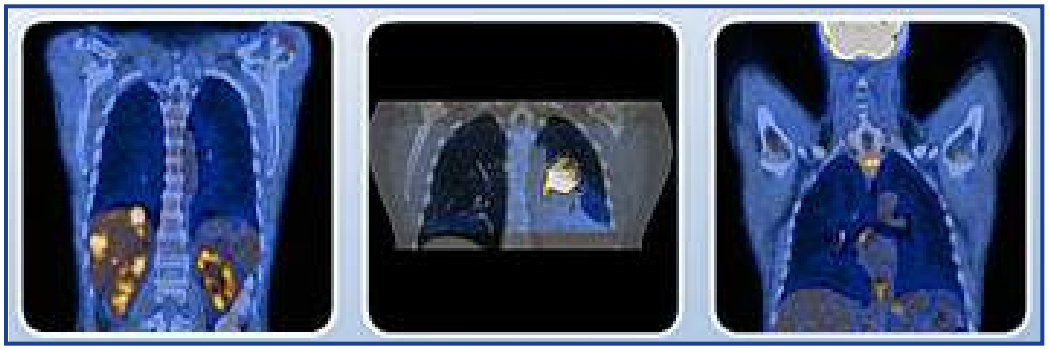
Moly-99 Project Update for the US NRC
August 2011



GE Hitachi Nuclear Energy

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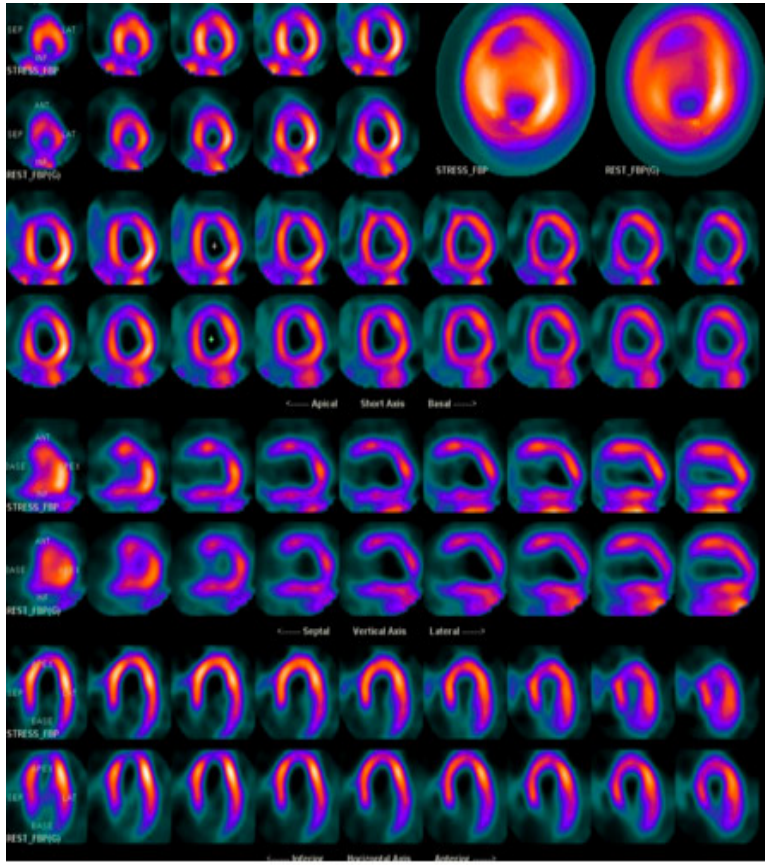
What is molybdenum-99?

- Used in approximately 85% of all nuclear medicine procedures …brain, heart, thyroid, lungs, liver, kidneys, skeleton, blood and tumors.
- Rapid uptake by target organ…is bound to another drug that transports it to the organ of interest
- Decay results in relatively low energy gamma…easily detected providing accurate imaging
- Short half-life results …allows for quick scans and lower patient dose, also lends BWRs to being ideal for activation



Myocardial perfusion SPECT – stress/rest

Myocardial perfusion SPECT- stress/rest scan in a patient with dilated cardiomyopathy.

