Decommissioning and Radwaste Transportation

EESI Congressional Briefing

Rm 2318 Rayburn Bldg

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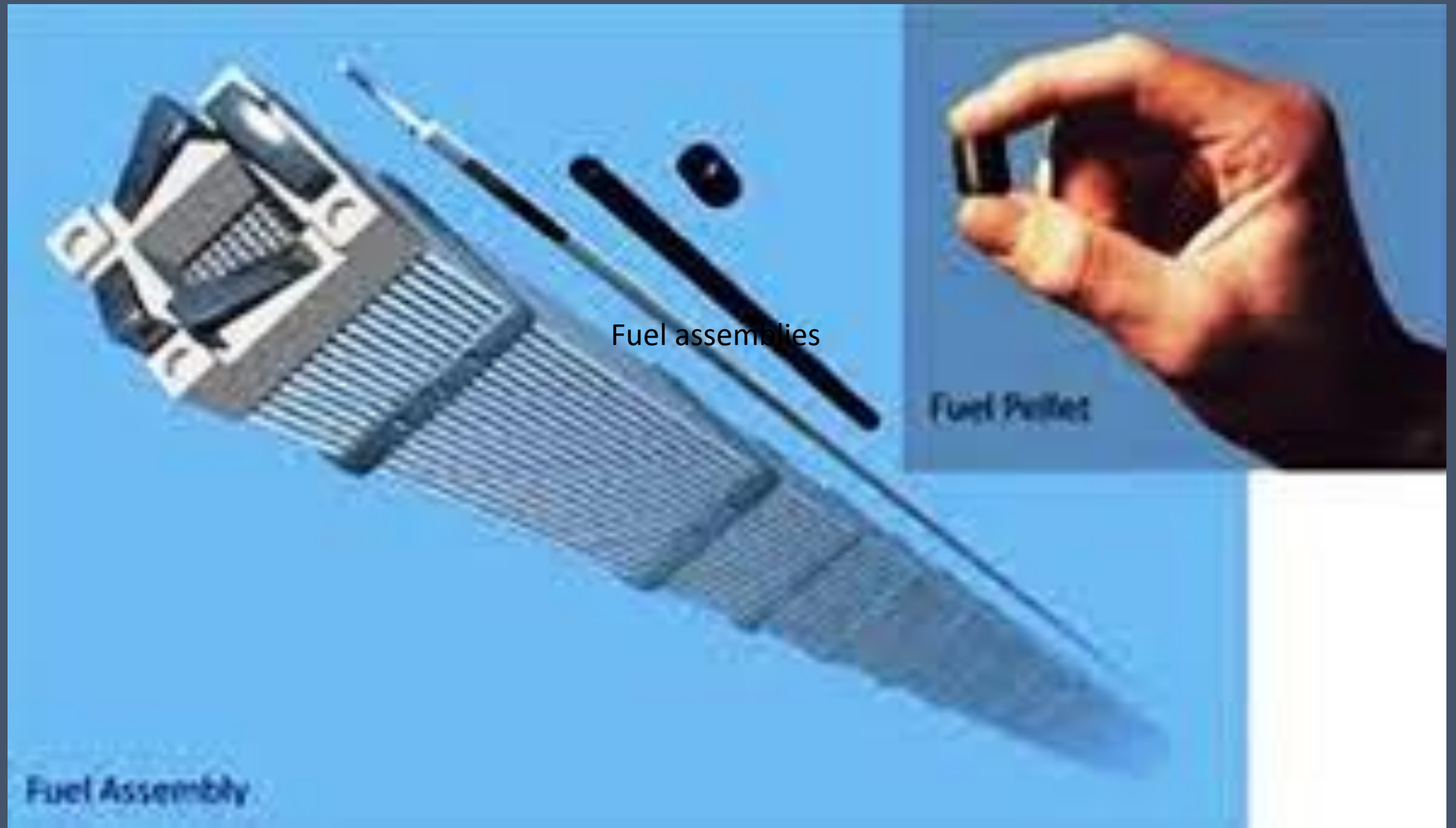
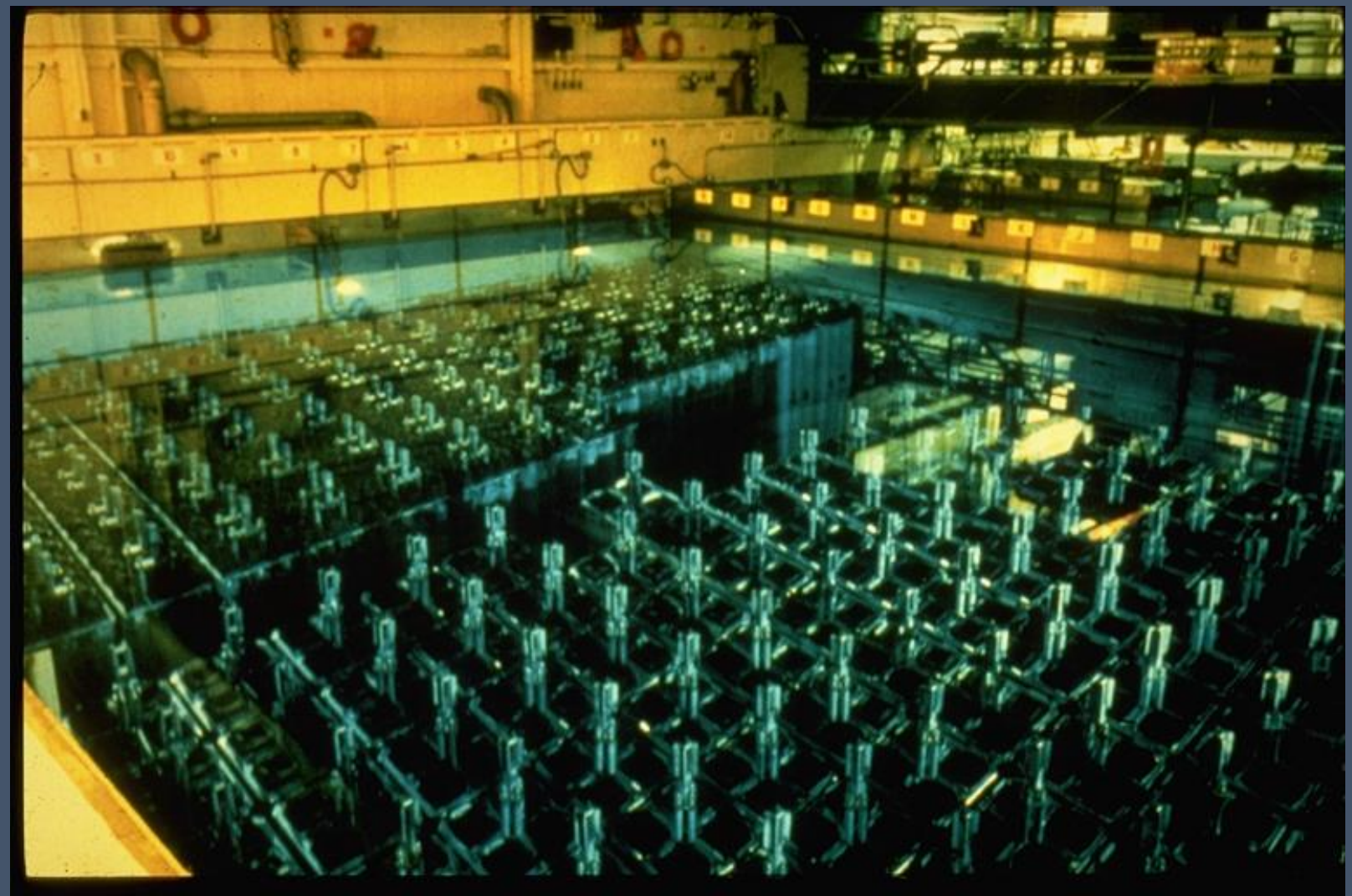
Radioactive Waste Management Associates

