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**ATTRIBUTE VERIFICATION AND INFORMATION  
BARRIERS: DESIGN AND IMPLEMENTATION**

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## **Attribute Verification and Information Barriers: Design and Implementation**

**D. W. MacArthur**

**Abstract:** Demonstrating that declared weapons-related plutonium matches the declaration is complicated by the fact that the material itself may be classified. In this case, the problem becomes one of proving that the material is consistent with a declaration without revealing any of its classified characteristics. Two concepts, the information barrier (IB) and attribute verification can be combined to address this issue. In this paper, both concepts are introduced and their combination into a complete concept for a measurement system is described.

## Attribute Verification and Information Barriers: Design and Implementation

**Measurement System Requirements:** Demonstrating that declared weapons-related plutonium matches the declaration is complicated by the fact that the material itself may be classified. In this case, the problem becomes one of proving that the material is consistent with a declaration without revealing any of its classified characteristics.

A measurement system intended for use on this material must meet three potentially conflicting requirements. It must:

- 1) prevent the release of classified information,
- 2) allow the inspecting party to reach credible and independent conclusions, and
- 3) perform reliably for the intended lifetime.

The interaction between these three areas of concern is illustrated schematically in Fig. 1.

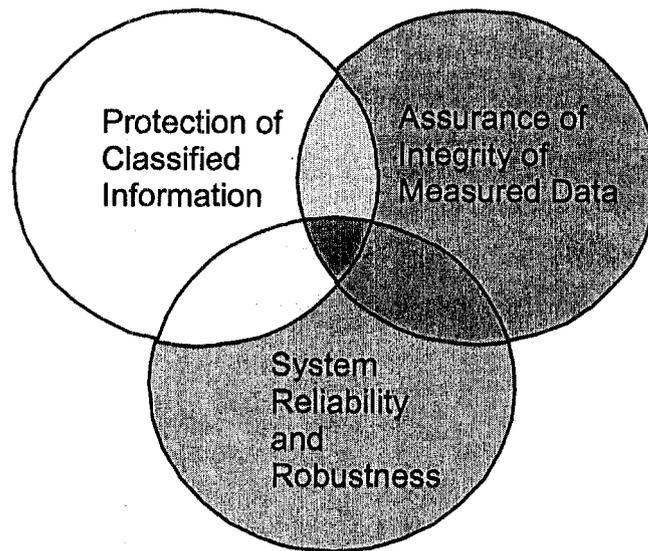


Fig. 1. Interaction of concerns for protection of information, reliability of data, and system reliability. Although each of these areas may contain individual concerns, many concerns, and design strategies, are of interest to more than one area.

Measurement systems addressing either 1 & 3 or 2 & 3 have been thoroughly researched but systems intended to address all three requirements simultaneously have not.

**The Information Barrier:** An information barrier (IB) can be used to isolate the classified information and allow only unclassified information to be displayed. The protection of classified information is critical; no party wants a measurement system that violates this requirement. However, if monitoring party assurance cannot be achieved simultaneously, then the measurement systems will not perform a useful function.

An IB is composed of a combination of hardware, software and procedural protective systems. In order to enhance inspectability of the system by all parties, each element should be as simple as possible. Rather than a single complex protective shell, the IB can be built from a series of simple protections. Along with inspectability, this layered structure provides resistance to single-point failures; any single failure cannot result in the release of classified information. Another important concept in IB design is minimization of the amount of classified data in the system. The best way to protect data is never to acquire that data in the first place.

Many of the requirements for an IB-protected measurement system are addressed by modular design. Designing the measurement system as a series of well-defined modules will allow:

- individual elements to be tested and optimized individually,
- failed elements to be isolated and replaced individually,
- each module to have a single function and be only as complex as required, and
- straightforward accommodation of future changes in attributes.

The requirements for data protection are very different for classified measurements and unclassified measurements. In particular, all measurements of unclassified material can be conducted in an "open" mode with video displays connected to the data streams within the IB. Only when a measurement of a classified item is being performed must the output display be limited. A system employing open and closed modes will allow the inspecting party to gain confidence that the measurement system is operating as designed. This is particularly true is the operation of the data acquisition computers are demonstrably independent of the security mode of the system.

**Attribute Verification Techniques:** Standard NDA methods and detectors are capable of quantifying plutonium accurately. Unfortunately, any *useful* radiation

measurements performed on a classified object will yield classified results. In attribute verification, these classified results are compared with unclassified thresholds within an IB. The results of such comparisons are unclassified; either the measured result is consistent with the declaration (indicated by a green light) or the result is not consistent with the declaration (a red light). Thus, the attribute verification system performs accurate measurements of classified items within an IB and then generates unclassified “attributes.” of classified objects. For measurement of an item with classified characteristics, only these unclassified attributes are displayed outside the IB.

In order to meet the inspector assurance requirement, the displayed unclassified attributes must have a demonstrated causal relationship to (classified) measurements. One important concept is that the attribute verification system itself is unclassified. The data may be classified, but the measurement system itself is not. This is necessary if the design is to be fully shared with all parties to an agreement.

**Attribute Verification Systems:** A conceptual attribute verification system incorporating an IB is shown in Fig. 2. The data barrier ensures that only unclassified information is passes to the display.

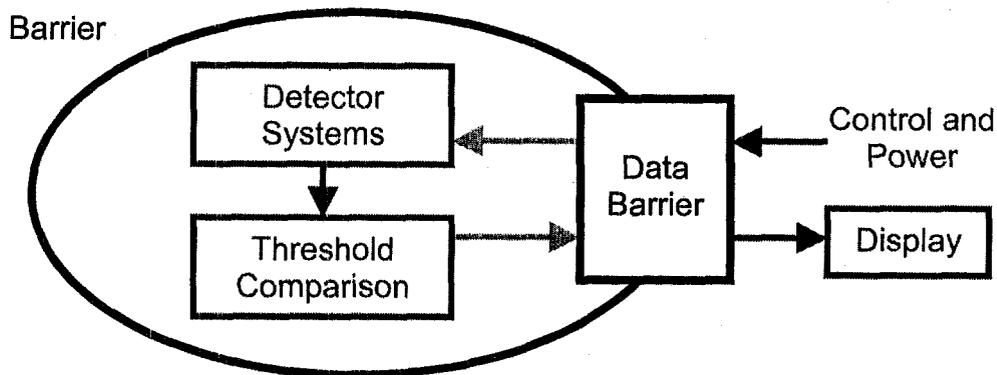


Fig. 2. Conceptual attribute verification system with information barrier. The components that could contain classified information (**detector systems** and **threshold comparison**) are completely contained within the **barrier**. The **display**, **control** and **power** are accessible to the operator and must be unclassified. All information passing through the barrier must pass through one or more **data barriers**.

A more detailed implementation of this concept is the measurement system termed **Attribute Verification System with Information Barrier for Plutonium with Classified Characteristics utilizing Neutron Multiplicity Counting and High-Resolution Gamma-ray Spectrometry or AVNG**. This combined measurement system that can verify three attributes: plutonium presence, plutonium isotopic ratio less than a threshold and plutonium mass greater than a threshold; it is described in more detail in Annexes 7 & 8.