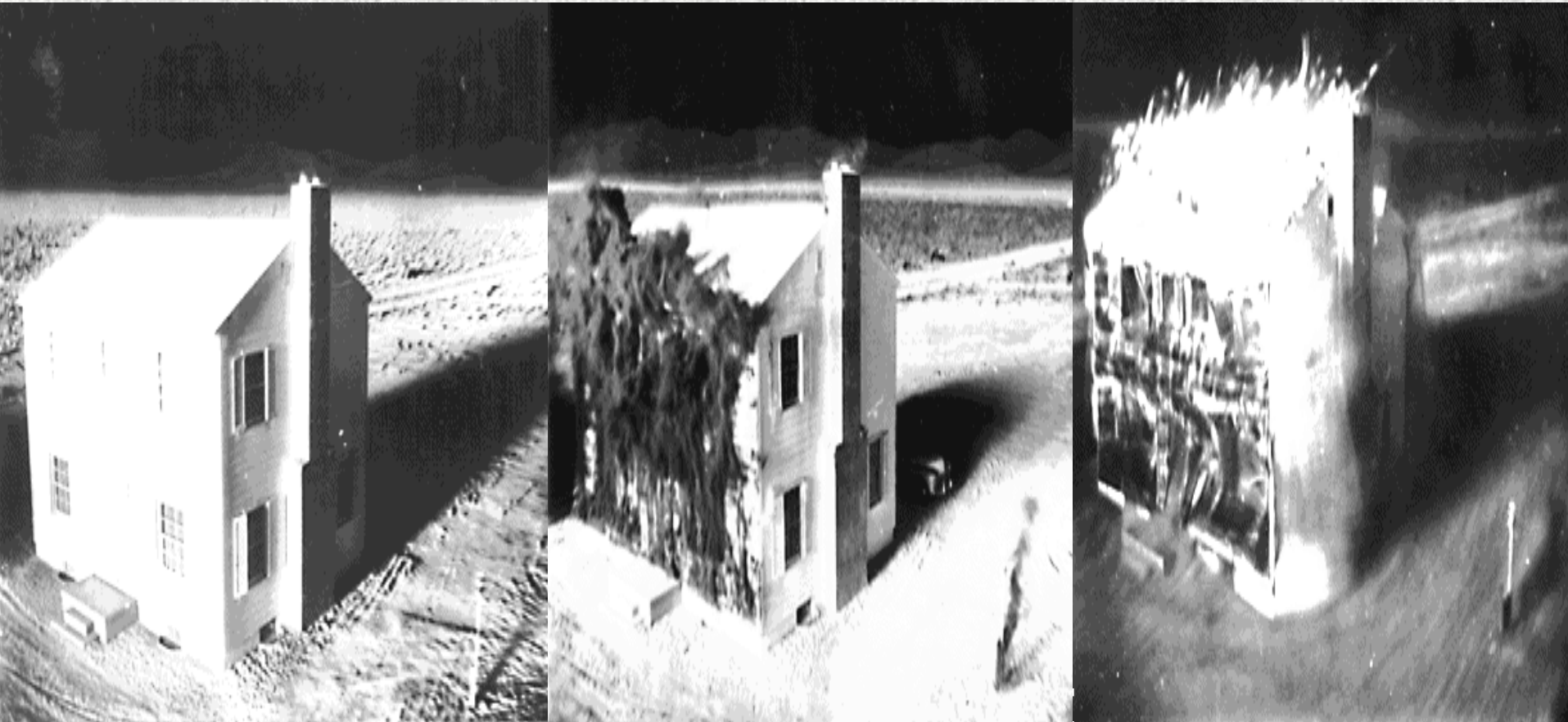


Nuclear Weapons:

Security or Insecurity?



