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Preliminary Results related to Human Factors Engineering Specifications for Advancing Radiation Detection Equipment's

The current state of portable and handheld radiation detection instruments and systems used to detect a criminal or an unauthorized act with nuclear security implications involving nuclear or other radioactive material that is out of regulatory control is often inadequate to meet the nuclear security needs of the users within States. This paper focuses on one important, and often overlooked, aspect of the specifications for radiation detection equipment that leads to a mismatch in the operational needs for nuclear security operations and the equipment used.

Oftentimes, specifications for detection equipment are more focused on performance issues such as the library of isotopes, the dose rate measurement ability, etc. However, just as important to the user of the equipment is the ability to "hold"the handheld equipment in the position needed to take the required measurement. In the field, measurements are frequently taken that require physically unsupported arm positions and holding the equipment at odd angles for 2 to 5 minutes. Additionally, the outside conditions may be very hot, very cold, raining –each with their own clothing or other constraints that affect equipment holding times, and as a direct result the ability of the detection system to yield results. To address the gap between operational/human needs and the performance capabilities of the equipment, common system engineering principles can be applied. The interdisciplinary approach of systems engineering can enable the realization of successful systems. In this specific case, human factors must be considered as an important component to focus attention on the human element of the system and identify human performance requirements. A rigorous systematic approach should be used to identify critical interactions between people and equipment and thus mitigate negative impacts of the equipment itself on human performance.

Incorporating human factors early in design is also a cost-effective approach to maximizing the likelihood that a deployed instrument can provide a measurement under actual field and operational conditions, and by extension enhancing the sustainability of effective nuclear security detection activities. Mitigating human interface issues for an established system is more difficult than factoring in human capabilities and limitations in initial design. In some cases, performance (detection sensitivity, battery life, etc.) of the instrument has been sacrificed to reduce weight. In other cases, weight is not properly distributed for one-handed use or for long durations of carrying or holding in the expected use conditions. The use of equipment under field conditions should match the physical capabilities of the expected population of users (not just militarily fit 21 year old, 175 cm tall males in summer uniform) and support the measurement times and conditions under which performance will be effective. Equipment design should be assessed from a human interface perspective to help design engineers to create a better product. If the human interface is considered, the implementation of a State's detection strategy will improve with more effective use of equipment and increase the probability of detection of radioactive materials out of regulatory control.

This paper provides some of the preliminary results of the research experiments studying the form and weight factors of different types of radiation detection equipment. More than 1000 experimental measurements have been taken using a diverse body of users and also simulation of various weather and clothing conditions. These measurements are providing important information about realistic times that users can hold up instruments given various weights and form factors (affecting the distribution of the weight around the hand). The results can support development of optimal equipment specifications using established systems engineering principles. Systems engineering is an interdisciplinary approach to enable the realization of successful systems. Human factors is an important component to focuses on the human element of the system, identifies human performance requirements for a successful system, identifies critical interactions between people and equipment, Mitigates negative impacts of the environment on human performance.

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