PWR Fuel Assembly



Spent Fuel Pool

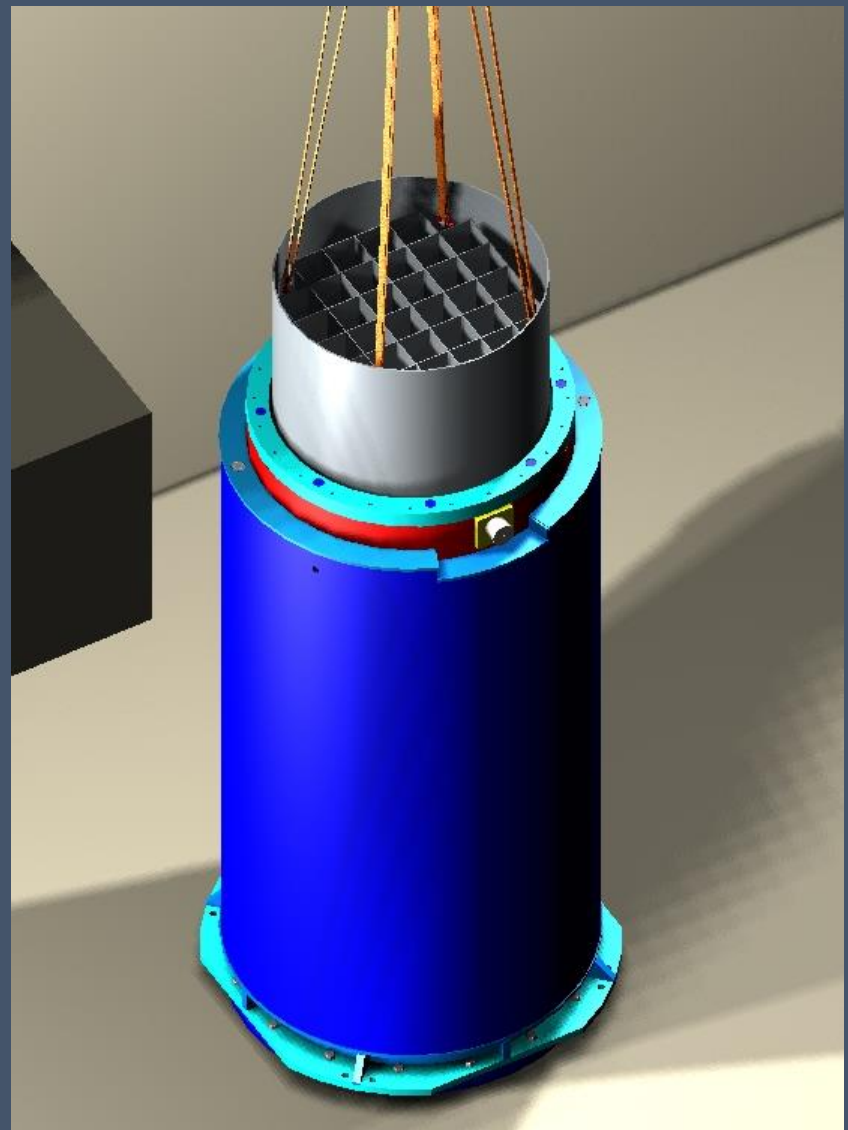


Cs-137 Quantity as Hiroshima Release

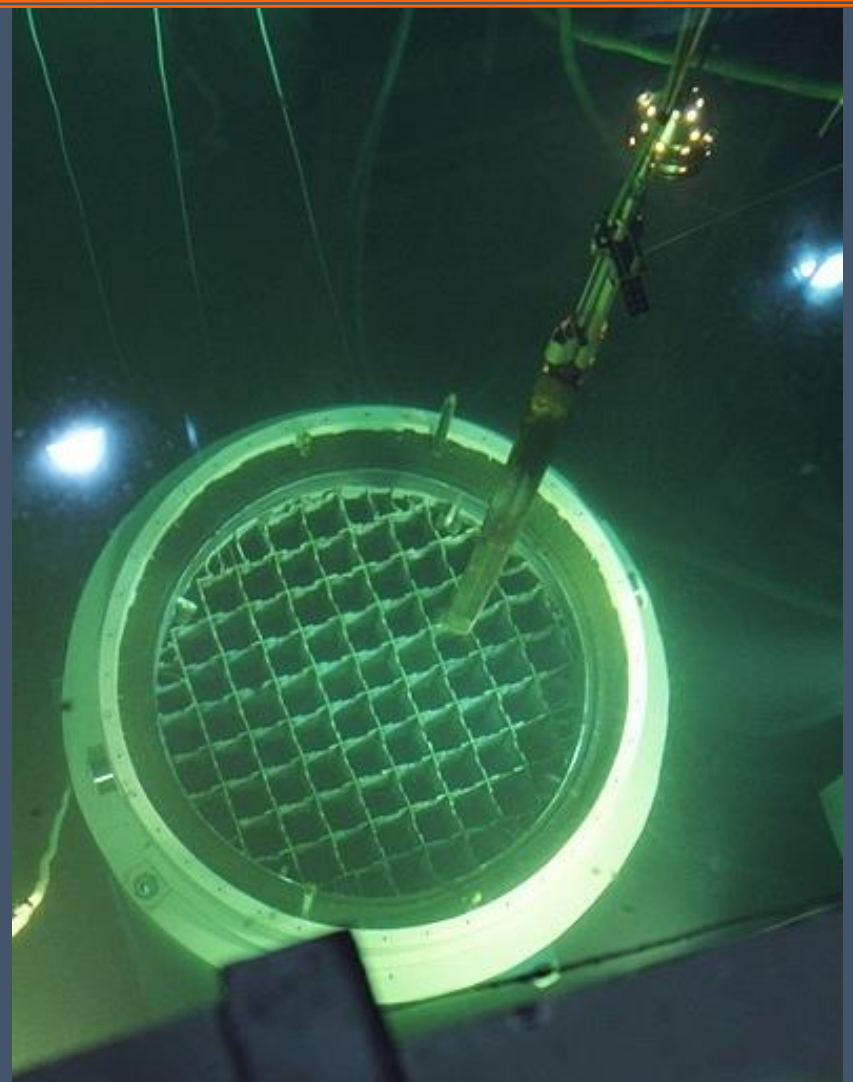
PWR	High Burnup (60 GWd/MTU)	Medium Burnup (40 GWd/MTU)
24 PWR cask	662	445
37 PWR cask	1020	686

