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Security of Devices Containing Radioactive Materials

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NNSA National Nuclear Security Administration

Sandia National Laboratories

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Who We Are and Why We Are Here

- DOE National Nuclear Security Administration (NNSA)
  - Office of Global Radiological Threat Reduction

- Mission
  - Reduce the risk posed by vulnerable radioactive materials that could be used in a radiological dispersal device (RDD)
- Goal
  - Use a prioritized Defense-in-Depth approach to deny terrorist access to assets by securing or removing vulnerable radioactive materials throughout the world

Why NNSA?

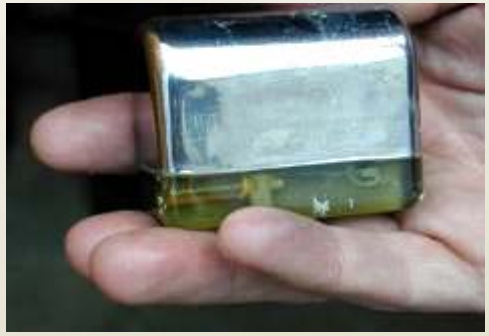
- Supported radioactive source security upgrades in over 50 countries
- Lessons learned from this effort are being applied internationally and within the US
- Actively working with the IAEA to assist others in recovering, removing, and securing radioactive sources
- Seeks to work with industry to improve security of radioactive sources

Objectives of this Presentation

- Create an awareness of the need to secure high risk radioactive sources
- Describe the general means to secure those sources

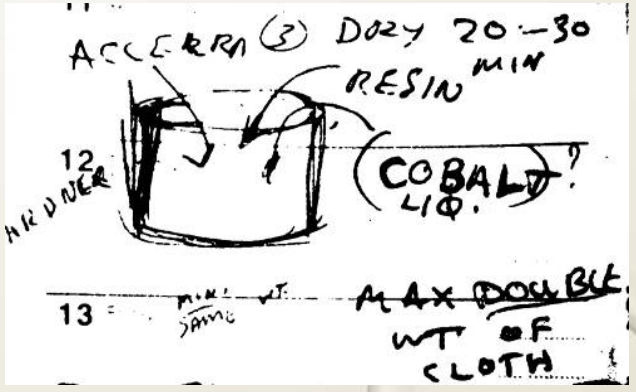
Malicious Use of Radioactive Material

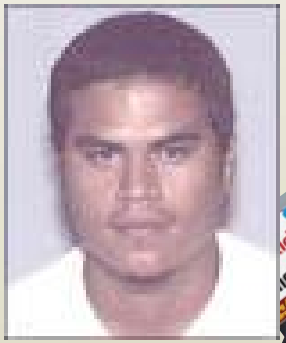
- Readily available material
- Relatively unsophisticated technology
- Minimal security in many instances
- Cause fear and panic
- Results in area denial, disruption, and economic impact



A Matter of When, Not If

- 1987 – Iraq tested RDD
- 1995 – RED discovered in Moscow Public Park
- 1998 – Chechnya: Explosive mine filled with radioactive material
- 2002 – Jose Padilla found to have plans
- 2003 – Al Qaeda plans in Afghanistan
- 2004 – Large stockpile of Americium 241 found in London





Article Published on Bin Laden Web Site

http://www.israelnewsagency.com/binladenislamicnuclearterror.html

الحرب النووية هي الحل لتدمير أمريكا

بسم الله الرحمن الرحيم

نعم لم تخطئوا قراءة النص ،إنه السبيل الوحيد لقتل أكبر عدد ممكن من الأمريكان ،إنه الرعب النووي الذي لا يخشى الأمريكان مثله أبداً ففي الحرب العالمية الثانية استخدمت أمريكا هذا السلاح مرتين خلال ثلاثة أيام بسبب الغارة اليابانية الناجحة على بيرل هاربر ،والآن تقوم الولايات المتحدة الأمريكية باستخدام أعنف الأسلحة وأشدها فتكاً وتطوراً في قصف المدنيين الآمنين في العراق ،والمدنيين الآمنيين في أفغانستان وندعم وبكل فخر الحرب الروسية ضد الشيشان ،ليس حباً في الروس ولكن بغضاً في المسلمين .

لقد قصفت أمريكا العراق بأسلحة لوثت الأرض والماء والهواء بالإشعاع لآلاف السنين، بل قد قامت بإشاعة الفاقد باليورانيوم المستنفد لكي توقع أكبر ضرر في الأرض والإنسان، حتى تخرج من جزيرة محمد ،وقد حولتها إلى منطقة محرمة فلا يفكر أحد بعد ذلك في العجز إليها ،و لكن يبدو أن حيوانات البيت الأبيض نسوا أو تناسوا شيئاً هاماً للغاية ،هذا الشيء هو وبكل الفخر والاعتزاز «تنظيم القاعدة».

