

# **Industry and Test Reactors: Collaboration for Production of Medical Isotopes**

TRTR & IGORR: Research Reactor Conference  
University of Maryland, College Park  
June 22, 2023

Sarah Jones, Serva Energy  
Chris Bryan, ORNL  
Patrick Ruddock, AtomVie



Serva Energy was founded in 2017 focused on developing accident tolerant fuels (ATFs).

Spring 2022, ASU Mayo Clinic Med Tech Accelerator.

Technology that underpins our fuel innovation – **Smart Nuclear Materials** - used to develop novel reactor-based production methods for rare life-saving isotopes.





## Support for Nuclear is growing And investment is increasing.....

MURR announces plans to build a 2nd, bigger reactor to produce medical isotopes and help with cancer research – March 23, 2023<sup>2</sup>

\$6.8 million awarded to bump medical isotope production at McMaster's University – March 27, 2023<sup>3</sup>

Bill Gates' Terra Power celebrates historic achievement in next-gen cancer treatment – April 11, 2023<sup>4</sup>







Production of Medical Radioisotopes at  
Oak Ridge National Laboratory

**Chris Bryan**



Industry perspective: Partnering with  
Research Reactors to Develop Ac-225

**Sarah Jones**



Medical Isotopes: Regulatory Considerations

**Patrick Ruddock**

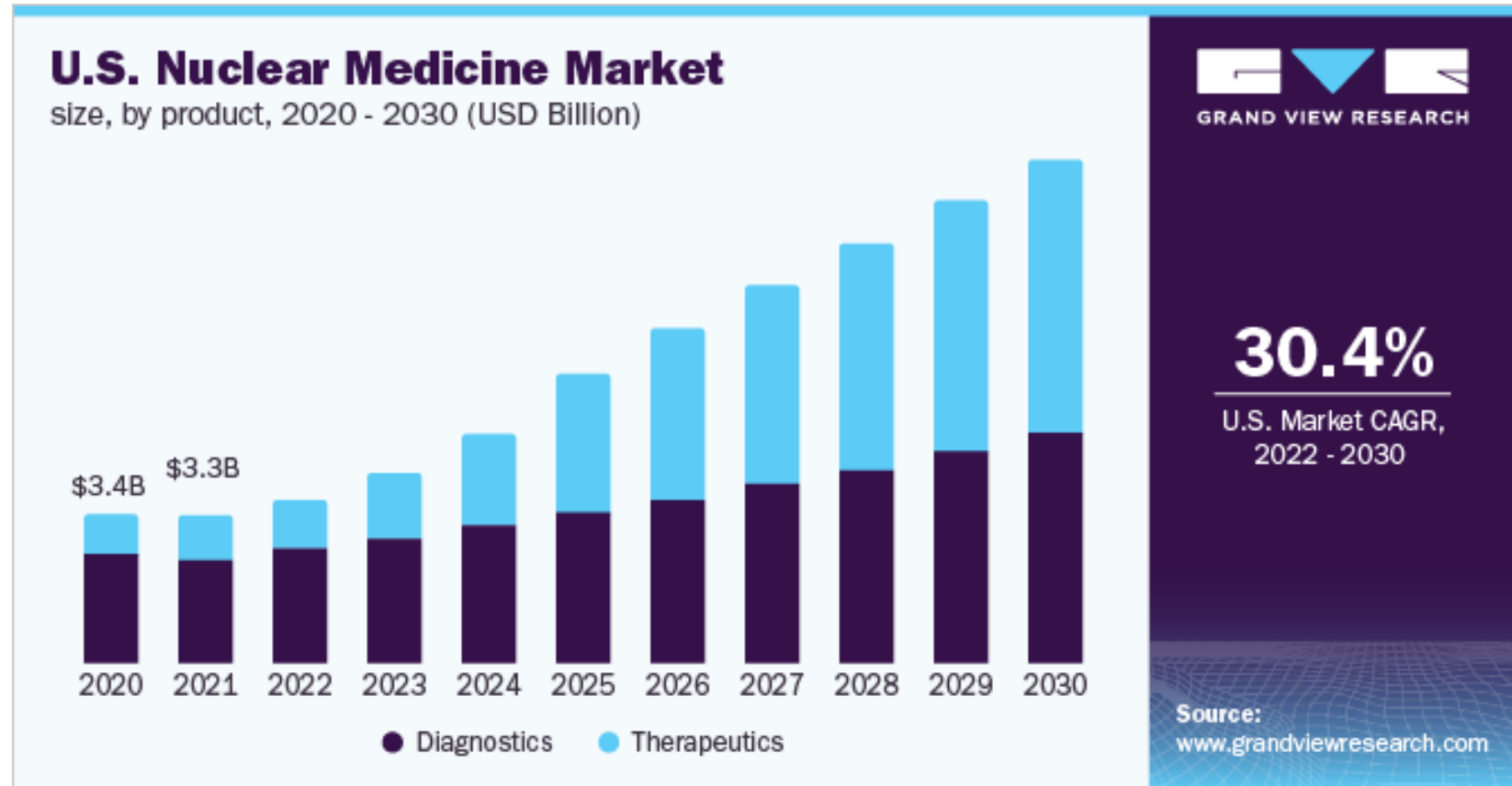


# Industry perspective: Partnering with Research Reactors to Develop Ac-225

Sarah Jones, PhD, MGM

# Medical Isotope Market

- \$8.9 Billion global market
- North America - 45% market share
- Projected 13% compound annual growth rate from 2022-2030 – projected \$24.4 Bil by 2030