SLAC Colloquium March 12, 2007

Wolfgang K.H. Panofsky

Many pending nuclear weapons issues are before Congress or in the news

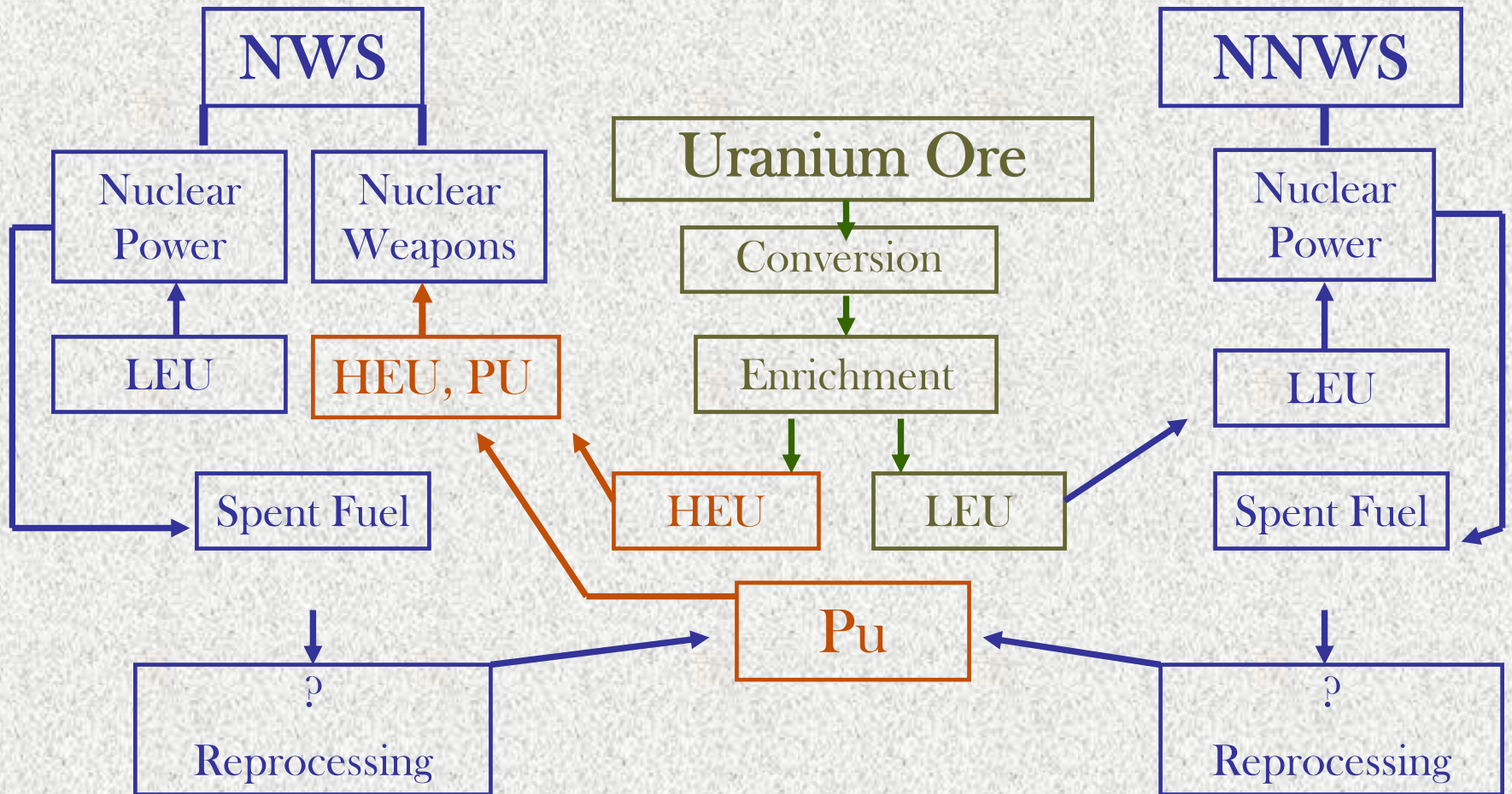
Examples:

- Annual NW budget
- Required NW infrastructure
- New plutonium facility
- Replaceable Renewable Warhead (RRW)
- Nuclear weapons in Europe
- Missile defense
- Alert levels of nuclear weapons
- Numbers of US nuclear weapons deployed or in Reserve
- Response to States with perceived nuclear weapons ambitions

Some uncontested but poorly comprehended facts

- NWs multiply the destructive energy that can be carried by ammunition of given size and weight by a factor of about 10^6
- ALL NWs kill and destroy through blast, heat (fires), prompt radiation, delayed radiation (fallout). Mixture of effects can be modified to some extent
- Knowledge is no longer a barrier to constructing a nuclear weapon
- Some elements of the peaceful nuclear power fuel cycle (enrichment and reprocessing) greatly shorten the lead time to produce a nuclear weapon, but do not establish evidence for a nuclear weapons program as such

