University of Missouri Research Reactor (MURR®)

Russell Gibson, Assistant Reactor Manager - Operations

Research Reactor
University of Missouri

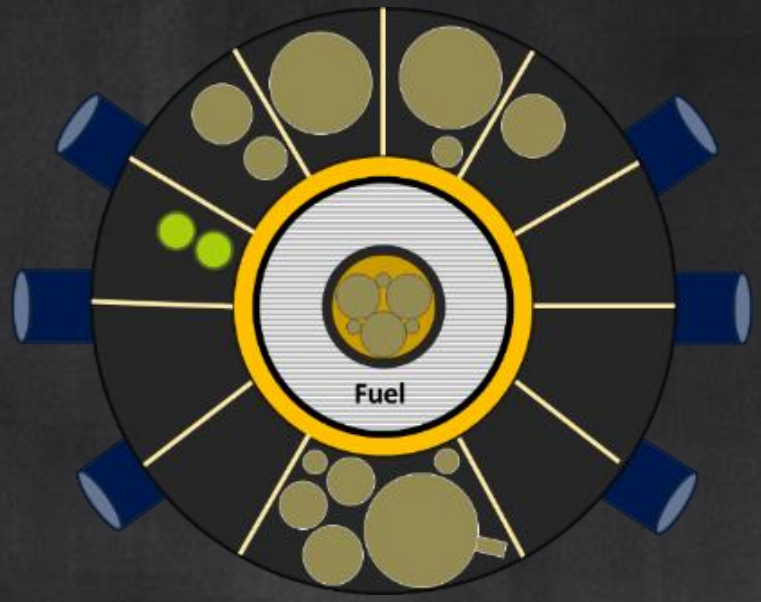
MURR®

OVERVIEW

MURR is Unique in the World

- Operates at 10 MW
- 24 hours a day
- 6.5 days a week
- 52 weeks per year

MURR started operations in 1965 and currently has 250+ full-time employees, not including students, interns, or part time workers



MURR Core Missions

Research & Development

Education

Our Core Missions: Research & Education

Products & Services

Reactor Operations

RESEARCH AT MURR

Life Sciences

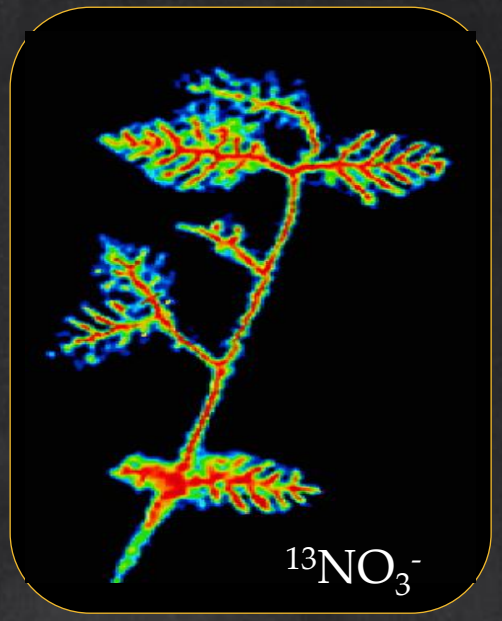
- Radiopharmaceutical Research
- Trace Element Epidemiology
- Plant Biology

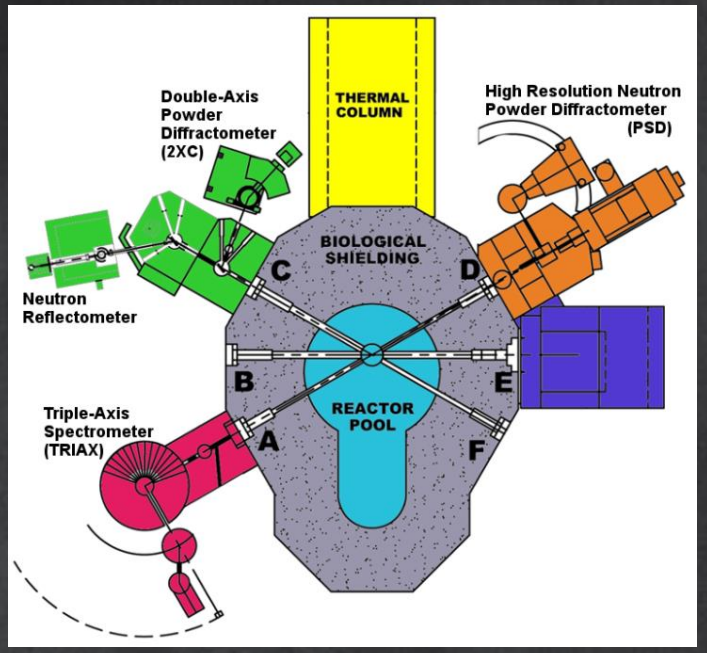
Social Sciences

- Archaeometry

Material Sciences

- Quantum Magnetic Materials
- Crystallography and Magnetic Structure
- Materials for Energy Storage
- Post Irradiation Examination
- Multi-Functional Materials