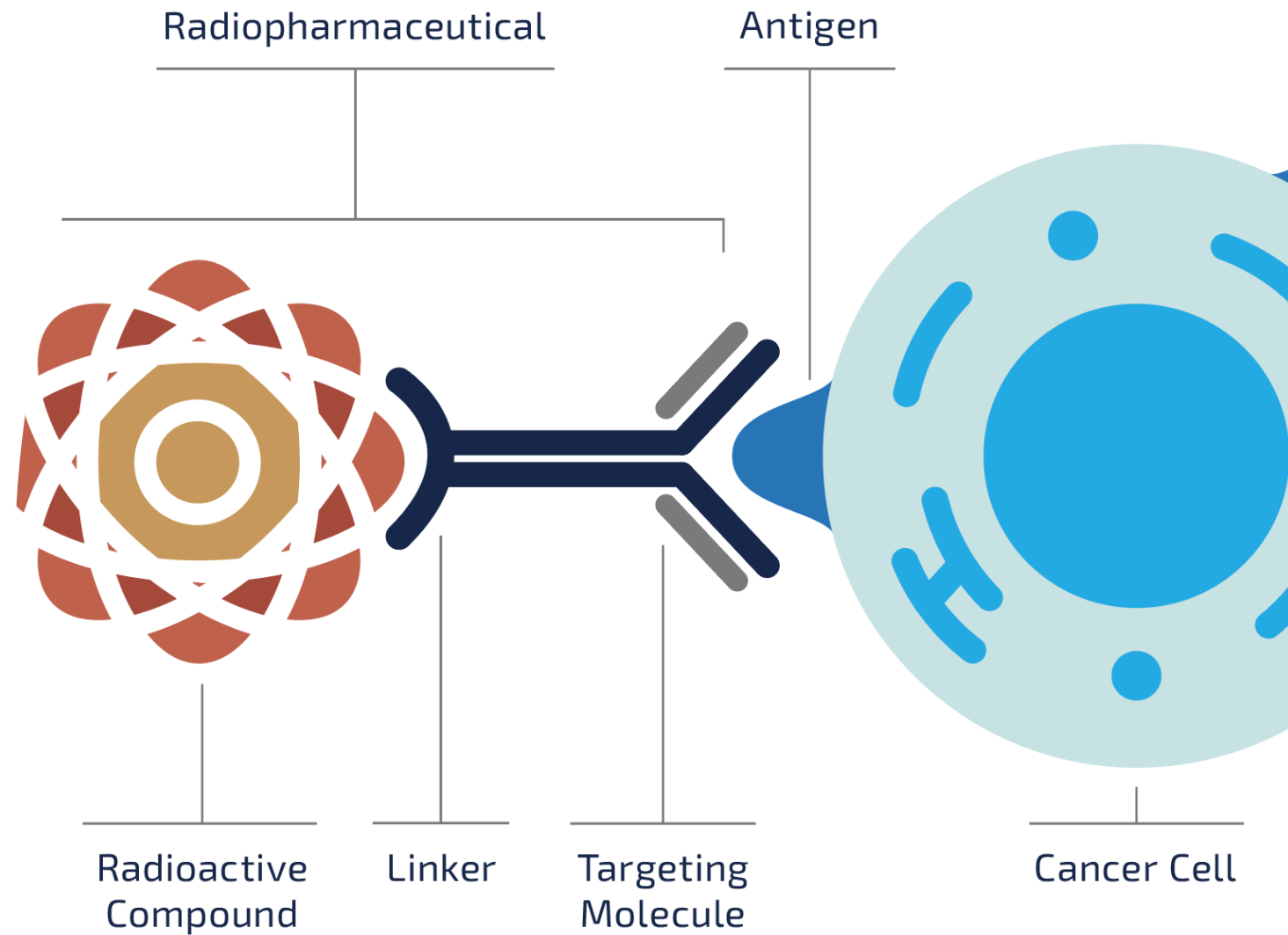


# Revolution in Radiation

## Targeted Therapies

Radiopharmaceuticals seek out cancer cells throughout the body.

Destroying cancer while leaving healthy cells intact.





Radioisotopes like Actinium-225 are at the forefront of a revolution