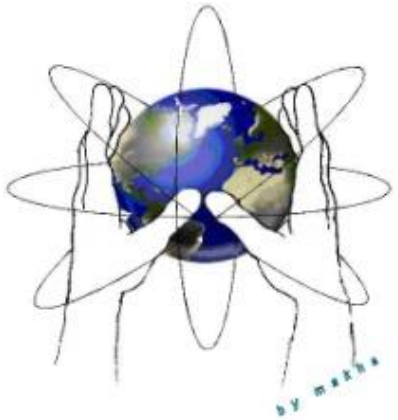
Comitato per una Civiltà dell'Amore
Committee for a Civilization to Love

The concern of military Plutonium to convert in MOX fuel



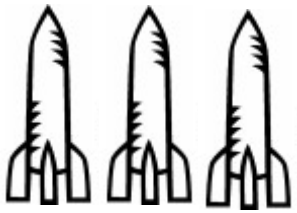
Ing. Massimo Sepielli - Ing. Giuseppe Rotunno

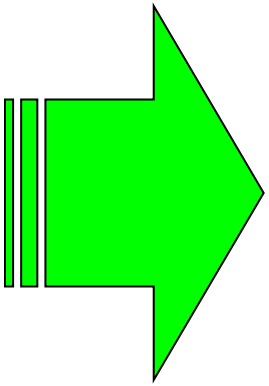
Comitato
per una Civiltà dell'Amore

Objectives of the Programme of Nuclear Conversion

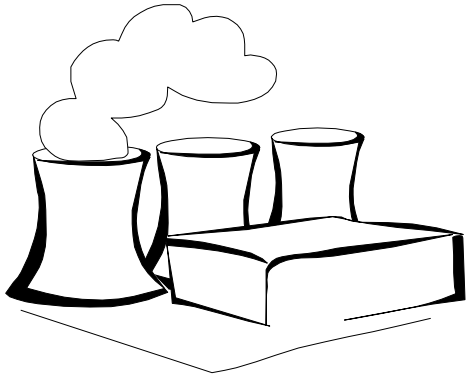
Main purpose of the Programme is the conversion of nuclear weaheads into fuel for power generation devoted to the development of poor Countries

