

Possibilities for Comprehensive Nuclear Arms Reductions

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Nuclear arms control has focused on limiting/eliminating US-RF delivery vehicles and launchers (INF, START)...

...limits deployed strategic warheads, but no controls on nondeployed or nonstrategic warheads

CISAC is exploring ways to increase transparency and verifiably limit warhead, fissile-material stockpiles

- Begin with US-RF, extend to all NWS

Rationale

- Transparency enhances security by reducing worst-case analysis, communicating benign intentions...
...but some argue opacity enhances security by preserving uncertainty, concealing vulnerabilities
- Nondeployed warheads could be used to break out of limits by uploading missiles, bombers
- Nonstrategic warheads do not have unique nuclear delivery vehicles
- Prohibition of nuclear weapons would require accounting for all nuclear weapons and nuclear explosive materials
- Facilitate cooperation on physical protection, control, accounting of warheads and materials

Items Covered: Warheads

- Undefined in most treaties (NPT, START), except NWFZ:
 - ‘Nuclear explosive device’ means any nuclear weapon or other explosive device capable of releasing nuclear energy, irrespective of the purpose for which it could be used. The term includes such a weapon or device in unassembled and partly assembled forms, but does not include the means of transport or delivery of such a weapon
- What about unassembled weapons?
 - If all parts available for assembly, count as warhead
 - If key parts destroyed (e.g., HE), count as fissile material

Items Covered: Materials

- Any material able to sustain a fast-fission chain reaction (fissile material, SFM, SNM)

HEU (>20% U-235/U-233)

plutonium (any isotopic composition)

others? (Pa-231, Np-237, Am, Cm, Cf)

- In assembled weapons; weapon components (pits, CSA); fresh/spent reactor fuel; bulk metal, oxides
- Including fissile materials makes definition of “warhead” less important
- Don’t include tritium or other weapon materials

Elements of a Regime

- declarations
- inspections and other measures to confirm
 - declared inventories of warheads, materials
 - absence of undeclared warhead, material stockpiles
 - warhead dismantling
 - warhead remanufacture/assembly (no net production)
 - fissile-material disposition
 - fissile-material production cut-off

These elements would be phased in over time (not necessarily in this order)

Declarations: a phased approach

Warheads

HEU, Pu

aggregate stockpiles

aggregate stockpiles

by type, delivery system

chemical/isotopic composition

status (deployed, reserve)

status (warhead, pit, fuel...)

by declared facility

by declared facility

facility descriptions

facility descriptions

historical data on stocks,
assembly, disassembly

historical data on stocks,
production, losses

serial number/tag, location of
each warhead

location, mass, composition
of each item, container

Declarations

Exchange/update data every six months

Should data be public or confidential between parties?

How to accommodate imprecise accounting or uncertainties?

Should US-RF initiate and refine declarations, then invite other NWS to join later, after deep reductions? Or should declarations include all NWS?

When and how should de facto NWS join?

Verifying Declared Stocks

Warheads

Are all declared items warheads (of declared type)?
Any undeclared warheads at declared facilities?

Use tags, random sampling to limit items examined

Deployed strategic warheads: START RVOSI

Stored warheads

attributes/templates, info barriers to verify declared item is warhead (of declared type)

attributes can be used to verify that other items are not warheads

Attributes v. Templates

Attribute: a set of characteristics that are consistent with an object being a warhead (or pit)

Pu mass > 1 kg; $^{240}\text{Pu} : ^{239}\text{Pu} < 0.1$; Pu age; symmetry; metal v. oxide; etc.

Template: a set of characteristics that identify an object as a warhead (or pit) of a particular type

Gamma-ray emissions at several energies; neutron emissions/multiplication; IR, acoustic signature; etc.

A trusted system would measure attributes/templates, compare with agreed standards, and provide a decision without revealing sensitive information

Nuclear explosive materials

In warheads

no verification

Weapon components (pits, CSAs)

attributes/templates plus info barriers

Reactor fuel, bulk metal/oxides

transfer materials to IAEA safeguards if possible

standard NDA techniques

Verify that other items don't contain HEU, Pu

Undeclared Stocks

Warheads undetectable, require little maintenance

Consistency of historical data on warhead, material production; consistency with intelligence information; forensic analysis of records

Nuclear archaeology: confirm FM production at facilities

Monitor warhead maintenance facilities (T production?)

NTM for suspicious-looking storage, assembly facilities

Societal verification

Challenge inspection

If no undeclared stocks detected, gain confidence over time that none exist

Warhead Dismantling

DOE examined several options:

- monitored storage: warheads exit monitored storage, pits enter monitored storage
- perimeter-portal monitoring: monitor warheads entering facility, materials exiting facility
- chain-of-custody: track warheads from storage to bay/cell
- direct observation or remote monitoring of dismantling

Warhead Assembly

- monitor warhead assembly facilities (e.g., with PPM) to assure no net increase in number of warheads

Fissile Material Disposition

- render the recovered fissile materials as unattractive for warheads as fresh/spent reactor fuel:
 - blend HEU to LEU
 - use Pu in MOX fuel or dispose with vitrified HLW

Fissile Material Cutoff

- under consideration in CD
- enrichment facilities, production reactors, reprocessing facilities: shut down or place under IAEA-type safeguards
- NTM, environmental sampling to detect hidden facilities