in treating cancer... but short supplies are limiting research and patient access.

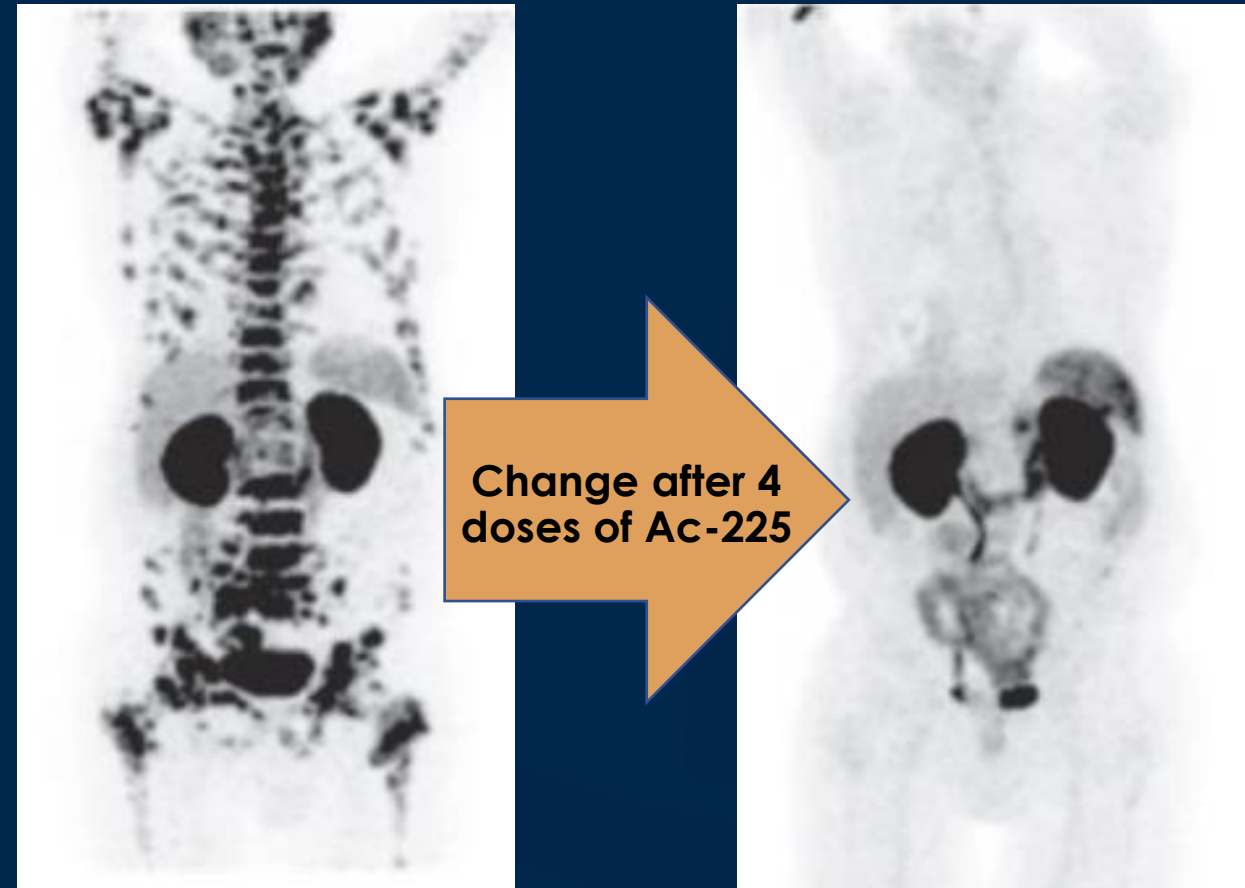
**Serva is leveraging proprietary nuclear technology to develop novel production methods, dramatically increase the supply of Ac-225 and other rare isotopes**



