

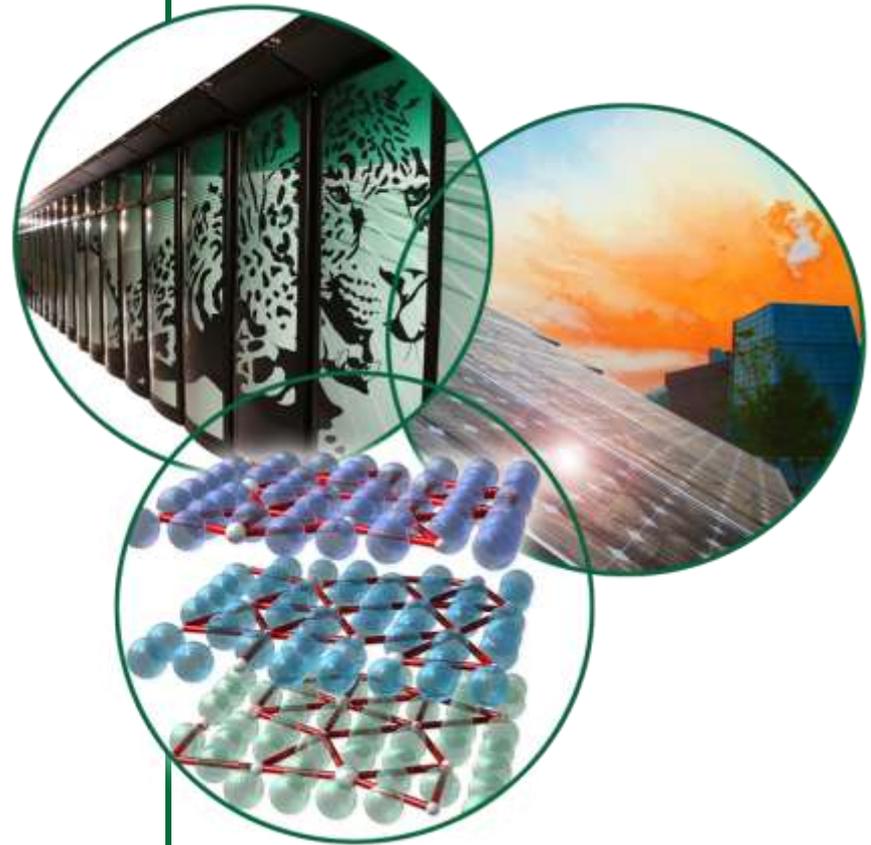
Nuclear Nonproliferation: How it Impacts You

Jeff Chapman

NonDestructive Assay Technologies Department

February 8, 2011

U.S. Women in Nuclear
Region II Conference at ORNL



Nuclear Nonproliferation

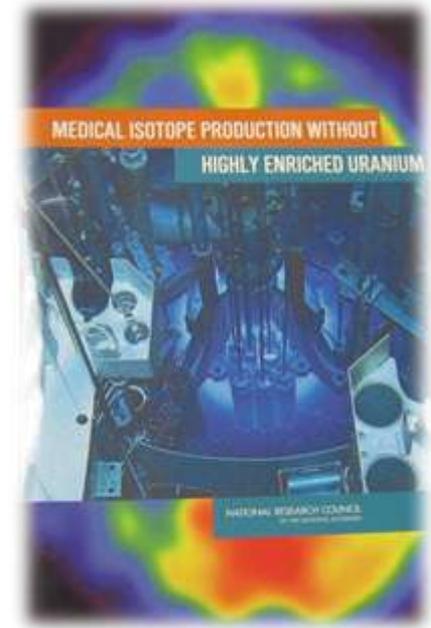
TWEETS

BLOGS

CLOUDS

Three Topics

- IAEA Safeguards
- Mo-99 Production and Safeguards
- Joint Engagement and Support Projects in:
 - Republic of South Africa
 - Republic of Kazakhstan



(Ref: American Academy of Science)



The technical objective of International Nuclear Safeguards is:

“...the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities ...

