Title: *Simple Yet Novel Dismantlement Confirmation Instrument*

Authors: Gene A. Kallenbach, Sandia National Laboratories;
Dr. Sharon M. Deland, Sandia National Laboratories

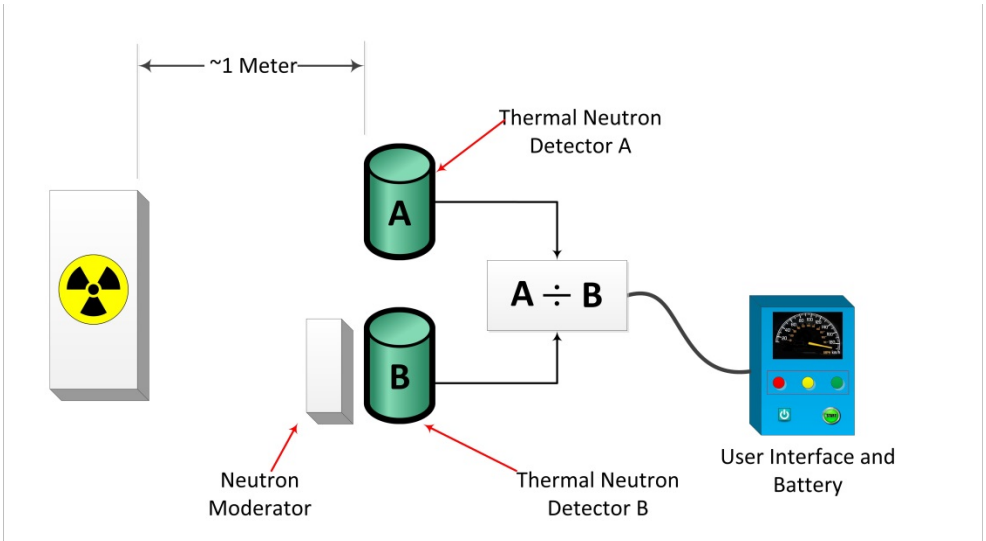
Working Group Topic: WG2 Arms Control

Working Group Subtopic C: Novel Technologies for Arms Control Verification

Note: The views expressed here do not necessarily reflect the views of the United States Government, the United States Department of Energy or Sandia National Laboratories.

Problem Statement and Proposed Solution

The generally accepted definition of nuclear warhead dismantlement is the separation of the High Explosives (HE) from the Fissile material (FM). When attempting to perform any treaty verification measurements on a warhead, conflicts arise between the desire to perform a detailed measurement with high confidence and the data security and device safety concerns of the host nation possessing the warhead. This paper describes a simple, yet novel instrument for use in warhead dismantlement confirmation that attempts to address the host nation concerns while still providing a high level of confidence to the inspecting nation. The objective is to produce a certifiable, authenticatable, instrument that verifies the separation of the HE from the FM in a device by looking at the ratio of slow neutrons to fast neutrons radiating from plutonium based weapons. By utilizing a ratio and never exposing the counts or count rate of the object to the inspector, sensitive design information remains secure while still allowing verification of dismantlement. The instrument will confirm the separation in a matter of minutes, will be portable, and does not require an information barrier.



Slow to Fast Neutron Ratio Measurement

Concept

The proposed instrument uses two thermal neutron detectors (e.g. ^{3}He tubes) mounted side by side. One of the detectors is moderated by a thick layer of high density polyethylene and the other is not moderated. Simple, discrete electronics will calculate

the ratio of the counts from the un-moderated detector (slow neutrons) to the moderated detector (fast neutrons). Prior to dismantlement, a measurement is made of the device and the slow-to-fast ratio recorded. After dismantlement, a second measurement is made of the Fissile Material (FM) portion. The slow-to-fast ratio will decrease by a repeatable amount due to the removal of the High Explosives (HE) which acts as a neutron moderator. Measurement of the HE component can be accomplished by using a fast neutron check source such as ^{252}Cf or even the previously measured FM component. By placing the HE between the source and the instrument, the measurement will produce a high slow-to-fast ratio indicating the presence of moderator. Measurements of the other dismantled components will show background level ratios of slow-to-fast neutrons. To assist the operator, a simple threshold will be included to indicate when a neutron source is being measured as opposed to background radiation. The system will not display or record the count rate of a device, so its data is unclassified and therefore no information barrier is required. All of the functions described can be implemented with simple, discrete digital and analog electronics. The circuitry will not contain a processor, software or memory so it is easily certifiable for use on classified objects. The simplicity of the design will make it easy to authenticate. The instrument will operate at a 1 meter standoff distance so safety considerations are easy to address. Because it utilizes a ratio, it is tolerant of variation in measurement distance.

Design Philosophy Discussion

This concept is an example of a larger design philosophy that emphasizes collecting minimal information and simplicity. By using a measurement that indicates the presence/absence of moderator while protecting sensitive information, this concept is potentially usable in a broader verification regime that includes non-weapons states. The key is the simplicity of the design which collects the least information possible to address a verification problem. The design also makes it easier to inspect the equipment itself and be confident in the operations of the device, thus enabling authentication and certification.

The challenge for the larger technical community is to identify what information provides value in a verification context and how might that information be presented without collecting or reporting sensitive information. One consideration that can enable simplification is that an instrument like this operates within a larger verification regime. This regime provides additional information and capabilities (such as operational context, chain of custody or additional warhead authentication measurements) that when combined, leads to a higher overall confidence than that derived from individual measurements.

Summary

The proposed instrument addresses the safety and security concerns on the host nation while providing confidence to the inspecting nation that dismantlement has been performed. The instrument utilizes simple, discrete electronics without a processor, memory or software so it will be easy to certify and authenticate.