Global Nuclear Risk Reduction by Science Diplomacy

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Perry-Hecker Nuclear Risk Reduction Project

- Fewer nuclear weapons
- Fewer fingers on the nuclear trigger
- Keep them out of terrorists' hands

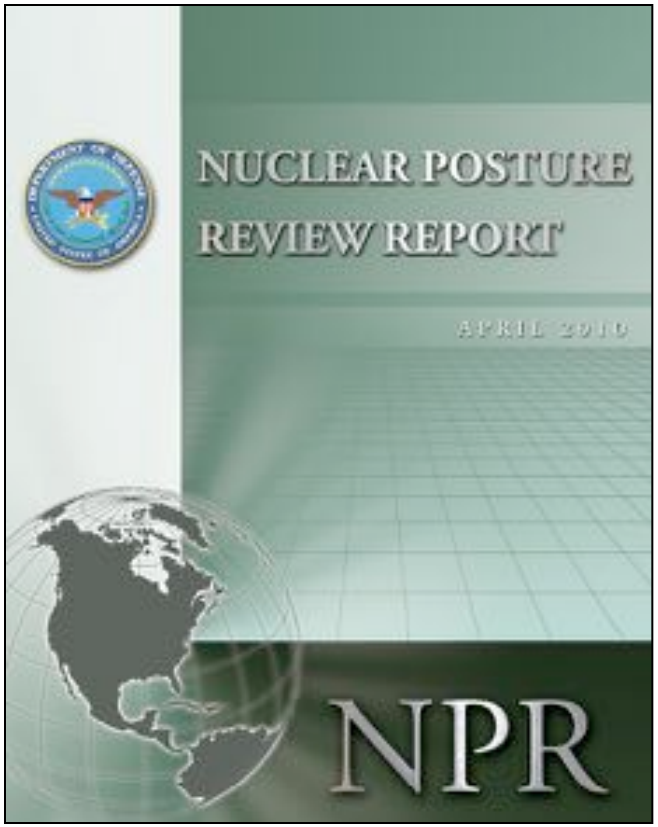
Shultz, Perry, Kissinger and Nunn with President Obama

… on the road to the elimination of nuclear weapons

Nuclear Risk Reduction: Fewer nuclear weapons

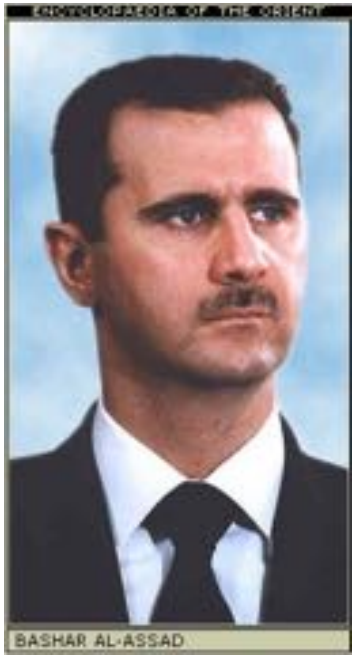
- New START ratification
- Comprehensive Test Ban Treaty
- Fissile Materials Cutoff Treaty
- START follow-on
- Role of ballistic missile defense
- The road to zero

