

North Korea
Nuclear weapons, risk and hope

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Nuclear weapons, risk and hope
EE 190, Prof. M. Hellman
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The inevitability of proliferation

"A Report on the International Control of Atomic Energy".

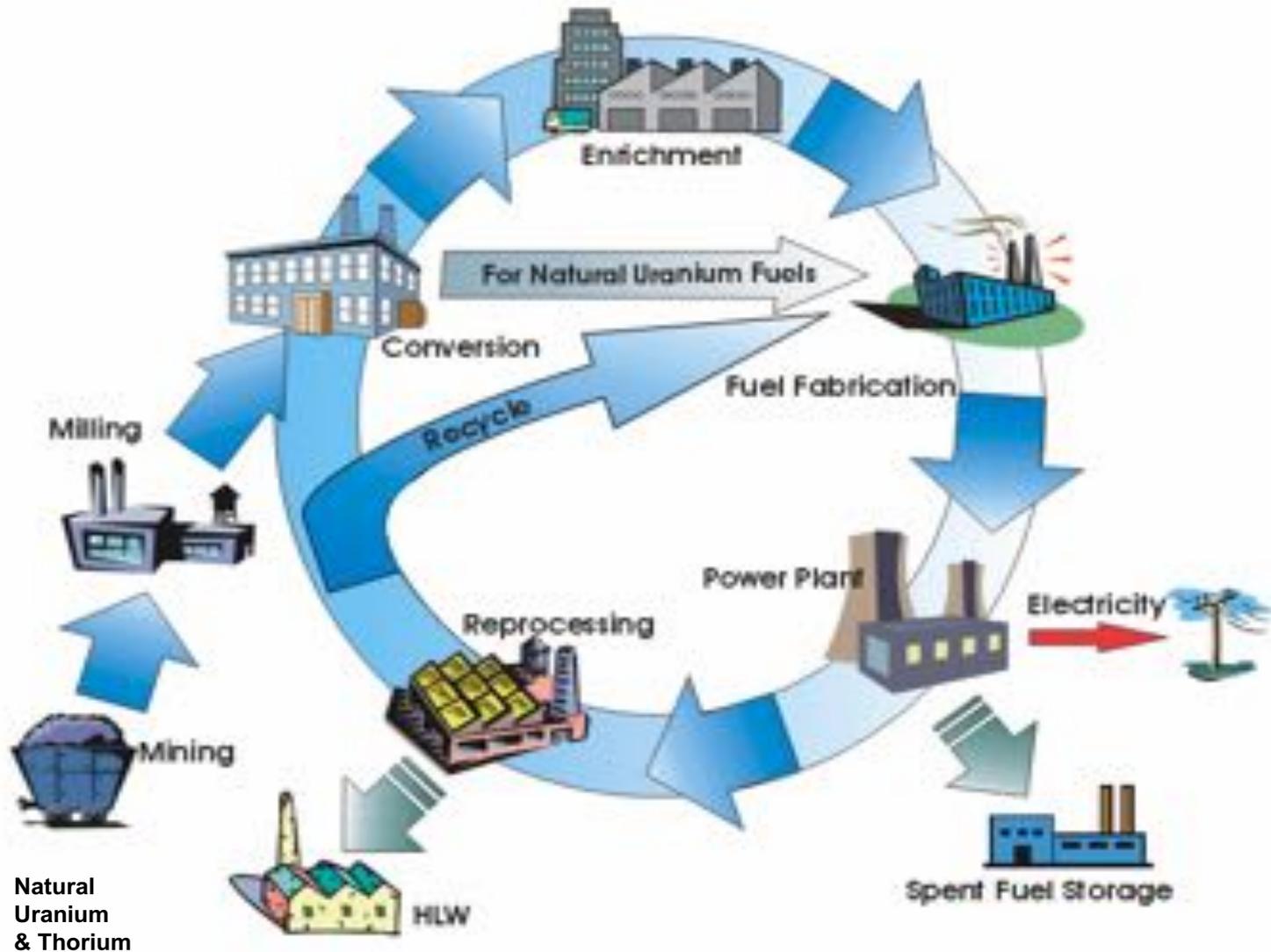
- It is further recognized that atomic energy plays so vital a part in contributing to the military power, to the possible economic welfare, and no doubt to the security of a nation, that the **incentive** to other nations to press their own developments is **overwhelming**.
- The development of atomic energy for peaceful purposes and the development of atomic energy for bombs are in much of their course **interchangeable and interdependent**.

