Future Challenges for Global Fuel Cycle Material Accounting

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Users Annual Training Meeting

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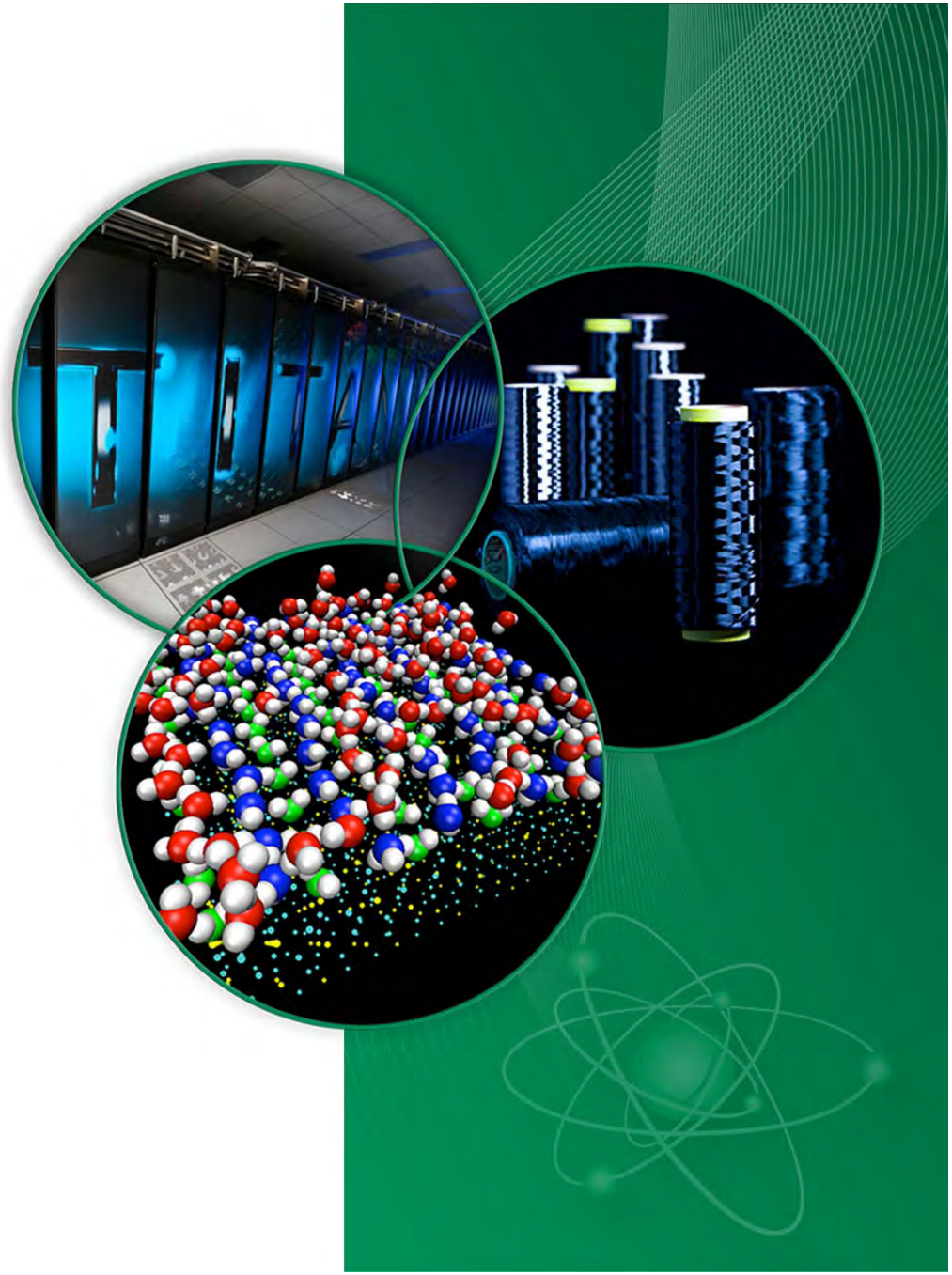
St. Louis, Missouri



