A First-Hand Look at North Korea's Nuclear Program

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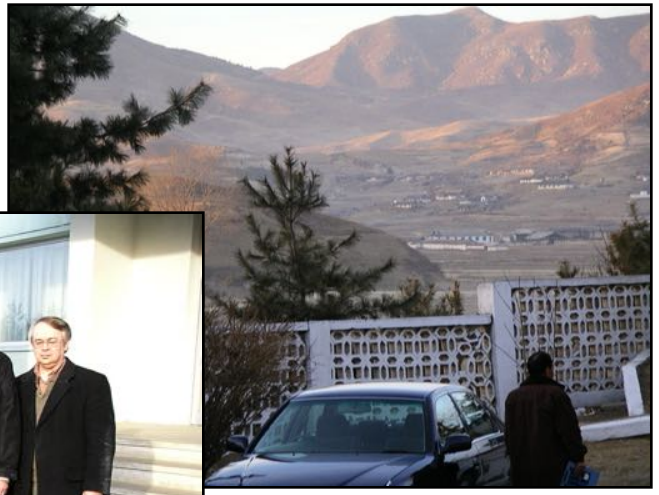
Visit to Pyongyang and Yongbyon
Jan. 6 to 10, 2004

Lewis delegation visit to Yongbyon – 8 January 2004



Key nuclear issues as of January 2004

- What is the status of the nuclear reactors?
  - 5 MWe (previously operating – generates ~6kg Pu/year)
  - 50 MWe – under construction (56 kg Pu/year)
  - 200 MWe – under construction (220 kg Pu/year)

- What happened to the spent fuel rods from 5 MWe reactor?
  - Placed in safe storage (25 – 30 kg Pu) with U.S. help
  - Monitored by IAEA until December 2002

- Does the DPRK have a uranium enrichment program?

- Does the DPRK have nuclear weapons?

Vice Minister Kim Gye Gwan
"This visit can have great symbolic significance."

"We view the delegation's visit to Yongbyon as a way to help contribute to breaking the stalemate and opening up a bright future."

"We will not play games with you. We have invited you to go to Yongbyon. The primary reason for this is to ensure transparency. This will reduce the assumptions and errors."

"Hecker's presence will allow us to tell you everything. This is an extraordinary approval by us."

5 MWe reactor restarted and operating smoothly

Reactor is providing heat and electricity for town …

Lewis delegation in reactor control room

… and producing 6 kg of plutonium annually.

But, the 50MWe reactor will not be completed any time soon

We concluded the 8000 spent fuel rods were no longer in pool

Lewis delegation at pool observation platform

Randomly chosen empty canister convinced us

Courtesy U.S. Canning Team

DPRK officials stated all fuel rods were reprocessed between mid-January and end of June, 2003

8000 spent fuel rods contained an estimated 25 – 30 kg of plutonium

Lewis delegation at Radiochemical Laboratory

Vice Minister Kim Gye Gwan denied HEU program

- Alleged Oct. 2002 admission of HEU program triggered the current nuclear crisis

During our visit, Kim Gye Gwan stated:

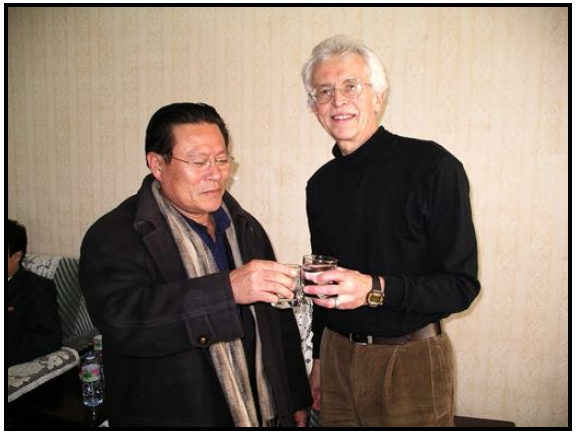
- We chose the plutonium path to a deterrent
- We have no HEU program
- We have no facilities or equipment
- We have no scientists dedicated to an HEU program

- A.Q. Kahn revelations shortly after our visit:

- Admitted export of enrichment technologies and equipment to Iran, Libya and North Korea

- Said to have taken 13 trips to North Korea

Ambassador Li Gun – "we have shown you our deterrent"



Of the three requisites of a "deterrent," we saw –

- The capability and capacity to make Pu metal sufficient for nuclear weapons

We did not see:

- Facilities or specialists who could design and build a nuclear device
- Or, facilities or experts who could integrate the device into a delivery system

Additional technical issues as of August 2005

- What is the status of the nuclear reactors?
  - 5 MWe - is it operating with a fresh core? (5 to 7 kg Pu/year)
  - 50 MWe – has construction resumed? (56 kg Pu/year)
  - 200 MWe – future plans? (220 kg Pu/year)
  - What is status of fresh fuel fabrication?

- Reprocessing status?
  - If reactor was refueled, what is status of spent fuel rods?
  - How much additional plutonium was extracted?

- Status of DPRK uranium enrichment program?

- Status of DPRK nuclear weapons program?

