A Technical Assessment of the DPRK Nuclear Program

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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 IEAE until December 2002

- Does the DPRK have a uranium enrichment program?

- Does the DPRK have nuclear weapons?

Lewis delegation visit to Yongbyon – 8 January 2004

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

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 …

… and producing 6 kg of plutonium annually.

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

Lewis delegation in reactor control room

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

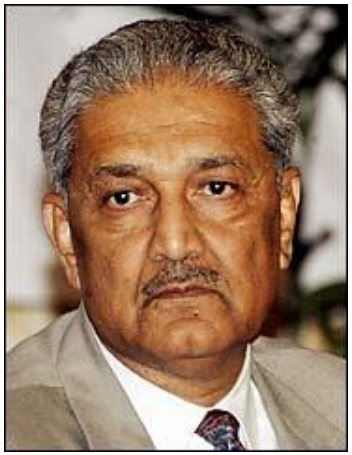
Lewis delegation at Radiochemical Laboratory

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. Khan – Pakistan's nuclear black marketer and "national hero"

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?

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?

"We are not able to have you come to Yongbyon this time …
we are not allowing outsiders because we are reprocessing"

Yongbyon Director Ri Hong Sop

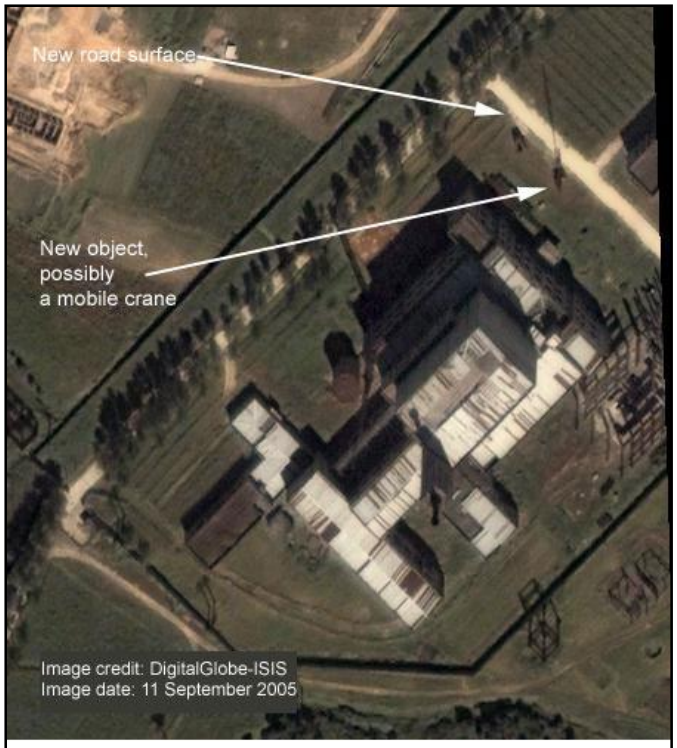
Status update on 5 MWe reactor

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

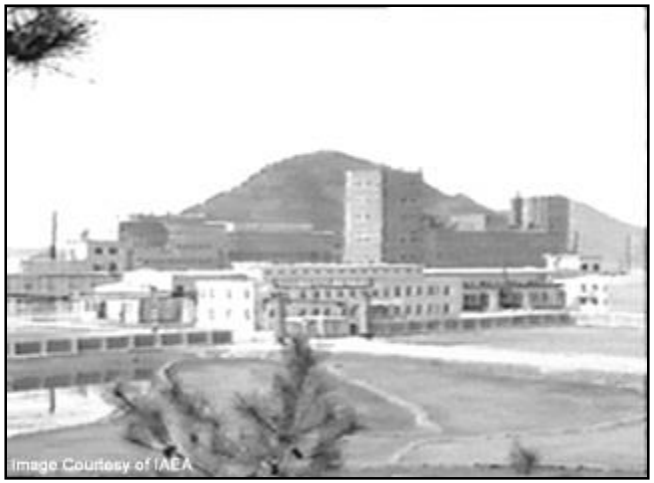
50 MWe reactor

- **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
- **Ri would not commit to a completion date**
  - He implied a couple of years, 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



