Contribution ID: **431** Type: **Paper**

US-Japan Joint Study on Materials Attractiveness: Evaluating and Reducing the Risks to Nuclear Materials and Facilities from Potential Malicious Acts

This paper summarizes preliminary results of a joint US-Japan study to establish, through science-based study, a mutual understanding of the risk from non-state actors conducting malicious acts involving nuclear material and facilities. The ultimate goal of this study is to develop a methodology to evaluate, assess, and reduce the risk associated with hypothetical (i.e., not specific existing) nuclear facilities, fuel cycles, and waste products related to nuclear materials, and to formulate nuclear security systems as appropriate.

To date, the focus of this study has been on quantifying the intrinsic risk associated with the theft and sabotage of nuclear materials at facilities that handle these materials. Concept to reduce risks will be evaluated later in the study. Intrinsic, or internal, risk reduction factors include gross weight, radiation dose rate, processing complexity including chemical dilution, heat content, and other material properties that either provide self-protection or increase the required mass of material that must be stolen to produce an effective malicious act. The sum of these factors may be expressed as the overall material attractiveness of the nuclear material. Extrinsic, or external, risk factors include physical measures, such as containers, structures, buildings, guards, and other external mitigating barriers. Extrinsic factors also include administrative controls, such as procedures, regulations, training, etc. that define and defend the use of physical controls.

Theft and sabotage define the two broadest categories of malicious acts. These two categories are divided into nuclear and radiological malicious acts, and the four resultant categories are subdivided into ten specific radiological or nuclear malicious acts. The malicious acts considered range from radioactive dispersal due to acts of sabotage, to a radiological dispersal device, to a nuclear explosive device.

Three levels of adversary are considered, each with varying capability to commit various malicious acts identified in the study. In this initial phase of work, nineteen nuclear materials and seven nuclear facilities are evaluated. These are nuclear materials and nuclear facilities that are common to the commercial nuclear industry in the US and Japan.

For each potential malicious act, metrics were identified. Metrics are only considered if they can potentially provide an effective barrier to one of three adversary types in using a nuclear material or nuclear facility in a malicious act. In the case of theft of nuclear material, the metrics selected are gross weight, radiation dose rate, processing complexity, bare critical mass, and heat content. Each nuclear material is graded against these five metrics. This provides the overall attractiveness of the nuclear material to an adversary, which is a measure of the probability that the adversary could successfully execute the malicious act in question. The study also considers the overall consequences of such malicious acts, including number of deaths, number of injuries, and the economic impacts of each act.

The Goal 9 study is being conducted at the request of the United States Department of Energy/National Nuclear Security Administration (DOE/NNSA) and at the request of the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT).

State

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Gender

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Track Classification: CC: Advances in nuclear security research and development; international cooperation on nuclear security research