هذا التنظيم الذي أثار الرعب في قلب الغرب الكافر ،وجعل من بضع شباب لا يملكون من الدنيا إلاّ حبهم لله ولرسول تكالاً في أبناء المومسات، بل لقد صدر هؤلاء الشباب نوع الأمثلة في تحفهم للدنيا ،فقد أنهم الدنيا وفروا منها لأنهم شيء سوى رغبتهم بما عند الله تعالى ،فباعوا النفسهم لله ،والله ثم بهم وتقبله.

إذا قارنين بالعين والسن بالسن ،وإذا كان الأمريكان يمتلكون القنابل التي لاتقبل لا حد بها ،فالقاعدة تملك من القنابل التي تسمى «بالقنابل القذرة» و «القنابل الفايروسات القاتلة» ، التي ستشمل المدن الأمريكية بالأمراض القاتلة لتحول هذا الشعب «المتأنق والمتفنن في إذلال الشعوب الأخرى» إلى شعب من المنبوذين المرعبون الحاملين للأمراض وستثبت الأيام القادمة أن قاعدة الجهاد بإذن الله تعالى قادرة على تحويل أمريكا إلى بحيرة من الإشعاع القاتل ،الذي سوف للعالم أقرب النهاية ،وسوف يُضاً أن القاعدة ستكون عند حسن ظن العالم الإسلامي بها من القضاء على أمريكا .

نعم ستدمر أمريكا ومن تحالف معها ،لأنهم أساؤا استخدام القوة ضد الضعفاء ،والآن أقتربت نهايتهم على يد شباب الصحوة الذين إن ركبوا خيولهم لايترلون عنها إلا منتصرين أو شهداء بإذن الله ،وكلتا الحالتين نصر مؤزّر .

فأكثروا من الدعاء لإخوانكم بالتسديد والنصر والله القادر على كل شيء.

هذا بيان للناس ليتفقه فيه المؤمنون فقط أما الكافرين فإنا نسأل الله تعالى أن يهديهم أو أن يعجّل في قبض أرواحهم وأما عدوّنا فإنه سيجدنا عليه.

والله من وراء القصد وهو أرحم الراحمين .

منقول

«أبو شهاب القندهاري»

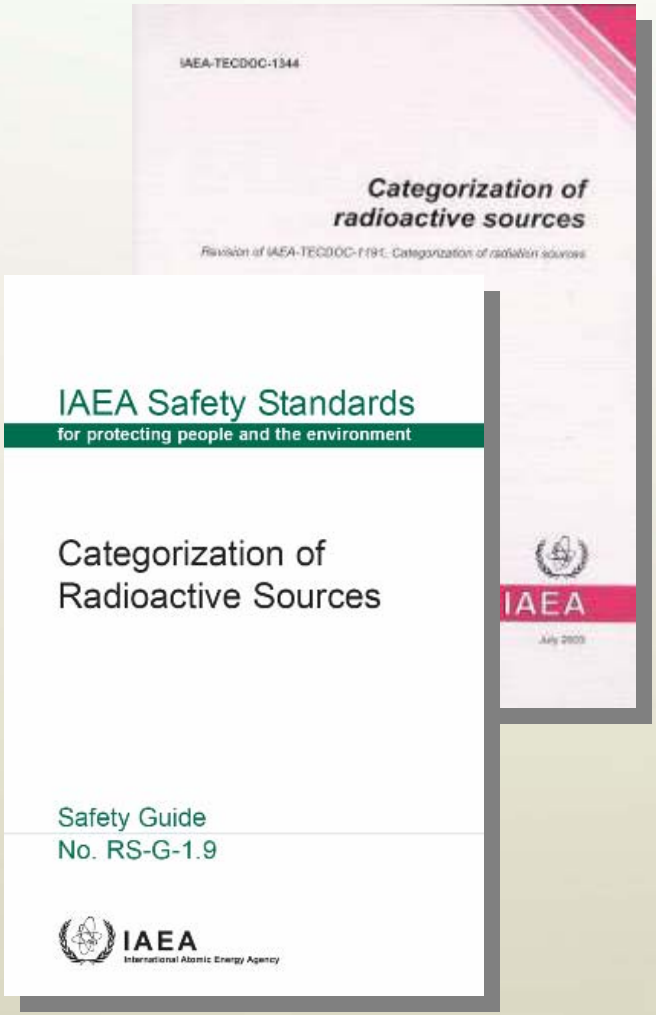
تم تحرير هذا المقال في 02-12-26 عند 07:00 AM

"Even though the Americans have bombs possessing enormous power, Al-Qaeda is even more powerful than they, and it has in its possession bombs which are called "dirty bombs"