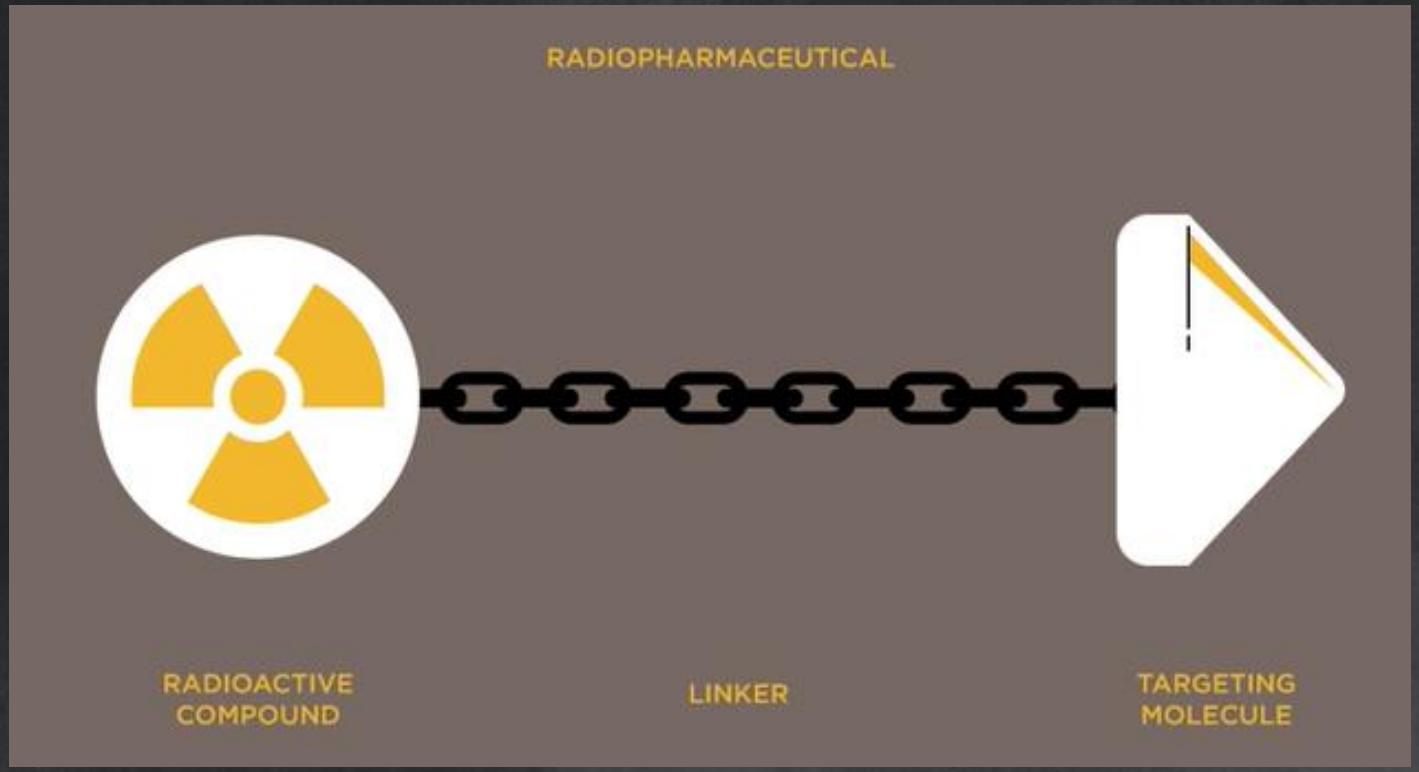
Radioisotopes

- Saving and extending lives for patients

Diana Pummill,
MU Health Care Lutathera patient

Targeted Radiotherapy

Radioactive compounds are attached to targeting molecules using a linking agent. The targeting molecule attaches to cancer cells and the radioactive compound then kills the cancer cells. The radioactive compound also allows physicians to monitor the therapy's effectiveness via imaging.



Current Radiopharmaceutical Production

MURR supplies radioisotopes to treat or diagnose up to 1.6 Million patients per year.

