A person in silhouette is working with a large white cylindrical container labeled 'H1514 MODEL'. The person is holding a yellow rectangular object and a black device. The container has a handle labeled 'COVER LIFT ONLY' and a label 'H1514 MODEL'. The background is a concrete wall with a pipe.

FROM ABSENCE MEASUREMENTS TO VERIFIED DISMANTLEMENT OF NUCLEAR WEAPONS

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Federal Foreign Office



Toward Nuclear Disarmament

Building up Transparency and Verification

MALTE GÖTTSCHE AND ALEXANDER GLASER (EDITORS)

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BACKGROUND



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

..., the negotiations should include weapons delivery systems, including the exotic new missile systems Putin is rolling out, as well as the warheads themselves—that is, the actual bombs. New START limited delivery vehicles like missiles and bombers, as well as launch systems. But it didn't directly limit nuclear warheads, in part because the issue was too sensitive given the top-secret nature of the weapons.

Last year, President Donald Trump got Putin to agree in principle to a total freeze on warheads. This was a positive step toward a New START replacement. Figuring out how to constrain warheads and verify those constraints is a big deal for both sides.

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

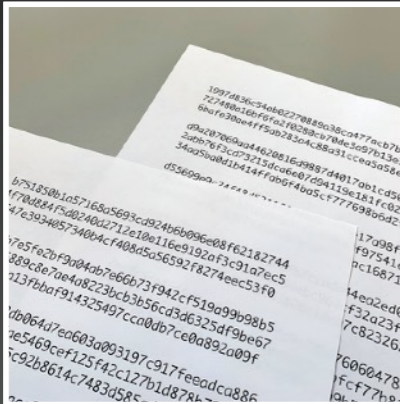
Source: xpda.com/kingsbay



MONITORING REGIMES
FOR ALL-WARHEAD AGREEMENTS

POSSIBLE MONITORING REGIMES

FOR ALL-WARHEAD AGREEMENTS



A. 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



B. 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



C. 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)

THE ABSENCE REGIME

Confirming numerical limits without
access and identification

NEW START

ALLOWS FOR MEASUREMENTS ON ITEMS DECLARED AS NON-NUCLEAR OBJECTS

Section VI. Methods and Procedures for Use of Radiation Detection Equipment

1. During Type One inspections, the inspected Party shall have the right to use radiation detection equipment in order to:

(a) Demonstrate to inspectors that an object located on the front section of a deployed ICBM or deployed SLBM and declared by a member of the in-country escort to be a non-nuclear object, is, in fact, non-nuclear; and

(b) Demonstrate to inspectors that an object located on a designated heavy bomber and declared by a member of the in-country escort to be a non-nuclear object, is, in fact, non-nuclear.

For these purposes, the inspected Party shall have the right to use radiation detection equipment provided by the inspected Party, if agreed by the Parties within the framework of the BCC, or radiation detection equipment provided by the inspecting Party.

Annex on Inspection Activities to the Protocol to the Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms, media.nti.org/documents/new_start_annex_inspections.pdf

EXPANDING ABSENCE MEASUREMENTS

TO INCLUDE OBJECTS AT ANY INSPECTED SITE



BASIC CONCEPT OF AN ABSENCE REGIME

- During an onsite inspection, the host gets “credit” for the number of items declared for that site and identifies these items as such
- Declared items will be accepted as “treaty accountable” and never be accessed or inspected
- Inspector has to be able to confirm that other items are not treaty accountable



