Nuclear Energy: Promise and Problems

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Fig. 1. IIASA Projection of Future Energy Demand

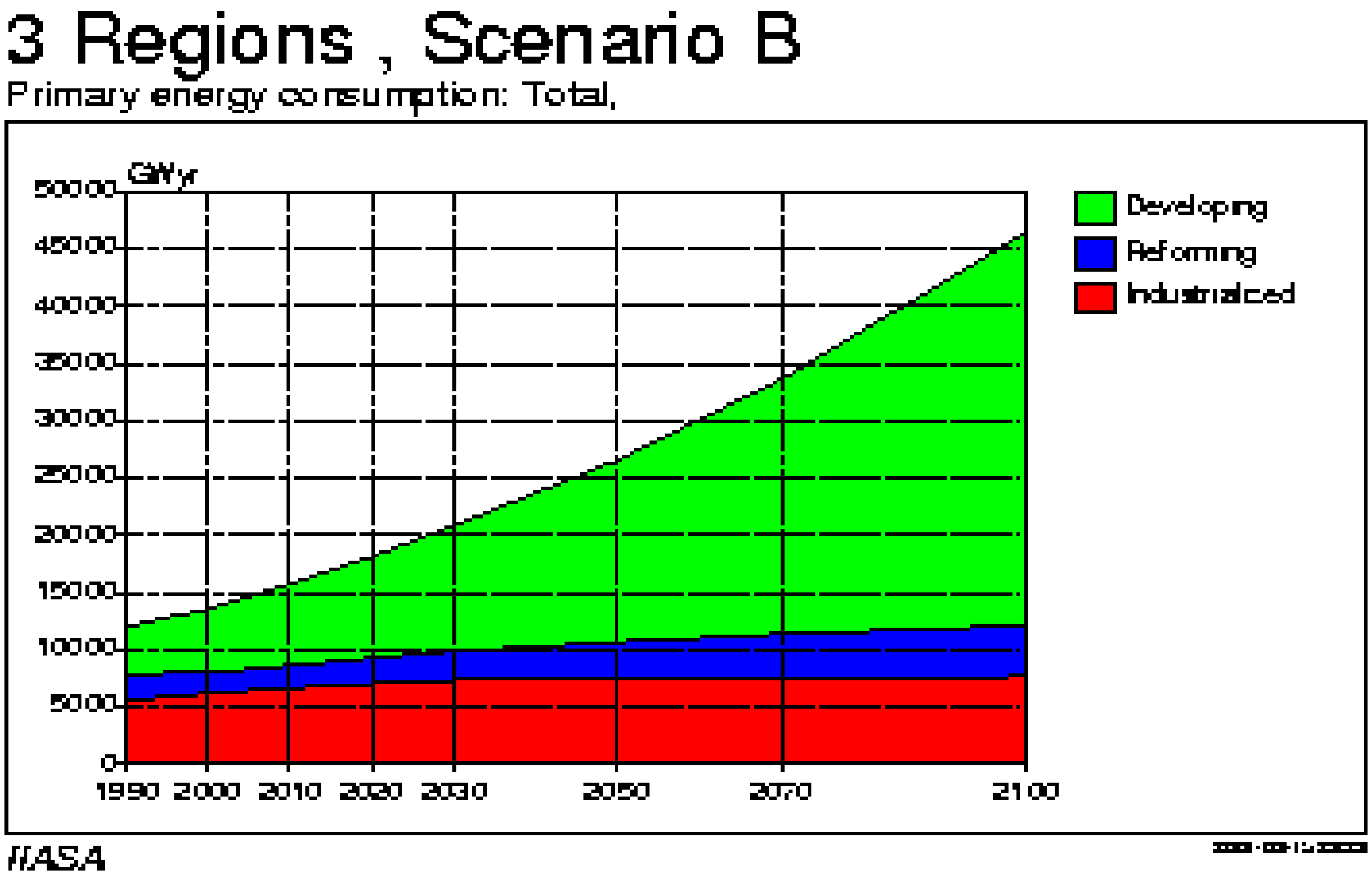


Fig. 2. CO_2 Intensity

Area	**GDP (ppp)** (Billions of U.S. Dollars)	**CO_2/GDP Kg/$(ppp)**
World	42,400	0.56
France	1,390	0.28

(IEA, Key World Energy Statistics 2003)