MURR is the only U.S. supplier of four radioisotopes used to detect and treat cancer and diagnose heart disease:

- TheraSphere® (Y-90) for liver cancer
- Lutathera® (Lu-177) for neuroendocrine tumors
- Pluvicto® (Lu-177) for prostate cancer
- I-131 for thyroid cancer and hyperthyroidism
- RadioGenix® (Mo-99/Tc-99m) for imaging and diagnosis

Current Radiopharmaceutical Production

Number of Patients Treated by MURR products

Isotope	Patients/year	Indication
I-131*	16,000	Treatment for hyperthyroidism and thyroid carcinoma
Lu-177	62,000	Treatment for Neuroendocrine tumors (Lutathera®) and prostate cancer (Pluvicto®)
Y-90	5,000	Treatment for liver cancer
Mo-99	1,560,000	Mo-99 decays to Tc-99m, the leading imaging agent used to diagnose heart disease and cancer and to study organ structure and function

*Number of patients treated will double in mid-2023 under new supply agreement.

Routine Isotope Supply & Global Distribution

Isotopes Shipped Annually by MURR		
Au-198	Ir-192	Sb-122
Au-199	Kr-79	Sb-124
Ba-131	Mo-99	Sc-46
Ca-45	Na-24	Se-75
Cd-115	P-32	Sm-153
Ce-141	P-33	Sn-117m
Co-60	Pd-109	Sr-89
Cr-51	Po-210	W-181
Cu-64	Rb-86	Y-90
Fe-59	Re-186	Yb-169
Lu-177	Ru-103	Zn-65
Hg-203	S-35	Zr-95

Shipping Radioactive Materials:

- MURR ships more than 1,000 packages each year
- MURR owns a fleet of shipping packages
- Logistics & Shipping staff ship around the globe

Research & Development for Future Production

New Radioisotopes on the Horizon

- Rhenium-186
- Lutetium-177
- Gold-199
- Arsenic-77
- Terbium-161
- Targeted Alpha Therapy (TAT)
  - Actinium-225, Lead-212, Terbium-149, and Thorium-227

New Radiotherapies in the Pipeline

Number of ongoing clinical trials for new radiotherapeutics

2,549 Phase 1

5,789 Phase 2

1,962 Phase 3

Source – ClinicalTrials.Gov

Complex Radiopharmaceutical Supply Chain

MURR supports the entire radiopharmaceutical supply chain from new drug development and regulatory filing, to API production and delivery to pharmacies around the world.

New Drug Development

Regulatory Filing

Isotope Supply

Drug API Production

Shipping

Campus Partnerships

Benchtop to Bedside Development

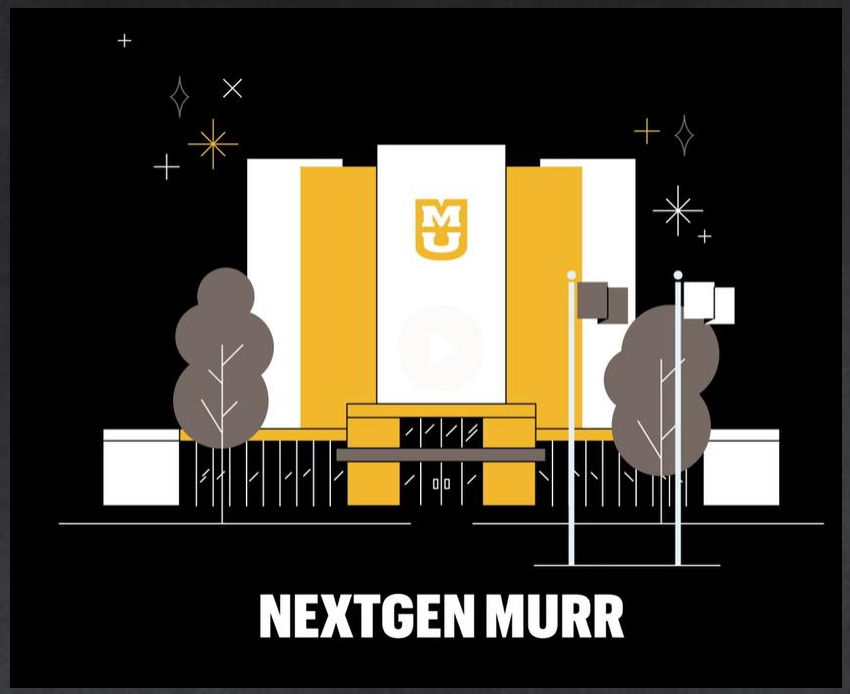
MU | NEXTGEN PRECISION HEALTH

MU School of Medicine
University of Missouri

MU College of Veterinary Medicine
University of Missouri

MURR UPGRADES AND FUTURE PLANNING

MURR West and NextGen MURR



MURR WEST

48,000 Square Feet of Additional Space

- **Ground Floor** - 16,000 square feet to expand laboratory and production space.
- **Second Floor** - 16,000 square feet to provide office space and additional conference rooms for the expanding workforce at MURR.
- **Third Floor** – 16,000 square feet for engineering labs, student use, and shell space for offices and production needs.

