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# Nexus of Technologies:

# International Safeguards, Physical Protection and Arms Control

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Dianna S. Blair, PhD
Sabina E. Jordan, and Heidi A. Smartt, PhD
International Safeguards and Technology Systems

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# The World is Changing

- International Safeguards continues to evolve
  - From the Additional Protocol to implementing Integrated Safeguards there are incentives to
    - Improve efficiency
    - Increase effectiveness
  - If anticipated Nuclear Renaissance arrives
    - 2010: 371 GW(e), 2030: ranging from 511 to 807 GW(e)*
    - Increase in the number and diversity of facilities under Safeguards
- Arms Control is being discussed
  - New START Treaty
  - Article VI of the NPT

*Nuclear Technology Review 2010, IAEA

# Security's Future Continues to Grow

- Global markets for intruder alarms continue to grow at a surprising rate
  - Annual growth rates of 8.2% have been predicted*
- Global video surveillance market is also predicted to grow
  - From $13.5 billion in 2006 to $46 billion by 2013**
- Latest generation of detection systems utilize techniques to improve performance
  - Intelligent learning algorithms
  - Neural networks
  - Advanced multi-parameter signal processing

*IMS Research http://imsresearch.com/news-events

**"Boundaries of Security" 2009 FFT Future Fibre Technologies Pty Ltd, Australia

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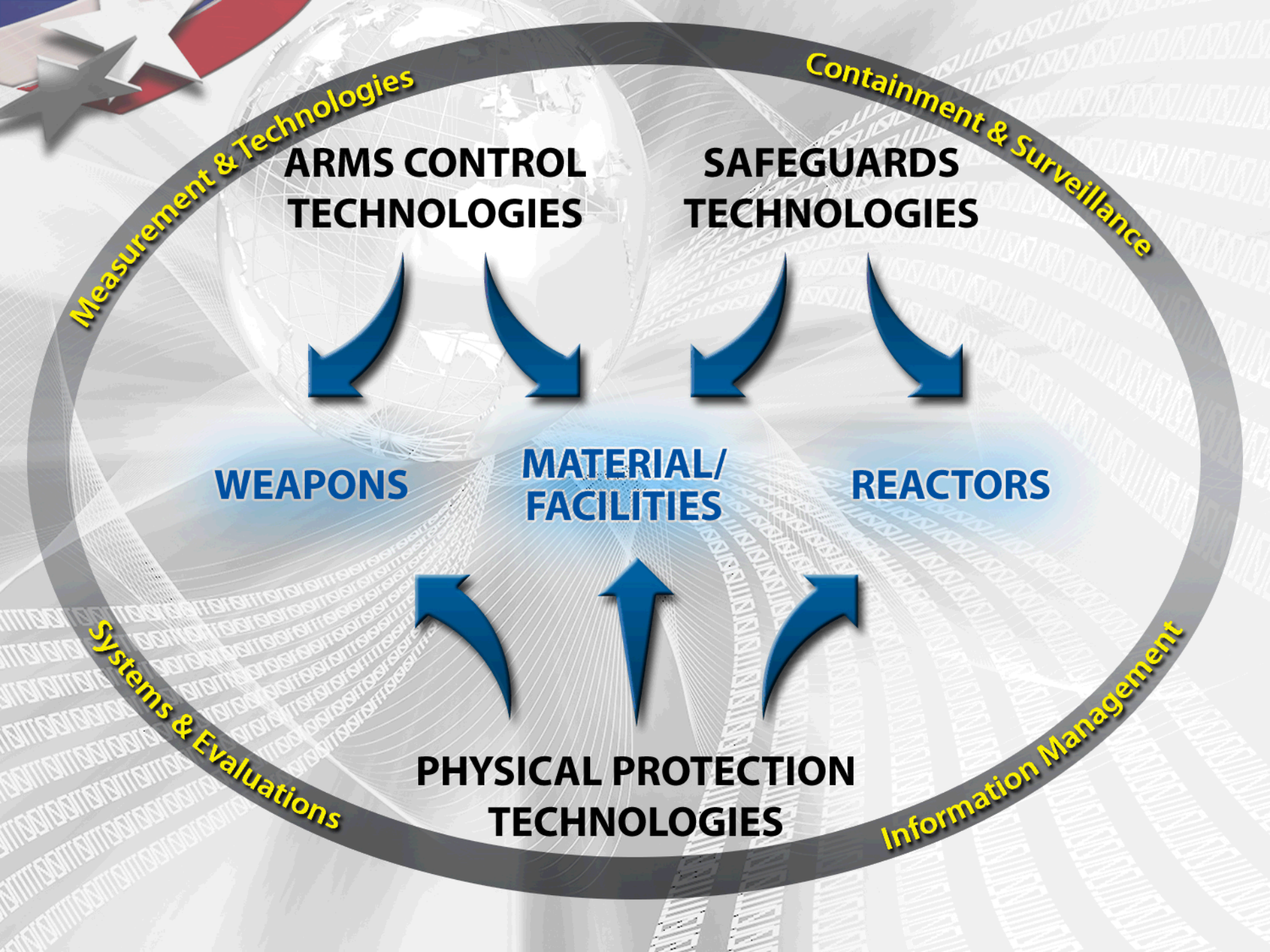
Measurement & Technologies
Containment & Surveillance
ARMS CONTROL TECHNOLOGIES
SAFEGUARDS TECHNOLOGIES
WEAPONS
MATERIAL/ FACILITIES
REACTORS
PHYSICAL PROTECTION TECHNOLOGIES
Systems & Evaluations
Information Management