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Current isotope production

- Aging & obsolete production facilities…54 year old NRU reactor and HFR for ^{99}Mo experienced extended shutdowns.
- Isotopes from nuclear fuel… ^{99}Mo is obtained mostly from HEU targets
- Shortage resulting in high visibility in Washington…DOE awards grants to solve shortage crisis with reliable, domestic supply of ^{99}Mo w/o HEU use and NRC working group devoted to project

	Typical
Canada NRU – 1957 HEU Targets	40%
Netherlands HFR – 1961 HEU Targets	25%
Belgium BR-2– 1961 HEU Targets	20%
South Africa Safari – 1965 HEU Targets	10%
France Osaris– 1966 HEU Targets	5%
Australia Opal– 2008 HEU Targets	N/A

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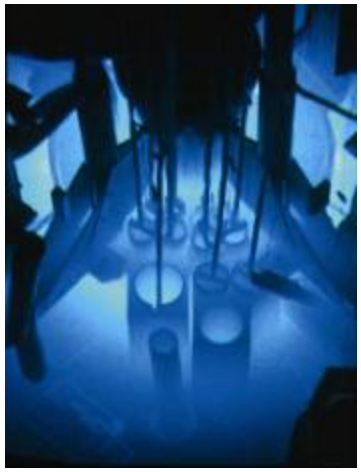
Molybdenum-99 to technetium generators



Molybdenum-99 (66h)

β decay

Technetium-99m (6h)