"We are not able to have you come to Yongbyon this time …
because it's not safe for you to visit"

Yongbyon Director Ri Hong Sop

"We are reprocessing the spent fuel now and do not allow any outsiders to visit"

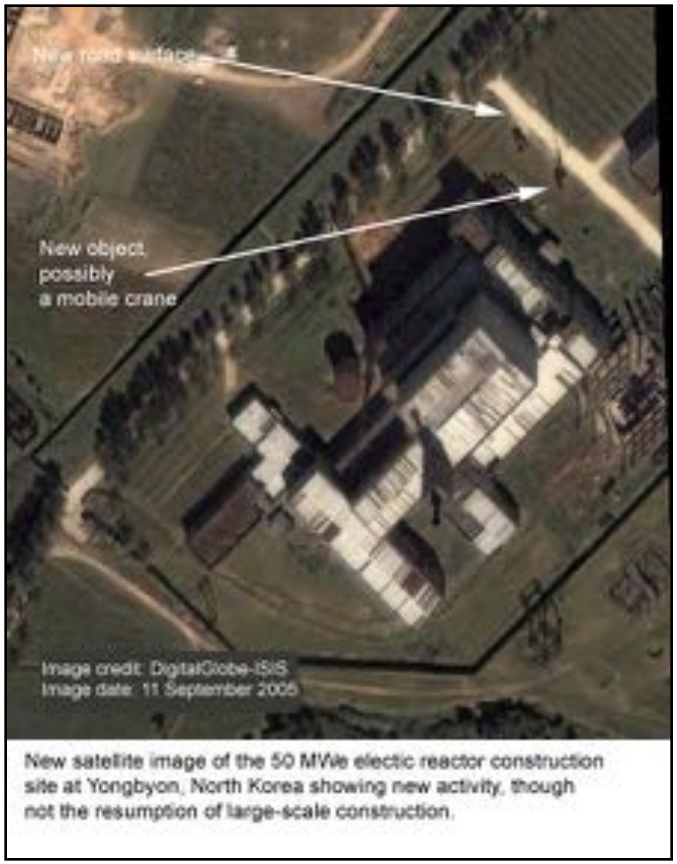
Status update on 5 MWe reactor

New satellite image of the 5 MWe reactor at Yongbyon, North Korea that shows a steam plume from the cooling tower. This plume indicates that the reactor is operating.

5 MWe reactor at Yongbyon

- Reactor operated from Feb. 2003 to end of March 2005
- It operated well at full power – 25 MWth
- We unloaded the reactor in April 2005
  - Prompted by concerns about fuel rods fabricated prior to Agreed Framework of 1994 and
  - To extract the plutonium
  - We found the fuel rods in good shape
- We reloaded the reactor and resumed operation in mid-June 2005

Status update on 50 and 200 MWe reactors



New satellite image of the 50 MWe electic reactor construction site at Yongbyon, North Korea showing new activity, though not the resumption of large-scale construction.

50 MWe reactor site

50 MWe reactor

- **Ready to resume construction soon**
  - Redesign has been completed
  - Construction workers preparing to return
  - Some components will be retained, others replaced
  - Only the containment vessel is inside now
  - Core was fabricated elsewhere in 1994 – will be retained
- **No commitment for a completion date**
  - A couple of years was implied, rather than five
- **Regulatory framework**
  - Start-up license from State Nuclear Regulatory Commission required before operations
  - Self-regulated for operations
- **Electricity will go into the grid**

200 MWe reactor

- **Still analyzing the 200 MWe construction**
- We have methods of recovering construction
- But, investment is bigger than starting anew

Fuel fabrication update

- **No fuel fabrication since 1994**
  - Natural uranium, U-Al metallic fuel
  - Facility under IAEA inspection until 12/2002
  - Significant corrosion problems – especially in fluorination process
  - No UF_4 produced since 1994
- **Loaded last fresh fuel charge in May 2005**
  - A few spare rods remain for 5MWe reactor
  - Some rods have been produced for 50 MWe
  - Dimensions slightly different than for 5 MWe
  - Mg alloy cladding is almost the same as 5 MWe, but more complicated for 200 MWe reactor
- **Refurbishing fuel fabrication facility now**
  - Expect to make more fuel for 5 MWe reactor next year
  - Will make fuel for bigger reactors later

Plutonium reprocessing update

Yongbyon Radiochemical Laboratory

- **8000 spent fuel rods were unloaded beginning in April 2005**
  - Cooled ~ 3 months in spent-fuel pool
- **Reprocessing to extract Pu began in late June**
  - Through-put increased by x 1.3 by technical improvements
  - Explained the mystery of the "second" line
  - It is used as a back-up and spare
  - Claimed reprocessing almost finished in late August
- **As in 2003, the Pu was processed to metal**
- **When asked about fuel burn-up, reply was:** "you know the power and the operating times, you can calculate it."
- **U.S. estimates are 10 to 14 kg Pu metal was extracted during this campaign**

Isotope production update

- **Soviet supplied IRT research reactor**
  - Began operation in 1965 at 2 MWth
  - Pool-type, enriched U fuel, LW moderated, cooled, and reflected
  - Increased power to 8 MWth by using 80% HEU
  - Placed under IAEA Safeguards in 1977
  - Suspected of making Pu with U-238 target until 1991
  - Used for neutron research in early days
- **Adjacent hot cells for isotope separation**
  - Small capacity hot cells
  - Can be used for reprocessing or isotope separation
- **Isotope production**
  - Run sparingly now for I-131 isotope production
    - 8 day half life, used for thyroid cancer therapy
  - Problem of no new fuel since Soviet demise in 1991
  - Very interested in more isotope production work
  - Believe they can extend lifetime another 20-30 yrs
- **IRT not part of Agreed Framework**
  - Never much interest from IAEA

Technical summary of nuclear status

- **5 MWe reactor**
  - Operated for 26 mo., unloaded, reloaded – operating well at full power (can run indefinitely).
- **Reprocessing**
  - Throughput improved by x1.3; reprocessing of 8000 fuel rods almost complete.
  - Will have extracted 10 to 14 kg plutonium (Pu) [U.S. estimate].
- **Reactor construction**
  - Redesign of 50 MWe complete. Construction workers preparing to restart construction.
  - 200 MWe still under study. Cost more to complete than to start over.
- **Radioisotopes**
  - Run Soviet-supplied IRT research reactor occasionally to produce I-131 for thyroid cancer therapy. Limited by not having received fresh fuel since Soviet times.