# Technologies are Similar but Requirements May Vary

- Timeliness requirement
  - Safeguards: normally Weeks to months
  - Arms Control: normally Weeks to months
  - Physical Protection: Immediate
- Encryption
  - Safeguards: Sometimes
  - Arms Control: Typically
  - Physical Protection: Expanding
- Data Authentication
  - Safeguards: Mandatory
  - Arms Control: Mandatory
  - Physical Protection: Expanding
- Remote monitoring
  - Safeguards: Desirable
  - Arms Control: Desirable
  - Physical Protection: Desirable

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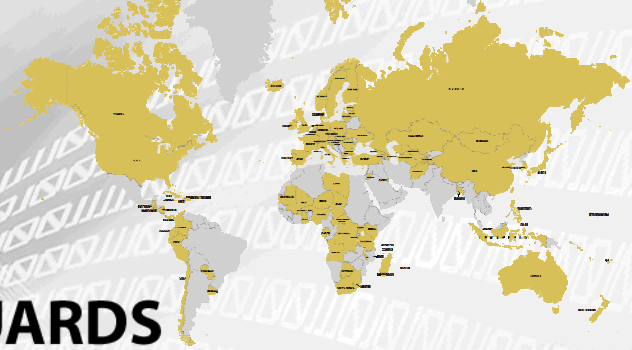
ARMS CONTROL

SAFEGUARDS



Additional Protocols
in Force
(as of May 2010, IAEA)