THE NUCLEAR FUEL CYCLE



12 countries enrich uranium

8 countries reprocess

During Cold War

- Deter with nuclear Triad: ICBM's, Strategic Bombers, SLBM's
- Nuclear war fighting abandoned in plan

MAD

Mutual Assured Destruction

During the Cold War

- The world nuclear weapons stockpile grew to about 70,000 warheads of average explosive power 20 times of those that killed one-quarter million people at Hiroshima and Nagasaki
- Today that number has shrunk to about 27,000
- The US still has about 10,000 nuclear warheads
- This number will shrink to about 6,000 by 2012

The Cold War is over -- but...

Current Doctrine

- Deter, assure, dissuade, defeat
- Pre-empt, with nuclear weapons if necessary
- “All options” open
- “Capabilities based” not “threat based”
- Nuclear weapons play “smaller role”
- Adaptive planning

NUTS

Nuclear Use Target Selection

DETERRENCE

Remains a valid mission, but requires only a very small number of nuclear weapons.

DISSUASION

Defined as “our forces will be strong enough to dissuade potential adversaries from pursuing a military buildup in hopes of surpassing, or equaling the power of the United States” is counterproductive if applied to NWs.

NWs are the great equalizer: a very small number of nuclear weapons affects the flexibility of great powers.

DEFEAT

Nuclear war fighting, but there are only losers in a nuclear war.

ASSURE

Giving negative or positive security assurances to States without NWs

– The US assures not to retaliate with NWs against attacks by States not having NWs, unless they are allied with a NWS

+ The US will protect such States if they are attacked with nuclear weapons

Nuclear weapons risks remain after the Cold War

- US-Russia nuclear weapons release, deliberately or by accident or misinformation
- Regional nuclear conflict, e.g., India and Pakistan
- Nuclear weapons proliferation
- Nuclear weapons terrorism

Accidental Nuclear Detonation

- Russian Early Warning Radar coverage diminished
- Russian satellite coverage diminished.
Result: many instances of false alarms; e.g., Norwegian research rocket
- Many past accidents involving nuclear weapons, none leading to a nuclear explosion, but some dispersing plutonium

Regional Conflicts

- Acquisition of nuclear weapons by India and Pakistan may have increased caution in managing their conflict but...
- if war breaks out it may turn nuclear
- if Pakistani regime is overthrown, control of nuclear weapons is in doubt

I will emphasize the problem of proliferation:

In the history of mankind, all newly developed technologies

- have been “dual purpose”
- have spread over entire globe

This precedent must be broken for nuclear weapons.

Knowledge is not a bar to proliferation today

Cornerstone of nonproliferation regime is Nuclear Nonproliferation Treaty (NPT)

- Came into force in 1970
- Signed and ratified by all nations except
 - Israel -India -Pakistan
 - North Korea withdrew
- Review Conferences every five years
- Became a treaty of indefinite duration at 1995 Review Conference

