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Intent, Capability, and Opportunity: A Holistic Approach to Addressing Proliferation as a Risk Management Issue

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Abstract

Proliferation risk assessment models are designed to evaluate only a portion of the overall risk, focusing exclusively on either technological or social factors to determine the extent of a threat. Many of these models are intended to predict proliferation potential rather than assess the system as a whole, ignoring the ability to enhance mitigating factors and manage the threat in addition to establishing its presence. Information gathered through these analyses is necessary but incomplete. By incorporating political, social, economic, and technical capabilities with human factors such as intent into a single, multi-faceted risk-management model, proliferation risk can be evaluated more effectively. Such information can provide a framework for ideas to improve and expand the existing regime and identify gaps in the system, allowing for a more complete approach to risk management, mitigation, and resource allocation. The research conducted here seeks to combine all three elements (intent, capability, and opportunity) in a comprehensive evaluation that incorporates an assessment of state-level variables, possible proliferation pathways, and technical capability. Each portion of the analysis is carried out independently, then combined to illustrate the full scope of a state's nuclear infrastructure while showing areas of weakness in the institutional framework.

Importance of a Comprehensive Approach

According to a recent International Atomic Energy Agency (IAEA) report, construction of 24 new reactors began between 2008 and 2009, bringing the total number of plants under construction worldwide to 60. Despite setbacks and economic difficulties, "many countries have expressed a new or renewed interest in nuclear power. In the context of growing energy demands to fuel economic growth and development, climate change concerns, and volatile fossil fuel prices, as well as improved safety and performance records, some 65 countries are expressing interest in, considering, or actively planning for nuclear power" (IAEA). Of the interested countries, 21 are in Asia and the Pacific region, 21 are in Africa, 12 are in Europe (primarily in Eastern Europe), and 11 are in Latin America (IAEA).

As interest in nuclear technologies grows and more countries pursue programs, it will be critical that the nonproliferation regime, and the risk assessments conducted to strengthen this regime, adjust to these increases in technology, material, and knowledge. While traditional single-platform evaluations offer important insight into part of the threat, the ability to implement risk mitigation mechanisms is severely limited when the scope of the initial analysis is confined to only one aspect of the problem. This paper discusses the importance of comprehensively addressing nonproliferation and international safeguards and recommends the execution and implementation of a full-scope review. The first section describes each type of review and its

importance. The second portion introduces the combination and implementation of the resulting information.

State Level Analysis

The Importance of Considering Intent

Several countries currently possess the technological capability to proliferate nuclear weapons. In many instances, the transition to a deployable device would mean a shift in resource allocation and a relatively short turn-around time. However, the international community does not perceive most of these countries security threats because the intent to pursuing a program remains nonexistent. In these instances, a purely technical evaluation of these states would indicate that they pose a threat, despite the low likelihood that they would choose to proliferate. In a state where no previous history of a nuclear infrastructure exists and all newly fielded components of the program have been procured through illegal means, a technical evaluation alone would miss the presence of the threat entirely, as nothing undeclared would be noted until the program was well underway. In instances involving questionable activity, the ability to improve timely detections (a primary goal of the IAEA), would be contingent on recognizing the threat through other means. Here, an evaluation of the state itself would create the opportunity to detect early "red flags" or items of concern that could be further investigated long before a new facility could be completed.

Purpose and Structure of the State Evaluation

The state evaluation used in this analysis was developed to perform a "state-based" assessment of a country's proliferation risk based on its need, domestic considerations, and standing within the international community. Each focal area is divided into individual factors which were deemed relevant indicators of a possible problem or "red flag". When grouped with several other questionable instances in context, these points signify an area of concern and justify additional investigation. The evaluation was designed to be carried out by a single subject matter expert using only open-source information. However, for a more complete investigation, additional reviewers and information can be used to create as comprehensive a review as necessary.