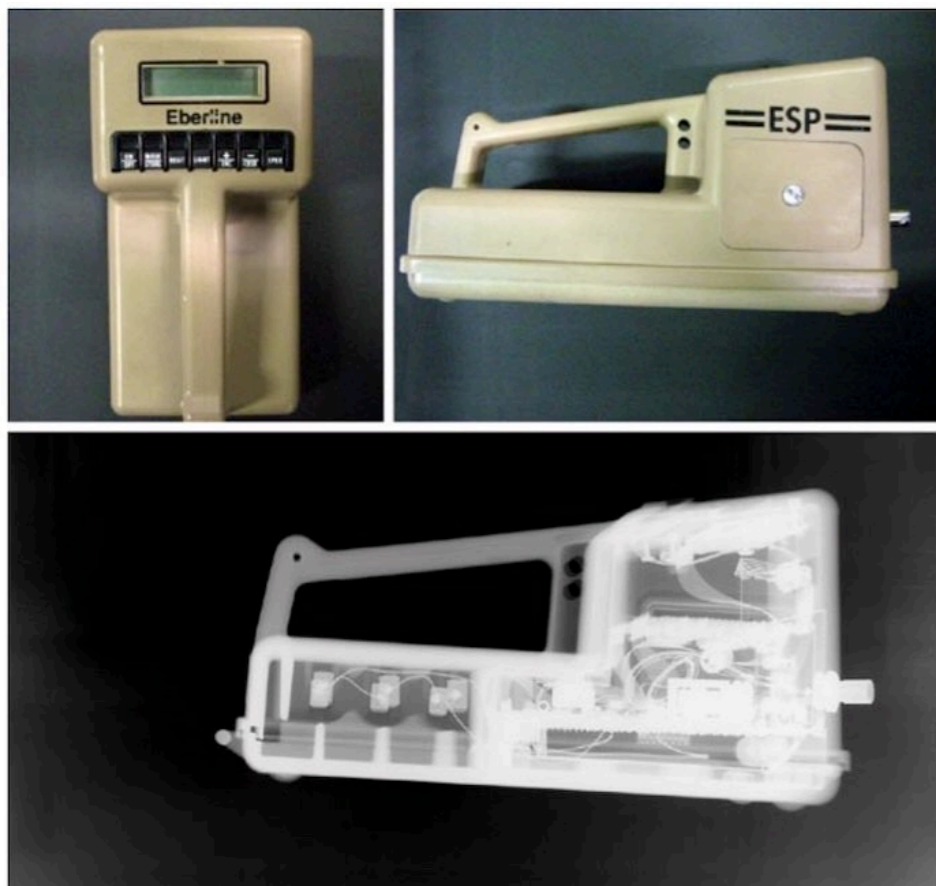
BENEFITS & CHALLENGES

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

Source: quad-nvp.info (top) www.vandenberg.spaceforce.mil/News/Photos/igphoto/2000614747 (bottom)



Modified U.S. Eberline ESP-2 Detector
Defense Threat Reduction Agency, 2011

PROTOTYPE OF AN ABSENCE MEASUREMENT SYSTEM USING PASSIVE GAMMA-RAY DETECTION



Photos: Jihye Jeon and Eric Lepowsky

E. Lepowsky, J. Jeon, and A. Glaser, "The Absent-Minded Inspector: Confirming the Absence of Nuclear Warheads Via Passive Gamma-ray Measurements," this conference; see www.youtube.com/watch?v=JuNA6D4kGe4 for a demonstration

THE LIMITED-ACCESS REGIME

Confirming numerical limits with
positive identification

FROM ABSENCE CONFIRMATION TO POSITIVE IDENTIFICATION



BASIC CONCEPT OF A LIMITED-ACCESS REGIME

- Same as absence regime, but treaty-accountable items would be tagged
- Identity of treaty-accountable items — but NOT their nature — could be confirmed during inspections by confirming the integrity and the ID of the tag
- Over time, inspectors would gain confidence in the nature of the items



BENEFITS & CHALLENGES

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)