Nuclear Posture Review
April 6, 2010



NEW START – April 8, 2010

Nuclear Risk Reduction:
Fewer fingers on the nuclear trigger



Six visits to North Korea helped us make an assessment

Jan. 2004 Yongbyon

Aug. 2005 Pyongyang

Nov. 2006 Pyongyang

August 9, 2007, Yongbyon

Feb. 14, 2008, Yongbyon

Feb. 27, 2009, Pyongyang

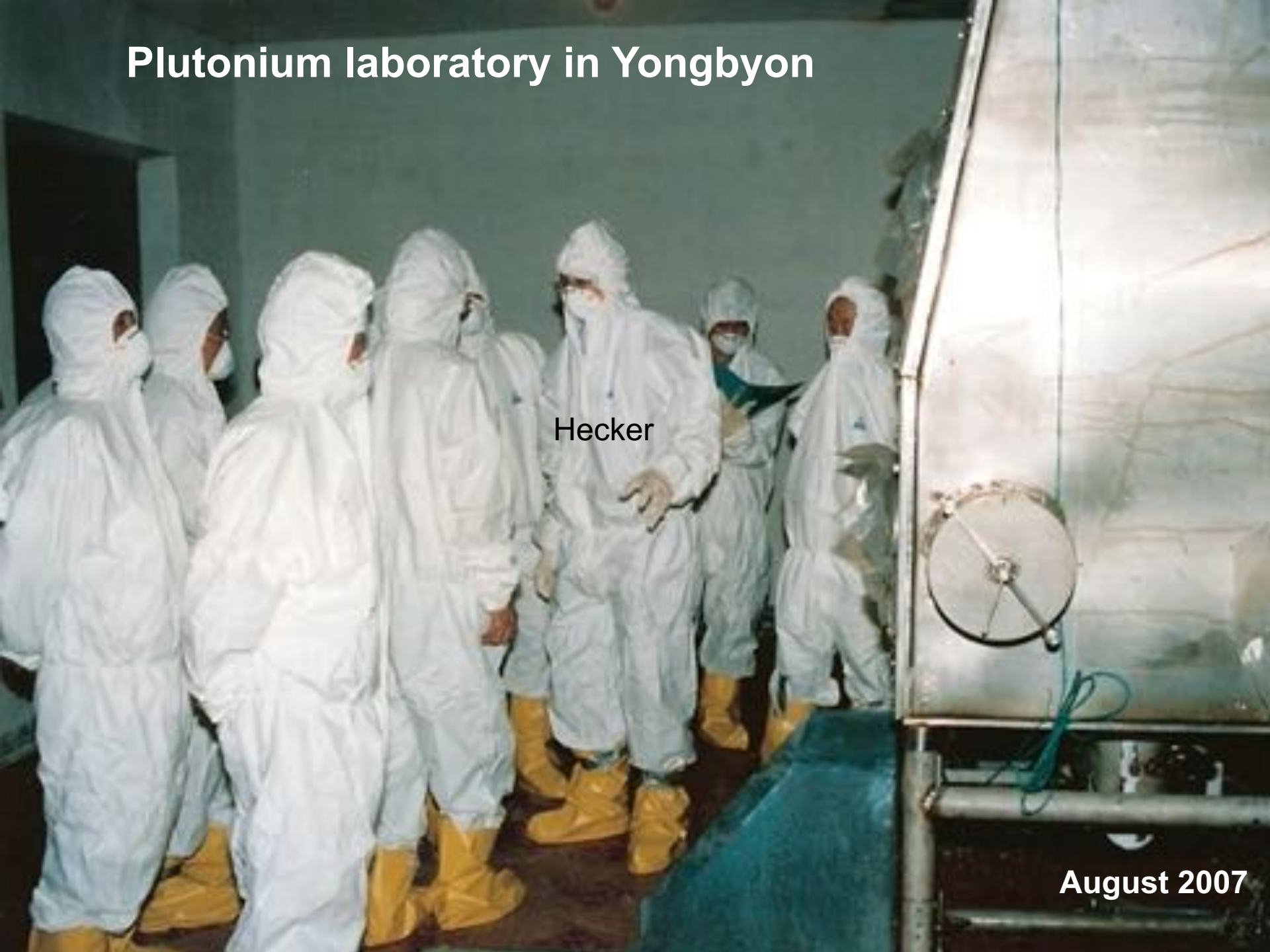
… and better assess the risks


Yongbyon 5-Mwe reactor control room
Jan. 8, 2004

Yongbyon Spent-Fuel Cooling Pool


Yongbyon Plutonium Reprocessing Facility

Plutonium laboratory in Yongbyon



August 2007

Feb. 14, 2008, Yongbyon

DPRK nuclear status

- Plutonium: 24 to 42 kg (~4 to 8 bomb's worth)
- Nuclear weapons (~4 to 8 primitive bombs)
  - Limited by plutonium and sophistication (lack of testing)
- No plutonium in the pipeline – reactor not restarted
  - Fuel for one more load – but requires 6 months
  - Reactor needs cooling tower – requires ~ 6 months
  - Reprocessing facility – ready to operate
- Potential nuclear test – needed for miniaturization for missiles
  - Plutonium scarcity; may look for another confrontation
- Uranium enrichment
  - Likely long-standing R&D effort but denied by DPRK
  - Now announced success – still likely only R&D
  - Industrial scale uranium enrichment unlikely

What did DPRK get for 20 yrs of diplomacy?

