

Assessment of DPRK Nuclear Program
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Yongbyon Director Ri Hong Sop

Technical update of DPRK nuclear program: Aug. 2005

- **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

Technical update of DPRK nuclear program: Nov. 2006

- **5 MWe reactor**
 - Operating, but with some restrictions.
- **Reprocessing**
 - Improvements made to fix some problems. Also increase throughput.
- **Reactor construction**
 - Redesign of 50 MWe complete. Problems in industrial sector slowing down restart. No decision on when to restart.
 - 200 MWe still under study. Cost more to complete than to start over.
- **Nuclear test**
 - Political and military people: "Fully successful, filled with pride."
 - No access to the technical people involved in design, production, or test
- **Nuclear weapons**
 - They believe they have a deterrent, but no indication that they appreciate responsibility and risk that goes with a deterrent
- **Uranium enrichment**
 - No discussion (also not mentioned in U.S. government statements)

One nuclear test, but plutonium program has slowed down

Oct. 9 nuclear test

- **U.S. DNI statement**
 - Radioactive debris shows that test was nuclear. Stated test was < 1 kt
- **China officials confirmed 2-hr advance notice of test**
 - Gave location, time and expected yield of approximately 4 kt
- **China nuclear specialists told us:**
 - Picked up seismic signals close to border of magnitude 4.1 to 4.2
 - Believe actual yield was close to 1 kt
 - Believe simple design was tested but scaled back to 4 kt to fully contain
 - Their assessment: They tried for 4 kt, got 1 kt: Not bad for the first try. Call it "successful, but not perfect."
- **Yield estimates around the world**
 - Seismic magnitudes range from 3.5 to 4.2. Yields range from 0.2 to 1 kt
- **We can still only speculate about test - was yield low because:**
 - Simple, relatively large design of relatively low yield to ensure containment?
 - Sophisticated, smaller diameter and mass design to fit on a Nodong missile?
 - If the latter, it is difficult to believe the test gave them confidence to put one on a missile.

No indication of another nuclear test being planned

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- **Nuclear test**
 - Political and military people: "Fully successful, filled with pride."
 - No access to the technical people involved in design, production, or test
 - Still only speculate if test was simple, scaled-down design or smaller, missile-capable design. In either case, yield was low < 1 kiloton
- **Nuclear weapons**
 - They believe they have a deterrent, but no indication that they appreciate responsibility and risk that goes with a deterrent

One nuclear test, but plutonium program has slowed down

Current status - DPRK nuclear program

• Plutonium

- | | | |
|--------------------------|------------|-----------------|
| • < 1994 (IRT & 5 MWe) | ~ 8.6 kg | (1 + weapons) |
| • 2003 (5 MWe) | ~ 25 kg | (4-6 weapons) |
| • 2005 (5 MWe) | ~10-14 kg | (~ 2 weapons) |
| • In reactor (Nov. 2006) | ~ 4-8 kg | (not separated) |
| • > 2005 MWe capacity | ~ 6 kg/yr | 1 weapon/yr |
| • Future 5 + 50 MWe | ~ 60 kg/yr | ~ 10 weapons/yr |
- (Little progress on restart of 50 MWe reactor)

• Nuclear weapons

- One nuclear test - some success. Must assume they have a few simple nuclear weapons. Do not know how sophisticated.
- Unlikely to have confidence that devices are missile capable.
- Plutonium itself represents a major threat, regardless of test and of sophistication and number of weapons

• Uranium enrichment

- Program still being denied, but little discussion.
- Strong evidence points to some level of uranium enrichment.

There is increasing awareness of the plutonium export threat in both U.S. and Chinese government

Stated DPRK motivations for allowing our visits

January 2004

- "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." Vice Minister Kim Gye Gwan

August 2005

- "We want you to tell your government that it is OK for us to get a Light-water reactor. No proliferation concerns with LWR."
Vice Minister Kim Gye Gwan

November 2006

- "Let American people know that DPRK people are living with confidence and pride." Amb. Li Gun

Typical views seen of DPRK



Technical update - DPRK nuclear program

- **5 MWe reactor**
 - Operating since June 2005 with some restrictions
 - Reduced output temperature and some fuel replacements
- **Reprocessing**
 - Finished reprocessing of second campaign by Oct. 2005
 - Doing waste treatment now (high radiation levels)
 - Improved throughput by $\times 1.3$: pulsed columns for co-extraction
- **Reactor construction**
 - Slowdown in 50 MWe reactor construction. Problem in the industrial sector getting components refurbished
 - No action on 200 MWe still under study. Cost more to complete than to start over.

Some indications that technical problems have slowed down program

Current status - DPRK nuclear program

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| • 2006 (5 MWe) | ~ 4-8 kg in reactor | |
| • > 2005 MWe capacity | ~ 4-6 kg/yr | 1 weapon/yr |
| • Future 5 + 50 MWe
(but slowed down for technical reasons) | ~ 60 kg/yr | ~ 10 weapons/yr |

• Nuclear test

- Chinese were given advance notice of ~ 4 kt yield
- Seismic signals suggest 0.2 to 1 kt
- DPRK officials say and act like - "fully successful test"
- Either small size and weight - partial success
- More likely, simple design scaled back to ensure containment
- China view: Tried for 4 kt, got 1 kt, not bad for first try.

• Nuclear weapons

- No indication of nuclear strategy nor responsibilities for safety and security that come with possession of nuclear weapons

Discussions of nuclear weapons risks of two reactor fuel cycles

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

	<u>Graphite-moderated reactor (Magnox)</u>	<u>Light-water reactor (LWR)</u>
Front end	<ul style="list-style-type: none">- No enrichment (but U technology to UF₄).	<ul style="list-style-type: none">- 3-4% enriched fuel.- Enrichment poses greatest risk.
Reactor	<ul style="list-style-type: none">- Not very efficient for electricity- Makes good weapons-grade Pu.- Can be degraded by long burn-up (less weapons-usable).	<ul style="list-style-type: none">- Efficient for electricity.- Poor WG Pu.- Can be enhanced by short burn-up.
Back end	<ul style="list-style-type: none">- Reprocessing is direct nuclear weapons threat.- DPRK has adequate facilities.	<ul style="list-style-type: none">- Reprocessing represents some weapons threat.- Need to modify reprocessing facility.
Technical risk reduction	<ul style="list-style-type: none">- High burn-up.- IAEA monitored reprocessing or export spent fuel.	<ul style="list-style-type: none">- 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

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 DPRK. *[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.

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 Chong Bok) appeared to understand potential safety problems with nuclear weapons kept in a state of readiness.

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.

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