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Title: Threat Characterization in Nonproliferation Assessment

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Abstract**Threat Characterization in Nonproliferation Assessment
C. Olinger (LANL)**

NNSA established a nonproliferation assessment methodology (NPAM) working group in 2002 to survey and advance methodologies for performing quantitative, reproducible assessments of nonproliferation activities and programs. A draft of the guidelines¹ was issued in November 2002. The guidelines have subsequently undergone peer review. The objective of this paper is to discuss the characterization of threats in nonproliferation assessments.

Because of the complexity of nonproliferation assessments, the problem must be decomposed into manageable elements. The proposed decomposition involves the definition of a finite set of threats, definition of barriers to proliferation, development of metrics, and segmentation of the system being evaluated.

The spectrum of potential threats of nuclear proliferation is complex and ranges from small terrorist cells to industrialized countries with advanced nuclear fuel cycles. Adding to this complexity, the potential objectives of these threats are highly multidimensional. This paper discusses three categories of proliferant organization: subnational, non-industrialized state, and developed state. These three categories can be further subdivided depending on the aspirations of the proliferant regarding number of weapons sought, weapon yield, weapon reliability, and delivery vehicle. Because a fuel cycle's proliferation resistance depends on the specific threat being evaluated, some assessments may be a vector of results with a calculated value of proliferation resistance for each threat. The alternative would be an aggregation of results where the proliferation resistance is averaged over the different threats, but valuable information may be lost in integrating results this way.

The guidelines document describes the metrics that can be used to assess proliferation risk or proliferation resistance. Although a hierarchy of metrics can be developed, the definition and measurement of metrics vary depending on the character of the threat and the analysis approach. Proliferation barriers protecting against a subnational terrorist organization differ from those that might be effective against a developed state. Additional development work is required to fully understand proliferation metrics, their associated measures, and their weights for the different types of threat, and meaningful approaches to aggregate the effectiveness of layered barriers.

¹ NNSA, "Guidelines for the Performance of Nonproliferation Assessments," draft, November 2002.

Threat Characterization in Nonproliferation Assessment

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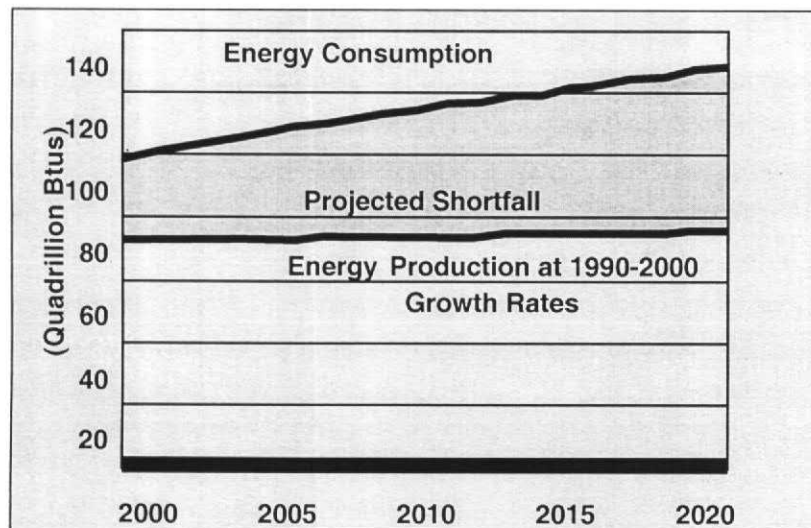
Nonproliferation Assessment Methodology (NPAM) Steering Group

Richard Denning, Bob Bari, Jim Eagle,
Stephen Mladineo, Suzanne McGuire,
Chad Olinger, Jon Phillips, Gary Rochau,
Jordi Roglans, Robert Schock , Jon Phillips

Objective:

Develop a Nuclear Proliferation Assessment Methodology (NPAM), which is a framework to support the evaluation of the proliferation characteristics of reactor designs and fuel cycles, as input to policy analysis

