

# Verifiably, Irreversibly Halting Operations at Yongbyon

David Albright,

ISIS

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# Plutonium Activities in North Korea

- Solving the current crisis will require re-establishing some type of “freeze” over all plutonium production and separation activities at Yongbyon.
- Whatever happens, this task will require more than just re-establishing IAEA monitoring at the site.
- A freeze alone does not include steps to irreversibly halt operations at Yongbyon.
- Refreezing thus may need to be part of a broader verified dismantlement approach.

# Dismantlement Actions

- One approach may be to remove remaining irradiated fuel and separated plutonium from the DPRK.
- The DPRK will need to declare its actions at Yongbyon since late 2002.
- The verification organization will need to verify the correctness and completeness of North Korean declarations about its activities at Yongbyon since late 2002.

# Critical Questions about Post-2002 Actions

- What has been the fate of the irradiated fuel that was discharged in 1994?
- How much of this irradiated fuel has been reprocessed?
- How much plutonium has been separated from this irradiated fuel?
- How much transparency is necessary to confirm DPRK answers to the above questions?
- What does irreversible mean in this context?

# A Special Issue

- A potentially difficult issue is whether the verification organization will need the DPRK to declare all its pre-1994 plutonium production and separation activities at an early stage.
- This declaration would be followed by an effort by the verification organization to determine the correctness and completeness of this declaration.
- Part of this effort may require the settling of the outstanding issues between the IAEA and the DPRK in 1992 and 1993.

# Irradiated Fuel Rods and Verification Requirements

- The answer to the extent of the declaration and verification activities that may be needed depends importantly on the amount of irradiated fuel rods the DPRK has reprocessed in the last year.
- The more rods that the DPRK has reprocessed, the more information, access and sampling the verification organization will need to successfully conduct its mission.

# Illustrative Cases

- 1) If essentially all the fuel rods discharged in 1994 remain intact, the verification organization can concentrate on verifying the number of rods. Decisions about the need for revisiting pre-1994 plutonium production and separation could be delayed.

## Cases (cont.)

2) If a significant fraction of these rods have been reprocessed, the verification organization will need to verify the number of unprocessed rods and the amount of plutonium, uranium, and waste separated from the fraction of the rods that were reprocessed. It will also need to see and verify the separated plutonium.

## Cases (cont.)

3) A subcase of the second case is if all the rods discharged in 1994 have been reprocessed. This case may be easier to verify than the subcases where a significant number of rods remain.

# Discussion

- If a significant fraction of the rods discharged in 1994 have been reprocessed, the verification effort may not be able to succeed in verifying DPRK actions since late 2002 without knowing about pre-1994 plutonium production. For example, the verification organization will need to know how much plutonium was in the irradiated fuel discharged in 1994 and detailed information about individual rods.

# Discussion (cont.)

- Likewise, the verification organization will need to conduct activities at the Radiochemical Laboratory. These activities may require taking samples of waste tanks and swipe samples at a range of locations. These activities may be difficult to interpret without a full declaration of all plutonium separation activities, including a resolution of prior issues from 1992 and 1993.

# Discussion (cont.)

- Although some verification measures can be implemented without examining these old issues or requiring a declaration about all plutonium production, questions and uncertainties are bound to arise that will be unacceptable to the DPRK or the verification organization.

# Major Facilities and Items Subject to Verification

- 5 MW(e) reactor
- Irradiated fuel discharged in 1994
- Radiochemical Laboratory
- Fuel fabrication complex
- 50 MW(e) and 200 MW(e) reactor
- Any nuclear waste sites

# Illustrative Halting of Operations at the 5 Megawatt Reactor

- Verification organization witnesses shutdown.
- Cooperative (US/DPRK) determination of best way to store new irradiated fuel to delay corrosion of fuel cladding and ease its verification.
- Verification organization verifies unloading and storage of about 50 tonnes of fuel and any other fuel unloaded since early 2003.
- Verification organization conducts on-going monitoring of reactor and irradiated fuel.

# The 5 MW Reactor: Additional Measures

- The verification organization may want the DPRK to provide sufficient access and information so that it can estimate the plutonium content of the discharged fuel. Specific measures could include providing operating records and allowing the verification organization to take measurements of the irradiated fuel.
- The irradiated fuel may be removed from the DPRK after sufficient cooling has occurred.

# Irradiated Fuel Discharged in 1994

- The DPRK freezes any of the remaining irradiated fuel in place and the verification organization verifies the locations of irradiated fuel
- DPRK provides records of movement of irradiated fuel
- Irradiated fuel is consolidated under verification organization supervision
- The verification organization confirms amount of irradiated fuel.

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• The verification organization conducts on-going monitoring of irradiated fuel

# Irradiated Fuel Unloaded in 1994: Additional Considerations

- The verification organization may receive sufficient records or be allowed to conduct activities in order to determine plutonium content of this irradiated fuel.
- One approach may be to seek agreement to remove any of the remaining irradiated fuel from North Korea.

# Radiochemical Laboratory

- DPRK halts operations with verification organization present.
- The verification organization applies seals and conducts other measures to ensure that the plant is shutdown.
- DPRK empties process lines and tanks with verification organization present, preparing for permanent shutdown.
- The verification organization conducts on-going monitoring.

# Radiochemical Laboratory: Additional Measures

- DPRK would provide information about its plutonium separation activities during the last year, including recent operating and accountability records.
- The verification organization will need to verify this information, which may require access to plant personnel and the right to take samples.
- One approach is to seek agreement to remove any newly separated plutonium from North Korea.

# Other Sites Subject to Refreezing

- Fuel Fabrication Complex--verification organization reestablishes monitoring and the DPRK provides fresh fuel inventories.
- The 50 and 200 MW(e) Reactor—The DPRK halts any construction activities and verification organization resumes monitoring.
- Nuclear waste sites.

# Conclusions

- Any effort to halt operations at Yongbyon should be part of a broader verified dismantlement approach.
- Verification arrangements should be central to any agreements to halt activities or facilities.
- Verification arrangements that seek to avoid knowing the amount of plutonium in the irradiated fuel discharged in 1994 or avoid resolving past plutonium issues will be extremely difficult.