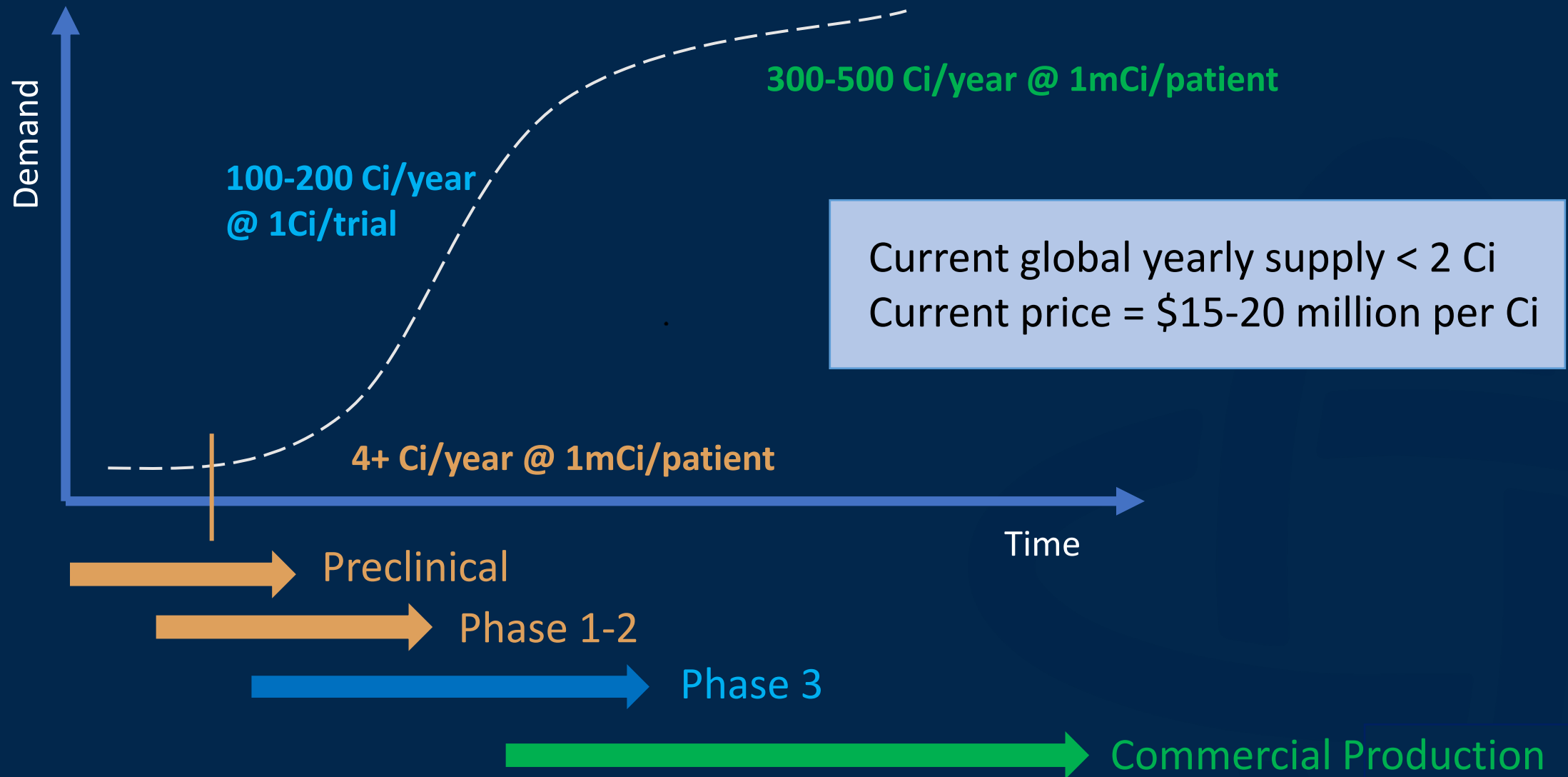
# Clinical studies with Ac-225

**“Drugs containing Ac 225 have the potential to treat otherwise untreatable cancers”**






Dr. Steven Larson, M.D.  
Memorial Sloan Kettering  
Cancer Center



# Projected Demand Curve for Ac-225



# Actinium Landscape: Serva is well positioned

Method	Required infrastructure	Company	Production potential & timing	Limitations
Thorium generator $^{229}\text{Th} \rightarrow ^{225}\text{Ra} \rightarrow ^{225}\text{Ac}$	Thorium generator (limited)	<ul style="list-style-type: none"><li>Tri Lab (national labs)</li><li>Terra Power</li></ul>	 Available	Supply of $^{229}\text{Th}$ - limited
Thorium spallation $^{232}\text{Th} (p,x) \rightarrow ^{225}\text{Ac}$	Cyclotron	<ul style="list-style-type: none"><li>TRIUMF</li></ul>	 Available	$^{227}\text{Ac}$ contamination & waste
$^{226}\text{Ra} (p,2n) \rightarrow ^{225}\text{Ac}$	Cyclotron/High energy	<ul style="list-style-type: none"><li>Ionetix</li><li>Alfarim</li></ul>	 2024/2025	Limited production per cyclotron. Scaling requires multiple cyclotrons (higher capital expenses)
$^{226}\text{Ra} (\gamma,n) \rightarrow ^{225}\text{Ra} \rightarrow ^{225}\text{Ac}$	Electron Accelerator	<ul style="list-style-type: none"><li>Northstar</li><li>Pantera</li><li>Niowave</li></ul>	 2024/2025	High capital expenses with long lead time to production. Ra-226 sourcing
$^{226}\text{Ra} (\gamma,n) \text{ \& } (n,2n) \rightarrow ^{225}\text{Ra} \rightarrow ^{225}\text{Ac}$	Nuclear Reactor	<b>Serva</b>	 2023/2024	Uses existing infrastructure. Ra-226 sourcing

