Comitato per una Civiltà dell'Amore

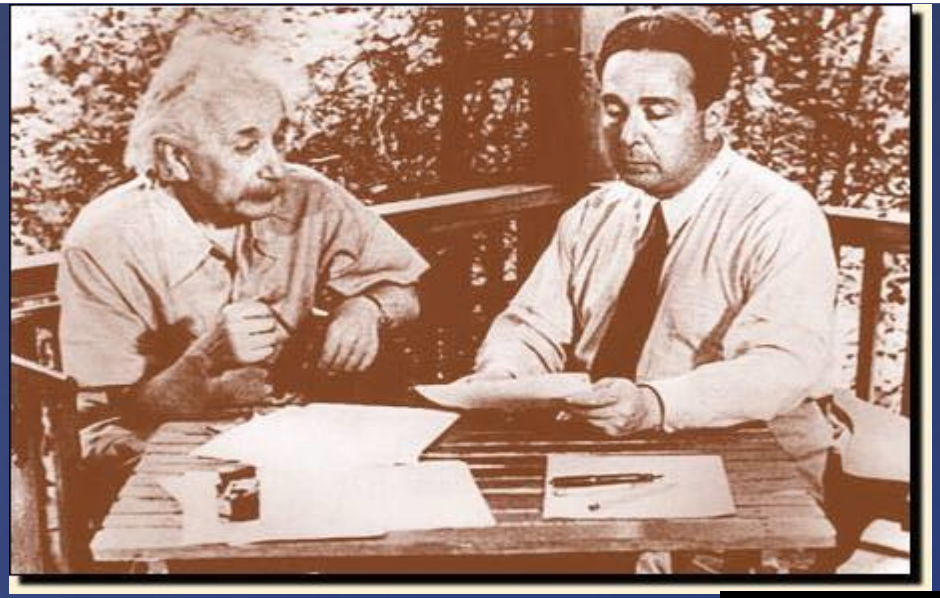
Non proliferazione nucleare

Seminario
PROGETTO DI PACIFICAZIONE DELL'AREA COREANA
Assisi 28 ottobre 2017
SACRO CONVENTO DI SAN FRANCESCO

Ing. Massimo Sepielli
Piattaforma Tecnologica Europea SNETP - Governing Board

Definizione
Introduzione storica
Materiali nucleari
Ciclo combustibile
Processi proliferanti
Arricchimento dell'Uranio
Reattori plutoniferi
Riprocessamento
Separazione (proliferante e non)
Trattato di non proliferazione nucleare (NPT)
Ruolo dell'Agenzia atomica
Salvaguardie e Sicurezza
Approccio del Giappone alla non proliferazione nucleare
Approccio Nord Coreano alla proliferazione nucleare
Evoluzione non proliferazione nelle recenti fasi storiche
Considerazioni finali (foto + frase + Sepielli)

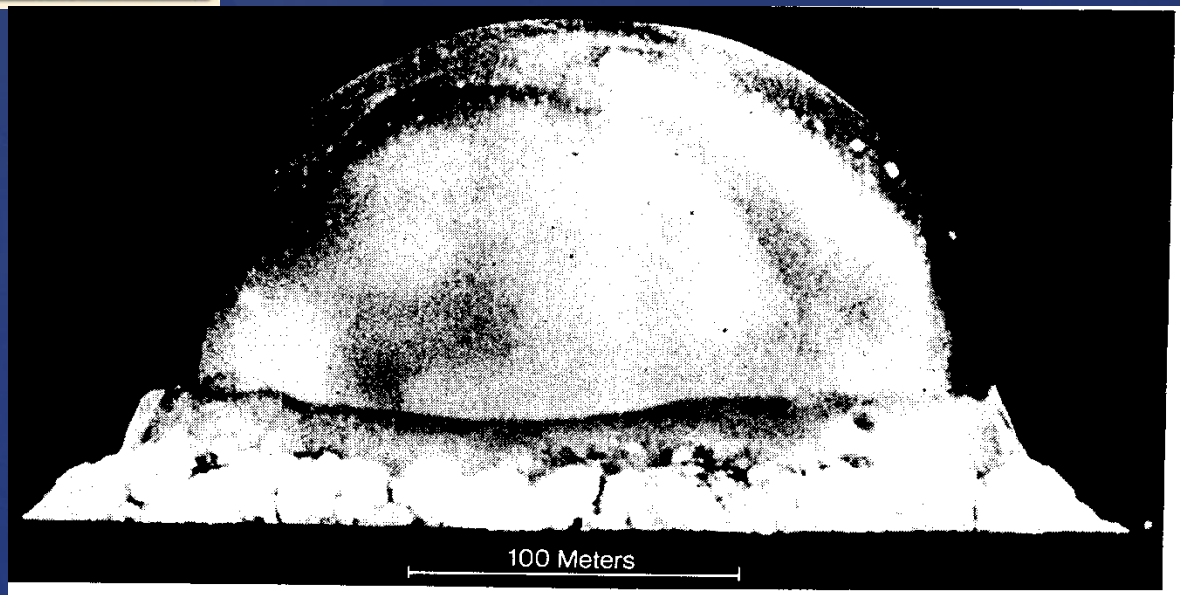
L'alba



1938: Scoperta della fissione dell'Uranio in Europa

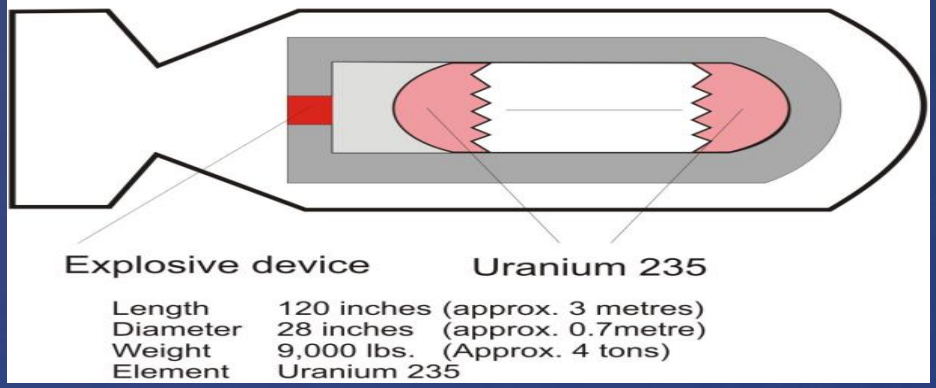
Luglio 1945:

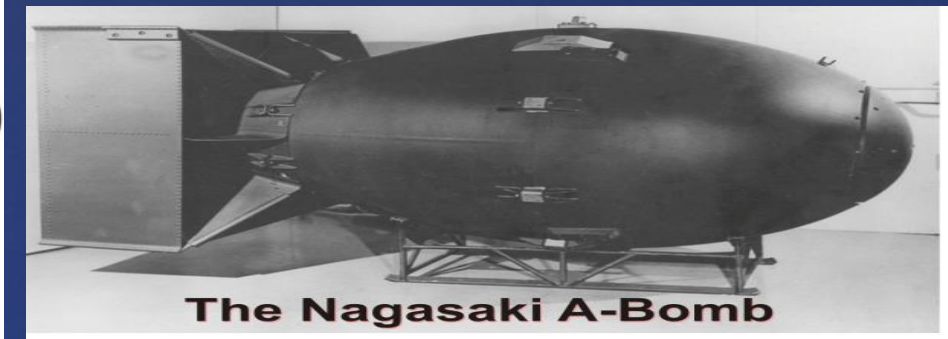
Trinity Test



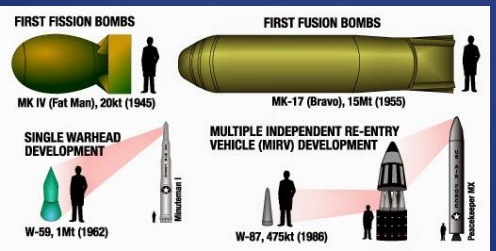
La bomba atomica

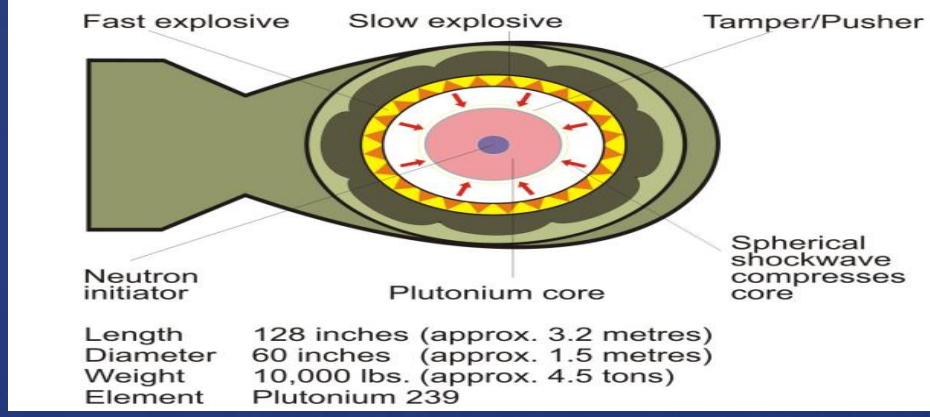
← 6 Agosto '45: "Little Boy"