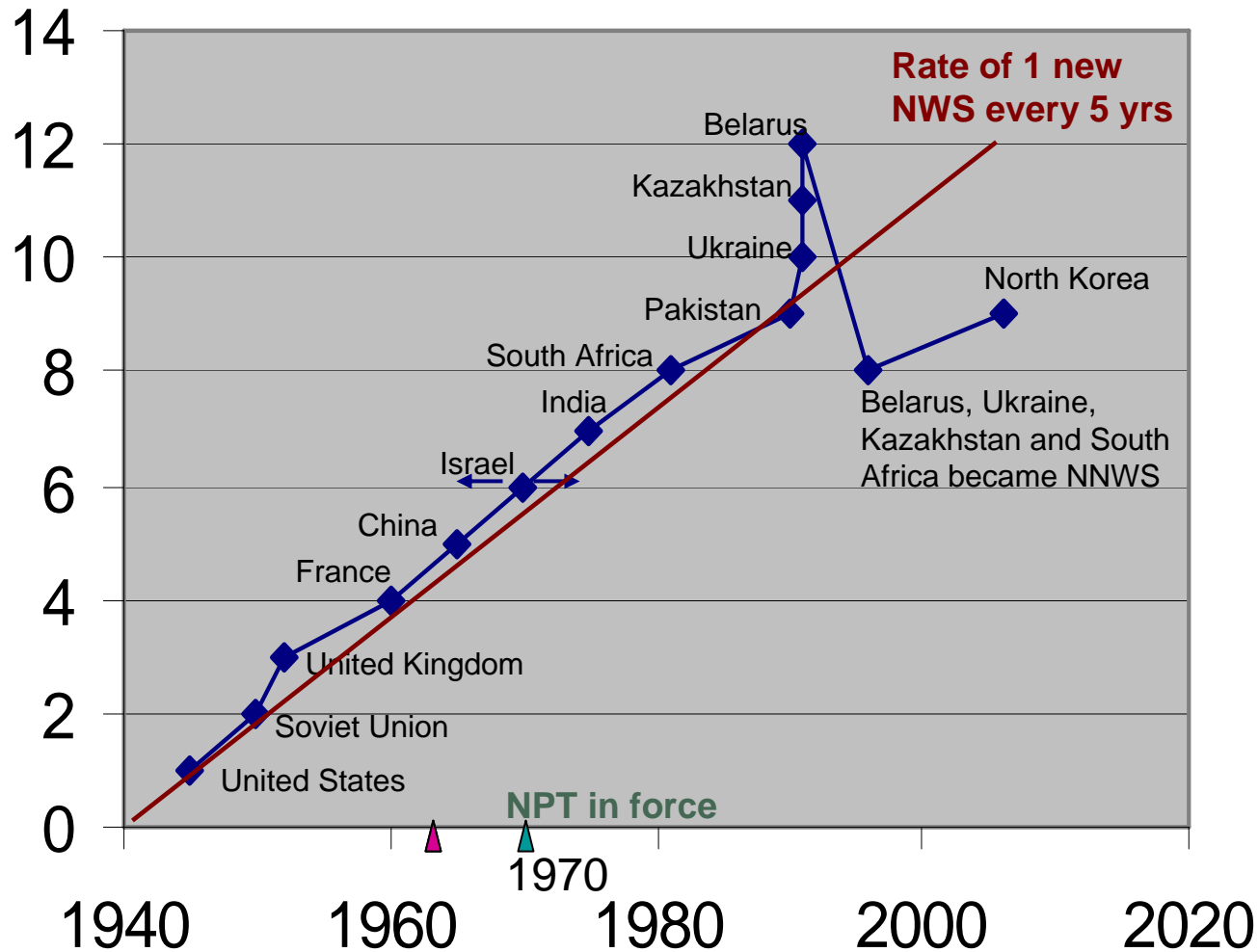
The NPT Bargain

- ❖ Nuclear Weapons States (NWS) and Non-Nuclear Weapons States (NNWS)
- ❖ US, Russia, UK, China and France are NWS
- ❖ NWS do not transfer NW or NW tools to NNWS
- ❖ NNWS do not receive such material

The NPT Bargain continued

- ❖ NNWS have “inalienable right” to nuclear power
- ❖ NWS work in good faith toward prohibition of NWS and General Disarmament (no specified timetable; implication is to deemphasize role of NW in international relations)
- ❖ NNWS must negotiate safeguards with International Atomic Energy Agency (IAEA)

Number of States with Nuclear Weapons



▲ “I am haunted by the feeling that by 1970, unless we are successful, there may be 10 nuclear powers instead of 4, and by 1975, 15 or 20.” John Kennedy, 1963

Historical Summary of Military Fissile Material & Nuclear Weapons Programs

Nuclear Weapons Programs begun before 1970 when NPT came into force, succeeded and are still ongoing

United States
Russia
United Kingdom
France
China
Israel
India

Programs ended by 1970

Sweden
Canada
Australia
Egypt

Programs ended after 1970

Argentina Brazil
Romania South Africa
Spain South Korea
Spain Switzerland
Taiwan Libya
Yugoslavia

Historical Summary (continued)