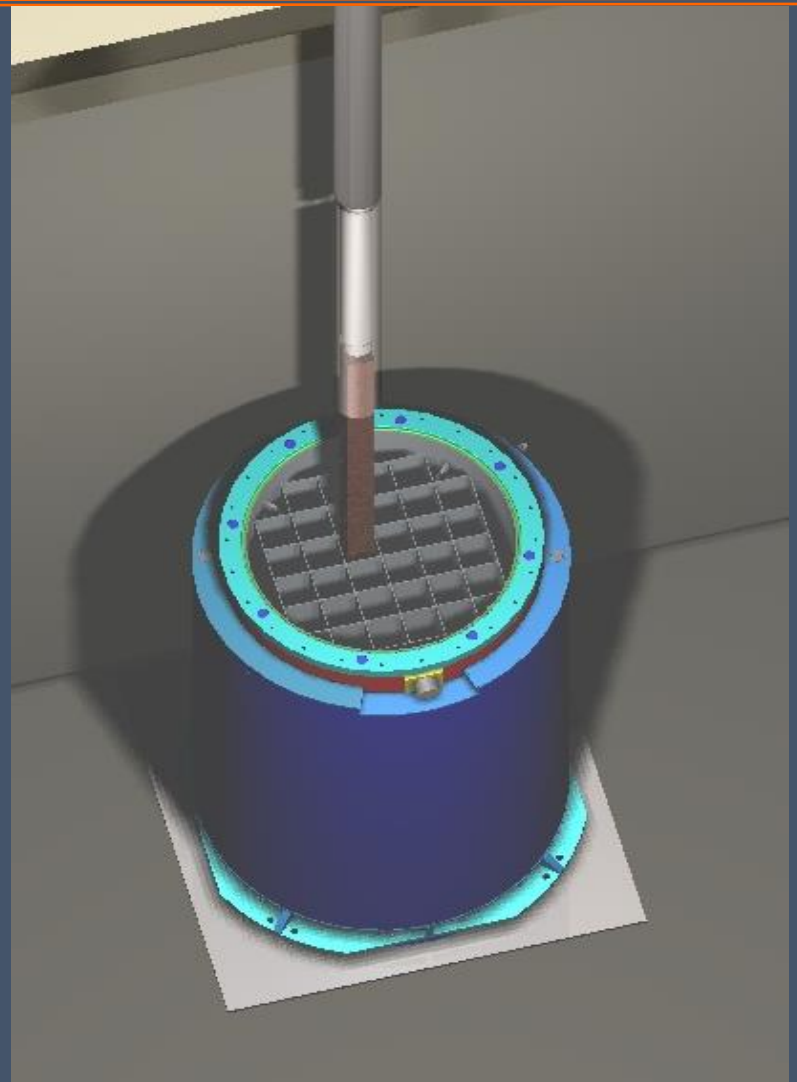
Hiroshima Cs-137 release: 89 teraBq, 2405 Ci

