

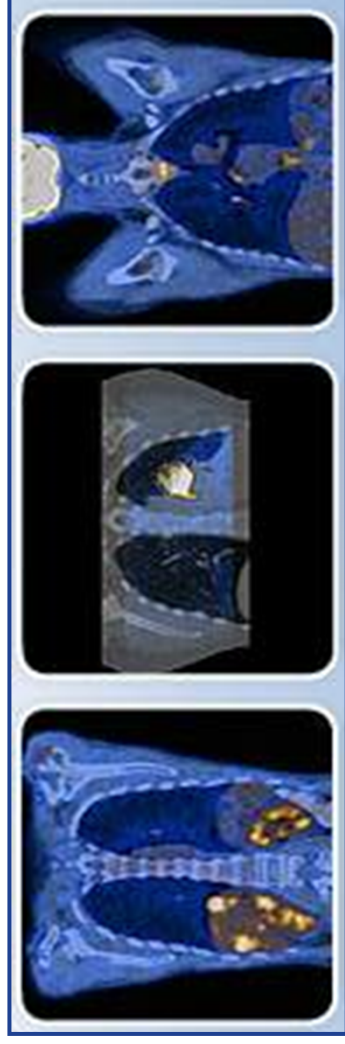
## ENCLOSURE 3

MFN 11-211

Moly-99 Project Update Public Meeting Presentation

# Moly-99 Project Update for the US NRC

## August 2011



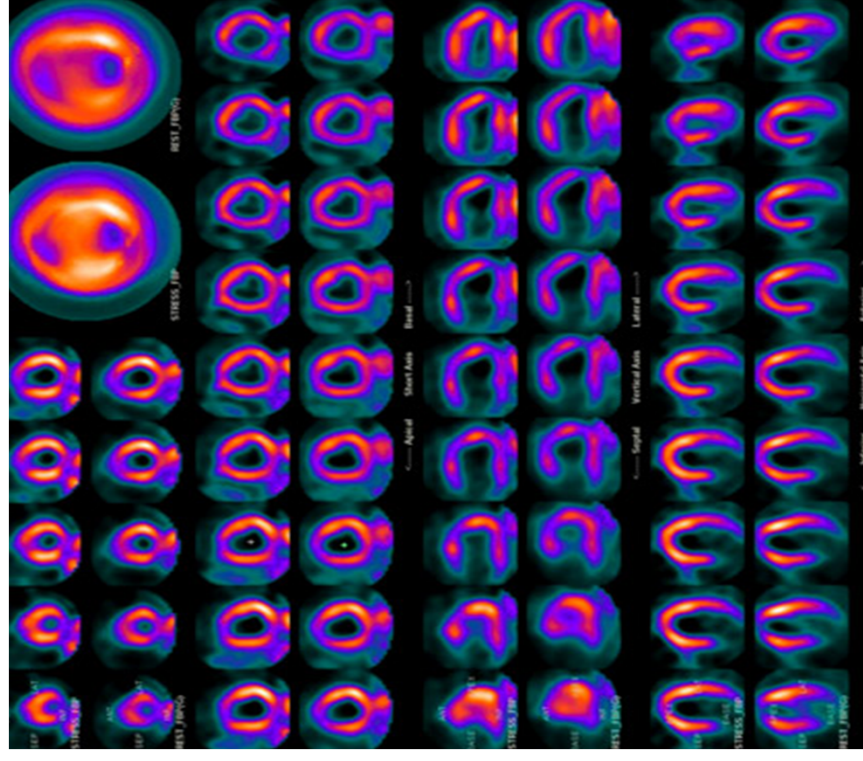
GE Hitachi Nuclear Energy

# 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



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**Myocardial perfusion SPECT – stress/rest**

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

# Current isotope production

- Aging & obsolete production facilities...54 year old Canadian reactor and HFR for Mo-99 experienced extended shutdowns.
- Isotopes from nuclear fuel...Mo-99 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 <sup>99</sup>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  
Osiris– 1966  
HEU Targets

5%

Australia  
Opal– 2008  
HEU Targets

N/A



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# Molybdenum-99 to technetium generators