Fig. 3. Nuclear Power Projection to 2030

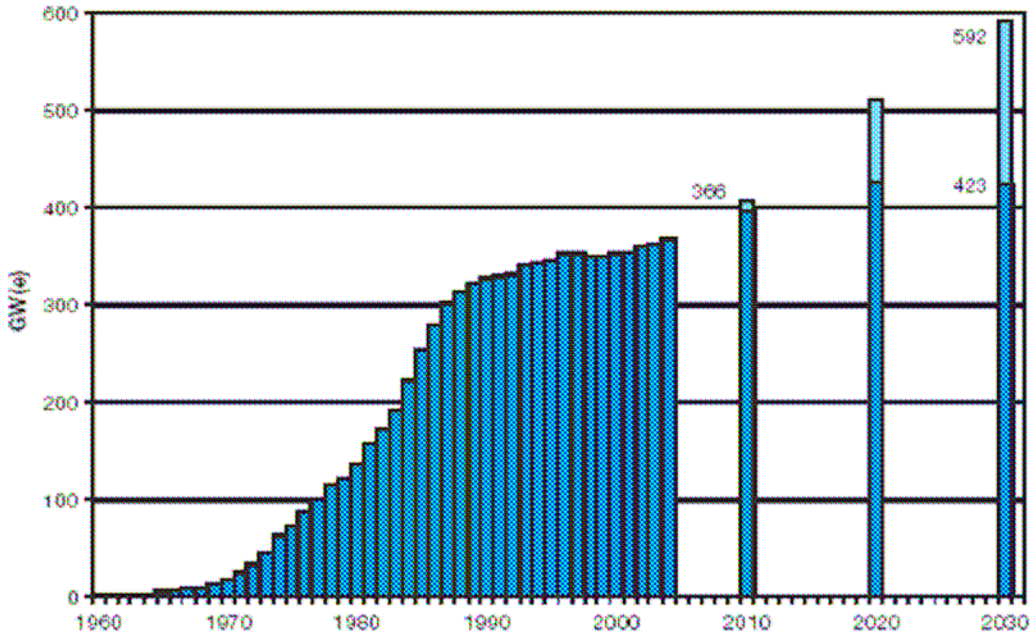


FIG.1. Historical growth in worldwide installed nuclear power capacity, 1960–2004, and the Agency's latest low and high projections through 2030 (low projections: dark blue bars; high projections: light blue bars). (Source: Energy, Electricity and Nuclear Power Estimates for the Period up to 2030, July 2004, *Reference Data Series No. 1, IAEA, Vienna (2004)).*

Fig. 4. Components of Spent Reactor Fuel

Component	Fission Fragments	Uranium	Long-Lived Component
Per Cent Of Total	4	95	1
Radioactivity	Intense	Negligible	Medium
Untreated required isolation time (years)	200	0	300,000

Fig. 5. Computed Yucca Mountain Repository Temperatures for Direct Disposal of 25 Year Old, 50 GWD/MT PWR Fuel