Empty Canister Installed in HI-TRAC

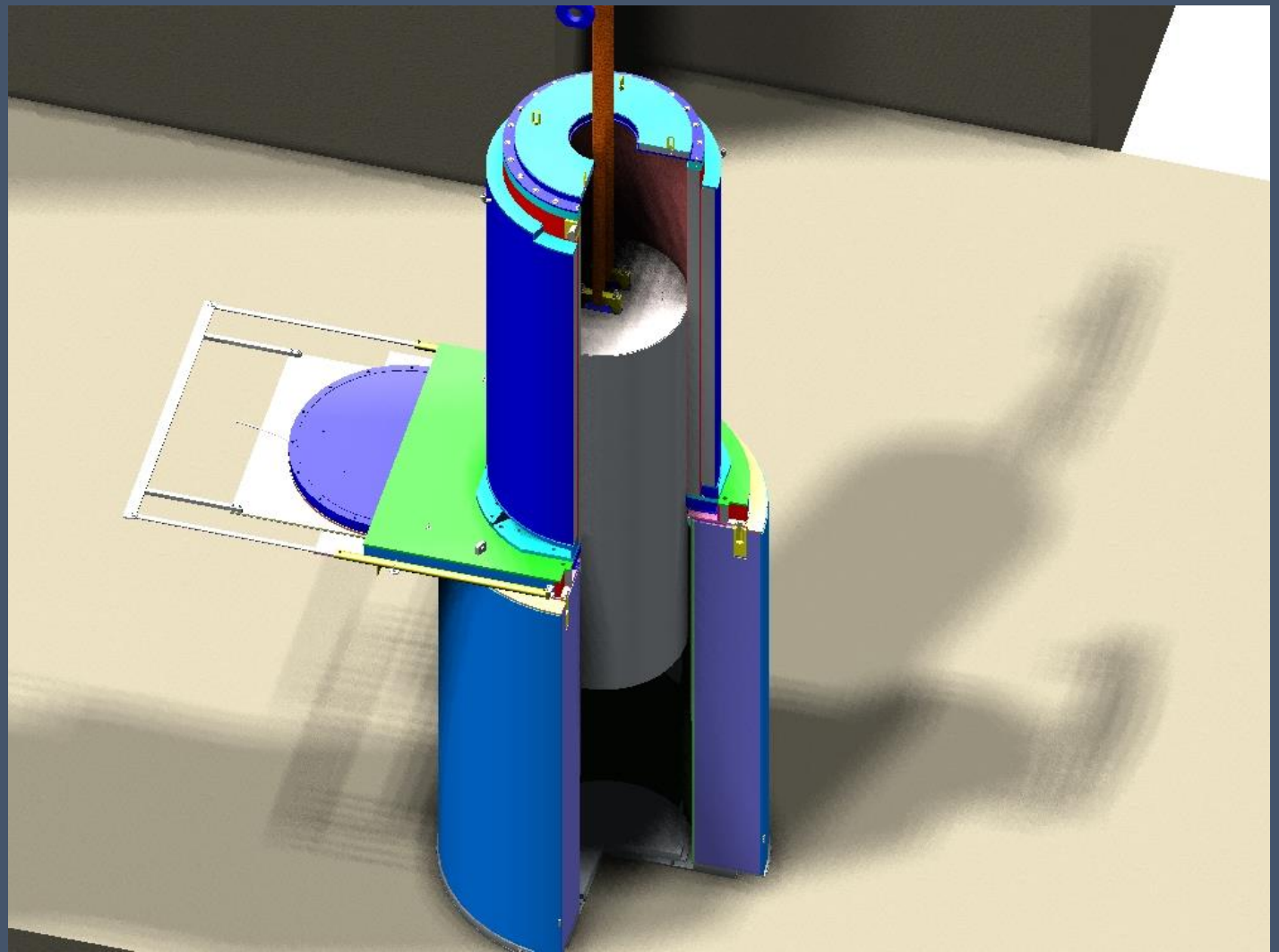


Canister Fuel Loading





LOWER THE CANISTER INTO CONCRETE CASK



MOVE CONCRETE CASK ONTO PAD

Figure II.10: HI-STORM Lifted from the top using the Vertical Cask Crawler

CHIMNEY EFFECT COOLING

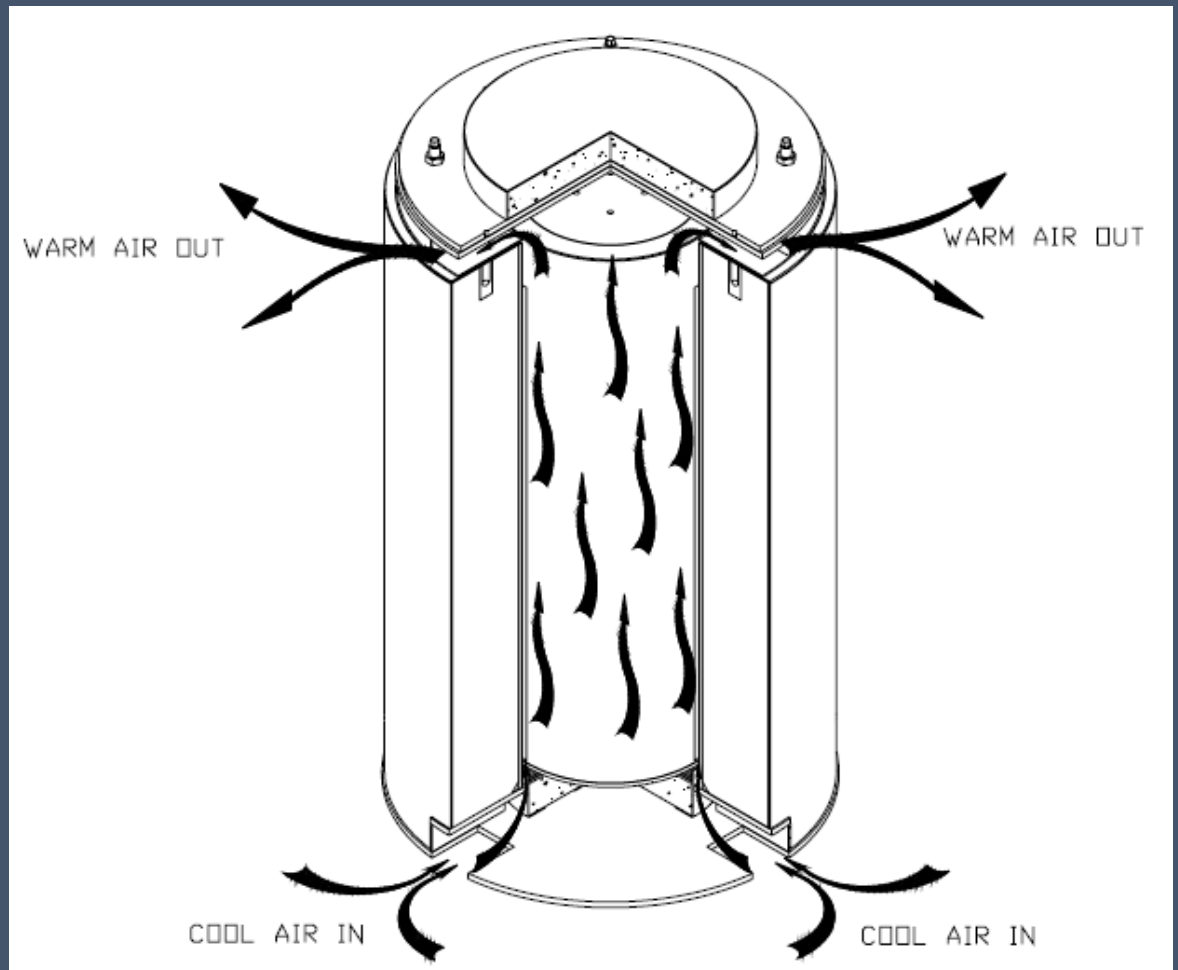


Figure II.9: Cooling by Natural Convection in the HI-STORM 100S

CT Yankee Dry Storage

San Onofre NUHOMS

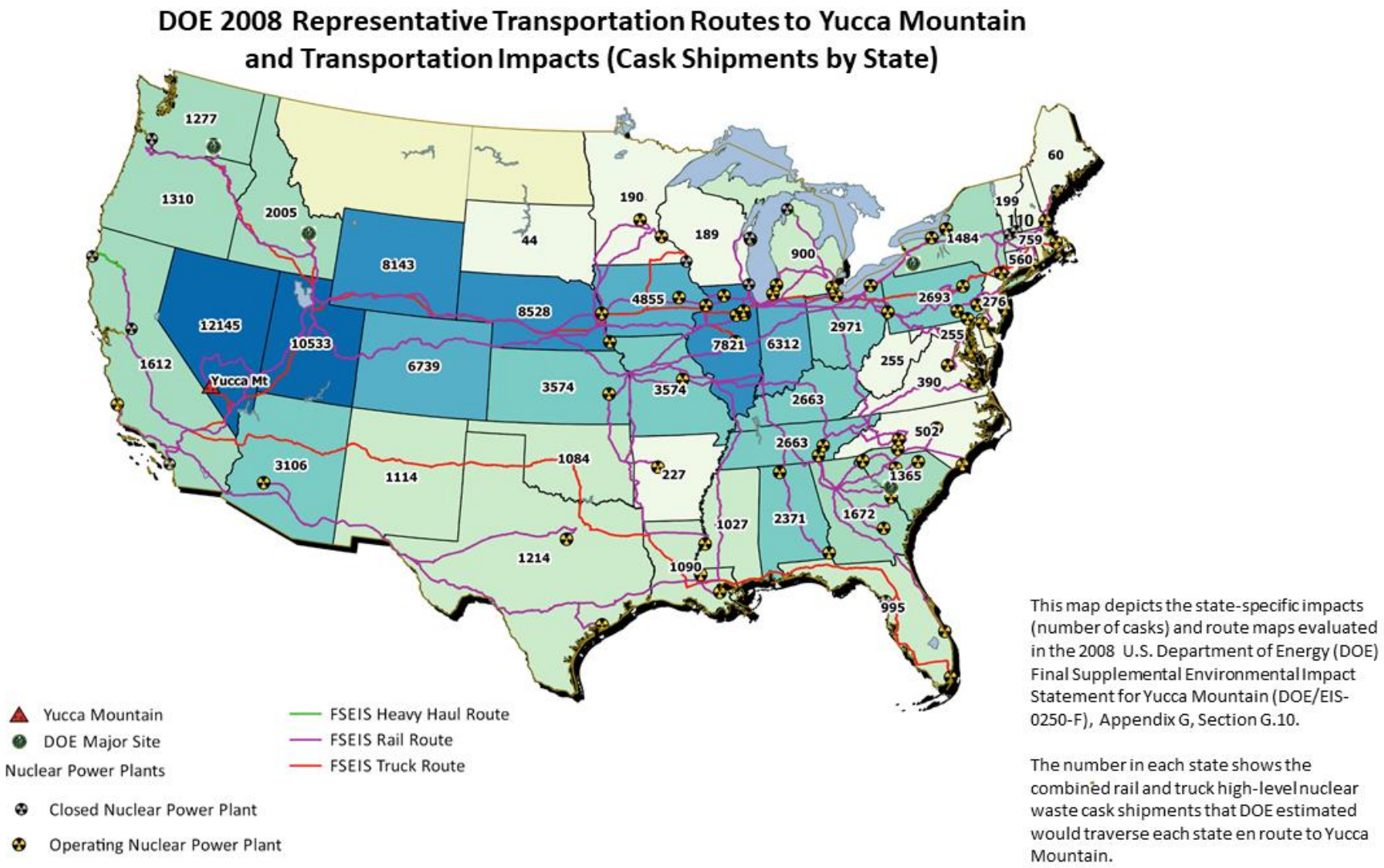
San Onofre Dry Storage Cask System

Irradiation/Storage Conditions for PWR Fuel

Category	Reactor	Pool	Dry Strge
ID Clad T	340-370	30-60	360
Water T	300-330	20-50	
In Rod Pressure	38-150		38-150
Coolant Pressure	140-160	2	1