Radioactive Material Prioritization

- Categorization Techniques
  - IAEA, NRC: Deterministic Methods (IAEA Category 1-5 and NRC Radionuclides of Concern)
  - IAEA: Transport Security
  - UN: Transport of Dangerous Goods
  - NNSA: Stochastic Methods (Assessment and Action Levels)
- Categories (levels, classes) determine levels of graded security

Categorization of Sources RS-G-1.9

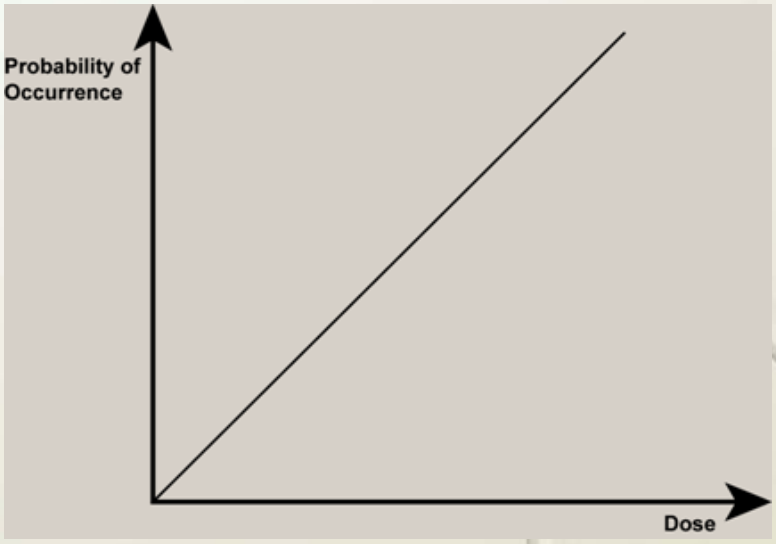


The new categorization provides a fundamental and internationally harmonized basis for risk-informed decision making, by providing a relative ranking and grouping of practices and sources, which is based on a logical and transparent methodology

Table of Radionuclides of Concern
(IAEA Category 2)

Radionuclide	Quantity of Concern	Radionuclide	Quantity of Concern
Am-241	0.6 TBq (16 Ci)	**Pm-147**	400 TBq (11 KCi)
Am-241/Be	0.6 TBq (16 Ci)	**Pu-238**	0.6 TBq (16 Ci)
Cf-252	0.2 TBq (5.4 Ci)	**Pu-239/Be**	0.6 TBq (16 Ci)
Cm-244	0.5 TBq (14 Ci)	**Ra-226**	0.4 TBq (10 Ci)
Co-60	0.3 TBq (8.1 Ci)	**Se-75**	2 TBq (54 Ci)
Cs-137	1 TBq (27 Ci)	**Sr-90 (Y-90)**	10 TBq (270 Ci)
Gd-153	10 TBq (270 Ci)	**Tm-170**	200 TBq(5.4 KCi)
Ir-192	0.8 TBq (22 Ci)	**Yb-169**	3 TBq (81 Ci)

Non-Deterministic or Stochastic Effects



- Probability of the effect is:
  - A linear function of dose
  - Without a threshold
- Effects of concern are:
  - Cancer
  - Hereditary effects
- Model is oversimplified and overestimates health risks below 10 rem (0.1 Sv); however, long-term effects increase impacts
- Dose limits are established to make radiation risk equivalent to that of industry

NNSA Assessment, Action Levels Based on Stochastic Evaluations

- General Rules*
  - Action Level
    - Beta/Gamma – 1000 Ci (37 TBq)
    - Alpha – 20 Ci (0.74 TBq)

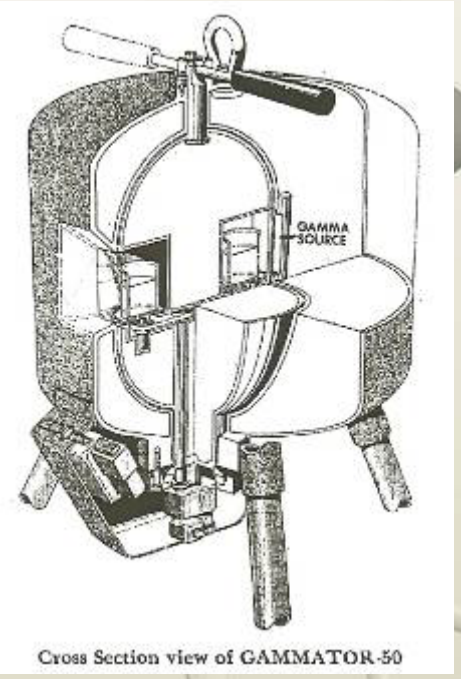
Amount of Radioactive Material Needed for Area Denial

- Basis is Draft US Department of Homeland Security Protective Action Guideline (PAG) for relocation
  - DHS recommends population relocation if the projected dose would exceed 2 rem (20 mSv) in the first year after the RDD event
- IAEA Categorization (TECDOC 1344) of radiation sources
  - Not based on RDD area denial scenarios

