A Proliferação de Armas de Destruição em Massa

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3 Fevereiro 2012

Consultar:
http://jddomingos.ist.utl.pt
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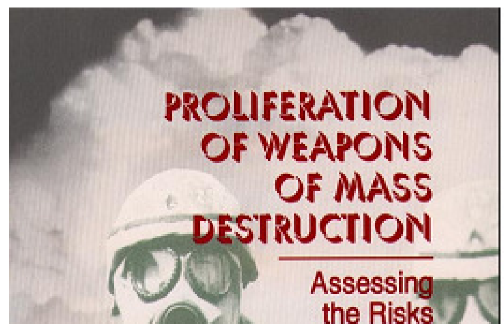


August 1993

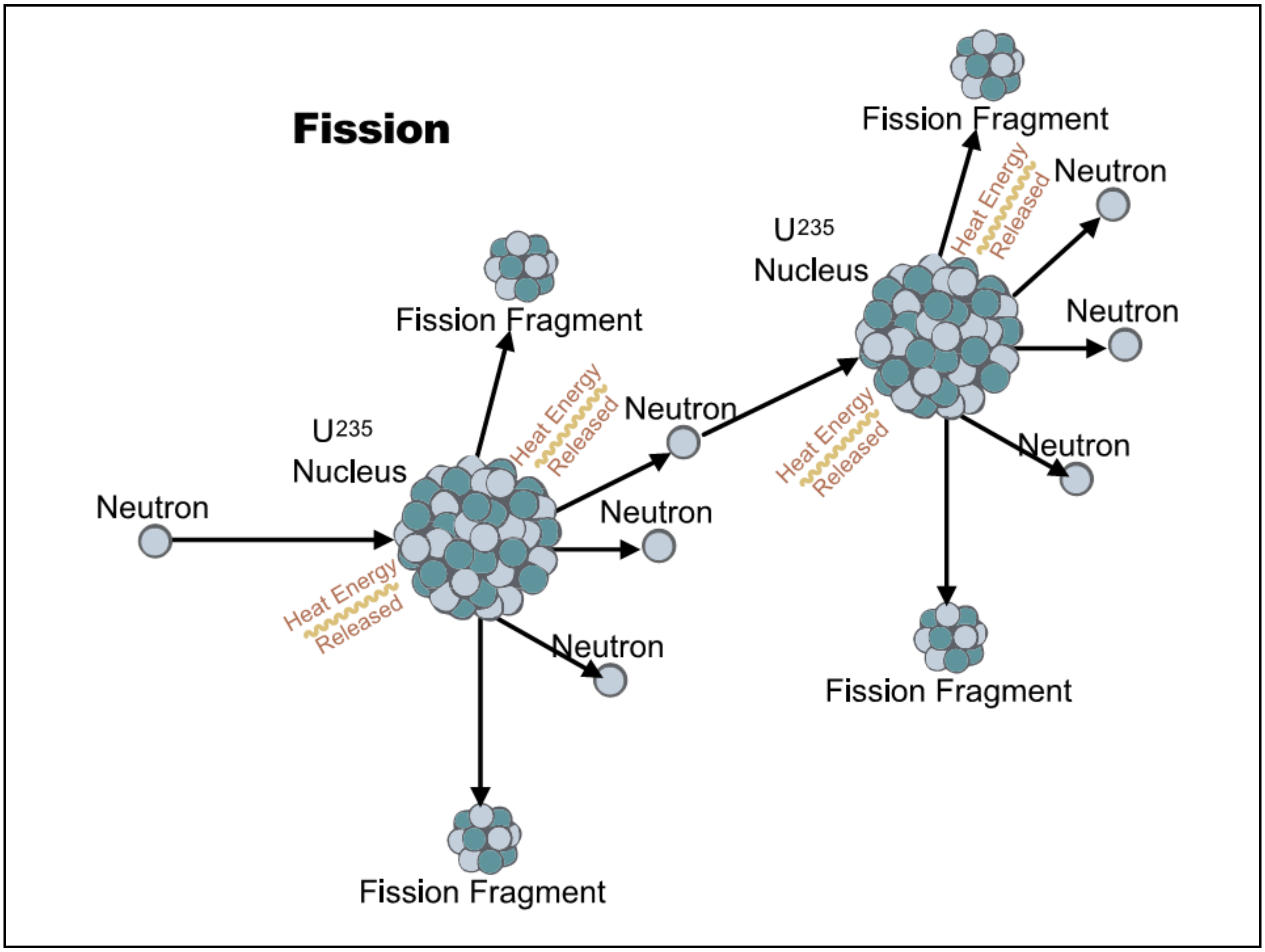
OTA-ISC-559
NTIS order #PB94-107612
GPO stock #052-003-01335-5

http://www.fissilematerials.org

Física Básica

$$E = mc^2$$

Se m=1kg   E=~ 3.000.000.000 kJ
Numa reação química normal a identidade do átomo mantem-se e a variação de massa é imperceptivel.
Numa reacção nuclear os átomos podem cindir-se (fissão) ou fundir-se(fusão nuclear) dando origem a novos elementos. Se a massa final é menor a energia é libertada sobre a forma de calor



Fission
Neutron
U235
Nucleus
Heat Energy Released
Fission Fragment
Heat Energy Released
Neutron
Neutron
Heat Energy Released
Neutron
Fission Fragment
U235
Nucleus
Fission Fragment
Heat Energy Released
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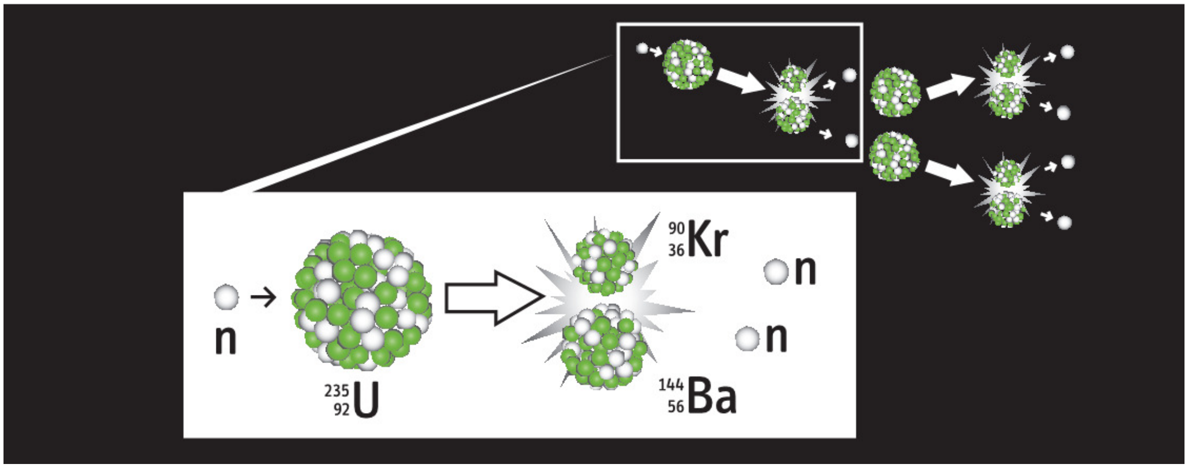
Neutron
Fission Fragment

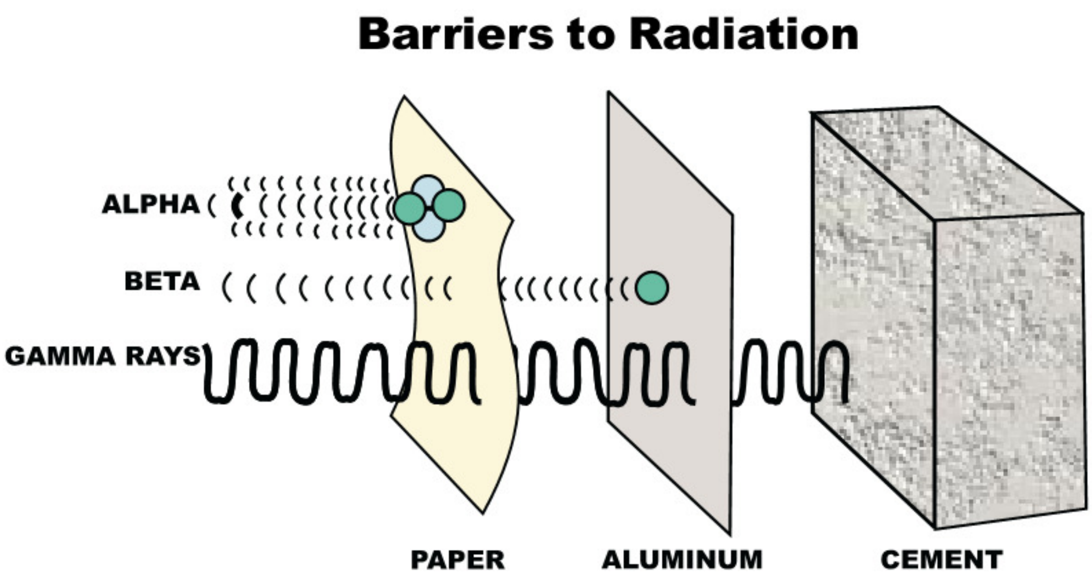
Reacção em cadeia: Fissão Explosiva



Um neutrão choca com o núcleo de urâninio 235 que se divide em dois (kripton e bário) libertando energia e emite neutrões adicionais que vão chocar com outros núcleos. Se a massa crítica for excedida, o processo de fissão repete-se, duplicando ~ 80 vezes num milionésimo de segundo.