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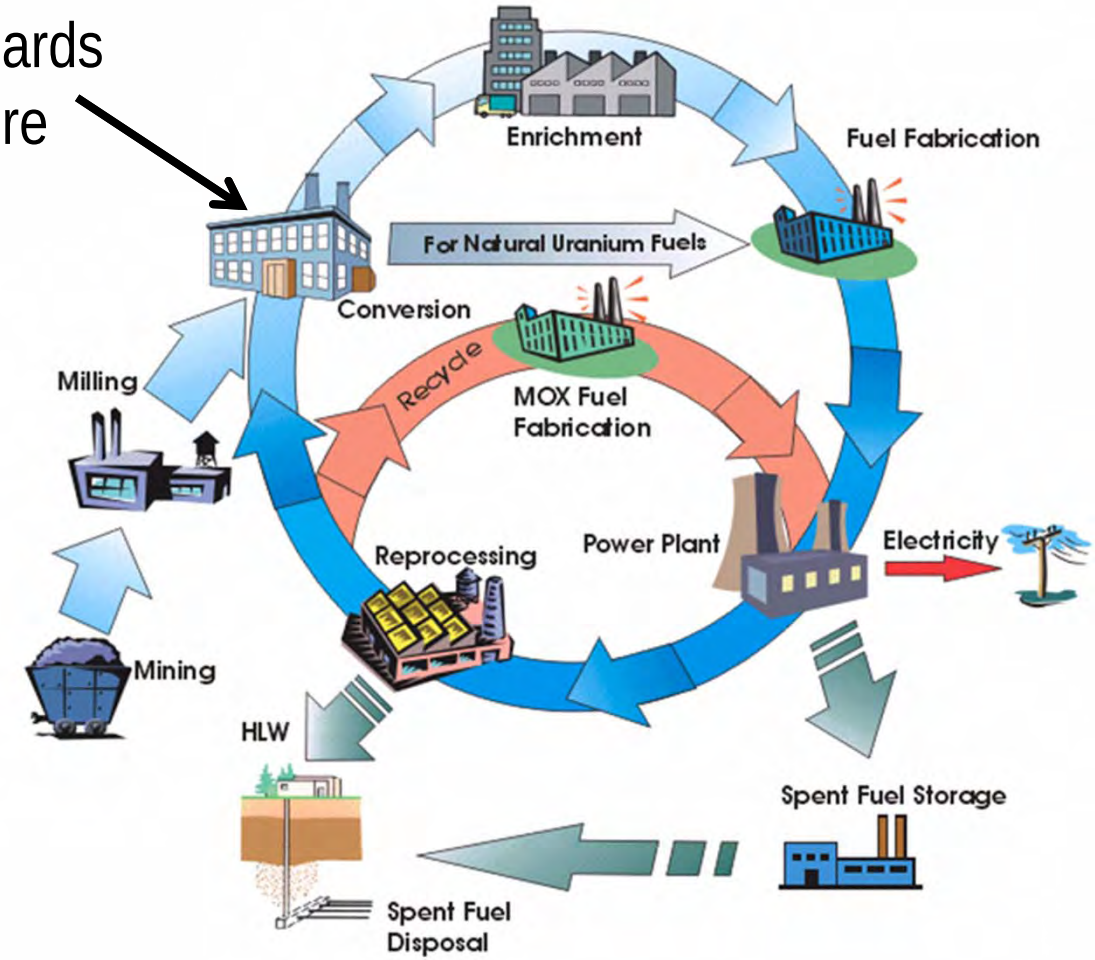
Introduction

- Changing Nuclear Fuel Cycle Activities
- Nuclear Security Challenges
- How to Respond?
  - Additional Protocol
  - State-Level Concept
  - Continuity of Knowledge
- Conclusion