Availability

- **"To all licensees, here at the University of ------, one of our responsible users would like to offer up a self-shielded irradiator for recycling. … Specifications: Isomedix (Parsippany, N.J.) Gammator M38-1 irradiator; Two source Cs-137 Reference date and reference activity 7/1/1969 800 Ci (400 Ci/source) Current activity and exposure rate 360 Ci 309 R/min. The two sources are contained within two welded, stainless steel concentric capsules locked in a third cavity by a shielding plug which is locked into place by a high strength weld."**

- **On a high school website: "In a specially constructed room in the main lab, we maintain a Model B Gammator Irradiator with a 400 curie source of Cs-137. For this the school is licensed by the State, and I am named as the control operator on the license. The gammator is used by students to irradiate everything from seeds to non-living materials."**



Cross Section view of GAMMATOR-50

Availability

Re: Cobalt-60 Gamma Irradiator
To: radsafe@*********
Subject: Re: Cobalt-60 Gamma Irradiator
From: John ******* <jm***r@********>
Date: Thu, 16 Dec
We have an AECL Gamma Cell 220 with about 900 Ci of Co-60. … Has anybody had experience getting rid of this much Co-60 or an irradiator?

I am storing a RAMCO (Radiation Machinery Co.) GAMMATOR 50. This source currently contains approximately 200 curies of Cs-137-Cl. This source is free to anyone who has a license and can remove it from our site

supply of cobalt-60 source for NDT
Posted by: **John H****** , E-mail: j*******g@comcast.net, on September 09:**

We have Cobalt-60 nickel plated 1 x 1 mm pallet with high activity of 250 - 300 Ci/g suitable for the application of NDT or Gamma Knife. We have hot cell at the lab in China to process the Co-60 into source per customers' requirement as OEM. If anyone in this forum is interested, please contact me.

Price: £340.00

Nuclear Isotopes

Radioactive Sources

No NRC license required!