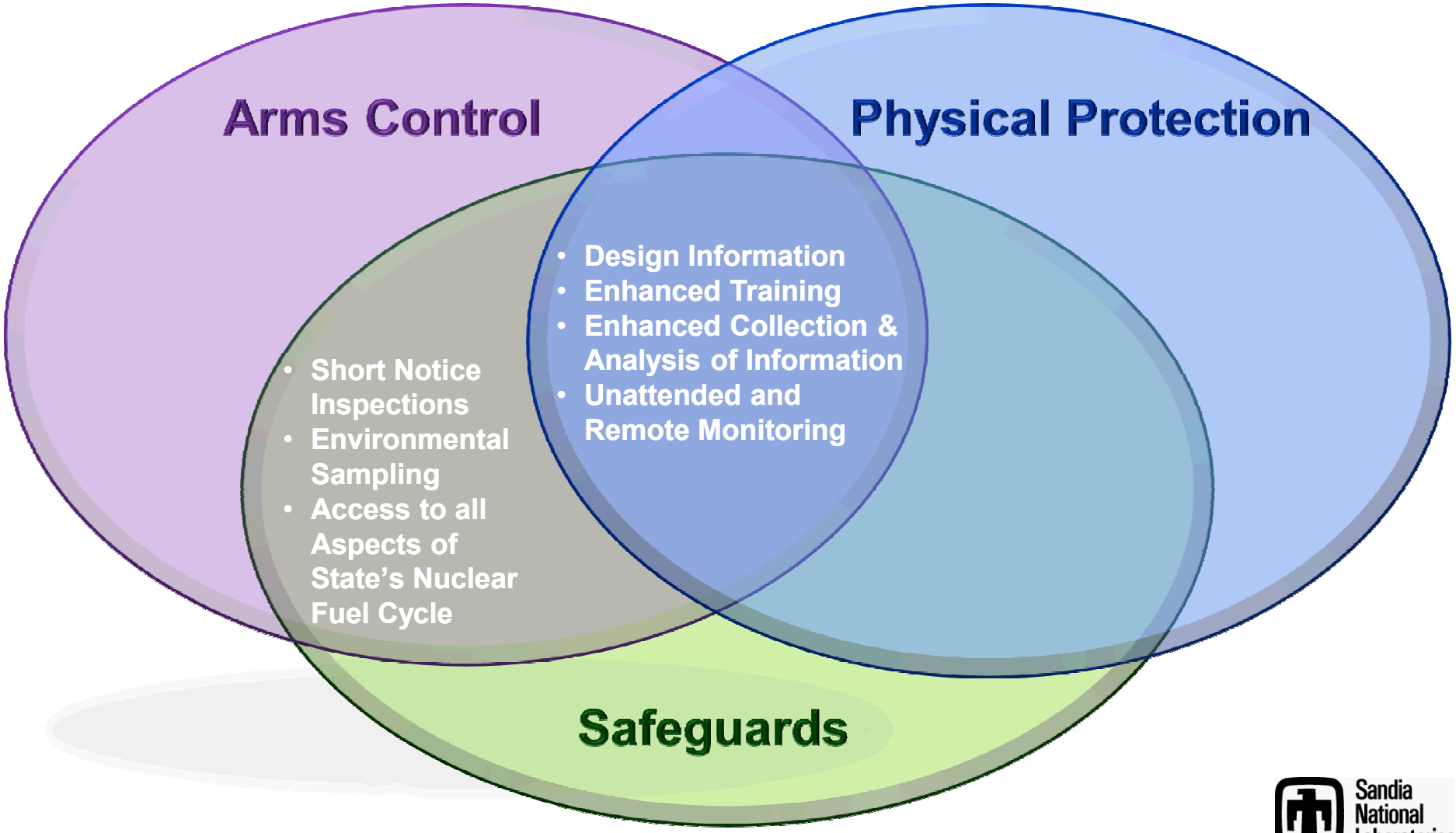
WEAPONS

MATERIAL/
FACILITIES

REACTORS

PHYSICAL PROTECTION

# Possible Commonalities with Additional Protocol

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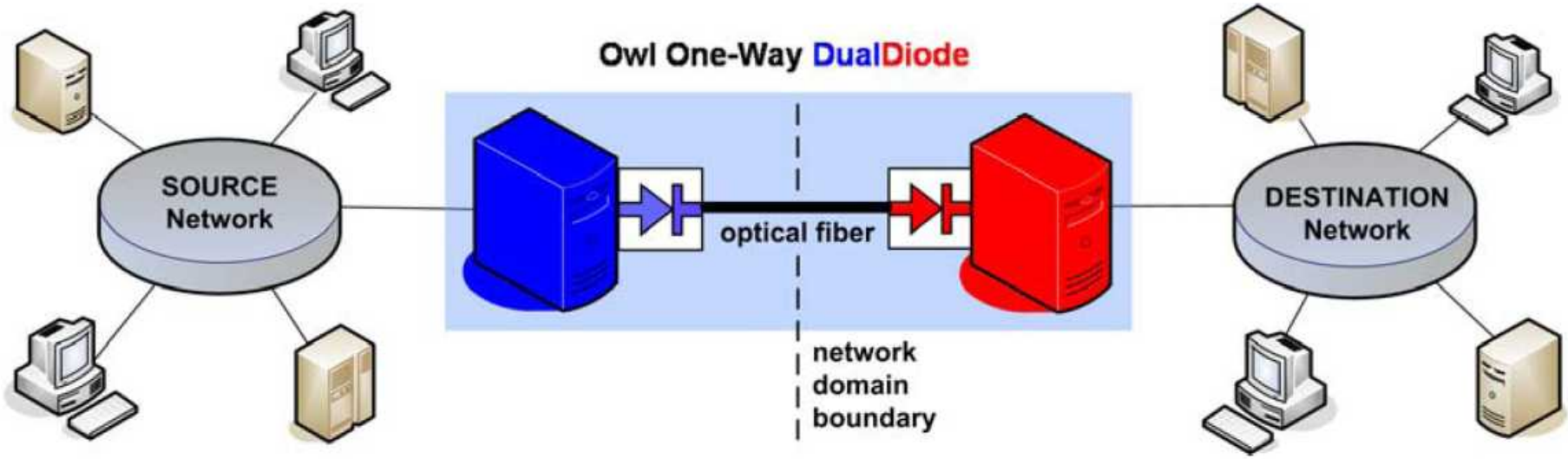
# Protecting Sensitive Host Information

