Global Threat Reduction Initiative

Research Reactor Conversion Program
U.S. National Academies – Russian Academies of Science
Symposium on Research Reactor Conversion
Jeff Chamberlin
November 29, 2010
**GTRI Program Goals**

**MISSION**

Reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide.

**GOALS**

1. **CONVERT**
   - Convert research reactors and isotope production facilities from the use of highly enriched uranium (HEU) to low enriched uranium (LEU)
   - These efforts result in permanent threat reduction by minimizing and, to the extent possible, eliminating the need for HEU in civilian applications – each reactor converted or shut down eliminates a source of bomb material.

2. **REMOVE**
   - Remove and dispose of excess nuclear and radiological materials.
   - These efforts result in permanent threat reduction by eliminating bomb material at civilian sites – each kilogram or curie of this dangerous material that is removed reduces the risk of a terrorist bomb.

3. **PROTECT**
   - Protect high priority nuclear and radiological materials from theft and sabotage.
   - These efforts result in threat reduction by improving security on the bomb material remaining at civilian sites – each vulnerable building that is protected reduces the risk until a permanent threat reduction solution can be implemented.
GTRI Reactor Conversion Program

As part of its larger mission to reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide, GTRI works to convert research reactors and isotope production facilities from the use of HEU to LEU.

- Assisting reactor operators to perform feasibility studies and safety analyses required for regulatory approval to convert and procure LEU replacement fuels
  - By 2020, convert or verify the shutdown of 200 reactors
  - To date, 72 converted or shutdown including all U.S. university research reactors that can convert with available LEU fuel
  - Since October 2004, 33 HEU research reactors have been converted, including 24 international and 9 domestic conversions
  - Received in June 2010 a “Meritorious Performance in Nuclear Operations Award” from the American Nuclear Society

- Developing and qualifying new high-density U-Mo LEU fuel to convert high performance reactors

- Developing a U-Mo LEU fuel fabrication capability to produce the new high-density fuel

- Establishing reliable U.S. domestic supplies of the critical medical isotope Mo-99 without the use of HEU
President Obama Prague Speech – April 5, 2009
“Today, I am announcing a new international effort to secure all vulnerable nuclear material around the world within four years. We will set new standards, expand our cooperation with Russia, and pursue new partnerships to lock down these sensitive materials.”

Obama-Medvedev Moscow Joint Statement – July 6, 2009
“We will continue cooperating on development of new types of LEU fuel for possible conversion of research reactor cores in third countries and on conducting feasibility studies to explore possibilities for conversion of such individual reactors in the United States and Russia. We note the importance of HEU minimization in civilian applications and support such efforts to the maximum extent possible, where feasible.”

UN Security Council Resolution 1887 – September 24, 2009
“Minimize to the greatest extent that is technically and economically feasible the use of highly enriched uranium for civilian purposes”

Nuclear Security Summit – April 13, 2010
“Participating states will consider, where appropriate, converting highly-enriched uranium fueled research reactors and other nuclear facilities using highly enriched uranium, to use low enriched uranium, where it is technically and economically feasible”
Reactor Conversion Status:
200 reactors converted by 2020; 72 completed (36%)

- Since GTRI was founded in 2004, 33 research reactors have been converted or verified as shutdown.
  - 24 international reactors and 9 domestic reactors
    - All U.S. reactors that can convert with existing qualified LEU fuel have converted

- FY 2010 success includes the March 2010 conversion of Japan’s Kyoto University Research Reactor (KUR) and the confirmation of the shutdown of three research reactors in Russia and one in Chile.

Foreign Mo-99 Conversion Status:

- GTRI provided South Africa support toward the conversion of their commercial-scale Mo-99 production from HEU to LEU targets. South Africa achieved the world’s first large-scale production of Mo-99 with LEU targets in July 2010, and received approval for use of the LEU-based Mo-99 in the United States in September 2010.
GTRI is currently leading efforts to convert 6 U.S. High-Performance Research Reactors to operate with LEU fuel.

These reactors cannot convert with existing fuels, and GTRI is developing a new monolithic LEU-Mo fuel and associated fabrication capability to enable their conversion.