Abandoned Sources

Devices Studied

- Blood irradiation
- Research
- Teletherapy

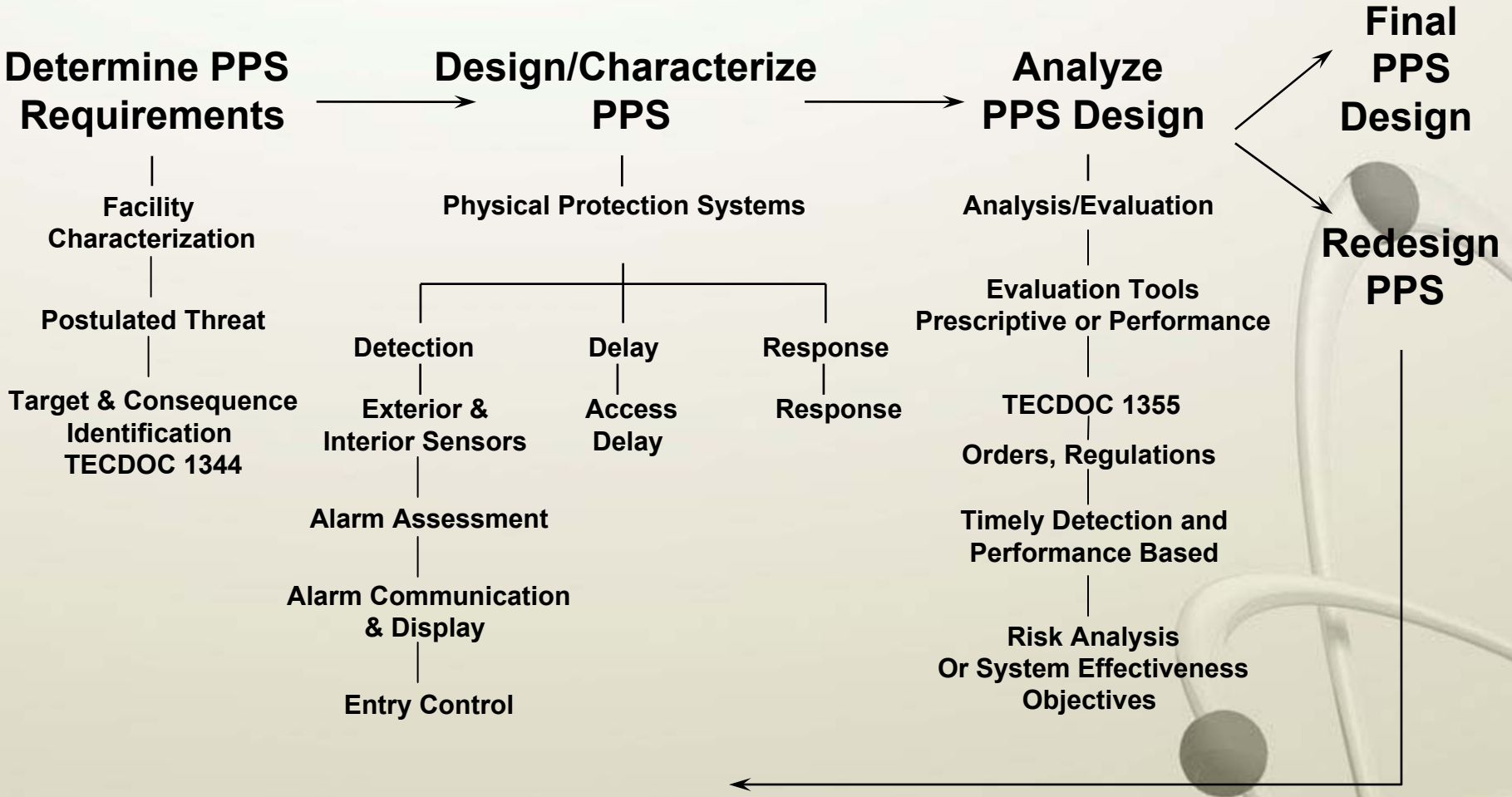
Objective

- Demonstrate removal of a radioactive source from self-shielded devices:
  - Remove source without regard to exposure level
  - Remove source, but minimizing exposure
  - Using open source information; minimal technical expertise
- Determine tools and time needed for source removal

Findings

- Machines designed for field re-sourcing
- Shielding provides advantage
- Sources can be removed

Physical Protection System (PPS) Fundamentals: Design and Evaluation Process Outline