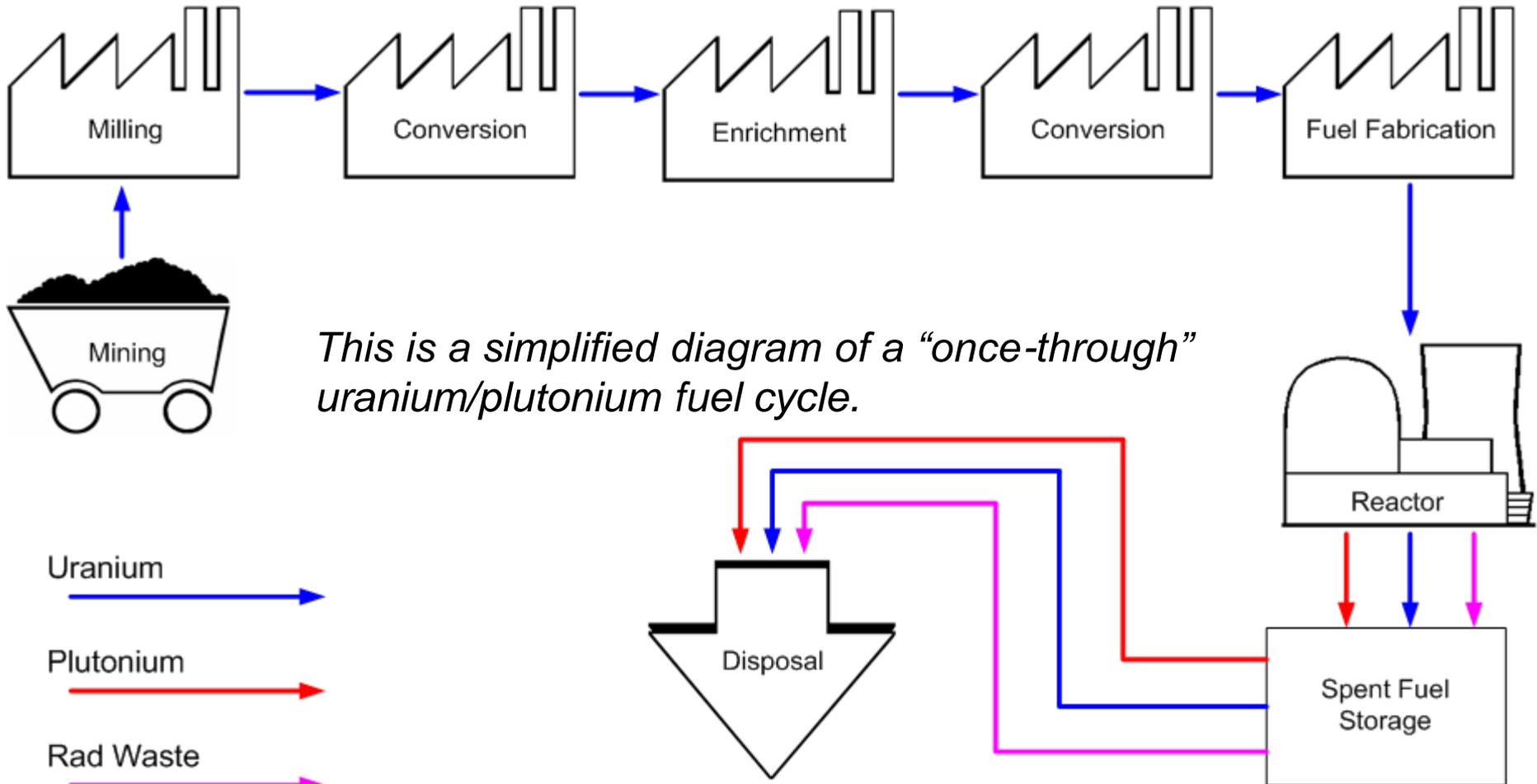
to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by risk of early detection.”



