Emerging Trends For Physical Protection

The 3rd U.C. Forum on the Future of Nuclear Power

Berkeley, California
June 11-12, 2009

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Sand 2009-3515P
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration
under contract DE-AC04-94AL85000.

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This Presentation

- Takes into consideration the potential for a nuclear renaissance and the corresponding increase in the number of nuclear facilities that are potential targets for theft and sabotage of nuclear material
- The need to reduce the risk of such theft and sabotage by improved physical protection
- Some existing international instruments that concern PP of nuclear materials/facilities
- Achievement of increased security at reduced cost by incorporating security in design of facilities
- The need to attain synergism among security, safety and safeguards

Facets of Nuclear Physical Protection

State: Responsible for Physical Protection Regime

***What* to Protect**	***Who* to Protect the *What* From**	***Risk Management Decision:* *How Well* to Protect**
Theft Targets •Category I amounts of HEU/PU/MOX •Other Category amounts	**Design Basis Threat(DBT)** →	**Requirements** • Compliance • Performance
	→	**Requirements** • Compliance
Radiological Sabotage Targets (fixed/transport) •Nuclear Power Plants •Spent Fuel •Other (e.g., low-level rad waste)	**Design Basis Threat** →	**Requirements** • Compliance • Performance
	→	**Requirements** • Compliance

Example Detail Found in a DBT

	Protestor	Criminal	Terrorist
Likelihood of Potential Action			
Theft			
Sabotage			
Other ______			
Motivations			
Ideological			
Economic			
Personal			
Capabilities			
Number of attackers			
Type of weapons			
Explosives (Type and Quatity)			
Transportation			
Power and hand tools			
Technical skills			
Level of funding			

- While not a Statement of Today's/ Projected Threat the DBT affects facilities designed based on it

System Functions to Provide PP

PP System Functions

Detection	Delay	Response
• Intrusion Sensing • Entry Control • Contraband Detection • Alarm Assessment • Alarm Communication and Display	• Passive Barriers • Active Barriers	• Guards • Response Force

Technology, Guards & Response Forces

International Requirements and Recommendations for Physical Protection

- UNSCR 1540
- Amended Convention on the Physical Protection of Nuclear Material (CPPNM)
- INFCIRC/225 (Rev 4): The Physical Protection (PP) of Nuclear Material and Nuclear Facilities
  - Elements of a State's System of PP
    - State Responsible for PP and Maintaining DBT
  - PP Requirements
  - Currently under revision to meet current threat environment and amended CPPNM

INFCIRC/225 (Rev 4): PP Requirements (Sections 6, 7, 8)

- Specific requirements:
  - Category I NM used or stored in inner area(s) within protected area (PA)
  - Intrusion detection at PA boundary
- Performance-associated objectives
  - Arrival of *adequately armed* response forces <u>in time</u>
  - Central alarm stations hardened against the DBT
- Performance-associated requirements
  - Regular exercise of coordination between guards and response forces

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Increasing PP Cost Trends

- Countries moving from Compliance-based to Performance-based Security using DBT's
- DBT's have expanded in a post-9/11/2001 world
  - Toolsets demonstrated: vehicle bombs, aircraft impacts
  - Demonstrated willingness to inflict mass causalities
  - Announced intentions to acquire nuclear material
- PP systems have been enhanced as a result
  - Increased numbers of response forces, and their levels of training, weaponry
  - Enhanced security systems
  - Decreased response time

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Reactors Designs in R&D Could Be Used in Facilities Needing PP 80+ years from Now

- Observation: DBT's tend to get more capable over time
- Issue: how does one design PP for facilities that may be operating in 2100?
  - Do not want to overbuild today
  - Adding security later is extremely costly
- Currently, design to meet today's DBT as set forth by competent authority
- Security by design will be important component of future facilities
  - Will help reduce life cycle physical protection costs

Design Option Studies for NPPs and Fuel Cycles

- Reduce sets of targets or harden them
  - Reduce number of Category I theft targets
  - Use “inherently secure” plants, processes, and materials against radiological sabotage
    - Associated issue: Maturity of understanding about sabotage sequences for non-traditional designs
- Improve passive security
  - Sizing of reactors to fit buried or bermed configurations
  - Use of remote handling and processes
  - Lay out facilities to maximize delays