The inevitability of proliferation

"A Report on the International Control of Atomic Energy".
Acheson-Lilienthal Report, March 28, 1946

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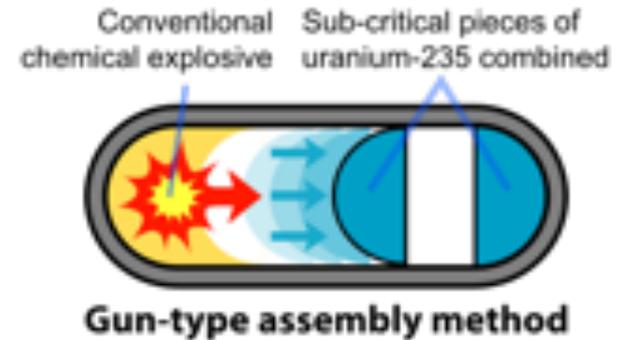
Nuclear Fuel Cycle



Two paths to the bomb

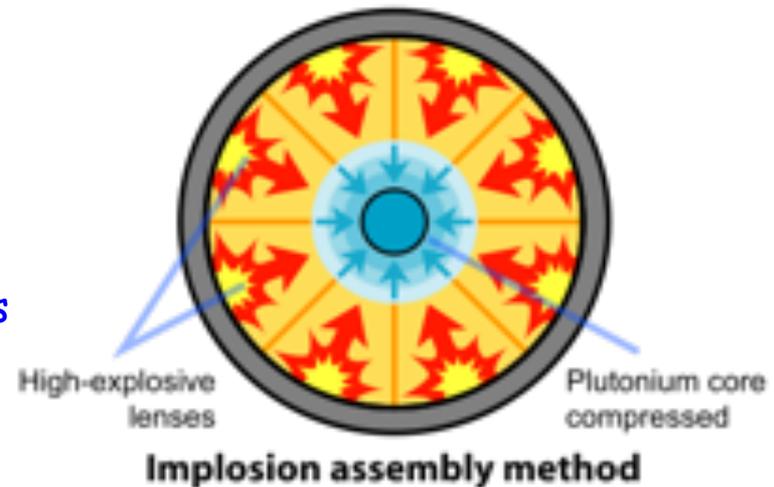
- **Uranium-235 (Produced by enrichment)**

- Uranium ore (0.7% U-235, the fissile isotope, the rest is U-238)
- Enrich uranium in U-235, typically > 90% (HEU)
 - Gas centrifuge, for example
- A few tens of kg required for a hypothetical bomb
- >20% HEU is weapons usable



- **Plutonium-239 (Produced in reactors)**

- Uranium ore to fuel rods or reactor targets
- Irradiate U-238 in reactor to make Pu-239
- Separate (extract) Pu-239 from spent fuel
- Pu-239 metal, typically >93% Pu-239 for bombs
- < 10 kg required for a hypothetical bomb
- Reactor-grade Pu (> 19% Pu-240) can be used for bombs, but is less desirable



North Korea's nuclear program

- What do they have?
- How did they get bomb?
- Why did they get the bomb?
- What is the greatest threat?
- Will they give it up?

Policy and politics become more important as
we go down the list

What is the DPRK nuclear program?

Yongbyon nuclear complex

- Fuel fabrication facility - uranium metal fuel
- 5 MWe reactor - Magnox (gas - graphite)
- Reprocessing facility - plutonium extraction (PUREX)
- 50 MWe and 200 MWe reactors - bigger reactors
- IRT-2000 research reactor - medical isotopes

Weapon manufacturing, weapons and uranium enrichment are all likely outside Yongbyon

What does North Korea have?

- **Nuclear weapons**
 - Plutonium: 24 to 42 kg (~4 to 8 bomb's worth)
 - Most likely simple, not confident to mount on missiles
- **Missile program**
 - Three long-range missile tests - one a total failure, two partially successful
- **Uranium enrichment**
 - Likely to have R&D, but not industrial scale
 - **Now admitted that they have some activity**

North Korea has the bomb, but not much of a nuclear arsenal.