It got:

- **A handful of nuclear weapons (likely primitive)**
- **Financial aid**
  - **US: ~ $ 1.3 B since 1994***
  - **ROK: $3.3 B + $1.1 B (KEDO)***
    - **But some ROK estimates say $7 B since 2000**

However, it did not:

- **Finish two larger reactors** (could possess > 100 weapons today)
- **Get much nuclear electricity** (total of 23 days of LWR equiv.)
- **Get modern nuclear complex** (Yongbyon is antiquated, contaminated)
- **Get much nuclear medicine** (IRT-2000 reactor has no new fuel)

But the Kim Jong-il regime remained in power

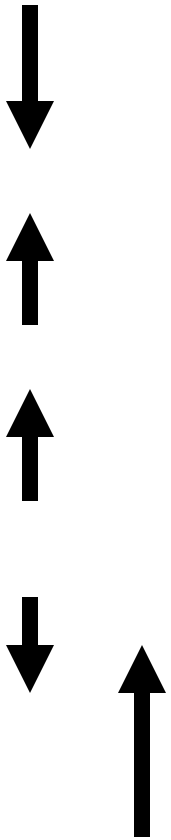
*Our preliminary estimates

What are the nuclear security threats?

- Nuclear bombs – low threat currently
- Miscalculations or accidents – possible
- Uranium enrichment (HEU) – low
- Export – materials or technologies – very serious

A look at history of security risks

- 1994 Agreed Framework
- 2002 Oct. Uranium confrontation
- 2005-6 BDA Sanctions
- 2007 Agreements
- Lack of export enforcement



DPRK exported while we looked for imports

Will DPRK give up the bomb?

- Not in the near future - not voluntarily
- And, we can't force it to give it up
- We need China, but China has different views of risks and different objectives

So, reduce risks now, and contain in near term, and develop comprehensive solution in long term.

The “three no’s” of risk-based approach

- No exports (or nuclear cooperation)
- No more bombs (no plutonium production)
- No better bombs (no nuclear testing)

U.S. holds key to incentives,
China to enforcement

A nuclear Iran raises grave concerns in Mideast

Iran – Atoms for Peace
Revolution and retreat
Covert development
Discovered, negotiate
Civilian "peaceful" cover
It has the "nuclear option"

Known Iran Nuclear Installations

- Bushehr reactor: 915 MWe, ready to fuel
- Natanz enrichment plant (discovered 2003)
  - Previously undeclared enrichment facility at Qom (2009)
- Esfahan: Uranium conversion
- Arak: 40 MW heavy water reactor (2012?)
  - Laser uranium enrichment experiments - milligrams
- Esfahan Nuclear Fuel Research & Production Center: 3 research reactors, other facilities
- Parchin military complex – high explosives and other work
- Vigorous missile program
  http://www.iiss.org/publications/strategic-dossiers/irans-ballistic-missile-capabilities/

Can Iran field a nuclear weapon?

What are Iran's capabilities?

- Most difficult Part
- Working on both

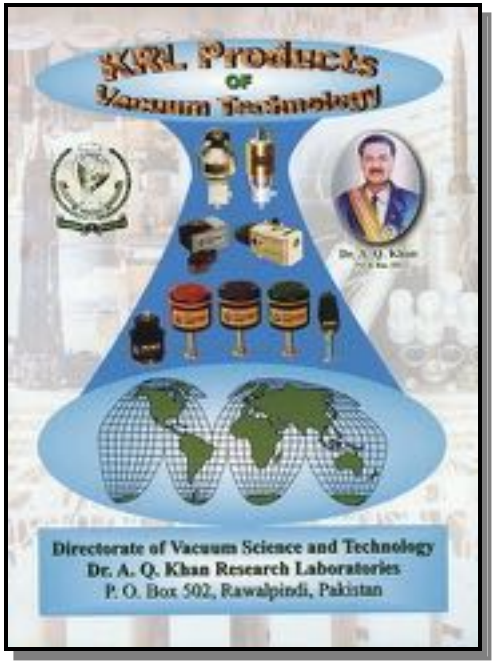
- High explosives
- Detonators
- Initiators
- Machining
- Assembly
- Need explosives tests

- Truck/van
- Plane
- Missiles
- Iran has significant missile capabilities

We must assume Iran will be able to build and field a weapon. Iran may be able to build a simple bomb in a year or so.

