Contribution ID: **427** Type: **Interactive Content Presentation**

Quantitative Model for Assessing Facility Level Radiological Risk

Abstract

The safety and security of a radiological facility share a common objective-ensure the protection of population and environment from undue radiation hazard. Historically, many analytical methods have been developed and implemented to support safety-based risk assessment and decision analysis. Adapting and extending risk assessment to security applications has been limited because of the adaptive nature of the sub-state actors and the lack of historical data of terrorist attacks on radiological facilities. Given the definition of an adversary or terrorist (i. e., any individual performing or attempting to perform a malicious act) the proposed tool utilizes a combination of probabilistic methods and pathway analysis to define terrorist, or more broadly, adversarial attack scenarios. The motivations behind an asset choice for stealing or sabotage, will influence the type of pathway the adversary is most likely to choose to achieve their goals. Bearing in mind that everything is vulnerable to some degree, even when the controls are in place and performing as intended; the threat scenarios were mapped across a spectrum of vulnerabilities including natural disasters, crime in the area and power disruption in the region of interest. Nuclear security culture assessed through surveys yielded a numerical value to reflect the importance of the human dimension in risk assessment. It is one factor that reflected the synergy between threat and vulnerability, lending the greatest weight towards the calculation of the risk metric, specific to the radiological facility. For risk analysis to be meaningful, it should include both the frequency and magnitude components. In the advent of a successful radiological theft and a hypothetical detonation and dispersion of radioactive material; the probable magnitude loss, unique to the threat included Loss of Life (LL) and Economic Loss (EL) as two separate variables expounding the severity of damage. The triplet definition of risk, structured as a set of threat, vulnerability and consequences was used to construct a single composite number by weighing the threat scenario probabilities, relative attractiveness and characteristics of the radioactive material, multiple parameters elevating vulnerability of source security and the consequence net loss. The proposed methodology and the risk program model made a suitable platform to compare the baseline risk index of the radiological security of different facilities in the United States. Risk metric, when converted into a qualitative scale delivered a better clarification and linkage between understanding risk and making decisions towards radiological security improvements. The contribution of the proposed research is significant because it is the next step towards development of a new tool in the field of radiological source security-one that is expected to introduce, analyze and numerically test a methodology that yields a facility level risk index.

Gender

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State

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Track Classification: PP: Risk-informed approach to the security of radioactive material in use and in storage