- Ensuring inspectorates' technical equipment does not record nor reveal classified or sensitive information
- DualDiode®, by Owl Computing Technologies®
  - Hardware based for data filtering
  - One-way transmission path to "filter" information from secure systems to less-restricted systems

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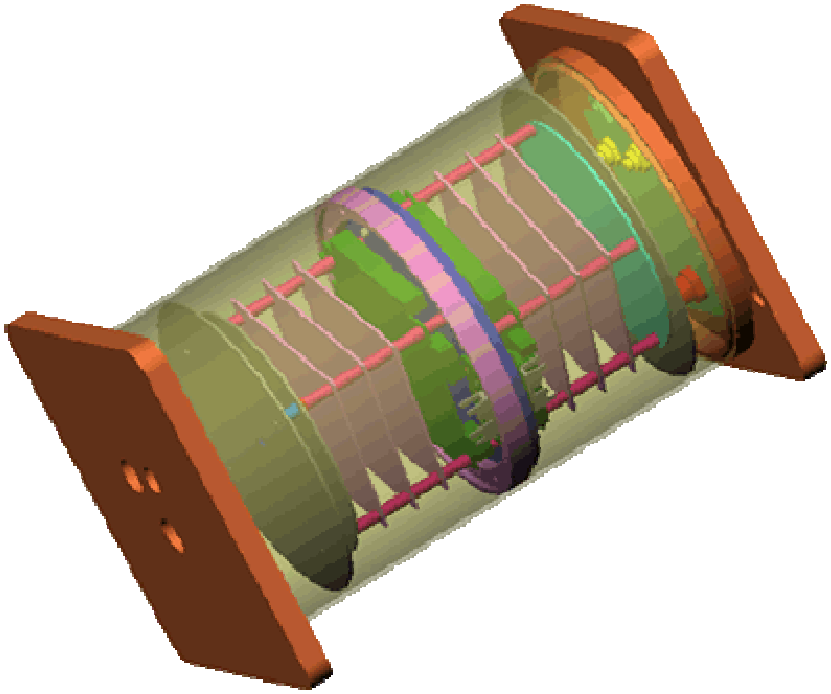
# Protection of Sensitive Information Directly at Sensor or Collection Source

- "Trusted Radiation Attribute Demonstration System" (TRADS)
  - Uses radiation measurements to authenticate attributes of weapons-grade plutonium and HEU
  - Employs high-purity germanium gamma spectrometer and gross neutron detector
  - Implementation of the trusted processor integral to design so attributes of classified components can be confirmed without revealing sensitive information (yes/no approach)
  - Portable, authenticated, tamper resistant
- "Trusted Radiation Identification System" (TRIS)
  - Confirms identities of treaty-accountable items by comparing gamma-ray spectral measurements using template matching
  - Also based on the trusted processor



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# Measurement Technologies

- Radiation detection equipment
  - Monitoring declared nuclear weapons in Arms Control
  - Monitoring radioactive material in International Safeguards
- Issues – geometry variances and container configurations
- Neutron measurements can avoid these issues, but used more routinely in Arms Control