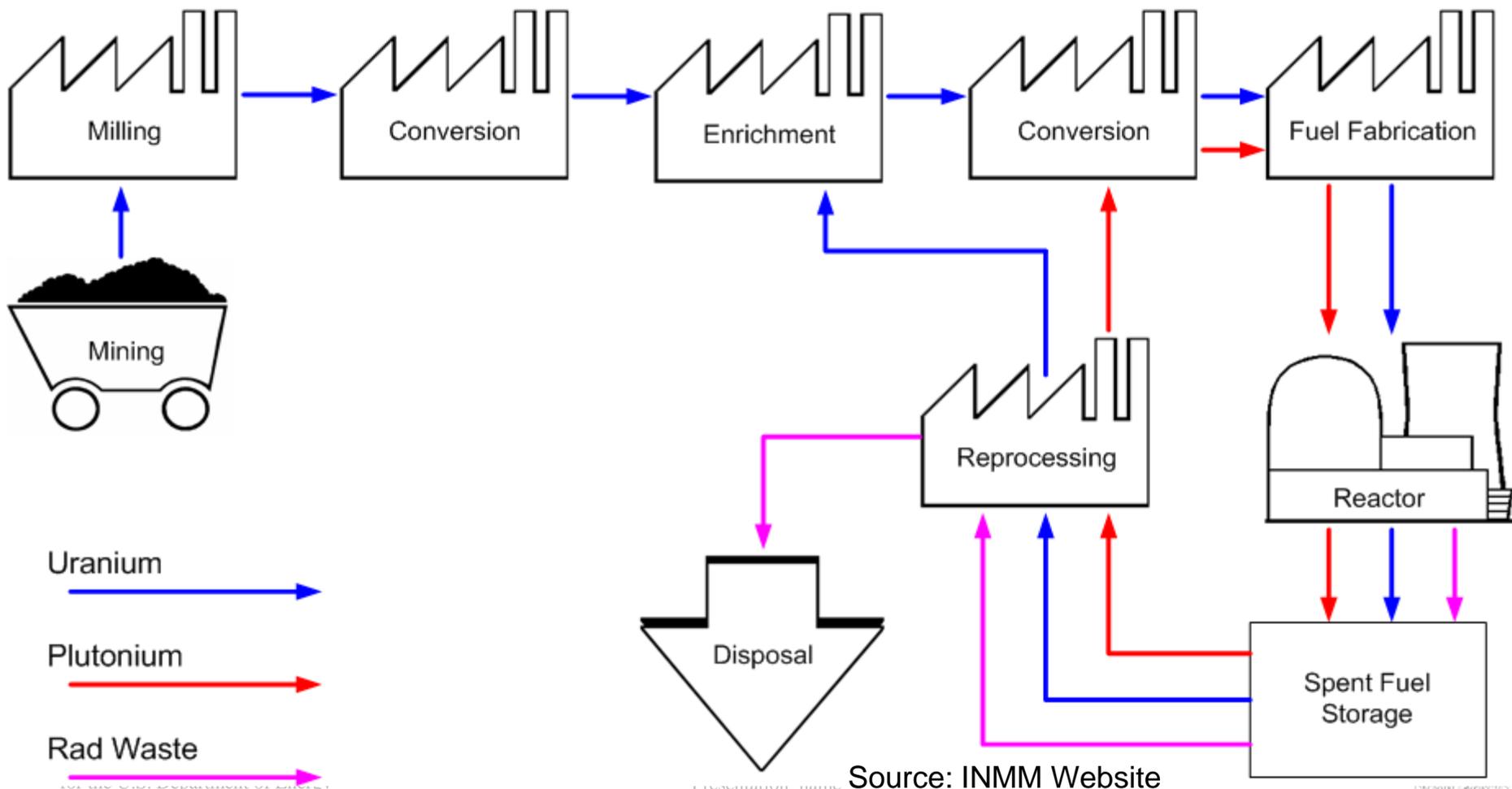
IAEA Information Circular (INFCIRC)153
paragraph 28

The INMM put some graphics together to help understand the concept...

