The Future of LEU in the Global Mo-99 Supply Chain

Ira Goldman,
Director, Strategic Product Supply

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LMI Mo-99 Supply Chain

Reactors

Mo-99 TARGETS:

LEU - OPAL, SAFARI
HEU - BR2, HFR, LVR-15, NRU, OSIRIS
LMI Mo-99 Supply Chain

Processors

Mo-99 TARGETS:
LEU – ANSTO, NTP
HEU – IRE, Nordion
Lantheus Mo-99 Supply Chain

Reactor
- HFR Reactor
  Netherlands (1961)
- BR2 Reactor
  Belgium (1961)
- LVR-15 Reactor
  Czech Republic (1957)
- OSIRIS Reactor
  France (1966)
- SAFARI Reactor
  S. Africa (1965)
- NRU Reactor
  Canada (1957)
- OPAL Reactor
  Australia (2006)

Mo-99 Extraction
- IRE
  Belgium

Mo-99 Purification
- NTP
  S. Africa
- AECL
  Canada
- ANSTO
  Australia
- Nordion
  Canada

Tc-99m Generator
Manufacturer

LEU and Non-HEU – DOE Cooperative Agreements

• S.99 American Medical Isotopes Production Act of 2011

• U.S. Domestic Projects
  • 3 active DOE/NNSA cooperative grants (non-HEU projects)
    • GE Hitachi-Clinton – power reactor, neutron activation, USA - currently inactive
    • Babcock & Wilcox – MIPS aqueous LEU solution reactor seeking new partner
    • SHINE/Morgridge - accelerator-driven LEU solution fission process
    • Northstar –Mo-100 accelerators; LSA w/Tc-99m generator/separator
Other U.S. non-HEU Projects

• Northstar/MURR - Mo-98 NA LSA w/Tc-99m separator

• Coqui Radiopharmaceuticals: fission, 2015?

• USR (US radiopharmaceuticals), Texas – new standard Tc-99m generator supplied by ANSTO

• Other Fission-based, multi-source

• Green-Tec: “non-enriched uranium; Alabama – 2014?

• Perma-Fix: neutron activation w/separation resins
International Mo-99 Supply Developments

• European processors conversion to LEU targets – 2015
  • Nuclear Security Summit 2012 commitment

• New European Research Reactors (LEU targets):
  • FRM II Reactor – 2015
  • Jules Horowitz Reactor (replace Osiris) – 2016
  • Pallas Reactor (replace HFR) - 2022?
  • MYRRHA (replace BR2) - 2023?

• ANM Australia (3600 Ci/week LEU) early 2016

• South Africa – SAFARI -2 (LEU)
International Mo-99 Supply Developments

- Russia – Rosatom/Isotope, 2013-16 (HEU/LEU)
- South Korea – new RR, fission 2017 (LEU)
- Brazil – new reactor & processing, 2017 (LEU)
- Argentina – new reactor & processing, 2018 (LEU)
- India, China – small-scale fission, 2016? (LEU)
Lantheus LEU Leadership

• FIRST – to receive FDA approval for LEU Mo-99 in North America:
  – ANSTO: June 2009, May 2011
  – NTP: September 2010

• FIRST – to commercially sell a generator made with only LEU Mo-99 (December 2010)

• FIRST – to have LEU Mo-99 as a routine part of blended Tc-99m production (since May 2011)

• FIRST – to commercially ship (Jan. 7, 2013) an “all-LEU generator” (CMS add-on payment compliant)
Lantheus Medical Imaging adds the innovative LEU TechneLite® (Technetium Tc 99m Generator) to our Nuclear Medicine Portfolio

Available NOW!
Lantheus LEU Leadership

- LMI working in tandem with key customers to implement LEU generator usage
- LMI actively educating customers on LEU myths vs. facts
- LEU currently comprises double-digit percentage of total LMI Mo-99 supply on monthly basis
- New LMI contract with NTP/ANSTO (October 2012 through 2017) will result in substantially greater amounts of LEU in 2014-15
- LMI plans to be 100% LEU by end of 2016
Lantheus Mo-99 Supply Strategy – Strength through Diversity of Supply and LEU

• LMI has established a balanced and globally diversified Mo-99 supply chain
  • continue to assess opportunities to further diversify and strengthen our supply chain with non-HEU technologies
  • actively engaged with U.S. (DOE cooperative agreement and other), Canada (ITAP), and international projects

• Anticipate future supply agreement with at least one U.S. project
  • production beginning by 2016 and ramp-up for 2017 and beyond

• LMI positioned for post-NRU secure Mo-99 supply
Summary

• U.S. (S.99, CMS add-on) and international community committed to non-HEU Mo-99 supply

• LEU is already part of global Mo-99 supply

• Further actions underway across the globe to convert to LEU or to establish non-HEU production

• LEU and non-HEU technologies will help to assure future stable and reliable supply of medical radioisotopes