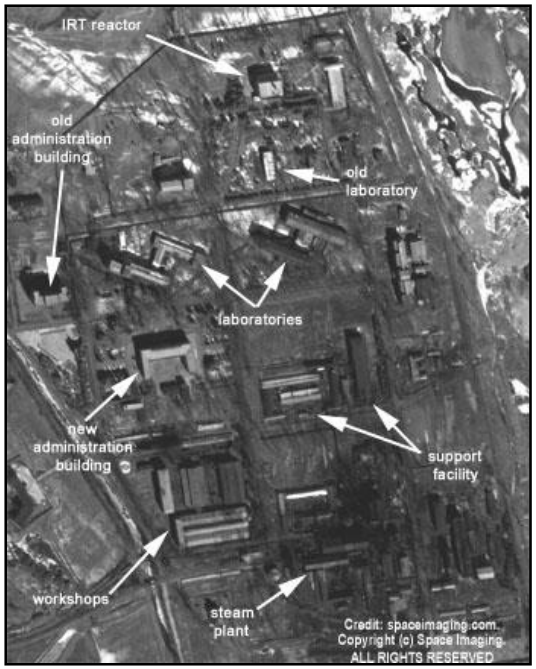
- **No fuel fabrication since 1994**
  - Natural uranium, U-Al metallic fuel
  - Facility under IAEA inspection until 12/2002
  - Significant corrosion problems – especially in fluorination process
  - No UF_4 produced since 1994
- **Loaded last fresh fuel charge in May 2005**
  - A few spare rods remain 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
  - Ri explained the mystery of the "second" line
  - It is used as a back-up and spare
  - Ri said reprocessing almost finished in late August
- **As in 2003, the Pu was processed to metal**
- **When asked about fuel burn-up, Ri said** "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 presented to DC government officials

- **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 12 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.

DPRK is moving full-speed ahead with nuclear weapons program

Rough 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 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 overwhelming evidence that they have 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.

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 Dir. Ri 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

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)

Threat matrix: Possible U.S. perspective

U.S.	DPRK	ROK	China
Fissile materials in hands of terrorists			
Use of nukes in act of desperation or miscalculation			
Accidental detonation of nuclear device			
Instability and regional arms race			
Threaten or blackmail U.S. and neighbors			
Undermine the int'l nonproliferation regime			
Long-term missile plus nuke threat to U.S.			

Possible DPRK view of U.S. threat

U.S.	DPRK	ROK	China
Fissile materials in hands of terrorists	U.S. military attack (existential)		
Use of nukes in act of desperation or miscalculation	Regime change (existential)		
Accidental detonation of nuclear device	Increased sanctions and consequences		
Instability and regional arms race	Limit exports and cash flow		
Threaten or blackmail U.S. and neighbors	Promote social unrest & instability		
Undermine the int'l nonproliferation regime	Impede relations with neighbors and access to int'l financial assistance		
Long-term missile plus nuke threat to U.S.			

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	

Most important technical threat reduction actions

- Prevent nuclear component and material export or trafficking
- Reduce weapon-usable plutonium inventory – remove from DPRK
- Stop production and processing of additional plutonium
- Dismantle any existing nuclear weapons and eliminate all plutonium
- Stop and eliminate uranium enrichment activities
- Eliminate infrastructure for nuclear weapons and nuclear materials
- Have DPRK rejoin NPT, allow IAEA inspections, and adopt IAEA additional protocol provisions for monitoring and inspection
- Assist DPRK nuclear workers make transition to non-weapons work

Mutual threat reduction diplomacy

DPRK	United States	Other parties
Immediately reduce plutonium inventory & freeze production#	Demonstrable security assurances*	Energy assistance (infrastructure & immediate energy)
Eliminate all plutonium inventories	Establish diplomatic relations Remove from terror sponsor list Remove sanctions, promote access to int'l financial institutions	Comprehensive energy strategy, agri. and economic assistance
Eliminate all facilities that can produce Pu and nuclear weapons	Peace treaty Changed military posture on KP Energy and economic assistance	ROK –peace treaty Increased assistance
Eliminate all uranium enrichment facilities and enriched uranium	Increase economic, technical and humanitarian assistance	Modernized energy, industry, and agri. sectors