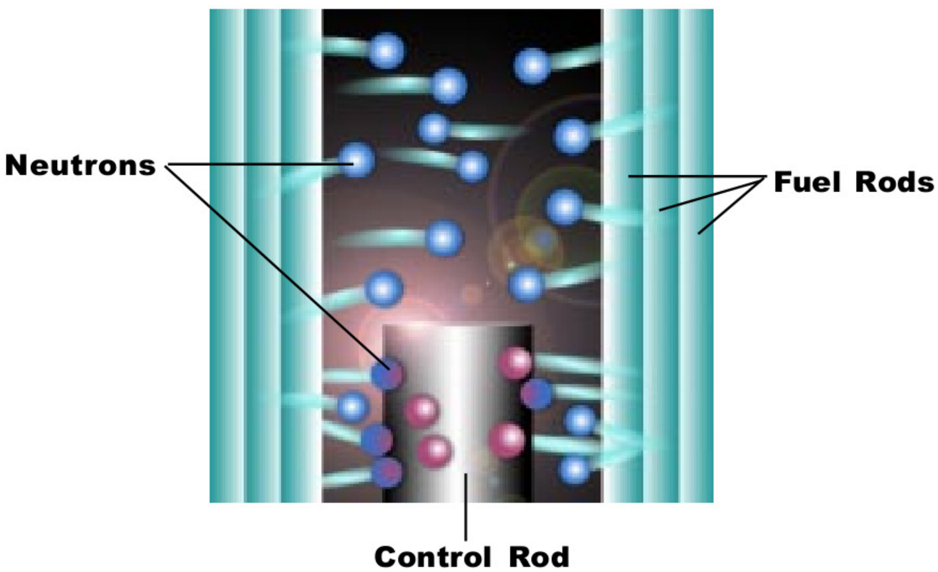
A energia libertada pela fissão de 1kg é ~ equivalente à libertada por 18.000 toneladas de TNT

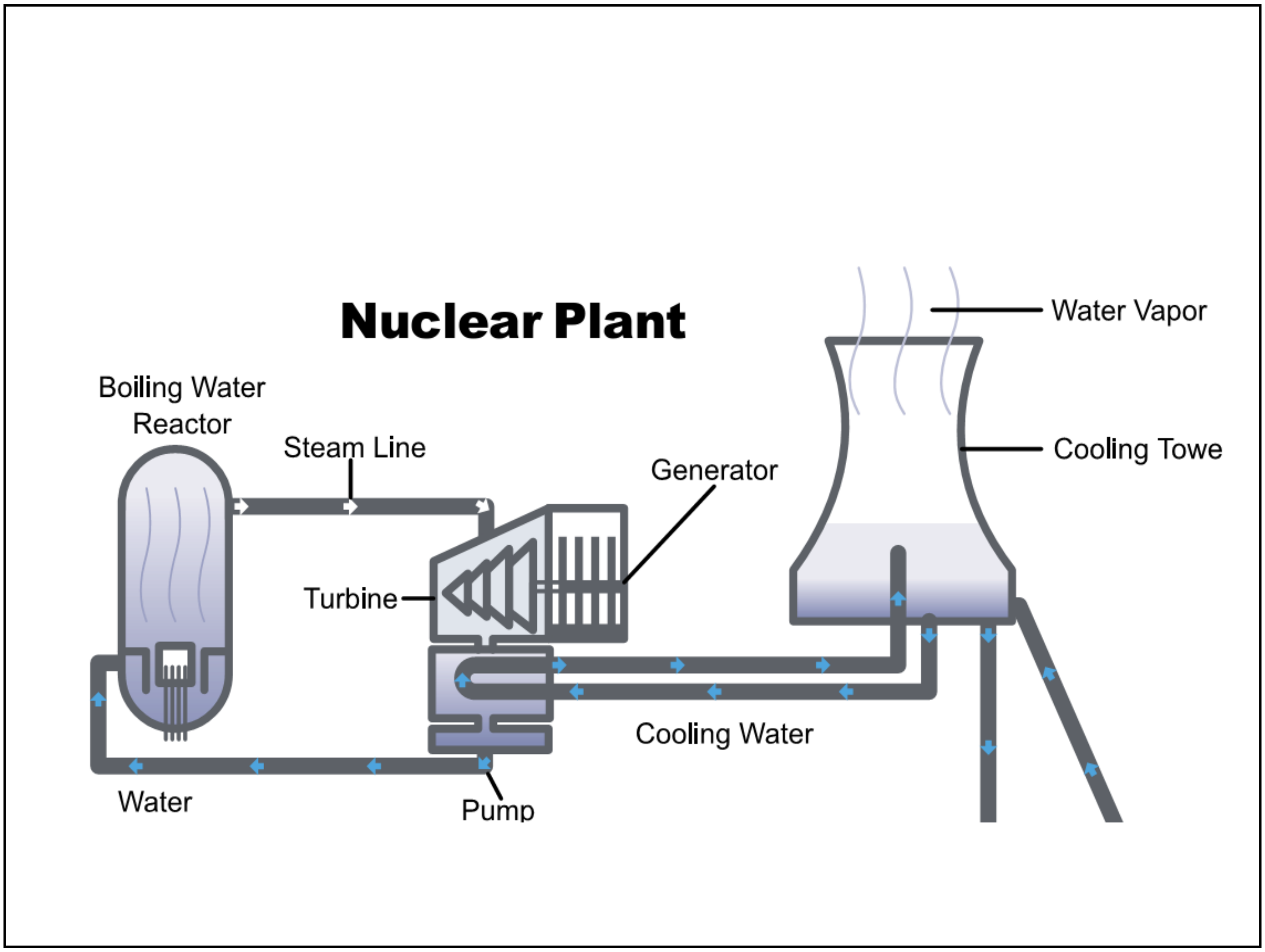
Radiações



Source: A Basic Guide to Nuclear Power, Edison Electric Institute

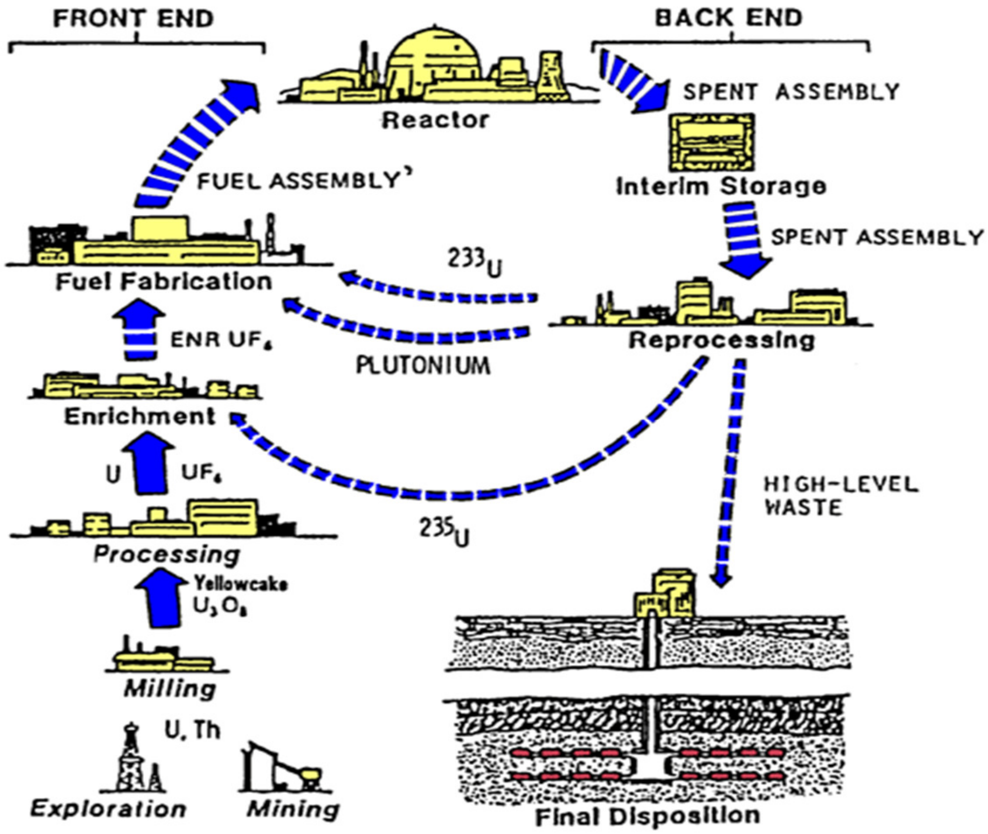
Numa Central Nuclear as barras de controlo absorvem os neutrões em excesso de modo a impedir a reação explosiva





Nuclear Plant
Boiling Water
Reactor
Steam Line
Generator
Turbine
Water Vapor
Cooling Towe
Cooling Water
Water
Pump

Ciclo do Combustivel Nuclear



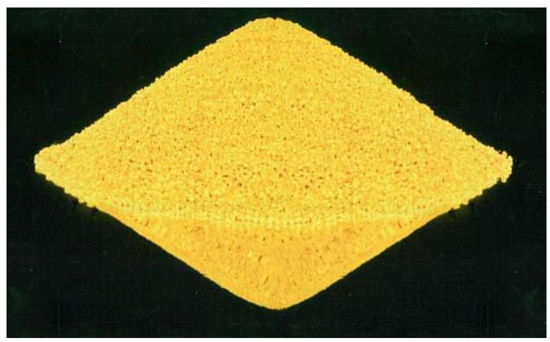
Riscos Intrinsecos

Devido às consequencias intrinsecas de altíssimas densidades de energia, todo o ciclo do combustível nuclear envolve riscos que crescem exponencialmente desde a extracção do minério à deposição dos resíduos após produção de energia numa central nuclear.

Processamento do Uranio

- Uranio 238 (U Natural)
- % no minério 0.05 a 1%

- O urânio natural é convertido a *Yelow cake (*hexaflureto UF6), matéria prima para posterior processamento



Enriquecimento do Urânio

A percentagem de uranio 235 (fissil) no U238 (uranio natural) é de ~0.7%. Aumentar a concentração de U235 no produto final é a operação de enriquecimento.