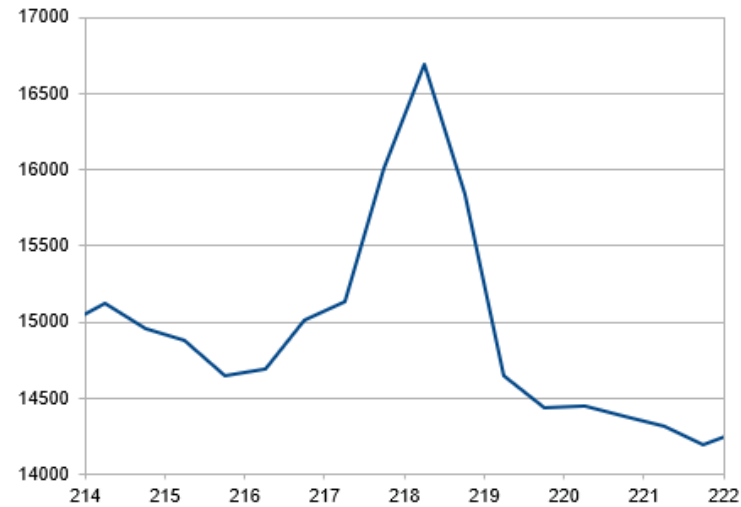
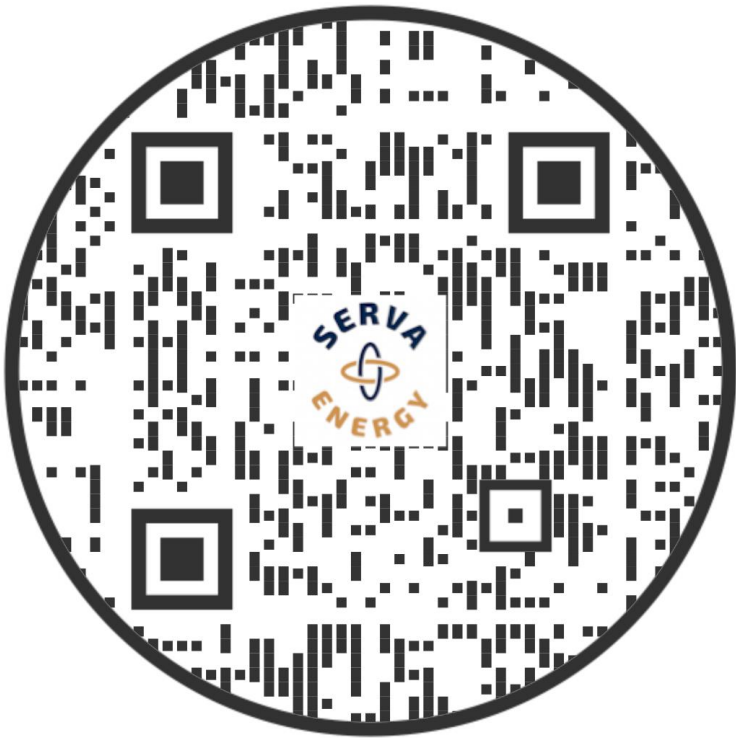


# Serva Advantage Ac-225 Production

- Serva's SNMs shift the radiation environment to increase the fast neutron flux **in thermal reactors**
  - needed to drive the (n,2n) reaction
- Existing reactor infrastructure allows production without large capital investment
- Produce significantly greater quantities than current methods
- Indirect method (via Ra-225) allows for "carrier-free" Ac-225 – free of Ac-227 contamination