We were given the impression that DPRK is moving full-speed ahead with its nuclear weapons program

Best estimate of DPRK nuclear status as of Nov. 2005

- **Plutonium**
  - < 1994 (IRT & 5 MWe) ~ 8.4 kg (1+ weapons worth)
  - 2003 (5 MWe) ~ 25 kg (4-6 weapons worth)
  - 2005 (5 MWe) ~10-14 kg (~ 2 weapons worth)
- **Nov. 2005. Highly likely to have 43 ± 10 kg of separated plutonium**
  - > 2005 5 MWe capacity ~ 5-7 kg/yr (1+ weapon worth/yr)
  - Future 5 + 50 MWe ~ 60 kg/yr (~ 10 weapons worth/yr)
- **Nuclear weapons**
  - We know very little. Given demonstrated technical capabilities, we must assume they have produced at least a few simple, primitive nuclear devices.
  - No information on whether or not devices are missile capable.
- **Uranium enrichment**
  - We know even less. Continued denial by Ministry of Foreign Affairs against very strong indications that DPRK has some level of uranium enrichment program.

*Based on estimates by David Albright and Kevin O'Neill, editors, "Solving the North Korean Nuclear Puzzle," ISIS Reports (The Institute for Science and International Security), Washington, D.C., 2000 and Lewis/Hecker Jan. 2004 and Aug. 2005 visits.

Some key diplomatic issues as of August 23, 2005

- What does denuclearization of Korean Peninsula mean?
- What are DPRK's conditions for denuclearization?
- What is DPRK's view of sequencing steps toward denuclearization?
- What does DPRK view as acceptable levels of safeguards?
- How insistent is DPRK on peaceful nuclear programs and on an LWR reactor?

DPRK denuclearization per VM Kim Gye Gwan

Denuclearization:

-The DPRK has made a bold decision to agree to the denuclearization of the Korean Peninsula. Denuclearization means no nuclear weapons and no nuclear weapons program.

- To the DPRK that means the entire peninsula. The DPRK claims that to the U.S. that means denuclearization of DPRK only.

- A denuclearized Korean Peninsula was said to be a death-bed wish of the Great Leader, Kim il Sung.

Conditions for DPRK denuclearization:

-U.S. must remove the nuclear threat against the DPRK – guarantee against the U.S. use of nuclear weapons.

-U.S. must prove there are no U.S. nuclear weapons in the ROK, subject to DPRK verification.

-U.S. must remove the nuclear umbrella from the ROK and alter U.S. forces accordingly.

-U.S. must recognize the sovereignty of the DPRK. *[This was stated as a goal, but also appeared to be a precondition. In addition, Kim stated that a light-water reactor (LWR) is the key to sovereignty].*

-U.S. must normalize its relations with the DRPK. *[Kim stated that as relations are normalized, we'll abandon our nuclear weapons].*

DPRK officials were not clear on how these conditions would be sequenced with the actions of the other parties.

Peaceful nuclear energy (PNE) – a must for DPRK (VM Kim Gye Gwan)

-DPRK insists on the right to PNE and the right to exercise the right.
  - It is our sovereign right; it is not something you, the U.S., grants us.
  - The light-water reactor (LWR) would demonstrate our sovereignty.
- DPRK energy study concluded it needs LWR for self reliance on energy and the economy.
  - DPRK has few natural resources – no oil, insufficient coal, but lots U and graphite.
  - Other countries have reached the same conclusion (Pres. Bush announced enhanced nuclear energy program for U.S.)
- DPRK is determined to have PNE. Either the U.S. supplies an LWR (or can have another country supply it) or the DPRK will continue with the graphite-moderated reactors. The U.S. must make a choice.
- If we do not get an LWR, then we will continue with our graphite-moderated reactors and consider not reprocessing the spent fuel.
- To DPRK, PNE includes radioisotopes for medical, agricultural, and industrial applications.
  - The U.S. seemed confused, but bottom line was nothing nuclear, forever.

Although Kim claimed that an LWR is needed because of energy, when we presented conventional alternatives, he fell back to the sovereignty position.
His bottom line: No LWR, no deal.

DPRK (Kim Gye Gwan) offered the following safeguards for PNE

- Because of U.S. concerns over past DPRK record, DPRK is willing to put reactor under complete IAEA safeguards.
- Since LWR can potentially lead to nuclear weapons, DPRK said it is prepared to let the U.S. operate the reactor until DPRK rejoins the NPT and abides by IAEA inspections. Then, it can be turned over to DPRK to operate.
- DPRK ready to return to NPT and abide by IAEA inspections once relations with U.S. are normalized.
- LWR enrichment concerns can be dealt with in two ways:
  - Build an inspected enrichment facility, or
  - Buy fuel from the outside until the U.S. concern is removed.
- If they keep the graphite-moderated reactor, they are prepared to stop reprocessing.
  - This is not so easy, however, since the Director stated the spent fuel can only be stored up to five years.

DPRK agrees (at least for the time-being) to forgo the front end (enrichment) and back end (reprocessing) of the fuel cycle and place the reactor(s) under international safeguards.

That would be a very big step if they could be trusted and if they agreed to eliminate their current clandestine enrichment activities.

Discussions of nuclear weapons risks of two reactor fuel cycles

S.S. Hecker and Yongbyon Dir. Ri Hong Sop (August 25, 2005)

	Graphite-moderated reactor (Magnox)	Light-water reactor (LWR)
Front end	- No enrichment (but U technology to UF_4).	- 3-4% enriched fuel. - Enrichment poses greatest risk.
Reactor	- Not very efficient for electricity - Makes good weapons-grade Pu. - Can be degraded by long burn-up (less weapons-usable).	- Efficient for electricity. - Poor WG Pu. - Can be enhanced by short burn-up.
Back end	- Reprocessing is direct nuclear weapons threat. - DPRK has adequate facilities.	- Reprocessing represents some weapons threat. - Need to modify reprocessing facility.
Technical risk reduction	- High burn-up. - IAEA monitored reprocessing or export spent fuel.	- Fuel leasing (no enrichment and return fuel. - IAEA Additional Protocol.

