced in South Carolina, giving them greater insight into the combating proliferation issue...

(S//SI//REL) Nuclear Proliferation (S2G11) representatives [redacted] and [redacted] visited Westinghouse Electric Company's nuclear fuel plant in Columbia, SC, on 22 September 2006. The Westinghouse facility designs, fabricates, and distributes nuclear fuel rod assemblies worldwide.

(S//SI//REL) [redacted], who has worked to establish a stronger bond with key U.S. industries, created this Department of Defense tour and arranged with Westinghouse personnel for a close examination of uranium hexafluoride (UF6) delivery, conversion and blending of UF6 into uranium dioxide (UO2) powder, uranium pellet manufacturing, and loading into zircaloy tubes.

(U//FOUO) The Columbia complex covers 1,156 acres and includes 550,000 square feet of manufacturing and office space. The facility was constructed on an old farm that Westinghouse tour guide [redacted] claimed he used for goat riding before beginning his 30+ years employment. The site is subject to annual drill requirements, reviewed by the Nuclear Regulatory Commission, to include simulated attacks against it.

(U//FOUO) One security upgrade post-9/11 included moving the visitor processing center from within the main facility to the outer entrance of the plant's property. In addition, significant funding (an over 400% increase) was applied toward the security force's equipment and training post-9/11. Fissile material security is controlled by administrative and physical controls, to include repeated inventories via bar coding, geometry constraints, radiation monitoring, and personnel checklists/signoffs.

(U//FOUO) Westinghouse claims to supply over 50 percent of the world's power plants. The facility is operating at its highest capacity in its 35+ years of operation and plant personnel are curious regarding possible changes occurring after the $5 billion purchase of the plant (by the Japanese) is finalized. The UF6 conversion (chemical area) is operating 3 shifts/day with five independent lines in operation.

(S//SI//REL) The travelers observed that the overall site perimeter is surrounded by chain-link fence that's routinely patrolled by a dedicated security force. Site structures consist of exterior support buildings, including low-level radwaste storage, processing water holdup tanks, chemical storage tanks, as well as warehouses for shipping containers. The interior buildings primarily include office/admin area, sampling laboratories, and the manufacturing floor. The manufacturing floor space is divided into 2 areas (chemical and mechanical):

- the **Chemical Area** is used to convert enriched uranium hexafluoride (UF6) into uranium dioxide (UO2) fuel pellets via the Ammonium Diuranate (ADU) process.
- The **Mechanical Area** is used to load pellets into zirconium alloy tubes/cladding, end plugs are welded onto tubes top/bottom, checked for weld integrity; grid assemblies are fabricated from zirconium alloy and inconel and subsequently used to build the nuclear fuel assembly "skeleton"; the fuel rods are loaded into the "skeleton" assembly which undergoes cleaning and final inspection.

Completed fuel assemblies awaiting shipment are stored in an enclosed compound within the Mechanical Area's envelope and adjacent to the shipping area. Of particular interest to the Iran watchers was the VVER-design fuel assemblies sold to a Czech reactor which is of the same design as the assemblies being supplied by Russia to Iran's Bushehr Nuclear Power Plant.

(SI) As CP analysts, the group noted the following equipment and material that could be used by a prospective nuclear proliferant:

1. UF6 cylinder handling, operations, and storage - (e.g. "vaporizers" used to heat up UF6 cylinders which took ~4 hours);
2. uranium recovery processes, including chemicals used (perchlorate, Tri-Butyl Phosphate (TBP), nitric acid, and kerosene);
3. differences between blending UF6 powder (solid phase)(for fuel pellet production) versus enriching uranium (UF6 gaseous phase);
4. the impact on manufacturing that a loss of offsite power would entail, including equipment re-start issues/challenges;
5. hazardous gases on-site (anhydrous ammonia, UF6 gas);
6. molybdenum "boats" used in sintering furnaces;
7. equipment/technology controlled by Nuclear Suppliers Group export restrictions (Parts 1 and 2), including Linear Variable Differential Transformer (LVDT) system (used for final fuel assembly inspection/alignment), isostatic presses (used for powder/pellet pressing/production), zirconium tubes, nuclear reactor control rods, automatic test and inspection stations especially designed and prepared for checking the integrity of completed fuel rods, etc;
8. nuclear criticality controls incorporated throughout the various stages of manufacturing; and
9. process activity durations (e.g. 26 -28 hrs to empty a full UF6 cylinder).

(U) Finally, as the group departed, plant security thanked DoD (NSA) personnel for helping to defend the country.