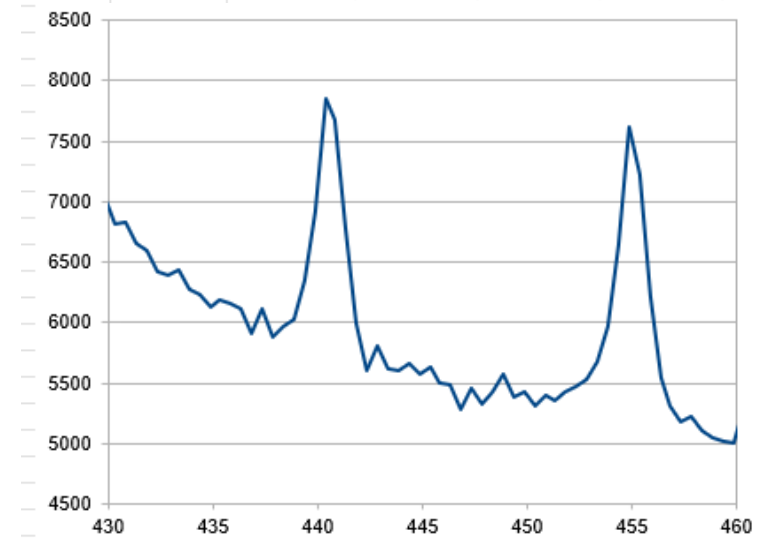


# Breaking News: Serva's New Production Method for Ac-225 