How did North Korea get the bomb?

- Soviet "Atoms for Peace" - 1950s & 1960s
- Going solo, but under civilian cover - 1970s to 1992
- Freeze: Agreed Framework 1994 - 2002
- Bomb production: Jan. 2003 - July 2007
- First test, Oct. 2006; Second test: May 2009

North Korean bomb - 50 years in the making.
Civilian cover followed by breakout.

How do we know what they have?



Jan. 2004 Yongbyon



Aug. 2005 Pyongyang



Nov. 2006 Pyongyang



August 9, 2007, Yongbyon



Feb. 14, 2008, Yongbyon



Feb. 27, 2009, Pyongyang

They invited us in.

We have a deterrent



Jan. 2004 Yongbyon

North Korea went to great length to convince us they had a "deterrent" (Jan. 8, 2004)



Facility in which ~ 25 kg of plutonium were reprocessed in 2003



Reactor control room

When I expressed skepticism about reprocessing, they asked:
"Would you like to see our product?"

Ready to deal, but we want an LWR



Aug. 2005 Pyongyang

The test worked; we are filled with pride



Nov. 2006 Pyongyang

The test changed everything (Oct. 9, 2006)

- Especially the way DPRK looked at itself
- Bush Administration came to the table
- DPRK returned to six-part talks
- But, it left the DPRK in the driver's seat

Tell American skeptics we shut down the reactor



August 9, 2007, Yongbyon

Tell them that disablement is serious



Feb. 14, 2008, Yongbyon

DPRK was prepared to give up Yongbyon

February 2009 - We never got beyond Pyongyang

Pyongyang insisted on
developing its "space program"

Kim Jong Il still in power

Confidence was increasing

Signaled end of talks

And it needed another
nuclear test



The 2009 crisis had a purpose

- DPRK created a crisis (rocket launch) and used it to justify the second test
- After President Clinton's visit, declared it was ready to talk
- But it appears that we are back in limbo arguing about pre-conditions for returning to six-party talks

Why did North Korea get the bomb?

- Security - Most powerful deterrent against aggression
 - Best assurance to keep the regime in power
- Domestic reasons - increase tensions in area and distract people's attention from daily grievances. Make people more scared and more submissive.
 - External threat justifies the bomb, bomb justifies the required sacrifices.
- International statement - International prestige, bring U.S. to bargaining table, use as a bargaining chip

Let's look at what DPRK did not get

- It did not complete its bigger reactors

BY 1991 DPRK had a big nuclear program



5 MWe reactor
In stand-by mode
(6 kg Pu per year)



50 MWe reactor
~ 10 bombs/yr
Expected compl. 1995



200 MWe reactor Taechon
~40 bombs/yr, Exp. ~2000

Let's look at what DPRK did not get

- It did not complete its bigger reactors
- It could have 100+ weapons today
 - More than India or Pakistan
- It got virtually no nuclear electricity
 - 23 days of one LWR equivalent

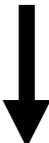
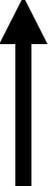
20 years of diplomacy did not get
the DPRK much

What are the nuclear security threats

- Nuclear bombs - low at current status
- Miscalculations or accidents - possible
- **Export - materials or technologies - very serious**
- Uranium enrichment (HEU) - low

We must prioritize the threat

Let's look at security risks history

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

DPRK exported while we looked for imports

Export history

- Missile exports - definitely
- Libya - Uranium hexafluoride (UF_6) - likely
- Syria - plutonium-producing reactor - yes
- Iran and Burma ???