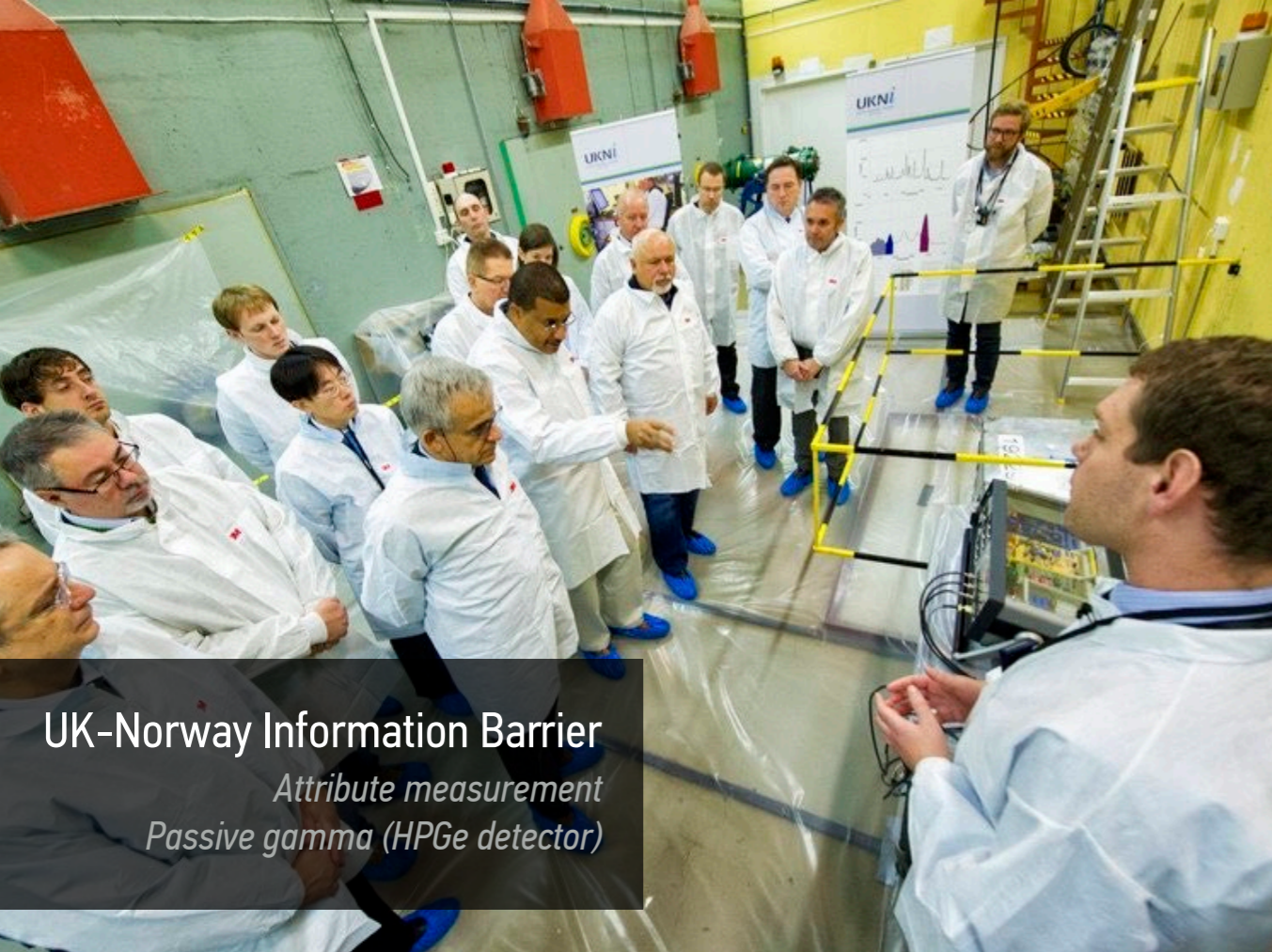
Photo: U.S. Air Force



REFLECTIVE PARTICLE TAGGING (RPT)