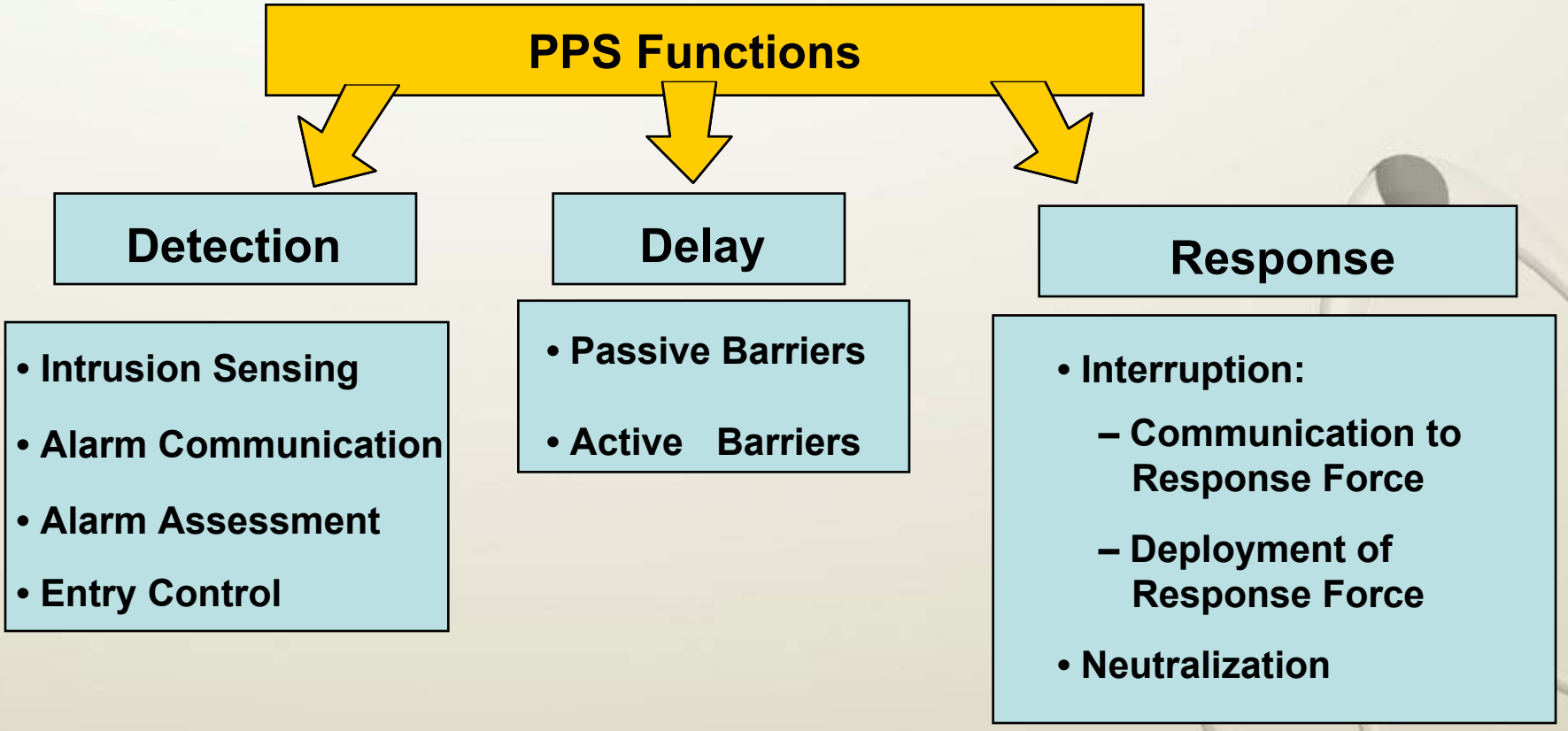
Threat Assessment

- An analysis that documents the credible motivations, intentions, and capabilities of potential adversaries that could cause undesirable consequences by causing sabotage at a facility or stealing a radioactive source

PPS Necessary Functions

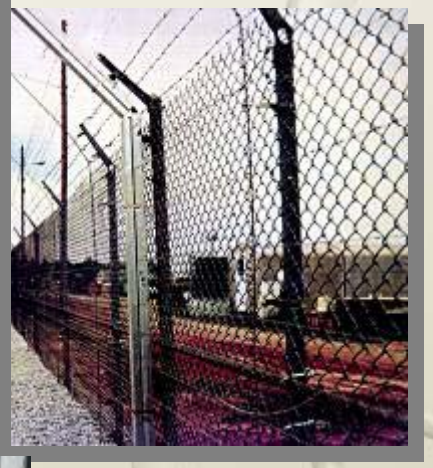
- **System functions that must all be present**
  - **Detection**
    - **Detects the start of the adversary act**
    - **Includes the assessment function**
  - **Delay**
    - **Retards the adversary to give the response (police or guards) time to respond**
    - **Effective only after detection is accomplished**
  - **Response**
    - **From on-site guards,**
    - **off-site police, or**
    - **military personnel**

PPS Functions



Detection

Sensor Activated → Alarm Signal Initiated → Alarm Reported → Alarm Assessed



Delay

Delay

Provide Obstacles to Increase Adversary Task Time

Response

Communicate to Response Force → **Deploy Response Force** → **Neutralize Adversary Attempt**

PPS Design Principles

- Place *detection* toward the *perimeter* and *delay* toward the *target*
- Protection-in-depth
- Minimum consequence of component failure
- Balanced protection
- Combine physical protection components into a system within constraints of the host facility
- Use components that complement each other and correct for weaknesses
- Response able to arrive in time to defeat the threat

Protection-in-Depth

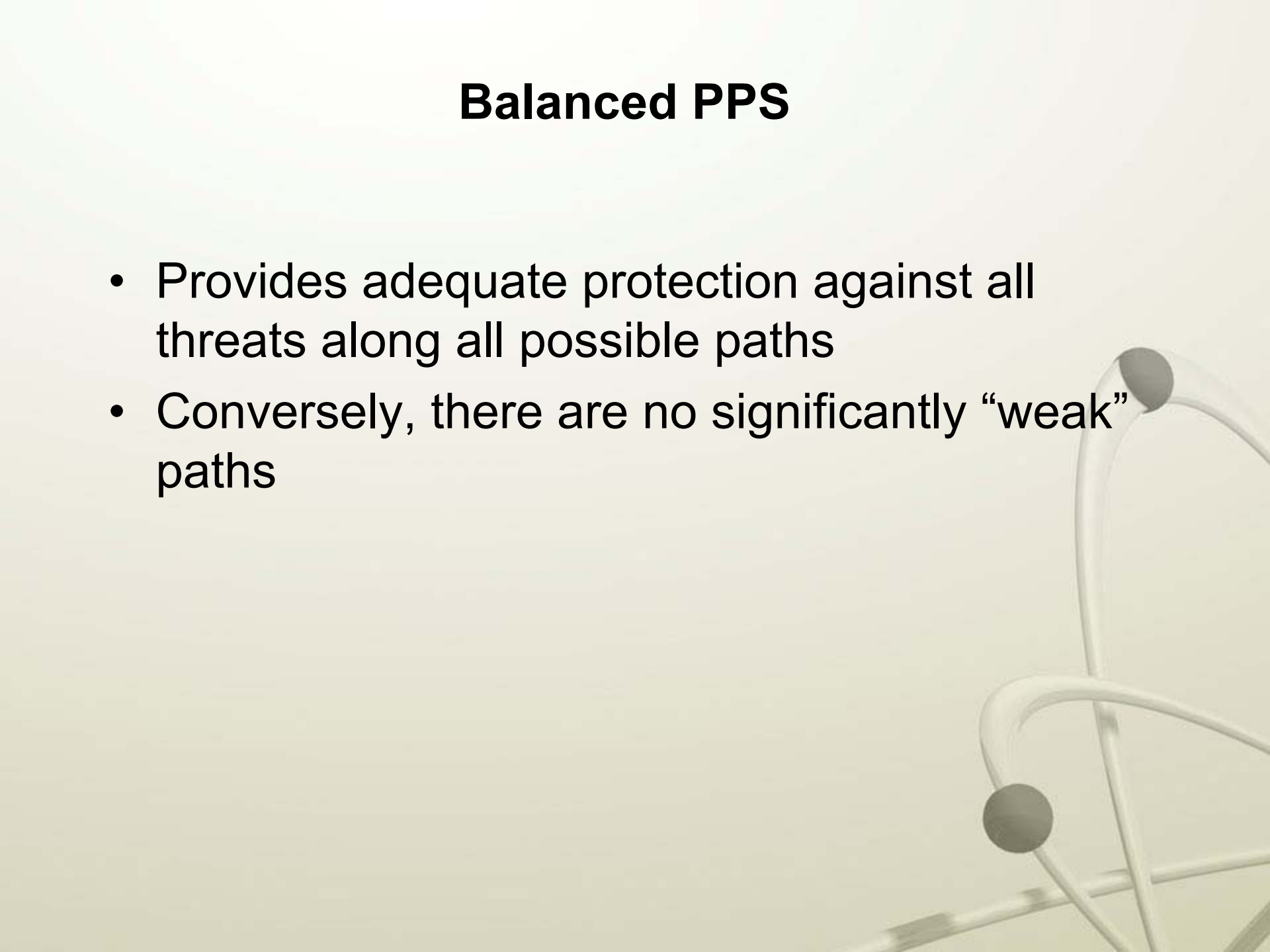
- Adversary must defeat or avoid a number of protective devices in sequence
- Protection-in-depth should
  - Increase adversary's uncertainty about the system
  - Require more extensive preparations by adversary prior to attacking the system
  - Create additional steps so the adversary may fail or abort his mission