Nuclear Fuel Cycle

IAEA Safeguards Begins Here



Source: International Atomic Energy Agency (IAEA), Nuclear Fuel Cycle Information System (NFCIS) web site

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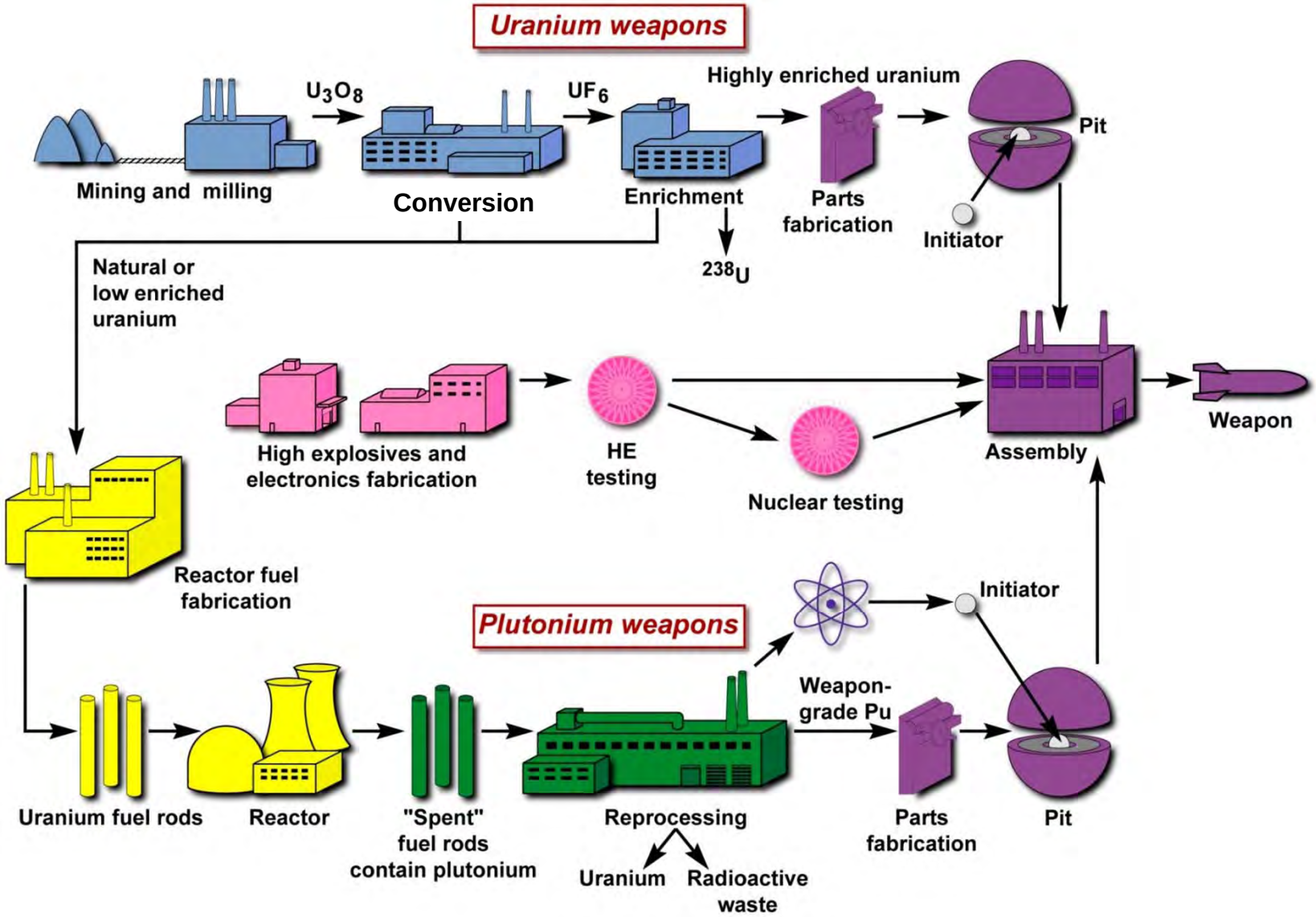
Nuclear Weapons Cycle