A matéria prima para o processamento é o Yellow Cake que se torna gasoso a baixa temperatura (~57 ºC)

Como se trata de isótopos, separar o U235 do U238 tem de recorrer a processos físicos que se baseiam na sua ligeira diferença de massa especifica.
Inicialmente utilizou-se a termodifusão.
A termodifusão é altamente consumidora de energia exigindo centrais electricas (dedicadas) com potencias superiores a 1000 Mwe (EUA,França,URSS…) que por si só eram um obstáculo à sua generalização

Modernamente, o enriquecimento em U235 é feito por centrifugação.
O U238 é mais pesado que o U235, pelo que a força centrifuga permite separá-los.
Devido à muito pequena diferença de peso a separação é muito pequena levando à associação das centrifugadoras em cascata.
O nº de centrifugadoras na cascata aumenta com a percentagem desejada no produto final que nas centrais nucleares civis é entre 1 e 4% e para fins militares > 20% e até 98%

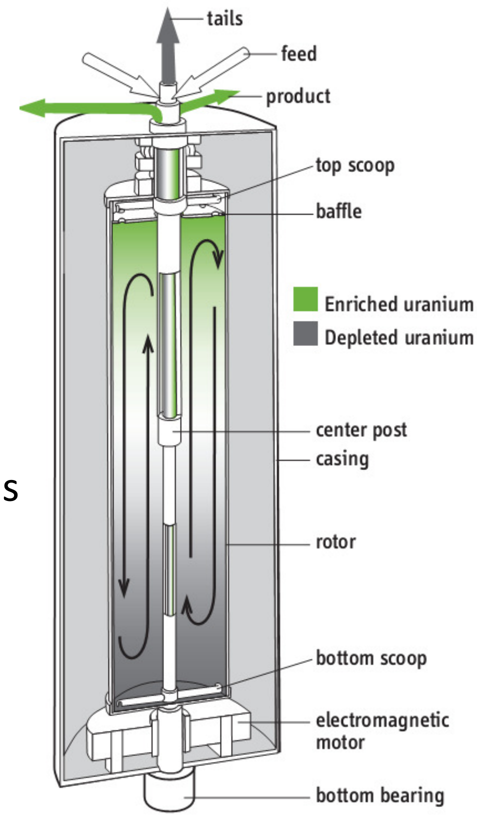


Figure 1.4: Centrifuges developed by USEC for the American Centrifuge Plant. The USEC AC100 centrifuge has a design capacity of 350 SWU per year and is over 12 meters tall. For comparison, a current Urenco centrifuge, the TC-21, has a capacity of 90–100 SWU per year and a height of about 6 meters, while Russian centrifuges are typically of the order of 5 SWU per year and have a height of about 1 meter.[59] *Source: www.usec.com.*

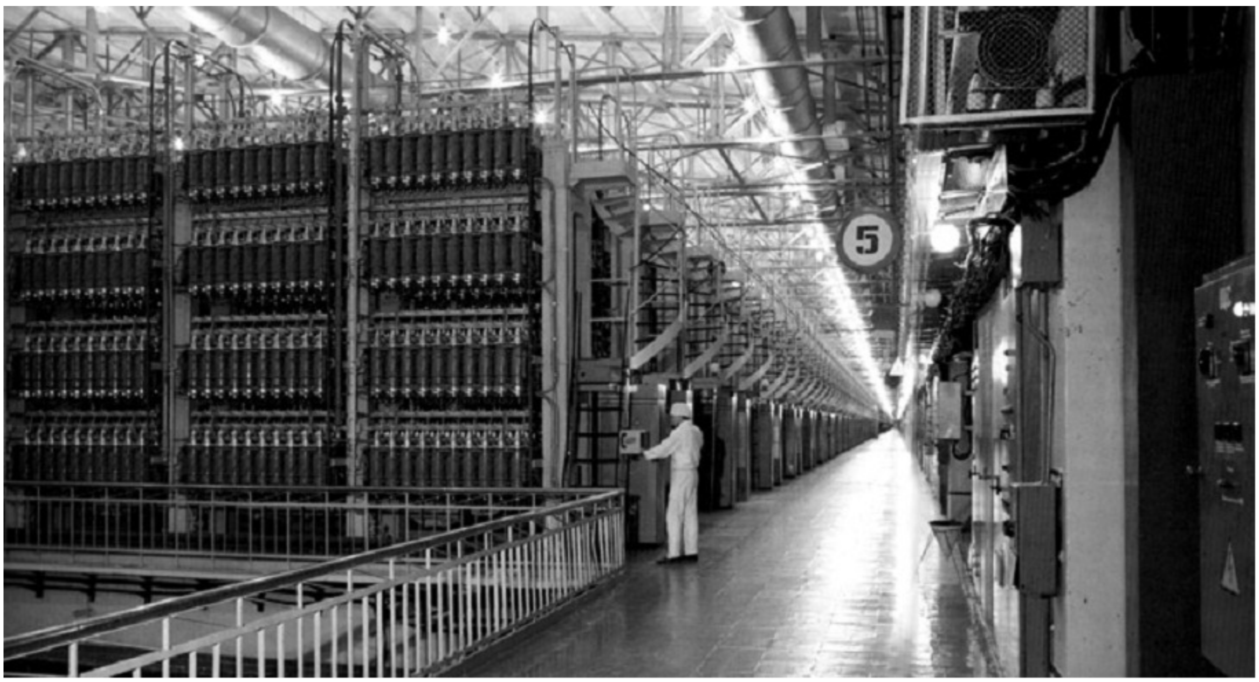


Figure 4A.1. Inside a centrifuge hall in Novouralsk in the 1990s. *Source: U.S. Department of Energy.*[330]

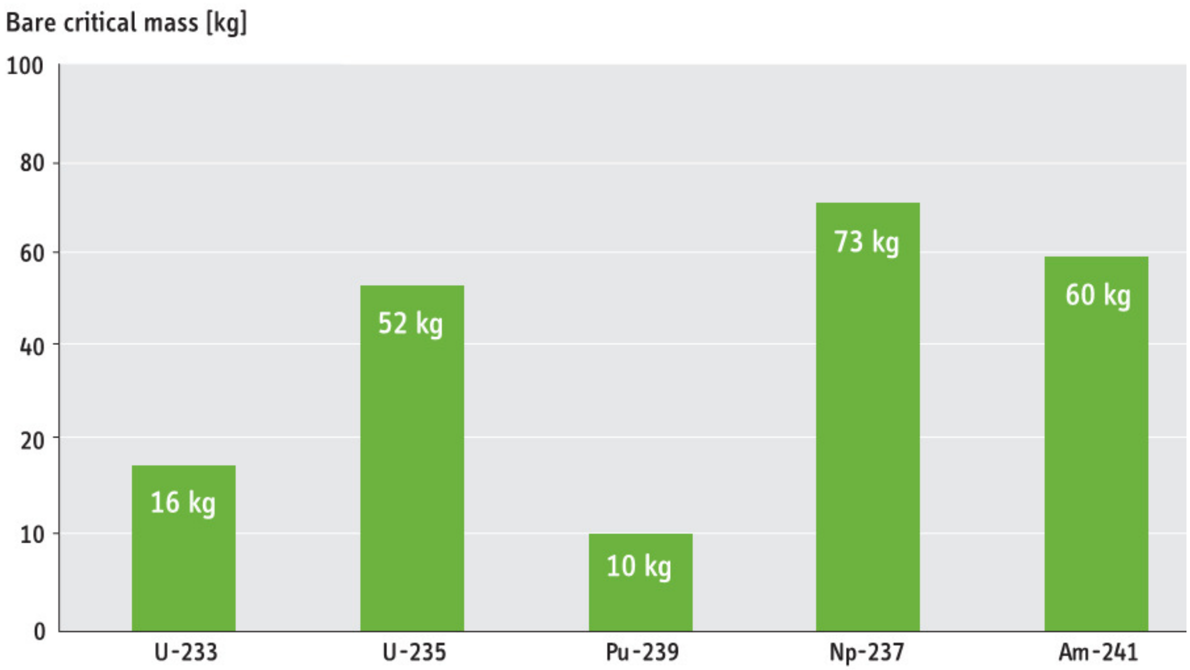


Figure A.2. Bare critical masses for some key fissile isotopes. A bare critical mass is the spherical mass of fissile metal barely large enough to sustain a fission chain reaction in the absence of any material around it. Uranium-235 and plutonium-239 are the key chain-reacting isotopes in highly enriched uranium and plutonium respectively. Uranium-233, neptunium-237 and americium-241 are, like plutonium-239, reactor-made fissile isotopes and could potentially be used to make nuclear weapons but have not, to our knowledge, been used to make other than experimental devices.

