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# *The Next Generation of Safeguards Instruments – A Combined, "Additional Protocol" System*

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# Overview

- *Introduction*
- *Implementation of the Additional Protocol*
- *The “Black Box” Concept*
- *Traditional and Integrated Safeguards*
- *Technical Specifications*
  - *Common Safeguards Requirements*
  - *Traditional Safeguards Requirements*
  - *Additional Protocol Safeguards Requirements*
- *Box Design*
- *Conclusion*

# Introduction

- *Safeguards equipment and the IAEA*
- *Use of digital optical surveillance systems*
  - *GEMINI*
  - *DCM-14*
- *Implementation of the Additional Protocol*
  - *Changing the paradigm of nuclear verification*
  - *“Integrated Safeguards”*
- *Changed Global Requirements*
  - *Adjustable and versatile safeguards technologies*
  - *Challenges cannot be met by traditional safeguards*

***New technological and political challenges present the opportunity to develop a next generation of safeguards equipment – The “Black Box.”***

# Introduction

- ***The Black Box will***
  - ***Assist the IAEA in overcoming technical and political obstacles***
  - ***Serve in traditional safeguards role***
  - ***Facilitate implementation of the Additional Protocol***

# Implementation of the Additional Protocol

- ***Expands the IAEA's scope of responsibilities and rights***
  - ***Inspecting facilities not declared as nuclear sites***
  - ***Conducting short- and no-notice inspections***
- ***Perceived benefits***
  - ***Eliminates need for inspections (and supporting equipment) under timeliness approach***
  - ***Allows IAEA to distinguish between countries who are inclined to cheat and those who have earned trust***

***The Additional Protocol reduces the strain on IAEA resources by concentrating efforts where they are needed most.***

# Implementation of the Additional Protocol (Potential Problems)

- ***Effectiveness of short- and no-notice inspections***
  - ***Work well where the IAEA is permanently present***
  - ***Work well where inspectors travel is unrestricted***
- ***Countries that may desire to divert materials***
  - ***Have strict travel policies***
  - ***Reduce possibility of "surprise" inspections***
  - ***Do not have continuous IAEA presence***

***A redefined approach to the design of safeguards equipment can help mitigate impediments to the Additional Protocol's implementation.***

# Traditional and Integrated Safeguards

- ***Facilities can be divided into three categories***
  - ***Traditional Safeguards Applications***
    - ***Countries that have not signed Additional Protocol***
    - ***Physical inspections under timeliness approach***
  - ***Applications under the Additional Protocol with Impediments***
    - ***Additional Protocol has been signed***
    - ***Inspectors are unable to conduct short- and no-notice inspections due to political and administrative impediments***
  - ***Applications under the Additional Protocol without Impediments***

***The Next Generation of Safeguards systems has to be suitable to serve in facilities in all categories, although each poses unique challenges.***

# Traditional and Integrated Safeguards (Application)

- ***The Black Box meets the needs of each application***
  - ***Traditional Safeguards Applications***
    - ***Replaces existing safeguards equipment***
  - ***Applications under the Additional Protocol with Impediments***
    - ***Monitors facility with sufficient lead-time before an inspection is announced or conducted***
    - ***Boxes are swapped out with ease and analyzed at IAEA headquarters***
  - ***Applications under the Additional Protocol without Impediments***
    - ***All Member States are treated equally***

***If countries change categories (e.g., trusted to suspected), the infrastructure is in place to alter the strategic inspection approach.***

# The “Black Box” Concept

- ***A container for modular safeguards instruments linked via Ethernet LAN***
  - ***Each instrument consists of a DCC connected to a specific front-end device***
  - ***Each DCC will encompass all data handling features***
- ***A single, combined, network-capable monitoring system***
  - ***Gathers, authenticates, and stores safeguards-relevant data***
  - ***Meets requirements of multiple IAEA disciplines***

***The Black Box concept breaks from the traditional approach to the design of safeguards equipment.***

# The “Black Box” Concept (Application)

- *Can gather data continuously or according to a timer*
  - *Continuously in traditional safeguards applications*
  - *Preceding a short- or no-notice inspection*
  - *Even if inspectors are otherwise delayed, the data is collected*
- *Facility personnel cannot distinguish easily between dormant and active Boxes*
- *Inspector takes data-filled Boxes to headquarters and replaces with “fresh” Boxes or downloads safeguards-relevant data*

# The "Black Box" Concept (Advantages)

- ***Data transmission is possible but not necessary***
- ***Box is designed to be completely self-sufficient (battery-powered)***
- ***Modularity of DCCs offers great versatility for desired applications***
- ***Review of system data can be standardized***

***Adaptability, modularity, and efficiency combined with affordability will allow the Black Box to meet the IAEA's technological, political, and financial needs.***

# Functional Requirements

- ***Independent data and authenticated information is required about***
  - ***All movement of declared nuclear material***
    - ***Equipment monitors locations where materials are stored, handled, and moved***
  - ***All movement of undeclared nuclear material***
    - ***More difficult – covert diversion activities will be attempted away from normally monitored handling areas***