Validated

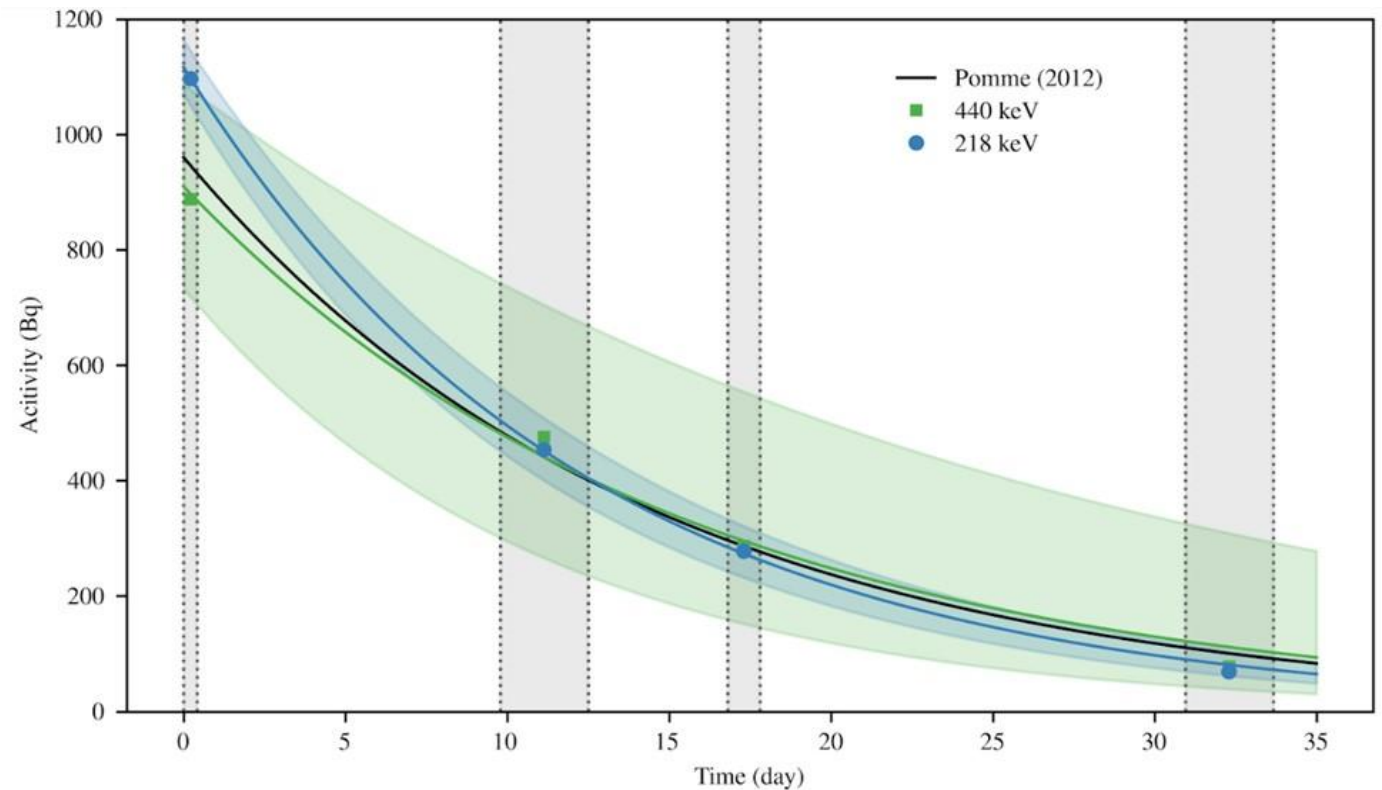
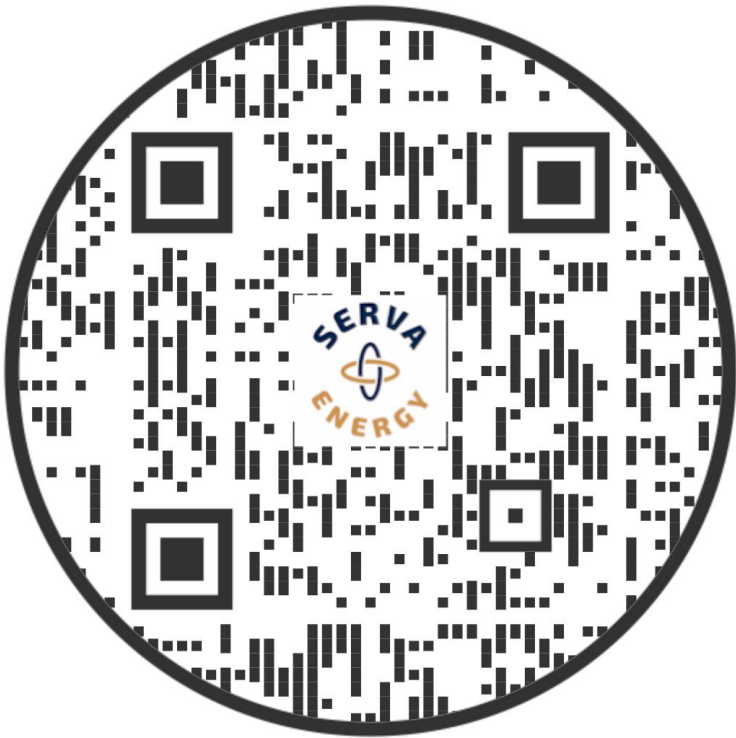


