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*Title:* Potential Confirmatory Measurement of Plutonium

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## Potential Confirmatory Measurement of Plutonium

Duncan MacArthur

**Abstract:** This set of slides addresses a number of issues inherent in confirmatory measurement of plutonium. These issues include the sensitivity and complexity of radiation signatures as well as methods, such as attribute and template measurement, for addressing the issues. The concept of "data-density" is useful in evaluating different potential measurement systems. After some discussion of types of material movement and generic threats, I conclude with a recommendation for a graded approach, where the level of monitoring is matched to the sensitivity of the situation

## Potential Confirmatory Measurement of Pu

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## Overview

- Information interpretation
- Radiation measurements
  - Attributes
  - Templates
- Confirmatory measurements
- Threats
- Approaches



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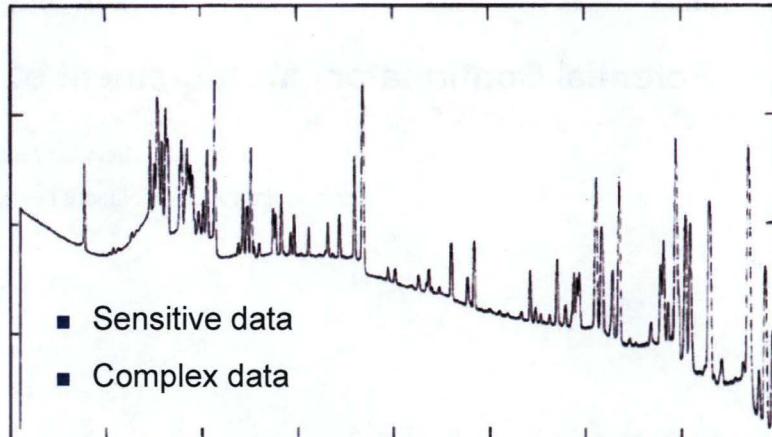
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## Information Interpretation



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## Sensitive Information

- Sensitivities - Not necessarily classified
  - Impurities
  - Isotopic composition
  - Geometry
  - Packaging
  - Etc.
- Similar to treaty verification problem
  - May be technically easier
  - Lower profile
  - Much more common



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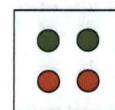
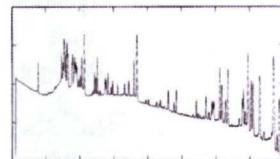
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## Data Density

- High-density
  - Complex
  - Requiring interpretation
  - Training requirements
  - More information than needed
- Low-density
- Why it's a problem
  - Mistakes
  - Lost time
- Approaches
  - Attributes
  - Templates



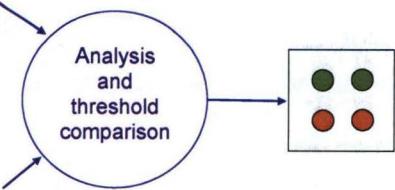
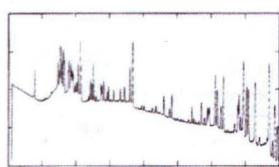
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## Attribute Measurement



Neutron Count Rates:  
Singles (S)  
Doubles (D) → Mass,  
Triples (T) Multiplication,  
Alpha ratio



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## Possible Attributes

- Physical Characteristics
  - Size
  - Weight
- Radiation
  - "It's radioactive"
  - Gamma Based
    - Specific Pu peaks (Pu presence)
    - Combinations of Pu peaks (Isotopic Ratio)
    - Other peaks ( $^{241}\text{Am} \sim \text{Age}$ )
  - Neutron based
    - Fissile material mass
- How much confidence?



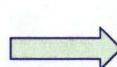
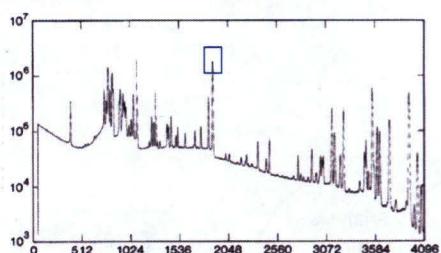
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## Simple Template



- Matches or not
- Same as an attribute



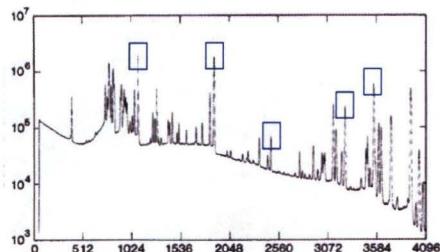
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## More Complex Templates



- Matches or not
- Multiple “attributes”
- Attributes may, or may not, be defined
- “Passport”



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## Material Shipments

- Continuity of Knowledge
  - Visual surveillance
  - Documentation
  - Measurements (Radiation and other)
    - “Choke points”
    - Portal monitors
    - Video
- Priorities
  1. Elimination
  2. Engineering controls
  3. Procedural controls



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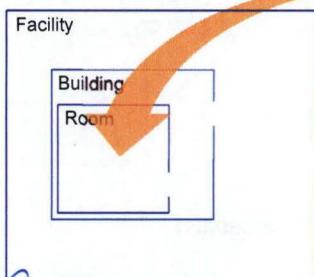
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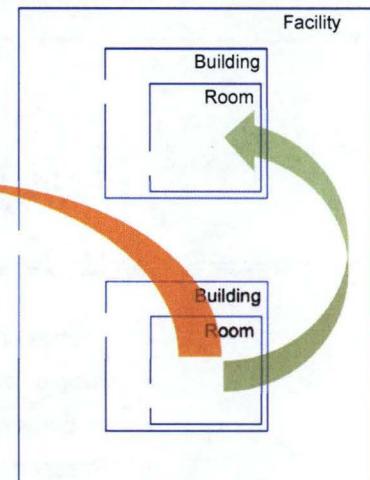
## Inter-facility vs. Intra-facility

- Choke points
- Obstructions
- Opportunities



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## Threats

- Mistakes
  - Complexity
  - Interpretation required
  - Amount of human interaction
- Insider threat
  - Attractiveness
  - Access
  - Amount of human interaction
- Issues with “traditional” methods
  - Visual surveillance
  - Procedures

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## Approaches to Confirmatory Measurement

- Graded approach much like “graded safeguards”
  - Attractiveness
  - Physical features
  - Choke points
- Types of radiation measurements
  - None
  - Simple
  - Attributes or Templates

“Everything should be as simple as it is, but not simpler.”

*Albert Einstein*



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