The CLOSED Nuclear Fuel Cycle → (OK)

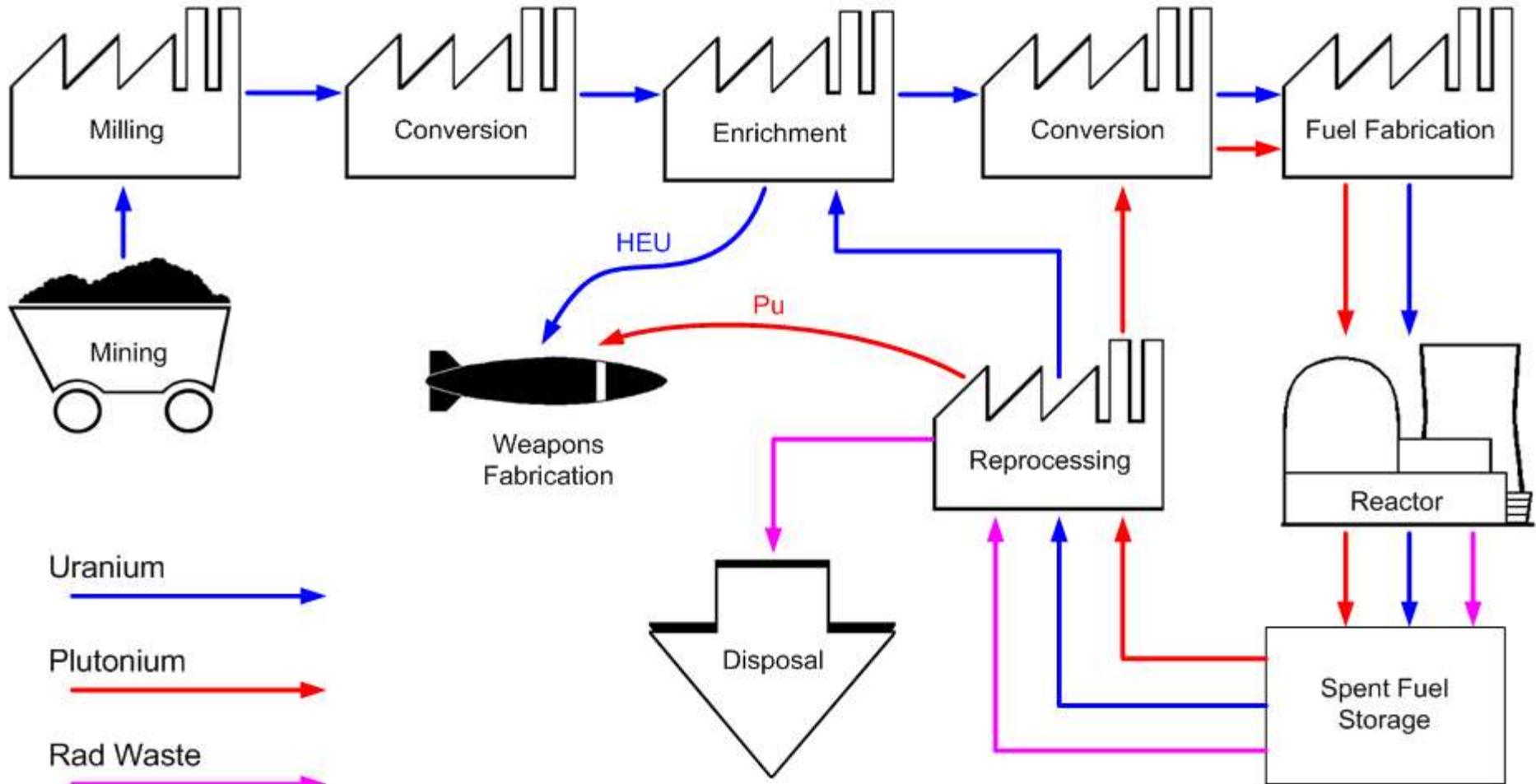


Recycle: A fuel cycle with reprocessing recovers unburned ^{235}U and plutonium from spent reactor fuel—(OK)