Nuclear warheads

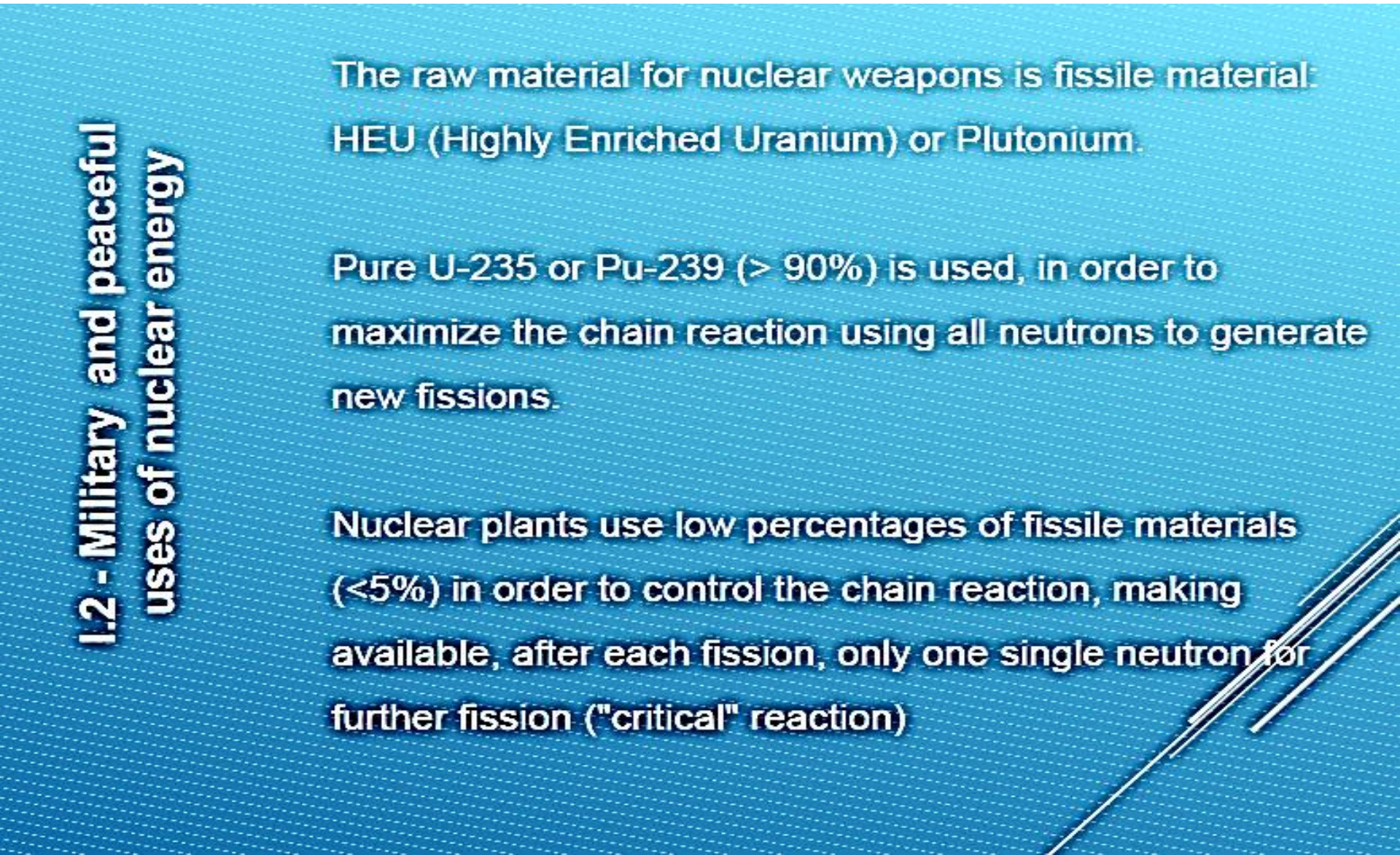




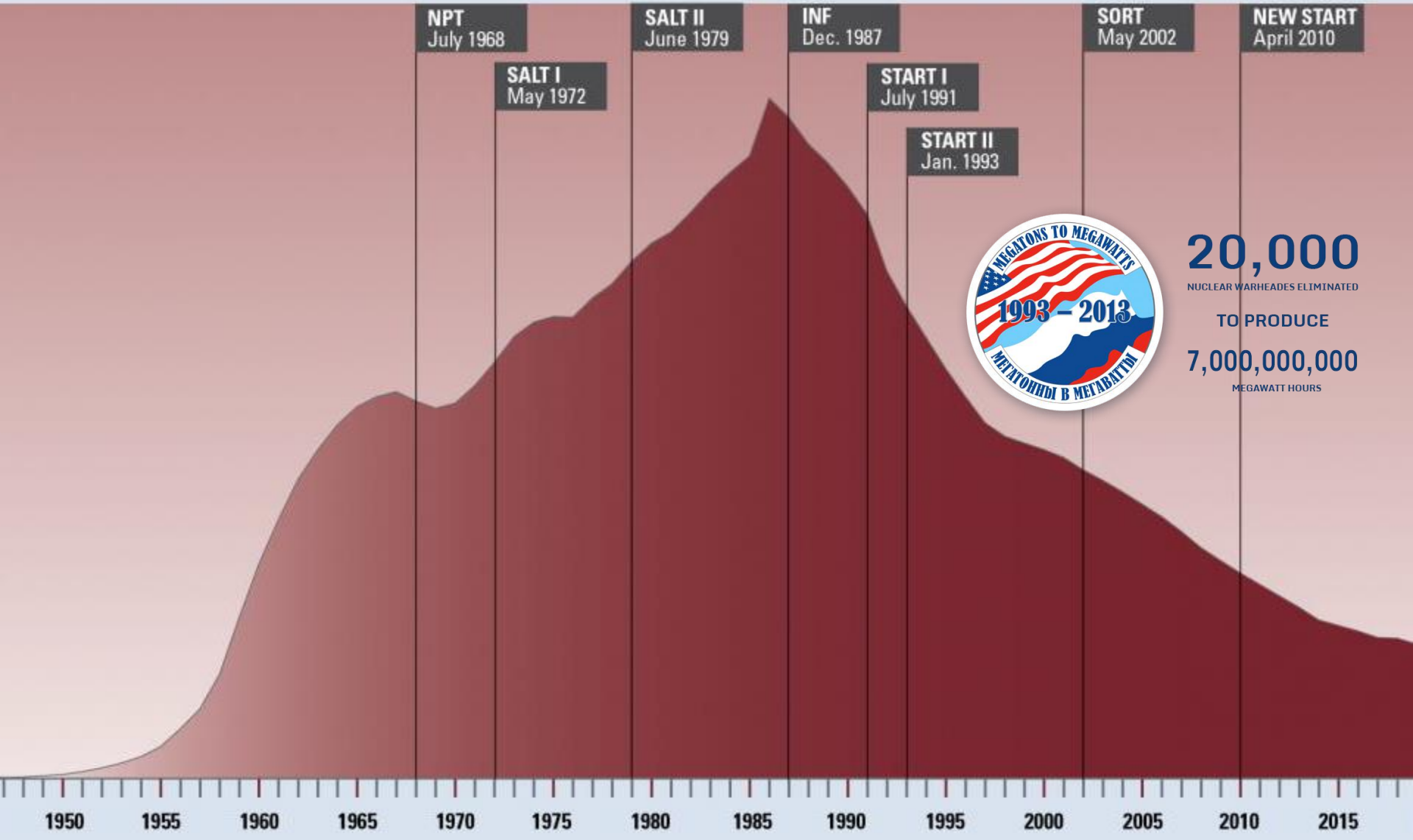
Nuclear Power Plant



Warheads nuclear material: HEU and Pu

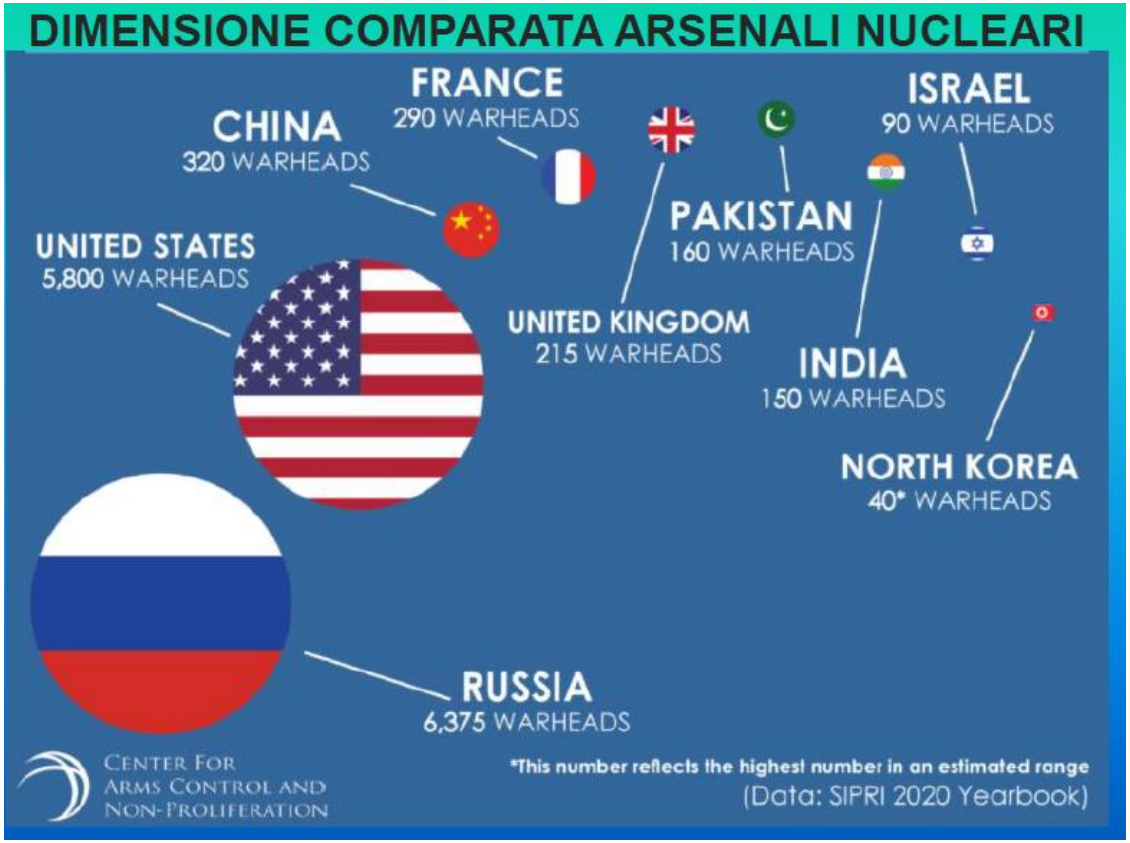


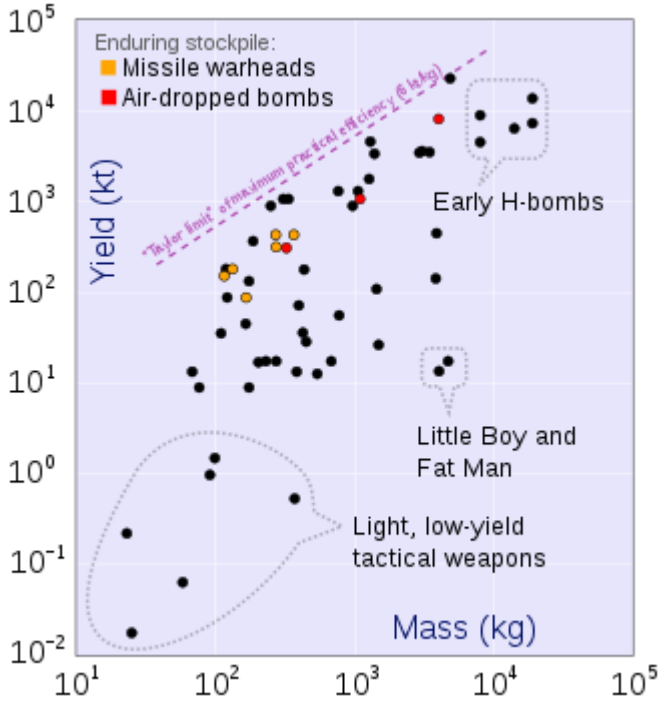
Estimated Global Nuclear Warhead Inventories 1945-2023



Kristensen, Matt Korda, Robert S. Norris, and Eliana Reynolds, Federation of American Scientists, March 2023.

The only way to eliminate bombs

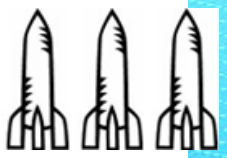




Total of 13,000 ready and more powerful warheads
50,000 potential inside arsenals
to convert and use in Nuclear power plants !!!!!!!!

Megaton to Development 2

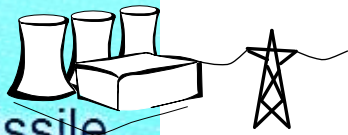
50.000 bombs into 400 x 1GWe NPS



II.4- Perspectives post-M2M

There is still the problem of eliminating:

- about 1,300 t of HEU (sufficient for over 50,000 bombs) *,
- about 500 t of Pu (harder to eliminate) *.