India and Pakistan represent the greatest risk of a nuclear exchange

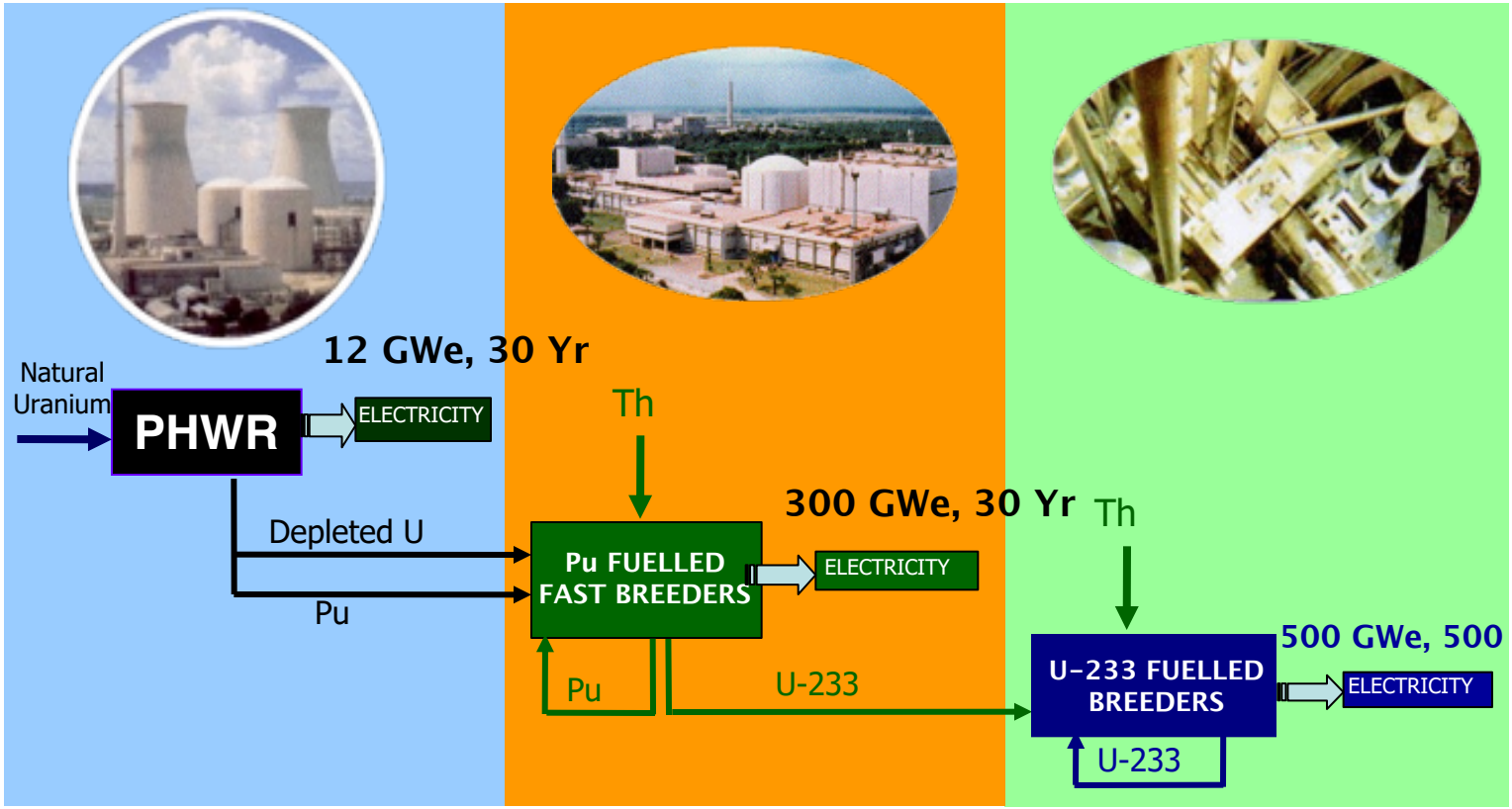
Pokhran II, May 11 & 13,1998. India declared itself a nuclear power