Source: INMM Website

Plutonium and high-enriched uranium diverted to produce nuclear weapons → (not OK)



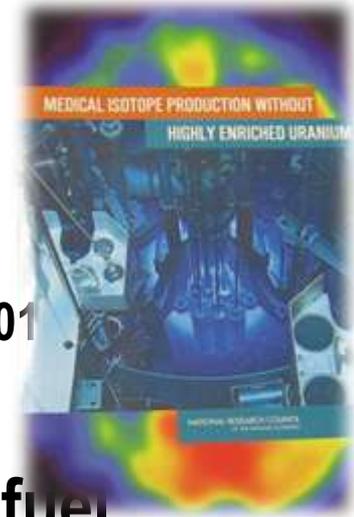
The NonDestructive Assay Department

- Develops and Deploys Nuclear Instrumentation to Monitor Nuclear Material as it moves through the fuel cycle



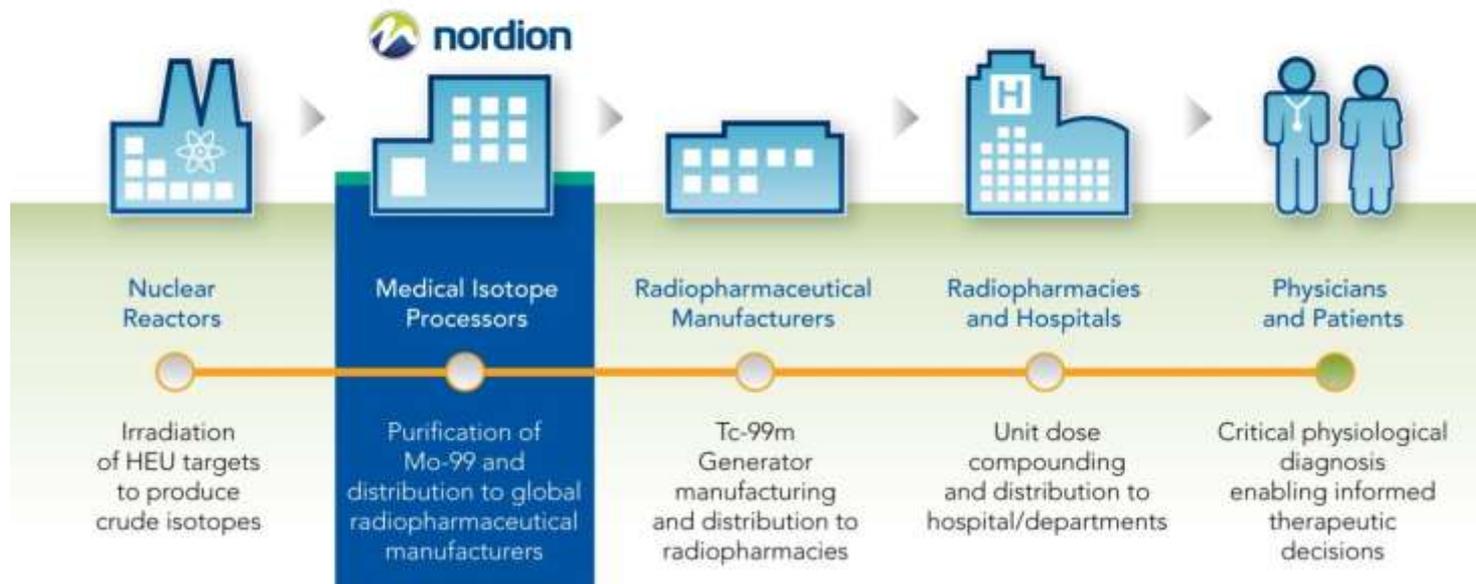
Mo-99 Medical Isotope (and Safeguards)