9 Ago. 1945: "Fat Man" →



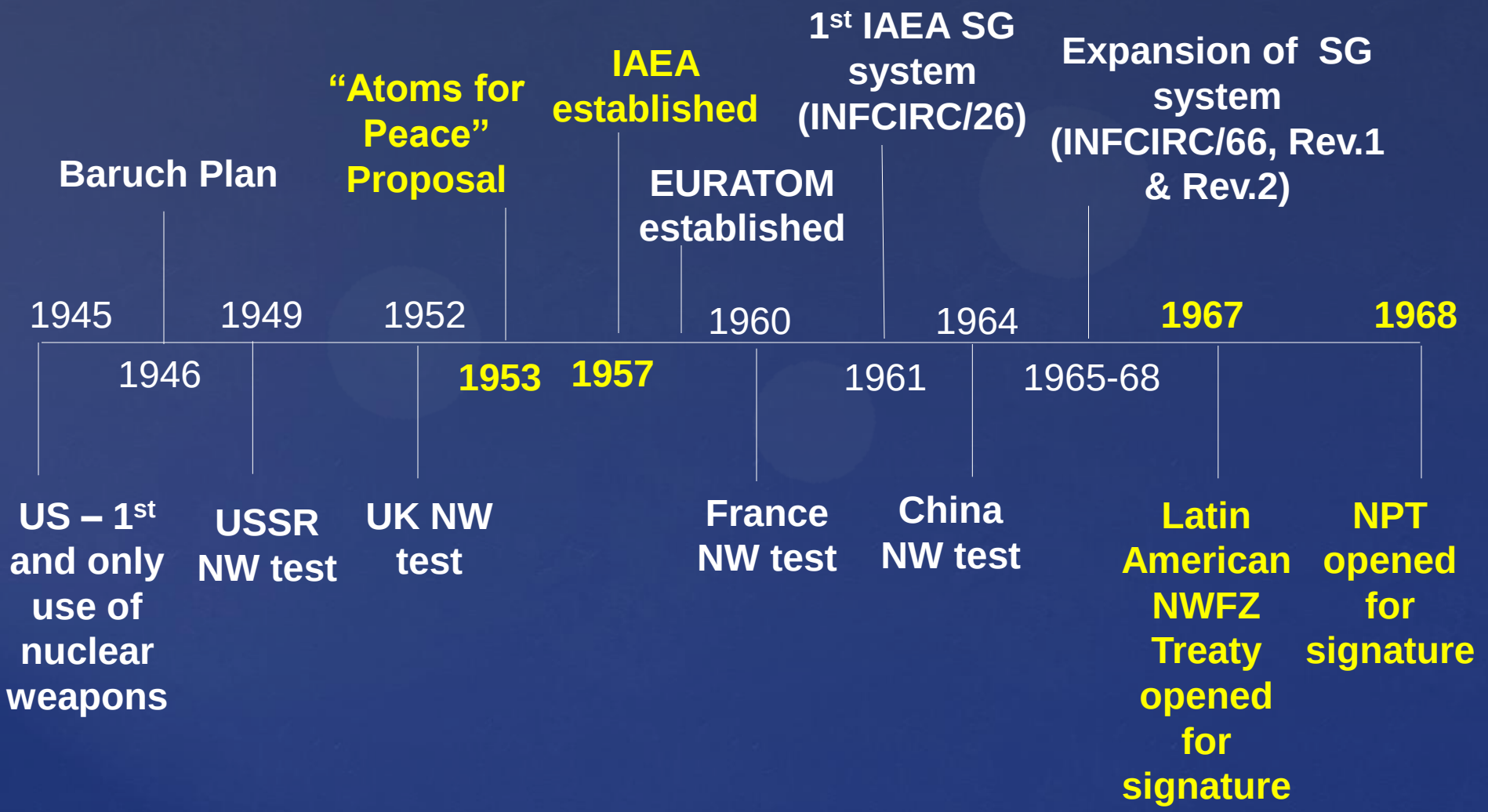


Le conseguenze

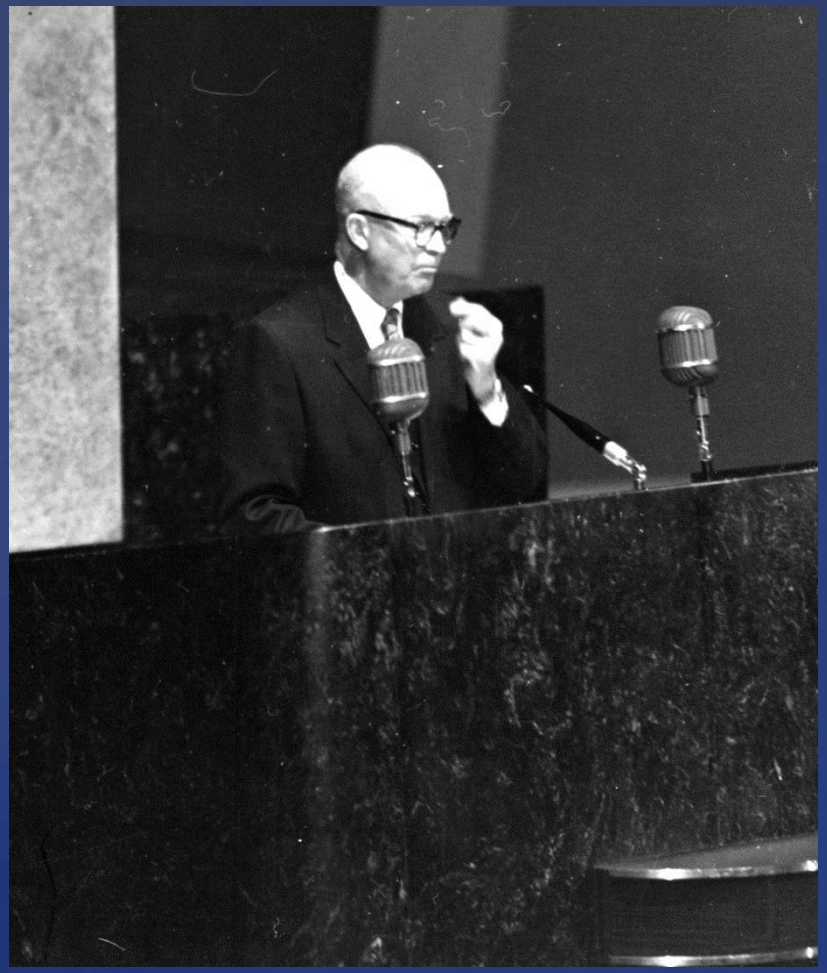
原爆投下直後のドーム／米国陸軍病理学研究所の返還資料・(財)広島市平和文化センター提供
Dome immediately after the A-bombing in 1945

Cronologia di eventi

Creazione dell'IAEA e del Sistema di Salvaguardie



Atomi per la Pace – 1953



"It is not enough to take this weapon out of the hands of the soldiers.

"It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace."

La IAEA

- Creata per Statuto nel 1957
- Autonoma organizzazione intergovernativa
- Unica relatione con il UN Security Council
- Non è una UN organizzazione
- 168 Member States
- Authorità che implementa le Safeguards

Il NPT

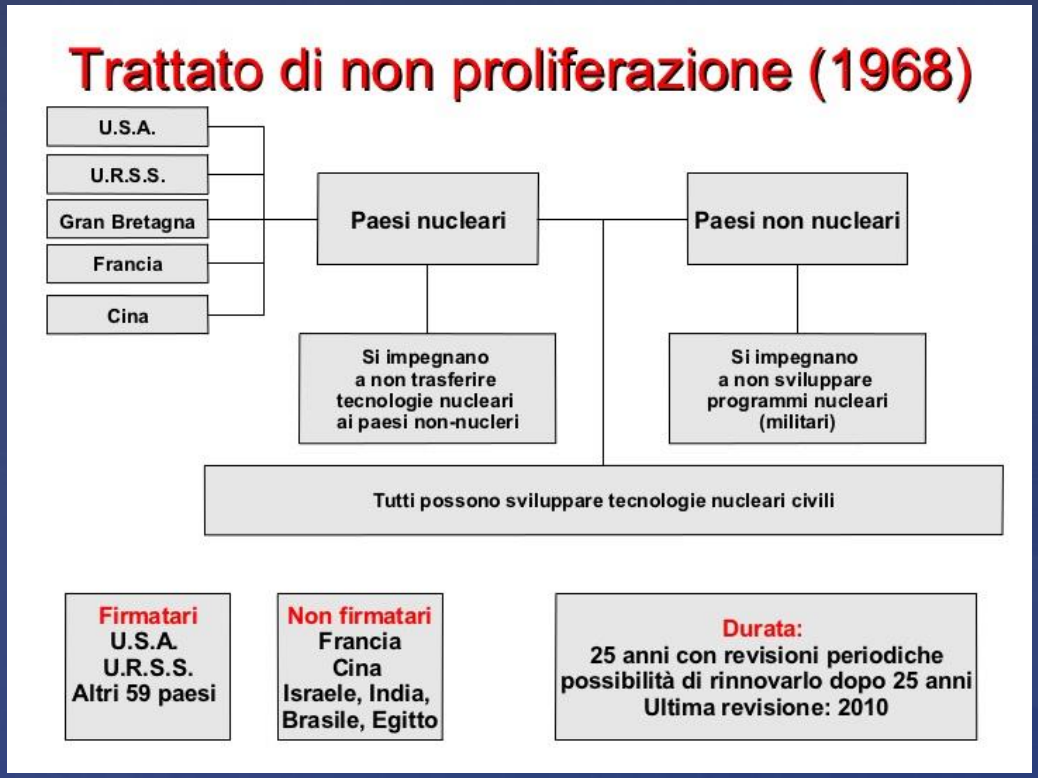
- Eighteen-Nation Disarmament Committee, Geneva 1965-1968
- Opened for signature 1968
- Entered into force 5 March 1970

Non proliferazione nucleare

Non proliferazione nucleare, come da Trattato di (TNP) Trattato approvato dall'Assemblea generale dell'ONU il 1° luglio 1968 ed entrato in vigore il 5 marzo 1970, prevede che:

- gli Stati in possesso di armamenti nucleari si impegnino a non cedere a terzi materiale fissile e tecnologia nucleare. Gli Stati non-nucleari, viceversa, sono tenuti a non mettere a punto armi di distruzione di massa o a non procurarsene.
- il trasferimento di materiale e tecnologie nucleari utilizzabili per scopi pacifici deve avvenire sotto lo stretto controllo dell'Agenzia internazionale per l'energia atomica

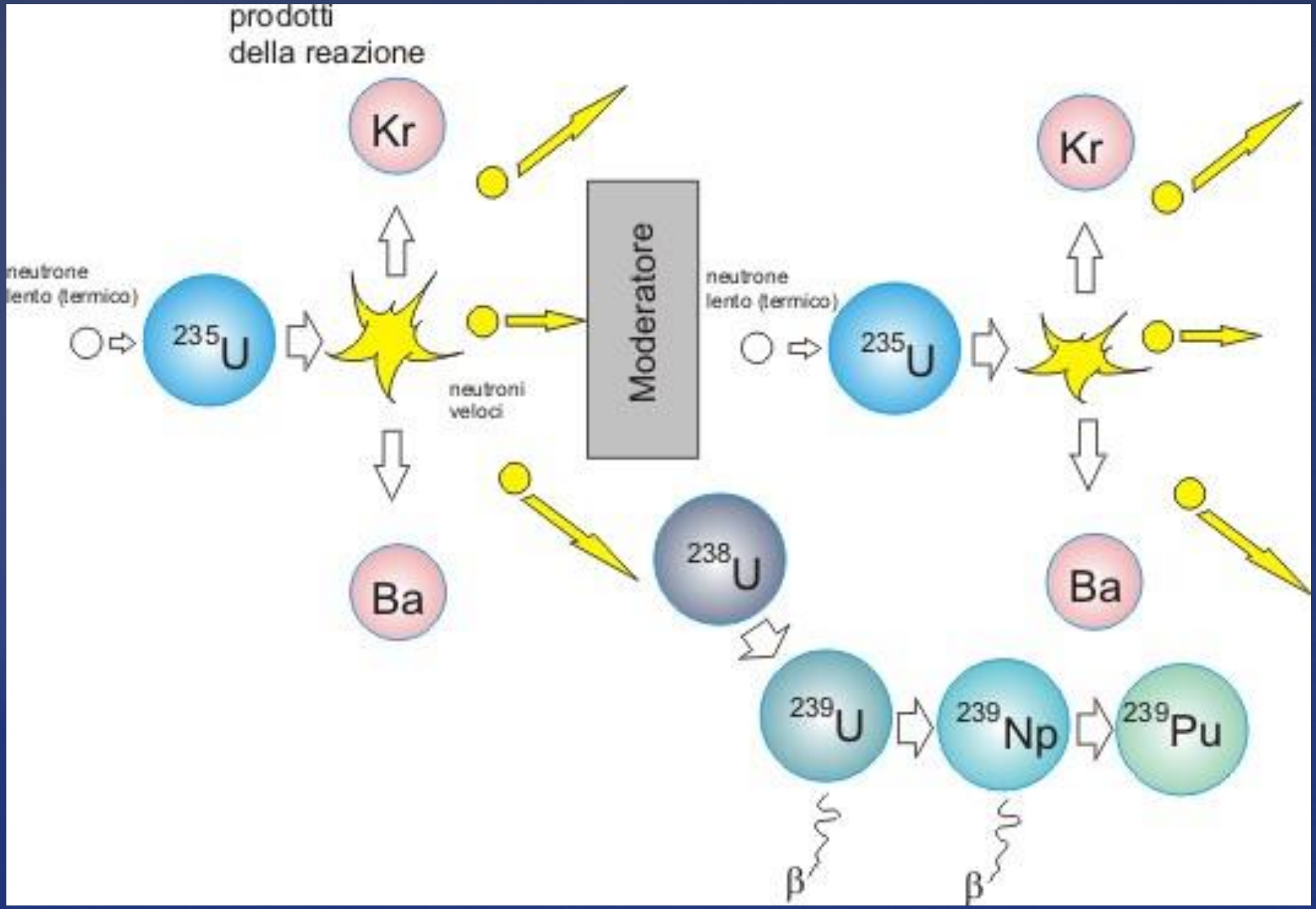
Ratifica del trattato



Campo d'applicazione del trattato il 1° ottobre 1991

Stati partecipanti	Ratificazione Adesione (A) Successione (S)		Entrata in vigore	
Afghanistan	4 febbraio	1970	5 marzo	1970
Africa del Sud	10 luglio	1991 A	10 luglio	1991
Albania	12 settembre	1990 A	12 settembre	1990
Antigua e Barbuda	17 giugno	1985 S	1° novembre	1981
Arabia Saudita	3 ottobre	1988 A	3 ottobre	1988
Australia	23 gennaio	1973	23 gennaio	1973
Austria	27 giugno	1969	5 marzo	1970
Bahama	11 agosto	1976 S	10 luglio	1973
Bahrein	3 novembre	1988 A	3 novembre	1988
Bangladesh	31 agosto	1979 A	31 agosto	1979
Barbados	21 febbraio	1980	21 febbraio	1980
Belgio	2 maggio	1975	2 maggio	1975
Belize	9 agosto	1985 S	21 settembre	1981
Benin	31 ottobre	1972	31 ottobre	1972
Bolivia	26 maggio	1970	26 maggio	1970
Botswana	28 aprile	1969	5 marzo	1970
Brunéi	26 marzo	1985 A	26 marzo	1985
Bulgaria	5 settembre	1969	5 marzo	1970
Burkina Faso	3 marzo	1970	5 marzo	1970
Burundi	19 marzo	1971 A	19 marzo	1971
Butan	23 maggio	1985 A	23 maggio	1985
Cambogia	2 giugno	1972 A	2 giugno	1972
Camerun	8 gennaio	1969	5 marzo	1970
Canada	8 gennaio	1969	5 marzo	1970
Capo-Verde	24 ottobre	1979 A	24 ottobre	1979
Cecoslovacchia	22 luglio	1969	5 marzo	1970
Ciad	10 marzo	1971	10 marzo	1971
Cina (Taiwan)	27 gennaio	1970	5 marzo	1970
Cipro	10 febbraio	1970	5 marzo	1970
Città del Vaticano	25 febbraio	1971 A	25 febbraio	1971
Colombia	8 aprile	1986	8 aprile	1986
Congo	23 ottobre	1978 A	24 ottobre	1978
Corea (Nord)	12 dicembre	1985 A	12 dicembre	1985
Corea (Sud)*	23 aprile	1975	23 aprile	1975
Côte d'Ivoire	6 marzo	1973	6 marzo	1973
Costarica	3 marzo	1970	5 marzo	1970
Danimarca	3 gennaio	1969	5 marzo	1970
Dominica	10 agosto	1984 S	3 novembre	1978
Ecuador	7 marzo	1969	5 marzo	1970
Egitto*	26 febbraio	1981	26 febbraio	1981
Etiopia	5 febbraio	1970	5 marzo	1970