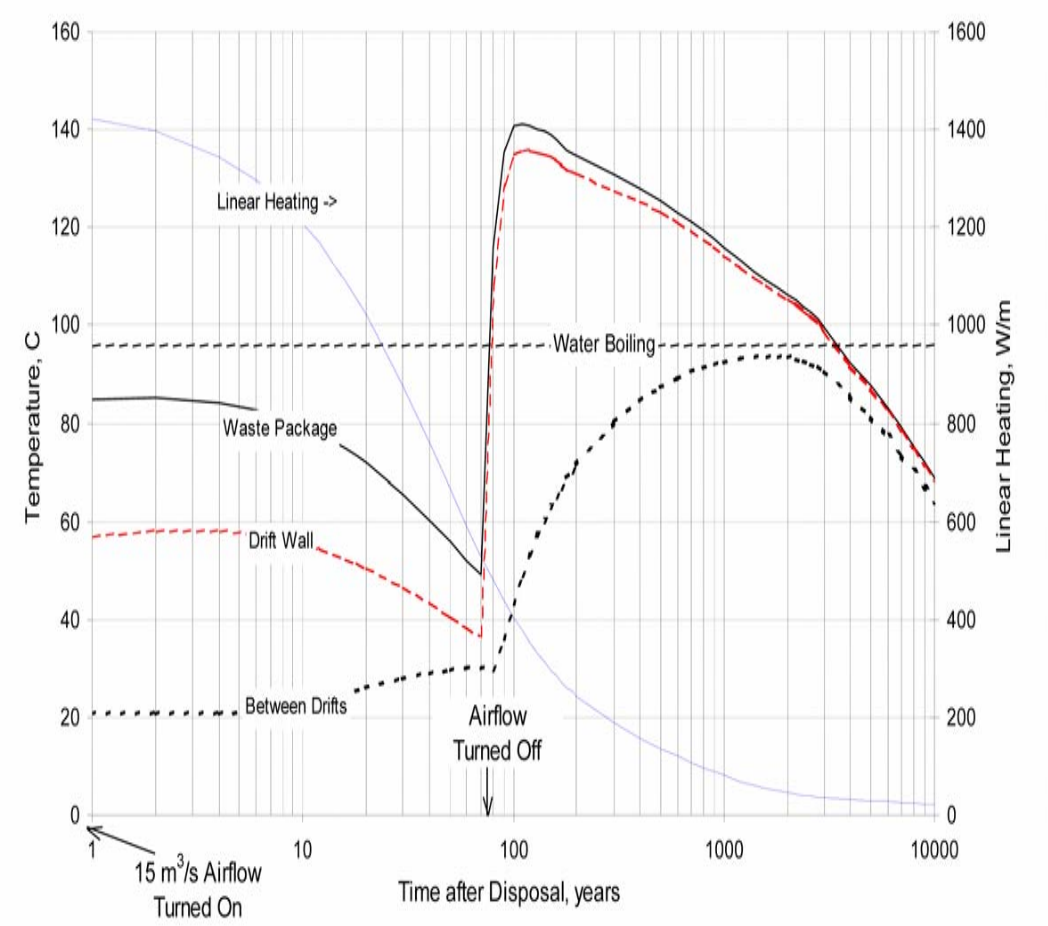


Fig. 6. Two-Tier Schematic

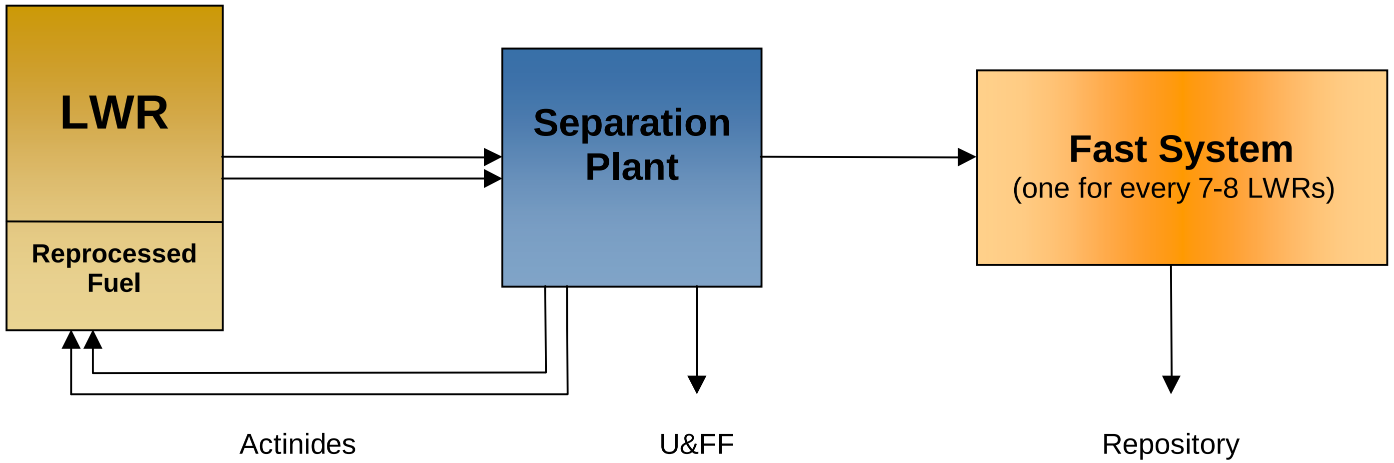