After establishing the scope and locating the information requested, the subject matter expert evaluates the information in relation to expected international norms. Each of these points is evaluated on a scale of 0-2; "0" indicates high proliferation risk, "1" illustrates baseline levels of risk, and "2" reflects low proliferation risk. The overall risk assessment is the combination of all other factors; the country with the highest numerical values illustrates the lowest risk of proliferation. This format provides simple metric that would allow the country or organization conducting the analysis to perform quick, open-source data collection. The 0-2 metric was used to limit the effect of a few instances in which a state may have a previous indiscretion that has since been resolved and not repeated. As a result, an evaluation must produce several red flags before a state is viewed as a potential threat.

The first section in the metric evaluates the energy needs of the state pursuing a nuclear energy program. As stated in Article IV of the Treaty on the Nonproliferation of Nuclear Weapons

(NPT), all states party to the treaty hold the inalienable right to pursue nuclear energy for peaceful purposes. This section does not seek to question this right, but rather to evaluate the correlation between the state's current infrastructure and the size and type of program being built. By looking at population, current energy consumption, industrial and economic growth, and funding sources, the evaluator can draw conclusions about the demonstrated need for a country to pursue a particular type or size of nuclear program. The second section of the evaluation is comprised of the domestic aspects of the state in question—including regulatory infrastructure, context of nuclear energy development, military expenditures, and internal sources of instability. The third section is the evaluation of the nation's relationship with international organizations and regulatory bodies.

Future Work

Future work on the state-based portion of the metric will include greater refinement of the points chosen for the evaluation and the means of calculating the risk associated with illustrated behavior that results in a red flag and further investigation. While it is often considered overly risky to complete this form of politically oriented evaluation, it is becoming increasingly critical as technology, amount of material, and the type of threat change.

Technical Review

Importance of Assessing Capability

The evaluation of a state's technical capability can yield the most definitive results regarding the possibility of diversion or misuse within a facility. For this evaluation, the evaluator can analyze several facility types, resulting in a broader analysis that has a greater likelihood of picking up inconsistencies.

The choice for a technical assessment is built upon previous research conducted by a small team of subject matter experts at Idaho National Laboratory (INL), which evaluated three proliferation resistance assessment methodologies in order to identify their strengths, weaknesses, ability to evaluate nonstandard configurations, and usability: (1) Evaluation Methodology for Proliferation Resistance and Physical Protection of Generation IV Nuclear Energy Systems (PR&PP),(2) the Guidance for the Application of an Assessment Methodology for Innovative Nuclear Energy Systems (INPRO), and (3) the Technological Opportunities to Increase the Proliferation Resistance of Global Civilian Nuclear Power Systems (TOPS). Each methodology was tested by applying each evaluation to several different reactor types. Building off of the conclusions made in this study and the applicability to the structure to this review, the TOPS methodology was chosen as the technical evaluation.

Structure of the Technical Evaluation

The TOPS methodology was developed by the U.S. Department of Energy (DOE) Office of Nuclear Energy, Science, and Technology and DOE's Nuclear Energy Research Advisory Committee to "define a set of attributes that describes the relationship between the elements of a fuel cycle, the threats to those elements and the effectiveness of barriers to inhibit these threats

(Attributes, 6). The evaluation is compares the material, technical and institutional barriers to the various stages of the cradle to grave fuel cycle. All portions are judged along a letter scale, with "I" indicating an ineffective barrier, "L" indicating a low barrier, "M" indicating a medium barrier, "H" a high barrier and "VH" a very high barrier. While this, as noted within the TOPS report, does not give a quantifiable result, it presents areas of concern for further consideration. The full evaluation is presented in a table format, with descriptions of each category set out in the Annex to the Report by the TOPS Task Force on the Nuclear Energy Research Advisory Committee (October, 2000).

