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Title: **THE EFFECTS OF INFORMATION BARRIER REQUIREMENTS ON THE TRILATERAL INITIATIVE ATTRIBUTE MEASUREMENT SYSTEM (AVNG)**

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ABSTRACT
Although the detection techniques used for measuring classified materials are very similar to those used in unclassified measurements, the surrounding packaging is generally very different. If a classified item is to be measured, an information barrier is required to protect any classified data acquired. This information barrier must protect the classified information while giving the inspector confidence that the unclassified outputs accurately reflect the classified inputs. Both information barrier and authentication considerations must be considered during all phases of system design and fabrication. One example of such a measurement system is the attribute measurement system (termed the AVNG) designed for the Trilateral Initiative. We will discuss the integration of information barrier components into this system as well as the effects of an information barrier (including authentication) concerns on the implementation of the detector systems.

ATTRIBUTE MEASUREMENT SYSTEMS
Verification measurements on large pieces of unclassified plutonium are relatively straightforward. Standard neutron and gamma measurement techniques can be used to verify the mass and isotopic ratio of the plutonium. However, radiation measurements are essentially intrusive techniques that typically contain classified information if classified items are being measured. Thus for measurements of classified items, an information barrier (IB) must be added to the system to protect the classified information. The stated intent of an IB is to allow meaningful radiation measurements to be performed on potentially classified objects without display of any classified data. To perform this task successfully, the IB must satisfy two basic constraints:

1) First and foremost, the IB **must** prevent the release of classified information.
2) However, in conjunction with the first constraint, the IB **must** also allow the inspecting party to reach credible and independent conclusions concerning the objects being monitored.

IBs are discussed in Refs {1} through {3}.

An attribute measurement system is intended to verify that an item possesses certain attributes without disclosing any classified information. In this case, very accurate neutron and gamma measurement systems are used to measure the (potentially classified) mass and isotopic ratio of an item. These potentially classified measured values are compared with mutually agreed unclassified thresholds to generate a series of binary outputs indicating agreement or disagreement with the agreed thresholds. These binary results pass through an output data barrier and are displayed as a series of green (agreement) or red (disagreement) indicator lights. The main function of the output data barrier is to ensure that no classified information can be passed to the display. Attribute verification systems are described in more detail in Refs {4} through {7}.

A simple schematic realization of this type of attribute measurement system is shown in Fig. 1. All potentially classified information is contained within a protective shell and only unclassified results are displayed outside the shell. In this case, the shell characteristics are more important than the characteristics of the internal elements in determining the protection afforded by the complete system.