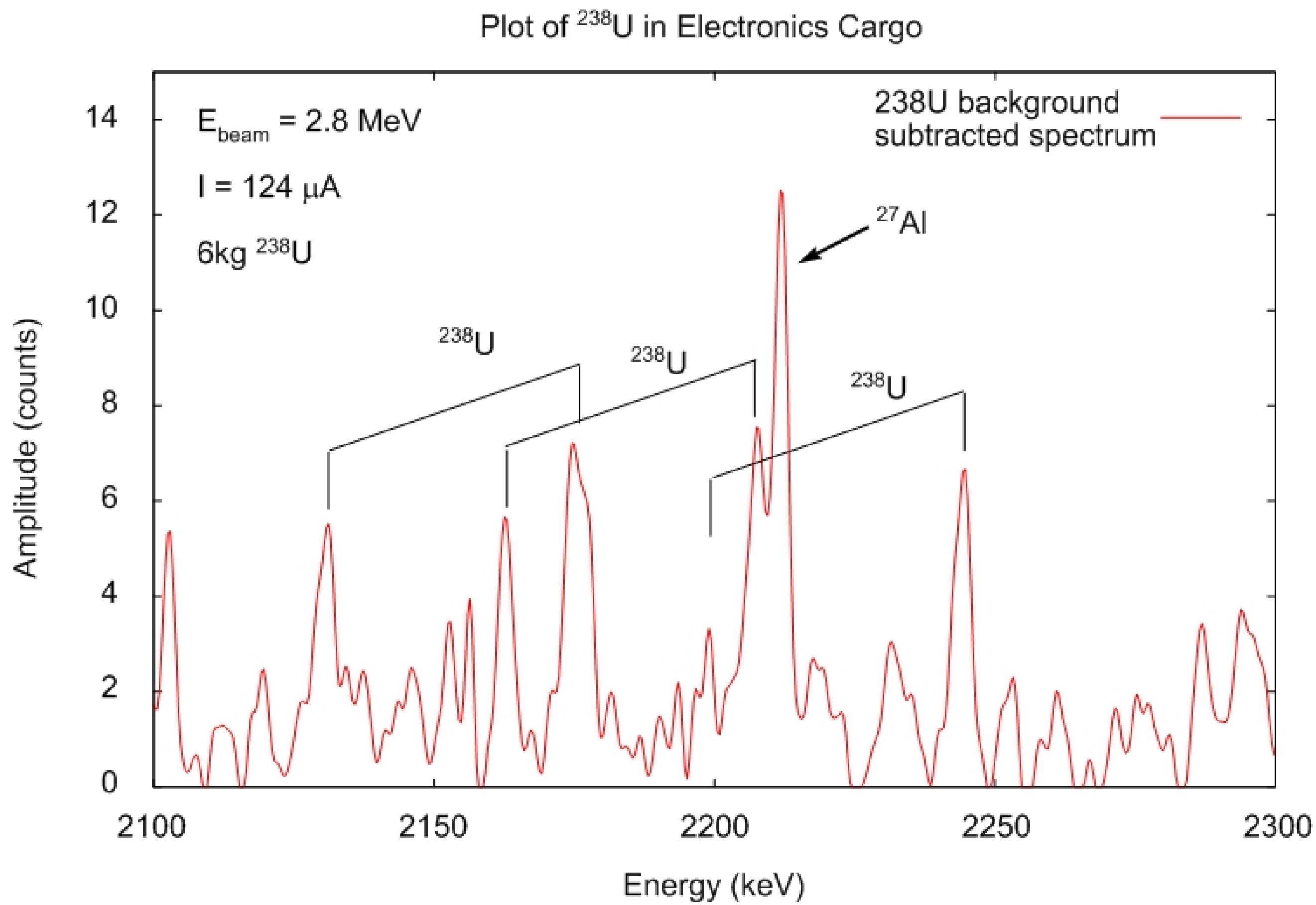


Fig. 7.



Courtesy of Passport Systems Inc.

Fig. 8.

