

## Pathway Aggregation (Clustering) in the Risk Assessment of Proliferation Resistance and Physical Protection (PR&PP) of Nuclear Energy Systems

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## **ABSTRACT**

The framework for PR & PP evaluation is to define a set of challenges, to obtain the system responses, and to assess the outcomes. The assessment of outcomes heavily relies on pathways, defined as sequences of events or actions that could potentially be followed by a State or a group of individuals in order to achieve a proliferation objective, with the defined threats as initiating events. There may be large number of segments connecting pathway stages (e.g. acquisition, processing, and fabrication for PR). This will lead to even larger number of pathways through possible different combinations of segment connections, each with associated probabilities contributing to the overall risk. Clustering of these pathways in specified stage attribute intervals is important for their tractable analysis and outcome assessment.

The project will explore the feasibility and performance of different pathway clustering schemes that can reduce the effort in pathway analysis and produce a software tool for pathway clustering that will utilize a Markov probabilistic assessment. The pathways can be analyzed either probabilistically or deterministically to identify system vulnerabilities. The pathway analysis capability will also facilitate communication of the major risk contributors to stakeholders.