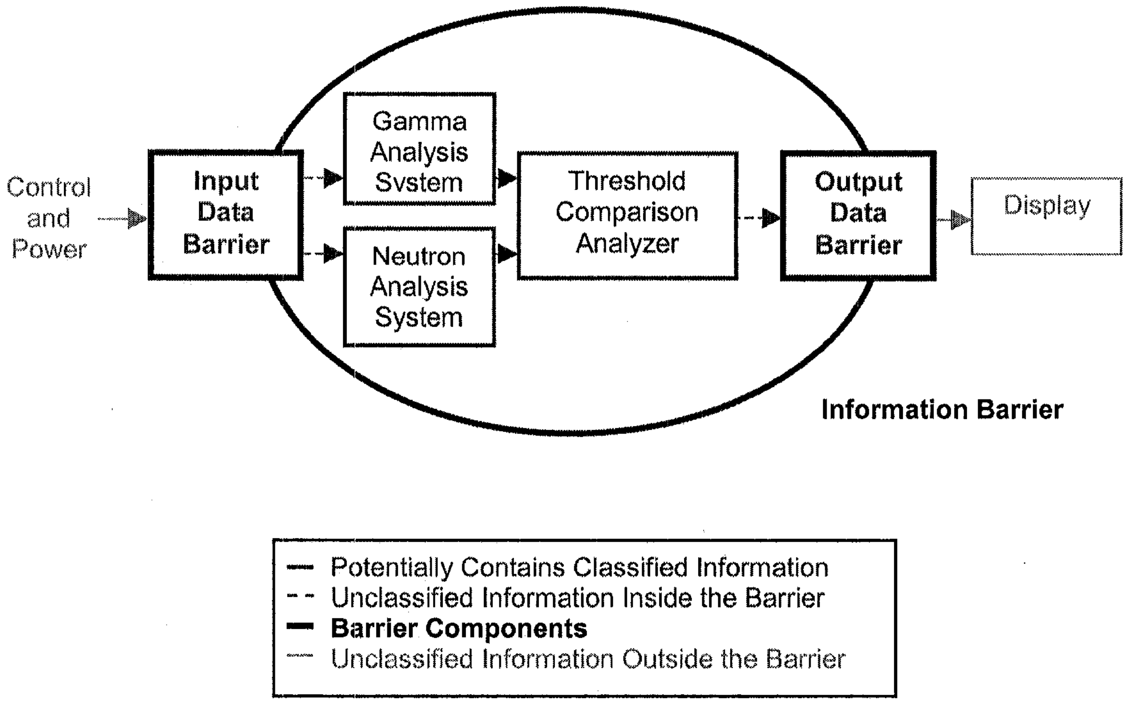

Fig. 1. Core concept of an attribute measurement system. The data barriers are the only points of contact between the internal computing systems and the unclassified display and controls.

THE AVNG MEASUREMENT SYSTEM

The attribute measurement system designed for the Trilateral Initiative, the AVNG, is shown schematically in Figs. 2a and 2b. The general features of this system are discussed in detail elsewhere. {6}

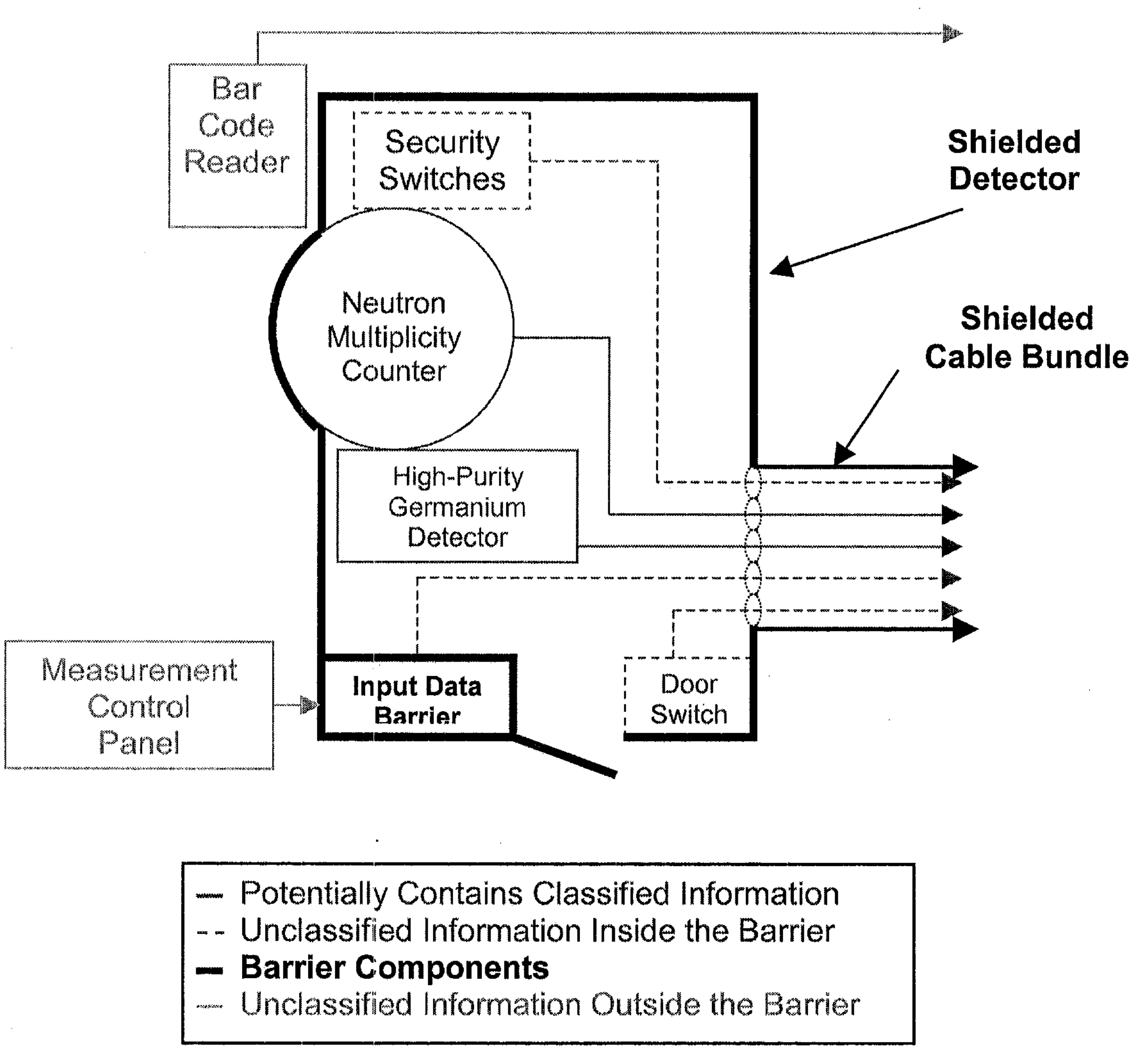

Fig. 2a. Detectors and detector enclosure for AVNG. This figure also includes all operator switches (the measurement control panel) as well as a bar code reader to register the identity of measured containers.

