Pacific Northwest
NATIONAL LABORATORY

Best Practices in Processing Obsolete Brachytherapy Sources at PNNL

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U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

PNNL Experience Handling ^{226}Ra from Obsolete Brachytherapy Sources

^{226}Ra

FROM OBSOLETE BRACHYTHERAPY SOURCES

Gram quantities of radium at PNNL

Large global inventory

PRODUCTION DEVELOPMENT

100’s mCi/batch

Normal needles and tubes

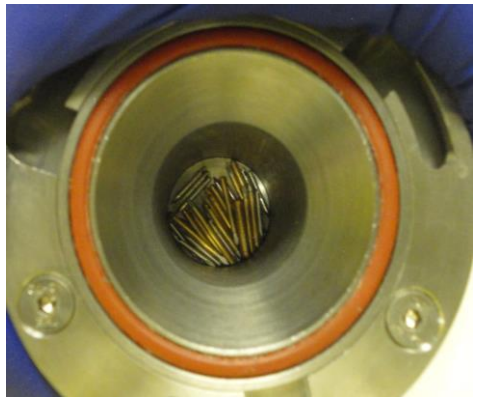
A-typical sources

CHALLENGE

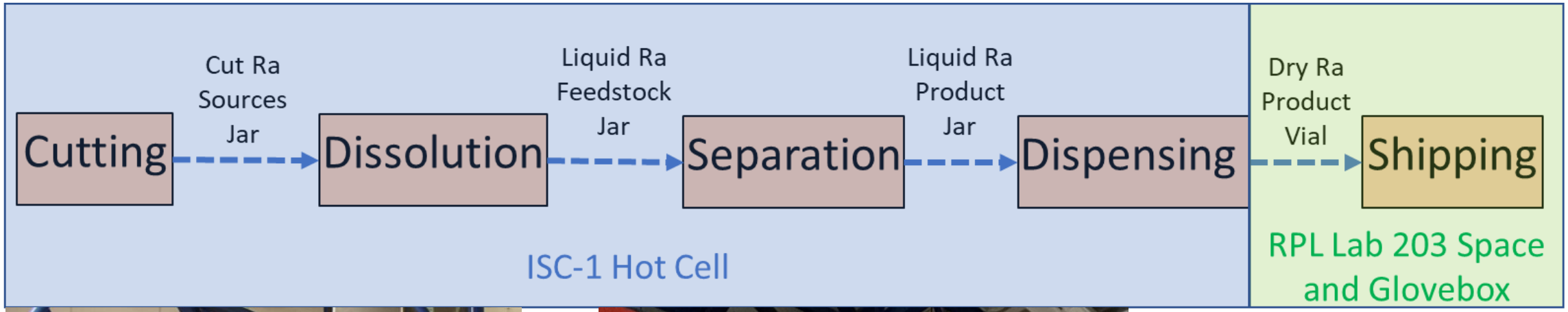
Develop ^{226}Ra recovery process for a wide variety of configurations