THE CONFIRMATION REGIME

Warhead confirmation and
verified dismantlement



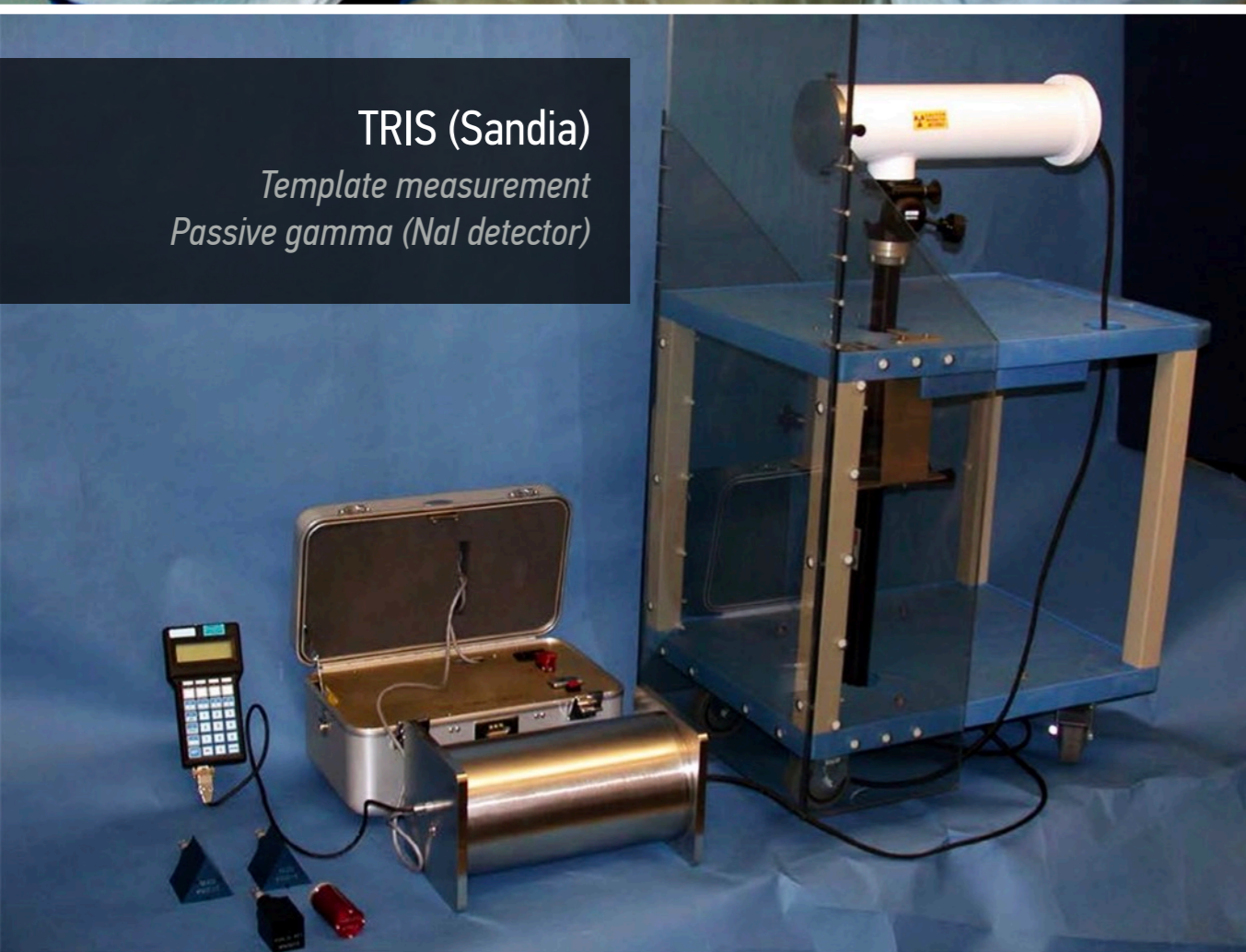
UK-Norway Information Barrier

Attribute measurement
Passive gamma (HPGe detector)



Excalibur (PPPL/Princeton)

Template measurement
Active neutron interrogation (ZKP)



TRIS (Sandia)

Template measurement
Passive gamma (NaI detector)



AVNG (VNIIEF/LANL, Trilateral)

Attribute measurement
Passive neutron and gamma detection

CONFIRMATION REGIME



BASIC CONCEPT OF A CONFIRMATION REGIME

Combined with strong chain of custody provisions, conduct measurements to confirm the authenticity of declared nuclear weapons prior to dismantlement (using an attribute or template-matching approach) and perhaps also during the “life cycle” of randomly selected weapons



CHALLENGES OF A CONFIRMATION REGIME

Even though major research and development efforts have been underway for the past thirty years, no inspection system has so far been successfully demonstrated in a true inspection setting

i.e., with measurements on actual nuclear weapons and the participation of international inspectors, while meeting the requirements for certification and authentication

Source: ukni.info (top)

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, [flickr.com/photos/iaea_imagebank/albums/72157659464420989](https://www.flickr.com/photos/iaea_imagebank/albums/72157659464420989) (top) and quad-nvp.info (bottom)