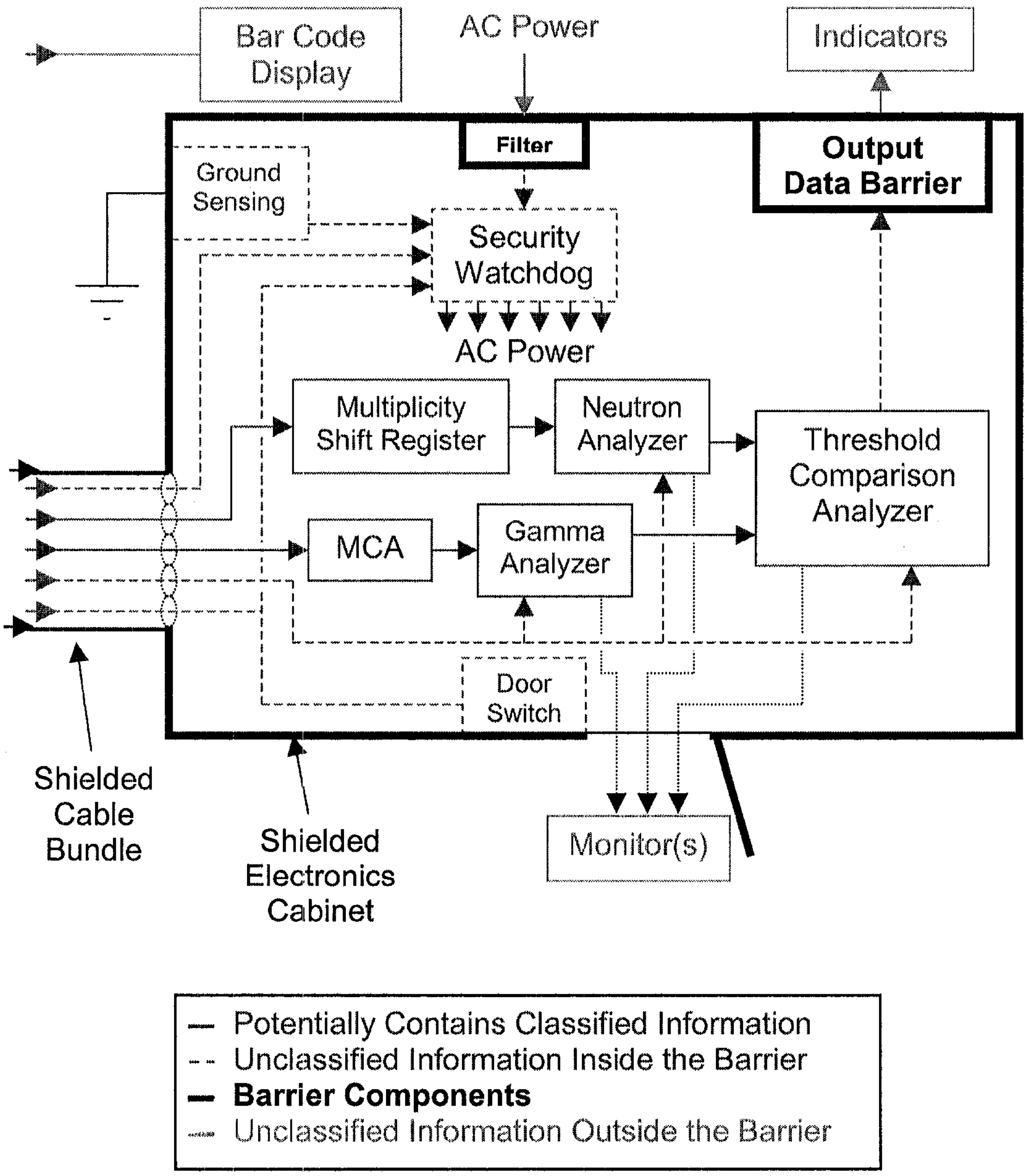

Fig. 2b. The second half of the AVNG. This illustration contains all of the data analysis components as well as the unclassified indicator display. The monitors that can be connected to the AVNG during unclassified measurements are also illustrated. The AVNG is illustrated in the open mode. If the video monitors were removed and all access doors closed and interlocked, then the AVNG would be in the secure mode.