A.Q. Khan's black market

Pakistan followed suit at Chagai Hills, May. 28 & 30

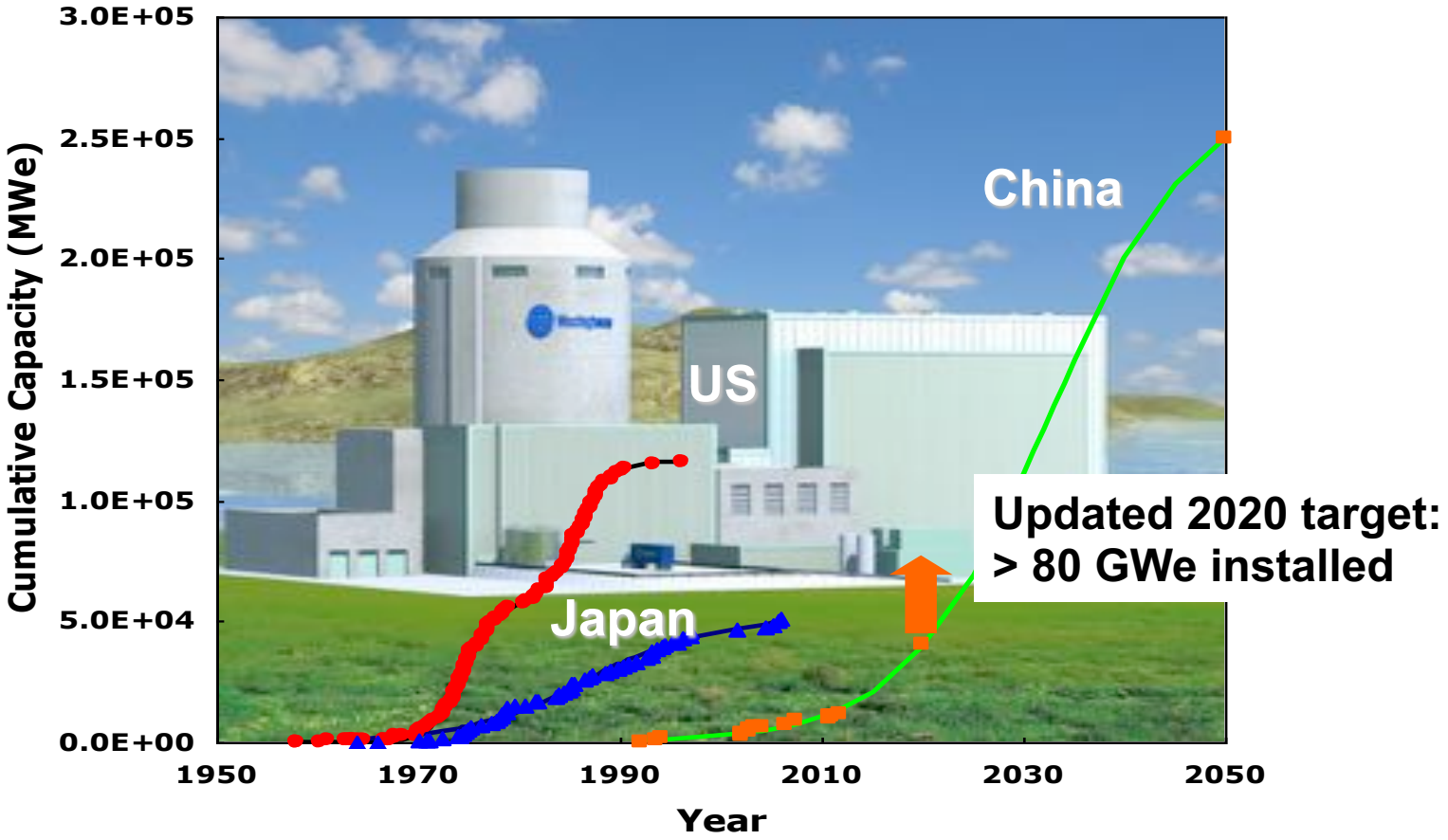
Pushing the envelope - India



- Compete economically
- Safety
- Security - prevent the use of nuclear weapons
- Nuclear waste disposal
- People and infrastructure


500 MWe Prototype Fast Breeder Reactor
Kalpakkam, India

Planned Nuclear Power Capacity Growth in China



Can it be done safely and securely?

