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Containment and Surveillance and Physical Protection Updates for Proliferation Resistance Analysis Using PRAETOR

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The Proliferation Resistance Analysis and Evaluation Tool for Observed Risk (PRAETOR) software code assesses the proliferation resistance (PR) of nuclear fuel cycle (NFC) systems. The Nuclear Security Science and Policy Institute (NSSPI) at Texas A&M University developed PRAETOR based on the well-established multi-attribute utility analysis (MAUA) methodology. MAUA methods facilitate compiling multiple PR characteristics into tiered PRAETOR output PR metrics enabling easier decision making at the analyst, program manager, and policy maker levels. PRAETOR uses intrinsic and extrinsic PR attributes to evaluate NFC systems. The PRAETOR 1.0 code originally had 63 attribute inputs representing the NFC system. The attribute input values assigned by the user are mapped to a utility value between 0 and 1 using utility functions. Each attribute has an associated weight obtained through a survey. Larger PRAETOR utility values indicate higher NFC system PR.

An updated version of PRAETOR (Version 2.0) added seven more attribute inputs representing the nuclear security PR aspects of: (1) physical protection systems (PPS) and (2) containment and surveillance (C&S). The applicability of PRAETOR is demonstrated through a set of case studies. Two cases of Pressurized Water Reactor (PWR)used fuel assemblies with different cooling times were considered in this paper: (a) non-cooled fuel assemblies, and (b) 30-year cooled fuel assemblies. The case studies consider the new PPS and C&S attributes with low and high utility values. The PR results for the case studies with the updated PRAETOR were compared with those without the PPS and C&S attributes. The new attributes increased overall PR value by about 10% for case (a) and decreased it by about 3% in case (b). The importance of adding new attributes capturing physical protection and containment & surveillance is established.

Country or International Organization

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