Artist's Rendering of MURR West

NextGen MURR

Why a New Reactor?

NextGen MURR

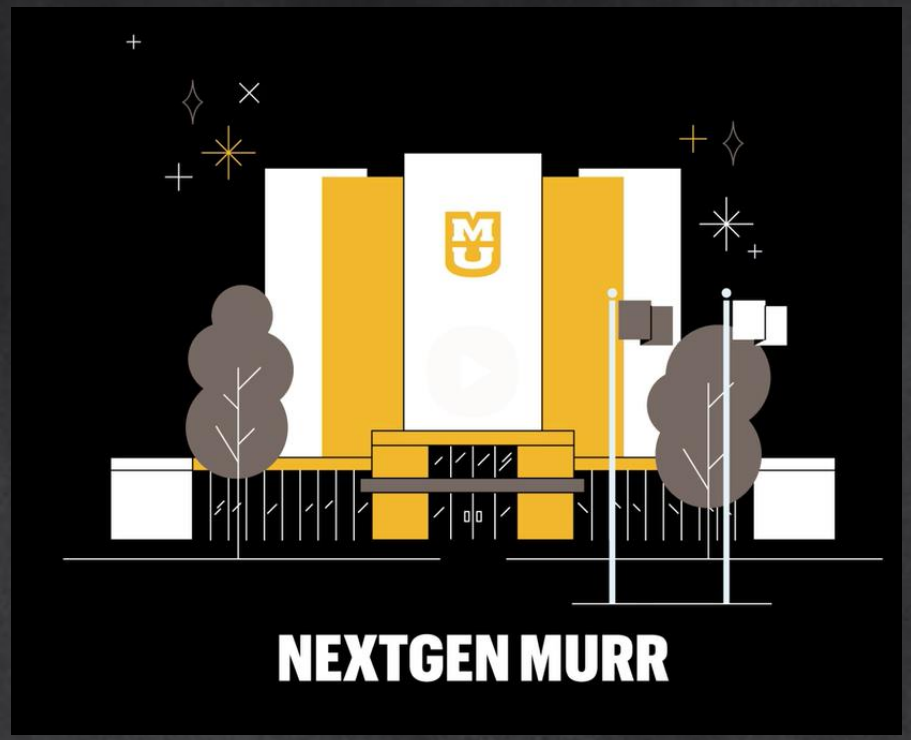
Why a New Reactor?

- MURR is currently the sole United States supplier of four short-lived medical radioisotopes critical to patient diagnosis and treatment of heart disease and cancer.
- MURR not only supplies the United States, but often serves as the sole supplier of certain isotopes in the world when other reactors shut down.
- MURR has been operating safely and reliably for over 55 years but its remaining functional lifetime is limited. If MURR stopped operating, patients would not get treatments.
- A new 20 MW research reactor will allow MU to continue to provide life saving radioisotopes and greatly expand our production capacity, including isotopes MURR is not currently able to produce.

NextGen MURR RFQ/RFP Overview

- On April 10th, the university issued a Request for Qualifications (RFQ) to qualify and contract with a single project team capable of providing design, licensing, environmental and development services for a nuclear reactor and facility.