Declaração, em Junho de 1945, de cientistas que criaram a primeira bomba atómica, antes de ter sido usada no Japão (Agosto 1945)

"The development of nuclear power is fraught with infinitely greater dangers than were all the inventions of the past. [...] In the past, science has often been able to provide adequate protection against new weapons it has given into the hands of an aggressor, but it cannot promise such efficient protection against the destructive use of nuclear power. [...] In the absence of an international authority which would make all resort to force in international conflicts impossible, nations could still be diverted from a path which must lead to total mutual destruction, by a specific international agreement barring a nuclear armaments race."[86]

The Franck Report

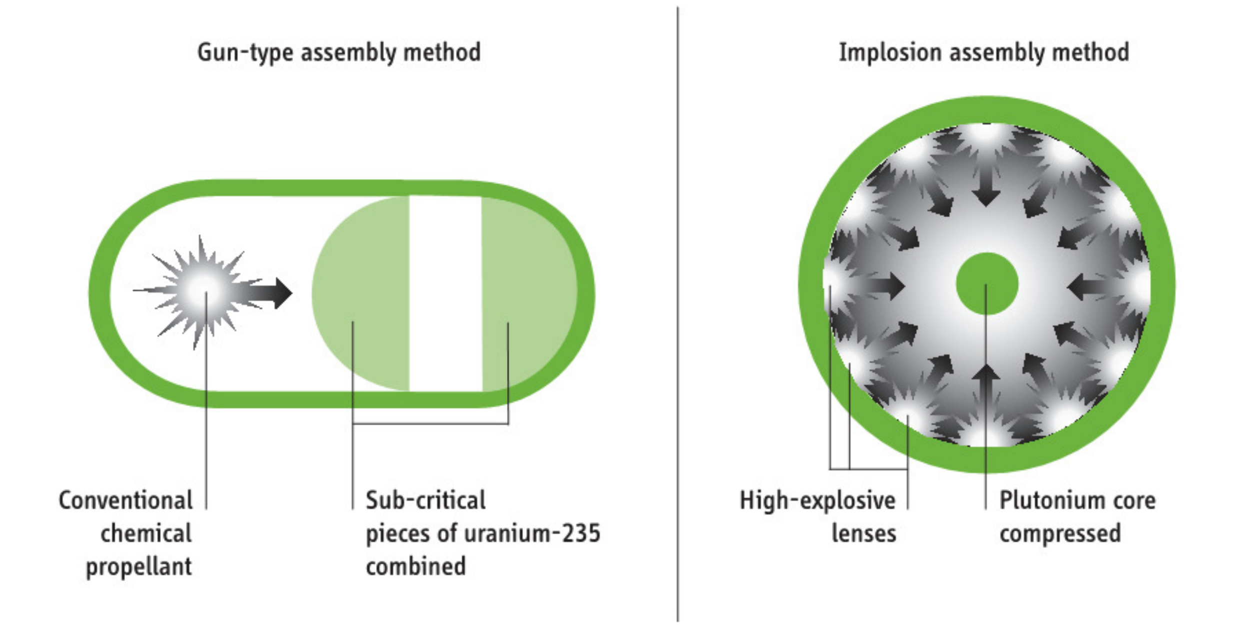


Figure A.2. Alternative methods for creating a supercritical mass in a nuclear weapon. In the technically less sophisticated "gun-type" method used in the Hiroshima bomb (left), a subcritical projectile of HEU is propelled towards a subcritical target of HEU. This assembly process is relatively slow. For plutonium, the faster "implosion" method used in the Nagasaki bomb is required. This involves compression of a mass of fissile material. Much less material is needed for the implosion method because the fissile material is compressed beyond its normal metallic density. For an increase in density by a factor of two, the critical mass is reduced to one quarter of its normal-density value.

Quantidades necessárias de Uranio ou Plutónio para uma bomba nuclear

	Plutonium	HEU	Yield	Example
IAEA Significant Quantity (SQ)	8 kg	25 kg*		
1st-generation gun-type weapon	n/a	50 – 60 kg	20 kt	Hiroshima
1st-generation implosion-type weapon	5 – 6 kg	15 – 18 kg	20 kt	Nagasaki (6 kg Pu)
2nd-generation single-stage weapon	4 – 5 kg	12 kg	40 – 80 kt	(levitated or boosted pit)
Two-stage low-yield weapon	3 – 4 kg Pu and 4 – 7 kg HEU		100 – 160 kt	W76
Two-stage medium-yield weapon	3 – 4 kg Pu and 15 – 25 kg HEU		300 – 500 kt	W87/W88
Two-stage high-yield weapon	3 – 4 kg Pu and 50+ kg HEU		1 – 10 MT	B83

Table A.1. Nuclear weapon generations and estimated respective fissile material quantities. Warhead types are U.S. warhead-designations. The estimates assume about 18 kt per kilogram of nuclear material fissioned, a fission-fraction of 50 % for a 2nd-generation and two-stage weapon, and a yield fraction of 50 % in the secondary from fission in the two-stage weapon. *The significant quantity specifies uranium-235 contained in highly enriched uranium.

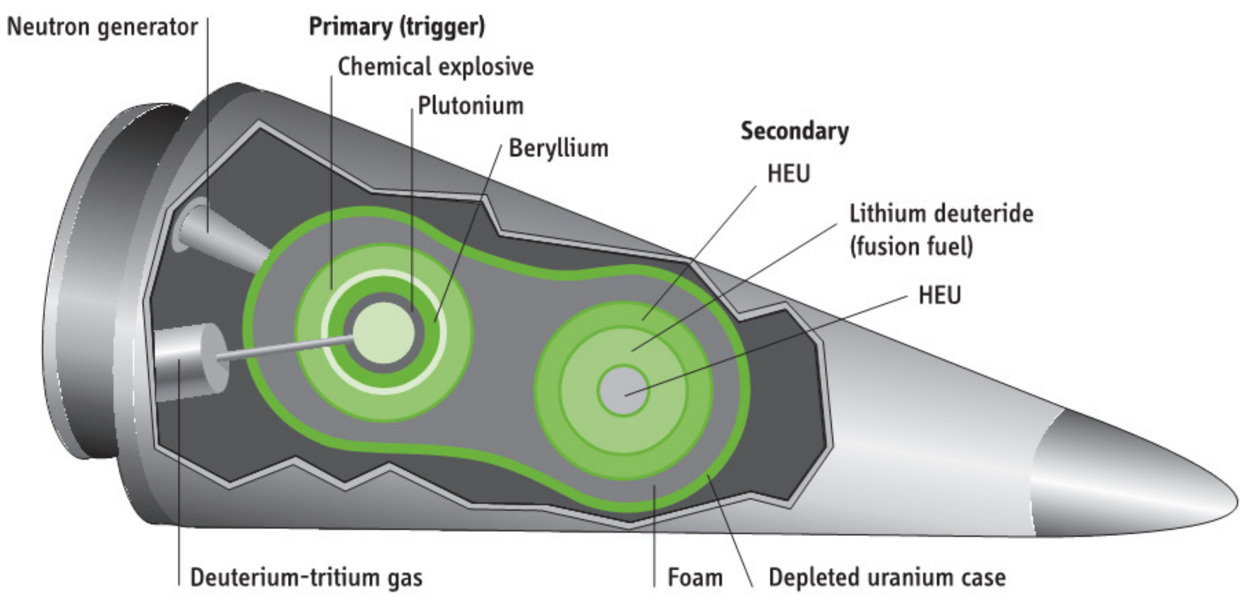
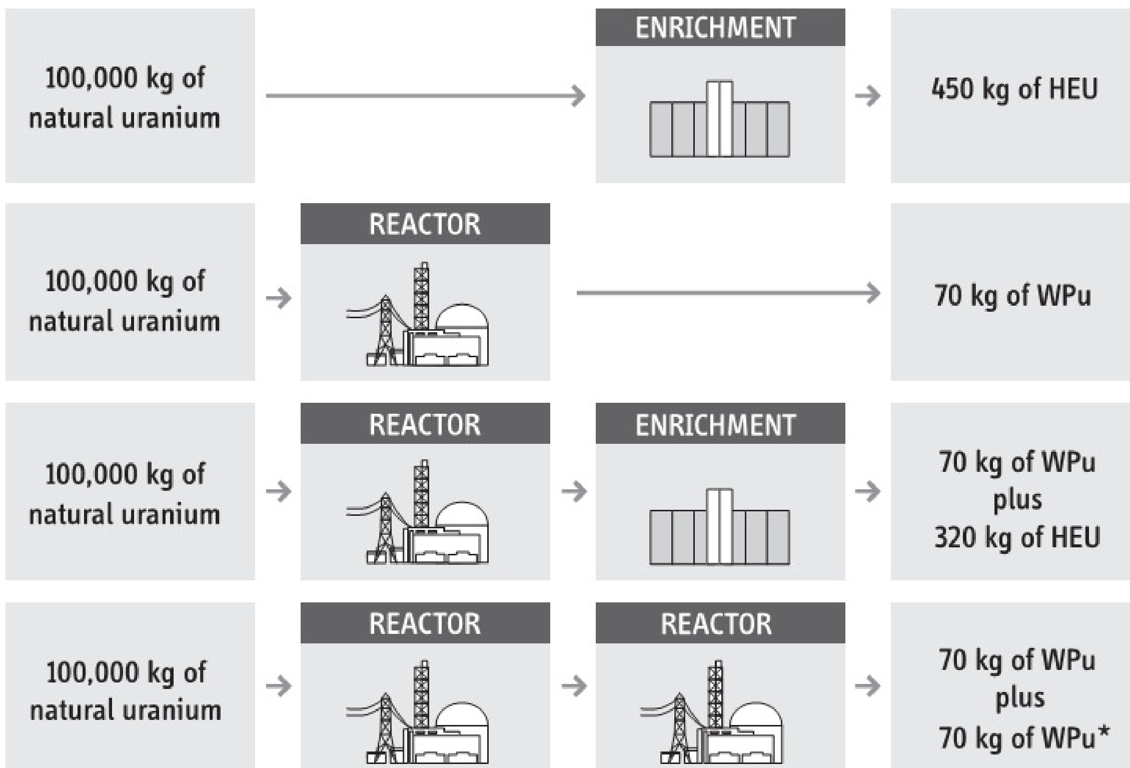


Figure A.3. A modern thermonuclear weapon usually contains both plutonium and highly enriched uranium. Typically, these warheads have a mass of about 200–300 kg and a yield of hundreds of kilotons of chemical explosive, which corresponds to about one kilogram per kiloton of explosive yield. For comparison, the nuclear weapons that destroyed Hiroshima and Nagasaki weighed 300 kg per kiloton.[162]