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# Continuity of Knowledge

- Typically required for high value assets
- Inspector equipment
  Safeguards
  - Equipment
  - Materials/items in storage
  - Location
- Arms Control
  - Equipment
  - Materials/Items, delivery systems to warheads, fissile materials, inspection equipment
- Physical Protection
  - Equipment
  - Locations

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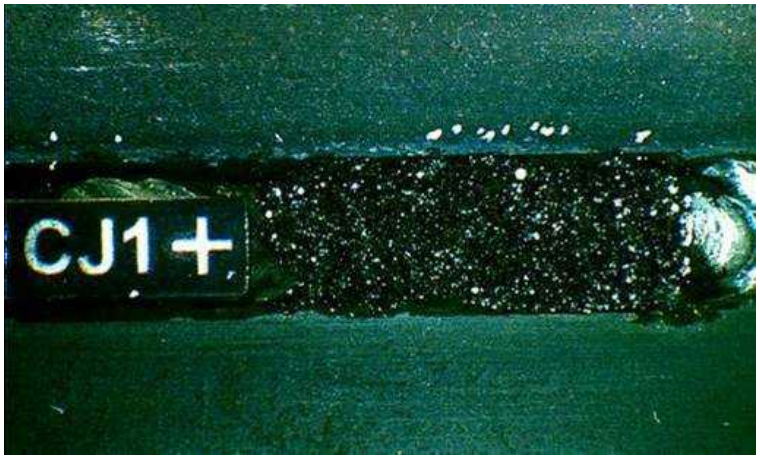
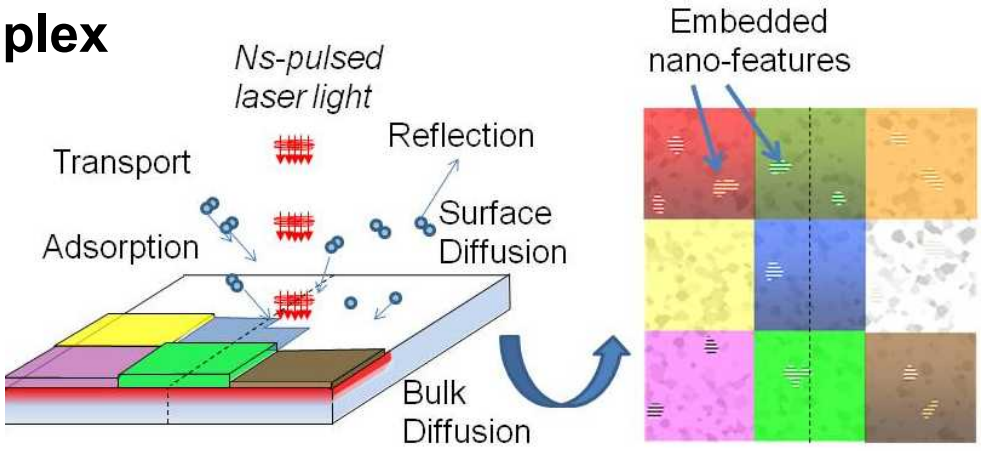
# Continuity of Knowledge - Tags

- Research is underway to create identifiers
- New approaches:
  - Reflective metallic particles suspended in polymer and spread through a template onto item of concern
  - Laser pulses to create complex color and morphological surface patterns based on intrinsic properties of item