* 2015 data from the International Panel on Fissile Material (based on declarations to the IAEA of 31/12/2014)

- ✓ M2M was a tool for disarmament, fight against proliferation and nuclear terrorism
- ✓ M2M was the main economic case of reconversion of weapons and military installations for civil purposes

Data Base for Pu weapon-grade in the world (https://fissilematerials.org/

Pag. 2 Data Base for Pu weapon-grade in the world (https://fissilematerials.org/)
Fonte International Panel on Fissile Materials

CCccCountre	Total HEU, MT	Of this, HEU available for weapons, MT	Total Pu, MT	Of this, Pu available for weapons, MT
Russia	680	672	193	88
United States	481	361	87.6	38.4
United Kingdom	23	22	120	3.2
France	29	25	102	6
China	14	14	3	2.9
Pakistan	5	5.3	0.58	0.58
India	6		11	0.7
Israel	0.3	0.3	0.9	0.9
DPRK	0.7	0.7	0.04	0.04
Others	4		46.08	
TOTAL	1240	1100	565	140

TECHNICAL / ECONOMICAL EVALUATION

TECHNICAL EVALUATION

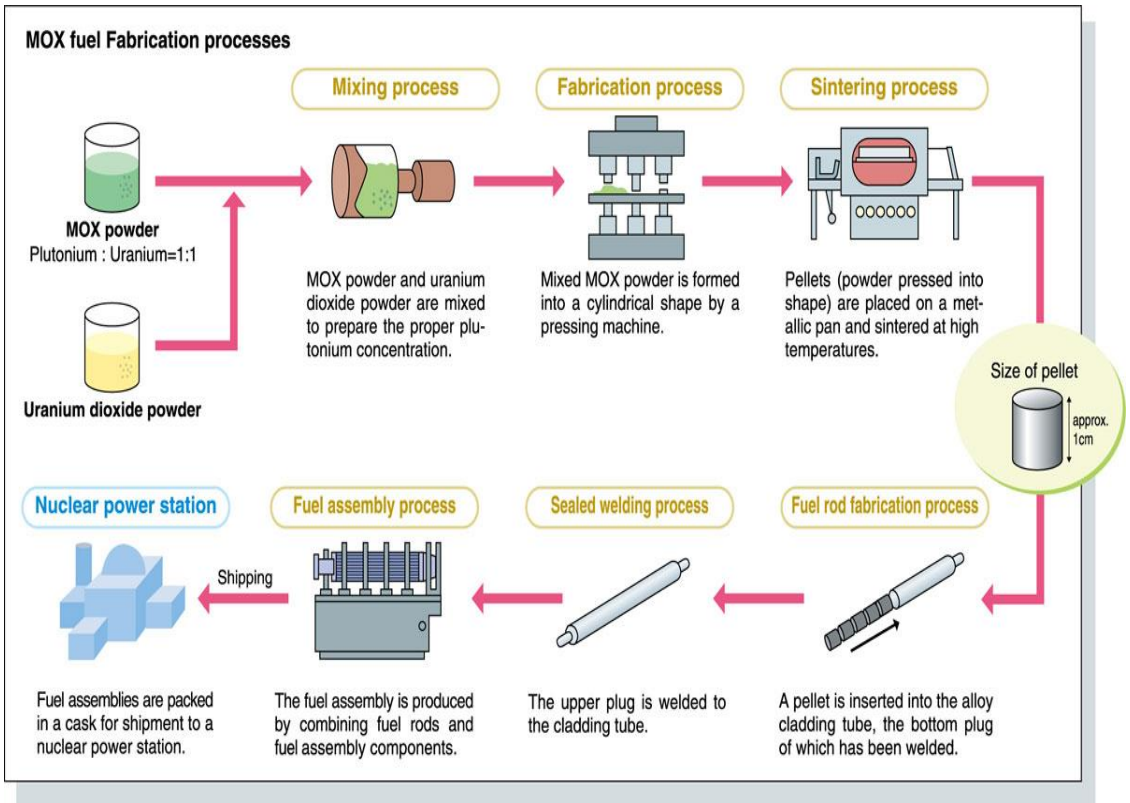
- **1 Ton** of Pu weapon-grade produces **7 TWh** (through a 1000 MWe Nuclear Power Plant working 7000 h/y)
- **140 MT** of weapon-grade Pu produces then **1000 TWh** (Italian overall electric power consume for 3 years)
- Number of 1000 MWe **NPP 200 tons core refuelling** using the aforementioned fuel = **140 core refuelling**