***While these activities overlap, tracking undeclared materials is directly connected to the IAEA proliferation prevention mission.***

# Functional Requirements

- ***The Black Box should have the following capabilities***
  - ***Nuclear material detection***
  - ***Nuclear material localization (ideally)***
  - ***Scene-change detection through photography***
  - ***Individual Box configuration***
  - ***Tamper-resistant and tamper-indicating enclosure***

***To serve as monitoring instruments in all three safeguards categories, the Black Box must meet other scenario-specific requirements.***

# Functional Requirements (Traditional Safeguards)

- ***The Black Box must perform same functions as traditional, non-integrated safeguards***
  - ***Configuration of instruments determined by facility layout, operational processes, and information required for verification***
  - ***Timeliness constraints apply***
  - ***Continuity of knowledge is necessary***
  - ***Synchronization of monitoring activities***

***The Black Box will easily be able to handle traditional applications, as well as both unattended and remote monitoring environments.***

# Functional Requirements (Additional Protocol Safeguards)

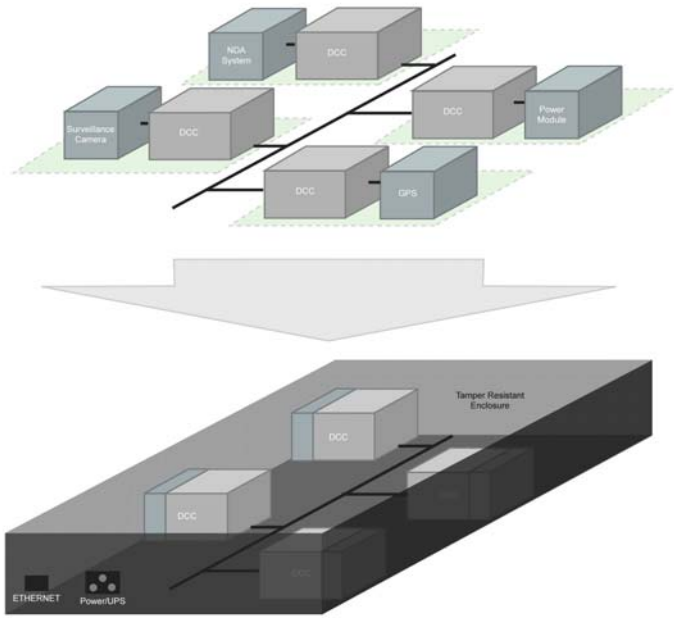
- ***Requirements are the same in scenarios with or without impediments***
  - ***Installation at every point deemed crucial based on strategic plan***
  - ***Masking of Box's operational status***
  - ***Stand-alone design that can operate on battery power for duration of its emplacement***
  - ***Event-triggered data storage: preset, alarm, scene-change detection***
  - ***Cryptographic capabilities for data treatment***

***The Black Box's versatility allows it to be applied in any monitoring scenario to gather independent data to verify compliance with all safeguards agreements.***

# Functional Requirements (Summary)

- *Modular nuclear material detection capability*
- *Nuclear material localization capability (Ideally)*
- *Modular scene-change detection through photography*
- *Interchangeable instruments*
- *Completely modular hardware/software*
- *Operation from battery, AC Mains, or conditioned DC power*
- *Operation with as little characteristic signature as possible*
- *Tamper-indicating housing and internals*
- *Delayed start timer to initiate operation at a pre-set time*

# Box Design (Internal Features)




***Interchangeability of DCC and all families of sensors and components used for safeguards purposes***

- *Video*
- *Radiation*
- *Seals*
- *GPI*
- *I/O*
- *Mass Storage*
- *User Interface*
- *UPS*

***Modular safeguards instruments (consisting of modular DCCs and appropriate front-end devices) are selected for each individual safeguards application.***



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# Box Design (Advantages)

- ***Black Box enables the realization of Economies of Scale for production, testing, training, installation, and documentation***
  - ***Reduces pressure on tight IAEA budgets***
- ***Availability of DCCs allows customized Boxes for specifically identified needs***
- ***Development of sensors is independent of DCC***
  - ***Simplifying research, design, development, and implementation of new safeguards instruments***
- ***Hardware modularization allows for similar software modularization***

# Conclusion

- ***The Black Box***
  - ***Combines state-of-the-art technologies with almost 20 years of experience in designing safeguards technology***
  - ***Serves in the traditional safeguards approach***
  - ***Serves as part of the Integrated Safeguards concept under the Additional Protocol***
  - ***Fits the specific needs of each individual facility where it is applied***
  - ***Offers option of incorporating "light" Black Boxes to meet budgetary restrictions***

# Conclusion

- ***The Black Box technology offers the advantages of***
  - ***Combining safeguards sensors in a single instrument, individually outfitted for every present and future need***
  - ***Providing modular components for easy replacement of sensors with scalable storage and stackable sensors***
  - ***Handling data communication and review with standardized software***
  - ***Allowing for development and implementation of new sensor technology independent from data storage and communication, as well as review capabilities***

***Once completed, the Black Box will be a safeguards device that will support the IAEA mission in every aspect for an extended lifecycle of 15 years or more.***