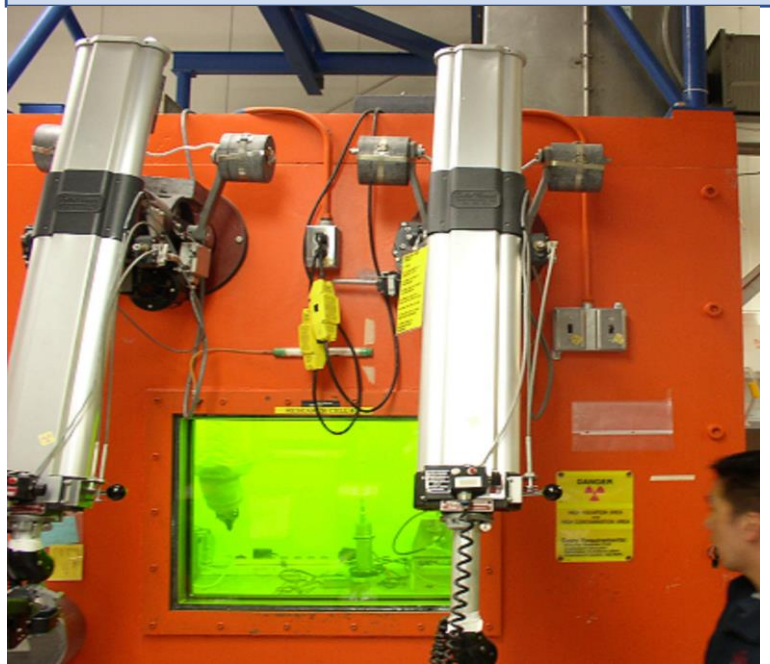
Minimize dose to staff

Contamination free product vial

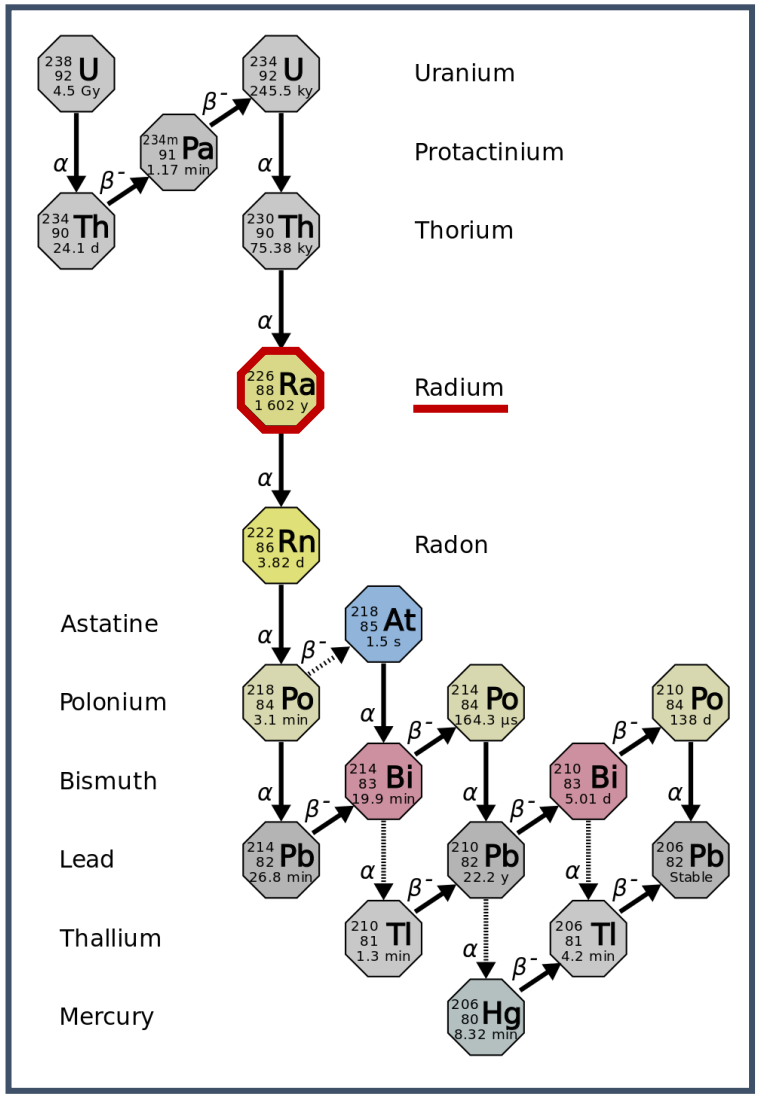


Facility and Processes



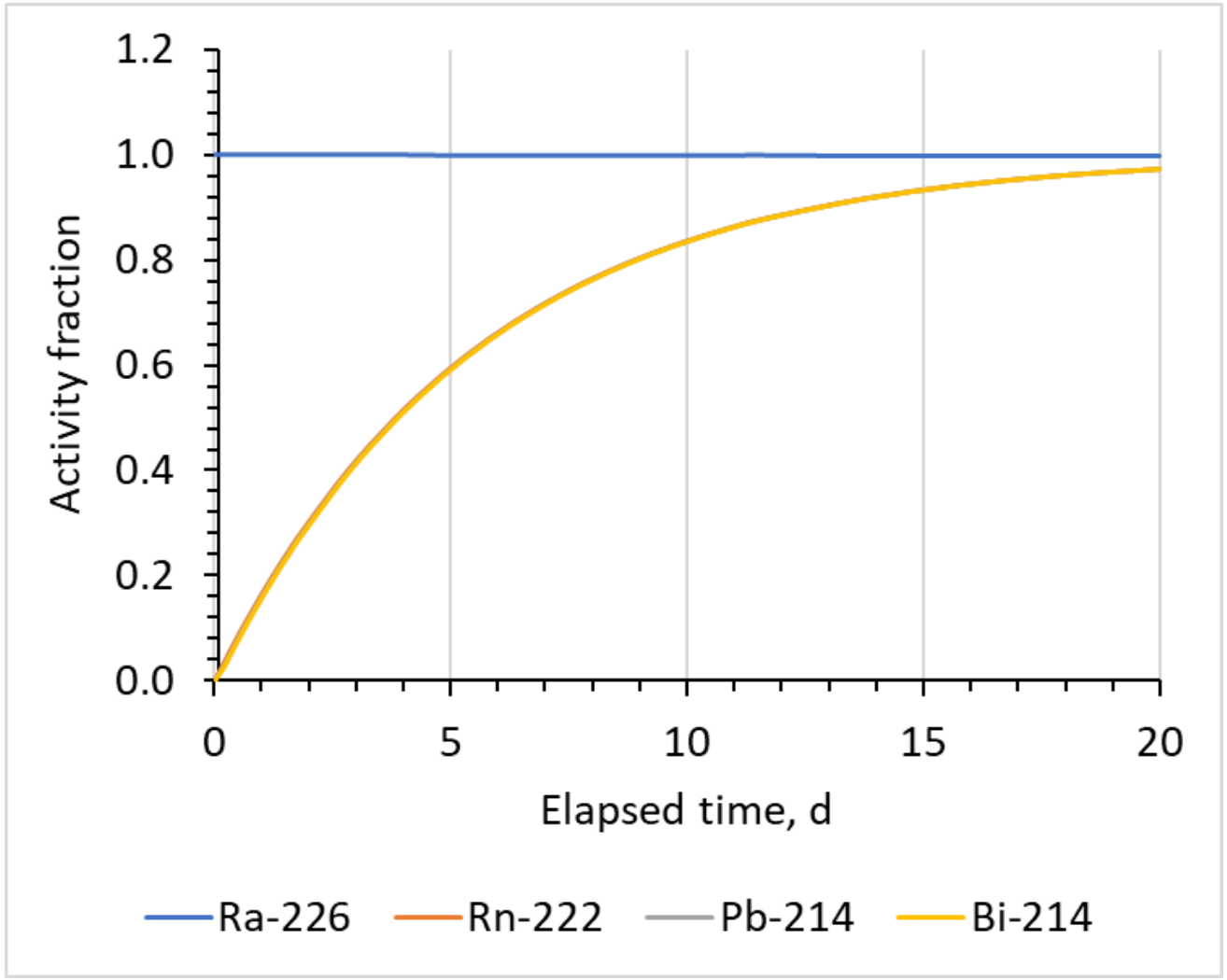


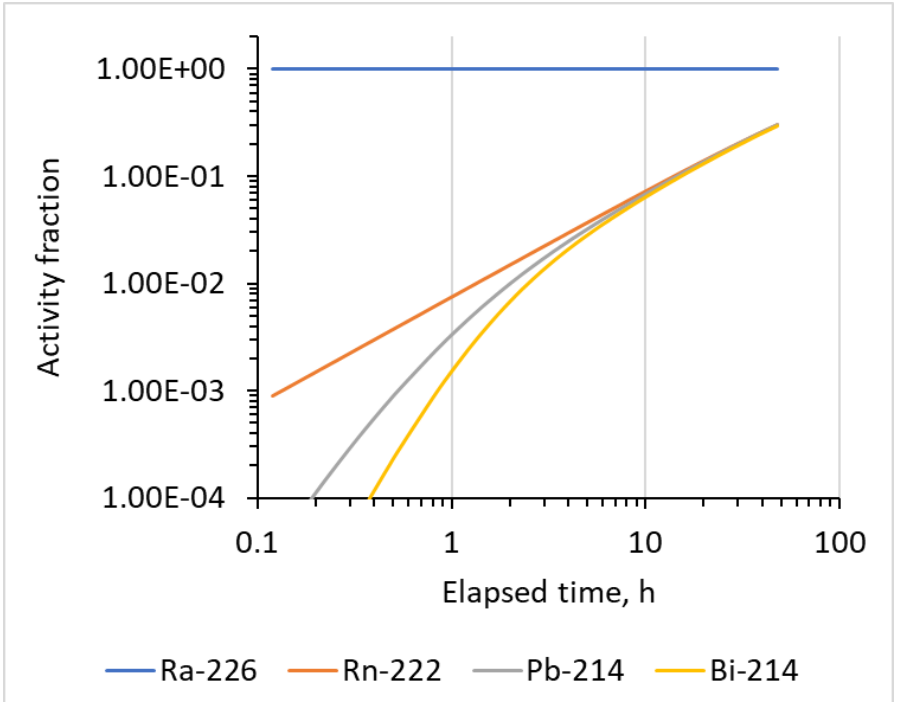