Nuclear Risk Reduction:
Keep them out of terrorists' hands

Focusing the world's attention on nuclear terrorism – April 2010

Goal: "Locking down" the world's nuclear materials in four years.

Nuclear terrorism presents very different challenges

- Nuclear detonation – a real WMD;
massive, devastating, no analogue

-Radiological dispersal device – "dirty bomb."
A weapon of mass "disruption"

-Radiological sabotage – nuclear facilities.
Radiation release concerns

"Terrorists are racing to get weapons of mass destruction;
we ought to be racing to stop them.
Former Senator Sam Nunn

The most likely nuclear threat is a "dirty bomb"

- Radiation sources are everywhere – key ingredients of medicine, commerce and agriculture
- "Orphaned" sources present a serious challenge
- IAEA found 110 countries have inadequate regulatory control
- Other suitable radioactive materials (spent fuel, nuclear waste) are plentiful

A dirty bomb is a weapon of mass disruption, not destruction

- Disruption can be devastating and expensive
- Much can be done to reduce supply – protect and dispose
- Much can be done to prepare – and limit the disruption

The terrorist's nuclear bomb

10 kt device

Immediate impacts are catastrophic:

- 100% death to 3/4 mile due to blast, radiation
- 50% 3rd burns to 1 mile
- Flash blindness to 7 miles if unobstructed
- Lethal radiation would extend for miles

See Graham Allison:
"Nuclear Terrorism: The ultimate preventable catastrophe"

Prof. Michael May

Nuclear terrorism is an old problem: What's changed?

- Easier access to nuclear materials
  (Greater supply)
- Greater technological sophistication and more information
  (More information)
- Proclivity toward greater level of violence
  (Greater demand)

Ukraine

How can terrorists get a nuclear bomb?

- Steal or divert a bomb
- Steal or divert components and assemble
- Steal or divert nuclear materials and build a bomb

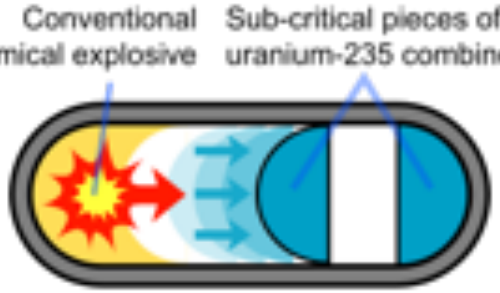
See NTI "Last Best Chance" film (2006)

Improvised nuclear device

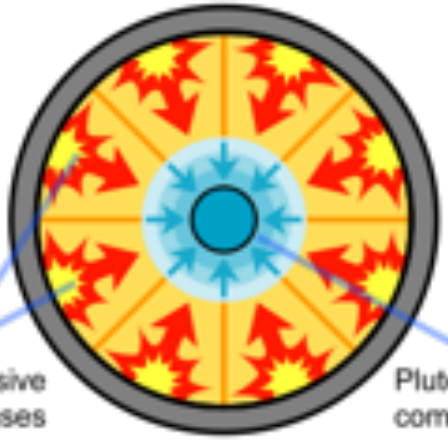
- Fissile materials (HEU or plutonium)
- Weaponize (build a rudimentary bomb)
- Delivery (plane, van, or boat)

Two paths to the bomb

Plutonium (Produced in reactors)

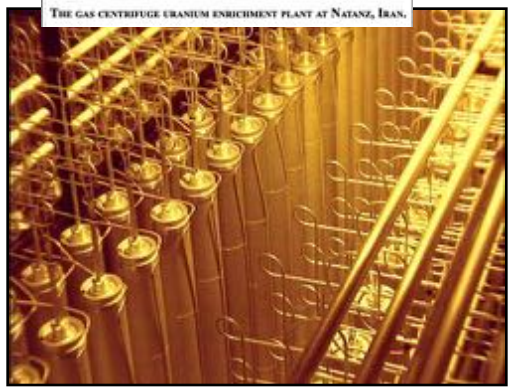


Gun-type assembly method



Implosion assembly method

Uranium-235 (Produced by enrichment)



