



U.S. DEPARTMENT OF  
**ENERGY**



# High Precision Nuclear Forensics: The Case of the Mk-18a Targets

Brief to:  
Citizens for Nuclear Technology  
Awareness

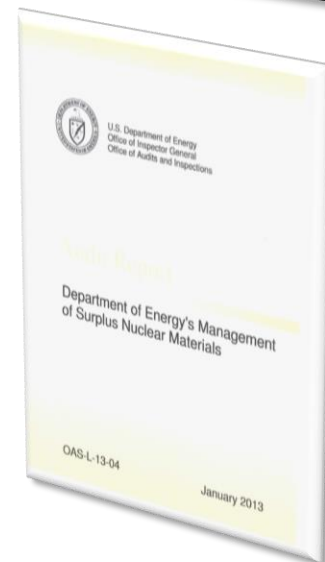
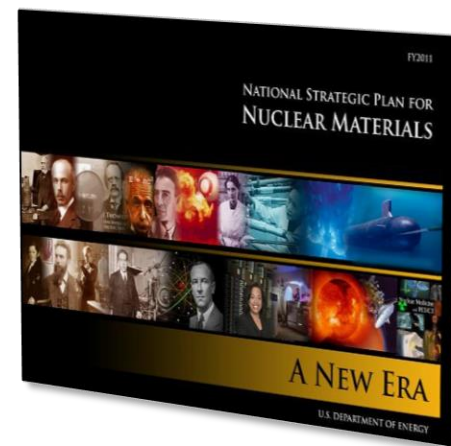
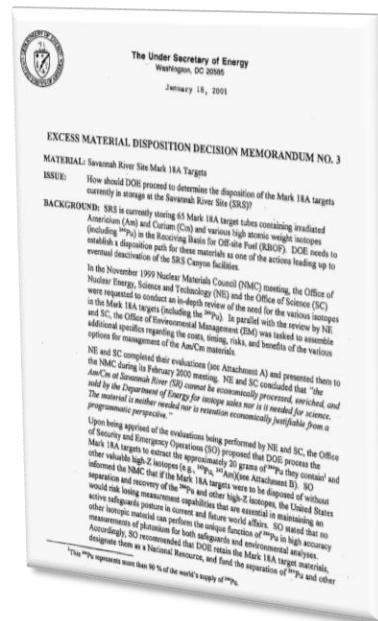
*"Up and Atom" Breakfast September 25, 2019*

Richard Meehan,  
*Director, Office of Nuclear Materials Integration*



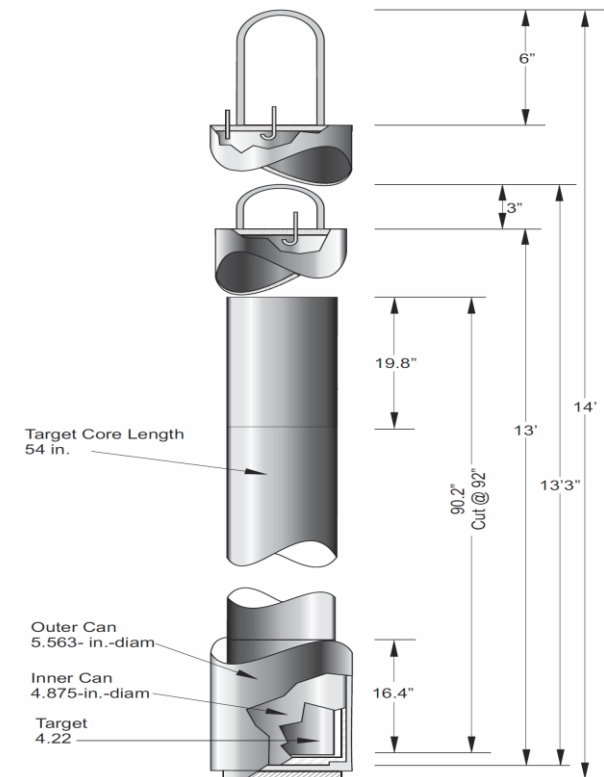
# Pu-244: A Rare and Irreplaceable National Security Resource

- Pu-244 is “essential in maintaining an active safeguards posture in current and future world affairs... Separate, enrich, retain and use the Pu-244”. (Excess Material Disposition Decision No. 3, 2001)
- “Preserve the irreplaceable Pu-242/244 and heavy curium as National Asset materials for future use” (DOE National Strategic Plan for Nuclear Materials, 2011)
- Preserve these valuable isotopes before “the opportunity is lost” (Inspector General audit report, 2013)



# What are the MK-18a Targets?

- Program initiated in 1969 to produce Cf-252
- Currently stored in L Basin
- **86 targets were irradiated in K-Reactor at SRS**
  - Very high neutron radiation ( $6 \times 10^{15}$  n/cm<sup>2</sup>-s)
  - Very long residence time
- **21 targets were processed at ORNL in 1972-73 to recover Cf-252, heavy curium, and Pu-244**
  - Recovered Pu-244 was enriched in ORNL
  - Calutrons This provided the supply of Pu-244 and heavy curium in use today
- **65 targets remain in L Basin**
  - ~510g Cm-246/248
  - ~20g Pu-244