Ensure Synergies Among Safety, Security, and Safeguards

- Designs that ensure synergies can have lower life-cycle costs
  - E.g., “inherently safe“ and “inherently secure”
- Historically, such potential synergies have not been adequately addressed
- Achievement of such synergies may require changes in regulatory approval for the design or for an operating license

Summary

- The increasing number of nuclear facilities are potential targets for theft or sabotage of nuclear material.
- There is need to reduce the risk of such theft and sabotage by improved physical protection.
- Some existing international instruments provide guidance for better protection of nuclear materials/facilities
- Increased security at reduced life cycle cost can be obtained by incorporating security in the design of facilities.
- It is important to attain synergism among security, safety and safeguards to improve all three at reduced cost.

Backup slides if there are questions

Feature-Based Versus Performance-Based Physical Protection

Feature Based Protection

Definition:

- PPS design and evaluation based on specification and implementation of a ***set of required features***

Example:

- Two intrusion sensors with video assessment
- Security locks on gates, doors, and containers

Performance-Based Protection

Definition:

- PPS design and evaluation based on specifying and ***achieving an overall system effectiveness*** against the Design Basis Threat (DBT) or current evaluation of the threat for theft and sabotage.

Example:

- PPS will, with a probability of P* or greater, 1) detect intrusion and 2) delay unauthorized entry until the response arrives.

Evaluation Requirements in INFCIRC/225/Rev. 4

- 4.4. Evaluation of the Implementation of PP Measures
  - *4.4.1. To ensure that physical protection measures are maintained in a condition capable of meeting the State's regulations and of effectively responding to the design basis threat, the State's competent authority should ensure that* ***evaluations are conducted by operators at nuclear facilities and for transport****. Such evaluations, which should be reviewed by the State's competent authority, should* ***include administrative and technical measures, such as testing of detection, assessment and communications systems and reviews of the implementation of physical protection procedures****. Such evaluations should also include exercises to test the training and readiness of guards and/or response forces. When deficiencies are identified, the State should ensure that corrective actions are taken by the operator.*

General Performance-Based Design and Evaluation Process

Define PPS Requirements → Characterize PPS → Evaluate PPS → Final PPS Design / Redesign PPS

Define PPS Requirements

What are we protecting? ***(Characterize Facility Identify Targets)***

Who are we protecting it from? ***(Define Threats/DBT)***

How well do we need to protect it? (***Performance metric goals)***

Feature requirements

Characterize PPS

Detection, assessment, communications

Delay

Response

- **Time to respond**
- **Neutralization capabilities**

Evaluate PPS

Timely response?

Overall effectiveness meets regulatory goals?

Final PPS Design

Redesign PPS

Define Design Basis Threat (DBT)

- A Design Basis Threat (DBT) specifies:
  - The attributes and characteristics of potential insider and/or external adversaries, who might attempt unauthorized removal of nuclear material or sabotage, against which a physical protection system is designed and evaluated
- The DBT is a policy document, not a statement of today's threat
- Value of a DBT
  - Provides technical basis for defining performance requirements used in the design and evaluation of PP systems
  - Supports efficient and effective allocation of resources
  - Helps provide assurance that level of protection is adequate

Performance Metric Goals

- Performance Metrics describe how well the PP System works:
  - System Effectiveness (P_E)

    The probability that the physical protection system will defeat the adversary

    - $P_E = P_I * P_N$
  - Probability of Interruption (P_I)

    Probability that the Response arrives in time to stop the adversary
  - Probability of Neutralization (P_N)

    The probability, given interruption of the adversary by the response force, that the response force kills or captures the adversary, or causes the adversary to flee
- Examples of Performance Goals
  - P_I must meet or exceed 90% against outsiders in the DBT
  - P_E must meet or exceed 85% against outsiders in the DBT

Target Identification

- Target Identification: Where can the adversary steal material or cause radiological sabotage?