Fissione e Materiale nucleare



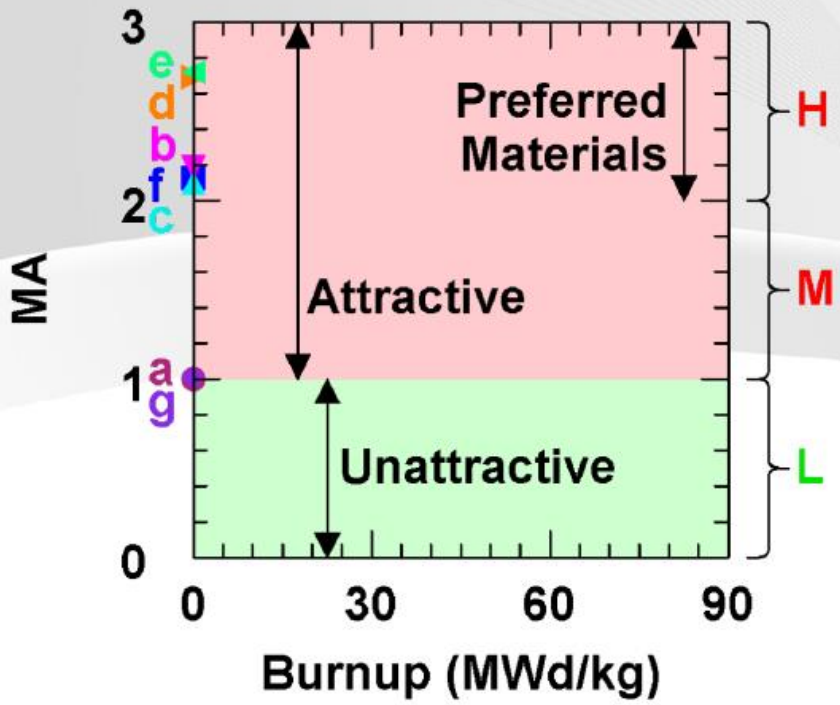
Fissione e Materiale nucleare

Nuclear material is necessary for the production of nuclear weapons or other nuclear explosive devices. Under comprehensive safeguards agreements, the IAEA verifies that all nuclear material subject to safeguards has been declared and placed under safeguards.
Certain non-nuclear materials are essential for the use or production of nuclear material and may also be subject to IAEA safeguards under certain agreements:

- ✓ Plutonium except that with isotopic concentration exceeding 80% in plutonium-238;
- ✓ Uranium- 233;
- ✓ Uranium enriched in the isotope 235 or 233;
- ✓ Uranium containing the mixture of isotopes as occurring in nature other than in the form of ore or ore residue;
- ✓ any material containing one or more of the foregoing

The Statute of the IAEA [39] uses the term special fissionable material, with the meaning essentially of nuclear material as defined here, but explicitly excluding source material. For the purposes of IAEA safeguards agreements, nuclear material is defined as “any source material or special fissionable material as defined in Article XX of the Statute

Attrattività del materiale nucleare



a – LEU (20% ^{235}U)

b – HEU (93% ^{235}U)

c – ^{237}Np

d – ^{233}U (10 ppm ^{232}U)

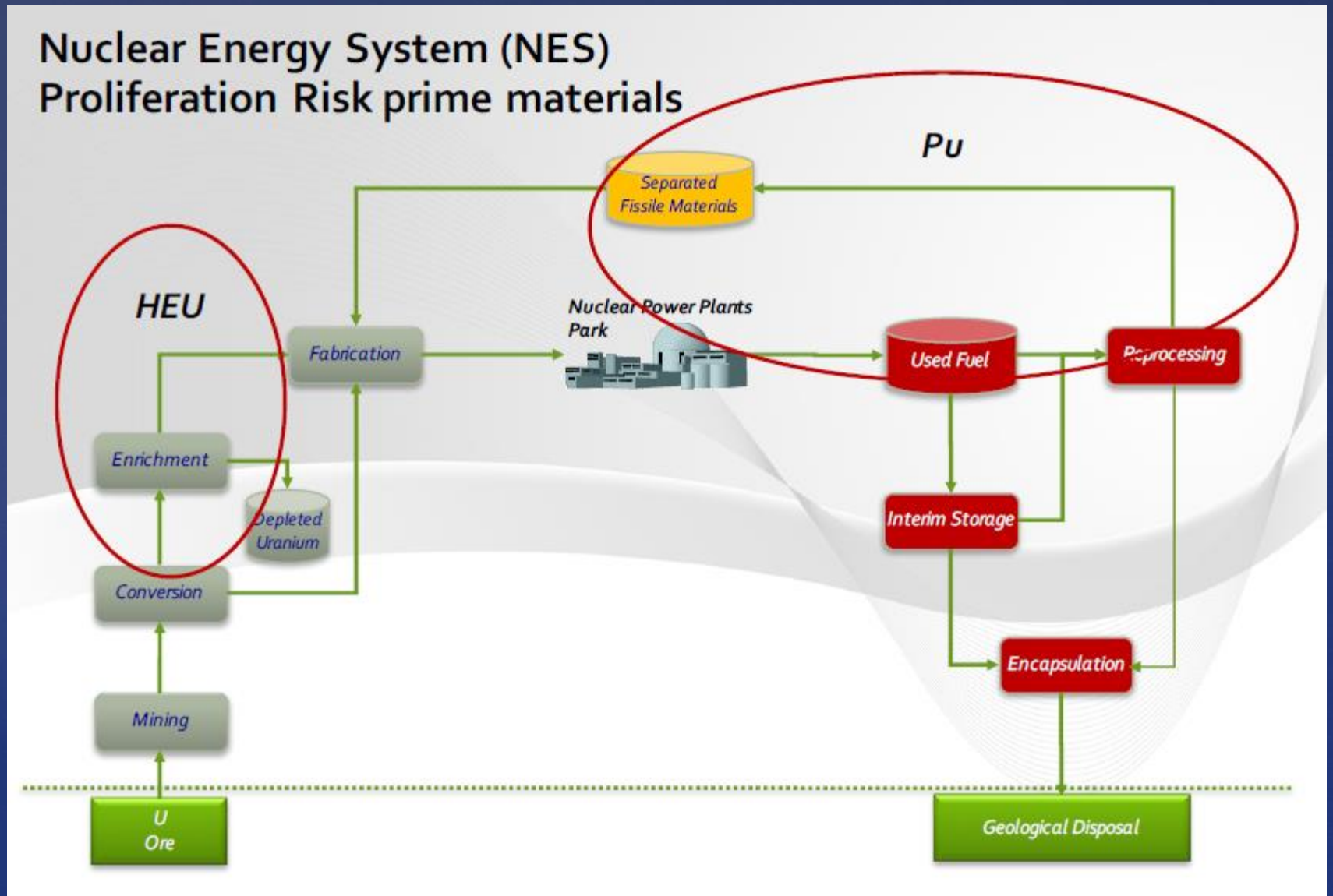
e – WG-Pu (94% ^{239}Pu)

f – RG-Pu

g– $^{238}Pu/^{239}Pu$ (80:20)

Ref: Chuck Bathke

Ciclo combustibile e processi proliferanti



Conversione U naturale per l' arricchimento

Conversion: an important step required towards enrichment of UF_6

Ore Concentrate
(yellow cake)

Pure U.N.

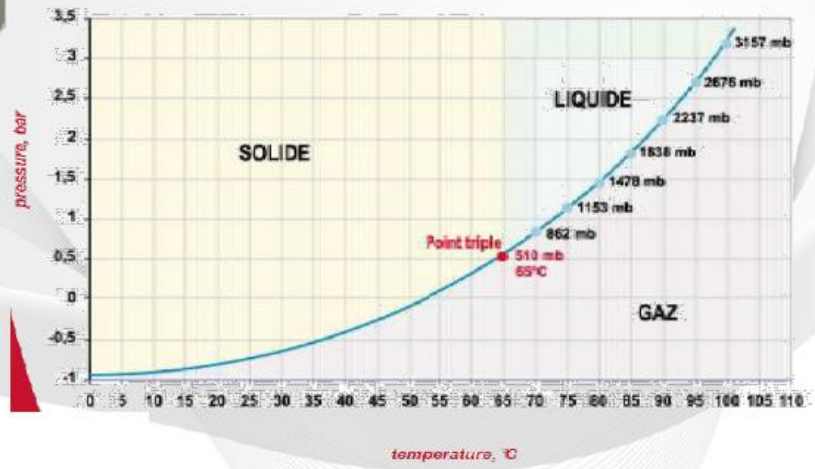
UO_3

UO_2

Pure UF_4

Pure UF_6

COMURHEX Malvési plant



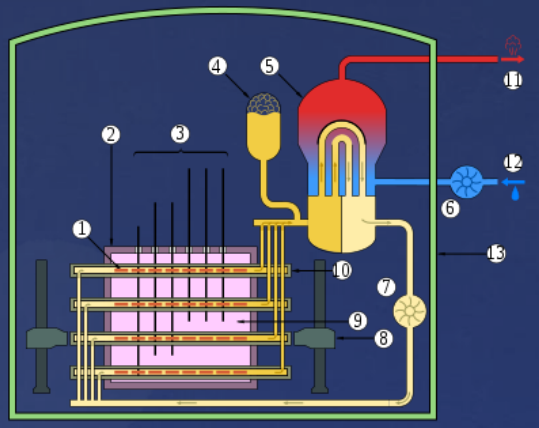
COMURHEX Pierrelatte plant

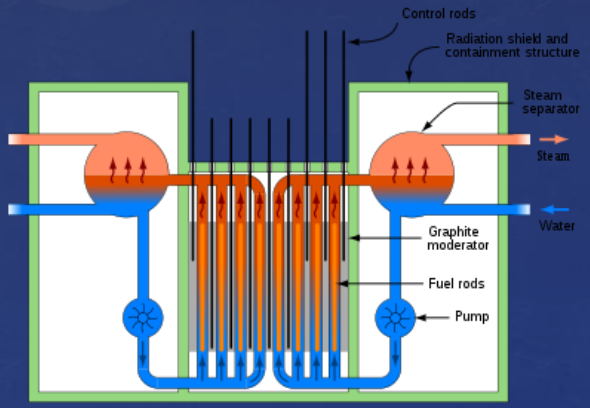
L'arricchimento dell'uranio

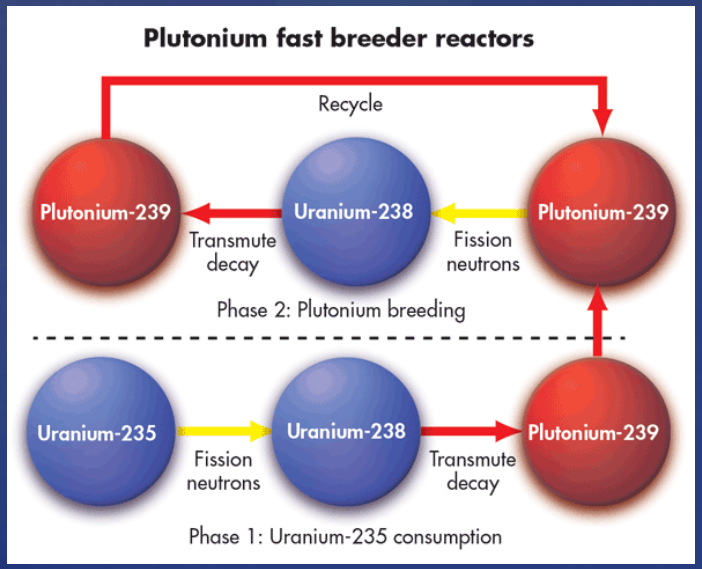
- TC12 centrifuges have been in operation since the early 1990's
- Well known economics optimized for size/output, manufacturing cost, and operational reliability
- Technology licensed in the Netherlands, the UK, Germany, France and the United States
- Easily scalable manufacturing continues to reduce unit cost
- Larger TC21 model has not achieved the same level of economics and history of performance as the TC12

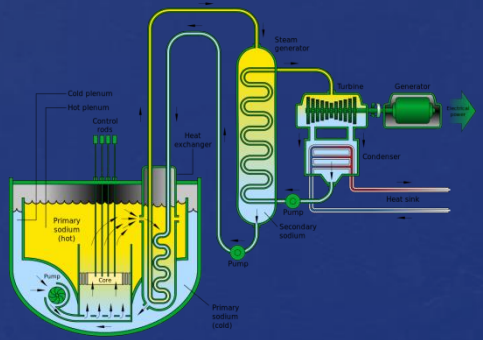
Reattori plutoniferi

- ✓ BWR e PWR
- ✓ CANDU (Acqua pesante e Uranio naturale)
- ✓ RBMK (acqua – grafite)
- ✓ Reattori veloci (fast breeder reactors)
- ✓ Ciclo U-Th (U-233) ???