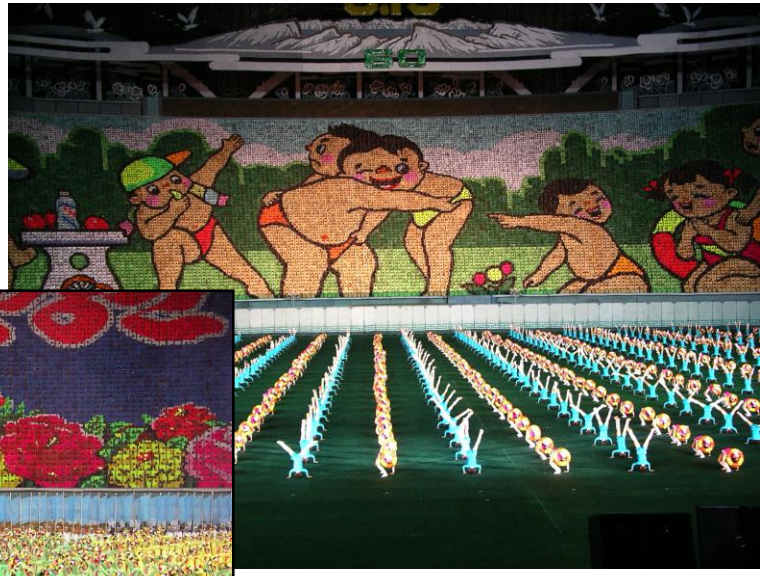
Stop illicit exports, address missile exports, CBW and improve human rights	Full normalization of relations. Address conventional force structures	Normalization

* Must have DPRK input on what constitutes security assurance. Encourage DPRK to give up as much Pu as possible by offering more incentives up front (move up incentives from second and third row for more plutonium)

Steps are designed to be sequential to build up trust and allow for more inspection and transparency. However, subsequent steps may be initiated before previous step is complete.

A touching performance at the Children's Palace

A masterful performance of "Arirang"



Tong il Street Market – a glimmer of hope

What is known about DPRK nuclear weapons?

- No direct information. Skill sets and facility requirements for bomb quite different from Pu production.
- Reported evidence of non-nuclear explosive tests crucial to a working bomb.
- Given the sophistication of rest of nuclear program, one must assume DPRK has a few primitive (Nagasaki type) nuclear weapons.
- Assume 4 to 8 kg Pu for potential bomb.
- A.Q. Khan's assertion of having seen DPRK nukes is not credible.
- A.Q. Khan weapon design not needed by DPRK, but may help.
- DPRK is most likely working on a next-generation bomb, but no information available on how sophisticated.
- Recent media report of 1000 kg bomb with 4kg Pu is questionable.
- Do they need to test to have confidence?
- How do they store their nuclear weapons and/or components?
- Security and control of weapons, components and materials?
- Do they have weapons storage problems – corrosion?

Uranium enrichment and HEU

- DPRK had pilot enrichment program in late 1980s and apparently shut it down in 1992
- DPRK specialists apparently worked with Urenco Group
- A.Q. Khan network connections most likely helped DPRK re-establish its HEU program
  - First Khan visit to DPRK in 1996
  - Apparent DPRK specialists visit to Kahuta HEU facilities
- Long trail of key uranium enrichment equipment procurements by DPRK on international market since the mid-1990s
- Apparently DPRK decided to build its own centrifuges
- Very little information on whether or not DPRK has progressed beyond R&D or pilot plant stage
- Did DPRK export UF_6 to Libya?
  - UF_6 needed only for enrichment, not for DPRK Magnox reactor fuel.