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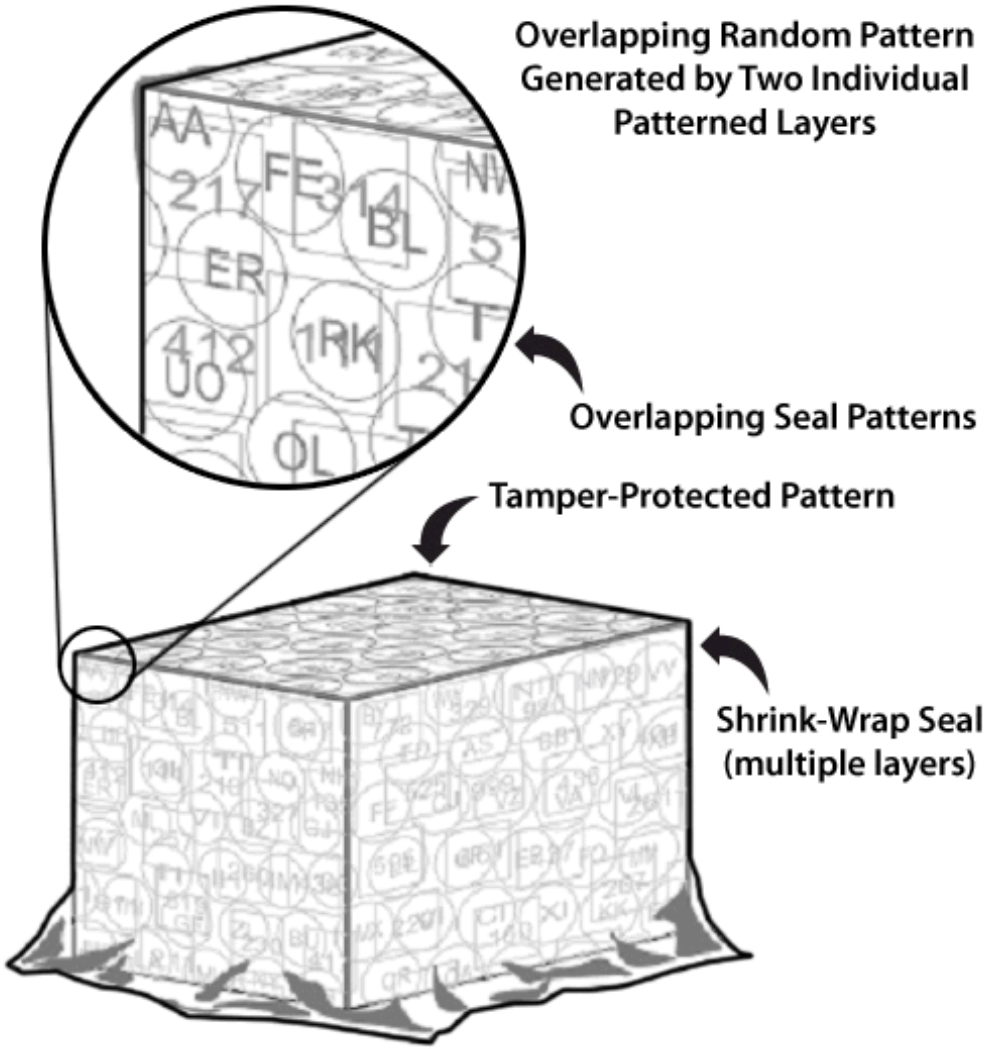
# Continuity of Knowledge - Seals




- There are a variety of active and passive seals available
  - Cobra, Vacoss, RMSA, metal E-cup
- Tamper-evident shrink wrap
  - Leverages packaging industry technology
  - Developed in support of Chemical Weapons Convention

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# Surveillance Systems

- Safeguards
  - Digital images captured to ensure Continuity of Knowledge
  - Authentication of images required
- Arms Control
  - Treaty dependent
  - Could be used to monitor sites or specific items
- Physical protection
  - Surveillance is constant and real-time capture of video
    - reviewed in real-time
  - Assessment video is captured in response to an alarm or trigger
  - Authentication is available and becoming increasingly important
    - Litigation
    - Expanded deployment scenarios

# Surveillance Systems: Example

- **Shared technologies**
  - **Video systems developed for Physical Protection could be adaptable to Safeguards if they meet security requirements**
  - **Frame rate may vary based on application**
- **Commercial surveillance systems may not meet Safeguards required security standards**
  - **New features, such as authentication and encryption, now becoming available**
- **Avigilon 2.0 Megapixel Day/Night High Definition IP Video Camera with 256-bit encrypted hash of image**



