Verification of treaty compliance and enhancement of the verification of international treaties: Perspectives on the DPRK

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Generic Safeguards Objectives

- Detect any diversion of declared nuclear material at declared facilities and locations outside facilities (LOFs).

- Detect any undeclared production or processing of nuclear material at declared facilities and LOFs.

- Detect any undeclared nuclear material or activities in the Stat.

All nuclear material and activities in a territory of a state has been placed under the IAEA safeguards (Declarations are correct and complete).
Cornerstones of the IAEA Verification System

- Nuclear material accountancy and verification
- Early provision of design information
- Environmental sampling
- Satellite imagery
- Remote monitoring
- Access to nuclear sites and information
- Additional Protocol
- State level approach
DPRK Nuclear Facilities Flowchart

- **Uranium mining and milling**: Confirmed: Packchon, Pyongsan; Unconfirmed: Cholsan, Kujang, Sunchon, Wolbisan
  - Location: Pyongyang

- **Uranium conversion**: U$_3$O$_8$
  - Location: Yongbyon

- **Uranium enrichment plant**: Yongbyon

- **Criticality testing facility**: Yongbyon

- **Neutron initiator fabrication facility**: Unknown location
  - Location: Yongbyon

- **Electronics fabrication plant**: Unknown location
  - Location: Yongbyon

- **U3O8 Pilot uranium enrichment plant**: Unknown location
  - Location: Yongbyon

- **Uranium component fabrication facility**: Unknown location
  - Location: Yongbyon

- **Uranium warhead assembly plant**: Unknown location
  - Location: Yongbyon

- **Critical assembly**: Yongbyon

- **Spent fuel rod**: Radiochemical laboratory (reprocessing plant)
  - Location: Yongbyon

- **Low enriched uranium fabrication plant suspected site**: Yongbyon

- **Uranium enrichment plant**: Yongbyon
  - Location: Yongbyon

- **High explosives fabrication plant**: Unknown location
  - Location: Yongbyon

- **Criticality testing facility**: Yongbyon
  - Location: Yongbyon

- **Neutron initiator fabrication facility**: Yongbyon
  - Location: Yongbyon

- **Electronics fabrication plant**: Yongbyon
  - Location: Yongbyon

- **Plutonium warhead assembly plant**: Unknown location
  - Location: Yongbyon

- **Uranium mining and milling**: 10, 36, and 80% enriched fuel
  - Location: Yongbyon

- **Radiochemical laboratory**: (reprocessing plant)
  - Location: Yongbyon

- **Plutonium metal laboratory**: Yongbyon

- **Plutonium component fabrication facility**: Yongbyon

- **Plutonium warhead assembly plant**: Unknown location

- **Isotope production laboratory**: Yongbyon

- **Critical Assembly**: Yongbyon

- **R&D for boosted nuclear device**: Unknown location
  - Location: Yongbyon

- **Deuterium**: Deuterium production facility
  - Location: Unknown location

- **Uranium mining and milling**: Packchon, Pyongsan

- **Uranium conversion**: Yongbyon

- **Uranium enrichment plant**: Yongbyon

- **Criticality testing facility**: Yongbyon

- **Neutron initiator fabrication facility**: Yongbyon

- **Electronics fabrication plant**: Yongbyon

- **Plutonium warhead assembly plant**: Yongbyon

- **Uranium mining and milling**: Yongbyon

- **Radiochemical laboratory**: Yongbyon

- **Plutonium metal laboratory**: Yongbyon

- **Plutonium component fabrication facility**: Yongbyon

- **Plutonium warhead assembly plant**: Yongbyon

- **Isotope production laboratory**: Yongbyon

- **Critical Assembly**: Yongbyon

- **R&D for boosted nuclear device**: Yongbyon

- **Deuterium**: Deuterium production facility

Key:
- Facility
- Facility canceled
- Resource
- Resource planned
- Location
Radiochemical laboratory, Yongbyon

