The Final Push

Ensuring LEU Use for Medical Isotope Production

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Outline

- The current situation
- Recent Positive Developments
- Technical, Political, and Economic Obstacles
- New strategies to ensure move to LEU
Medical isotope production: Switching from HEU to LEU or not?

Positive developments:

- Greater Political Support—UNSC 1887 and NS Summit
- U.S now receiving regular commercial shipments of medical isotopes produced using LEU fuel and targets, from South Africa and Australia
- 2016 closure of NRU
- New production capability moving forward in S Korea, S America, E Europe, US
- Conversion of Polish (2012), Czech reactors to LEU fuel

Not so positive developments:

- Delays in European licensing of Tc-99m
- Russia plans to export Mo-99 isotopes to fill in shortages in production but using HEU
**Potential New Projects for Mo-99 Production**

<table>
<thead>
<tr>
<th>REACTOR</th>
<th>Six-day ci EOP/yr</th>
<th>Six day ci EOP/wk</th>
<th>Weeks/yr</th>
<th>Potential first year</th>
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<tr>
<td><strong>PROJECTS WITH PROCESSING FACILITIES AS PART OF PROJECT</strong></td>
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<tr>
<td>ROSATOM*/**</td>
<td>52 000</td>
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<td>1 000</td>
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<td>-</td>
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<td>43.5</td>
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<tr>
<td>FRM - II**</td>
<td>102 860</td>
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<tr>
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<td>6 215</td>
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<td>5 200</td>
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</table>

* Project includes three reactors, two of which would be used to produce Mo-99 in a continuous fashion, with the third being a back up.
** Research reactor already exists, but is not yet irradiating targets for Mo-99 production.
*** Under active construction.
**** Projects in Europe would face a processing capacity limitation.

**SOURCE**: OECD Nuclear Energy Agency
Mo-99 producer NECSA has committed to operate solely on LEU
- $25 million from NNSA to produce fully LEU-based isotopes
- 2009: reactor fueled only with LEU
- Current: Anticipates using only LEU targets for Mo-99 production-2013

2 X density of LEU targets

More waste, problems with Mo-yield, NECSA wants to develop higher-density targets

Costs 10% more than HEU process—but little cost impact on patients

Tc-99m licensed quickly by FDA, but not by EU states
- Expensive, cumbersome process of country-by-country validation tests. necessary
Conversion: Not Mainly Technical Challenge

2009 National Academies of Science study:
- “...no technical reasons that adequate quantities [of medical isotopes] cannot be produced from LEU targets in the future.”

Fuel at major production reactors has been converted to LEU
- BR2 only exception, but seeking to convert

Need to develop LEU targets
- LEU substitution would require reactor and Mo-99 processors to process about five times as many targets and an equivalent increase in waste.
  —or—
- Make targets larger, or with greater uranium density, or with more uranium and less cladding
Conversion:
Not Mainly Technical Challenge (2)

- Production costs would likely rise marginally compared to the existing HEU targets and processes, but without significantly increasing the cost of diagnostic imaging.

- To minimize disruption, seek to ensure LEU targets are compatible with existing processes for target dissolution and Mo-99 recovery and minimize waste
  - Advantage of reactor irradiation vs. neutron capture etc (different specific activity levels)
Conversion:

An Economic Problem

- Instability in Mo-99 market
  - Exemplified by the shut down of aging NRU Chalk River reactor 2009-2010
  - No incentive for creation of new irradiation facilities due to operating subsidies
  - Government reimbursements rates for isotopes do not reflect the full costs of processing and other production
  - Lack of adequate geographic distribution hampers supply
  - Concerns that conversion could lead to shortages
Conversion: An Economic Problem (2)

- Processors resist additional $ of conversion
  - Changes to processing may be needed to accommodate higher throughput levels
  - Limited access to needed addl. reactor irradiation time
  - LEU isotopes need to be licensed

- Russia
  - Kiriyenko: LEU production the goal but need to ensure market supply
  - There are some indications Russia in the short term may switch to LEU fuel, but not targets
  - Better to convert now to LEU than gear up HEU production
  - Are incentives needed to ensure move?
    - Letter from NNSA Administrator D’Agostino to Congress positive move—Calls for Congress to consider measures to counter subsidized HEU-based production
      - Possibilities include labeling, addl export constraints, preferential gov procurement
Recent Responses to Instability

- Governments sought ways to ensure sufficient supply
  - Asked the OECD Nuclear Energy Agency and the IAEA for recommendations for altering the market structure
  - Better sharing of information about proposed reactor shutdowns and conversion

- Reduced demand:
  - Physicians and other participants chose alternatives or were conservative in using their supply of isotopes

- Increased production: New entrants or local reactors reaching the global market (all HEU)
  - Poland—converting to LEU fuel (2012)
  - Czech Republic—converted to LEU fuel
  - Russia—?
Policy Prescriptions Offered

- **US Congressional Action**
  - First introduced in 2009, passed House
  - Revised version has passed Senate recently
    - Would ban US exports of HEU for targets to Western Europe and Canada
    - Authorizes efforts to promote Mo-99 production through LEU fuels and targets, including the construction of domestic facilities
    - Would establish government responsibility for waste disposition

- **OECD Nuclear Energy Agency**
  - Governments should terminate subsidies
New Strategies (1)

- **Commitment by leaders at the 2012 NSS**
  - phase out deadline for HEU use for medical isotope
  - USG has sought this
  - May need to push date back some—2018-2020?

- **Further restrictions on US HEU exports**
  - Informal

- **Subsidy cutoffs**
  - Governments should more quickly raise prices of irradiated Mo-99 produced using HEU fuel or targets to market levels as suggested by the HLG-MR
  - US could consider countervailing duties for those who continue to use subsidized production (subsidized production will also tend to be HEU)
New Strategies

- **Preferential procurement**
  - By National governments and the WHO
  - Need clear studies by US and NEA of alternative strategies of preferential procurement strategies and costs and benefits
  - Should consider supporting or requiring government purchases of LEU-based isotopes
  - Natl governments should agree to take steps to move quickly to license LEU-based isotopes
  - Taxing HEU or ensuring full cost of HEU (enrichment)

- **US Market power**
  - World’s largest importer of Mo-99
  - The US could impose tariffs or a ban on the import of HEU-based isotopes
  - Once sufficient LEU supplies available