Molybdenum-99 (66h)



Technetium-99m (6h)



Generator Elution

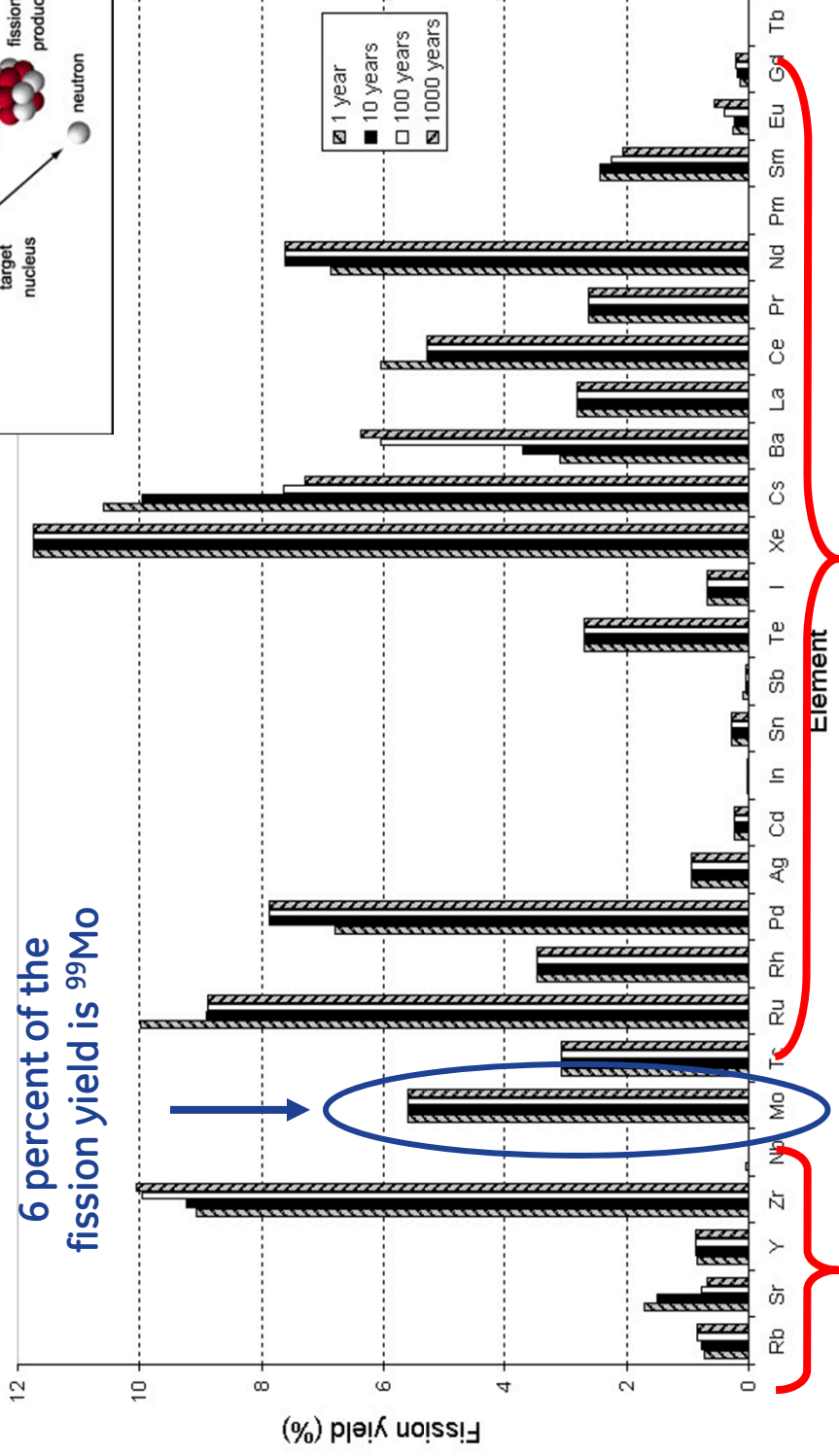
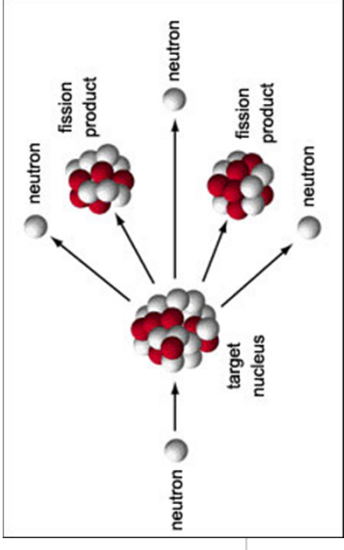
Saline Addition