Minimum Consequence of Component Failure

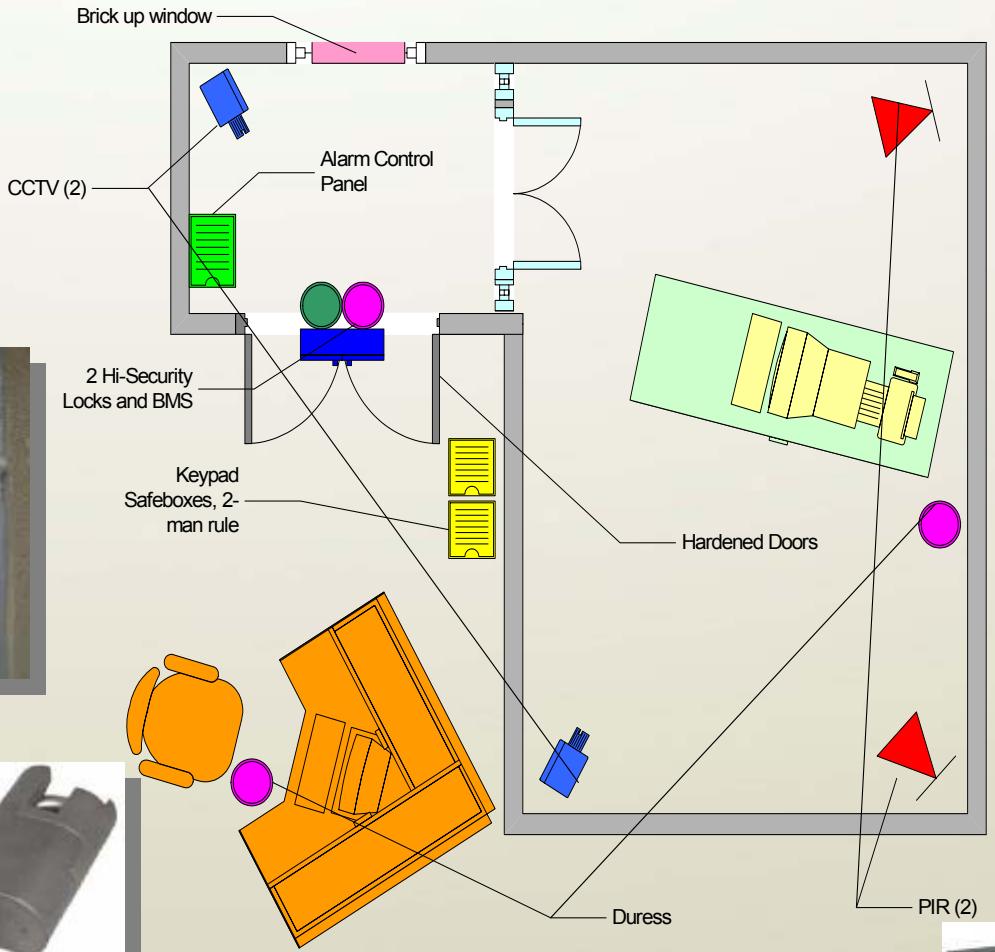
- Contingency plans must be provided so the PPS continues to operate after a component fails
- Redundant equipment can take over function of disabled equipment in some cases
- Some failures require backup assistance from sources external to the facility