Intentions suspected but no NW program identified

Algeria

Syria

Programs started after 1970

Succeeded and ongoing

Pakistan

North Korea

Are suspected to be actively
seeking nuclear weapons

Iran

Factions within advocated for/sought NW, but ceased by 1970

Italy

Germany

Japan

Norway

Inherited NW, but now non- NW State party to NPT

Belarus

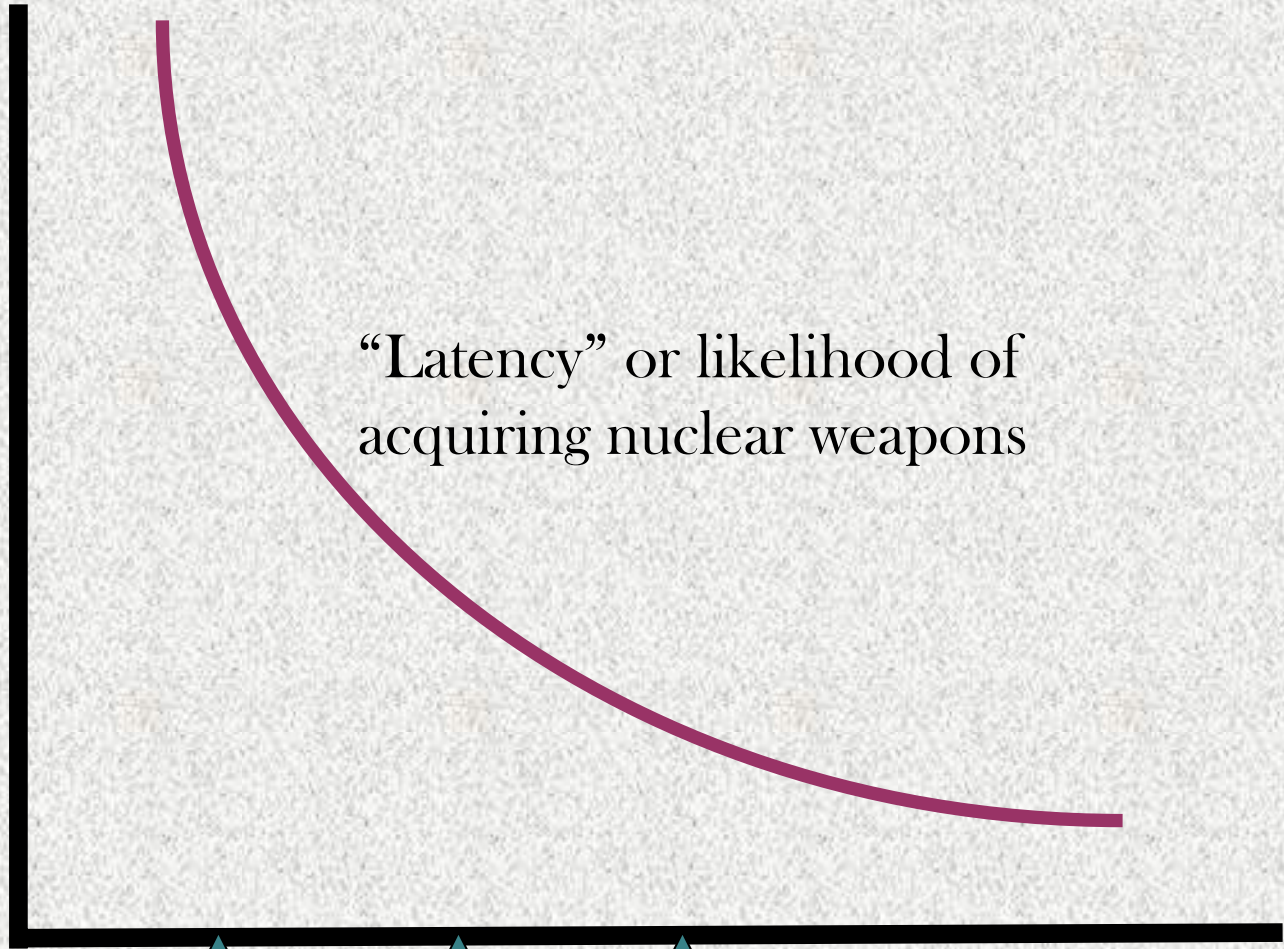
Kazakhstan

Ukraine

The Siege on the NPT

- All NWS continue to rely on nuclear weapons
- Only China has a No First Use Policy
- Four States are outside the Treaty
- The latency problem

INTENT



IRAN

BRAZIL

JAPAN

TECHNICAL CAPABILITY OF NNWS

Intent is in the eyes of the beholder

An outline of *technical* capability to construct nuclear weapons of the three countries shown in the figure follows...