Both fuel cycles can lead to nuclear weapons, although some technical measures can be taken to reduce risk. Level of acceptable risk is political decision.

Discussions of technically preferred path to energy

Lewis delegation with VM Kim Gye Gwan and DG Li Gun (Aug. 24-26, 2005)

- **Put off LWR decision; focus on near-term conventional energy solution.**
- **Implement immediate, massive enhancement of energy infrastructure, electrical grid, and conventional fuel supply.**

- Upgrade all phases of energy sector* - production; - transmission and distribution; - use

- **Production**
  - Coal infrastructure (mining – electricity, spare parts, tools; transportation system)
  - Thermal power plants (rebuild, supply boilers, turbines, build multiple small units, etc.)
  - Alternative energy (maintain hydros, build new ones, wind, biomass, etc.)
  - Convert some units and build others for LPG (liquid petroleum gas)
- **Transmission and distribution**
  - Upgrade (power transmission and distribution lines, switching stations, frequency controls)
  - Construct national grid to connect current, inadequate grid
  - Automated switching (replace current telephone and telex modes)
- **Use**
  - Rural energy rehabilitation (focus on agricultural and rural residential)
  - Upgrade, replace, maintain critical industrial infrastructure
  - Many generic upgrades (control & communications, modern manufacturing, tools, spares)

DPRK reaction ranged from energy infrastructure upgrade is "good idea," to "don't tell us about our own country, we need LWR. No LWR, no deal."

* Based on Nautilus Institute study, Peter Hayes, July 2005

One possible option for resolution of nuclear crisis

- Right to peaceful nuclear energy. Don't exercise now, but keep window open.
  - Help DPRK with radioisotope program for medicine, agriculture and industry.
  - Keep Kumho LWR site in stand-by to show good faith for future LWR option.
- U.S. offers concrete steps toward normalization of relations with DPRK.
- Focus 5-party assistance on immediate, massive revitalization of energy infrastructure, electrical grid, and conventional fuel assistance.
- DPRK eliminates nuclear weapons, nuclear weapons program, nuclear materials, all graphite-moderated fuel-cycle facilities, including all existing uranium enrichment facilities and equipment.
- DPRK returns to NPT and abides by all IAEA regulations and monitoring (including the Additional Protocol) – perhaps with additional measures.
- Five parties offer help for safe and secure remediation of Yongbyon nuclear site and rehabilitation of nuclear workforce.

Sequencing of steps and verification will be major challenges

Why does the DPRK want nuclear weapons?
A Russian perspective

- Use them as a diplomatic card to bring U.S. to bargaining table
  - Gain concessions – desire to negotiate a compromise based on mutual concessions, equality, and reciprocity
- Most powerful and cheapest deterrent against aggression
- Domestic consumption – increase tensions in area and distract people's attention from daily grievances. Make people more scared and more submissive
- International statement - Demonstrate that DPRK won't bend under pressure and defy all forms of control
- Raise international status – demonstrate technological achievement

Natalia Bazhanova in
Moltz and Mansourov (2000)

North Korea is the No. 1 national and international security concern – Mohamed ElBaradai – Director General, IAEA

"North Korea walks out of the NPT"

- It made use of loopholes in the agreement and in the export control system. It developed a second track of HEU for nuclear weapons.
- It sends the worst signal to would-be-proliferators: if you want to protect yourself, accelerate your program, because then you are immune in a way.
- If this is not a threat to international peace – what is?
- The Security Council did not even respond with a "we are concerned."

M. ElBaradai, Council on Foreign Affairs, New York, May 14, 2004

Possible threat matrix for four of the parties

U.S.	DPRK	ROK	China
Fissile materials in hands of terrorists	U.S. military attack (existential)	U.S. intervention and instability	U.S. intervention, instability, war
Use of nukes in act of desperation or miscalculation	Regime change (existential)	Regime change, instability, and derail economy	Regime change and rise of U.S. influence
Accidental detonation of nuclear device	Increased sanctions and consequences	Collapse of U.S. – ROK alliance	Derail China's economic rise
Instability and regional arms race	Limit exports and cash flow	Blackmail/coercion	Further fuel Japan's militarism
Threaten or blackmail U.S. and neighbors	Promote social unrest & instability	Nuclear accident	Undermine int'l nonproliferation regime (Japan, Taiwan, ROK)
Undermine the int'l nonproliferation regime	Impede relations with neighbors and access to int'l financial assistance	Undermine int'l nonproliferation regime (Japan)	Nuclear accident
Long-term missile plus nuke threat to U.S.			