Patient



# How is $^{99}\text{Mo}$ currently produced?

Currently Produced by Fission of Highly Enriched Uranium Targets

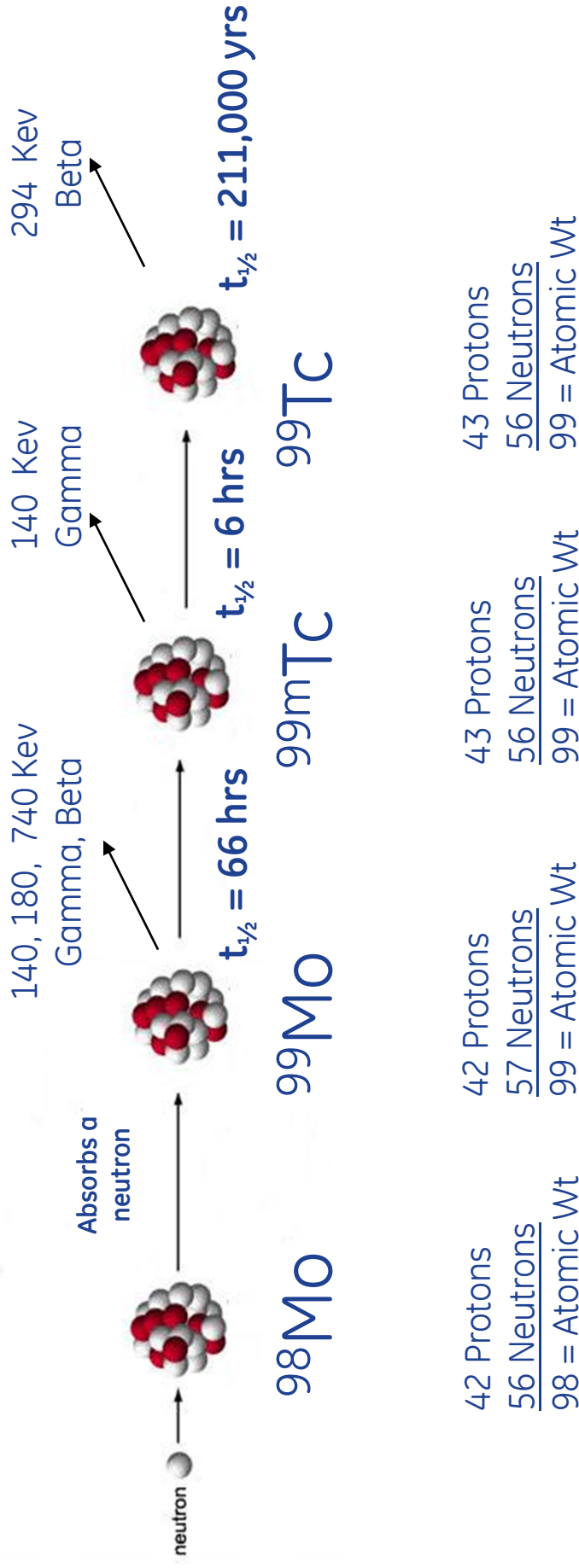


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Fission Product Waste (Spent Fuel)

# GEH method to produce $^{99}\text{Mo}$

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



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# GEH's process advantages

	Traditional Method	GEH Method
Target Composition/National Security	HEU	Natural Molybdenum
Waste/Environment	HLW w/ TRU and Long Lived FPs	LLW and no RCRA waste
Chemistry	Complicated separations of Mo from Uranium, FPs, and TRU	Simpler process w/o FP and TRU complications
Supply Reliability	Aging reactors and unreliable supply	BWRs (>90% CF) produces reliable supply
Cost	Requires new build	Leverages current infrastructure