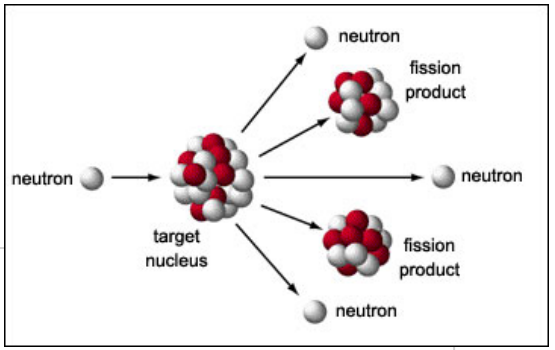
Generator Elution

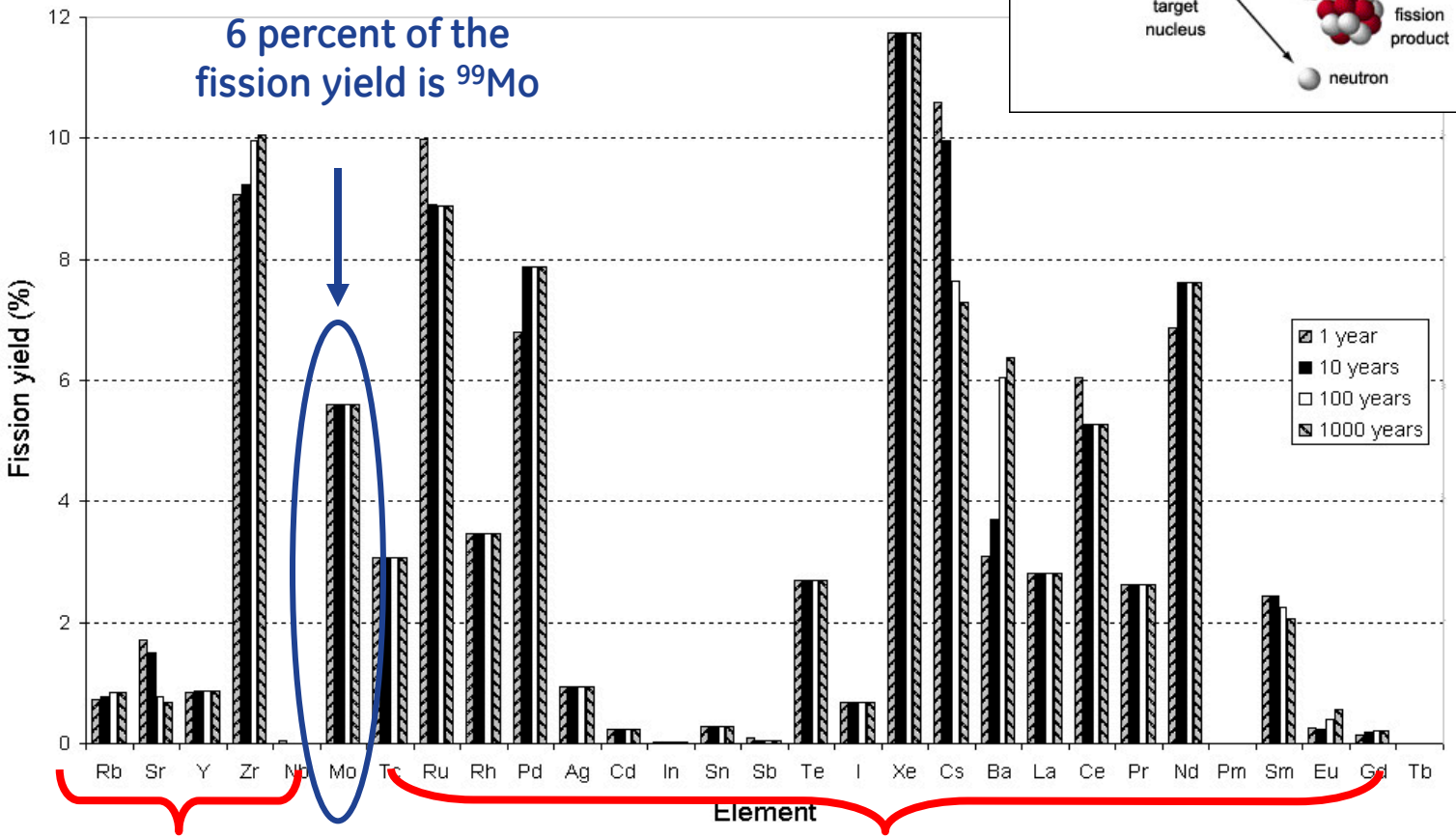
Saline Addition

Patient

How is ^{99}Mo currently produced?

Currently Produced by Fission of Highly Enriched Uranium Targets





Fission Product Waste (Spent Fuel)

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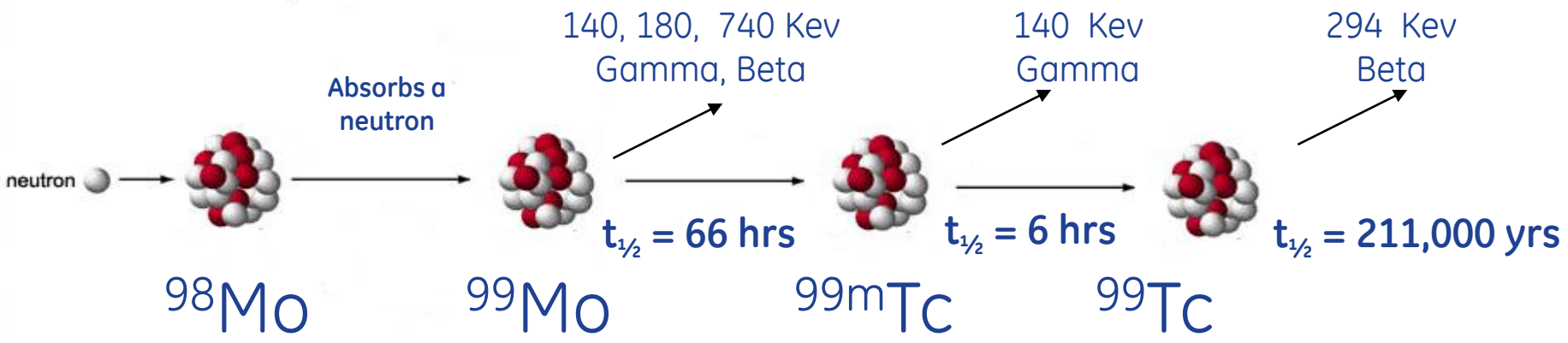
GEH method to produce ^{99}Mo

Our process uses neutron capture to produce the parent of ^{99m}Tc from ^{98}Mo



^{98}Mo	^{99}Mo	^{99m}Tc	^{99}Tc
42 Protons	42 Protons	43 Protons	43 Protons
56 Neutrons	57 Neutrons	56 Neutrons	56 Neutrons
98 = Atomic Wt	99 = Atomic Wt	99 = Atomic Wt	99 = Atomic Wt

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GEH's process advantages

	Traditional Method	GEH Method
Target Composition/National Security	High Enriched Uranium	Natural Molybdenum
Waste/Environment	High Level Radioactive Waste	Low Level Radioactive, not Hazardous (RCRA) waste
Chemistry	Complicated separations of Mo from Uranium	Simpler process, no uranium complications
Supply Reliability	Unreliable supply	BWRs (>90% CF) produces reliable supply
Cost	Requires new build	Leverages current infrastructure