Dose, Effluent, and Contamination Challenges

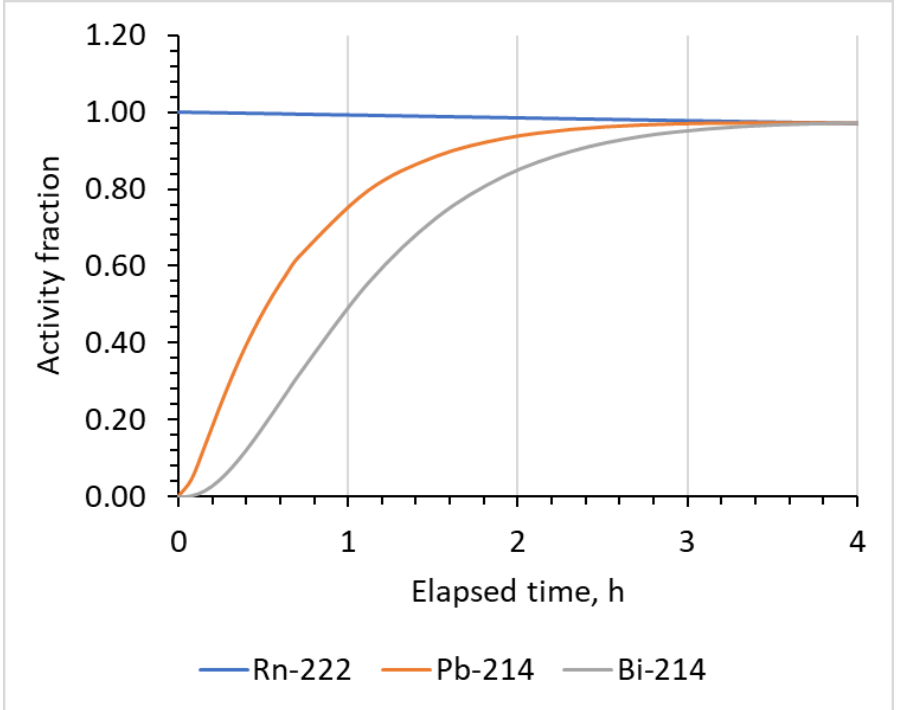


- Dose
  - High β dose from progeny
  - Approximately 90% activity in-growth in 13 days
  - Material degradation from both α and β decay
- Effluents
  - ^{222}Rn (gas)
  - Based on RPL ^{222}Rn emissions release limit, abatement of ^{222}Rn is not required
- Contamination
  - ^{226}Ra contamination can contribute to ^{222}Rn emissions from the facility and build-up of dose in facility ductwork