Good news: Reactors and enrichment are beyond means of terrorists

The bad news: There is plenty to steal or divert

Uranium-235

- 1,900,000 kg HEU in world inventory (A few tens of kilograms for a bomb)

Russia	~1,100,000 kg	Pakistan	~1,100 kg	Kazakhstan	10,800 kg
U.S.	705,000 kg	India	~ 510	Belgium	300
China	~22.000 kg	Israel	~ 34	Canada	1,350
France	~34,000 kg	Japan	2,000	South Africa	~ 700
UK	23,400 kg	Germany	1,000		

Plutonium

- 1,830,000 kg Pu (490,000 kg separated) (< 10 kg for a bomb)

Russia	~183,000	Pakistan	40 kg	North Korea	~ 40 kg
U.S.	92,000	India	~1,600	Belgium	3,500
China	4,000	Israel	600	Switzerland	800
France	84,000	Japan	5,400		
UK	99,000	Germany	12,500		

The importance of keeping these materials out of terrorists' hands is now appreciated,
The technical difficulty of doing so is not.

Estimates from D. Albright, ISIS, 2003

Keeping fissile materials out of the wrong hands

Much more difficult than appreciated

- There is a lot of material
- It is in many locations
- It is in many different forms
- It is difficult to handle and count
- Secrecy hampers safeguards

You can't just "lock it down" like the gold at Fort Knox or the Kremlin treasures at the Armory

U.S. plutonium inventories demonstrate magnitude of the nuclear materials security challenge

- Total U.S. acquisition of plutonium – 111,400 kg

- Total U.S. used
  - Expended in Wartime and Tests 3,400 kg
  - Inventory Differences 2,800 kg
  - Waste (Normal Operating Losses) 3,400 kg
  - Fission and Transmutation 1,200 kg
  - Decay and Other Removals 400 kg
  - U.S. Civilian Industry 100 kg
  - Foreign Countries 700 kg
    - Grand total used 12,000 kg
  - Classified transactions & rounding 100 kg

- U.S. plutonium inventory as of 1994 99,500 kg

Plutonium: The First 50 Years (DOE: 1995)

Our confidence rests in the integrity and rigor of the safeguards system

Nuclear threats that arose from the collapse of the Soviet nuclear giant

- Missiles, warheads, and bombs
- Loose nukes, materials, and know-how (people)
- Nuclear technology exports
- Infrastructure - huge and dangerous

Nuclear facility Ukraine

Nuclear-fueled icebreaker

The Guard House at the former Soviet Nuclear Test Site, Semipalatinsk, Kazakhstan

The world was threatened more by Russia's weakness than her strength

Nunn-Lugar Cooperative Threat Reduction to improve nuclear security in Russia and other states of FSU

Russia

Russia

Russia

FSU

FSU

FSU

The greatest nuclear terrorism threats today

Pakistan

HEU research reactors

Russian nuclear complex

North Korea

Iran

Kazakhstan

Based on the likelihood of HEU or Pu being diverted or stolen and getting into the hands of terrorists

How to deal with the threats?

- There is no silver bullet
- Domestic safeguards is first line of defense
- Build strong second-line-of-defense systems
- Push for strong international cooperation
- Implement comprehensive safeguards systems

It is crucial to work on the demand side of problem:
The roots of terrorism

Safeguards must fit into a comprehensive architecture

- **Prevention**
  - Know-how and technology for making a bomb is available
  - Must keep fissile materials out of hands of terrorists
- **Detection**
  - Very difficult because of weak signature of plutonium and HEU, which, in addition, are easily shielded
- **Intervention and disablement**
  - Intelligence is key, but obviously difficult
  - Knowing the design is very important
- **Response**
  - Catastrophic consequences unavoidable
  - Preparation helps to limit number of people exposed to radiation and limits panic and disruption
- **Attribution**
  - Important technical challenges
  - Cooperation among nuclear weapons states important

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