Front end reprocessing scheme in 1992

Timeline

DECEMBER 12, 1985
DPRK statement
DPRK accedes to the NPT

APRIL 10, 1992
DPRK statement
DPRK ratifies a comprehensive safeguards agreement

MAY 4, 1992
DPRK statement
DPRK provides initial declaration

SEPTEMBER, 1992
IAEA statement
IAEA inspections find discrepancies in declaration

FEBRUARY 9, 1993
IAEA statement
IAEA requests a special inspection

Key

Facility

Resource
North Korea’s Declaration in May 1992

5 MWe gas-cooled graphite moderated reactor

- Started operation in 1986
- Shut down for 100 days in 1989 to replace damaged fuel rods
- Fuel fabrication plant
- Reprocessing plant
  - Processed some damaged fuel rods together with fresh fuel in 1990
  - Ca 60 grams of separated plutonium
IAEA Findings

- Plutonium product: not consistent with the irradiation history;
- Plutonium product, and the declared irradiation history of the reprocessed fuel were mutually inconsistent with the waste from the single campaign;
- The characteristics of the product batches processed through were not consistent with the data declared by the DPRK; and
- Statement that only irradiated fuel diluted with fresh fuel was reprocessed was not consistent with the results of sample analysis.
The Agency had not seen the waste originating from the plutonium product.

Consequently, the IAEA had seen some nuclear waste, but it was from some other plutonium.

Hence there must be plutonium, which has not been declared to the Agency.

The IAEA was not able to conclude whether it is grams or kilograms.
Due to the lack of appropriate explanations, the IAEA asked for a special inspection, to two waste sites in Yongbyon, which could contain relevant information.

North Korea did not heed to the request, the IAEA Board referred the case to the UN Security Council.
On September 6, 2007 a gas-cooled graphite-moderated reactor destroyed in an air raid.

By October 10, 2007 the Syrians had destroyed the remaining structures and emptied the area.
Image just after bombing
Syrian statements

- President Al-Assad dismissed allegations that the site hosted, or was planned to host, a nuclear reactor.
- Syria eventually stated that the building was a non-nuclear military building.
- Anthropogenic natural uranium particles found.
- Isotopic and chemical composition and the morphology of the particles indicate that there is a low probability that the source of the particles were the use of missiles.
- Traces of graphite and steel.
- Notwithstanding the loss of substantial information, after all information available, the IAEA concluded that the destroyed building was very likely a nuclear reactor.

- The IAEA Board found Syria in non-compliance with its safeguards agreement and reported it to the UN Security Council.

High enriched uranium particles found in 2003 at the Kalaye Electric workshop in Tehran lead to a long series of revelations, which brought into day light not only Iran’s unreported uranium enrichment activities, but lead also to the busting of the A.Q. Khan network.
Impurities Can Tell About the Origin

- Yellow cake
- Uranium conversion process
- Uranium hexafluoride or Uranium dioxide
- Multielement analysis, patterns
Not Time to Rest

- There is still work for science: we need to develop techniques to analyze chemical composition of nanometer scale uranium and plutonium particles.

- International co-operation: sharing of nuclear “forensics” finger-print information vital in combating against black markets and terrorism.
Implementation Agreements

- Agendas for the meetings agreed in advance.
- Summaries of meetings.
  - Sent for the comments to the DPRK.
- IAEA activities in the DPRK – [rolling text].
- IAEA information requirements – [rolling text].
- Equipment and methodologies used
  - Seminars
  - DPRK attending demonstrations and calibrations
Logistics

- Transportation and shipments
  - rented cars
  - rail
  - helicopters
  - commercial airlines
- Equipment and even consumables need to be imported.

- Counterparts
  - The Permanent Mission of the DPRK
  - General Department of Atomic Energy
    - Pyongyang
    - Officials at the sites
  - Foreign Ministry

- UNDP and World Food Program
  - Cash payments in Euro required
- Faxes, letters and at a later stage, emails
  - Sent often after meetings to confirm the agreement
Thank you for your time
I look forward to answering your questions

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