Motivation: Nuclear Energy Future

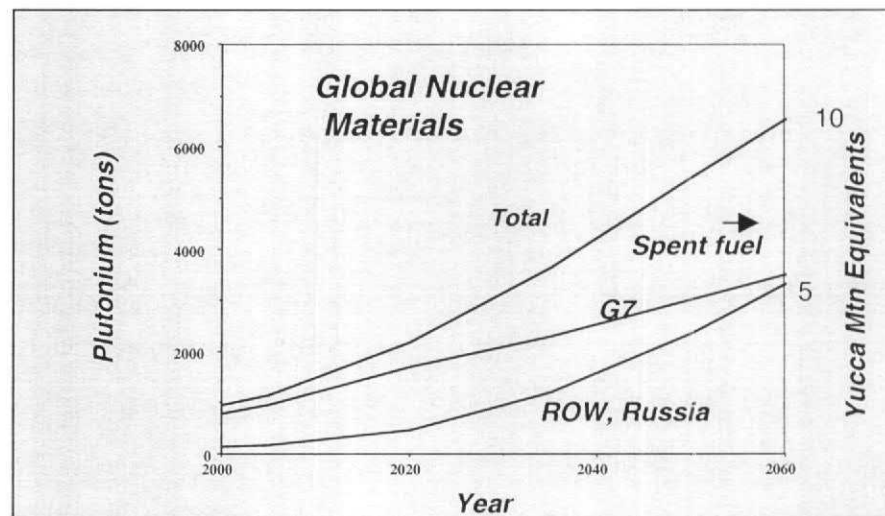


“The United States should also consider technologies (in *collaboration with international partners* with highly developed fuel cycles and a record of close cooperation) to *develop reprocessing* and fuel treatment technologies that are ... more *proliferation resistant*.”

(National Energy Policy)

“...A new era awaits. It is an era of nuclear energy marked by ... *improved physical security and proliferation resistance*... Meeting it will go a long way towards *safeguarding each of our nations from the perils* posed by those seeking to acquire dangerous nuclear materials.”

(Secretary of Energy Abraham, Tokyo, Sept 2002)



Key Challenge to National Security:
Balancing Energy Independence with Nonproliferation

NPAM Guidelines Document

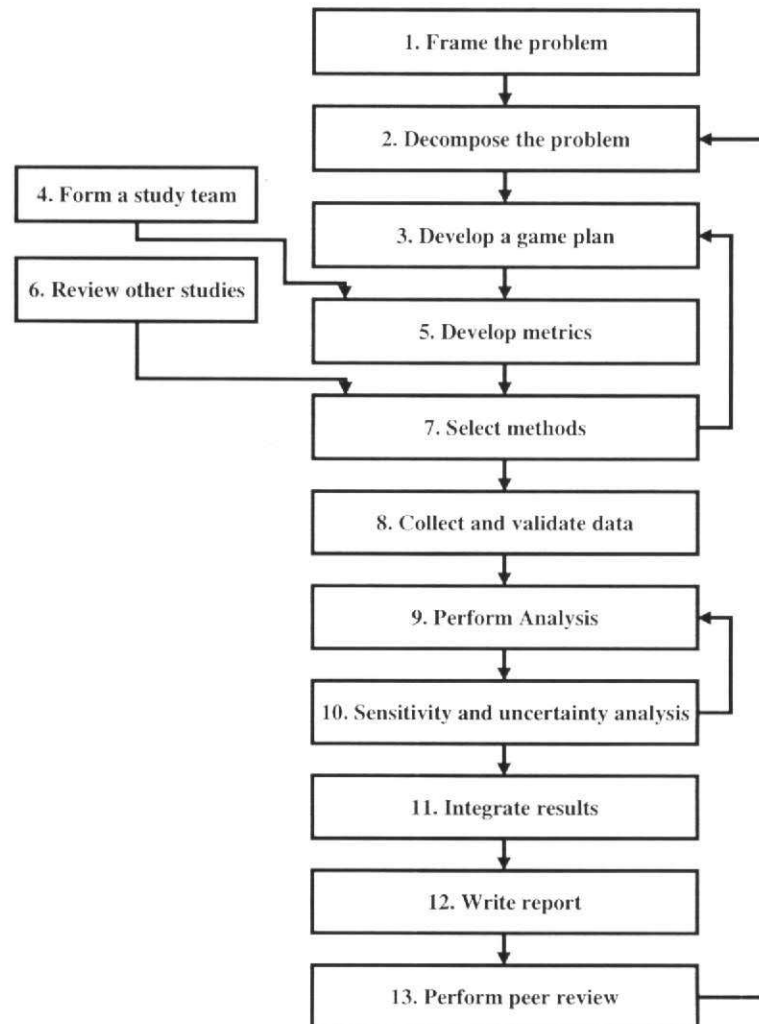
Guidelines for the Performance of Nonproliferation Assessments