Riprocessamento e separazione

95% of Used Nuclear Fuel is Recyclable

Typical composition of a Light Water Reactor Fuel

Before irradiation: ~ 500 kg of Uranium (PWR)

After irradiation:

U 475 to 480 kg (~95%)

Pu 5 kg (1%)

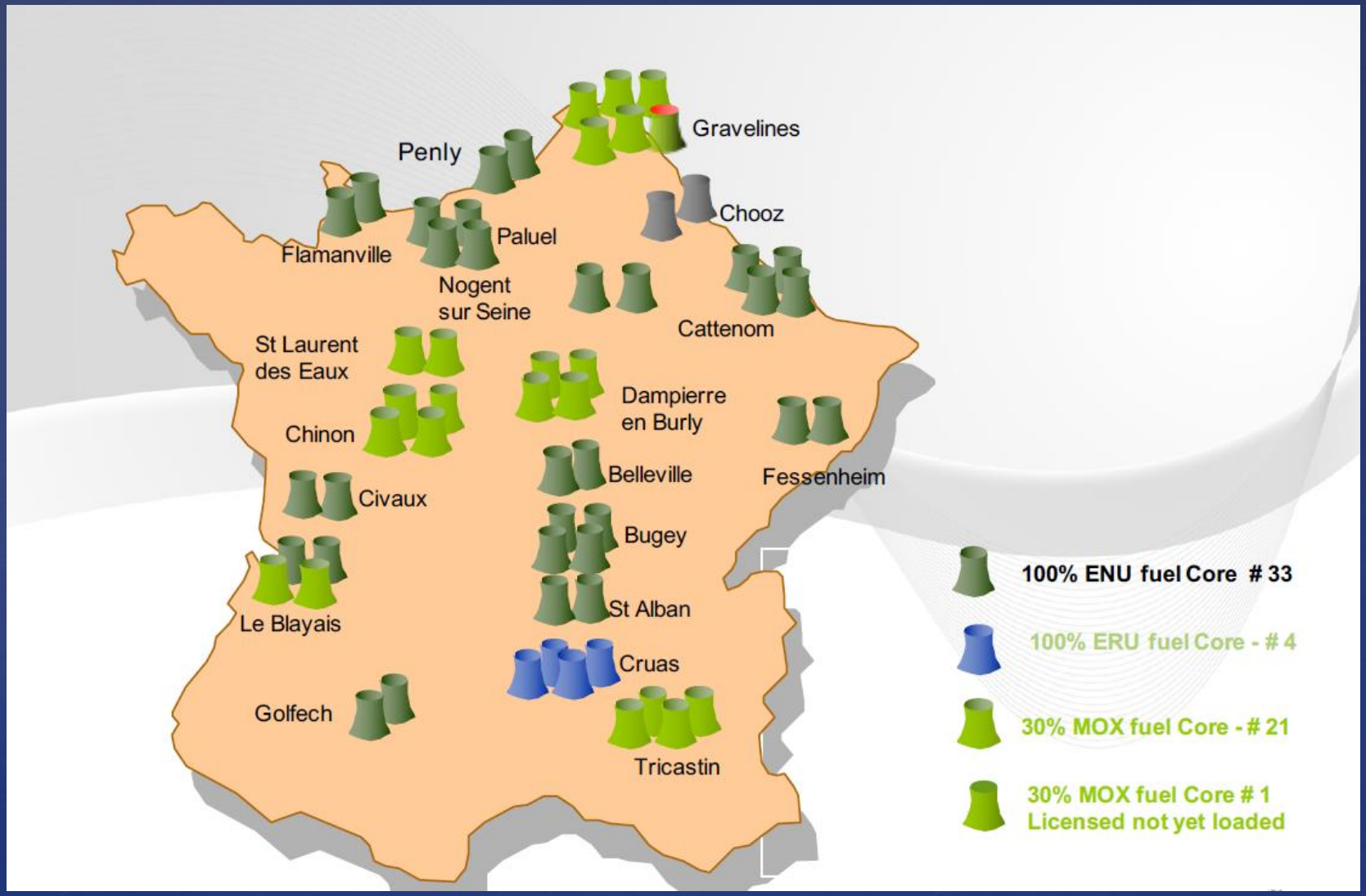
MA 0,5 kg (0,1%) (Partitioning & Transmutation)

Fission & Activation Products 15 to 20 kg (~4-5 %)

RECYCLABLE

ULTIMATE 'WASTE'

Impianti di riprocessamento

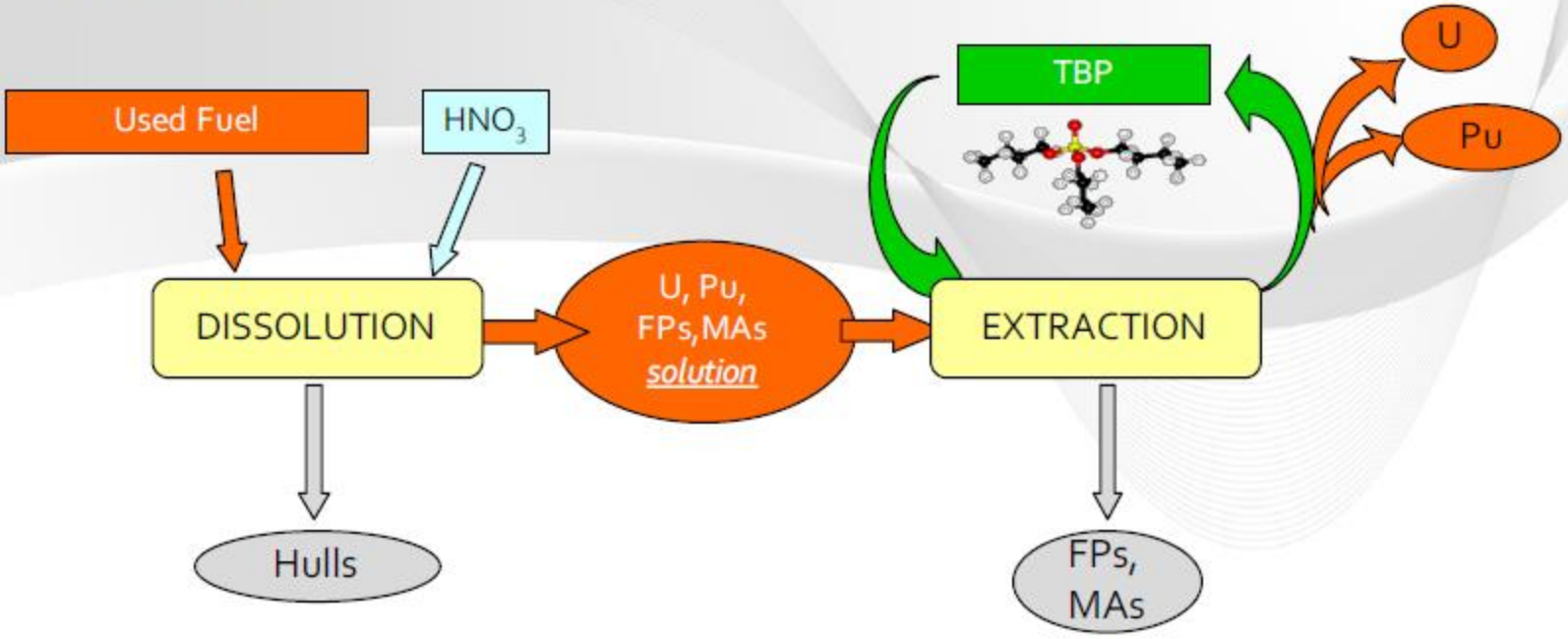


Separazione proliferante

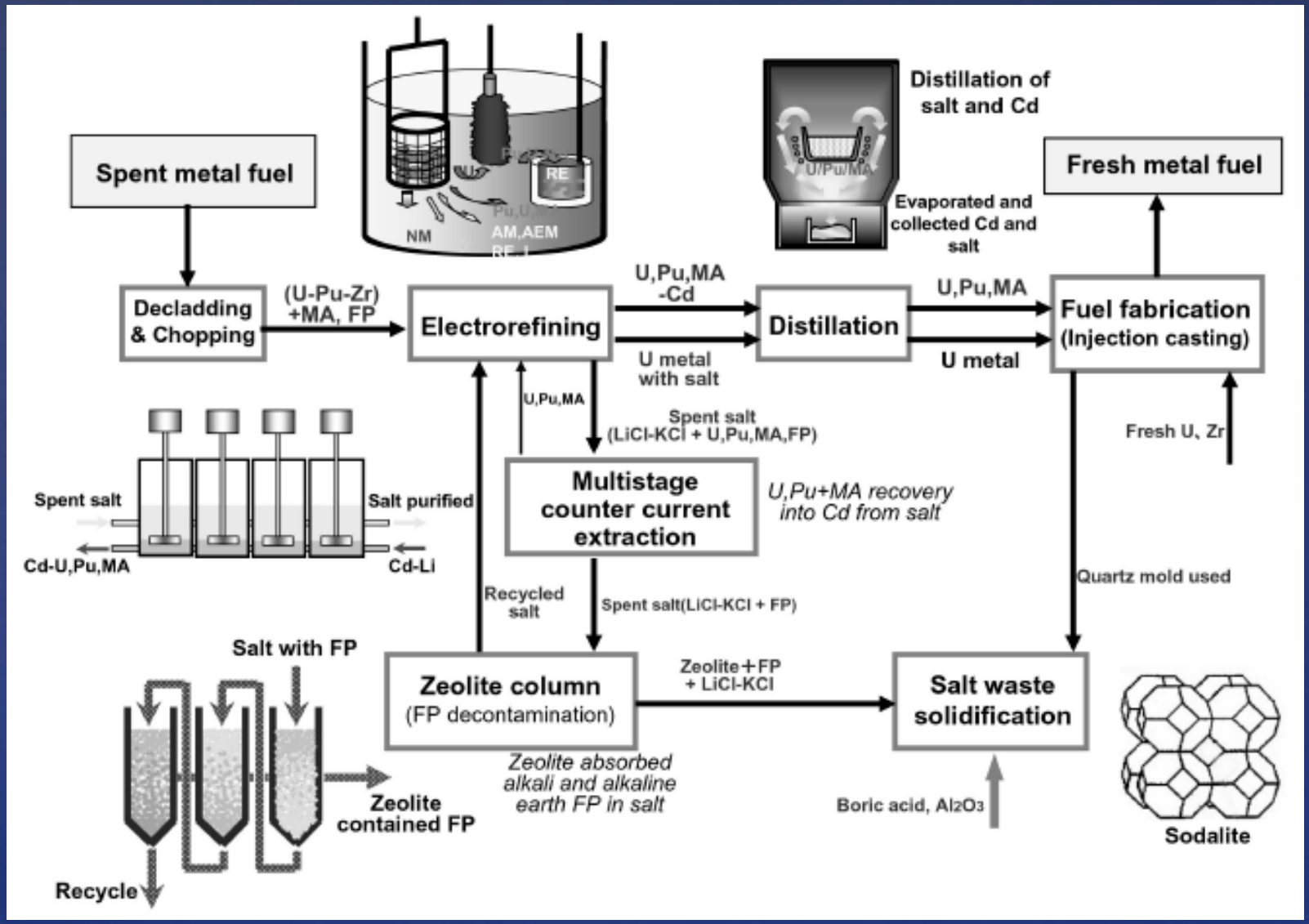
PUREX process

(Plutonium Uranium Refining by EXtraction)