The AVNG has been designed to operate in two modes; open or secure. Unclassified measurements (calibrations, references, etc.) can be performed in either the open or secure modes. The AVNG is designed so that measurements on classified radiation sources can **only** occur if the system is in the secure mode. Thus, the Host Party is most concerned with correct operation in the closed mode. The Inspecting Party is concerned with correct operation in both modes, and particularly that the analysis system operates in exactly the same fashion in both modes.

HOST PARTY EQUITIES

The most significant, although not the only, Host Party equity in the AVNG is in the first part of the IB definition. The host is primarily interested in the requirement that "the IB **must** prevent the release of classified information" and in the elements of the attribute measurement system that contribute to this protection. Several of these elements are described below {9}.

The threshold comparison analyzer, or computational block, compares the classified measurement results with unclassified thresholds to generate the binary outputs that eventually drive the unclassified indicator display. During normal operation, this element of the system has potentially classified inputs and unclassified outputs. Thus, correct operation of this element is one of the most important in terms of protecting classified information during normal operations of the AVNG.

The output data barrier controls the flow of information between the computational block and the unclassified indicator display. If this element is designed so that it cannot pass classified information, then overall information security is enhanced. In the AVNG, the output data barrier is specified as a hardware device to enhance inspectability and improve confidence (on both sides) that this element is operating correctly.

All power for the AVNG enters the security watchdog through an AC line filter. The only function of the security watchdog is to monitor the security status of the entire system and to remove all power from all other AVNG elements if the access doors are opened or if classified material is introduced into the system incorrectly. The security mode of the security watchdog (and hence the entire AVNG) is set by the security switches that are controlled by the measured container itself. No human intervention is necessary.

The cabinets and cable shielding in the AVNG serve two functions: data shielding and physical protection. Although the AVNG should be constructed of tested components using good assembly techniques, the final proof of the effectiveness of the system shielding must involve testing of the entire system after assembly is complete. Based on these measurements, a physical exclusion area around the AMS may also be defined. All of the CPUs and high-level signal (as opposed to detector output signal) wiring should be contained within a shielded enclosure.

If the video monitors are removed and the cabinet doors closed (and interlocks activated), the AVNG is placed in the secure mode. If, and only if, the AVNG is secure, measurements can be performed on classified material. When the AVNG is operating in the secure mode, the only display of results is the panel of red and green indicator lights show whether the measurements from a container are consistent with the declaration (green) or inconsistent (red).

INSPECTING PARTY EQUITIES

On the other hand, the primary interest of the inspecting party is in the second half of the definition, i.e., "the IB **must** also allow the inspecting party to reach credible and independent conclusions concerning the objects being monitored." The primary elements of the AVNG that impact this requirement are the Data Acquisition and Analysis Systems or DAAS. These elements of the AVNG must be operating correctly if the inspector is to have confidence in the result.

The correct operation of the data acquisition elements, the multiplicity shift register, and the multichannel analyzer (MCA), is important to the reliability of the output data. These elements of the system must function correctly, and as expected, if the Inspecting Party is to believe the indicator outputs.

As opposed to the output data barrier mentioned above, the input data barrier primarily serves the goals of the inspecting party. Under the assumption that the Host will be pressing the measurement control switches, there will be no opportunity for disclosure of classified information through these input cables. However, since the Host will have this opportunity to communicate with the analyzers, the input data barrier serves the needs of the inspecting Party if it (the input data barrier) can eliminate the opportunity for extraneous communication through the analyzer "start" connections.

The analysis software is critical to the Inspecting Party's confidence in the AVNG measurement system. These codes directly affect the validity of the analyzed output; at the same time, it would be relatively easy to hide small pieces of extraneous code in these large and complex data analysis programs.

Second in importance only to the software itself, are the data analysis computers that run this software. These computers are important to the data analysis capabilities of the entire AVNG and would be another easy place for extraneous functionality to be incorporated into the system.

To increase confidence that the elements of the DAAS have not be disturbed, it may be useful to enclose these elements in subenclosures that are under the control (by tags, seals, TIDs, etc.) of the Inspecting Party. The purpose of these enclosures is very different from the main cabinets mentioned above. The main cabinets may increase the Host Party's confidence in the AVNG while the subenclosures are present to increase the inspecting party's confidence that the elements of the DAAS are unchanged.

When the AVNG is in the open mode, the cabinet doors are opened and all intermediate signals and data streams can be directly observed. In this mode, video monitors can be attached to the computers within the AVNG so that an observer can watch all stages of data analysis. The open mode has been called the "authentication mode"—not because this mode is intended to provide complete authentication for the AVNG, but because measurements made in the open mode increase confidence that the neutron and gamma measurement systems are operating correctly.

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