

The Need: Inexpensive electronic loop seal

Technologies: Fibre optic or conductive loop
IR or RF communication (particularly ultra-wide band)

General requirements:

- Contactless communication
- Data authentication
- Data encryption
- Tamper resistance
- EMI shielding
- Radiation hardness
- Battery life > 5 years
- Cable length 0.3–30 m

Examples of technologies in use or under development:



Current IAEA loop seals: VACOSS (left) and EOSS (right)

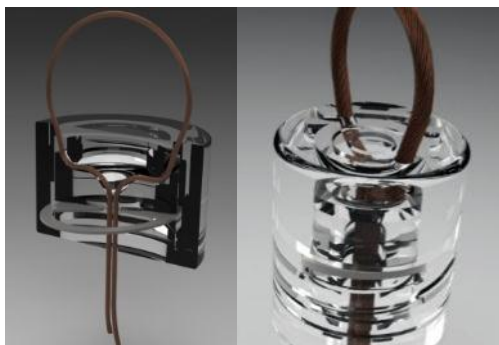
The Need: Replacement for the IAEA's metal seal

Technologies: Non-metallic (glass, ceramic, etc.) passive loop seals

General requirements:

- Authentication by unique physical pattern (surface roughness, impurities, bubbles, etc.)
- Durability
- Environmental resistance
- Radiation hardness

Examples of technologies in use or under development:



IAEA prototype glass seals

The Need: Enhancement of Cobra Sealing System

Technologies: Reusable Cobra seals
Automated Cobra verification
Active Cobra

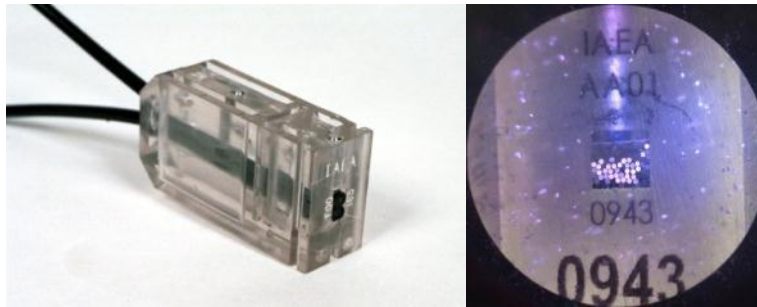
General requirements to seal body:

- Body material authentication by unique physical pattern (e.g. reflective particles)
- Reusability
- Ease of installation
- Protection of fibre signature from contamination

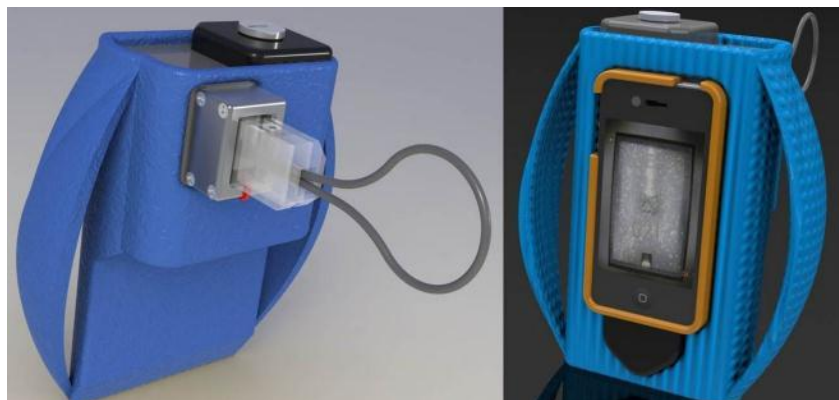
General requirements to Cobra verifier:

- Ease of use
- Lightweight
- Image data authentication
- Durability
- Support for cables up to 40 m

Examples of technologies in use or under development:



Passive Cobra seal and its signature



IAEA prototype Cobra verifier (iCobra)

The Need: Secure anchoring of containers and sealing wires to concrete and metal structures

Technologies: Authenticated epoxies
Smart bolts

General Requirements:

- Epoxy authentication by unique physical pattern
- Data authentication
- EMI shielding
- Environmental resistance
- Radiation hardness

The Need: Remote verification of underwater seals in spent fuel ponds

Technologies: A radiation-hardened electronics integrated into underwater seals

General Requirements:

- Contactless communication
- Data authentication
- Data encryption
- Remote monitoring
- Tamper indicating mounting
- High radiation hardness

Examples of technologies in use or under development:



IAEA ultrasonic underwater seals (left to right):
ARC (bolt head), USB (bolt + head), and JCSS (bolt head)