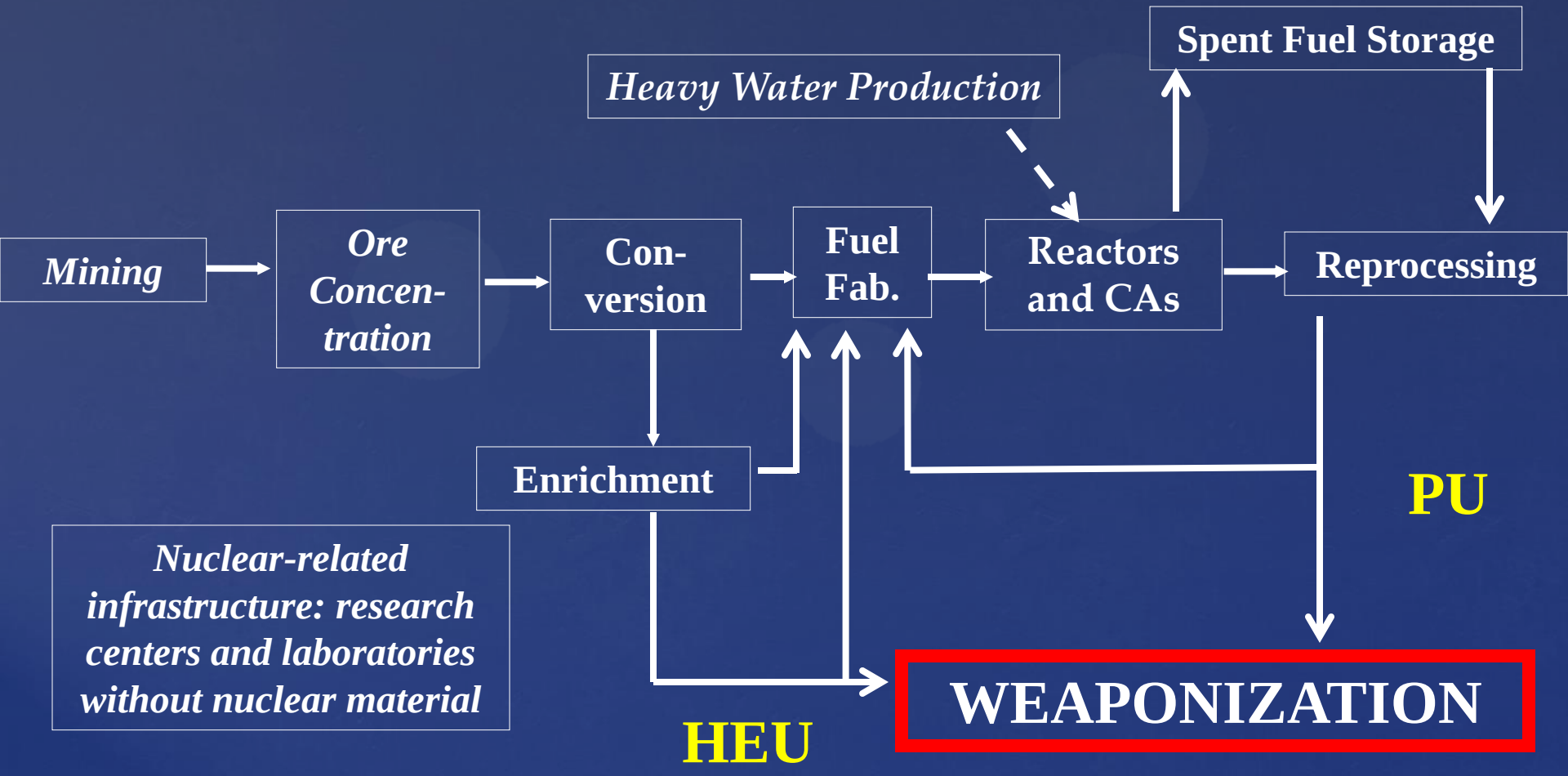
- The principle of spent fuel recycling generally adopted throughout the world is based on the separation of the different components by liquid/liquid extraction in tributyl phosphate (TBP) diluted in an alkane, after the fuel has been dissolved in nitric acid.



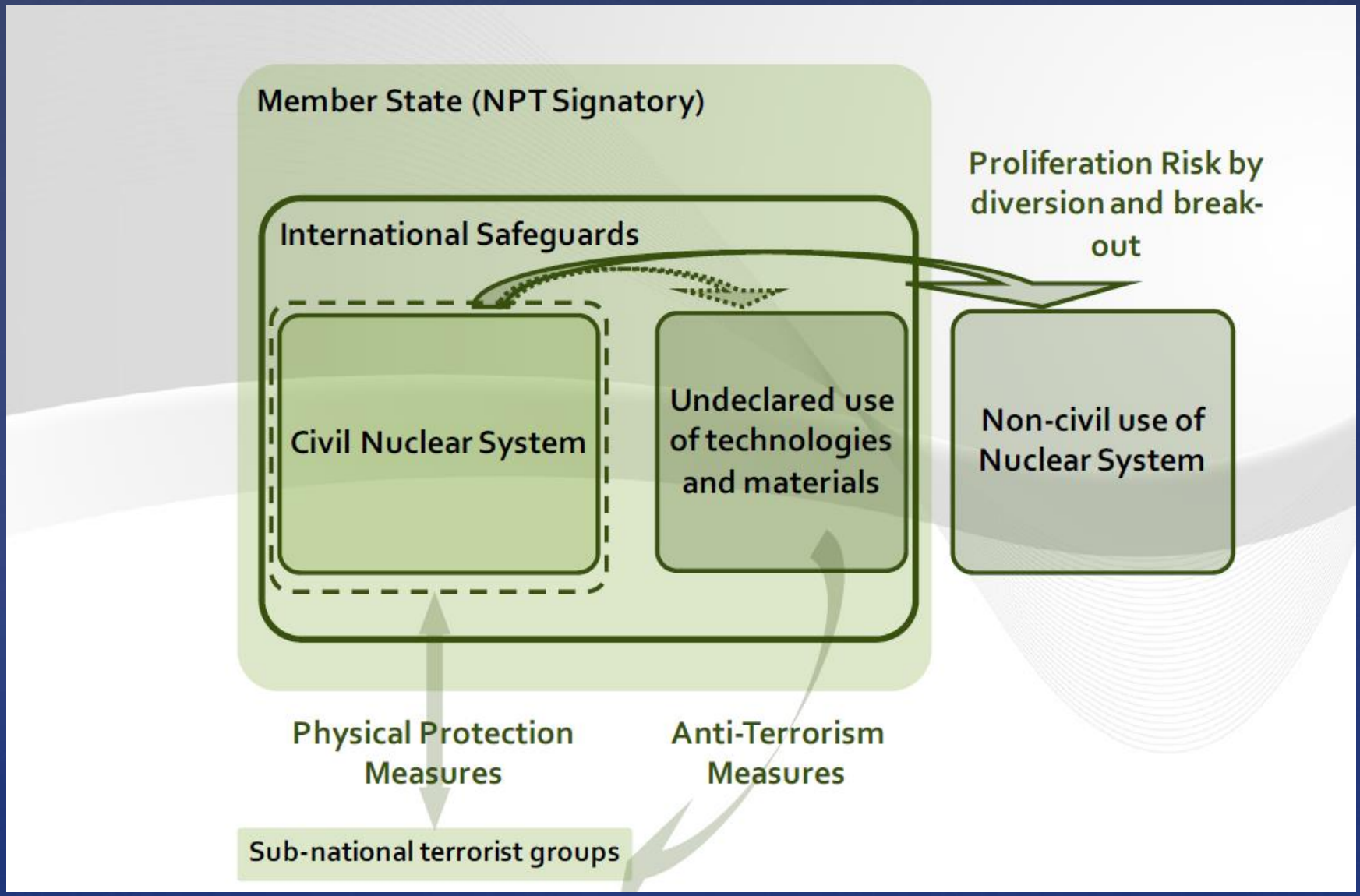
Separazione non proliferante



Cammino critico verso i Materiali d'Armamento

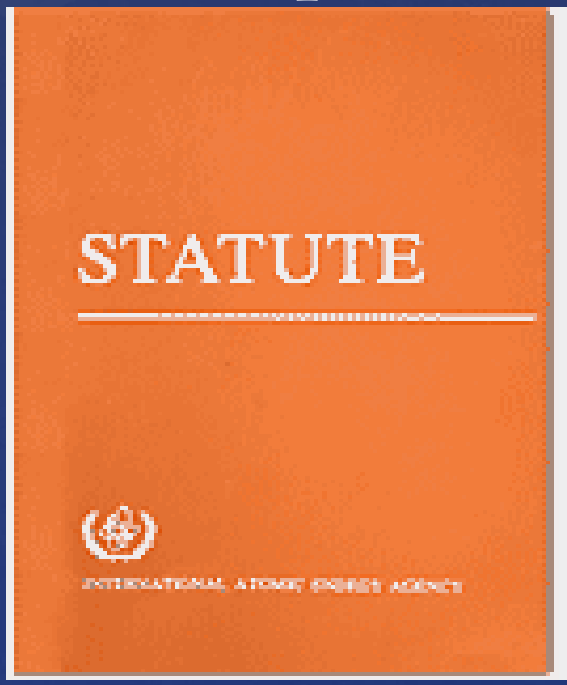


Rischio di proliferazione e salvaguardie



Lo Statuto IAEA

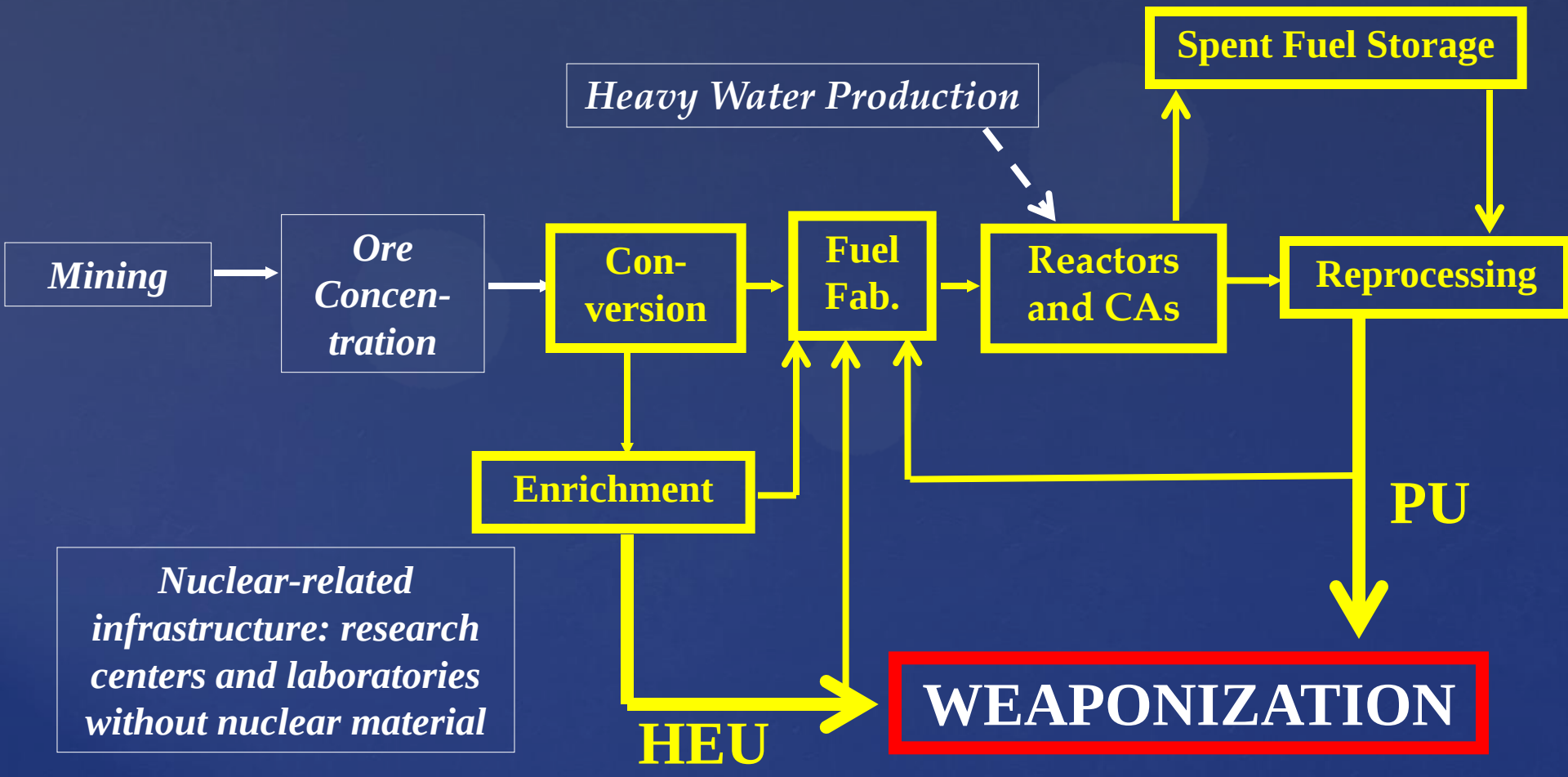
- Article III.A.5
  - Assistenza da parte dell'Agenzia
  - To bilateral or multilateral arrangements
    - *e.g. NPT; Nuclear Weapon Free Zone Treaties*
  - To any nuclear activities of a State, at its request
- Article XII
  - Misure di Salvaguardia
    - On site inspection
    - *Any time, any place access*
    - Reports and record keeping
    - Non-compliance
- Article XX
  - Definizione di materiale nucleare
    - Special fissionable material: Pu, U (enriched)
    - Source material: U (natural), Th