Current efforts are focused on experiments and analysis required to qualify the new fuel with the NRC, and to working with the reactor facilities to perform analyses and address issues necessary to convert.

The current program schedule plans for these reactors to begin converting in 2015.
Fuel Development and Fuel Fabrication Capability

Fuel Development

- GTRI continues to make progress on development and qualification of the monolithic LEU-Mo fuel design that will enable conversion of 6 U.S. HPRRs.
  - Conversion of the MITR, MURR, NBSR, ATR/ATRC, and HFIR will eliminate ~250kg HEU consumption per year.

- GTRI continues to support the LEONIDAS effort in Europe for development and qualification of dispersion LEU-Mo fuel designs that will enable conversion of at least 3 HPRRs in Europe.
  - Conversion of the BR-2, ORPHEE and RHF will eliminate of ~100 kg HEU consumption per year.

- GTRI continues to support efforts in Russia for development and qualification of LEU-Mo fuel designs that would support the conversion of at least 8 HPRRs in Russia

Fuel Fabrication Capability

- GTRI is working to develop and deploy a LEU-Mo fuel fabrication capability to produce the new high-density monolithic fuel for the U.S. HPRRs
  - Baseline fabrication process technology and optimization continues at the DOE National Laboratories
Cooperation with Russia

- To implement the Obama-Medvedev Joint Statement, Russia and the United States will sign an Implementing Agreement to begin studies to determine the technical and economic feasibility of converting six HEU-fueled research reactors in Russia.

- Prime Minister Putin has approved the Agreement, and signing is anticipated December 6-7 in Moscow, by Rosatom DG Kiriyenko and DOE Deputy Secretary Poneman.

- A Working Group will be established immediately following signature to oversee implementation of the IA.

- Historically, feasibility studies take approximately 9 months to complete

1. Kurchatov Institute (KI): OR
2. Kurchatov Institute (KI): IR-8
4. Moscow Engineering Physics Institute (MEPhI): IRT
5. Tomsk Polytechnical Institute (NPhRI): IRT-T
6. Science Research Institute of Atomic Reactors (RIAR): MIR, M1
MNSRs
- There are eight operational Miniature Neutron Source Reactors (MNSRs)
  - Three within China
  - Five supplied to other countries (Ghana, Nigeria, Syria, Pakistan, and Iran)
- Cooperation through the IAEA Coordinated Research Project (CRP) in converting the MNSRs to low enriched uranium fuel is key to global HEU minimization efforts
- China and the U.S., in September of this year, signed a contract to build a Zero Power Test Facility necessary for the conversion of the MNSRs.

Slowpokes
- There are three operational HEU Slowpoke reactors
  - Two within Canada (Alberta and Saskatchewan)
  - One in Jamaica
- Working with Jamaica through an IAEA CRP to convert their Slowpoke to low enriched uranium
- Agreement is still needed regarding the conversion of the two operational Slowpokes in Canada
- Working with Dalhousie University and AECL to return the Dalhousie Slowpoke spent HEU core to the U.S.
International Conversions: The Next 4 Years

Japan: KINKI and KUCA
Feasibility studies on the wet critical assembly are underway

Poland: Maria
LEU LTAs are currently being irradiated and a replacement LEU fuel contract has been signed

Czech Republic: REZ
LEU will soon be delivered for conversion in early 2011.

Kazakhstan: WWR-K/WWR-K CA
LTAs will arrive late in 2010 for irradiation

Belarus: Yalena
Converted to 21% HEU and will continue feasibility studies for final conversion once the LEU arrives this year.

Uzbekistan: Foton
Negotiations are taking place to complete the feasibility study.
Summary

• Close cooperation between the United States and Russia is critical to future international HEU minimization efforts

• U.S. and Russian leadership in this effort will increase the likelihood of other countries engaging.

• Signing of the Rosatom-DOE Implementing Agreement and continued progress on U.S. HPRR conversions are cause for optimism.

• Significant technical challenges remain in converting research reactors – particularly in the United States and Russia.

• GTRI views the engagement of leading scientists on both sides through this conference as an extremely important element in identifying and addressing these challenges to move this effort forward.