

**University of Missouri Research  
Reactor: Supplying  
Radioisotopes for Medical  
Research**

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Medical Radioisotopes Program

# Primary Objective

Develop a program for routine supply of reactor produced radioisotopes for research and clinical use at reasonable cost to the user.

# Features of MURR

- Highest neutron flux of any U.S. university reactor
- High reliability -- operates 105% of schedule [91% of clock time]
- Compact Flux Trap [ca. 8 cm diam. X 1 m long cylinder]
- Traditionally access flux trap samples once/week
- Currently access small samples several times each week

# History of Medical Radioisotope Production at MURR

- 1966 Start up (5 MW)
- 1969 100 hr/wk operation-Mo-99 Production begins
- 1975 Power Upgrade (10 MW)-P-32 & S-35 Prod.
- 1977 155 hr/wk operation-Increased Mo-99 Production
- 1980 Y-90 Glass Microspheres R & D begins
- 1982 Sm-153-EDTMP & Re-186-HEDP R & D begins
- 1989 Irradiation of Au-198 and Ir-192 Seeds begins
  - (Cintichem Reactor decommissioned)

# Selected Radioisotopes Currently Supplied by MURR

- Lanthanides [all  $M^{3+}$ ]
  - Sm-153, Ho-166, Lu-177
- Transition Metals
  - Rh-105, Re-186, Re-188 Ir-192, Au-198
- Main Group Elements
  - P-32, P-33, S-35, Se-75

# Therapeutic Radiopharmaceuticals Commercialized with MURR Support

- TheraSphere™
  - Y-90 microspheres for intra-arterial radiotherapy of primary liver cancer
  - Now marketed in selected countries by Nordion and recently approved in the U.S.
- QuadraMet™
  - An agent designed to relieve the pain associated with metastatic bone cancer
  - Now marketed worldwide (in US by Berlex/Schering)

# Y-90 Glass Microspheres [TheraSphere™]

- Y-90, beta-emitting, highly insoluble glass microspheres
- Administered by catheter into hepatic artery for treatment of primary liver cancers
- Developed in collaboration with **Theragenics Corp.**



# QuadraMet™

- Sm-153 identified as a useful nuclide for radiotherapy by MU researchers
- Successful in palliative treatment of bone cancer
- Developed in collaboration with the **Dow Chemical Company**

# Clinical Trial Support at MURR

- Ho-166 DOTMP Clinical Trial Support
  - Multi-Curie production
  - Distribution challenges

# Ho-166 DOTMP Clinical Trial Support

- Skeletal Targeted Radiotherapy (STR) for Multiple Myeloma
- Phase I/II Clinical Trials (NeoRx)
- 12 of 27 Patients have Achieved Complete Remission (single doses as high as 4 Ci)
- Pivotal (Phase III) Trials expected to Start in 2002

# Nuclear Properties of Various $M^{3+}$ Radionuclides

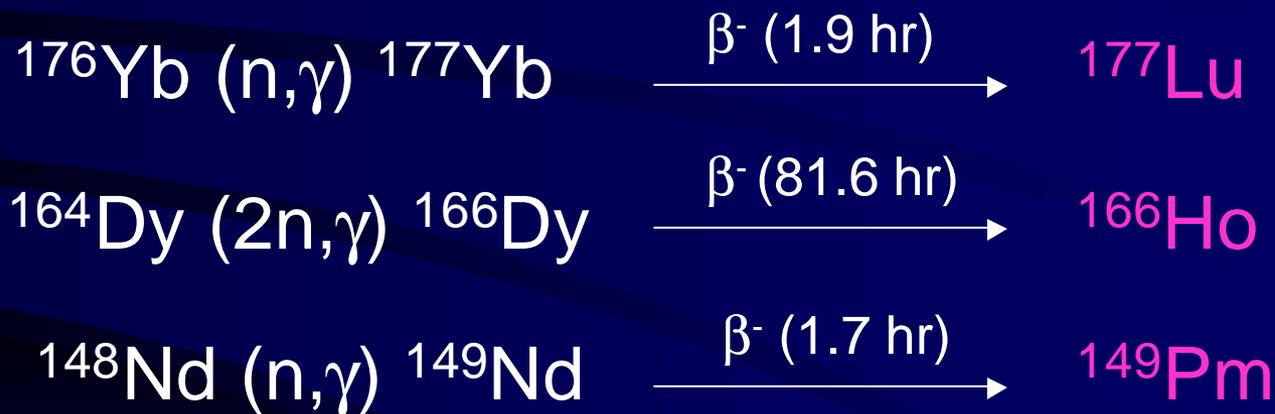
<b>Isotope</b>	<b>Half-Life (days)</b>	<b><math>\beta</math>- max (MeV)</b>	<b>Ave Range (mm in water)</b>	<b>Approx. Range (cell diameters)</b>
<b>Lu-177</b>	<b>6.65</b>	<b>0.50</b>	<b>0.24</b>	<b>20</b>
<b>Sm-153</b>	<b>1.93</b>	<b>0.69</b>	<b>0.35</b>	<b>30</b>
<b>Pm-149</b>	<b>2.21</b>	<b>1.1</b>	<b>0.71</b>	<b>60</b>
<b>Ho-166</b>	<b>1.12</b>	<b>1.9</b>	<b>1.4</b>	<b>120</b>
<b>Y-90</b>	<b>2.67</b>	<b>2.3</b>	<b>1.8</b>	<b>150</b>

# “No Carrier Added Radiolanthanides”

- Some applications require very high specific activities – i.e., ‘no carrier added’
- Lu-177 can be produced directly by irradiating Lu-176 or indirectly by irradiating of Yb-176 producing Yb-177, which then beta decays to produce Lu-177
- Indirect production requires a chemical separation, but produces Lu-177 which is approaches “carrier-free”

# No Carrier Added Radiolanthanides

Production of NCA radiolanthanides:



# Additions/Improvements Continue at MURR

- Regulatory Assurance group
- cGMP program
- New Hot cells
- Customer Relations
- Radioisotope Production Building
- Clean room

# Conclusions

- MURR is committed to developing and supplying radioisotopes for medical research
- MURR is also committed to providing commercial products, services and technologies that result from our efforts

# External Funding from Private Industry and DOE

- Theragenics Corp., MDS Nordion, Dow Chemical Co., NeoRx Corp., ABC Laboratories US
- Department of Energy Advanced Nuclear Medicine Initiative (DOE-ANMI) and Los Alamos National Lab