





## Outline

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- What is Environmental Sampling for Safeguards?
- ES basic principles
- History of ES implementation
- ES capabilities
- Example
- ES cycle



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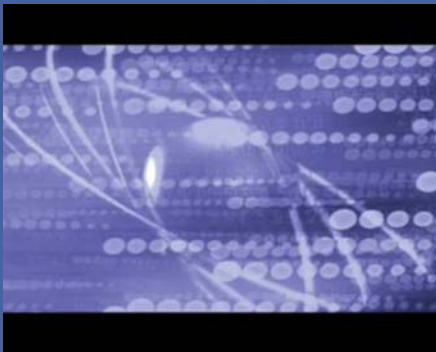
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## What is Environmental Sampling for Safeguards?

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## Basic principles

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Environmental sampling for safeguards is based on the premise that every nuclear process, no matter how leak tight, emits small amounts of process material to the environment.



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## Basic principles

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The released process material can settle on equipment and surfaces within buildings, and can be transported outside to deposit there.



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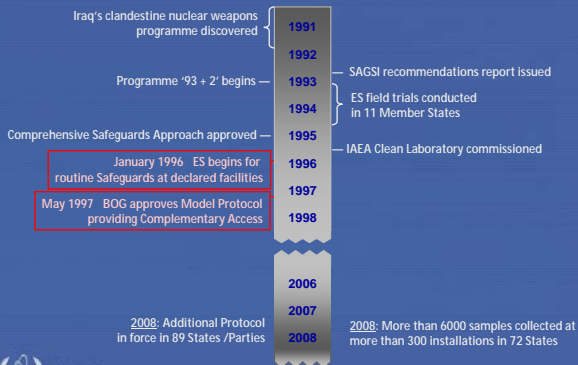
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## History of ES implementation

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## Field trials — types of environmental samples

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## Swipe sampling

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## IAEA inspector taking a sample

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## Sampling kits

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Swipe samples are easy to collect and transport; they can be used to detect a variety of nuclear signatures.

Standard swipe kit



Sampling kit for hot cells



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# ES analysis... "lake cocktail"

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# ES capabilities: bulk analysis

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Current analytical techniques are capable to detect *picogram* amounts ( $10^{-12}$  g, or *parts per trillion*) of U and Pu ...and determine their relevance for potential nuclear proliferation.



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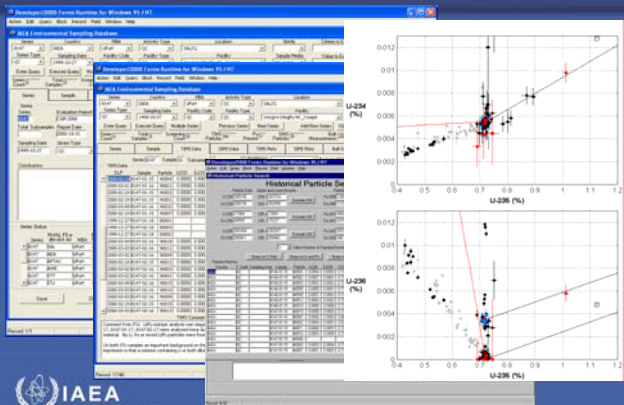
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# But what do the data mean?

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## Environmental sampling – a powerful tool for nuclear verification

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- Traces of nuclear material can be detected
- Their signatures are characteristic to a specific process where these materials were generated or used
- ES involves:
  - ✓ Collection of high quality samples
  - ✓ Sophisticated analytical techniques
  - ✓ Interpretation of analytical results using a variety of evaluation methods
- Proven to be one of the most powerful tools of nuclear verification
- Routinely used in safeguards practice in combination with other verification tools



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