Figure 3.6. Components of a U.S. B-61 thermonuclear weapon. A nuclear weapon is a complex mechanism, with the nuclear explosive or "physics package" (*) and its associated arming, fusing, firing and safety systems. The physics package is itself a composite, made up of a plutonium shell or pit surrounded by a high-explosive that when detonated compresses the pit into a super-critical mass able to undergo a fission chain-reaction, which in turn drives the explosion of a thermonuclear secondary. For more details see Appendix A. *Source: U.S. Department of Energy.*

Obter Plutónio



Global Fissile Material Report 2009

Stocks nacionais de Urânio altamente enriquecido (HEU)

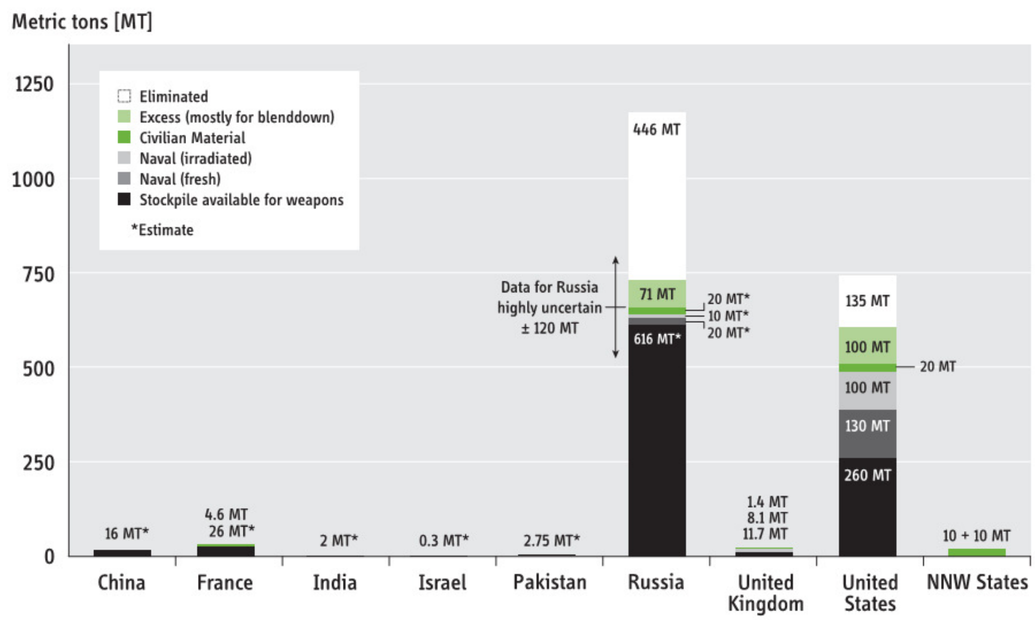


Figure 1. National stocks of highly enriched uranium as of 2011. The numbers for the United Kingdom and United States are based on their publications. The civilian HEU stocks of France, the United Kingdom are based on their public declarations to the IAEA. Numbers with asterisks are IPFM estimates, in France, about 30% for Pakistan, and about 40% for India. The 446 tons of eliminated Russian HEU include 433 tons from the 500-ton HEU deal and 13 tons from the Material Consolidation and Conversion (MCC) project. About 4 tons of HEU remain for blend-down within the MCC project. About 10 tons

Stock actual de bombas nucleares

Country	Current Nuclear Warheads
United States	about 8500, with about 4000 awaiting dismantlement
Russia	about 10,000, with a large fraction awaiting dismantlement
France	fewer than 300
United Kingdom	fewer than 225
China	about 240
Israel	100 – 200
Pakistan	90 – 110
India	80 – 100
North Korea	fewer than 5

Table 1. Estimated total nuclear-weapon stockpiles, 2011. *Source: FAS/NRDC.*[1] The estimate for North Korea assumes that the weapons stockpile consists only of plutonium weapons and does not include possible HEU weapons.

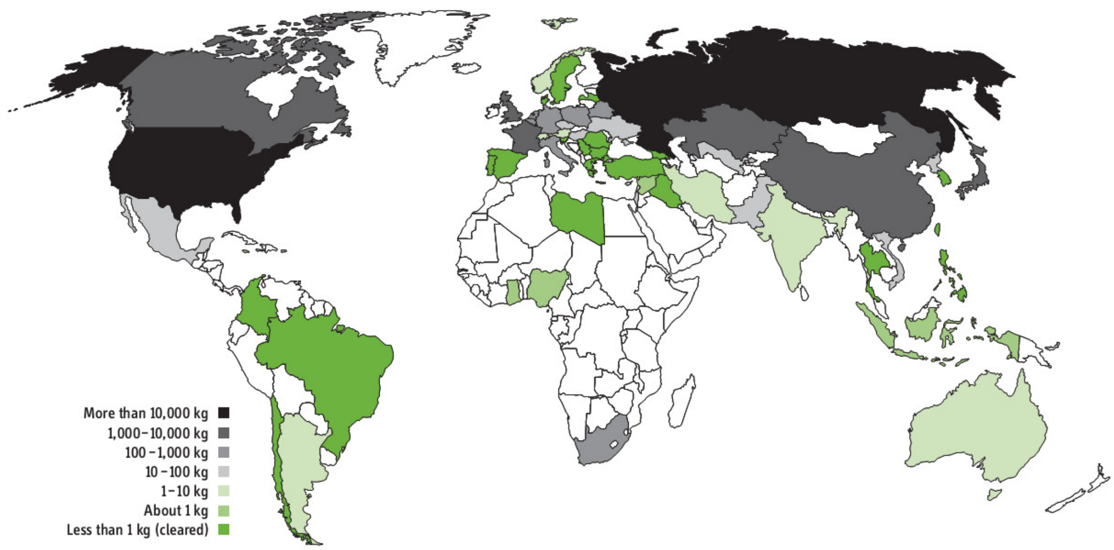


Figure 3. Distribution of civilian HEU worldwide as of 2011. There are still more than 50 sites in about 30 countries where the material can be found in significant quantities, at operational or shut down, but not yet decommissioned HEU-fueled reactors.

Instalações de enriquecimento de urânio -1

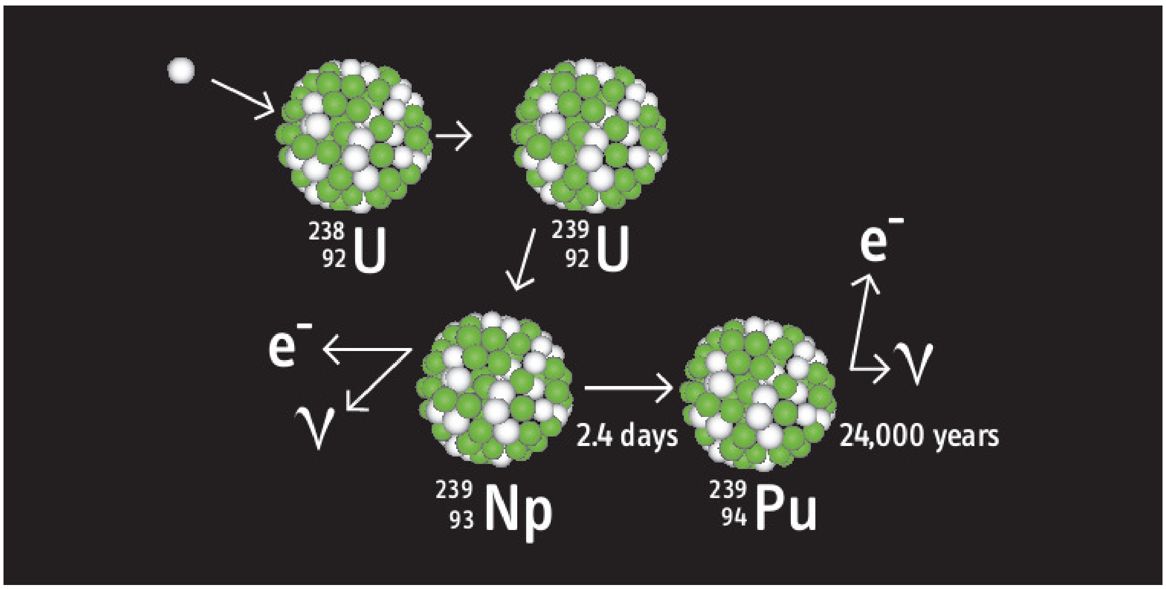
Facility	Type	Operational Status	Safeguards Status	Capacity [tSWU/yr]
Argentina				
Pilcaniyeu	Civilian	Resuming operation	yes	20–3000
Brazil				
Resende	Civilian	Being commissioned	yes	115–200
China				
Shaanxi	Civilian	Operating	(yes)	1000
Lanzhou II	Civilian	Operating	offered	500
Lanzhou (new)	Civilian	Operating	no	500
France				
George Besse I	Civilian	Scheduled for shutdown	yes	10800
George Besse II	Civilian	Operating	yes	7500–11000
Germany				
Gronau	Civilian	Operating	yes	2200–4500
India				
Ratehalli	Military	Operating	no	15–30
Iran				
Natanz	Civilian	Under construction	yes	120
Qom	Civilian	Under construction	yes	5–10

Instalações de enriquecimento de urânio -2

Japan				
Rokkasho	Civilian	Temporary shutdown	yes	(1500)
Netherlands				
Almelo	Civilian	Operating	yes	5000 - 6000
North Korea				
Yongbyon	?	?	no	(8)
Pakistan				
Kahuta	Military	Operating	no	15 - 45
Gadwal	Military	Operating	no	Unknown
Russia				
Angarsk	Civilian	Operating	offered	2200-5000
Novouralsk	Civilian	Operating	no	13300
Zelenogorsk	Civilian	Operating	no	7900
Seversk	Civilian	Operating	no	3800
United Kingdom				
Capenhurst	Civilian	Operating	yes	5000
United States				
Paducah, Kentucky	Civilian	Shutdown postponed	offered	11300
Piketon, Ohio	Civilian	Planned	offered	3800
Eunice, NM	Civilian	Operating	offered	5900
Areva Eagle Rock, Idaho	Civilian	Planned	(offered)	3300-6600
GLE, Wilmington, NC	Civilian	Planned	?	3500-6000

PLUTÓNIO

Produção de Plutónio num Reactor Nuclear



Um neutrão libertado pela fissão de U235 é absorvido pelo U238 originando U239 que decai para Neptuno que por sua vez decai, em poucas horas, para Plutónio 239 (físsil) cuja meia vida é de 24000 anos. **O plutónio não existe naturalmente na natureza e a sua produção é intrinseca ao funcionamente de um Reactor nuclear**

Reprocessamento do combustivel nuclear utilizado

Depois de produzir energia num reactor nuclear o combustivel irradiado é composto por uma mistura complexa de produtos radioactivos cuja composição exacta depende depende das horas de utilização.