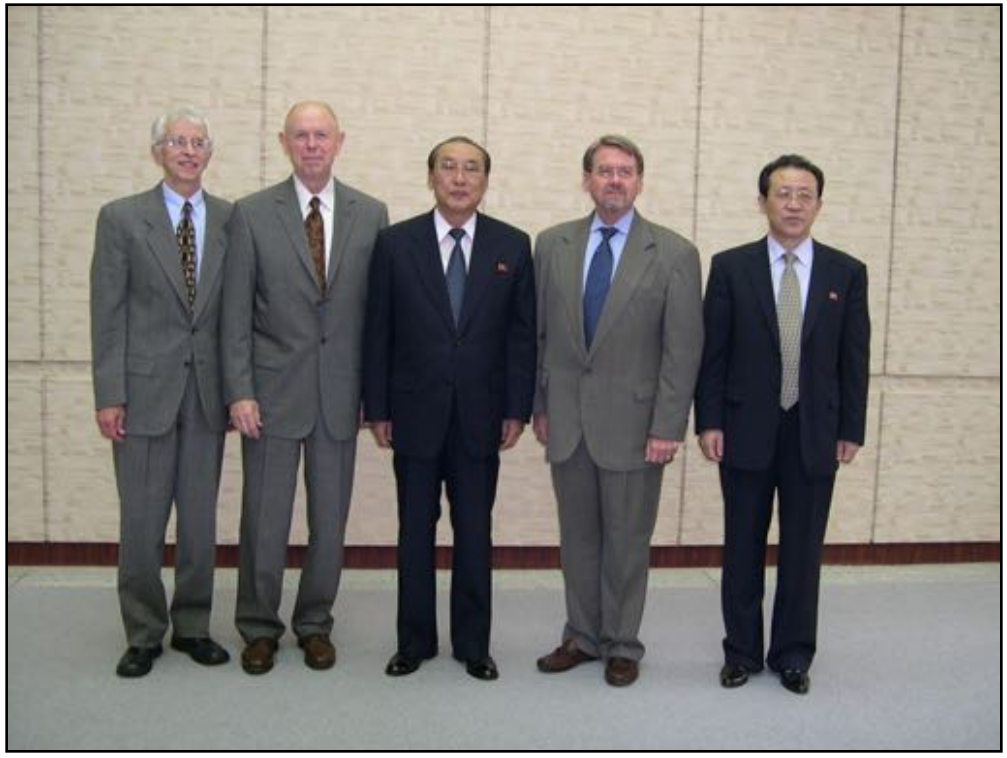
Possible threat matrix for Japan and Russia

U.S.	DPRK	Japan	Russia
Fissile materials in hands of terrorists	U.S. military attack (existential)	Nuclear attack	U.S. intervention and instability
Use of nukes in act of desperation or miscalculation	Regime change (existential)	Nuclear terrorism	Regime change and rise of U.S. influence
Accidental detonation of nuclear device	Increased sanctions and consequences	Nuclear accident	Potentially threaten Russia's civilian nuclear exports
Instability and regional arms race	Limit exports and cash flow	Blackmail/coercion	Nuclear accident
Threaten or blackmail U.S. and neighbors	Promote social unrest & instability	Instability, undermine economy	Undermine int'l nonproliferation regime (Japan, ROK)
Undermine the int'l nonproliferation regime	Impede relations with neighbors and access to int'l financial assistance	Undermine int'l nonproliferation regime	
Long-term missile plus nuke threat to U.S.		Rethink its own nuclear posture	

Very positive visit to Academy of Agricultural Sciences

Visit to Agricultural Co-op – 2005 crops better than expected

Friendly reception by Yang Hyong Sop – Vice President, Presidium of SupremePeople's Assembly