These are big money makers for the DPRK and our greatest threats

Syrian reactor site at Al Kibar bombed by Israel on Sept. 6, 2007



Before bombing

After bombing



Satellite Photos Show Cleansing of Syrian Site

By [WILLIAM J. BROAD](#) and MARK MAZZETTI

Published: October 26, 2007, New York Times



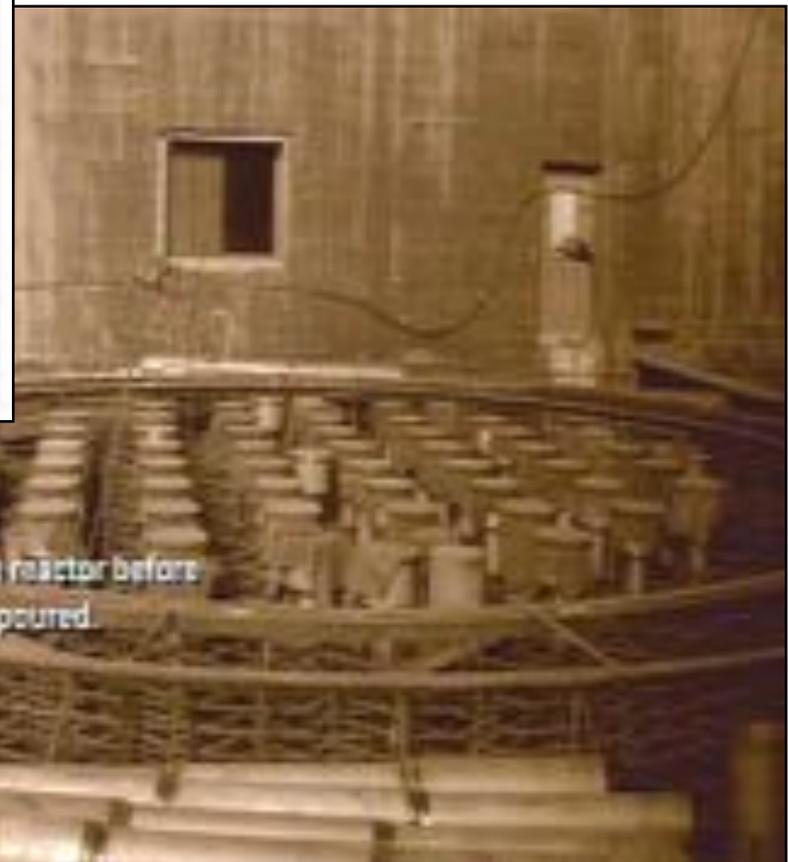
Suspected reactor site in Dayr az Zawr region bombed by Israel on September 6, 2007