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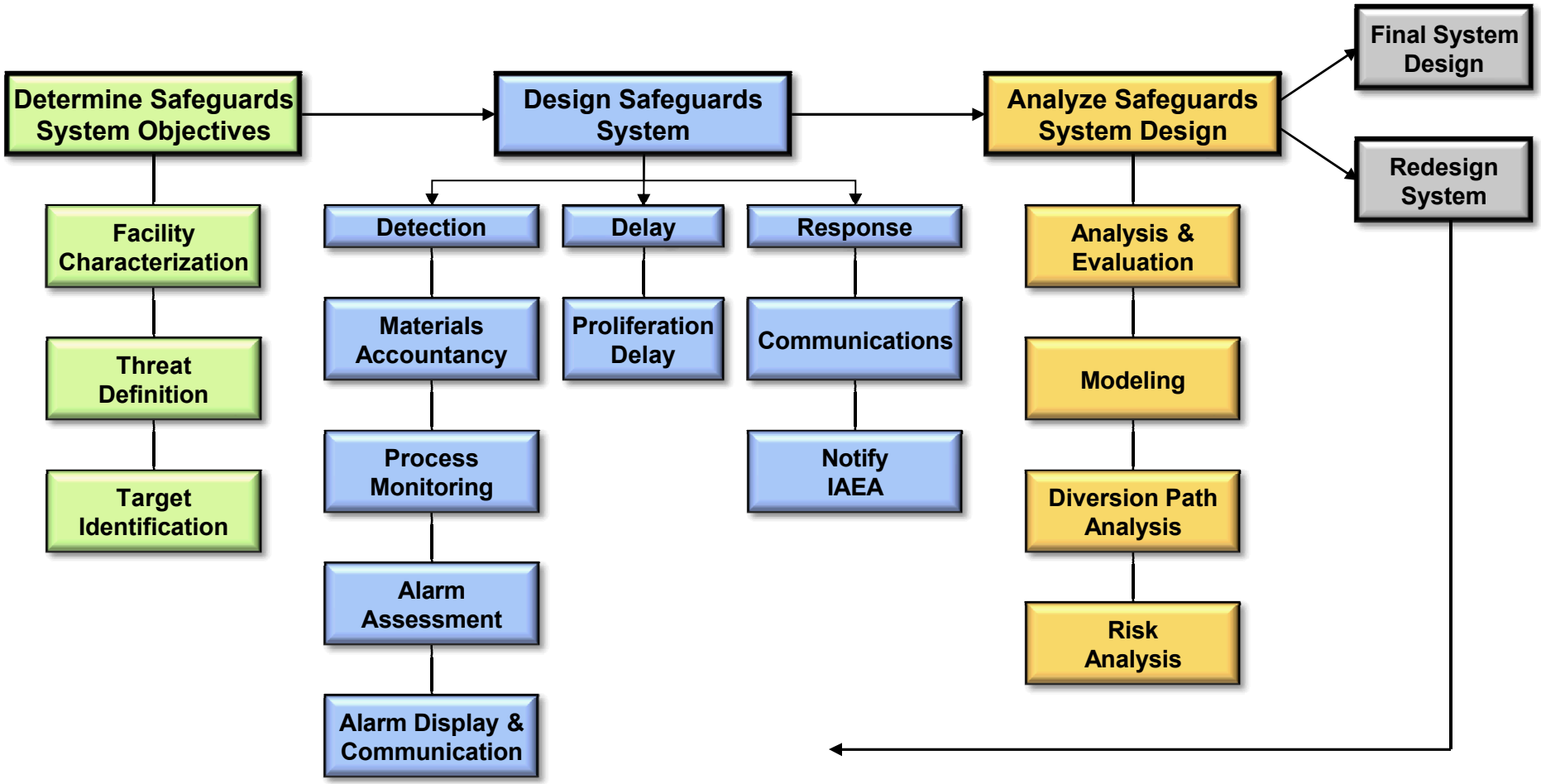
# Systems Engineering Process and Design Principles

- Effective Physical Protection system designs use performance-based approaches to meet protection system objectives rather than criteria-based or prescriptive-based approaches
- Approach allows:
  - Trade-offs and scenarios to be tested
  - Lessons learned to be effectively documented
  - Structured framework for which to impart experience and knowledge to next generation of workers