Brazil

- After 1970 a military government
 - Started an ambitious power reactor program
 - Pursued three parallel nuclear weapons programs
- After 1988, a civilian Constitution with a civilian President was established
- Argentina and Brazil terminated weapons programs and established bilateral and IAEA monitoring
- Centrifuge program continues; IAEA partial access limited by proprietary design
- Proclaimed motive: prestige, independence

Iran

- After 1957 US encourages ambitious nuclear power program under the Shah. Iran started Bushehr power plant.
- 1979 Iranian Revolution; Bushehr discontinued and damaged in Iran-Iraq War.
- Nuclear cooperation with China and Pakistan
- 2002 Natanz enrichment plant discovered
- 2006 large scale UF₆ production
- Now 2x 164 centrifuges installed producing some LEU; about 5000 needed to produce HEU for one bomb/year

Japan

- Owns about 45 tons of reactor grade Plutonium
- Only about 10% of this is stored in Japan
- The designated purpose of this material is for use in Mixed Oxide Fuel (MOX) and breeder reactors. These uses have been delayed or cancelled.
- Reactor-grade Plutonium is useable in NW

US pursues a policy of selective counter-proliferation

- Proliferation Security Initiative (PSI)
- Moves against Iran
- Vacillation of North Korean policy
- UN Resolution 1430 requires criminalization of proliferation

Only long range hope is to provide internationally assured supply of LEU

- IAEA and other proposals
- Russian guarantees to Iran

Nuclear Weapons Terrorism

- Only physical mechanism is to secure stocks of plutonium, HEU and nuclear weapons.
- Radiation detection highly limited
- Global stocks; >90% in Russia and US
- Only about \$1 billion annually of US funds dedicated to secure stocks of HEU and Pu in Russia, compared to
- About \$10 billion annually dedicated to ballistic missile defense

**GLOBAL PLUTONIUM AND HIGHLY ENRICHED
URANIUM (HEU), ASSIGNED TO CIVIL OR MILITARY
STOCKS, END 2003, IN TONNES**

CATEGORY	PLUTONIUM	HEU	TOTAL
CIVIL STOCKS*	1675	175	1850
MILITARY STOCKS	155	1725	1880
Primary	155	1250	
Naval and Other	--	175	
Retained in military stocks	--	300	
TOTAL	1830	1900	3730