Civilian nuclear program

- **Front-end infrastructure**
  - **Ore, mining, milling, refining, fuel fabrication**
  - **No enrichment needed for Magnox reactors**
  - **Metallic fuel for Magnox reactors – not oxide**
- **Reactors and cyclotrons**
  - **IRT – Soviet built research reactor**
  - **5 MWe Magnox in Yongbyon** (50 & 200 MWe construction frozen)
  - **None are very good for good for energy production**
  - **Cyclotron in Pyongyang**
  - **Possible use of 5 MWe and cyclotron for isotope production**
- **Back end**
  - **Large reprocessing facility operational**
  - **With two lines can handle all reactor fuels (incl. 200 MWe)**
- **Potential civilian applications**
  - **Nuclear power – not worth the risk at this time**
  - **Research – questionable utility**
  - **Isotope production – possible (medicine, industry, agriculture)**
  - **Fuel services – possible, but limit to natural UO_2 production**

Discussions about future paths for Yongbyon Nuclear Complex

- **Isotope production: Yongbyon Director Ri Hong Sop**
  - Yongbyon Center is very interested in expanding activity, but HEU fuel is a problem
  - Cyclotron in Pyongyang is only other isotope facility (short-lived isotopes)

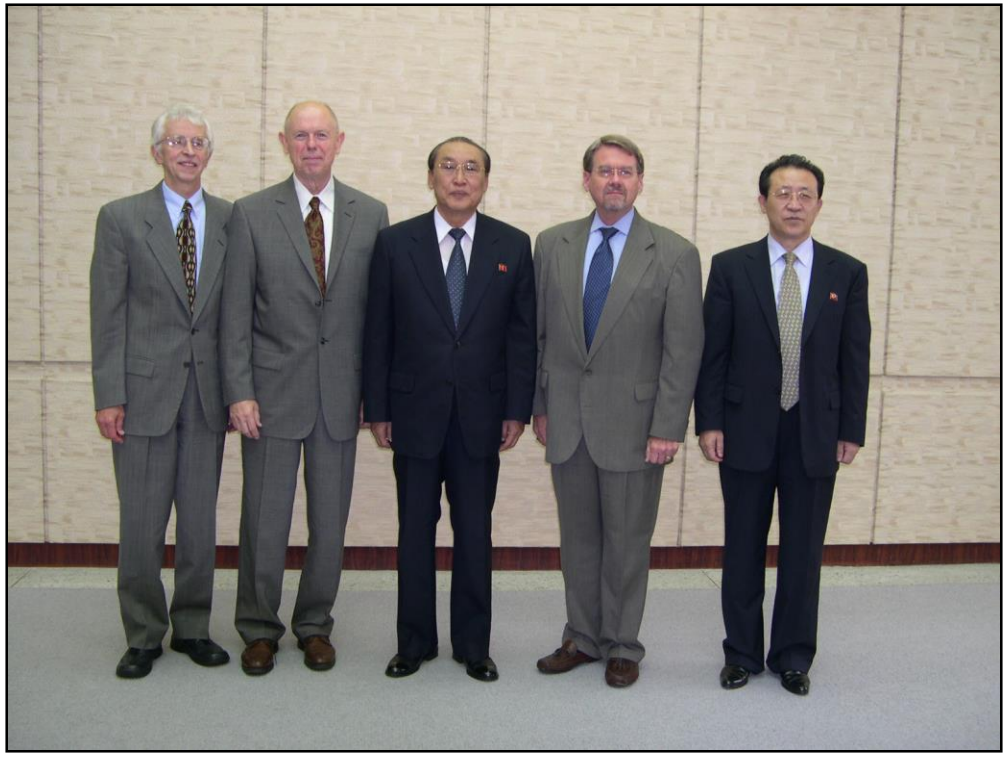
- **LWR reactors and other possibilities**
  - Yongbyon Nuclear Center is not involved in KEDO (different federal department)
  - Yongbyon reactor experts could be involved with reactor design and operations
  - Yongbyon has no interactions with Academy of Sciences and practically no interactions with universities

- **Nuclear worker rehabilitation: DG Li Gun**
  - Expressed great concern about the "rehabilitation" of the workforce at Yongbyon in case the nuclear facilities are closed and decommissioned.
  - He is particularly concerned about the general workers (non-specialists) who constitute the majority of the workforce in Yongbyon.
  - What will happen to them? The government will stop paying them as soon as the facilities are closed.
  - He mentioned that Yongbyon area was a major silk-producing area. Perhaps they can get help building silk factories to employ these people.