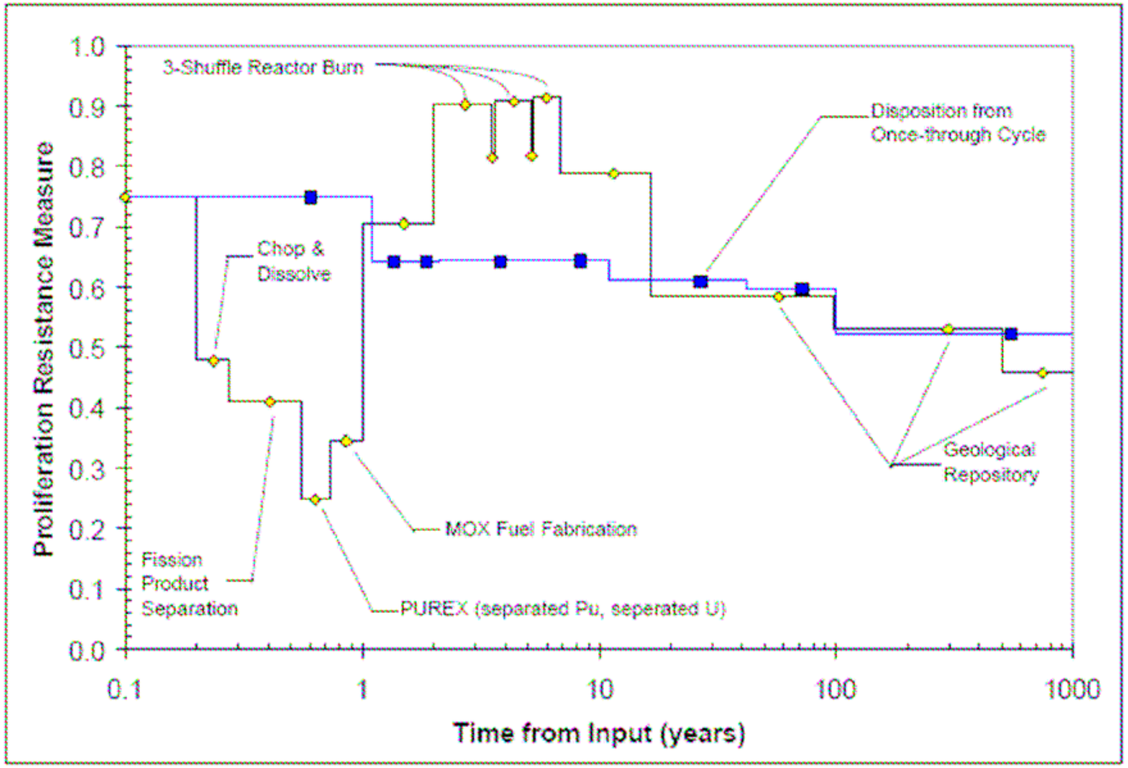


Figure 3 – Relative Proliferation Resistance Measure as a Function of Time for the PUREX/MOX Process (back-end of once-through cycle shown for comparison)

Fig. 9. Relative Proliferation Resistance Score (higher is better)

Cycle	Total Nuclear Security Measure
Once-Through PWR Cycle	0.657
LWR MOX w/ PUREX	0.641
LWR MOX w/ UREX	0.644
Inert Matrix Fuel w/ UREX	0.746
UREX with Np Doping	0.664
UREX with Np and Am Doping	0.665

Fig. 10. Plutonium Isotopic Mixture and Properties after Various Reactor Treatments (ANL)

Table 1. Mass and Radioactive Properties for Bare Critical Spheres of Plutonium[a] Metal.

	Plutonium Vector[b]	Critical Mass (*Rel. to WG-Pu*)	Decay Heat (W)	Neutron Source (n/sec)	γ Source (photons/sec)	γ Source (MeV/sec)
WG-Pu	0.02/**93.40**/ 6.04/0.50/ 0.04	1	24.9	5.97E+05	2.41E+12	2.54E+10
RG-Pu	2.63/**53.08**/ 25.11/11.82/ 7.36	1.3	255.6	5.96E+06	4.50E+13	4.56E+11
MOX-Pu	7.13/**43.80**/ 28.94/10.52/ 9.61	1.4	664.6	9.35E+06	1.17E+14	1.19E+12
IMF-Pu	15.76/**8.60**/ 32.44/14.65/ 28.55	2.1	2057.0	2.66E+07	3.64E+14	3.69E+12
IMF-HM[c]	15.76/**8.60**/ 32.44/14.65/ 28.55	2.2	5052.0	1.25E+10	9.54E+14	1.60E+13

[a]Except for weapons-grade, material is harvested from spent fuel assmebly five years after reactor discharge. Critical mass and other properties were calculated at the time of separation.
[b]Vector displayed as weight percents of Pu-238/Pu-239/Pu-240/Pu-241/Pu-242.
[c]Heavy metal in spent IMF assembly consists of 0.9% U, 3.5% Np, 79.0% Pu, 11.0% Am, and 5.6% Cm.