*Including military excess dedicated to civilian use

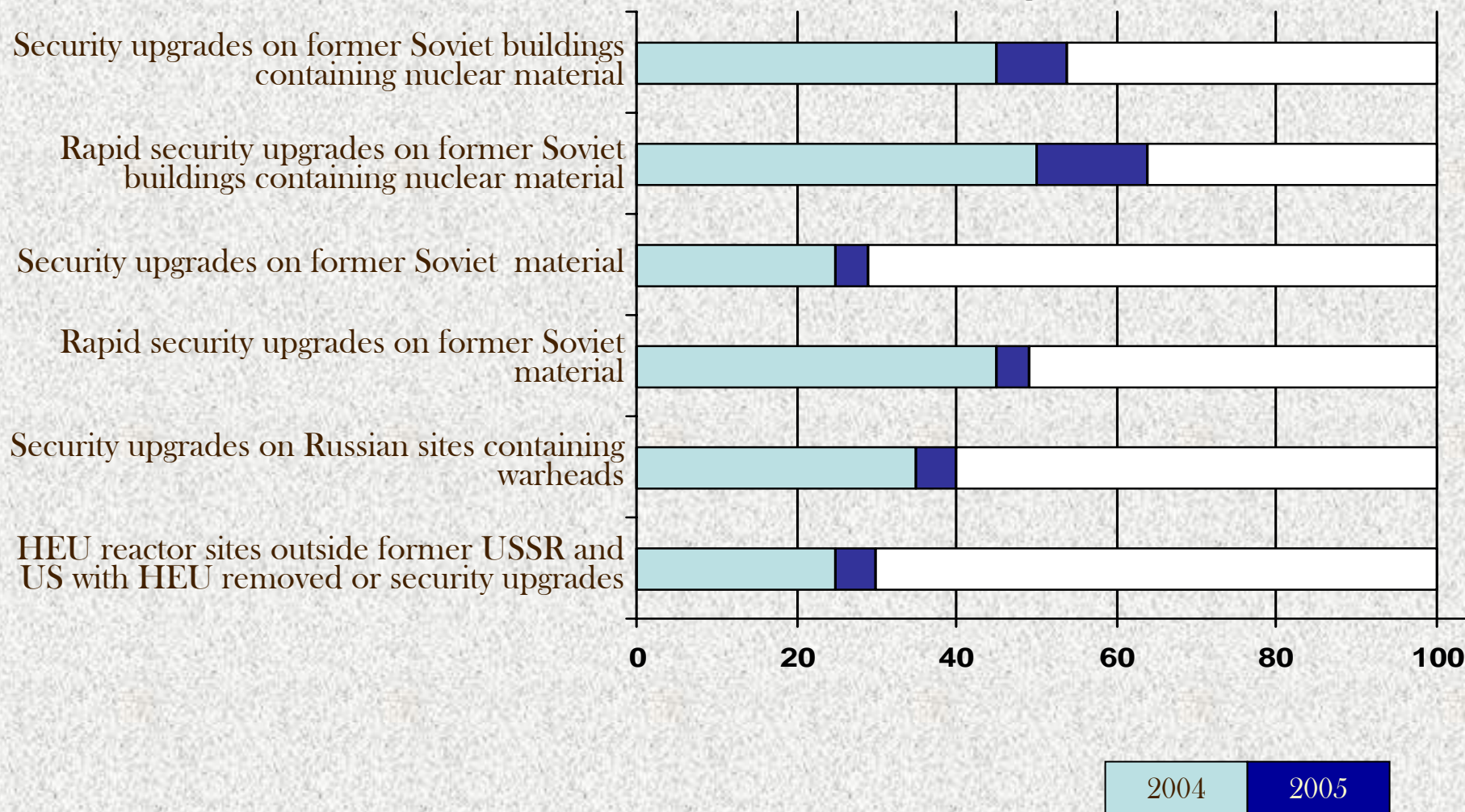
Reference "Significant Quantity": HEU 25kg, Pu 8 kg

US Program

- Cooperative Threat Reduction (government)
- Nuclear Threat Initiative (private)
- Radiation detectors at critical points

How much securing work have US-funded programs completed?

Percentages measure work completed through FY 2005



SECURITY



MISSION

v.

INSECURITY



RISKS

- ❖ With the end of the Cold War the primary mission - Mutual Assured Destruction vis-a-vis the Soviet Union has disappeared
 - ❖ The only remaining valid mission is deterring threat or attacks with nuclear weapons by others
 - ❖ Nuclear weapons have no role in the “War on Terror”
-

SECURITY



MISSION

v.

INSECURITY



RISKS (cont'd)

❖ The risk, defined as product of consequences of an adverse event times the probability of its occurrence, has increased over the last decades



Conclusions


1. The risk to benefit ratio of nuclear weapons has grown to an unacceptably large value (since the end of the Cold War), and threatens survival of civilization
2. The current US nuclear weapons policy of Assure, Deter, Dissuade and Defeat is an obsolete relic of the Cold War and is insufficient to guide pending decisions on force size, infrastructure, budgets and warhead characteristics.

Conclusions

3. The only justifiable mission of US nuclear weapons is to deter the threat and use of nuclear weapons by others
4. The United States, as the world's dominant power in “conventional” weapons should take leadership in declaring and promoting a universal “No First Use” policy

Ultimately, we must create conditions to make feasible a worldwide prohibition of nuclear weapons.

- Prohibition is not elimination. Some minimal evasion will remain feasible
 - Chemical and biological weapons have been outlawed by international convention and the world is better for it
-

- 
- This will be a protracted process but the US has most to gain from such a prohibition and must take leadership toward that end.
 - The US should do no less, or we will leave a very insecure world to our children.
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