National Nuclear Security Administration

(NA-241)

May 2003

NPAM Guidelines Approach



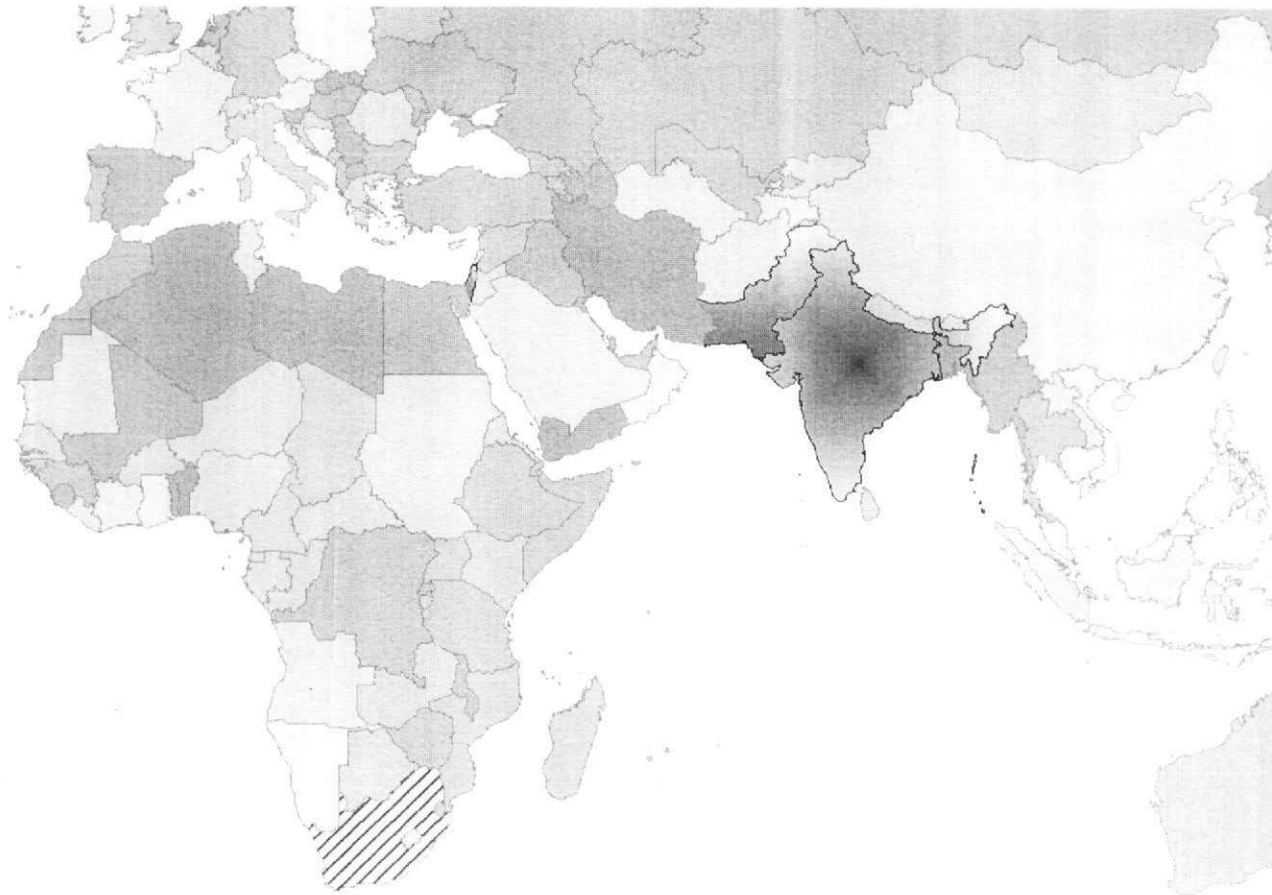
Threat History

NPT Nuclear Weapons States



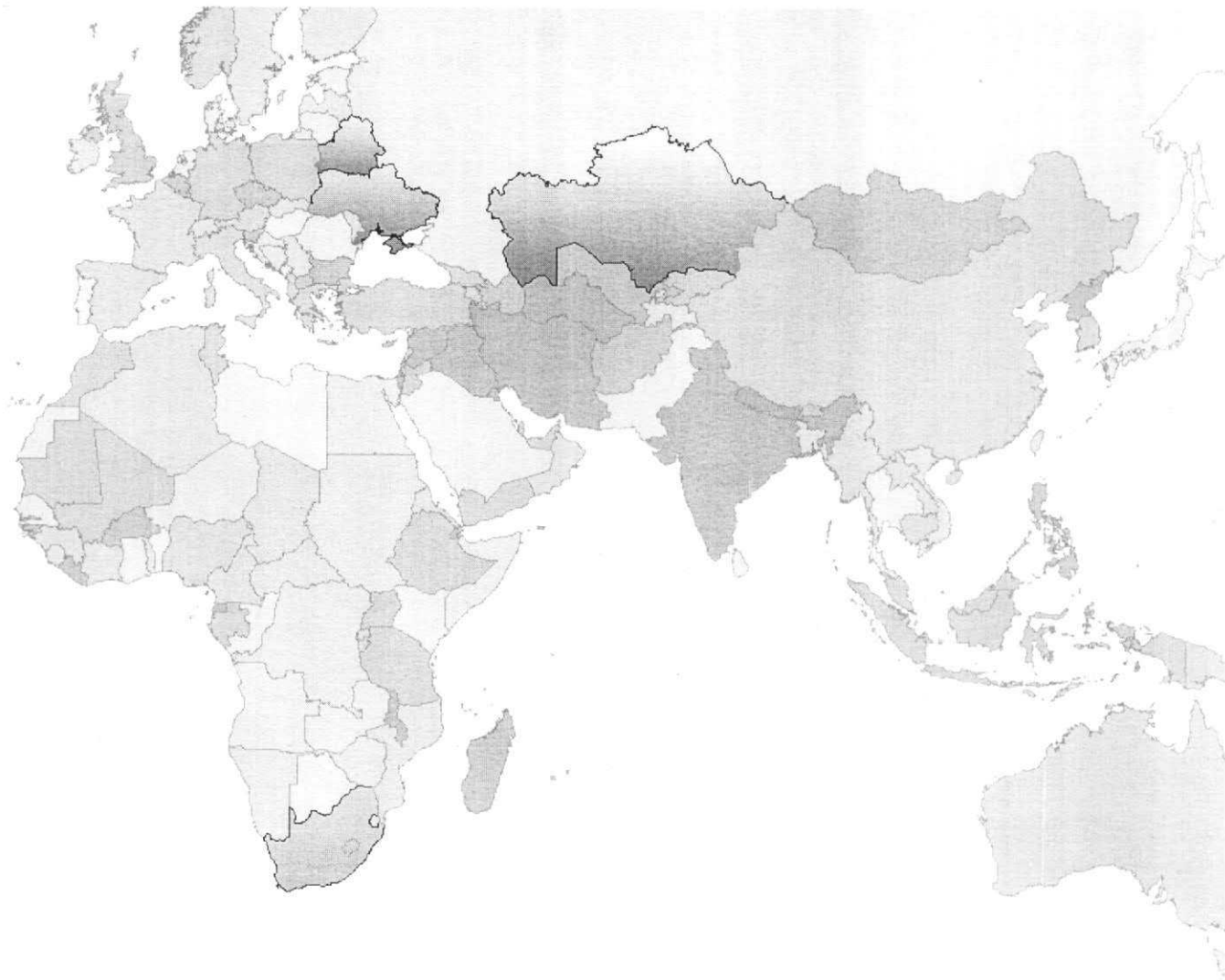
Threat History

De Facto Nuclear Weapons States