Mitigation Analysis

Purpose of Evaluating Opportunity

After evaluating the political and technical aspects of a state's nuclear infrastructure, it is necessary to also evaluate existing and proposed regulatory mechanisms for the country. The assessment of these mitigating factors starts by establishing the ways in which a country could pursue a diversion or clandestine scenario, establishing vulnerabilities early on in the evaluation. After these pathways are determined, the analyses input the "mitigating factors" (security forces, regulatory bodies, cooperation with international organizations, facilities type and design), adjusting the perceived attractiveness of the material in question based on the ability to remove or divert from peaceful uses.

Structure of the Mitigation Analysis

The mitigation analysis used for this evaluation was initially developed for a state to self-assess its nuclear security regime. A gap-analysis structure was developed that would highlight holes in the regulatory structure, showing nonexistent or limited barriers. The analysis starts by establishing the initial threat to the facility and the capabilities the threat possesses. This evaluation is best completed after the previous two evaluations, as it would give greater insight into the threats to the state. The threats are then traced out along four pathways: the construction of a nuclear explosive device, a radiological dispersal device, a radiological exposure device, and an attempt at sabotage. The first iteration of the evaluation creates the pathway without mitigations.

Upon completion of the pathway, the evaluator then reviews the regulatory infrastructure in place, filling in where the system hampers the pathway and noting areas needing improvement. At each point of the pathway, the ability of the threat to bypass the mitigation increases or decreases depending on the strength of the mitigation. The finished evaluation shows the complete pathway, the mitigation (highlights places where there is no mitigation and where it is important to allocate resources, further investigation), and the strength of the opportunity from the perspective of the threat.

While the results of this evaluation are not yet quantitative, the information garnered from this analysis is critical to the effective implementation of a nonproliferation regime. As previously mentioned, improved resource allocation is one of the primary advantages of incorporating this portion and, in turn, approaching the issue as one of risk management.

Creating a Comprehensive Data Set

The full integration of the results from these three individual parts is the critical aspect of the overall analysis. To successfully combine these three sections, the subject matter experts will need to review the red flags that emerge within each group in context with the other portions of the assessment. Following an assessment of these points, the reviewers should look for consistencies within the data that explain the apparent anomaly. An important consideration is the timeframe the indiscretion took place. Instances in which the anomalous event cannot be explained should be noted as a point where additional information is needed to reach a conclusive decision. This could also result in additional inspections in the case of the IAEA, or self-regulation in the event of a state performing a self-assessment.

Implementation of Findings and Application of a Risk Management Approach

A comprehensive evaluation could be widely implemented throughout an array of organizations, including offices within the United States Government, the IAEA, the Nuclear Suppliers Group, nongovernmental organizations, and within a state for self-assessment. The final analysis is designed to provide the evaluator with a broad-scope representation of a state, its nuclear infrastructure, and accompanying regulatory regime to establish areas of risk and mitigation. Implementing these findings leads to more timely detection of diversion or clandestine activities, improved resource allocation, expanded regulatory mechanisms, and new opportunities for cooperation. Integrating the results from this evaluation into a risk management model presents an opportunity to formalize the results and create a systematic means of implementing the mitigating tools that should be put into place.

Conclusion

As the amount of nuclear material, technology, and knowledge continues to spread, it will be of critical importance that the nonproliferation and international safeguards regime expands and adjusts. Evaluating only one aspect of the equation is no longer sufficient to establish the location and extent of a threat and could ultimately result in missing the detection of new proliferation attempts. By evaluating state, technical and mitigating factors and integrating them into one complete data set opportunity to fulfill the goal of timely detection while improving the nonproliferation regime increases significantly. Individual aspects which would have otherwise been overlooked become apparent within a series of red flags, indicating a need for further investigation. Alternatively, areas of concern can be more easily explained with limited additional formal investigations by drawing conclusions across multiple sections of the evaluation. Focusing on the risks present and working towards mitigating those risks though well informed multi-faceted evaluations, rather than solely establishing their presence, will be necessary to the successful implementation of the future nonproliferation regime.

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