Le Salvaguardie della IAEA

- **Membership in IAEA does *not require* acceptance of safeguards**
- **IAEA safeguards possible in non-Members (and in non-States)**
  - **DPRK**
  - **Taiwan, China**
- **Requires consent of State**
  - **Voluntary undertaking**
  - **Security Council Chapter VII**
  - **Safeguards Agreement**

Interventi delle Salvaguardie



La diversione

Obiettivi delle Salvaguardie (SG):

- Tempestiva **rivelazione della diversione** di quantità significative of materiale nucleare per la "fabbricazione of armamenti nucleari o di altri dispositivi esplosivi o altri scopi "
- **Deterrenza della diversione attraverso il rischio di rivelazione precoce**

Diversione:

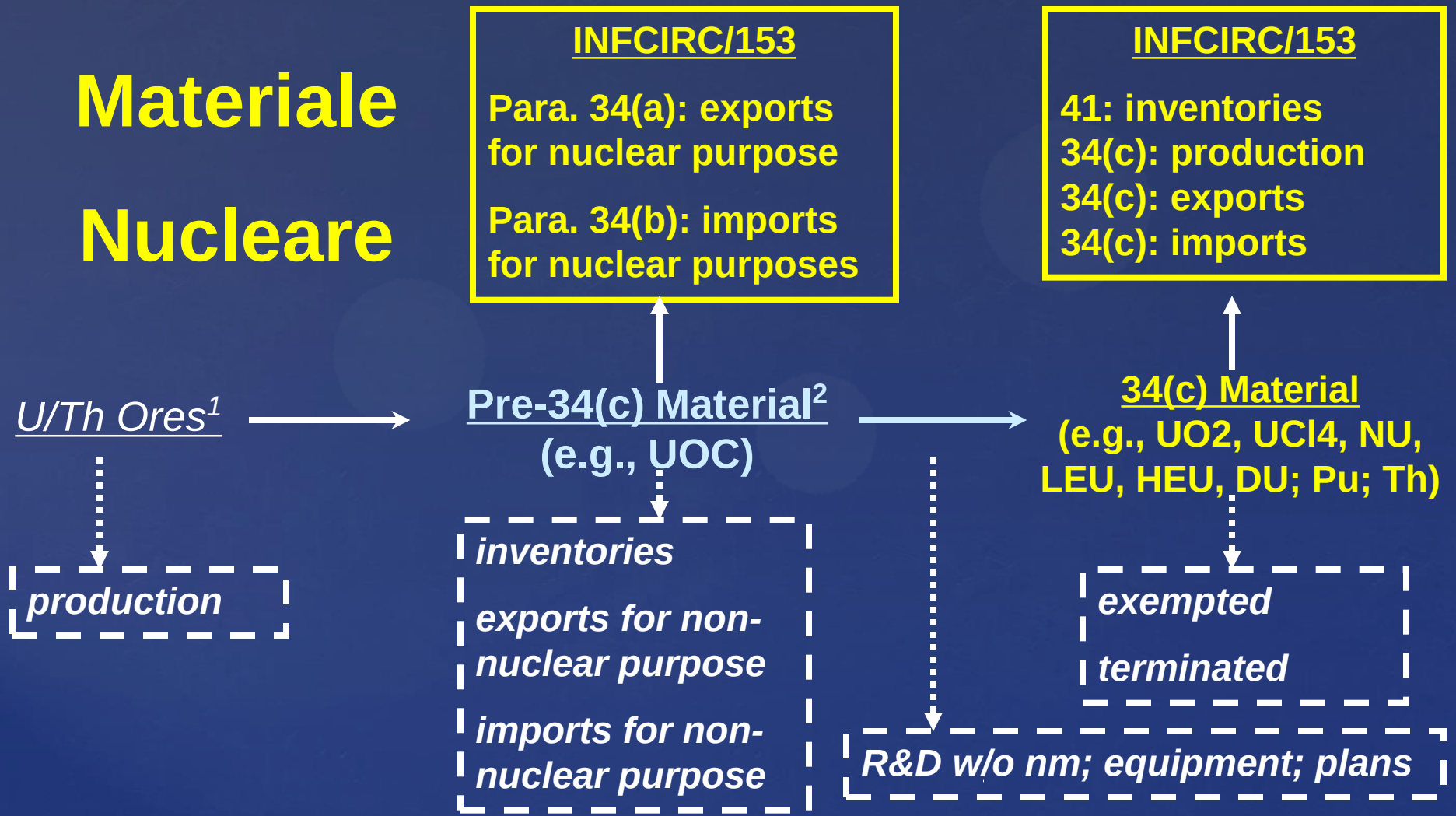
- Uso di materiale nucleare *dichiarato* o facilities per scopi proscritti
- Uso di materiale nucleare *non dichiarato* per scopi proscritti

Ruolo EURATOM per le salvaguardie

Euratom safeguards in numbers

2	nuclear weapons member states
25	non-nuclear weapons member states
200	Staff-mostly Inspectors
1000	MBAs
1500	inspections per year
2000000	lines of a/c data per year

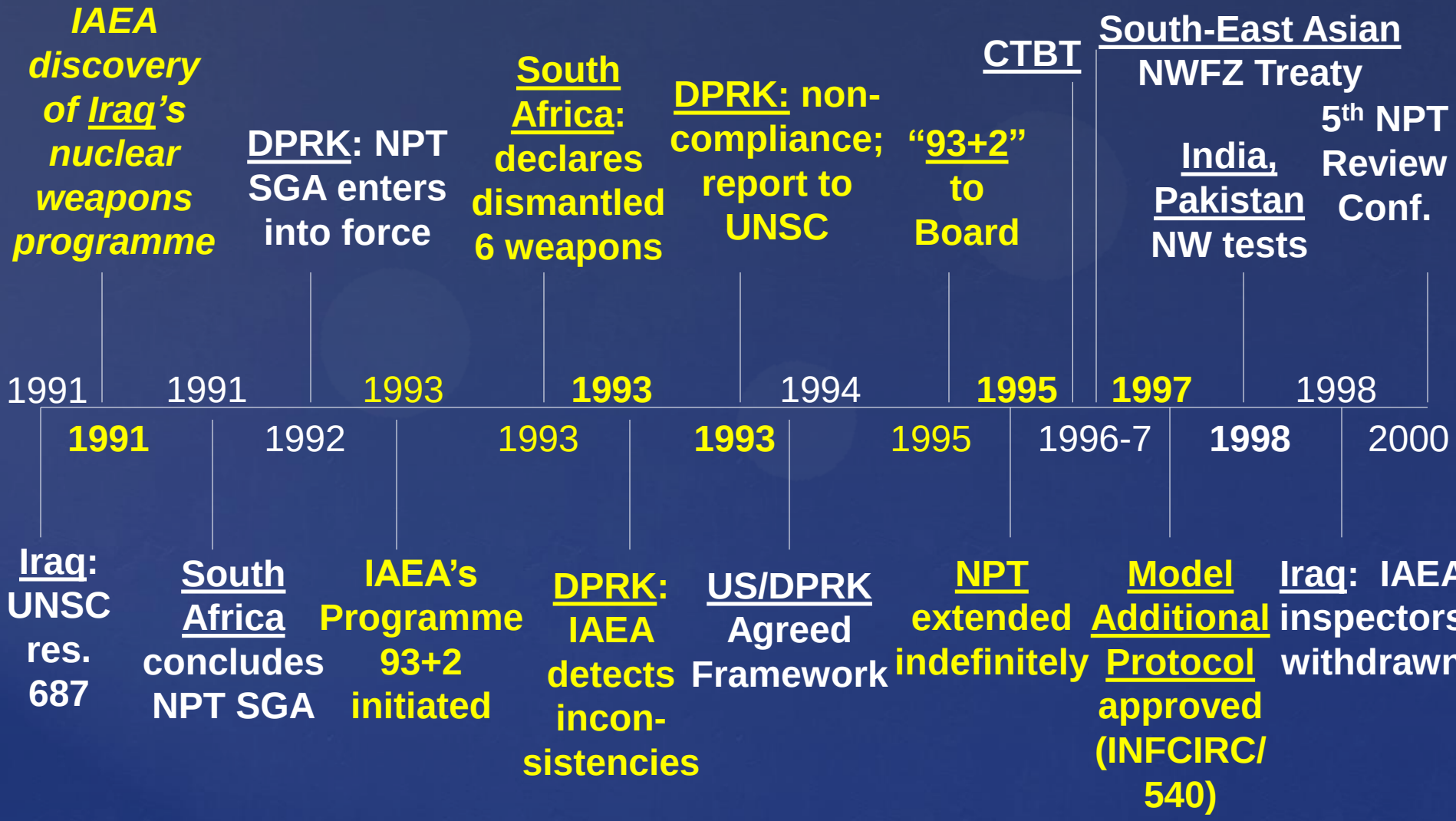
INFCIRC/153: Informazione & Accesso*



[1] No information or access [2] Some information *Routine/Ad hoc

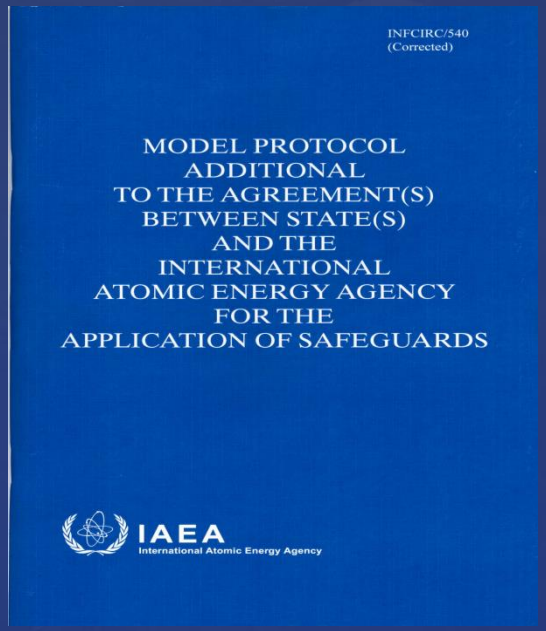
Anni Novanta:

Rafforzamento delle Salvaguardie



Protocollo Aggiuntivo

Model Protocol Additional
to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards
INFCIRC/540 (Corr.)



Controllo delle esportazioni

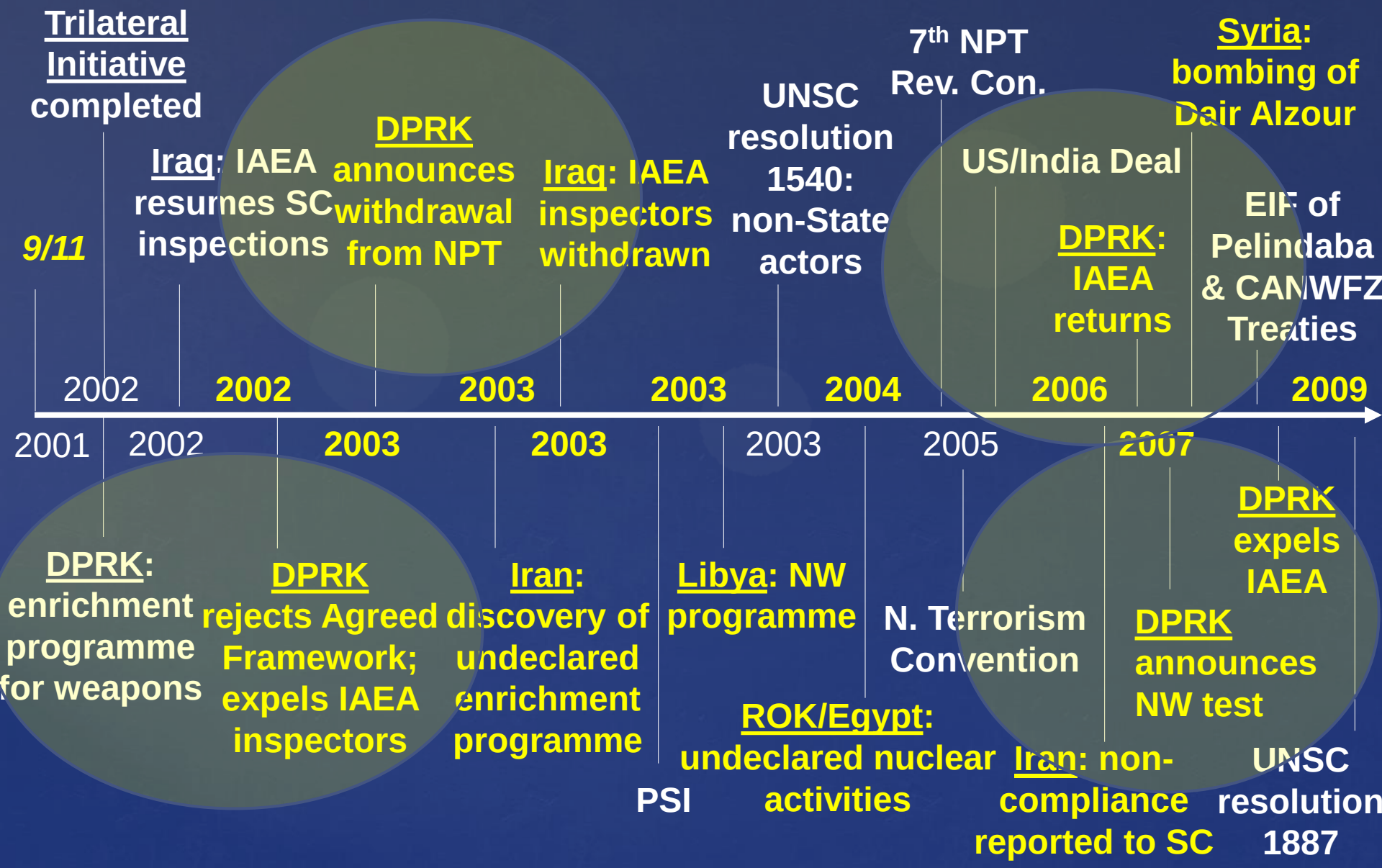
INFCIRC/254:

- Part 1 (1978): "EDP" items, and technology transfer
- Part 2 (1992): Dual-use equipment, material and technology
- Conditions:
  - ❖"Full scope" SG as condition for future supplies (1992)
  - ❖Exchange within NSG of notifications of denials

INFCIRC/539 (Rev.6): Outreach activities

1997: "The Nuclear Suppliers Group: Its Origins, Role and Activities" – revised in 2000, 2003, 2005, 2009, 2012 & 2015

Cronologia eventi recenti



Salvaguardie e Security

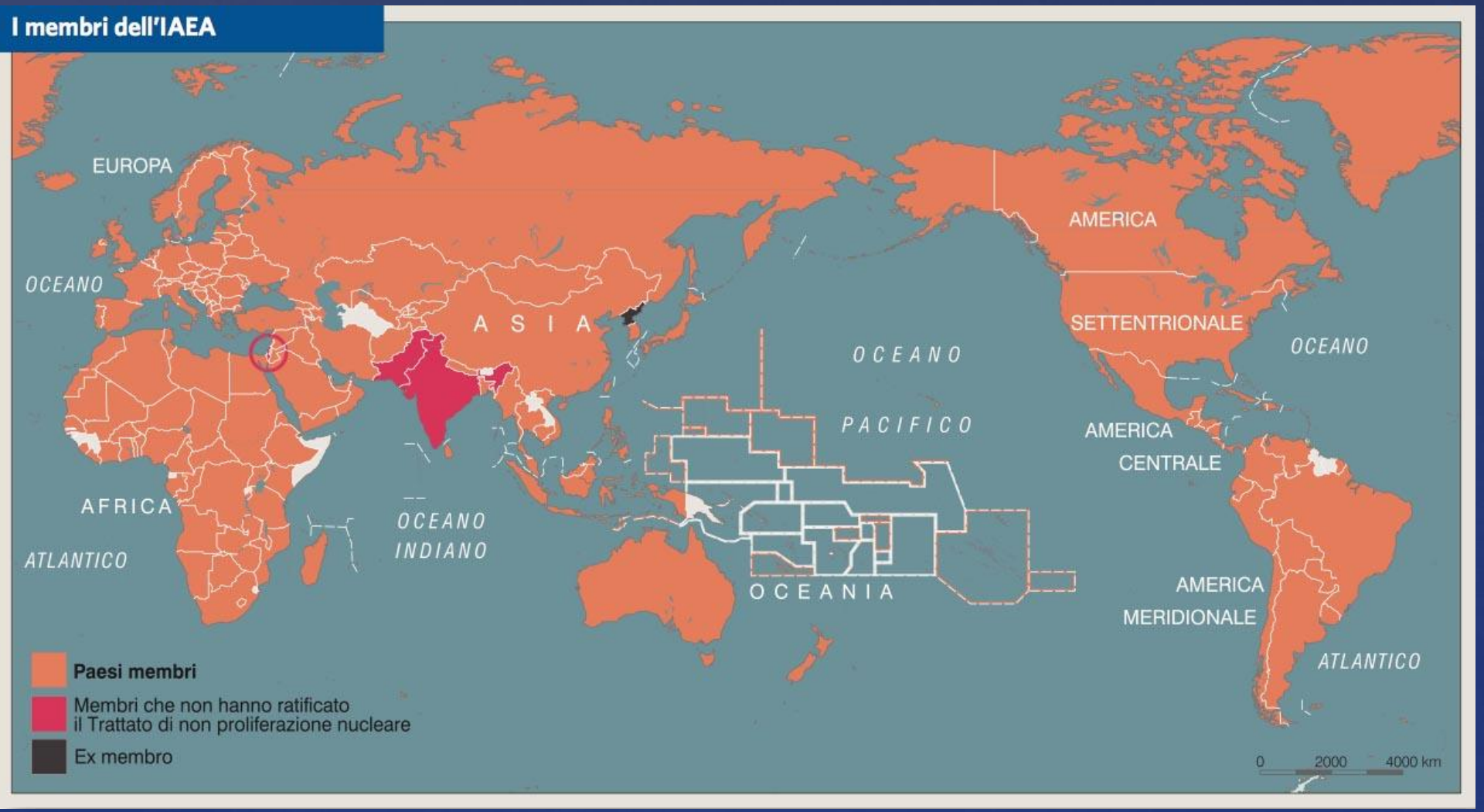
- **Salvaguardie nucleari:**
  - Detection and deterrence of diversion of *nuclear material* by a State
- **Security nucleare:**
  - Detection and deterrence of misuse of *nuclear material & other radioactive substances* by non-State actors

Consiglio di Sicurezza – 2004

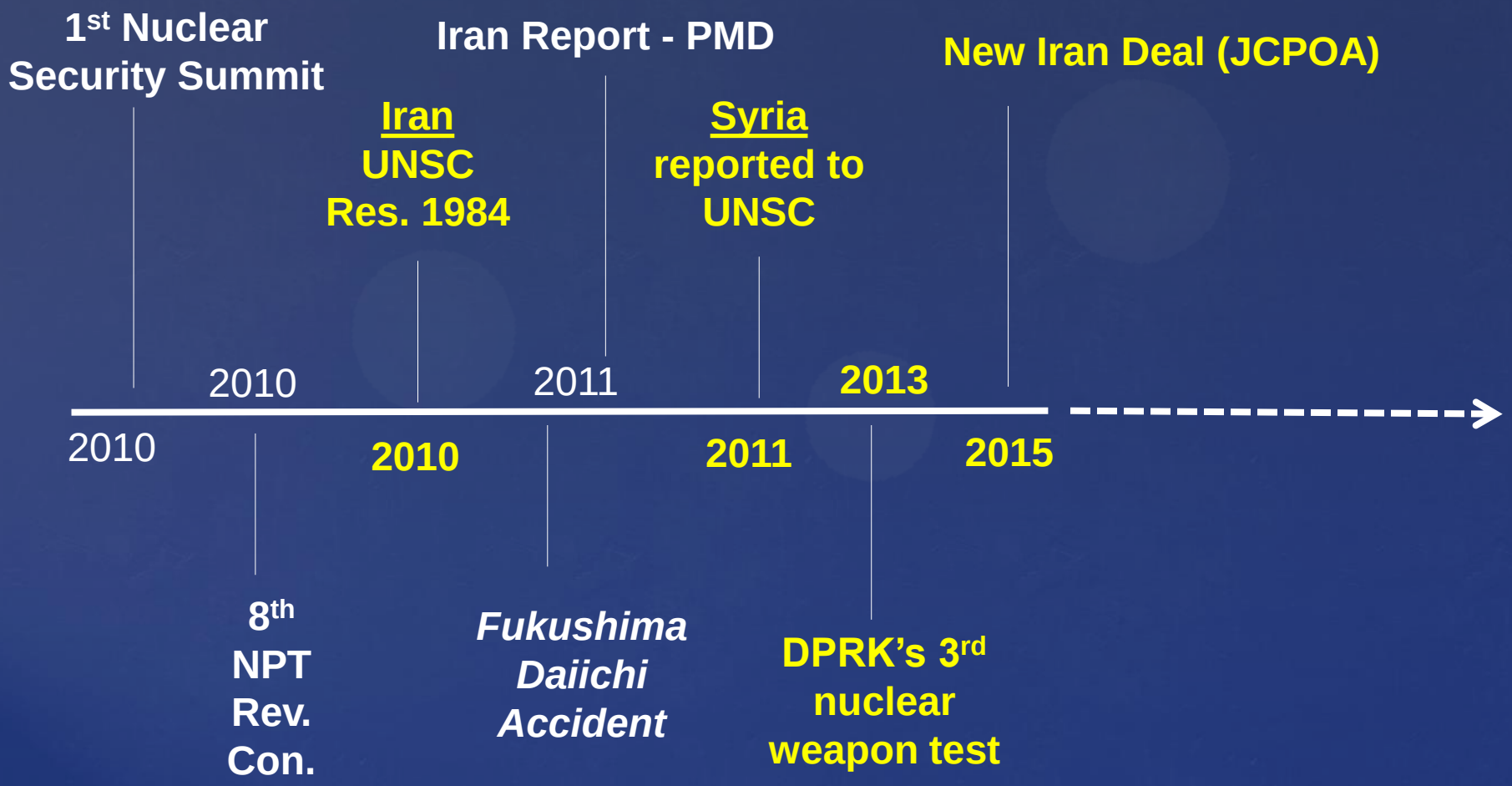
Risoluzione 1540

- WMD and role of non-State actors
- Need for domestic:
  - Border controls
  - Accounting & security controls
  - Physical protection
  - Effective national legislation

Membri dell'IAEA e NPT

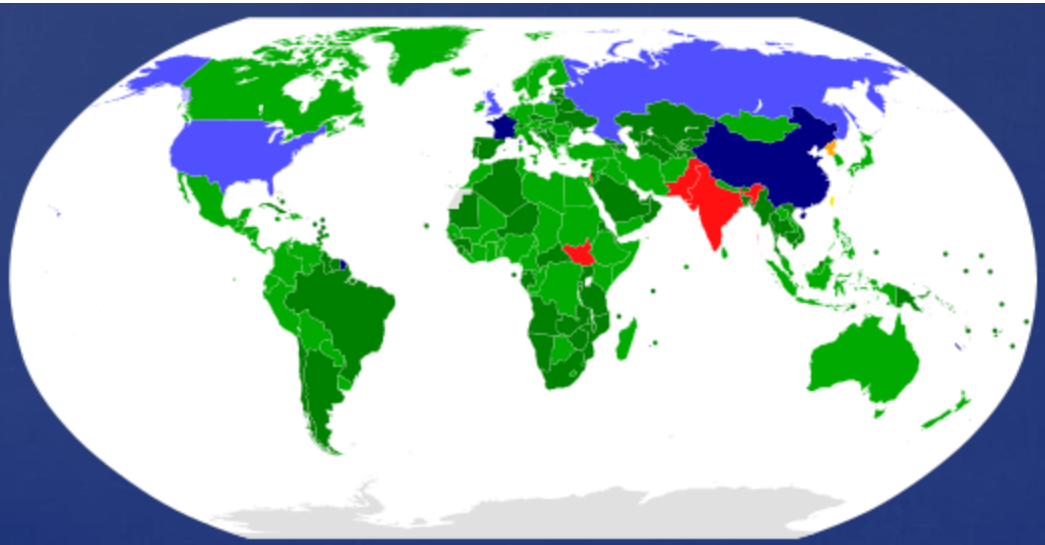


La situazione attuale



SITUAZIONE NPT e Testate

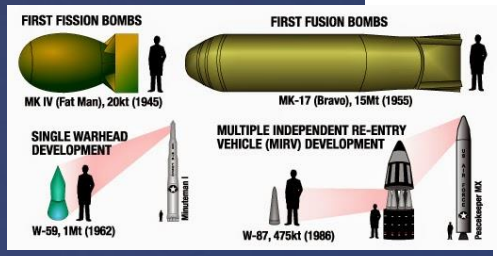
Nazione	Testate strategiche	Testate non strategiche	Totale testate operative	Totale testate operative e in riserva	Primo test nucleare	TNP	CTBT[14]
Russia	2 668	2 050	4718	12 000	1949 Pervaya molniya (RDS-1)	Si	Ratificato
Stati Uniti	1 968	500	2 468	9 400	1945 Trinity	Si	Firmato
Francia	300	n.a.	~300	300	1960 Gerboise bleue	Si	Ratificato
Cina	180	?	~180	240	1964 596	Si	Firmato
Regno Unito	160	n.a.	<160	225	1952 Hurricane	Si	Ratificato
Israele	80	n.a.	n.a.	80	Sconosciuto o 1979 Incidente Vela	No	Firmato
Pakistan	70-90	n.a.	n.a.	70-90	1998 Chagai-I	No	No
India	60-80	n.a.	n.a.	60-80	1974 Smiling Buddha	No	No
Corea del Nord	<10	n.a.	n.a.	<10	2006 Test nucleare nordcoreano del 2006	Uscita	No
Totale	**5 400**	**2 550**	**7 700**	**22 600**			

