Oak Ridge $^{224}$Ra/$^{212}$Pb Generator Production

Roy Copping

$^{212}$Pb User Meeting, July 30th 2020
Agenda

11:00 – 11:10 AM  Roy Copping, Oak Ridge National Laboratory (Moderator)
Introduction – “Oak Ridge Ra-224/Pb-212 generator production”

11:10 – 11:20 AM  Mengshi Li, Viewpoint / University of Iowa
“Preclinical evaluation of synergistic anti-tumor effect from combination of $^{212}$Pb alpha-radiation and immune checkpoint inhibitors”

11:20 – 11:30 AM  Sangeeta Ray, Johns Hopkins University
“Preclinical evaluation of $^{212}$Pb-based radiopharmaceutical therapy of prostate cancer”

11:30 – 11:40 AM  Ebrahim Delpassand, Chairman & CEO, RadioMedix Inc.
“$^{212}$Pb-AlphaMedixTM Targeted Alpha Therapy (TAT): A potential breakthrough in treatment of metastatic SSTR expressing NET”

11:40 – 11:50 AM  Matt O’Hara, Pacific Northwest National Laboratory
“Recent activities in $^{212}$Pb generator development at PNNL”

11:50 – 12:30 PM  Q&A Segment
Isotope production, enrichment and distribution began at Oak Ridge in 1946.
ORNL has a Rich History in Medical Radioisotopes

1946
1st $^{14}$C shipment to Barnard Free Skin and Cancer Hospital, St. Louis. 1946-1963: 1000’s of shipments of up to 60 different radioisotopes

1947-2009
Large-scale mouse genetics project to study the effects of radiation on mammals. Radiation Protection and Effects - Broad biological research program

1993
Cancer and Heart Disease Treatment

1997
$^{225}$Ac & $^{225}$Ac /$^{213}$Bi generator production

1998-2011
Office of Biological and Environmental Research: Low Dose Radiation Research

2017
$^{227}$Ac/$^{223}$Ra treatment for prostate cancer patients
224Ra/212Pb Generator production

- Production established in 2014
- $^{224}$Ra (3.6 d) separated from parent $^{228}$Th and loaded on cation resin
- “Generator” (<16 mCi) can be milked periodically for $^{212}$Pb ($t_{1/2} = 10$ hrs) and $^{212}$Bi (1 hr) and used in TAT applications
- Shipments every three weeks
- $^{228}$Th cow periodically supplemented from $^{232}$U parent
Chemistry

- $^{228}$Th parent recovered from $^{232}$U annually

- $^{232}$U in 8 M HNO$_3$
- Column 1
- MP 1 (NO3)
  - 1 ml BV
- 0.1 M HNO$_3$
- Matrix conversion to 10 M HCl
- Column 2
- MP 1 (Cl)
  - 1 ml BV
- 0.1 M HCl
- Trace $^{232}$U
  - $^{232}$U for storage
    - (Ra, Bi, Pb separated)

- Th-228
- Matrix conversion to 8 M HNO$_3$

Pb-212 User Meeting
\[ \text{Chemistry} \]

- \( ^{228}\text{Th} \) separated and recycled during \( ^{224}\text{Ra} \) separation for generator loading.
\(^{212}\)Pb Elution Profile

- \(^{212}\)Pb can be eluted from the generator in 2 M HCl
$^{224}\text{Ra}/^{212}\text{Pb}$ Generator
$^{224}\text{Ra}/^{212}\text{Pb}$ Generator Future Developments

- $^{228}\text{Th}$ available as a by-product of Ac-227 production
- Expanded production envisaged in FY20/21
- Glovebox shield under construction to minimize worker dose and increase loading activity
- Can work with customer on schedule/activities