A percentagem de putónio aumenta com o tempo e os produtos radiactivos, consoante o seu tipo, decaem com tempos que vão de segundos a milhares de anos, emitindo particulas alfa, beta e gama, as quais estão inversamente relacionadas com o tempo de vida do elemento que a origina.

O processo de decaimento liberta calor e por isso o seu depósito tem de ser contínuamente refrigerado e a sua quantidade tem de ser inferior à massa crítica para uma reacção em cadeia.

Calor libertado pelos residuos em função do tempo

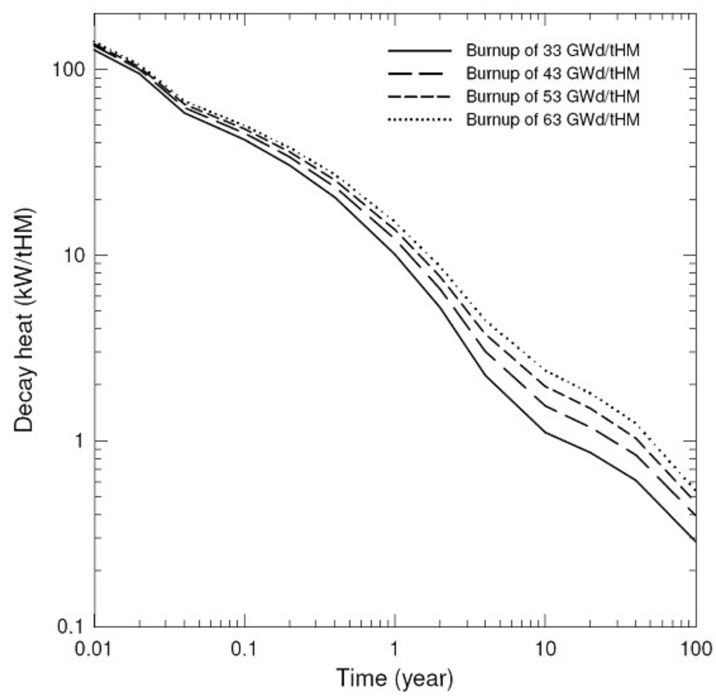


Figure 1. Decay heat as a function of time from 0.01 years (about 4 days) to 100 years for low-enriched uranium spent-fuel with burnups of 33, 43, 53 and 63 GWd/tHM. The lowest burnup was typical for the 1970s. Current burnups are around 50 GWd/tHM. Source: Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, and Frank N. von Hippel, "Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States," *Science and Global Security*, volume 11, 2003, pp. 1-15.

Reprocessing Plants

Facility	Type	Operational Status	Safeguards Status	Capacity (tHM/yr)
China				
Pilot Plant	Civilian	Operating	(no)	50–100
France				
UP2	Civilian	Operating	yes	1000
UP3	Civilian	Operating	yes	1000
India				
Trombay	Military	Operating	no	50
Tarapur-I	Dual	Operating	no	100
Tarapur-II	Dual	Operating	no	100
Kalpakkam	Dual	Operating	no	100
Israel				
Dimona	Military	Operating	no	40–100
Japan				
Rokkasho	Civilian	Starting up	yes	800
Tokai	Civilian	Temporarily shut down	yes	200
North Korea				
Yongbyon	Military	On standby	no	100–150
Pakistan				
Nilore	Military	Operating	no	20–40
Chashma	Military	Under construction	no	50–100
Russia				
RT-1	Dual	Operating	no	200–400
Seversk	Dual	To be shutdown after cleanup	no	6000
Zheleznogorsk	Dual	To be shutdown after cleanup	no	3500
United Kingdom				
B205	Civilian	To be shutdown after cleanup	yes	1500
THORP	Civilian	Operating	yes	1200
United States				
H-canyon, SRP	Converted	Special Operations	no	15

Stocks nacionais de Plutónio

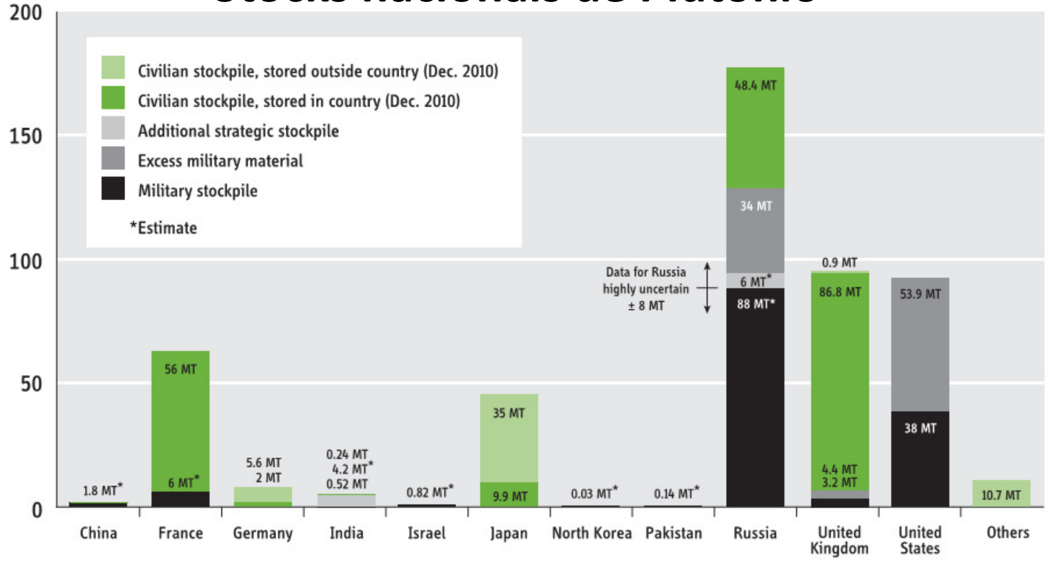


Figure 4. National stocks of separated plutonium. Civilian stocks are based on the most recent INF-CIRC/549 declarations for December 2010 and are listed by ownership, not by current location. Weapon stocks are based on non-governmental estimates except for the United States and United Kingdom whose governments have made declarations. Uncertainties of the military stockpiles for China, France, India, Israel, Pakistan, and Russia are on the order of 10–30%. The plutonium India separated from spent heavy-water power-reactor fuel has been categorized by India as "strategic," and not to be placed under IAEA safeguards. Russia has 6 tons of weapon-grade plutonium that it has agreed to not use for weapons but not declared excess.

Figure 7. A cooling pond at China's pilot reprocessing plant. The plant has the capacity of processing 50–60 tons of spent fuel per year and began operating in 2011. The hot testing of the plant in 2010 yielded 13.8 kg of separated plutonium, which China declared as its civilian stockpile. *Source: news.cntv.cn, 3 January 2011.*[144]

Country	Date of first nuclear test	Date of accession to NPT
United States	July 16, 1945	1970
Russia	August 29, 1949	1970
United Kingdom	October 3, 1952	1970
France	February 13, 1960	1992
China	October 16, 1964	1992
India	May 18, 1974	–
Israel	?[92]	–
Pakistan	May 28, 1998	–
North Korea	October 9, 2006	1985 (withdrew 2004)

Table 2.1. First nuclear weapons tests by current nuclear weapon states, 1945–2009.

PROLIFERAÇÃO

"Today disarmers are faced with ten thousand warheads in service, a similar number awaiting dismantlement, and materials and components from tens of thousands more.

There are also more than a hundred HEU-powered ships and submarines and over a hundred research reactors fueled with HEU mostly weapon-grade"

. Global Fissile Material Report 2009, p39

Even a robust verification system could not assure, that all fissile materials had been accounted for in a world in which enough fissile material has been produced to make more than 100,000 nuclear warheads.