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Changing Fuel Cycle Activities

- Nuclear Renaissance (WNA, August 2011)
  - ↑ 60 Reactors Under Construction
  - ↑ 45 Countries Considering New Nuclear Programs
- Small Modular Reactors
- Fuel Cycle Globalization (WNTI, May 2013)

~4
Million
Fuel Cycle Related
Shipments
Per Year

Source: World Nuclear Transport Institute (WNTI)

Non-Proliferation Challenges

- Detection of Undeclared Material
  - Iraq
- Iran/North Korea
  - Threat of Escalation by Neighbors
- Proliferation Sensitive Technologies
  - Pyroprocessing
  - Laser Enrichment

Source: The Nuclear Threat Initiative

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Non-State Threats

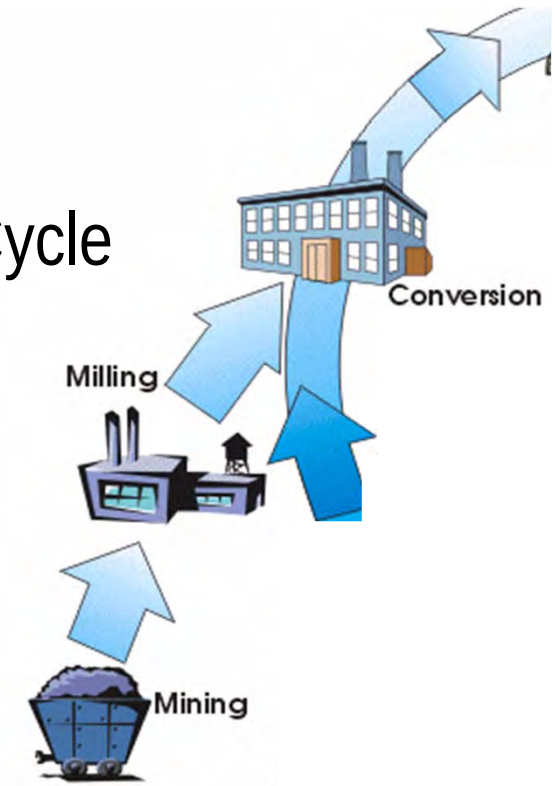
- Covert Nuclear Supply Networks
  - A. Q. Kahn

Source: Paul Efird, Frank Munger's Atomic City Underground

- Legacy Materials
  - Libya
  - South Africa
- Terrorist Threats
  - Global Initiative to Combat Nuclear Terrorism

How to Respond?

- Implement Safeguards Earlier in Fuel Cycle
  - Mining, Milling, Conversion



Source: International Atomic Energy Agency (IAEA), Nuclear Fuel Cycle Information System (NFCIS) web site

- Transition to "State-Level Concept"

- Increase use of Continuity-of-Knowledge (CoK)

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Additional Protocol

- Traditional Safeguards → Correctness
- Additional Protocol → Completeness

- Measures under Additional Protocol (IAEA Factsheet: IAEA Safeguards Overview)
  - Access to complete fuel cycle (Mining, Waste, etc.)
  - "Complementary" Access
  - Wide area environmental sampling
  - Open source data analysis
  - Verification for fuel cycle R&D

State-Level Concept

> Clearly, the quantity of nuclear material in a State, or even the size of its fuel cycle, constitute poor indicators of the proliferation risk posed by that country.
>
> (Herman Nackaerts, IAEA DDG Safeguards)

- State-Level Approach
  - Less Predictable → Higher Deterrence
  - More Focused → Better use of Resources
  - More Flexible → State-specific Approaches

- Broader Conclusion → Applied to Evaluation Only
- Need to apply state-level concept to implementation