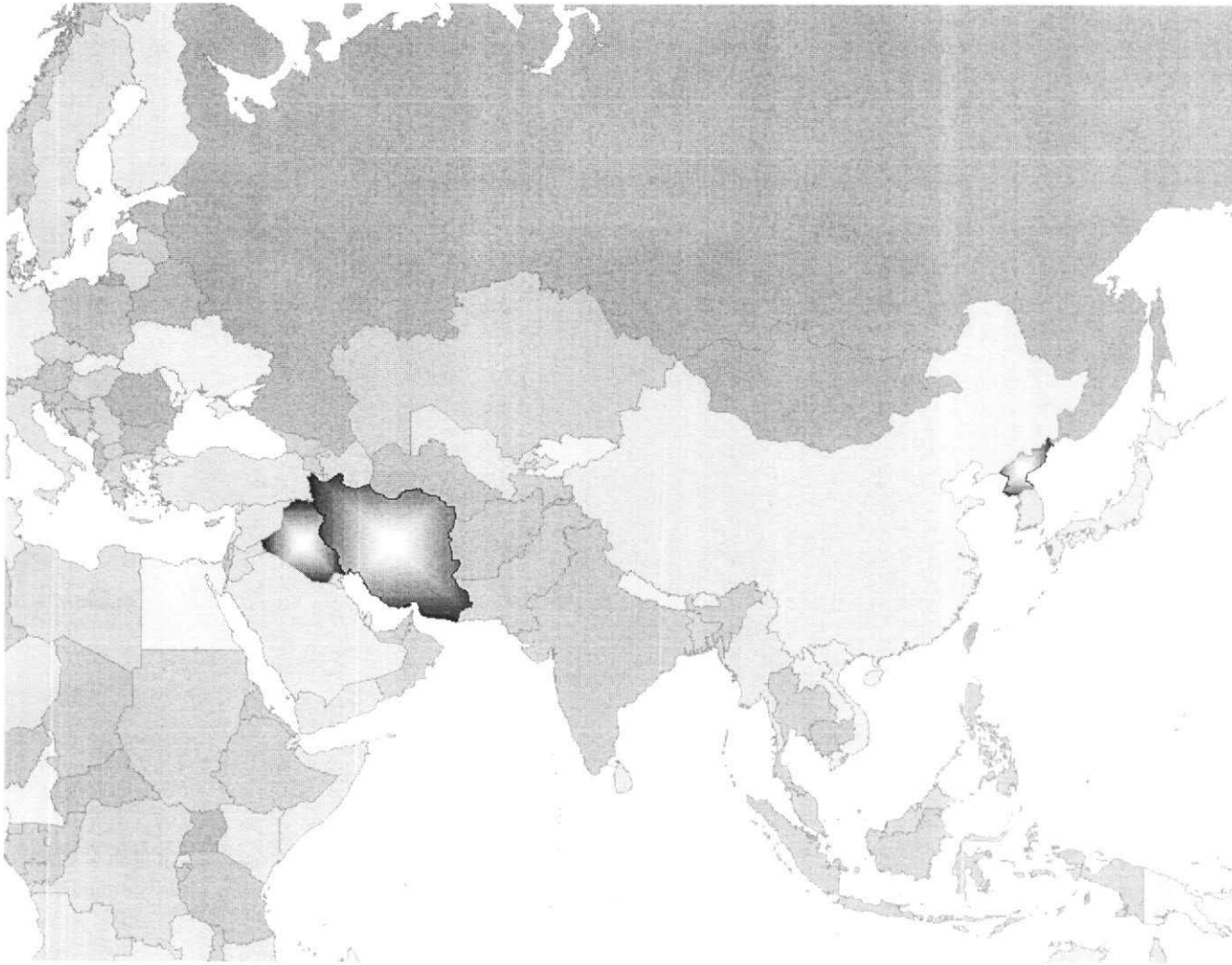
Threat History

Proliferation Roll-Back



Threat History

States of concern



Talk to general industrialized state
potential

Terrorists as Proliferants



Proliferation Threat Spectrum

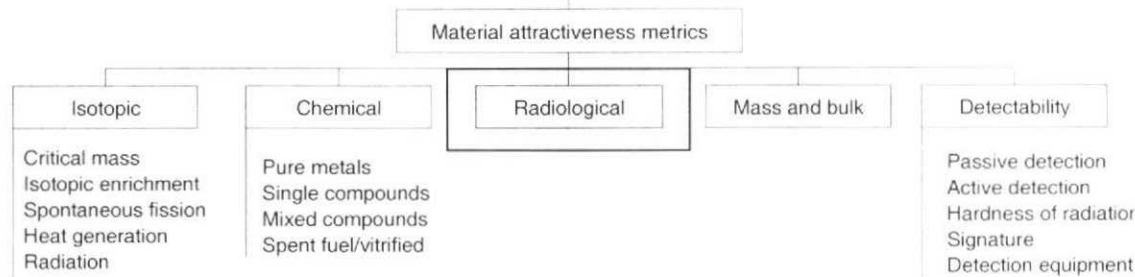
Nominal Weapons Aspirations of Various Types of Proliferation Threats.

		Nominal Weapon Aspirations				
Threat Categories		number	yield	reliability	delivery	to be stockpiled
1	sub national	1 or 2	any	any	truck/boat	no
2		5 to 10	any	any	truck/boat	no
3	non-industrialized State	1 or 2	any to 20kt	50-95	plane	maybe
4		5 to 10	any to 20kt	50-95	plane	maybe
5		10 to 50	any to 20kt	50-95	plane	maybe
6	developed State	1 or 2	any to 20kt	50-95	plane	no
7		5 to 10	any to 20kt	95	plane	yes
8		10 to 50	20-200kt	95	missile	yes