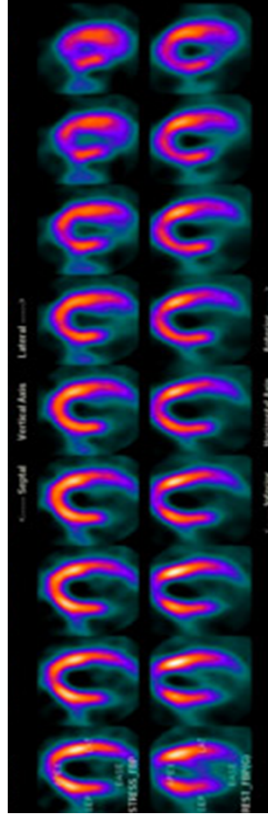
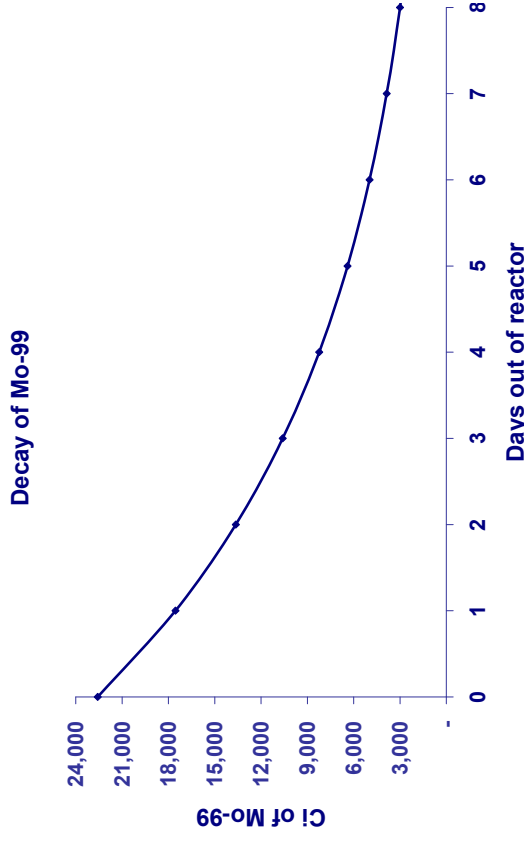


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# GEH's $^{99}\text{Mo}$ production goal

- **GEH Goal**...Produce up to 3,000 6-day Ci of  $^{99}\text{Mo}$ /week which equals ~50% of domestic demand
- **What is a 6-day Curie?**...Amount of curies due to  $^{99}\text{Mo}$  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  $^{99}\text{Mo}$  is required upon removal from reactor
- **BWR Activation**...Epithermal neutrons are responsible for majority of activation, calculated specific activity is approximately 1-2 Ci  $^{99}\text{Mo}$ /g initial Mo
- **Manageable Mass**...Specific activity requires activation of <30 kgs of Mo every week

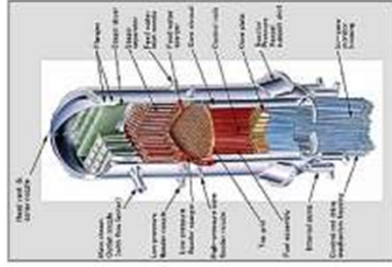


**Myocardial perfusion SPECT – stress/rest**

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



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



## Mo Target Preparation



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# Chemistry



# **$^{99m}\text{Tc}$ Generator Applications**



# Molybdenum Life Cycle



Mixed by pharmacist for use



## Patient Application

# Benefits of $^{99}\text{Mo}$ project

- **Saves lives**...Consistently supply important medical isotope for the USA
- **National Security**...Allows White House to achieve their goal of producing molybdenum-99 without the use of HEU
- **Environmentally Favorable**...System can generate the U.S.A.'s medical isotope supply without creating HLW
- **Asset Utilization**...Provides important medical isotope without the need for new reactors, while leveraging proven and licensed equipment



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