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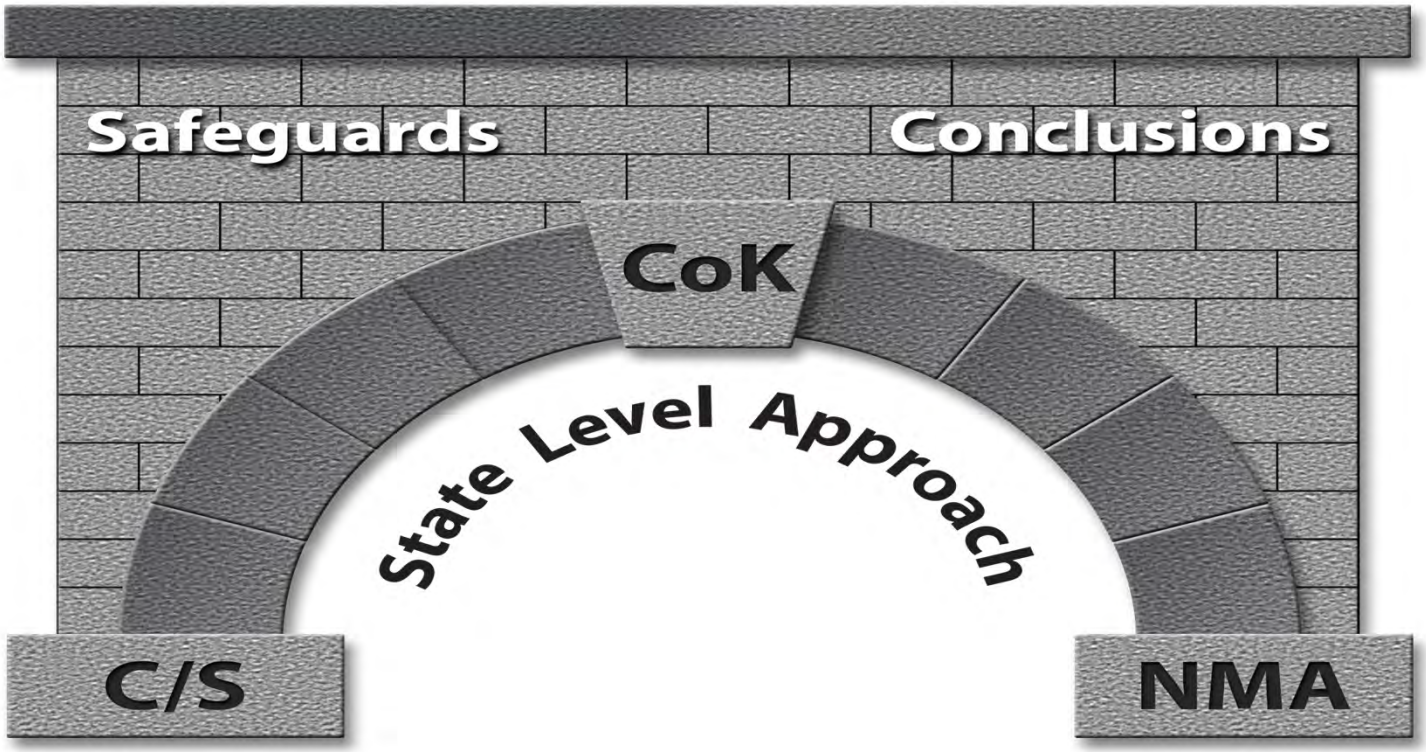
Continuity of Knowledge (CoK)

Information regarding an item or activity that is uninterrupted and authentic. This provides the IAEA with adequate insight to draw definitive conclusions that nuclear material is not being diverted from peaceful purposes.