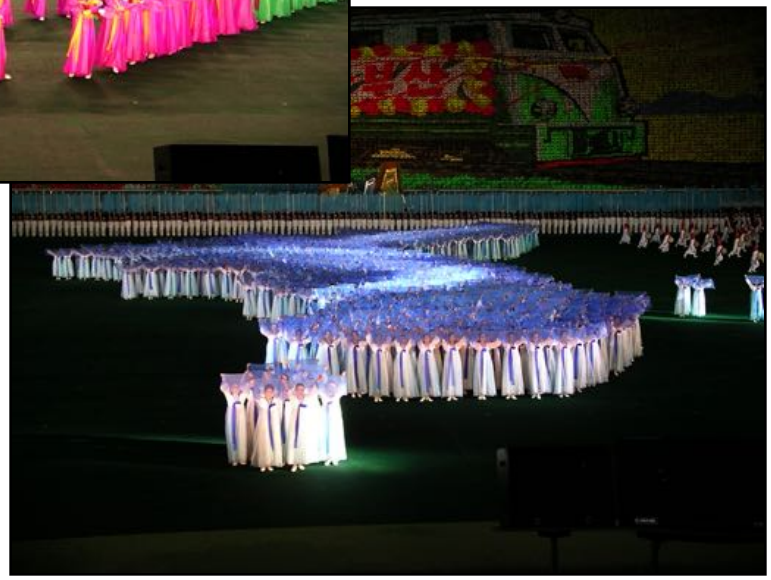
Return visits with KAS and CPIT

Academy of Sciences Councillor Ri Mun Ho

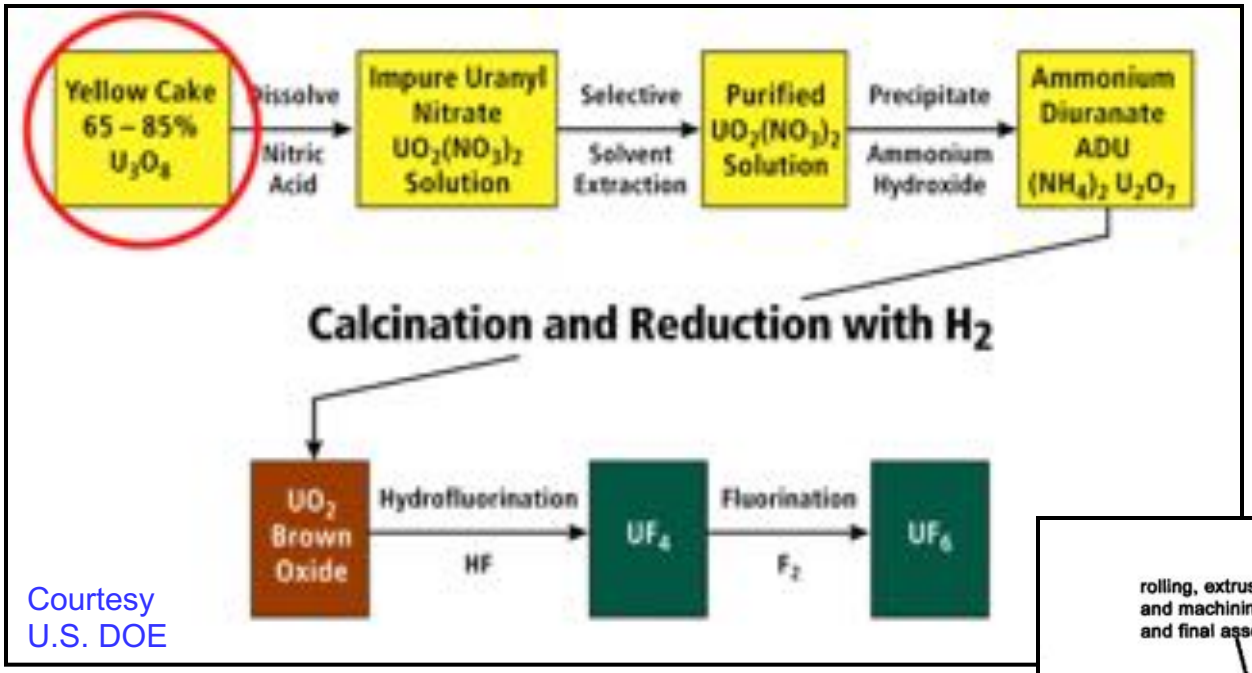
CPIT Jon Ki Man

A touching performance at the Children's Palace

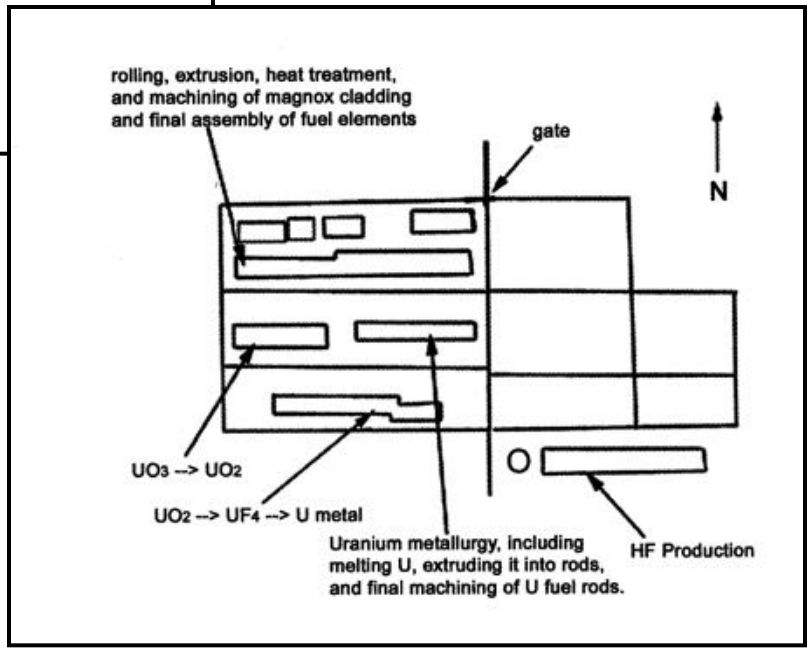
A masterful performance of "Arirang"