Nuclear Power Plants in the United States

Representative Transportation Routes



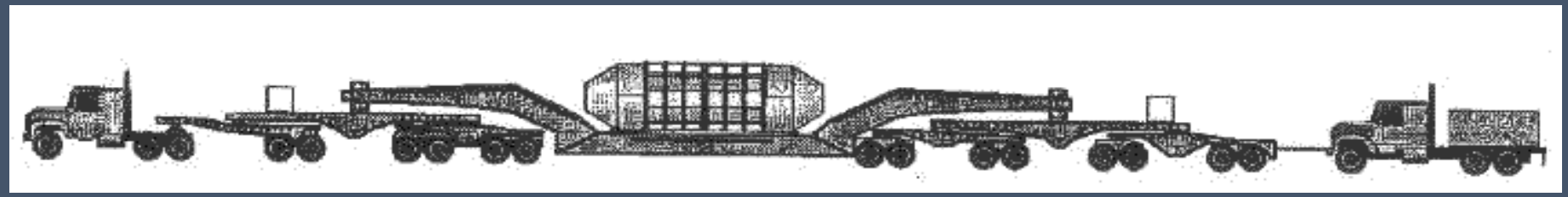
TransportationSystem (2008 SEIS)

- 21,909 rail casks (about 6,700 trains) & 5,025 truck casks [p.8-41]
- Average 1-3 trains (3-5 casks per train) & 1-2 trucks (1 cask per truck) per week for 50 years
- Every day, for 50 years, one or more loaded casks on rail or road, from 76 shipping sites to a single national repository or storage site

TRANSPORTATION ISSUES

- NRC hypothetical accident conditions (impact, fire)
- Cask tested by computer simulation, not physical
- Changed rail conditions (tank cars from North Dakota vs. oil pipeline)
- DOE EIS (size cask: 21 vs. 37 PWR fuel assemblies)
- Rail preferred, but Indian Point, CT Yankee, Yankee Rowe and others may require heavy haul transport or barge