# Systems Engineering Process for International Safeguards

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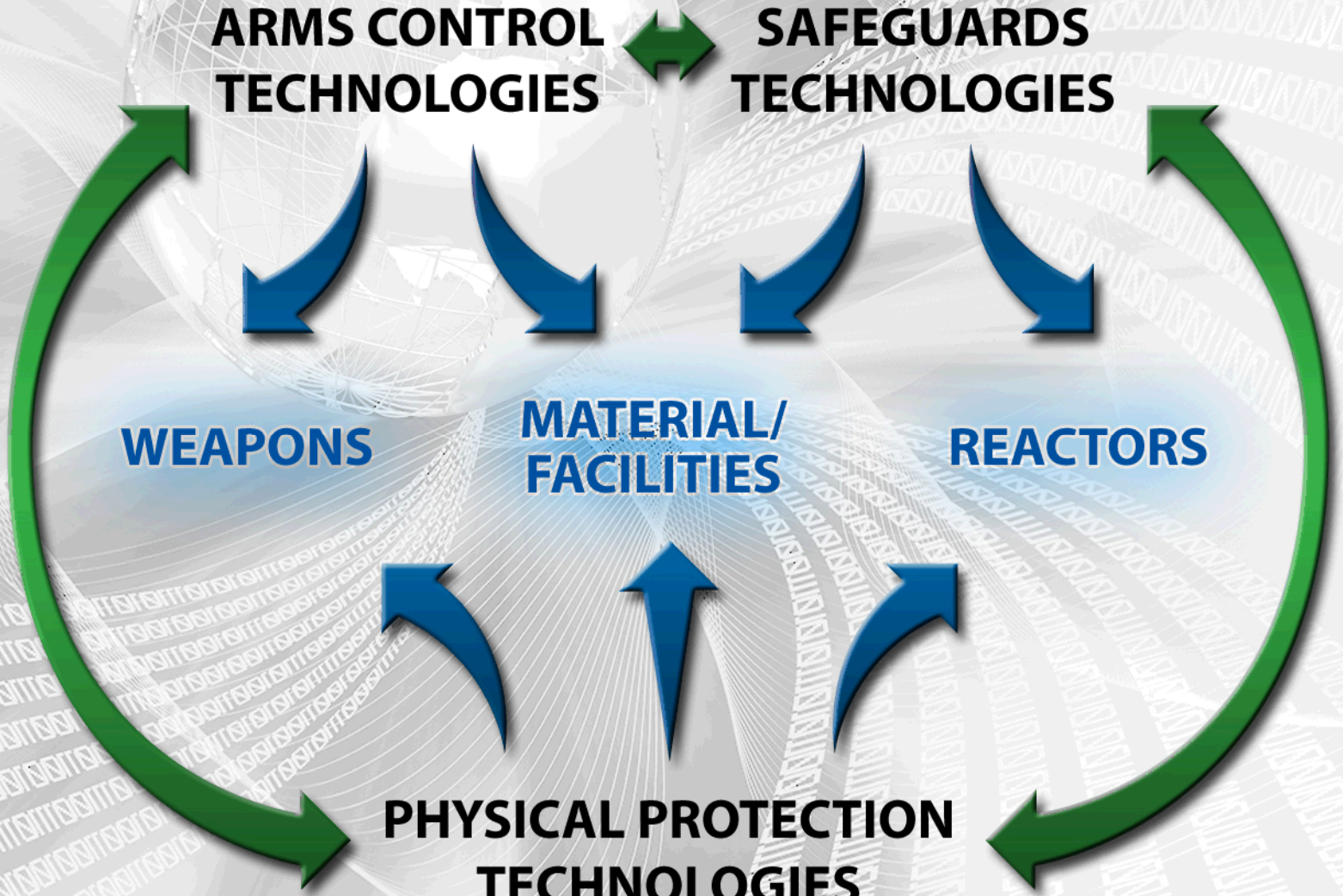


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# Conclusions

- New technologies have been, and are continuing to be developed for Safeguards, Arms Control, and Physical Protection
- Growing recognition that application spaces and technical requirements are evolving
  - Overlaps are developing
- Lessons learned from IAEA's extensive experience could benefit other communities
- Leveraging technology development costs across communities provides opportunities to have state-of-the-art technology without bearing full development cost