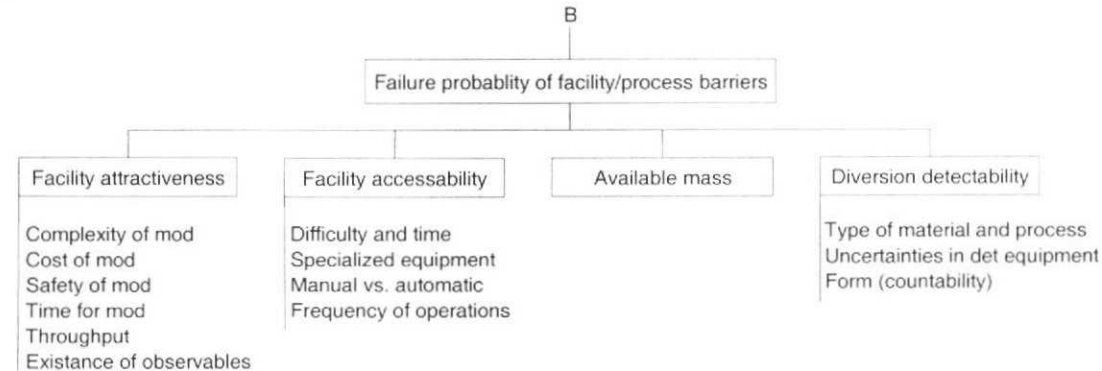
Proliferation Resistance Measures

Intrinsic measures

Material attractiveness metrics

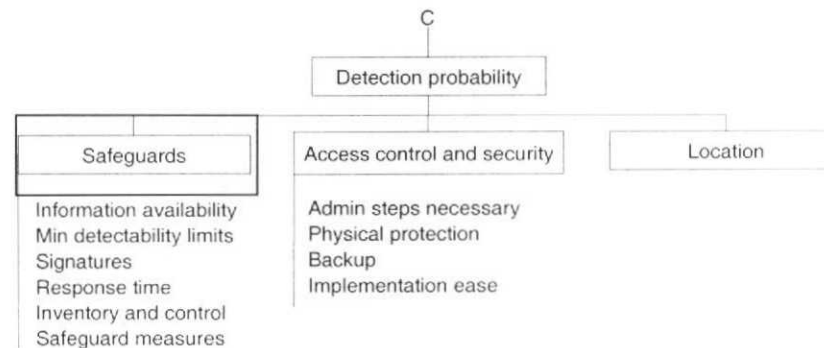


Facility and process barrier metrics



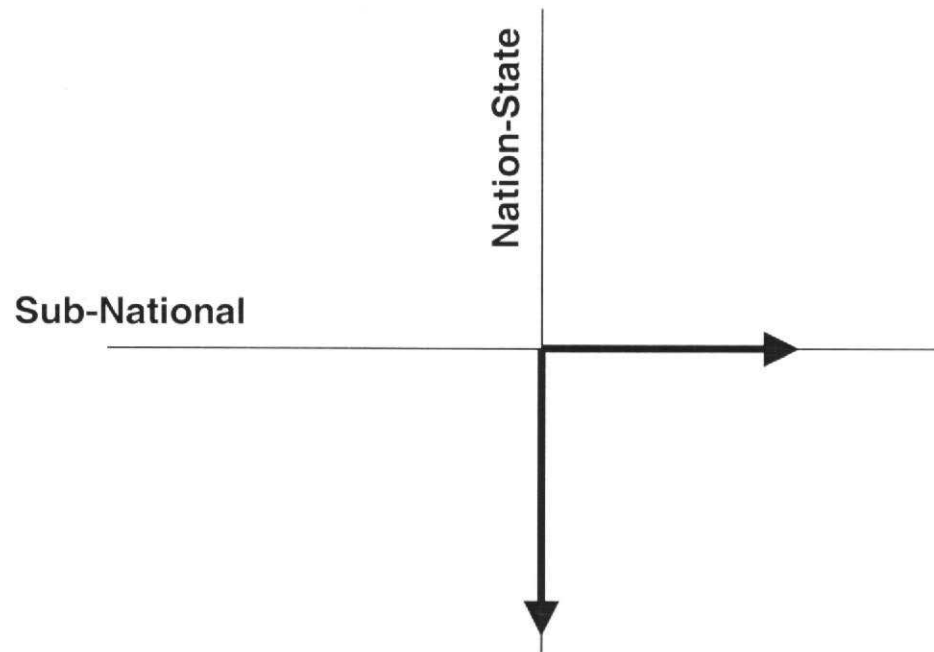
Extrinsic measures

Detection metrics



Effect of Threat Spectrum on Analysis*

Radiation Barrier on Pu separated from Fission Products



*Proliferation Resistance should be considered a vector

Implications of the Threat Spectrum

- Relative scale factors
- Non-linearities in both threats and barriers
- Covariance between barriers may vary among threats (e.g., radiation barriers and safeguards measures)
- Effective intrinsic barriers provide delay mechanism against proliferation threats
- In the event that extrinsic measures fail, intrinsic barriers may provide time to respond to the failure

Summary/Conclusions

- A wide range of potential proliferation threats exists
- Proliferation-resistance measures DO NOT universally address these threats
- Carefully thought-out proliferation-resistance measures can contribute to overall nonproliferation goals
- Intrinsic proliferation-resistance barriers should be considered a complement to extrinsic barriers, not a substitute