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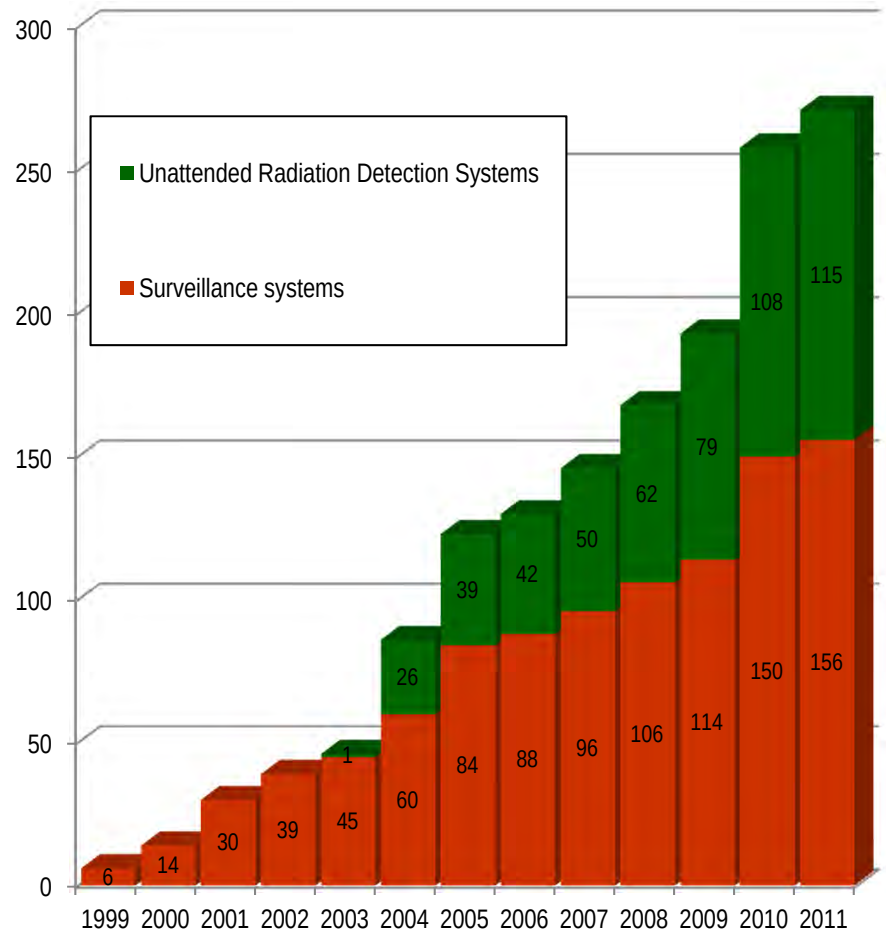
Unattended Monitoring Systems

- Automatic and Continuous Monitoring
- 24 hours / 365 days a year
- Significant Growth Area

- Primary Goals
  - Tamper Indication/Detection
  - High Reliability
  - Assurance of Authenticity



*A. Anichenko,, Equipment Development and Challenges of Safeguards Implementation, May 10, 2012.