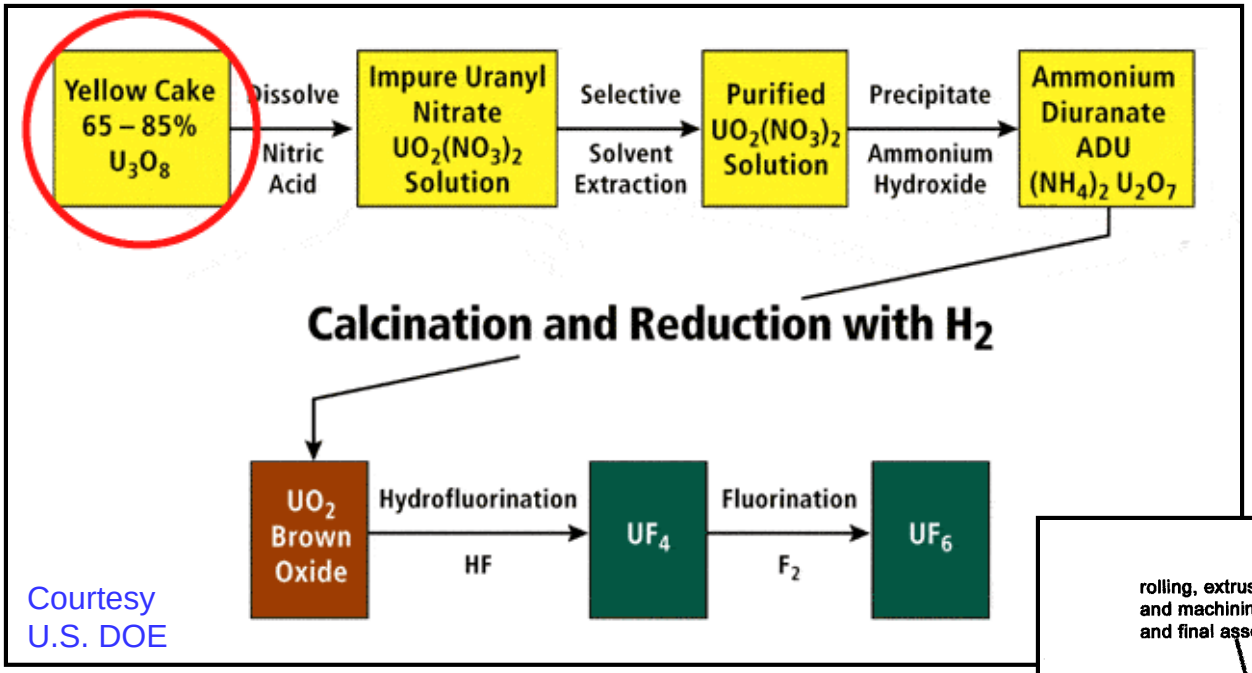
Very positive visit to Academy of Agricultural Sciences