2 daughters of Ac-225

- Fr-221 peak @ 218 keV
- Bi-213 peak @ 440 keV



# Breaking News: Serva's New Production Method for Ac-225 Validated



4 sample orientations/geometries – 3 detectors - 2 coasts  
Activity normalization of Ra-226

# Business Model: Rapid Scaling through Partnership



Serva produces Ac-225 and other isotopes at network of nuclear reactors



Partner with radio-CDMOs to accelerate timeline for production and distribution

# Benefits to Partnering

## Industry

- Rapid scaling with existing infrastructure
- Access to academic expertise and equipment
- Increased success with grant opportunities
- Pipeline for workers – students, interns, new hires.

## Test Reactor/Universities

- Sustainable revenue
- Collaborative research – faculty/industry
- Increased funding – grant and industry sponsored
- Real-world experiences/employment opportunities for students
- Exposure to cutting edge technology
- Positive press on nuclear



## Obstacles to Partnership

Challenges encountered:

- Speed of academia vs industry
- Cumbersome and slow legal/contracting – 6 months (and counting) to get an NDA.....
- Dosimetry for industry partner - ability to effectively conduct experiments
- Complicated fee schedule
- Communication with other partners, universities/gov't entities - sharing RAM licenses, shipping radioactive samples (quickly!)

## Industry Needs\*

- Operations: 24 hour runs across multiple days (e.g. 5-7 days for Ac-225)
- Power – more is generally better but...
  - UCI is 250kW – great R& D partner!
  - For production, more power=more isotope, but flux enhancements can support lower power (e.g. 1MW)
- Facilities – count rooms, radiochemistry labs, hot cells, analytical tools for use with radioactive materials
- Ease of engagement
  - Work-flow for experiments (SOPs, flexibility - 50.59 & license amendments)
  - Fee schedule – cost per neutron
- Protection of IP

\*for Ac-225



# Future Development: In-Demand Isotopes

CDMOs and pharmaceutical companies requesting Serva's expertise to develop domestic production of difficult-to-source isotopes

*\*Co-production with Ac-225 possible and sometimes preferred*

**I-131**

**Mo-99**

**Lu-177**

**Tb-161\***

**Ra-223\***

**Bi-213\***

**Cs-131**

**Th-227\***

**At-211**



# Thank you

Sarah Jones, PhD

VP Serva Medical

[s.jones@servaenergy.com](mailto:s.jones@servaenergy.com)

Ian Horvath

CEO

[ian@servaenergy.com](mailto:ian@servaenergy.com)

[www.servaenergy.com](http://www.servaenergy.com)



# Best-in-class radiation spectroscopy

- Serva's proprietary ADC (Analog digital converter) hardware coupled to software suite fueled by largest nuclear database assembled to date
- FPGA driven, 250 MS/s, 16 bit, full data utilization, 100% real-time analytics with new AI-assisted post processing
- Unprecedented resolution and reduced dead time
- Simple, easy to use desk top user interface with cloud processing. Compatible with nearly all detectors
- Significant interest by National labs, nuclear power plants, independent and university-based spectroscopy labs – Beta testing with partners expected Q4, 2023
- Accelerating Serva's development of fuels and isotopes