Measurement errors and material lost irretrievably in wastes and during testing by the United States and Russia in particular, will make it impossible to verify to a level of 99 percent (i.e. to within the equivalent of 1000 warheads) that all fissile material has been disposed of or placed under international monitoring

Global Fissile Material Report 2009, p30

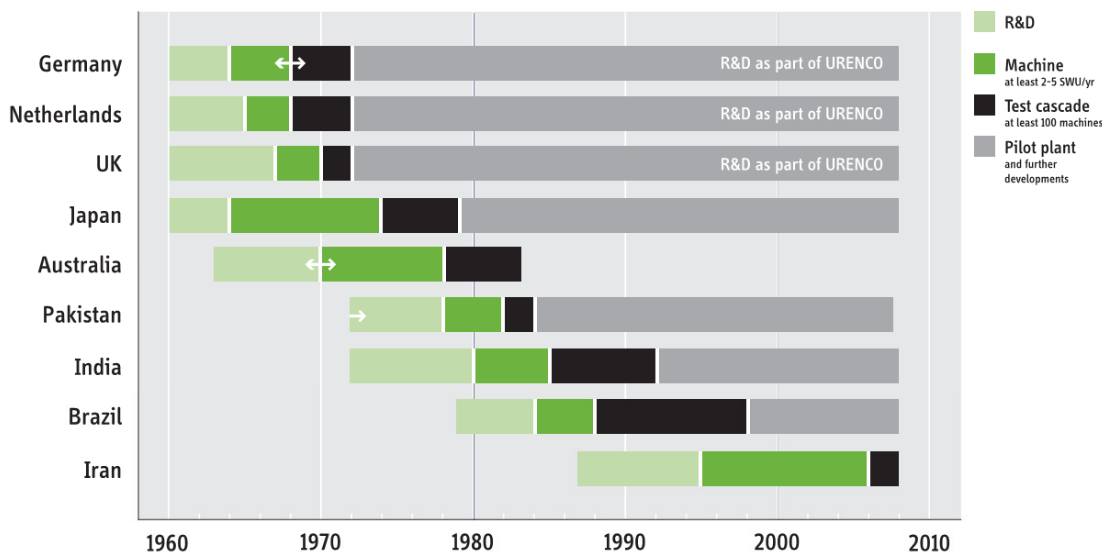


Figure 8.1. Timeline of selected centrifuge development programs from the R&D stage to operation of a pilot facility. Studies of national centrifuge development programs suggest it takes about 10–20 years to develop the basic technology. The time required to develop such basic first generation centrifuges is being reduced as key technologies for producing precision components are increasingly available worldwide and are being integrated into computer-controlled machine-tools.[352]

Enough plutonium to make a first-generation Nagasaki-type bomb could be recovered from a single ton of spent fuel.

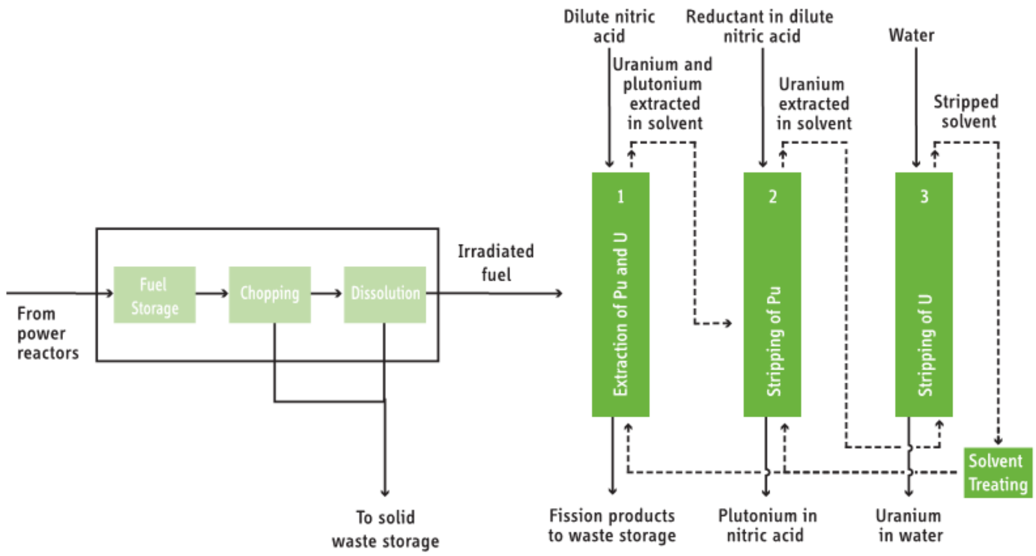


Figure 8.2. The key steps in a basic reprocessing plant. With the current PUREX technology, the spent fuel is chopped into small pieces and dissolved in hot nitric acid. The plutonium is extracted in an organic solvent that is mixed with the nitric acid using blenders and pulse columns, and then separated with centrifuge extractors.

A state with access to spent fuel could construct in advance a "quick and dirty" re-processing plant with minimal and rudimentary arrangements for worker radiation protection and radioactive waste management.

This might be accomplished in a year or less. A relatively small reprocessing plant with a capacity of 50 tons heavy-metal per year could separate up to 500 kilograms of plutonium annually, or enough for a single bomb in a week or less.

A FRESH EXAMINATION OF THE PROLIFERATION DANGERS OF LIGHT WATER REACTORS ,Victor Gilinsky et al, 2004

Gregory Schulte, *U.S. ambassador to the International Atomic Energy Agency*, at the to opening of the one-day meeting organized by the 56-state Organization for Security and Cooperation in Europe (OSCE) . Viena 8.11.2006, Associated Press

" Terrorist use of weapons of mass destruction is one of the gravest threats today to the world community (...) The threat is real, the consequences would be enormous.(...) We have to assume that terrorist groups will continue to try and acquire the sensitive materials they need to produce weapons of mass destruction (...) Any dedicated group with some knowledge of science and engineering and access to the Internet and some funding can construct such a device(...) The U.N. nuclear watchdog confirmed 18 incidents between 1993 and 2004 of trafficking of plutonium or highly enriched uranium in the OSCE area".

Former **defense Secretary William Perry** "**Testimony, House Armed Services Committee Strategic Forces subcommittee**" J**uly 18, 2007**

"Terrorists would not use a ballistic missile to deliver their bomb; they would use a truck or a freighter.

The mode of operation could be like the delivery of the truck bomb in Oklahoma City, but with the truck carrying a nuclear bomb instead of a few tons of explosives.

So it seems all too clear that we can not deal with the danger of nuclear terrorism by missile defense. Similarly, deterrence is not likely to be effective against a terror organization like Al Qaeda"**.**

Former **defense Secretary William Perry** "**Testimony, House Armed Services Committee Strategic Forces subcommittee**" J**uly 18, 2007**

A "socalled" tactical bomb could be put in a suitcase.

The plutonium need to make a bomb as destructive as the Hiroshima bomb is about the size of a grapefruit.

There is no interdiction system that exists or that is conceivable that would have a good probability of stopping a clever smuggler from transferring either of these.

Plutónio

- Reportedly, 270-300 kg of plutonium are transported per shipment from La Hague to Marcoule for fuel fabrication.
- 56 MOX-fueled reactors need between 400–500 kg of plutonium per year, which may be delivered in one or two shipments. **Thus shipments of a few hundred kilograms of plutonium—enough to make 30-60 Nagasaki bombs—are on the roads during an average week in France and Germany.**

International Panel on Fissile Materials, *Global fissile material report 2007.* Online at *www.fissilematerials.org*.

Rotas de plutónio na Europa

International Panel on Fissile Materials, *Global fissile material report 2007.*

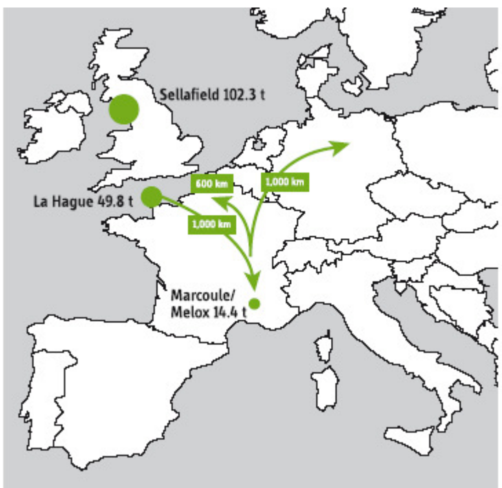


Figure 1.6. Sites and transport-routes of separated plutonium in Europe. Separated plutonium oxide is shipped regularly from the French reprocessing facilities for fuel-fabrication at Marcoule and from there to reactor sites in France, Germany, and elsewhere. Right: In October 2004, Greenpeace activists were able to intercept a truck carrying 140 kilograms of U.S. weapon-grade plutonium across France at a public gas station.[54] [Photo courtesy of Greenpeace/Clements]

Figure 3.3: Fresh MOX shipment escorted by police vans on a French country road, 27 January 2011.

Source: Yannick Rousselet – Greenpeace.

IAEA-2007

- The U.N. nuclear Illicit Trafficking Database contains 1,266 incidents that have been reported by 99 nations over the last 12 years.
- Between 2002 and 2006, the last year for which records have been compiled, reports of trafficking events increased by 385 percent

Fonte: Richard Hoskins, section head in the IAEA Nuclear Safety and Security Department.