- The world demand is growing
 - Current Demand: 12,000-15,000 6-day Curies per week
- Bulk of Supply from Four Reactors
 - Until recently, 100% of U.S. Supply from two reactors
 - Canada (MDS-Nordion) and the Netherlands (Mallinckrodt)
 - Both reactors were down for extended periods of time (2009-2011)
- All Mo-99 Production Reactors designed for HEU fuel and/or targets
- Worldwide transition to LEU fuel and LEU targets



The Mo-99 Supply Chain

Nordion Mo-99 Supply Chain



(Source: nordion.com)

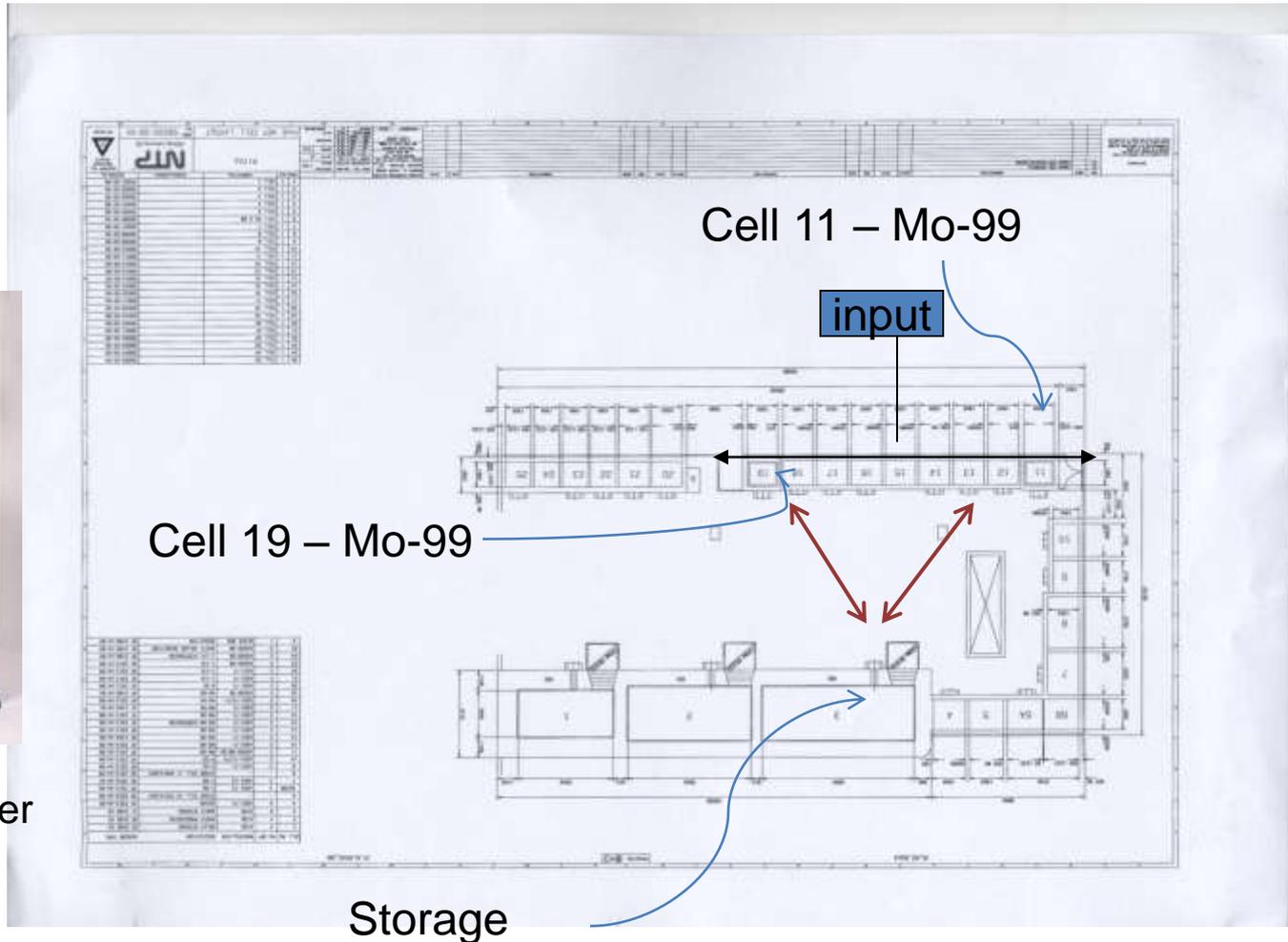


NRU: Ontario Canada
HFR: Petten Netherlands
Osiris: Saclay France
BR2: Mol, Belgium
OPAL: Sydney, Australia
Safari: Pelindaba, South Africa

