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# Future directions for C/S technologies and approaches – a working group discussion

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*PRESENTED BY*

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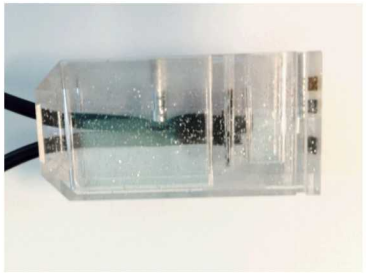
# Topics

- Seals
- Tags
- Tamper-Indicating Enclosures
- C/S Applications to New Facilities
- Surveillance Systems
- Unattended Systems
- New technologies

# Seals

- Currently deployed seals:
  - Electronic Optical Sealing System (EOSS) (being phased out)
    - Active fiber loop seal
    - Physically-attached verification
  - Remotely Monitored Sealing Array (RMSA)
    - Active fiber loop seal
    - Seal data collected wirelessly and transferred via Internet to HQ
  - Metal Cup (looking for replacement)
    - Single use, passive seal
  - Cobra Seal
    - Single use, passive seal
  - Ultrasonic Sealing Bolt (USSB)
    - Ideal for harsh environments

Pictures from left to right: EOSS and reader (courtesy Mirion), RMSA seal (courtesy SNL), metal cup (courtesy SNL), Cobra (courtesy SNL)



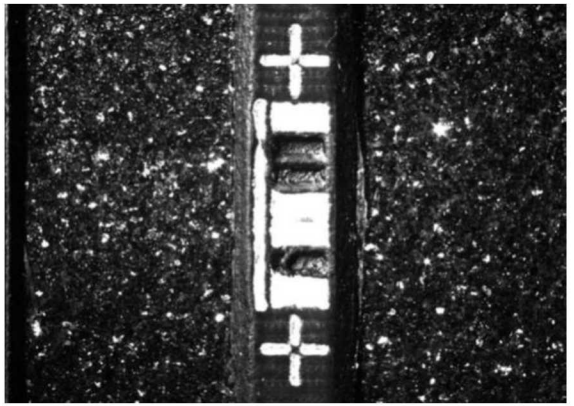
# Seals

- Upcoming seals:
  - Glass Seal (mitigation underway)
  - Active Optical Loop Seal (AOLS)
    - Active fiber seal with wireless verification
  - New IAEA-developed electronic seal
- Where are the new advances in seals?
  - Materials
  - Operator-applied
  - Electronics – crypto-processors, potted electronics, what else?

Glass Seal, IAEA

# Tags or unique identifiers

- Reflective Particle Tag (RPT) – not used for safeguards typically, but has been demonstrated in arms control exercises
- Ultrasonic – studied by JRC, Ispra for unique identifying copper canisters (by adding chamfers inside canisters)
- Laser surface authentication – uses unique surface properties of materials as a signature
- Electronic identifiers
- New approaches?
  - Materials
  - Digitizing analog phenomenon (lava lamps)
  - What else?



RPT, SNL

# Tamper-indicating enclosures

- Existing
  - Anodized aluminum enclosures
  - Active, conductive foils or fibers surrounding electronics
  - Eddy current for metal containers (external verification equipment)
- Current R&D
  - Bleeding materials
- New approaches?
  - Materials
  - Active approaches through fiber optics or conductive pathways
  - External verification equipment?
  - What else?

# C/S approaches at new facility types

- Geological repositories
- Floating reactors
- What else?

# Surveillance systems

- Current:
  - NGSS
- Under consideration:
  - NNGSS
- New approaches?
  - Imaging outside the visible region of electromagnetic spectrum, i.e. UV or SWIR
  - What would these provide us?
  - Assembly of COTS-only components
  - Improving mean time between failure of components, or considering new philosophies?
  - Battery improvements?
  - Sensor fusion (i.e., parallel systems such as NGSS and SWIR camera)
  - What else?

# Unattended systems

- Current:
  - Lots of radiation detection systems
- Under consideration:
  - Unknown
- New approaches?
  - Cryptography (quantum computing)
  - Blockchain
  - Internet of things (IOT)
  - Sensor fusion, sensor integration
  - 5G/6G
  - Automation
  - Artificial Intelligence

# New technologies

- Cryptography (quantum computing)
- Potted electronics
- Blockchain
- Internet of things (IOT)
- Automation
- Artificial Intelligence
- Infinite/long living batteries
- Sensor fusion, sensor integration
- 5G/6G
- Material research
- Battery improvements