Heavy Haul Truck Configuration



220 feet

6 ft
bicycle

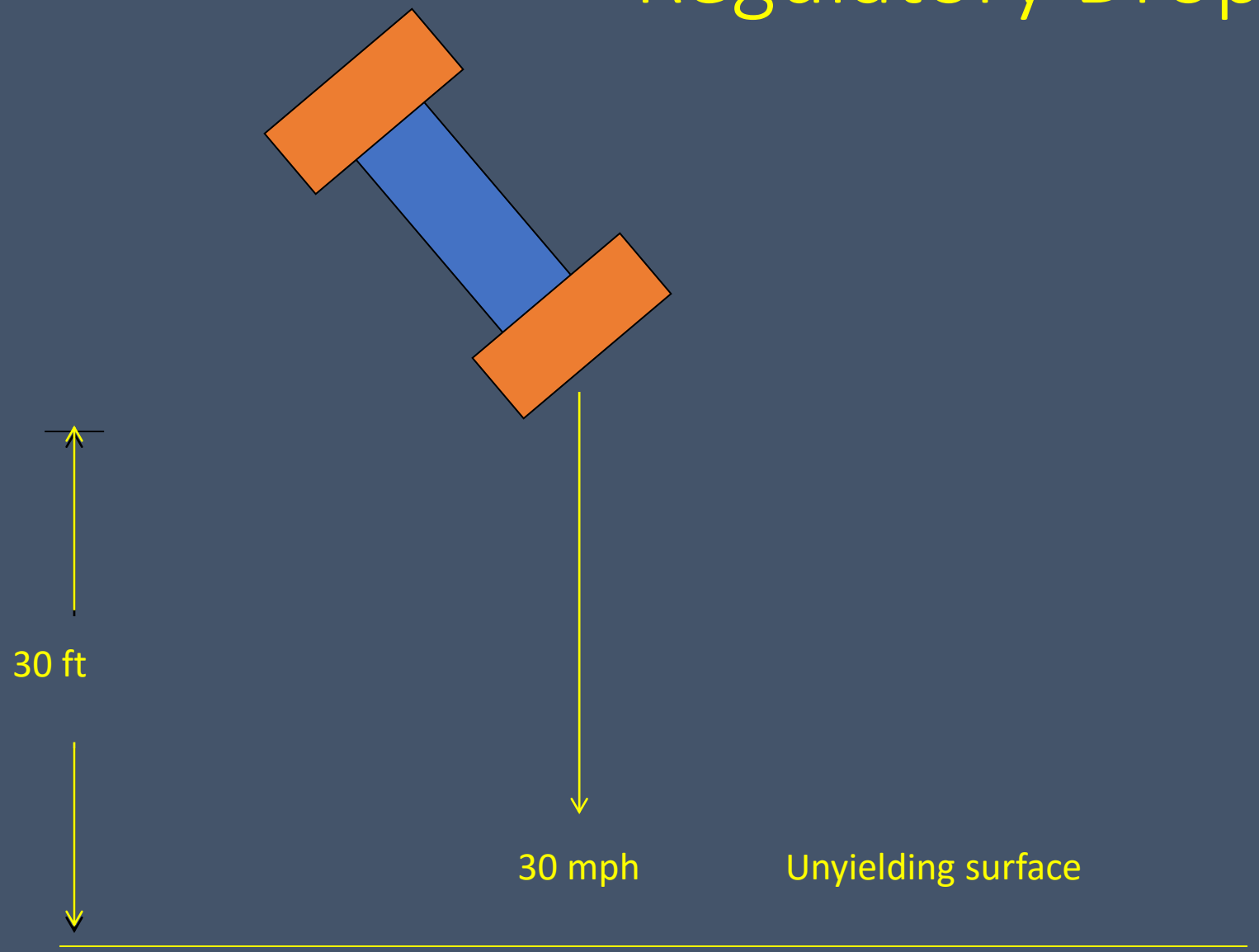
15 ft
car

20 ft
van

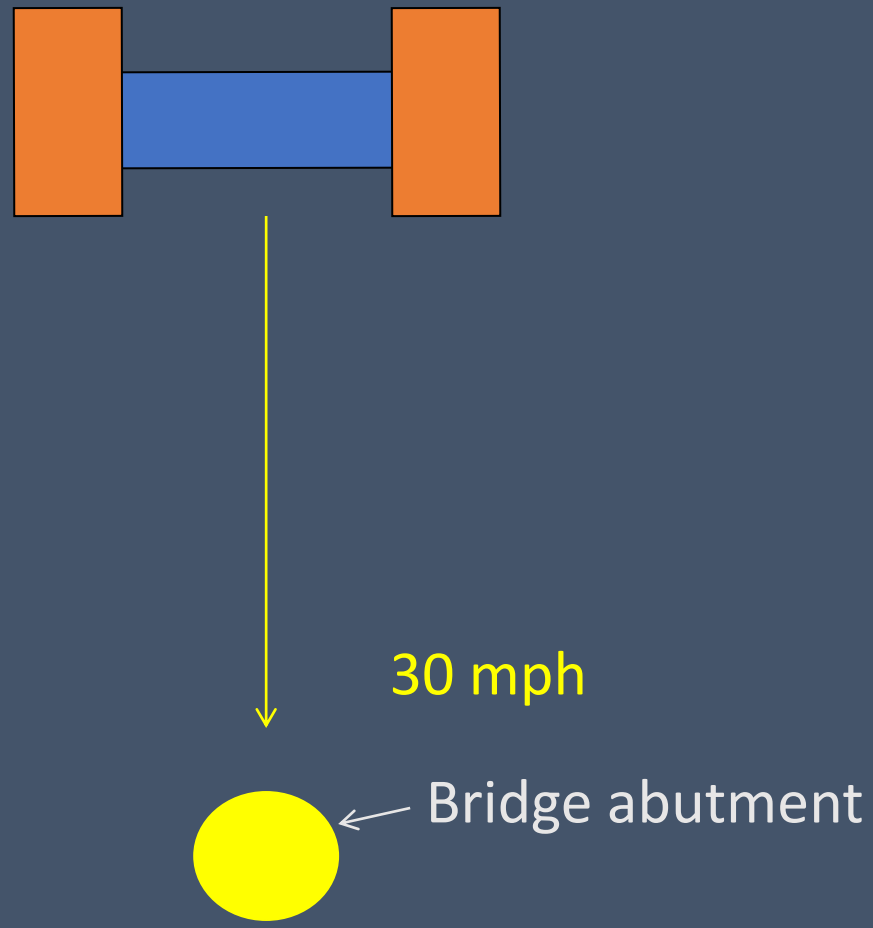
30-40 ft
bus

70 ft
Legal-Weight Truck Cask

Regulatory Drop Test

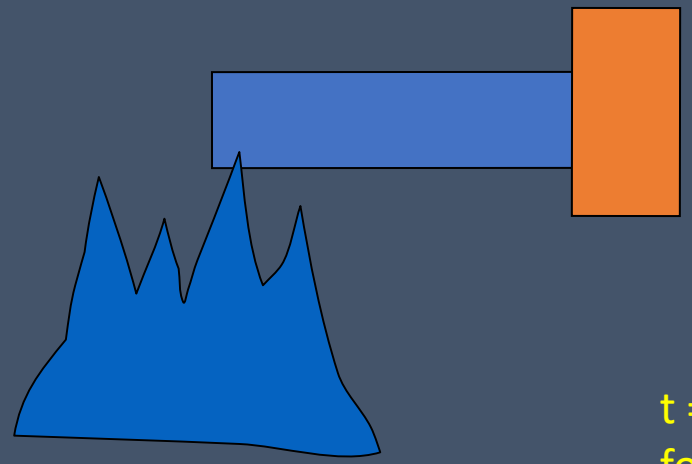


Potential Side Impact



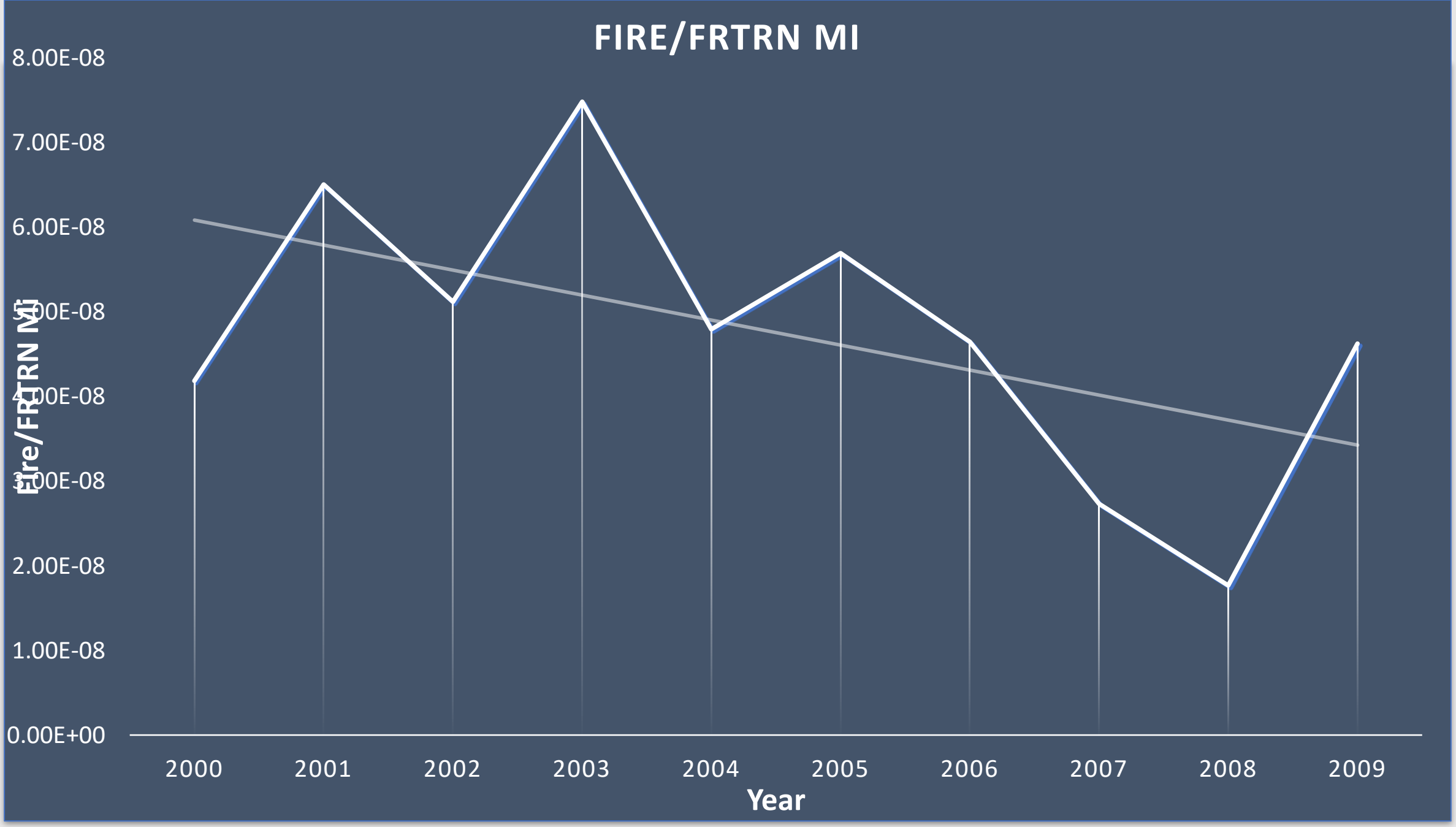
Seals Damage in Fire

No Impact Limiter

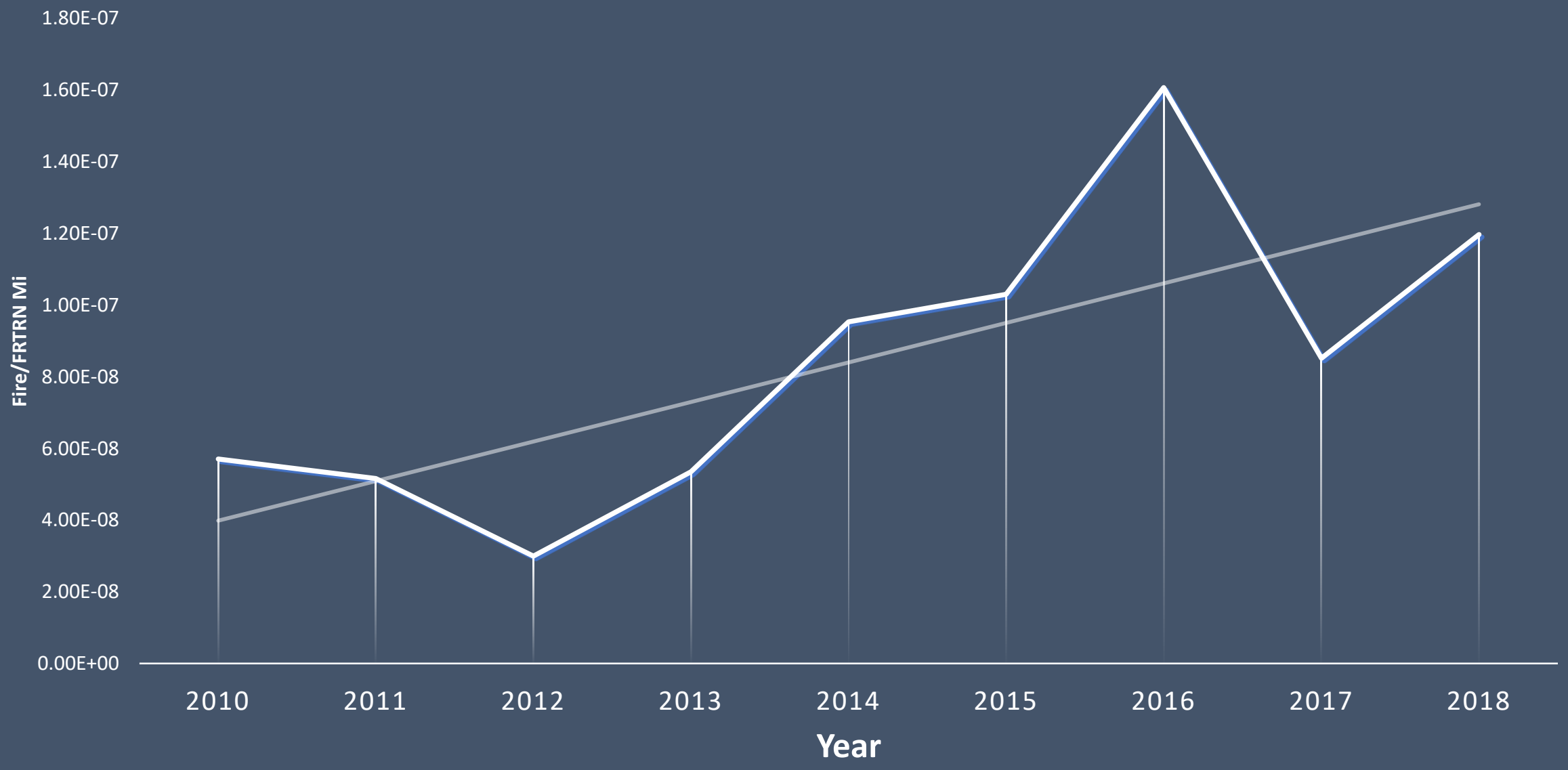


t = 24 min
for seal failure

Fire T = 1000 °C


FIRE/FRTRN MI
8.00E-08
7.00E-08
6.00E-08
5.00E-08
4.00E-08
3.00E-08
2.00E-08
1.00E-08
0.00E+00
Fire/FRTRN MI
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year

FIRE/FRTRN MI



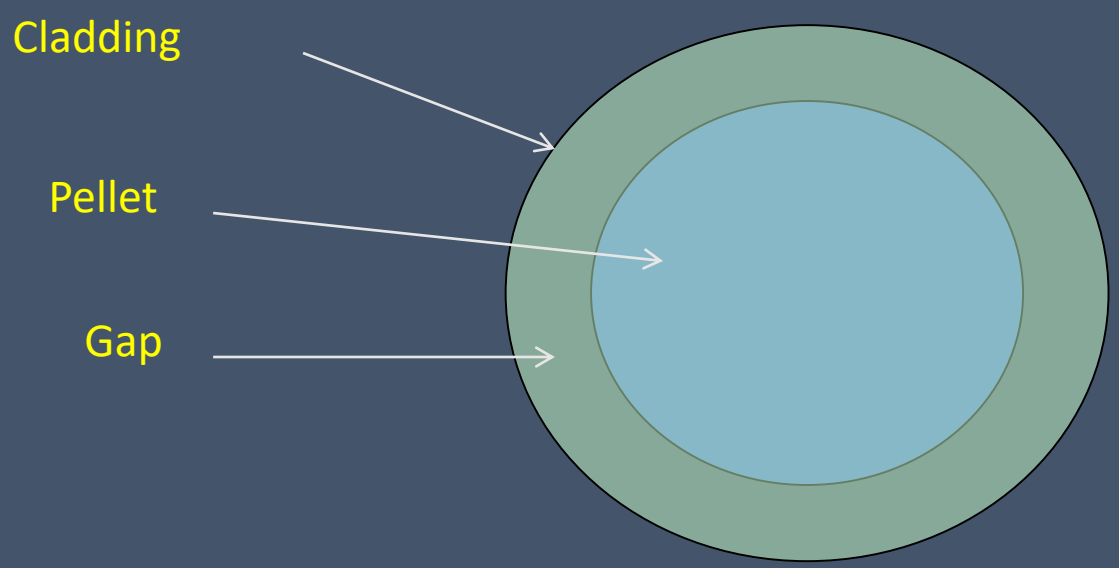
Before

The train rolled downhill for seven miles (11km) before derailing at Lac-Megantic

Flame Temperatures

Chemical	Flame Temperature (°F)
Acetone	2160-7072
Diesel	1740-1839
Propane	2242-6487
Vinyl Chloride	2552-11,142

Cesium in Gap



Study	Cs in Gap
Modal	0.3%
Gray	9.9%

High Burnup Fuel

- Previously, every year 1/3 reactor core removed. Fuel burnup to 35 GWd/MTU
- More recently, fuel in reactor longer, now up to 72 GWd/MTU.
- For fission products like Cs-137 and Sr-90, transportation cask inventory is proportional, 72/35 = 2.06
- While buildup of fission products is roughly proportional to burnup, buildup of higher actinides like Pu, Am and Cm is greater. The subsequent decay of Pu-241 (14 yr half-life) with beta emission leads to buildup of Am-241 (432 year half-life) which has an alpha decay, accounting for greater heat production up to year 70 after fuel removal, then decline. This is not taken into account by the NRC.