ECONOMIC EVALUATION

- **1000 TWh x 0,155 $/KWh = 155 billion $**

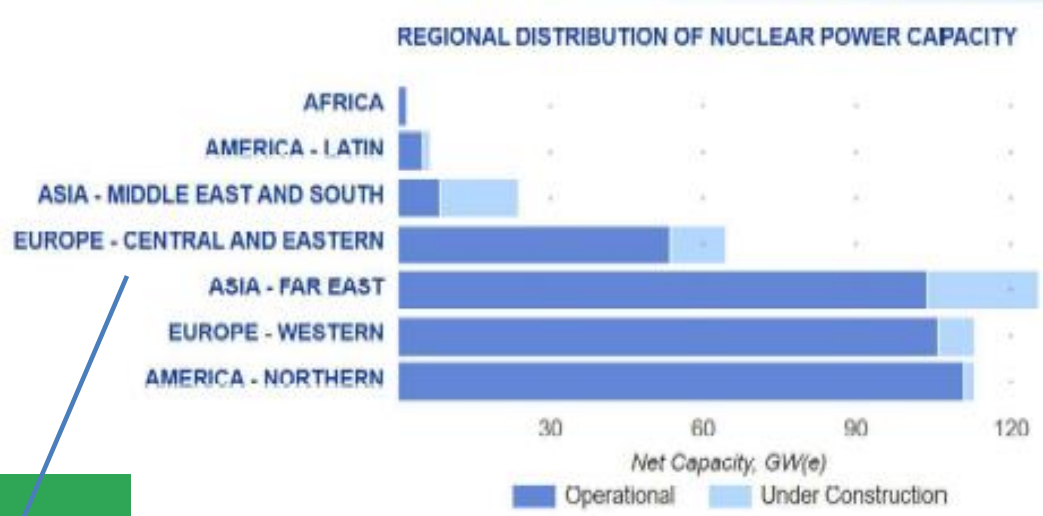
The Mix Oxide fuel to burn Plutonium

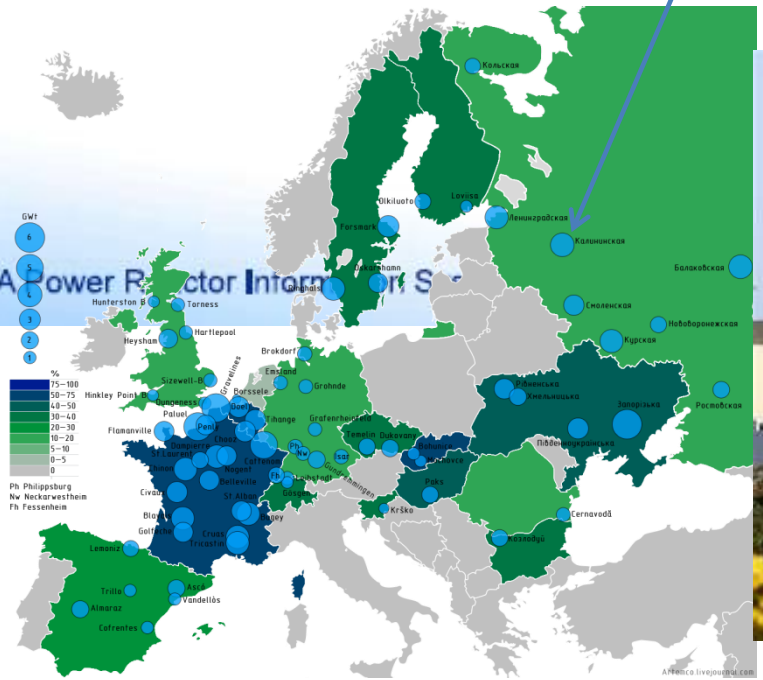
The Plutonium, as oxide, is mixed with depleted Uranium (obtained from a enrichment plant) to form fresh mixed oxide fuel (Mox which is UO2 + PuO2). MOX fuel consisting of 7-11% of Plutonium with depleted Uranium, is equivalent to Uranium oxide fuel, enriched about 4,5% of U-235, assuming that the plutonium has about two-thirds fissile isotopes. If weapon grade Plutonium is used (Pu -239 >90%), only about the 5% Plutonium is needed in the mix.