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

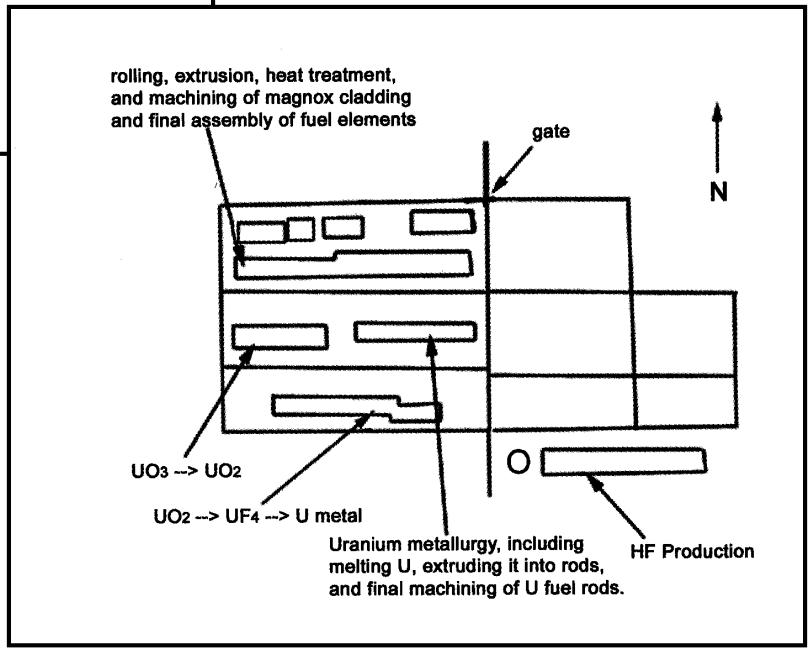
Friendly reception by Yang Hyong Sop – Vice President, Presidium of SupremePeople's Assembly



