How can the two presidents make the best of their one shot at setting the nuclear table?

I have some advice for them: Keep it simple.

Rose Gottemoeller, June 2021
Lead U.S. negotiator of New START (2009)

Photo credit: NATO

TECHNOLOGIES & APPROACHES

(Chapter 4 in the Report, with Irmgard Niemeyer)
INSPECTION APPROACHES

WITHOUT (OR WITH LIMITED) ACCESS

1. SATELLITE IMAGERY
   Satellites have historically played an important role in arms-control verification, and their potential is likely to grow further in coming years. Not only relevant for detecting undeclared sites, but also for monitoring declared ones.

2. PERIMETER MONITORING & REMOTE (VIRTUAL) INSPECTIONS
   For facilities where access is initially considered too intrusive, perimeter control or sensors at the site boundary could provide reassurance of compliance. Virtual inspections: Could inspectors even conduct some activities remotely?

3. MINIMALLY INTRUSIVE INSPECTION APPROACHES ... WHERE NECESSARY
   When onsite inspections are clearly preferable or indispensable, approaches that avoid certain types of measurements (putting at risk sensitive information) could help facilitate early adoption of new verification provisions.

Source: DigitalGlobe (top), U.S. DOE (middle), Randy Montoya via Sandia National Laboratories (bottom)
ALTERNATIVES TO ONSITE INSPECTIONS
FOR SENSITIVE NUCLEAR FACILITIES

(or complements)

(Some examples)
USING SATELLITE IMAGERY TO CONFIRM THE OPERATIONAL STATUS OF DECLARED FACILITIES

1. Surface temperatures at a nuclear power plant (Landsat-7)
2. Water-vapor plume from cooling towers (Source: Planet Labs)
“Display in the open” of road-mobile launchers; concept used under START (Article XII) but **not** under New START

(June 22, 2005 @ LAT +55.381 LON +82.920)
# Using Satellite Imagery

## Opportunities and Challenges for Nuclear Verification

### Opportunities

- New satellite constellations may offer quasi real-time imagery, often with multiple revisits of the same site per day.
- Advances in data sciences offer automated analysis of imagery.
- Potential cost-savings, perhaps also relevant for IAEA safeguards.

### Challenges

- Few countries and organizations have robust satellite imaging capabilities; it raises the issue of equitable access and (possibly) of data authenticity.
- Increasing need to work with machine-learning techniques; joint research, development, and training could help ensure that satellite imagery can unfold its true potential as a verification technology.

*Source: Airbus Industries (top) and ESA (bottom)*
USING PERIMETER MONITORING TO AVOID ACCESS TO SENSITIVE NUCLEAR SITES

Field Test FT-34: Demonstrated Destruction of Nuclear Weapons
U.S. Arms Control and Disarmament Agency, January 1969

Herbert Kouts, A Perimeter Safeguards System for Enrichment Plants, November 1972

A Perimeter Safeguards System for Enrichment Plants
(A joint Arms Control & Disarmament Agency and U.S. Atomic Energy Commission Project Plan)
Naval Submarine Base King’s Bay, GA
GPS: +30.78598, -81.53776

Reserve nuclear warheads and missiles are stored underground and in bunkers
These buildings are not inspected as part of New START
Source: xpd.com/kingsbay
MONITORING REGIMES FOR ALL-WARHEAD AGREEMENTS

(Chapter 2 in the Report)
POSSIBLE MONITORING REGIMES

FOR ALL-WARHEAD AGREEMENTS

1. ABSENCE REGIME
   • Conduct routine & challenge inspections to confirm correctness of declarations
   • Accept all items as treaty accountable that the host declared as such
   • Only inspect other items present at site to confirm that they are indeed not accountable

2. LIMITED-ACCESS REGIME (for lack of a better name)
   • Conduct routine & challenge inspections to confirm correctness of declarations
   • Use serial numbers or unique identifiers to account for declared items
   • Authenticity of the items themselves is not confirmed

3. CONFIRMATION REGIME
   • Warhead confirmation measurements confirm authenticity of declared nuclear weapons prior to dismantlement (using an attribute or template-matching approach), perhaps also during “life cycle” of (randomly selected) weapons

Source: Author (top and middle), U.S. DOE (bottom)
FROM ABSENCE CONFIRMATION TO POSITIVE IDENTIFICATION

ADVANTAGES & SHORTCOMINGS OF AN ABSENCE REGIME
Well established (as part of New START)
Very low risk of exposing sensitive information
Concept could help address security concerns of some states and encourage them to join arms-control efforts at an early date

TOWARD IDENTIFICATION OF TREATY-ACCOUNTABLE ITEMS
Need to facilitate & manage some inspector access
Could begin with serial numbers or other identifiers used by the host
Regime could be strengthened by (gradually) phasing in unique identifiers; opportunities for joint R&D on concepts and technologies

Source: Paul Shambroom (paulshambroom.com/nuke, top) and pryormarking.com (bottom)
A PATH FORWARD
FOR NUCLEAR DISARMAMENT VERIFICATION

RE-IMAGINING NUCLEAR DISARMAMENT VERIFICATION

Explore verification approaches that minimize the need of access to sites and treaty accountable items or avoid measurements on those.

Consider approaches that offer “on-ramps,” i.e., that start off simple and can accommodate “upgrades” later on.

FROM ABSENCE TO CONFIRMATION REGIMES, STEP-BY-STEP

Several types of approaches are available to verify all-warhead agreements; they range from “simple” (absence) regimes to more rigorous but also more intrusive confirmation regimes.

The different regimes can build on each other and be phased in “gradually.”

Source: IAEA (top, flickr.com/photos/iaea_imagebank/albums/72157659464420989 and quad-nvp.info (bottom))