The Need: Monitoring of doors and gates in Material Balance Areas

Technologies: Authenticated tamper-resistant door and gate sensors

General Requirements:

- Remote monitoring
- Data authentication
- Tamper indication
- EMI shielding
- Radiation hardness

Examples of technologies in use or under development:



IAEA prototype door monitor
(EOSS seal is used for events recording and communication)

The Need: Securing of cages containing accountable assets

Technologies: Cages integrated with fibre optic grid

General Requirements:

- Easy visual check of the content
- Data authentication
- Data encryption
- Remote monitoring
- EMI shielding
- Radiation hardness

The Need: Material enclosures with embedded physical signatures that can be read from a distance

Technologies: Micro-engraving, optically stimulated luminescence, etc.

General Requirements:

- Remote identification
- Environmental resistance
- Radiation hardness
- Portable lightweight reader

The Need: Tamper indication for unusually shaped items

Technologies: Tamper indicating foils and authenticated heat shrink wraps

General Requirements:

- Physical strength
- Easy verification
- Environmental resistance
- Radiation hardness

The Need: Protecting internals of cabinets and equipment enclosures from unauthorized access

Technologies: Acoustic, optical, etc.

General Requirements:

- Tamper resistance
- Data authentication
- Remote monitoring
- EMI shielding

The Need: Inexpensive mutual authentication of inspectors and equipment

Technologies: Smart cards (RFID or contact) in combination with technologies to attach them to passive seals or to embed them in active seals

General Requirements:

- Strong authentication
- Tamper resistance
- Tamper indicating attachment to passive seals or embedding into active seals
- Radiation hardness

The Need: A single light-weight computer platform for inspectors to review procedures (text, images and videos) and analyse data

Technologies: Tablet computers offer a convenient platform but require that security features be built-in to mutually authenticate the inspector and the system and prevent unauthorized access

General Requirements:

- Security concept for the use in untrusted environments (including, but not limited to, user authentication and data encryption)
- Tamper indication
- Portability
- Lightweight

The Need: Protecting security sensitive electronics and data during shipment

Technologies: Secure cases for equipment, documents and data storage media

General Requirements:

- Tamper indication
- Durability
- Lightweight
- Easy sealing (e.g. with loop seals)

Examples of technologies in use or under development:



A prototype secure case for IAEA inspectors

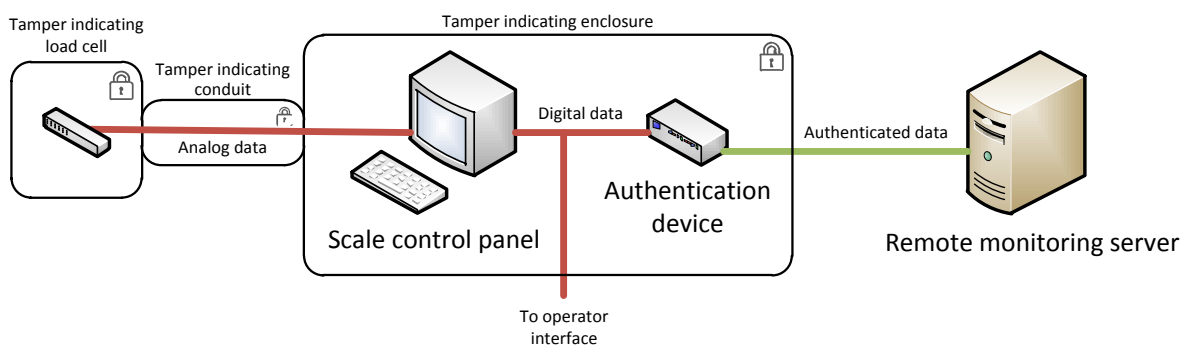
The Need: An attended scales that could be remotely monitored

Technologies: Fully authenticated weighing systems from 1 kg to 14 t

General Requirements:

- Tamper indicating enclosure
- Data authentication
- Remote monitoring
- EMI shielding

Example of implementation concept:



The Need: Tracking containers with accountable items within nuclear facilities

Technologies: Long range RFID (particularly ultra-wide band)

General Requirements:

- Data authentication
- Tamper indication
- Environmental resistance
- Remote monitoring
- Tamper indicating attachment to the container externals

The Need: Tracking containers with accountable items worldwide

Technologies: Cargo tracking

General Requirements:

- Data authentication
- Data encryption
- Tamper indication
- Environmental resistance
- Remote monitoring
- Tamper indicating attachment to the container externals