Looking for uranium signatures in North Korea



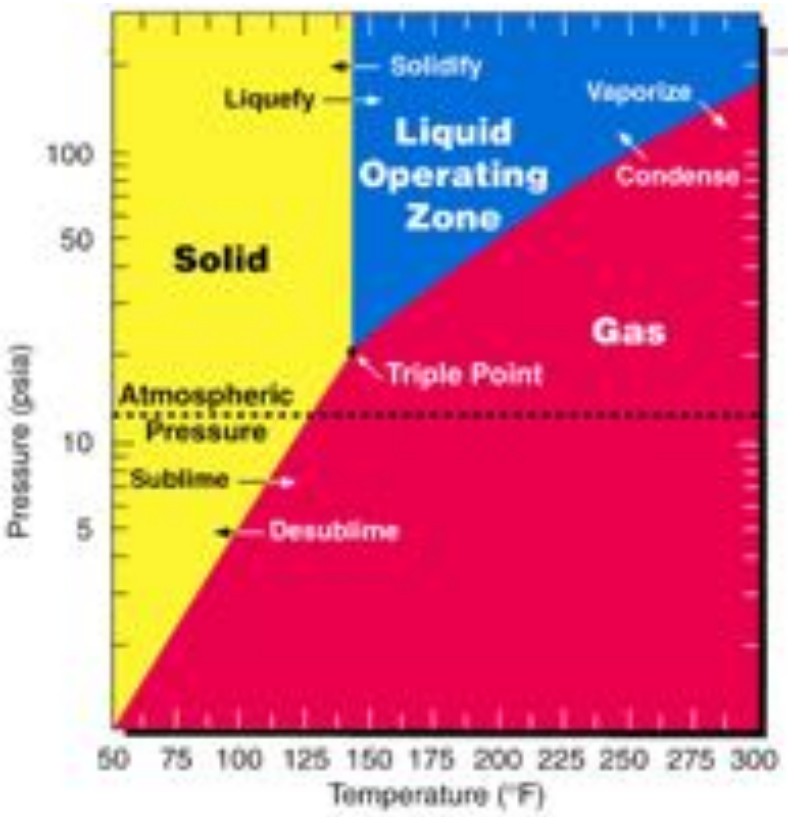
Courtesy
U.S. DOE



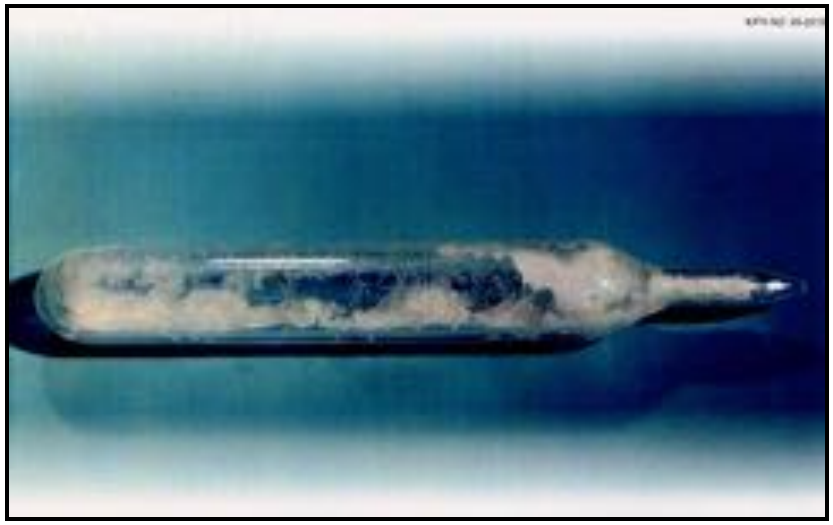
Uranium fuel rod fabrication in Yongbyon stops only one step short of UF_6

Courtesy, D. Albright, ISIS

UF_6 – the key ingredient for enrichment to HEU



The uranium hexafluoride [UF_6] phase diagram



Within a reasonable range of temperature and pressure, it can be a solid, liquid, or gas. Solid UF_6 is a white, dense, crystalline material that resembles rock salt.

Spent fuel pool held 8000 spent fuel rods from reactor operations prior to 1994

Spent fuel pool building
(before)

DPRK spent fuel rod storage - before

DPRK fuel baskets

Spent fuel building
(during canning team effort)

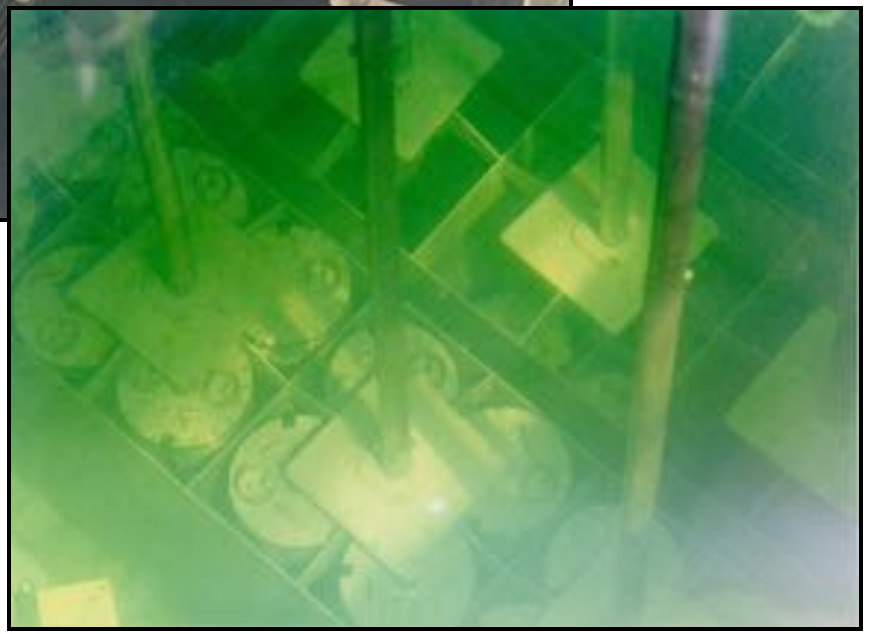
Courtesy U.S. Canning Team

Remote possibility that 8000 fuel rods are stored somewhere, such as in the dry pit in the pool building…

… but such storage would be dangerous and foolish.

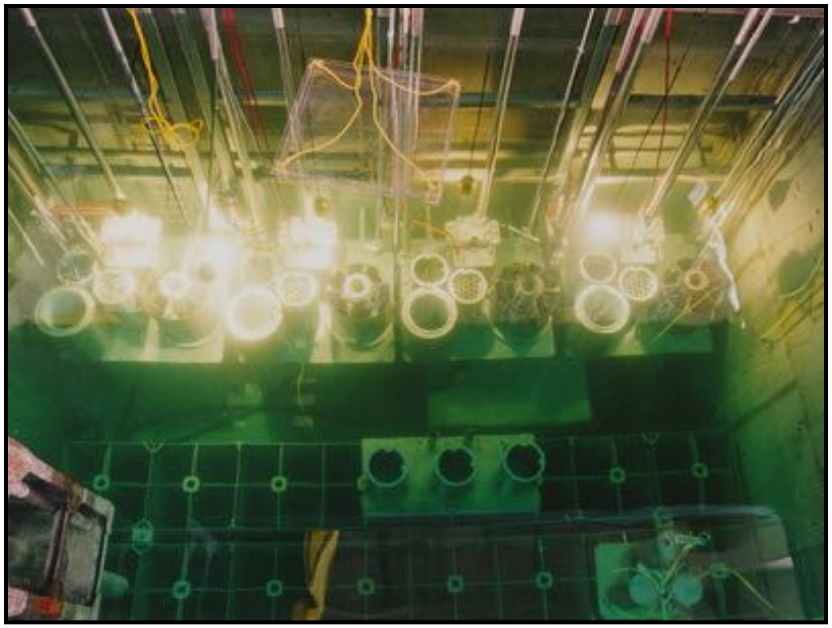
Courtesy U.S. Canning Team

IAEA monitored the U.S. safeguarding mechanisms



Courtesy U.S. Canning Team

U.S. Canning Team repackaged rods for safe storage



Courtesy U.S. Canning Team

DPRK nuclear program – Valery Denisov (Moltz & Mansourov, 2000)