Same site in Dayr az Zawr region in October after Syrian cleanup

Syrian gas-graphite reactor at Al Kibar



Yongbyon 5 MWe reactor

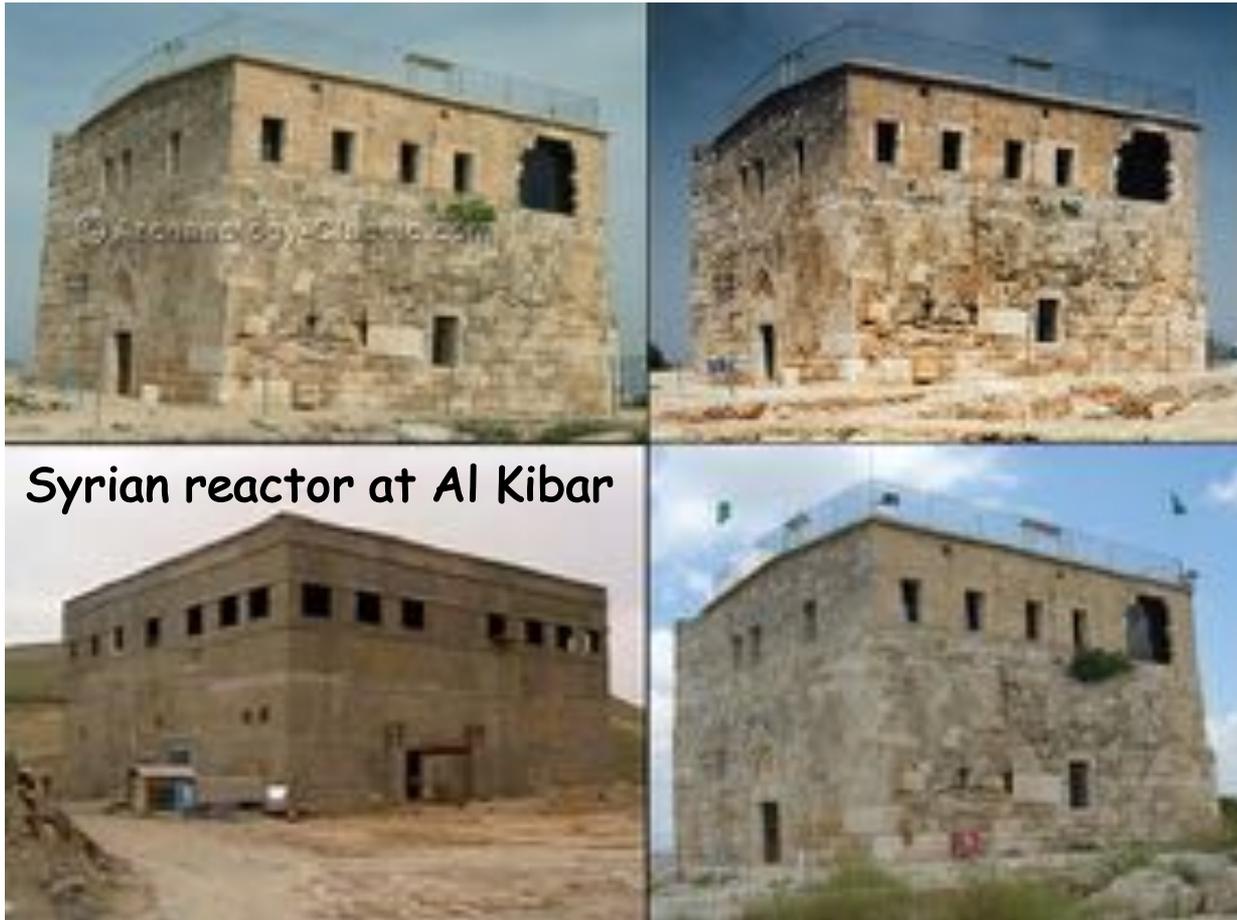


Syrian gas-graphite reactor at Al Kibar



A masterful job of deception in Syria

Byzantine fortress in Zippori (Sepphoris) National Park, Israel



Syrian reactor at Al Kibar

There are also Byzantine/Crusader-age fortress ruins in the immediate vicinity on the Euphrates River, at Halabiya and Zennobia

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)

China leads enforcement and U.S. leads developing incentive package

For the U.S., the biggest risks are political

The "three no's" will be difficult because:

- The need to manage alliances
- The difficulty of managing domestic politics

For the North the risk is existential



The winds of change

Pyongyang subway - Nov. 2006



What will "just do it" mean in DPRK?

North Korea: Repressive and reclusive

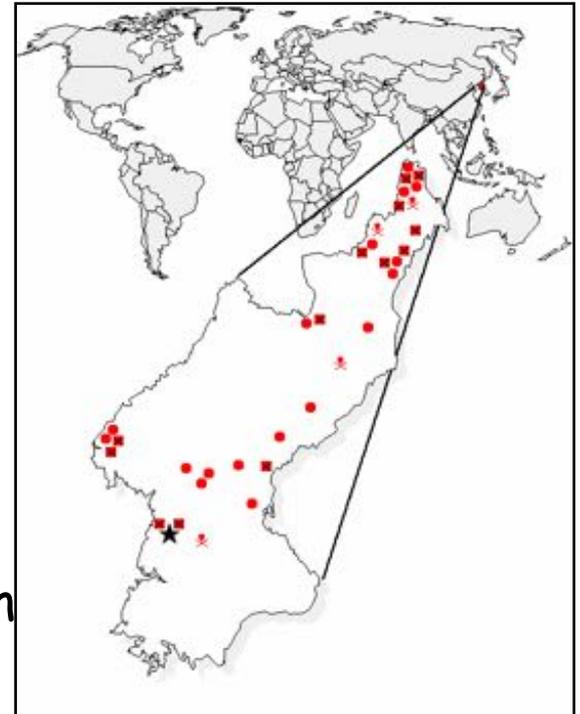


DMZ



- 4 death camps
- 17 forced labor concentration camps
- 13 torture facility prisons

Human rights concerns



But there is another face: Pyongyang - 2006



Signs of market activity: Pyongyang 2006



Tong il Street Market - signs of commerce



Instructions, discipline and friendship in Middle School #1



A touching performance at Children's Palace (Aug. 2005)





Arirang
Pyongyang, Aug. 9, 2007



Foreign Language School Pyongyang, Feb. 15, 2008



University for Foreign Studies
Pyongyang, Feb. 15, 2008





The winds of change are on our side

Pyongyang subway - Nov. 2006



Where there is swoosh, there is hope