Global Nuclear Power Plants

441	NUCLEAR POWER REACTORS IN OPERATION
393 977	MW_e TOTAL NET INSTALLED CAPACITY
51	NUCLEAR POWER REACTORS UNDER CONSTRUCTION
53 870	MW_e TOTAL NET INSTALLED CAPACITY
19 170	REACTOR YEARS OF OPERATION



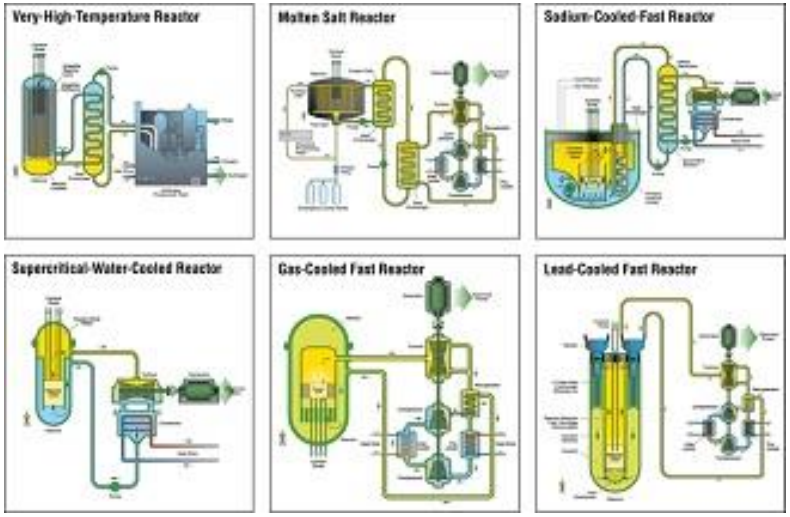


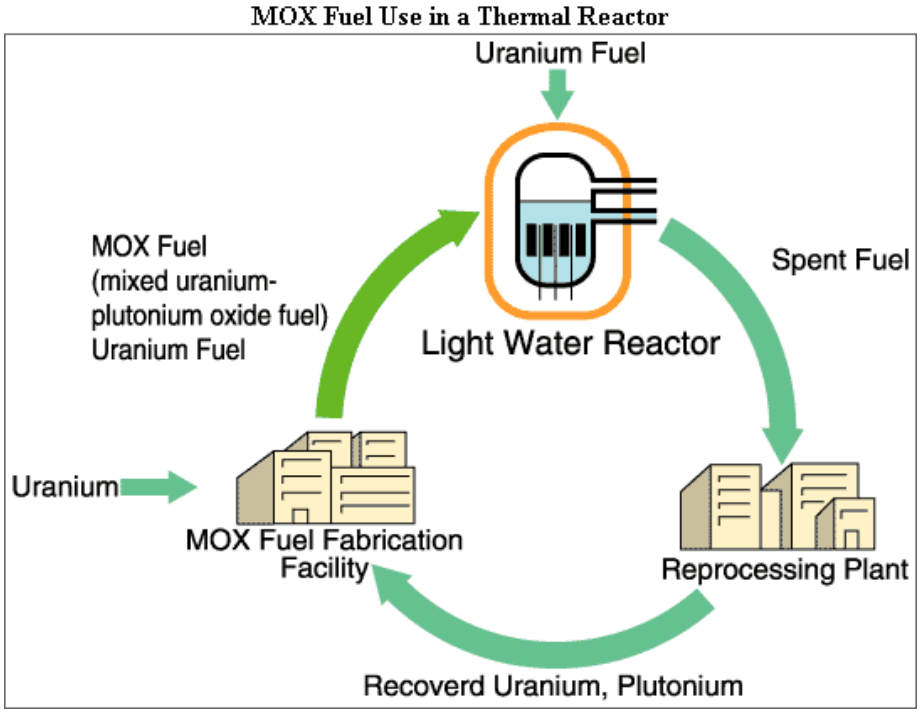
Source: IAEA Power Reactor Information System