- mid-1950s Began theoretical studies at Dubna
  - Soviet – DPRK agreement on peaceful uses of atomic energy
  - Some training in Japan, East & West Germany, China

- Soviet assistance in construction of Yongbyon nuclear center
  - 2 MWth research reactor (LW moderated and cooled)
  - Enriched U fueled
  - Later upgraded by DPRK to 8 MWe
  - Small radiochemical laboratory built by Soviets

- DPRK focus on nuclear power stations (1970 and 1980 WPK Congress)
  - Decision on gas-graphite reactors (26 million tonnes of U ore)

DPRK nuclear program – Valery Denisov (Moltz & Mansourov, 2000)

- 1970s Kim il Sung decision to build nuclear weapons capability to ensure the regime's survival
    - Feeling of having lost economic competition with ROK
    - Policies of Soviet Union and China viewed with greater suspicion
- Enhance the Yongbyon nuclear center
- Nuclear Energy Research Institute
- Radiological Institute
- Establish Department of Nuclear Physics at Pyongyang State Univ.
- Nuclear reactor technology chair at Kimch'aek Polytechnic Univ.
- Soviet research cyclotron installed at Kim il Sung University
- Industrial cyclotron installed in Pyongyang's suburb

- Moved most of the nuclear institutes from Pyongyang to Pyonsong (50 km away) and combined into scientific center (part of Korean Academy of Sciences)
    - Now houses 17 institutes and one experimental test facility
- Funding from State Committee on S&T and Ministry of Finance

KAS institutes involved in nuclear research

- Institute of Physics (est. 1952) – 250 persons
  - Director Cho Chen Nam (laser physics)
  - Deputy Ryo Yin Gan (signeto-electric materials)
  - Lasers & optics, solid state, extreme conditions, acoustics & surface waves
  - Nam Hong Woo (nuclear and particle physics)

- Institute of Mathematics
  - Director Prof. Ho Gon
  - Academician Lee Cha Gon
  - Academic Computing Center

- Institute of Electronic Control Machines – flexible manuf. systems
  - Contols, servers, math support, digital program controls, robotics, and sensors

- Institute of Electronics
  - Production of large integrated circuits for computers

Nuclear program controls

- Ministry of Atomic Energy for nuclear-energy sector
  - Minister Choe Hak Kyun (alternate member of Central Committee of WPK and Supreme Assembly Deputy)
- Ministry of People's Armed Forces – must have controlled military effort
- Nuclear institutes controlled by State Committee on S&T
  - SCS&T chaired by Choi Hee Cheng (same connections as Choe H K)
  - Guidance and oversight by Chon Byon Ho – member of Politburo of the WPK Central Committee and secretary
- Both energy and military nuclear programs "personally" controlled by General Kim Jong Il

Chinese Academy of Engineering Physics view of North Korea nuclear program (Liu Gongliang, Xie Dong and Shi Xueming)

NK has a rich uranium resources

- The known 16 uranium mines, 4 uranium milling facilities, the most important one is "Mt. Chonma Power Plant" which is a suspected uranium enrichment facility.
- Uranium conversion and fuel fabrication facilities built in 1980's.

There are several suspected Uranium Enrichment facilities while they are not confirmed

- However it is certain that NK plans to use the centrifuge technique.
- It also reported that NK imported duralumin and frequency converters from outside world. However, it needs at least 2000 centrifuge's cascade connection to form a so called "pilot plant" and this would take several years.
- Exception. It could import thousands of centrifuges from other countries or buy relatively HEU from outside. However, the possibility is very small.

CAEP estimate of plutonium production

- The 5MWe reactor is far away from a "medium test plant". So, an average burnup of 150-200MWd/t U is more reasonable, in which case, there are 0.15-0.2kg plutonium/ton uranium. So, 4-9kg plutonium have possibly been extracted.

- There are at most 14kg plutonium contained in the 8000 spent fuel rods.

- There are at most 30kg plutonium contained in all spent fuel rods.

- There are 2kg plutonium contained in the IRT-2000 reactor.

- No other sources of plutonium such as smuggling is of concern.

(Liu Gongliang, Xie Dong and Shi Xueming)

China: CAEP estimate of nuclear weapons capability

- **Nuclear material ≠ Nuclear weapon**
  - NK wants a nuclear weapon so as to defend the threat from US. A nuclear weapon must be armed in missiles.
- **NK is capable of nuclear design.** 50MWe reactor is designed by NK itself. So it has strong nuclear design capability. Furthermore, its computers are much better than what the nuclear weapon states used to design their first atomic bomb.
- **Performed many high explosive tests.** It is said more than 70 tests have been performed,so there is great possibility for NK to take related weapon components' test.
- **Capable of producing neutron source**
- **We don't know to what extent NK grasps technologies required for integration of nuclear device into a missile.**

(Liu Gongliang, Xie Dong and Shi Xueming)

China: CAEP report conclusions (Liu Gongliang, Xie Dong and Shi Xueming)

- NK spent several decades in its nuclear weapons program. What they want is not a nuclear device but a nuclear weapon which can be armed in a missile so as to defend the threat from US.

- NK has the ability to produce a crude atomic bomb, however we are not sure about whether it can produce a nuclear warhead armed in missiles now.

- If NK has 4-9kg plutonium, it can produce 1-2 nuclear bomb. Under this circumstance, the possibility to have a nuclear test is very small. However, if it has 15kg plutonium, the possibility to have a nuclear test will be bigger.

(S.S. Hecker note: This report was made before evidence of reprocessing of 8000 spent fuel rods)