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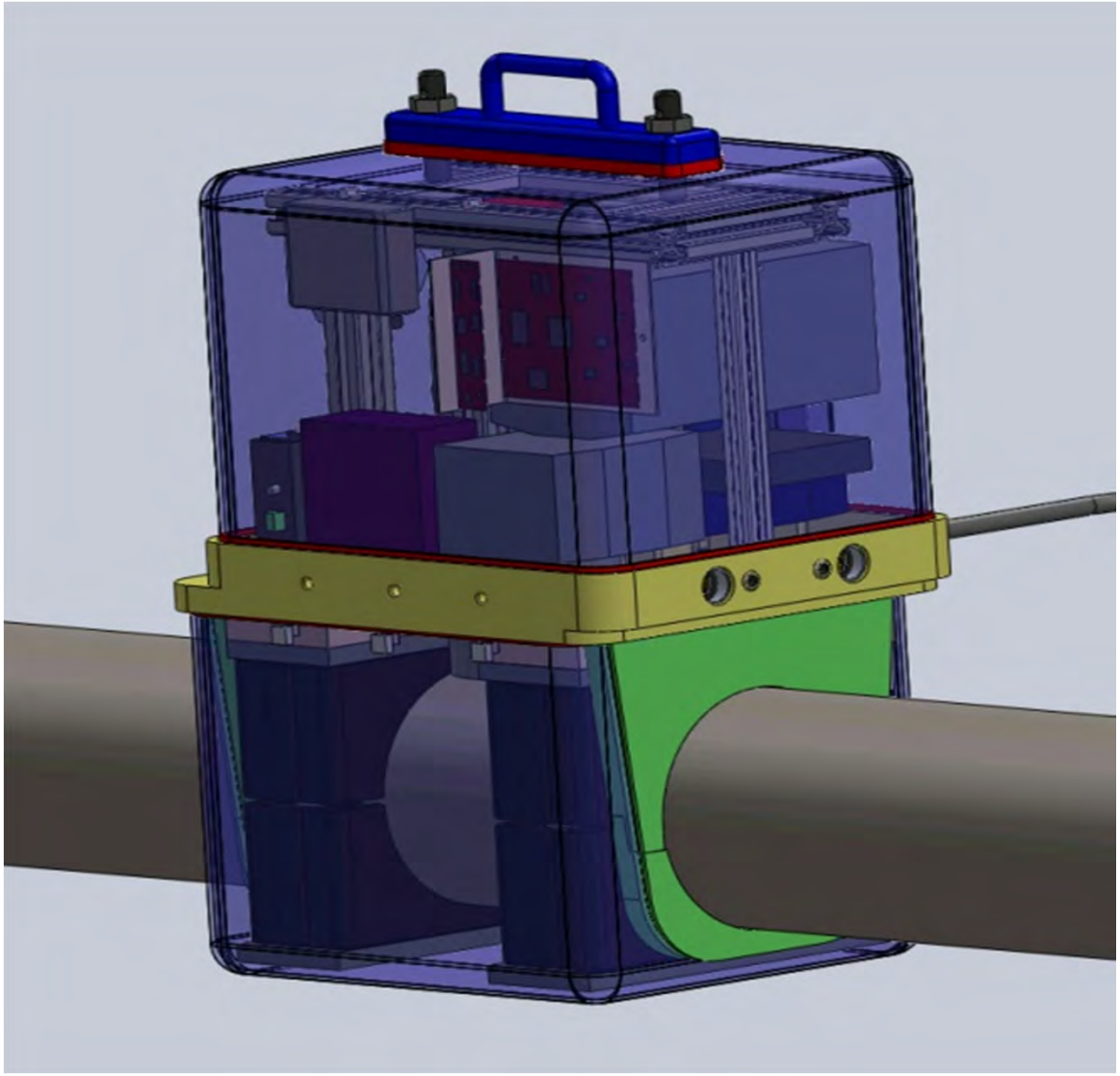
Example: On-line Enrichment Monitor



Data Collection

- Requirements
  - Accuracy
  - Authenticity
  - Reliability (Uninterrupted)
  - Multisource for Confirmation

- Challenges
  - Data Storage
  - Deriving Meaningful Information

Source: The Economist

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Summary

- Respond to fuel cycle expansion, non-proliferation challenges, and non-state threats by:
  - Implementing Safeguards Earlier in Fuel Cycle
  - Transitioning to “State-Level Concept”
  - Increasing use of Continuity-of-Knowledge

- Continuity of Knowledge must be based on a firm foundation in containment & surveillance and nuclear material accounting

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Challenges

- Address fuel cycle expansion with limited resources
- Develop methods to better maintain and sustain CoK
- Improve ability to detect undeclared material and activities

> Only by adapting the safeguards system and by applying safeguards more intelligently, will we be able to continue to provide the international community with credible assurances that States are in compliance with their safeguards commitments.
>
> (Herman Nackaerts, IAEA DDG Safeguards)

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