Looking for uranium signatures in North Korea



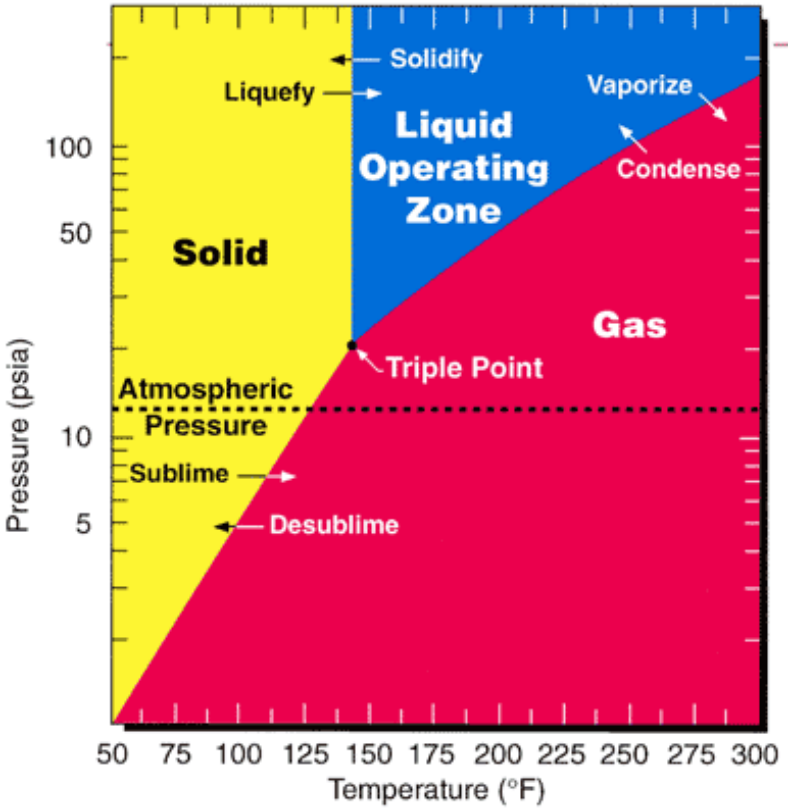
Courtesy
U.S. DOE



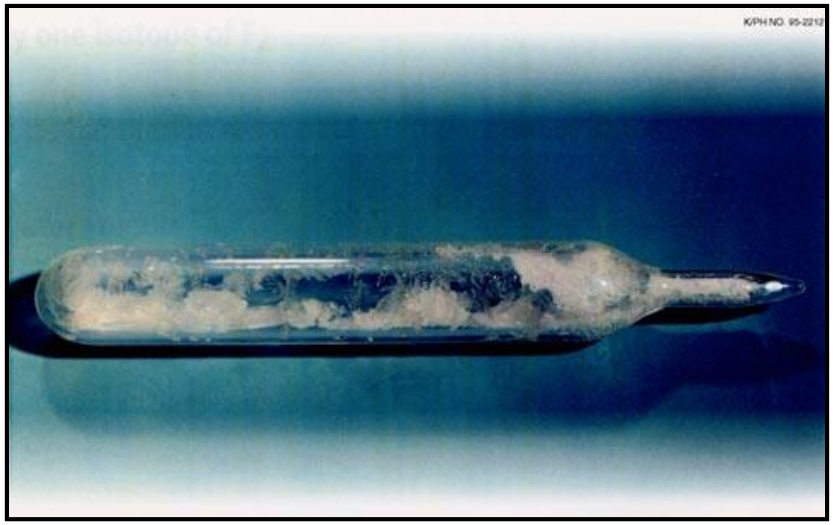
Uranium fuel rod fabrication in Yongbyon stops only one step short of UF_6

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.

Nuclear weapons discussions, cont. – (Aug. 24 - 26, 2005)

- **Uranium enrichment denial: Yongbyon Dir. Ri Hong Sop**
  - In Jan. 2004, Dir. Ri told John Lewis that DPRK had an experimental uranium enrichment program in the 1980s, but abandoned it in favor of concentrating fully on plutonium once the reprocessing facility was complete in 1992.
  - In Aug. 2005, Dir. Ri denied the statement. He said "you do not have the right explanation."
  - Upon being asked specifically by Lewis, Ri replied: "…DPRK did not purchase centrifuges in the 1980s."

- **Nuclear worker rehabilitation: DG Li Gun**
  - Expressed great concern about the "rehabilitation" of the workforce at Yongbyon in case the nuclear facilities are closed and decommissioned.
  - He is particularly concerned about the general workers (non-specialists) who constitute the majority of the workforce in Yongbyon.
  - What will happen to them? The government will stop paying them as soon as the facilities are closed.
  - He mentioned that Yongbyon area was a major silk-producing area. Perhaps they can get help building silk factories to employ these people.

Nuclear weapons – DPRK comments

- **Nuclear weapons discussions, Aug. 24 – 26, 2005**
  - When we asked Dir. Ri about the Feb. 10 official DPRK announcement that it had manufactured nuclear weapons, and what his role was, he responded:
  - "The center's role is to provide the plutonium metal. After that it's someone else's responsibility."
  - Li Gun to Hecker – "you should go to our nuclear weapons sites and see our nuclear weapons, why not?"
  - Kim Gye Gwan to Hecker – "our nuclear weapons are secret. We cannot show you our nuclear weapons. Our countries are still in a cease fire – a state of war."
  - Kim – "we know as much about nuclear weapons as you."
    - "If you can make a bomb of 5 kg of Pu, so can we.
    - If you can mount one on a missile, so can we.
    - If you can fit one in a backpack, so can we."
  - Neither Kim nor Li Gun (nor Lt. Gen Ri Chang Bok) appeared to understand potential safety problems with nuclear weapons kept in a state of readiness.

Discussions about future paths for Yongbyon Nuclear Complex

- **Isotope production: Yongbyon Director Ri Hong Sop**
  - Yongbyon Center is very interested in expanding activity, but HEU fuel is a problem
  - Cyclotron in Pyongyang is only other isotope facility (short-lived isotopes)

- **LWR reactors and other possibilities**
  - Yongbyon Nuclear Center is not involved in KEDO (different federal department)
  - Yongbyon reactor experts could be involved with reactor design and operations
  - Yongbyon has no interactions with Academy of Sciences and practically no interactions with universities

- **Nuclear worker rehabilitation: DG Li Gun**
  - Expressed great concern about the "rehabilitation" of the workforce at Yongbyon in case the nuclear facilities are closed and decommissioned.
  - He is particularly concerned about the general workers (non-specialists) who constitute the majority of the workforce in Yongbyon.
  - What will happen to them? The government will stop paying them as soon as the facilities are closed.
  - He mentioned that Yongbyon area was a major silk-producing area. Perhaps they can get help building silk factories to employ these people.

One possible option for resolution of nuclear crisis as presented in DC

- 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, <u>including</u> 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