In-Growth of Progeny







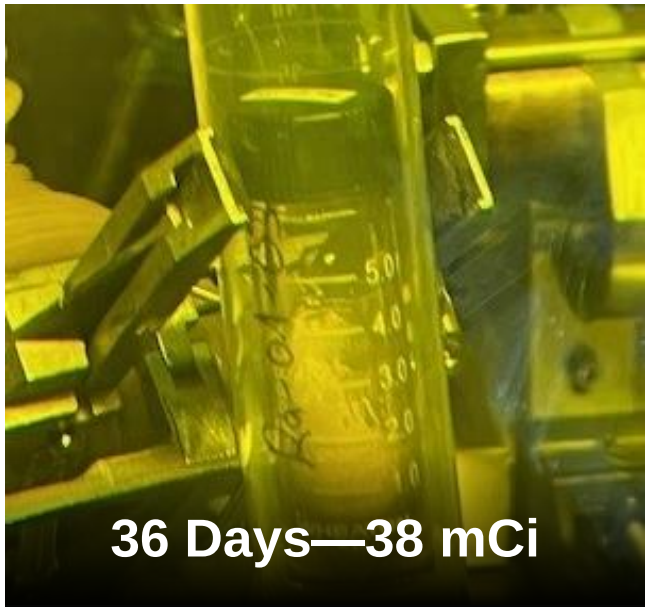
Contamination Control

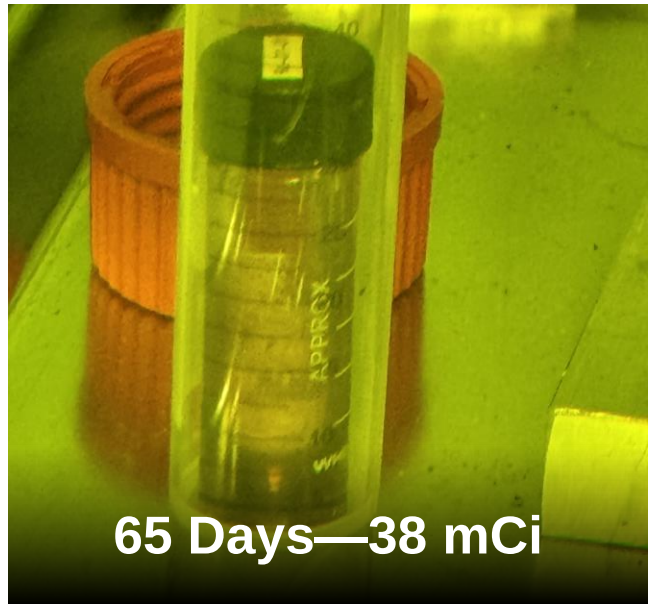
- Maximize recovery of ^{226}Ra
- Minimize contamination
  - ^{226}Ra
  - Progeny including gaseous ^{222}Rn
- Store ^{226}Ra in closed containers
  - Vent only when being processed
- Secondary containment
  - Opening the brachytherapy sources
  - Separation
  - Evaporation
- Equipment designed to be cleaned with a containment vessel for cleaning solutions and rinses
- Regular housekeeping

^{222}Rn Control and Monitoring

- ^{222}Rn permeates plastics and rubber
  - O-rings and seals
  - Bags
- Stainless steel Swagelok© container is the airtight container for shipping and storage
- Timeliness from evaporation to packaging is important in minimizing ^{222}Rn and its progeny in the product
  - Contamination
  - Dose during handling (< 2 mrem per batch)
- Monitor activity
  - Roughing filter (increased dose has not been observed)
  - Stack

Dose Considerations





- α and β- dose from in-growth of progeny can degrade product container
  - Darkening of the borosilicate glass vial observed at 65 days
  - Cap and rubber liner showed no visual signs of degradation at 65 days
- Digital electronics are shielded to protect against radiation induced degradation

^{226}Ra Packaging

- Product is a dry crystalline solid
- Borosilicate glass vial minimizes contamination of the product from materials of construction
  - For long-term storage metal cap is preferred
  - Metal vial should be considered for long-term storage
- Stainless steel Swagelok© container is the airtight container
  - No contamination observed outside the container
  - Likely internally contaminated at receipt
- Type A package shipped as Yellow II or Yellow III
- Modeling for shipping documentation
  - Activity increases during shipment

PNNL Core ^{226}Ra Production Team

- Matt Fountain
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Thank you