Mobile Change Detection System

- Monitoring use
  - Inspection activities of tags, seals and tamper-indicating enclosures (TIE)
  - Chain-of-custody verification for warheads, materials, equipment, devices, locked doors, secure areas
- Hand-held mobile device, small and light-weight
  - Uses device camera for image capture
  - Currently tested on smartphones, phablets, tablets, and digital cameras that use the Android OS
- Performs *in-situ* image authentication
- Mobile image software platform does NOT require additional infrastructure
Mobile Change Detection System

• Physical principle of method
  • Image analysis based upon computer algorithms to align images that are acquired with hand-held cameras
  • Human image analysis elicited by flicker technique ("animation effect")
  • Change Detection System (CDS) provides integrated method of capturing, categorizing, aligning and storing large datasets of images of seals

Before Image | After Image | Image after CDS process
Mobile Change Detection System

• Technology limits
  • Being expanded from PC version to Android interface
  • Proposed image processing for other technologies

• Time required to use and install
  • Less than 5 mins to align multiple images simultaneously - typically completes the Classify and Align process of a project file containing 30 images
  • 1-2 mins for image analysis using flickering
  • Minimal time to install software

• Complexity of hardware, software, use
  • Hardware: complex electronics for mobile devices
  • Software: complex imaging algorithms
  • Use: simple user interface with intuitive layout and requires minimal training to master

• Other functionality
  • Wide range of functionality available on devices including wireless capabilities

• Commercially availability
  • Wide range of commercially-available devices

• Cost
  • $200-1000 for digital platform
• Monitoring use – verification of warheads, materials, or non-nuclear objects; used by U.S. START & New START inspectors to confirm items declared to be non-nuclear actually are non-nuclear

• Physical principle of method – Neutron measurements collected on an object are compared with measured neutron background

• Time required to use and install
  • Setup of equipment – 10-15 minutes
  • Measuring of background – about 5 minutes
  • Obtaining 2-3 measurements & calculating comparison – 10-15 minutes
START Treaty
Radiation Detection Equipment

• Physical description, size/weight
  • 4 carrying cases containing 2 detector systems, tripod and mounting gear, and ancillary equipment – 20 pound (9 kg) He-3 detector, 205 pounds (93 kg) total equipment

• Additional infrastructure required
  • Calibration of detector using radioactive source before each use
  • Secure storage of source and RDE equipment
START Treaty
Radiation Detection Equipment

• Technology limits
  • Detection capability limited to neutrons and by the mass of He-3 in the detector configuration

• Complexity of hardware, software, use
  • Equipment is simple to use but heavy to transport and set up

• Other functionality
  • None

• Commercially availability
  • Complete set was a special build by Sandia National Laboratories containing a custom neutron detector and a modified Eberline electronic counter

• Cost
  • True replacement cost of He-3 very high
  • Sunset Technology places current system beyond commercial availability
  • Comparable system with same functionality costs about $150K, if He-3 is available for recycle for new detector. If need to purchase He-3, costs will increase.
Trusted Radiation Identification System (TRIS)

• Monitoring use – to initialize Treaty Accountable Items into an arms control regime and to maintain continuity of knowledge during storage

• Physical principle of method – uses template matching to confirm that a gamma-ray spectrum is consistent with another weapon or weapon component of the same type

• Trusted system – utilizes information barrier, digital signatures, software authentication, and tamper indicators to establish trust.
Trusted Radiation Identification System (TRIS)

- Physical description, size/weight
  - Gamma detector and cart (~20 kg, 65x50x100cm)
  - Trusted processor, display and keyboard (~10kg, 34x20x20cm)
  - External 12V battery pack (~8kg, 40x20x20cm)

- Time required to use and install
  - Setup of equipment – 10-15 minutes
  - Obtaining measurements & performing comparison - 10-15 minutes

- Additional infrastructure required
  - Storage of RDE equipment with intrusion detection in place
  - Storage of templates for future comparison

Diagram:
- Gamma-Ray Detector: NaI detector with embedded calibration source and tungsten shield
- Trusted MCA & Processor: Trusted Multi-Channel Analyzer and Processor provide information barrier via divided hardware/firmware architecture
- Display and Keypad: Hand-held user input/output (I/O) device
Trusted Radiation Identification System (TRIS)

• Technology limits
  • Medium-resolution NaI detectors do not provide the capability to reliably distinguish some isotopes of interest but do provide sufficient resolution for most template applications

• Complexity of hardware, software, use
  • Software and hardware designed with simplicity in mind
  • User provided only with “Confirmed” or “Not Confirmed”
  • Most challenges lie in working with public/private key for the template
  • Custom-designed to eliminate extraneous functionality

• Commercial availability
  • Specialized Sandia National Laboratories design using commercially available parts

• Cost: $100-$150K per system