***Additional Mk-18A material can no longer be produced since the DOE production infrastructure has been shut down***

# Why Are the Mk-18a Targets so Important?

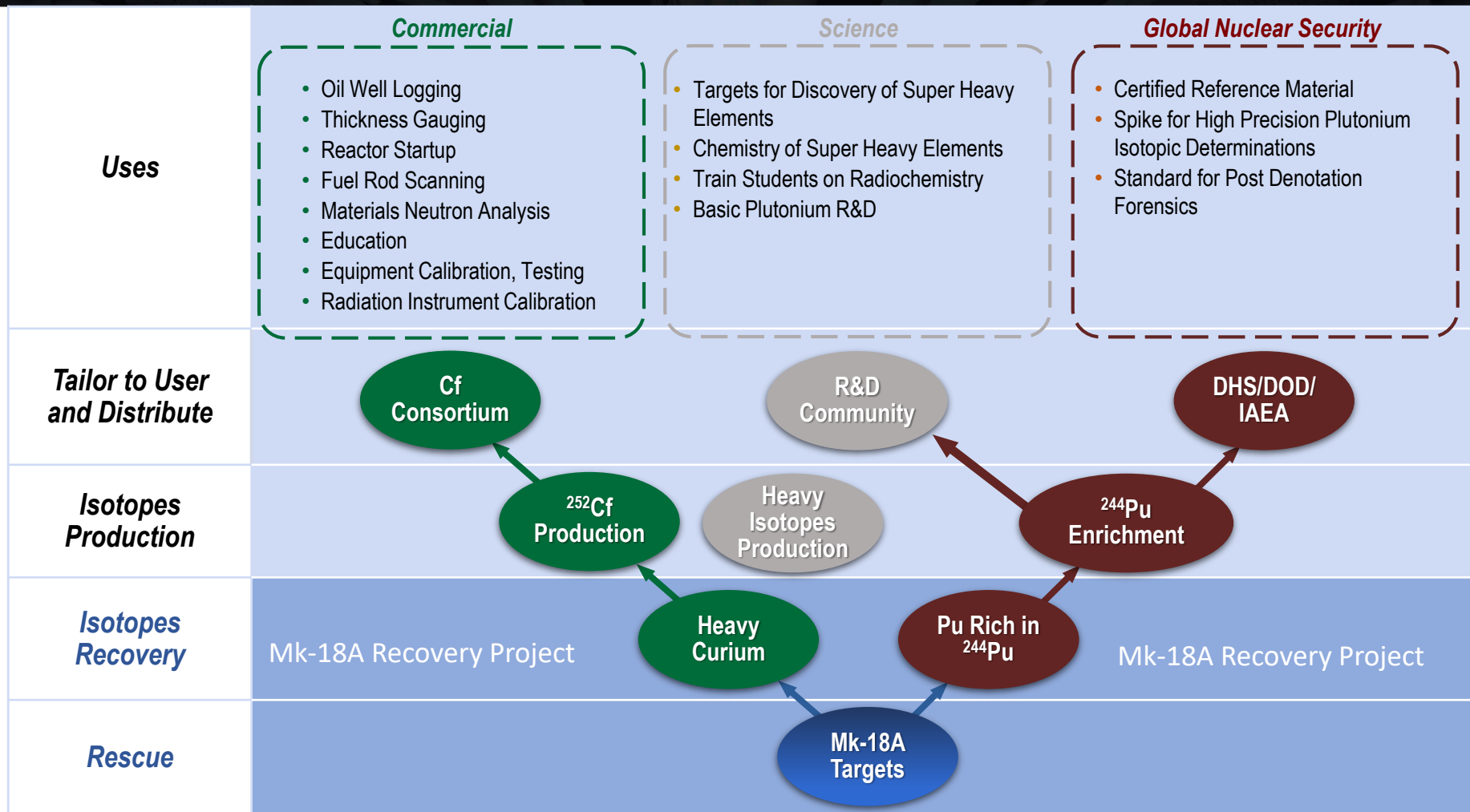
- **Mk-18a targets have the last known cache of Pu-244 in the world.**
- **Pu-244 is entirely man made, it occurs nowhere in nature.**
- **Serves as a known and unique reference point supporting high precision measurements.**
- **Vital for a number of national and international security related programs**
- **Used for unique research into “super heavy” elements.**



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# Mk-18a Material Applications





# Innovations

- **Removed several extraction steps to increase efficiency of extraction.**
- **Repurposed automotive robot to package isotope shipping packages – to significantly reduce exposure to radiological hazards.**
- **Developed technique for horizontal loading of targets into hot cell – reducing exposure to radiological hazards as well as high vertical lifts.**
- **Designed modular cask laydown table to facilitate disassembly and storage of equipment between target loading events.**
- **Continue to use comprehensive project risk register to guide investment in equipment and facility modifications.**

# Current Status

- **Process has been defined. Design completed.**
- **Transfer Cask designed, procured and received.**
- **Laydown table designed, fabricated and delivered.**
- **Hot Cell equipment has been designed, procured, received, and installed in the Mk-18 Mock Up facility supporting:**
  - Design shake down
  - Operation procedure development
  - Readiness reviews
  - Workforce training.
- **Project continues to remain on schedule and budget.**



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