NUCLEAR WEAPONS AND DETERRENCE IN THE 21ST CENTURY
SECRETARY ROBERT GATES,U.S. DEPARTMENT OF DEFENSE, 28.10.2008
http://carnegieendowment.org/files/1028_transcrip_gates_checked.pdf

"What worries me are the tens of thousands of old nuclear mines, nuclear artillery shells and so on, because the reality is the Russians themselves probably don't have any idea how many of those they have or, potentially, where they are"

Terrorismo

Cenários

H.R.Kelly,testimony Senate Comitee on Foreign Affairs, 6.3.2002

- Dia calmo (Vento fraco< 2km/h)
- O material é distribuido por uma explosão que causa uma mistura de particulas finas que são arrastadas pelo vento. 20% das particulas são suficientemente pequenas para serem inaladas

As pessoas na área afectada serão expostas à nuvem formada e ao material depositado

Nas áreas rurais as pessoas serão expostas a radiação dos alimentos e da água contaminada

Fontes Radioactivas para fins civis

Raios Gama:

Cobalto-60 e Cesium-137, utilizados em oncologia, tratamento produtos alimentares

Raios Alfa :

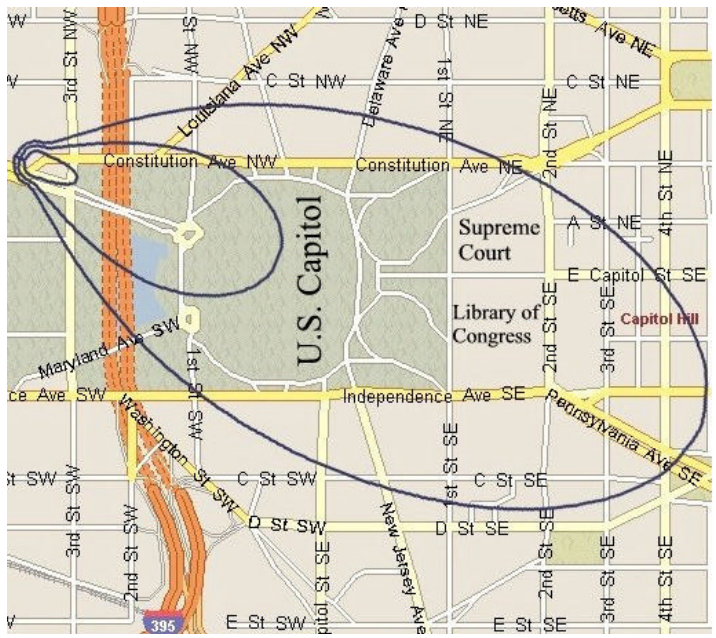
Americium, plutónio, utilizados em detectores de fumo exploração de petróleo...

Cenário 1
Cesium-emissor gama

- Um padrão radiológico perdido,contendo cesium, foi encontrado na Carolina do Norte
- Se este cesium fosse disperso por uma bomba de 5kg TNT em Washinton DC a nuvem radioactiva não obrigaria à evacuação.
- Qual a área contaminada ?

Long-term contamination due to Cesium Bomb in Washington DC

Inner Ring: One cancer death per 100 people due to remaining radiation
Middle Ring: One cancer death per 1,000 people due to remaining radiation
Outer Ring: One cancer death per 10,000 people due to remaining radiation
EPA recommends decontamination or destruction



Cenário 2
Cobalto-emissor gama

- Barra de cobalto de uma instalação de irradiação de alimentos.
- Dimensão típica 2,5 cm de diametrox33cm de comprimento, e por vezes centenas destas barras numa instalação
- Lançada em NY

Long-term Contamination Due to Cobalt Bomb in NYC – EPA Standards

Inner Ring: One cancer death per 100 people due to remaining radiation

Middle Ring: One cancer death per 1,000 people due to remaining radiation

Outer Ring: One cancer death per 10,000 people due to remaining radiation

EPA recommends decontamination or destruction

Cenário 3
Americium-emissor alfa

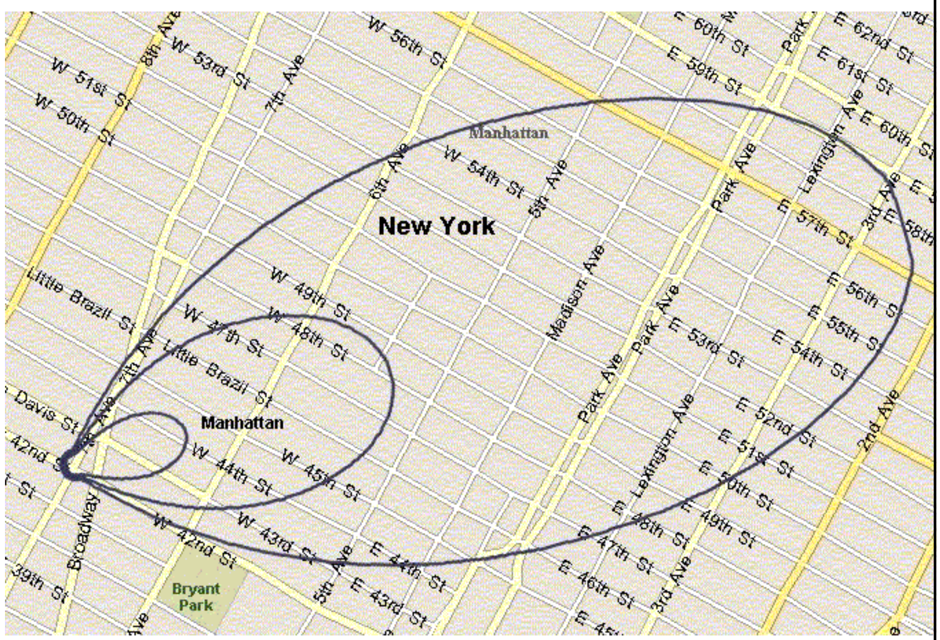
- Um tipica fonte utilizada na prospecção de petróleo
- Dispersa por uma momba com -1kg TNT
- Após a passagem da nuvem a maior parte do material deposita-se no solo e algum será posteriormente resuspenso e inalado

Immediate Effects Due to Americium Bomb in New York City

Inner Ring: All people must receive medical supervision

Middle Ring: Maximum annual dose for radiation workers exceeded

Outer Ring: Area should be evacuated before radiation cloud passes



Erro humano

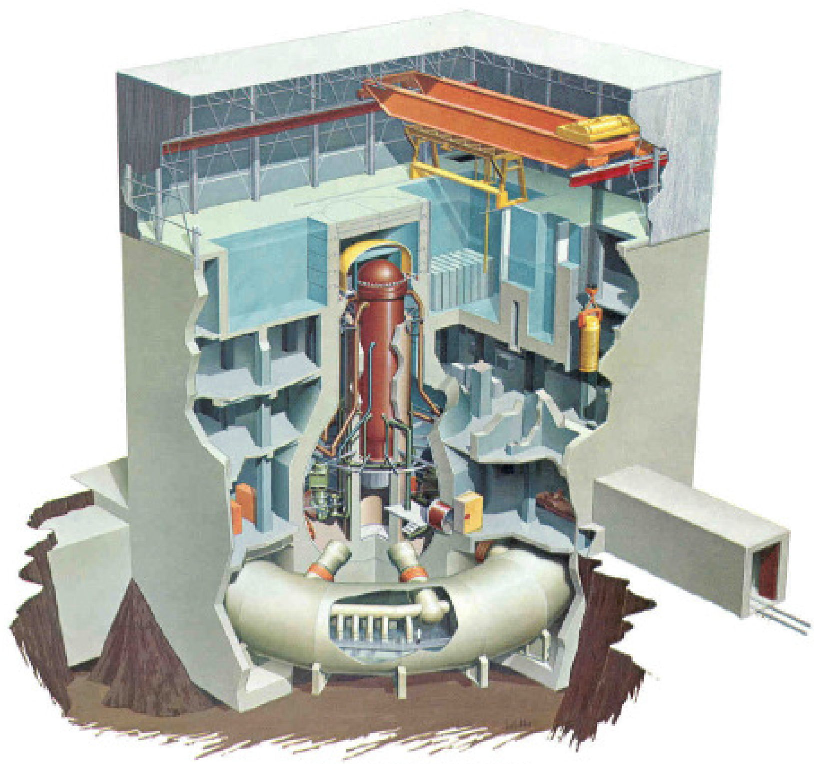
Figure 2.3. An Advanced Cruise Missile is loaded onto the wing of a B-52 at Minot Air Force Base (North Dakota). In August 2007, six nuclear-armed Advanced Cruise Missiles were inadvertently loaded onto a B-52 bomber and flown to Barksdale Air Force Base (Louisiana). The transfer remained unaccounted for at both bases and by the crew until discovered 36 hours later. *Source: Jocelyn Rich, U.S. Air Force, picture available on wikipedia.org.*

Global Fissile Material Report 2009

FUKUSHIMA

Factos relevantes pouco referidos:

- Fusão do núcleo em 3 reactores
- Situação só declarada como controlada passados 11 meses. Estabilizada só passados 30 anos, pelo menos
- Em Janeiro de 2012, 47 dos 54 reactores parados para inspecção
- Desrespeito por regras fundamentais de segurança
- **Resíduos radioactivos de 6 anos de funcionamento depositados na central**



DRYWELL TORUS

GENERAL ELECTRIC

Energia Nuclear no Mundo

As motivações subjacentes aos grandes programas de desenvolvimento da energia nuclear foram e continuam a ser militares (China, India, Pakistão Brasil, Israel, Irão ...) embora apresentadas como aspirações naturais a energia barata, segura, abundante e imprescindível para o desenvolvimento económico.

"The fireball created by a nuclear explosion will be much hotter than the surface of the sun for fractions of a second and will radiate light and heat, as do all objects of very high temperature. Because the fireball is so hot and close to the earth, it will deliver enormous amounts of heat and light to the terrain surrounding the detonation point, and it will be hundreds or thousands of times brighter than the sun at noon. If the fireball is created by the detonation of a 1-MT (megaton) nuclear weapon, for example, within roughly eight- to nine-tenths of a second each section of its surface will be radiating about three times as much heat and light as a comparable area of the sun itself. The intense flash of light and heat from the explosion of a 550-KT weapon can carbonize exposed skin and cause clothing to ignite. At a range of three miles surfaces would fulminate and recoil as they emanate flames. Particles of sand would explode like pieces of popcorn from the rapid heating of the fireball. At 3.5 miles, where the blast pressure would be 5psi, the fireball could ignite clothing on people, curtains and upholstery in homes and offices, and rubber tires on cars. At four miles, it could blister aluminum surfaces, and at six to seven miles it could still set fire to dry leaves and grass. This flash of incredibly intense, nuclear-driven sunlight could simultaneously set an uncountable number of fires over an area of close to 100 square miles"

Director of Central Intelligence Stansfield Turner in
Oral and Written Testimonies Submitted to a Hearing of The United States House of Representatives, Committee on Government Reform Subcommittee on National Security, Emerging Threats, and International Relations , September 26, 2006