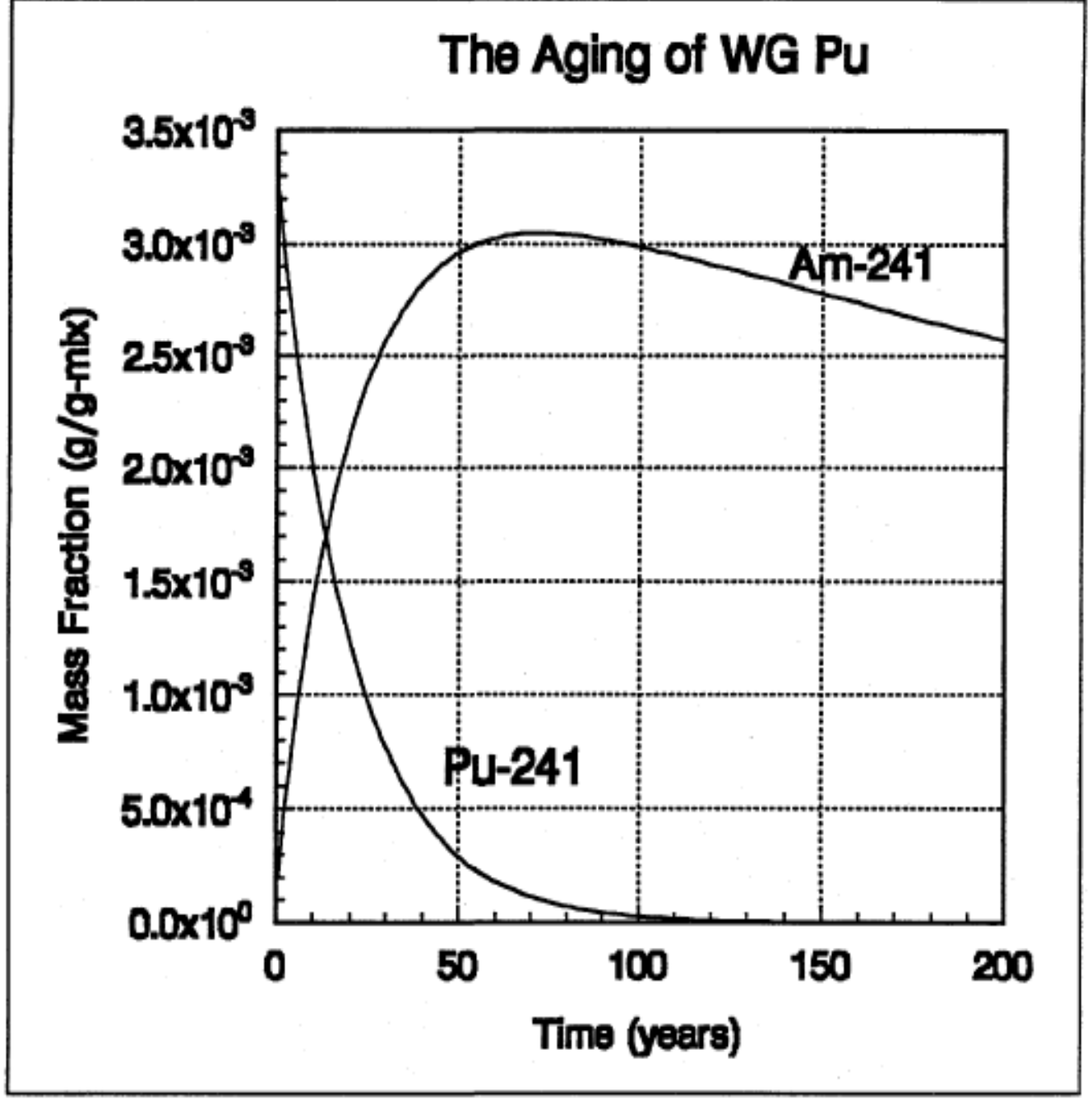
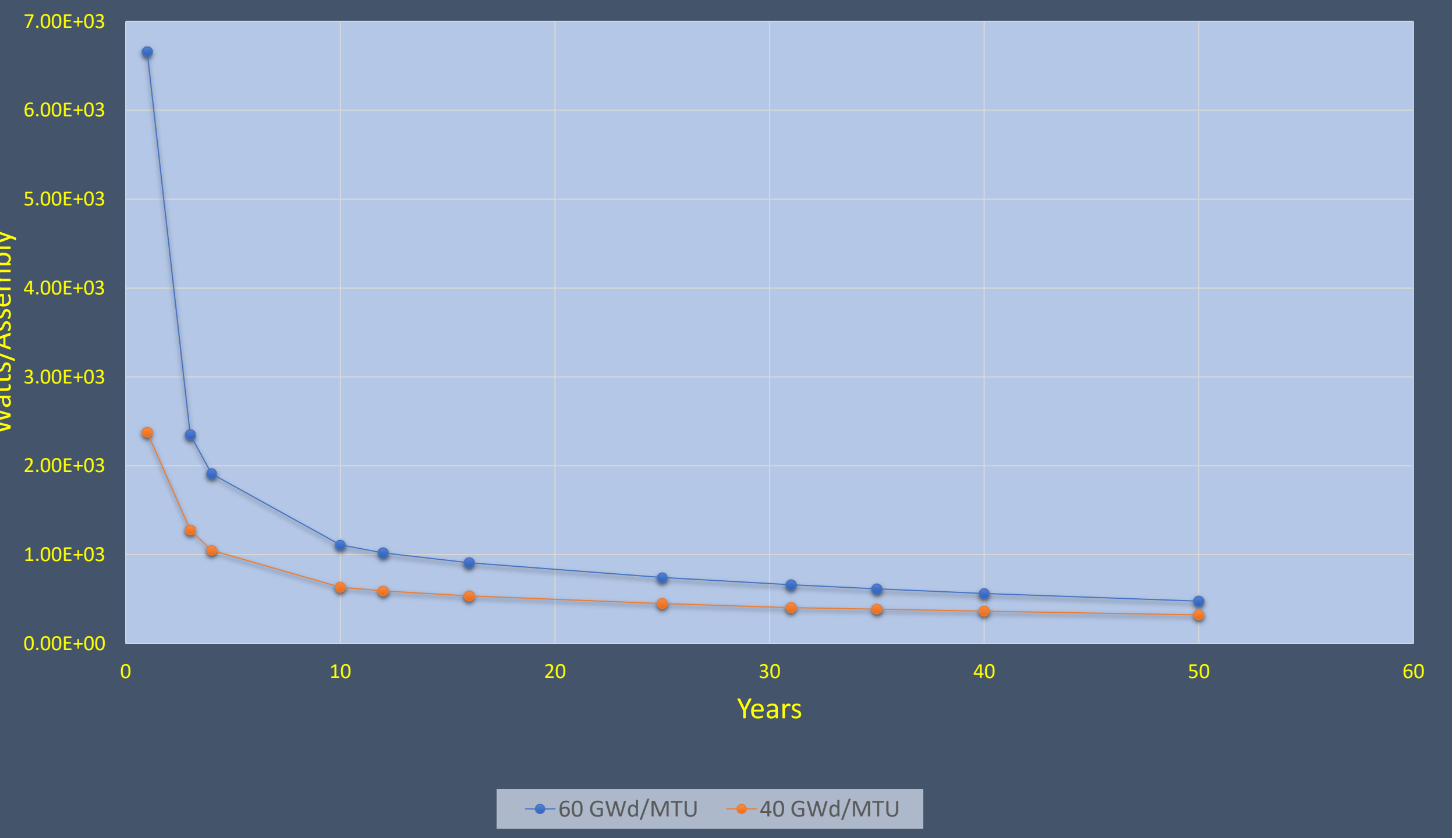


Figure 5-1. The time variation of ^{241}Pu and ^{241}Am over a 200 year time span.


7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Watts/Assembly
0
10
20
30
40
50
60
Years
60 GWd/MTU
40 GWd/MTU

High Burnup Fuel (continued)

- This increased heat production means cask must remain at reactor longer before shipping, at least 40 years (if CoC remains the same).
- In 2008 FSEIS for Yucca Mountain, cask contained 21 PWR fuel assemblies. Now Holtec's HI-STAR 190 contains 37 PWR fuel assemblies. With HBF, the new inventory of Cs-137 and Sr-90 can be 3.63 as much. This is important for accident analysis.
- Cladding can be more brittle and 15% thinner. Vibrations on rail may cause major degradation.