MOX FUEL (PuO2 + UO2)

- Recycling of Pu resulting from nuclear warheads in the HALEU (High-Assay Low Enriched Uranium) 5 – 20 % of U235

- Burning of UO2/ Pu mixed oxide III (ALWR) e IV generation (liquid metal fast reactors)





Fast Reactors in Operation & under Commissioning

Country	Name	Coolant	Purpose	Power (th/e) MW	Year (Op.)	Status
Russia	BOR-60	sodium	experimental	60/10	1969	operating
	BN-600	sodium	prototype	1470/600	1980	operating
	BN-800	sodium	commercial	2100/880	2015	operating
China	CEFR	sodium	prototype	65/20	2011	operating
India	FBTR	sodium	experimental	40/13	1985	operating
	PFBR	sodium	prototype	1250/500	(Est.) 2022	commissioning
Japan	JOYO	sodium	experimental	150/--	1978	license renew

BN-600
Russia, 1980

BN-800
Russia, 2015

CEFR, 20 MW(e)
China, 2011

FBTR, 13 MW(e)
India, 1985

PFBR, 500 MW(e)
India, 2022

Conclusion 1/2 – The Past

Conversion of Military Pu in electric energy by using MOX Technologies

- Plutonium is a fissile material which can be used in an atomic bomb (it has been already used in Alamogordo for the first atomic bomb, and later in **Nagasaki**).
- Besides, Plutonium is used as e **trigger for H-bomb**. After some years of the Megatons to Megawatts program, in 2000 USA and Russia agreed upon the Plutonium Management and Disposition Agreement (PMDA) for the disposal of 34 tons of weapon-grade Plutonium for each part by 2014.
- The plan is to use this Plutonium to make **Mixed Oxide (MOX)** fuel to be used in water cooled reactors (by mixing depleted Uranium from enrichment process, and Plutonium from weapon dismantling).
- in 2011 a new agreement allowed Russia to use this Plutonium to feed its **fast neutron** reactors BN-600 and BN-800, still in operation.
- On the contrary, USA did not succeed to build a factory to make MOX, now is considering to dispose **Plutonium as a waste** (a large loss of potential energy…)

Conclusion 2/2 – The Future

New M2M plan (M2D)

- A new updated plan **"Megatons to Megawatts"**, to foster the military nuclear fissile material into the commercial NPPs **located in UE** and actually producing more than **100 GWe**
- **Employ ALWR (Advanced Light Water Reactors) able just now to burn U and Pu**
- In the mid term encourage the employ of **not breeding Gen IV NPPs** (fast neutron reactors)

- Cochran update from Trump Adm. seems to encourage the **restart** from USA of 2000 program for Pu conversion to NPPs. **Very good !!!**
- This will eliminate Pu, produce electricity, avoid emission of million tons of pollutants and green house gases (CO2)
- Deploy the great **PEACE SAVING** (ECONOMIC EARN) from conversion of atomic bombs into electricity for sustainable development of poor Countries (PVS) and demanding people
- Create an **Integral Safety and Security for all States, the whole world (main actors USA, Russia, China) towards the final Nuclear Peace for all**