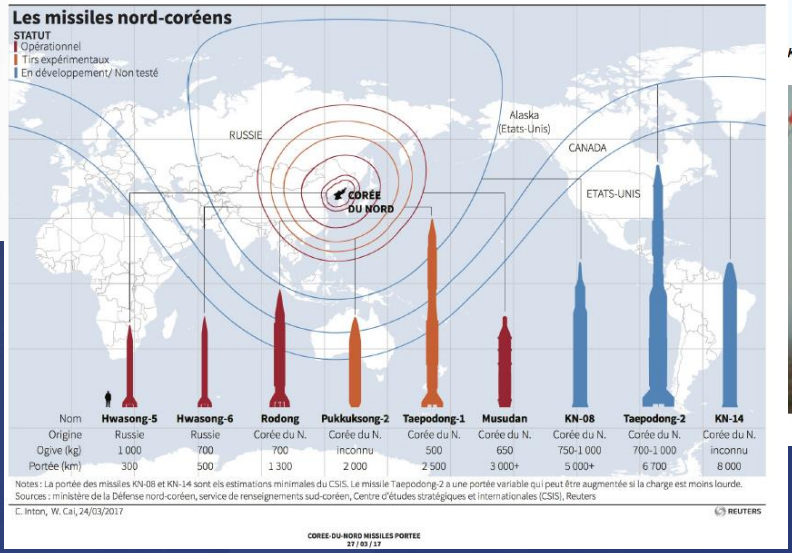


DPRK

(Un momento della parata militare del 15 aprile 2017)

Kim Jong Un, succeduto nel dicembre del 2011 al padre Kim Jong Il)





(Il lancio di un missile a lungo raggio Taepodong-2)

- Entra nelle Nazioni Unite 1991
- Entra in IAEA nel 1974
- Entra in NPT nel 1985
- Esce da IAEA nel 1994
- Esce da NPT nel 2003

Approccio militare vs civile

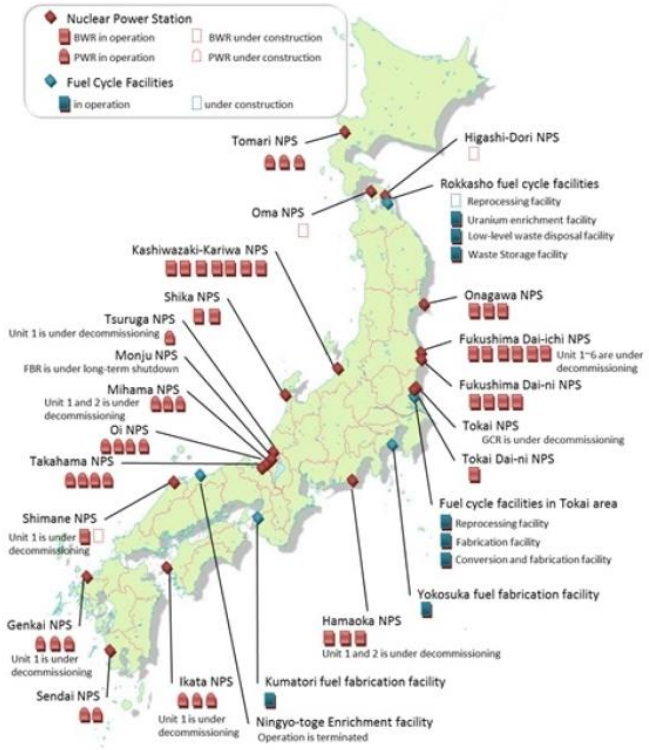
Giappone: nucleare civile

AGREEMENTS WITH THE IAEA

• "Amendments of Article VI of the Statute of the IAEA"	Ratified:	31 May, 2000
• "Agreement on the privileges and immunities of the IAEA"	Entry into force:	18 April, 1963
• "Agreement between Japan and the IAEA implementation of Article III, 1 and 4 of the NPT"	Entry into force:	2 December, 1977
• "Protocol Additional to the Agreement between Japan and the IAEA implementation of Article III, 1 and 4 of the NPT"	Entry into force:	16 December, 1999
• "Regional Co-operative Agreement for Research, Development and Training Related Nuclear Science and Technology (RCA)"	Entry into force:	12 June, 2012

MAIN INTERNATIONAL TREATIES

• "Treaty on the Non-proliferation of Nuclear Weapons"	Entry into force:	8 June, 1976
• "Convention on physical protection of nuclear material"	Entry into force:	27 November, 1988
• "Convention on early notification of a nuclear accident"	Entry into force:	10 July, 1987



- Giappone aderisce ma… non può non difendersi…

Negoziazioni con Iran: 2013 – 2016

- Joint Comprehensive Plan of Action (JCPOA)
  - 14 July 2015
- Roadmap for Clarification:
  - Past & present outstanding SG issues - 15 Dec. ‘15
- Implementation Day
  - Sanctions lifted - 16 Jan. ‘16

1st NWFZ: America Latina & Caraibi

Trattato Tlatelolco

- ✓ Non-proliferation and peaceful use undertakings
- ✓ IAEA SG on all nuclear activities
- ✓ Ban on NW testing
- ✓ OPANAL
- ✓ Protocols:
  - ✓ States with territories in the zone
  - ✓ NWSs – negative security assurances

Global Thread Reduction Initiative

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration Defense Nuclear Nonproliferation

GTRI Mission and Goals

DOE STRATEGIC GOAL 2.2

Prevent the acquisition of nuclear and radiological materials for use in weapons of mass destruction and other acts of terrorism

GTRI MISSION

Reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide.

GTRI is:

- A part of President Obama's comprehensive strategy to prevent nuclear terrorism; and
- The key organization responsible for implementing the U.S. HEU minimization policy.

Convert

Convert research reactors and isotope production facilities from the use of highly enriched uranium (HEU) to low enriched uranium (LEU)

These efforts result in permanent threat reduction by minimizing and, to the extent possible, eliminating the need for HEU in civilian applications – each reactor converted or shut down eliminates a source of bomb material.

Remove

Remove and dispose of excess nuclear and radiological materials; and

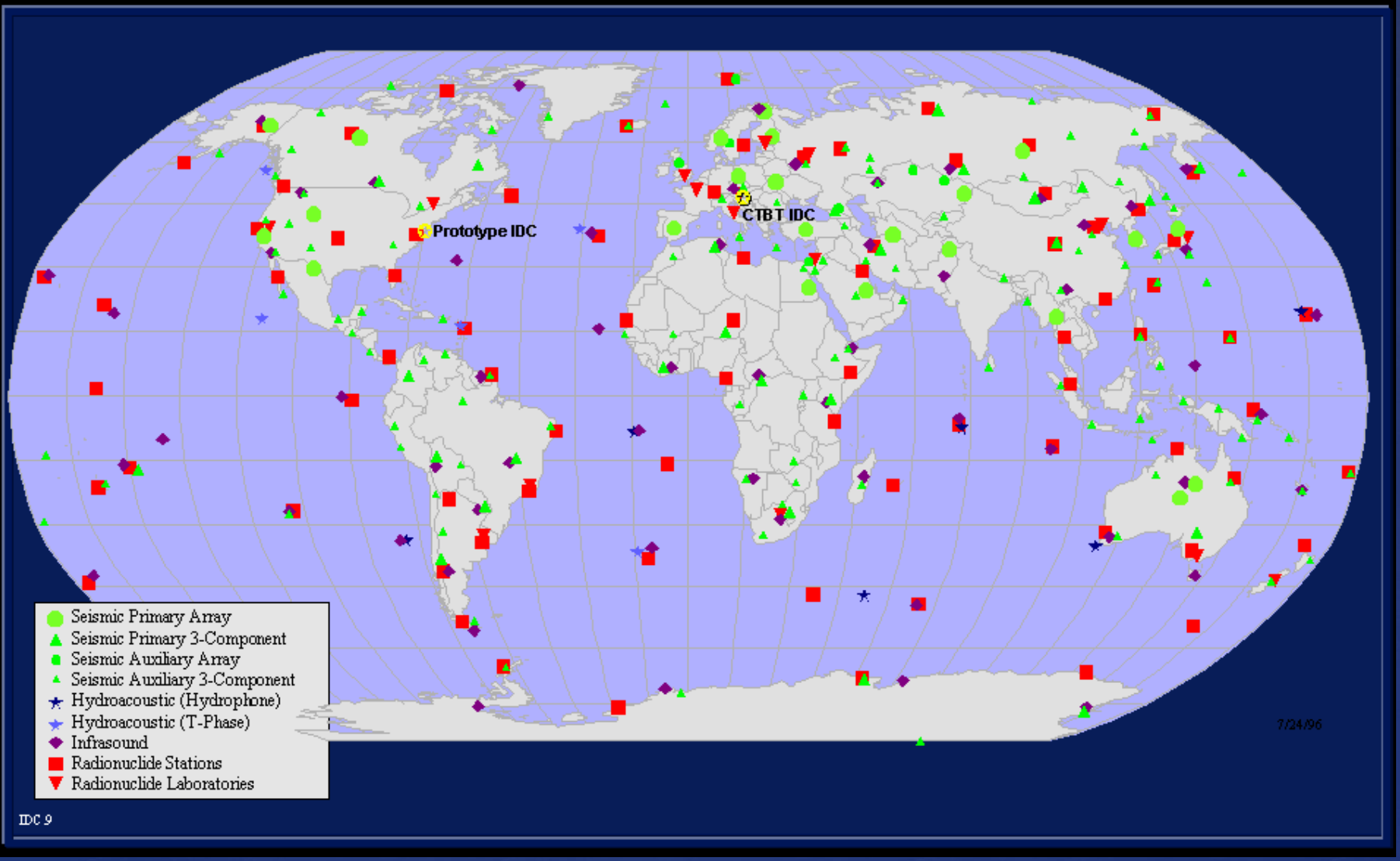
These efforts result in permanent threat reduction by eliminating bomb material at civilian sites – each kilogram or curie of this dangerous material that is removed reduces the risk of a terrorist bomb.

Protect

Protect high priority nuclear and radiological materials from theft and sabotage

These efforts result in threat reduction by improving security on the bomb material remaining at civilian sites – each vulnerable building that is protected reduces the risk until a permanent threat reduction solution can be implemented.

CTBT International Monitoring System Network



Cosa possiamo fare…

Disarmo

Security

Rispetto dei Trattati
NPT & NWFZ

Consiglio di
Sicurezza

Salvaguardie IAEA

Sicurezza di
approvvigionamento

Controllo
dell'export

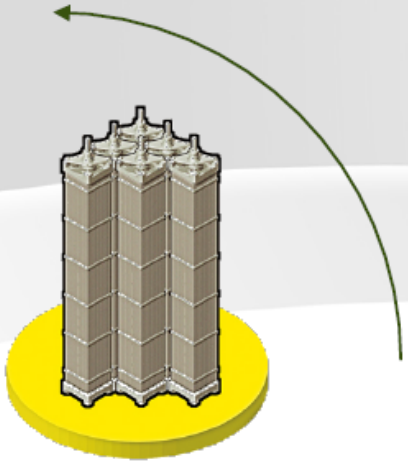
Countro Proliferazione

Safety

Garanzia della Security

Differenza fra nucleare civile e bellico

- **Civil nuclear applications have been derived from military nuclear applications: the opposite has never occurred**
  - 2000 nuclear tests have been performed since 1945; none have been carried out using plutonium taken from light water reactors
  - In reality, creating an A-bomb from a nuclear reactor by isolating plutonium is a more difficult task than simply using enriched uranium (as Iraq, Iran, etc. can confirm)



It would be as absurd to refuse civil nuclear energy because of the military utilization of the atom as it would be to refuse medication because of the risk of making chemical weapons

Reminder

There is no single « magic bullet »

There is no nuclear fuel cycle that can, on technical grounds alone, be made proliferation-proof against governments bent on siphoning of materials to make weapons

Burton Richter

- *There's no reason to delay options towards increasing nuclear sustainability until something "magic" might become available*
- *Although there are technical improvements that can reduce proliferation risk, as already practiced continuously today, it is only in the political arena that real proliferation-risk reduction can occur*
- *International safeguards are extremely important and increasingly needed including continuous optimisation towards overall effectiveness as practiced today*

Comitato
per una Civiltà dell'Amore

Comitato per una Civiltà dell'Amore