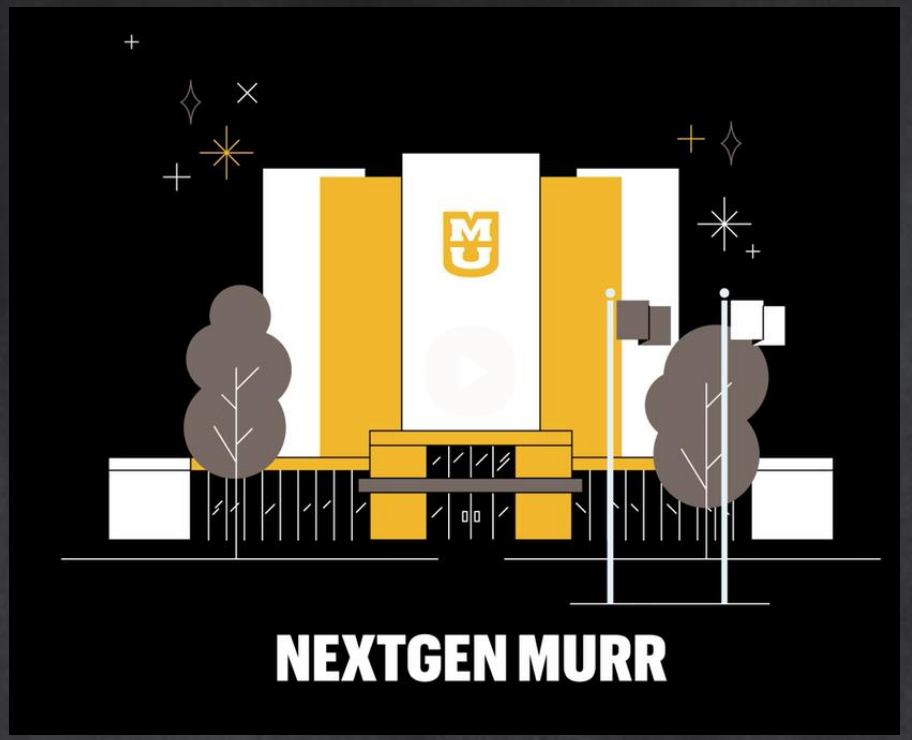
- On June 9th, RFQ responses were received from five (5) project teams.



NextGen MURR RFQ/RFP Next Steps

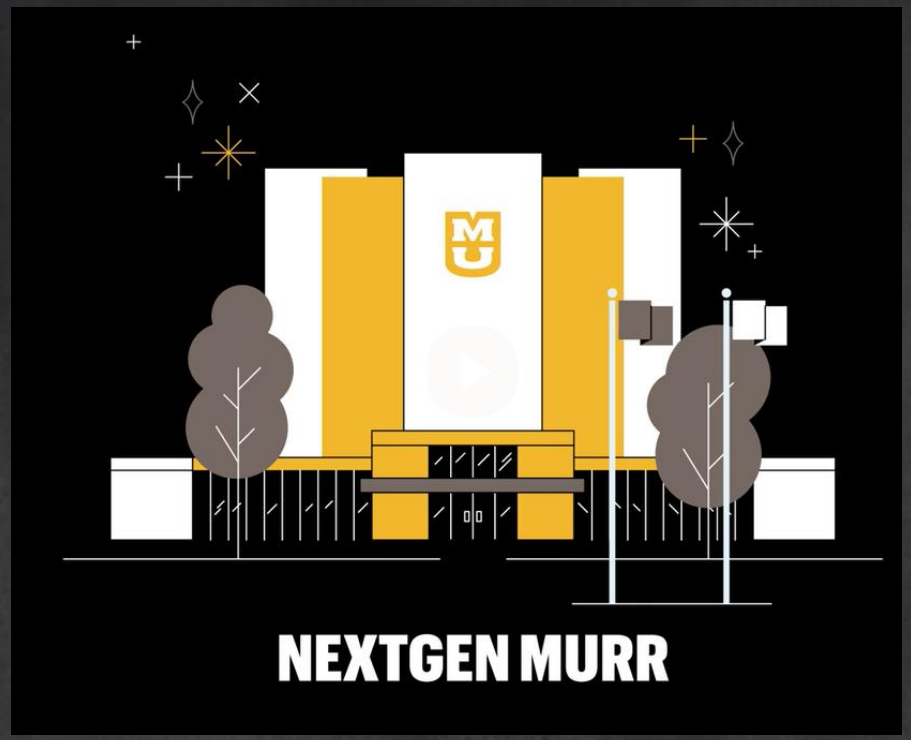
- **RFQ** - Project teams that meet the university's requirements related to qualifications, relevant experience, conceptual work plan, management framework and financial capacity will be invited to participate in step-two of the process.

- **RFP** - In step two, the University will evaluate and compare specific proposals, preliminary reactor designs, and financial structures proposed by the respondents selected in step-one of the process.



NextGen MURR RFQ/RFP Project Schedule

- **RFQ Shortlist Deadline** — **July 7, 2023**
- **RFQ Interviews** — **July 17-21, 2023**
- **RFQ Finalist Selection** — **Aug. 8, 2023**
- **RFP Issued** — **Aug. 11, 2023**
- **Project Team Selected*** — **Oct. 24, 2023**
- **RFP Finalist Selection** — **Spring 2024**



**Current MURR management will continue to focus on operations at the original MURR facility and a separate Project Team will oversee the NextGen MURR project.*

Questions?