Balanced PPS

- Provides adequate protection against all threats along all possible paths
- Conversely, there are no significantly “weak” paths

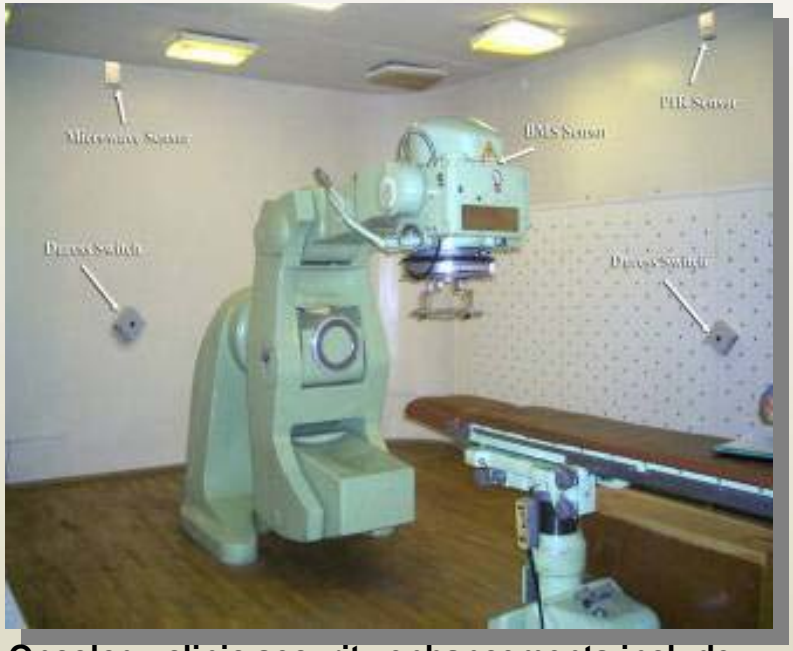


Upgrading Security for Teletherapy Treatment Room

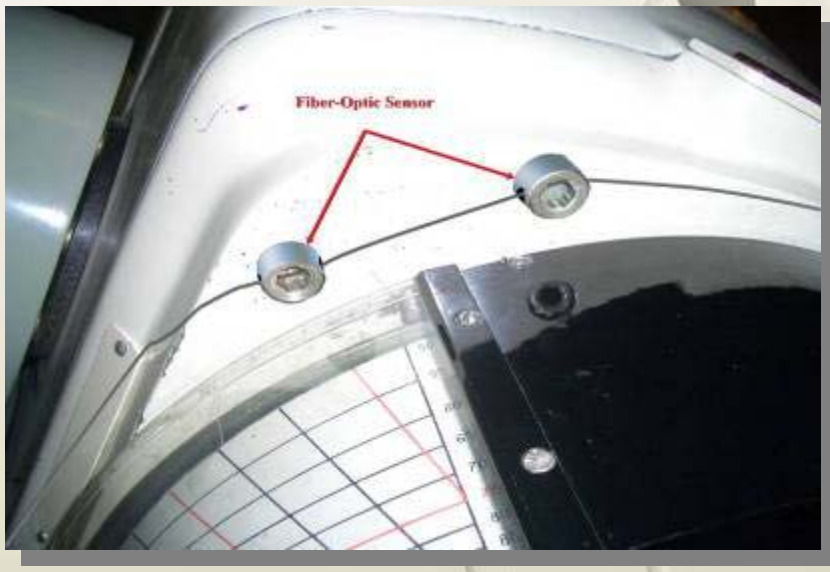


Upgrading Security for Oncology Clinics

- Install improved access control system and intrusion detection sensors to source room; install low-cost/ low maintenance “always on” sensor to source device



Oncology clinic security enhancements include installation of sensors to detect entry into room that holds source and sensor on the teletherapy unit itself.



A fiber optic seal encloses the teletherapy unit. Any attempt to access the unit requires breaking the seal, which results in an alarm signal.

Physical Protection Summary

- Effective physical protection requires
  - Detection
  - Delay
  - Response
- The total time for detection and response must be less than adversary task time once the first detection occurs
- Protection-in-depth, minimum consequence of component failure, and balanced protection are all present in a well-designed system

Summary

- Radioactive sources are vulnerable for malevolent use
  - Availability
  - Devices
- Physical protection methodology can be used to improve security