Joint Collaboration with NECSA



Padirac Transfer Cask



Install Nuclear Instrumentation into the Hot Cell Facility to help facilitate the characterization of Mo-99 waste targets

Characteristics of the U Residue in the ^{99}Mo Production Process⁽¹⁾

- **Isotopic Composition (w%)**
 - $^{234}\text{U} \leq 1.5\%$
 - $^{236}\text{U} \leq 4\%$
 - $^{232}\text{U} \leq 2 \mu\text{g/kg}$ (ppm)
- **Total α -activity of isotopes of Np, Pu and Am $< 500 \text{ Bq/g}$**
- **Total β and γ activity of all isotopes**
 - Total β emitters ^{90}Sr , ^{99}Tc , ^{147}Pm
 - Total $\beta + \gamma$ emitters $^{95}\text{Zr/Mb}$, ^{103}Ru , $^{106}\text{Ru/Rh}$, ^{125}Sb , ^{134}Cs , $^{137}\text{Cs/Ba}$, $^{144}\text{Ce/Pr} < 12,000 \text{ Bq/g U}_{\text{tot}}$
 - Total activation products ^{58}Co , $^{60}\text{Co} < 100 \text{ Bq/g U}$

(1) From: Lize Stassen, NECSA (NECSA-DOE Workshop May 2010)

Press Release (December 6, 2010)



Press Release

First LEU-Produced Molybdenum-99 Approved for Patient Use Arrives in U.S.

Dec 6, 2010

NNSA and South African Nuclear Energy Corporation (Necsa) Cooperate to Achieve First-Ever Large-Scale Medical Isotope Production Using Low Enriched Uranium

WASHINGTON, D.C. – The National Nuclear Security Administration (NNSA) and the South Africa Nuclear Energy Corporation (Necsa) today announced that the first shipment of the medical isotope **molybdenum-99 (Mo-99) produced with low enriched uranium (LEU)** and approved for patient use has arrived in the United States.

Safeguards Engagement in Kazakhstan



President Nursultan Nazarbayev Outlines Road Map for Nonproliferation, Peaceful Energy Use at Nuclear Security Summit, April 12-13, 2010



Test Site of Joe-1. August 29 1949 (Semipalatinsk, Kazakh SSR)
Photo taken: August 23, 2010



Semipalatinsk, Kazakh SSR
Photo taken: August 23, 2010



Semipalatinsk, Kazakh SSR
Photo taken: August 23, 2010

Kazakhstan Interest in Producing Mo-99 (and other Medical isotopes)....

With LEU

THE 2005 RERTR INTERNATIONAL MEETING
November 6-10, 2005
THE FAIRMONT Copley Plaza
138 St. James Avenue
Boston, MA 02116

COMPARATIVE STUDY OF THE WWR-K REACTOR USING U-MO LOW ENRICHED FUEL PIN- AND TUBE-TYPE ASSEMBLIES

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ABSTRACT

Several options of the WWR-K reactor initial and stationary core configurations are considered with the tube/pin-type fuel assemblies on a base of the high-density low-enriched U-Mo fuel. Outcomes of the comparative study of the neutron characteristics and the WWR-K reactor cycle periods are presented.

Fuel Moved from Aktau to
Semipalatinsk, Kazakh SSR
Photo taken: August 24, 2010



Nuclear Nonproliferation

- **It does impact you**
- **It is more important to your every day life than you probably could have imaged before you heard this presentation**