HEU Consolidation: The U.S. and Russian pictures

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United States and Russia have special responsibility for HEU minimization

The United States and Russia:

- Possess >90% of the world stockpile of HEU
- Operate >50% of the world's HEU-fueled research reactors
- Operate ~2/3 of the reactors with the most dangerous material – critical assemblies and pulse reactors
- Provided most of the HEU-fueled reactors and HEU to fuel them in the rest of the world
- Co-chair the Global Initiative to Combat Nuclear Terrorism – which has identified minimizing use of HEU and plutonium as a key priority

Both presidents have publicly called for minimizing the use of HEU and converting HEU-fueled reactors to LEU – but stark differences in priority and approach

Next steps for consolidation

- Current programs to minimize HEU use are making progress and deserve support
  - Pace of reactor conversion has accelerated
  - Pace of HEU removals has accelerated
  - ~20 countries have eliminated all weapons-usable material
  - Key element of nuclear security summit agenda
- To broaden and accelerate progress
  - Need to cover broader set of facilities and materials
  - Need to use broader set of policy approaches and incentives
  - Both the United States and Russia have to lead

Consolidating HEU
U.S. policy and issues

- Strong U.S. support (and funding) for HEU minimization
- Major consolidation of HEU and Pu in U.S. complex, driven by cost of post-9/11 security requirements
- GTRI (established 2004) has accelerated research reactor conversions, HEU removals
- All U.S. research reactors that can convert with existing fuels have converted
- When new high-density fuels become available, U.S. committed to convert all reactors that can use them
- U.S. providing assistance to other countries for reactor conversions, HEU removals, non-HEU isotope production…

Consolidating HEU: U.S. policy and issues (II)

- Most U.S.-origin HEU (>10 tons) not planned for take-back:
  - Most material not eligible for take-back, and not covered by "gap" program; some countries with eligible material not sending it back
  - Do countries *really* have disposition plans that will eliminate these stocks soon?
- Need broader set of policy approaches and incentives
  - Need incentives for underutilized reactors to shut down, share other facilities – in many cases quicker and cheaper complement to conversion
  - Need broader packages of incentives targeted to the needs of each country, facility (some incentives may be necessary even in developed countries)
  - U.S. should make a broad offer to buy HEU – perhaps $25,000/kg (less for lower enrichments, irradiated material)
  - U.S. should establish a preference for buying isotopes produced without HEU – perhaps a hefty user fee on all HEU-based isotopes

The importance of national nuclear security requirements

- The United States and other interested countries should seek to ensure that all countries with HEU or separated plutonium enact and enforce stringent security requirements
  - Helps ensure that effective security measures are put in place and sustained
  - Avoiding the high cost of security creates strong incentive for minimizing HEU and Pu use
- Harold McFarlane: should consolidate to achieve "more money for research, less for security":

> "In the United States at least, it costs far more to secure the fissile material than it does to operate a critical facility for a year, including all the measurement and analysis… Although the situation is unique in every country, if comparable security upgrades are not being made for other facilities, the international community has reason to question the adequacy of safeguards measures."

Consolidating HEU bulk processing

- Almost all known thefts of HEU or plutonium have been bulk material (e.g., powders) – apparently stolen from bulk processing facilities
- U.S.: 3 remaining HEU bulk processing facilities
  - 1 weapons component fabrication, 2 fuel fabrication
- Russia: changing picture
  - Reduced to 1 weapons component fabrication
  - 3 fuel fabrication
  - Plus several facilities processing at huge scale for HEU blend-down (which will end, at least in current form, in 2013)
- Consolidation *within* facilities: Elektrostal example
  - Kirienko 2008: high cost because floor space 100x, staff 10x, comparable Western facilities
  - Now consolidating all HEU operations to 2 connected buildings, with impressive continuous accounting and control system

U.S., Russian, and world HEU-fueled research reactors

Country	Steady-state	Crit. Assemblies	Pulse	Total
Russia	15	22	15	52
United States	7	5	2	14
Other	27	15	5	47
Total	49	42	22	113

Source: Data provided by Strykaar Hustveit (to be updated)

- Russia will soon have the majority of all the world's HEU-fueled research reactors
- Russia has ~ half the world's critical assemblies, 2/3 of the world's pulse reactors
- Russia is scaling up HEU-based isotope production

Critical assemblies and pulse reactors can have a *lot* of HEU

- BFS critical facility at IPPE (pictured) has tons of weapon-grade HEU, hundreds of kilograms of plutonium, in tens of thousands of pocket-sized disks
- BIGR pulse reactor at Sarov has 833 kg of weapon-grade HEU

Consolidating HEU: Russian policy and issues

- Basic approach: Russian material is secure and accounted for, so consolidating it to fewer locations not a priority
- Russia *has* significantly consolidated processing of HEU and Pu in its nuclear complex since the collapse of the Soviet Union, closed a few HEU-fueled research reactors, and cooperated in returning Russian-supplied HEU from other countries (and positive examples like Elektrostal)
- But:
  - Russia still has ~200 buildings with HEU or Pu
  - Russia still has world's largest number of nuclear weapon storage sites
  - Russia has announced no plan for consolidating, converting HEU-fueled research reactors or other HEU facilities

Russia can save money, improve security, maintain science, and show leadership by launching a major consolidation

Consolidating HEU: Russian policy and issues (II)

- Russia is a natural leader: founder of the nonproliferation regime; co-chair of the Global Initiative to Combat Nuclear Terrorism; leading nuclear technology state
  - Russia should seize a leadership role on consolidating HEU
- Russian scientists have made major proposals to consolidate HEU:
  - Kurchatov Institute and Argonne proposed to develop comprehensive plan for conversion, decommissioning, cleanup, and safety at Kurchatov
  - Sarov scientists proposed study of conversion of BIGR pulse reactor
  - Russian experts have been developing new high-density LEU fuels
  - World-class Russian expertise can provide needed science, training, isotope production without HEU
- Taking a leadership role on HEU consolidation is in Russia's interests and plays to Russian strengths

Consolidating HEU: Russian policy and issues (III)

- Russia could:
  - Announce that it will drastically reduce the number of HEU-fueled critical assemblies and pulse reactors
  - Commit to converting all reactors that can use existing LEU fuels as rapidly as practicable, and to convert additional reactors when appropriate fuels become available
  - Modify its nuclear security rules so that appropriate difference between cost of security for HEU and for LEU gives facilities an incentive to minimize HEU use
    - *Krylov manager: will save "zero dollars" by eliminating HEU*
  - Assign funds to remove and blend-down or reprocess all unneeded HEU at Russian facilities
  - Accelerate conversion of nuclear icebreaker fleet
  - Join with United States in financing take-back, processing of Russian-origin HEU
  - Expand efforts to convince Belarus to eliminate its HEU stock

Consolidating nuclear stocks: the vision

- Both United States and Russia have more to do to lead the global effort to consolidate and secure weapons-usable materials
- With strong U.S. and Russian leadership and a broad range of policy approaches and incentives, may be possible, within a few years, to:
  - Reduce the number of countries with weapons-usable nuclear material on their soil by as much as 50%
  - Reduce the number of buildings and bunkers with nuclear weapons or weapons-usable nuclear materials by 30-50%
  - Provide highly effective security at all the remaining locations
  - Both the United States and Russia should consider announcing new commitments and initiatives for the Seoul nuclear security summit
  - Would be a major contribution to nuclear security, peaceful use of nuclear energy, nonproliferation, and disarmament