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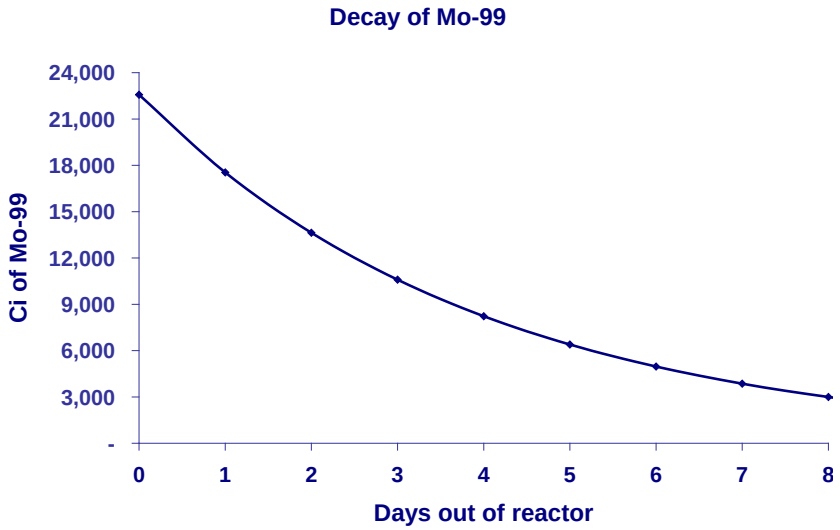
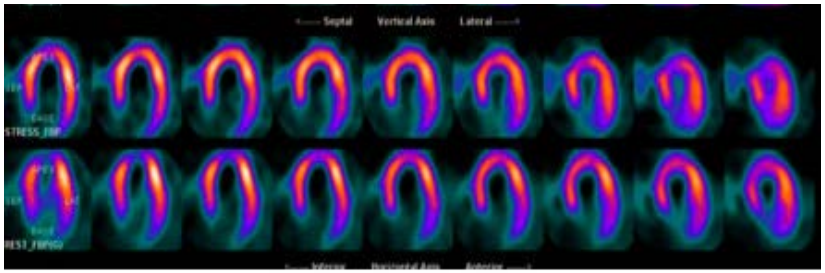
GEH's ^{99}Mo production goal

- GEH Goal…Produce up to 3,000 6-day Ci of ^{99}Mo/week which equals ~50% of domestic demand
- What is a 6-day Curie?…Amount of curies due to ^{99}Mo six days after the Tc generator is on manufacturer's shipping dock
- Short Half Life…Allowing two days for transport and generator fabrication, approximately 23,000 Ci of ^{99}Mo is required upon removal from reactor
- BWR Activation…Epithermal neutrons are responsible for majority of activation.





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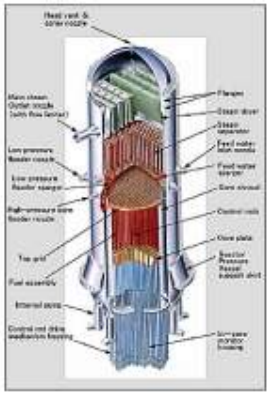
Molybdenum Life Cycle



Reactor (research or BWR) irradiation ^{98}Mo to ^{99}Mo

Chemistry metal to gel

^{99m}Tc Generator Applications

Mixed by pharmacist for use

Patient Application

Mo Target Preparation

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Benefits of ^{99}Mo project

- Saves lives…Consistent supply of important medical isotope for the U.S.
- National Security…Allows White House to achieve their goal of producing molybdenum-99 without the use of HEU
- Environmentally Favorable…Generates U.S. imaging medical isotope supply without creating HLW
- Asset Utilization…Provides important medical isotope without the need for new reactors, while leveraging proven and licensed equipment

Definitions and Acronyms

- BWR – Boiling Water Reactor
- CF – Capacity Factor
- DOE – Department of Energy
- FP – Fission Products
- GEH – GE Hitachi Nuclear Energy
- HFR – High Flux Reactor
- HEU – High Enriched Uranium
- HLW – High Level Waste
- LLW – Low Level Waste
- LWR – Light Water Reactor
- Mo – Molybdenum
- NRC – Nuclear Regulatory Commission
- NRU – National Research Universal
- RCRA – Resource Conservation and Recovery Act
- Tc – Technetium
- TRU – Transuranic Elements

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