Nuclear Safety and Security Culture

Roles and Responsibilities of Individuals

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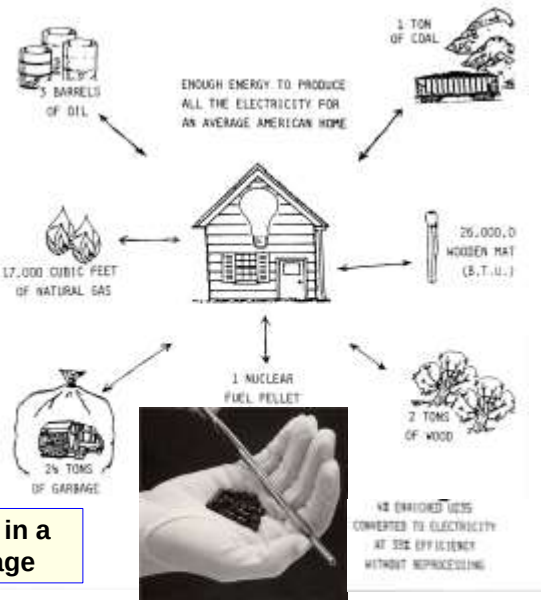
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Overview

- Benefits and Challenges of Nuclear Energy and Material
- Safety and Security Impacts of Nuclear Accidents
- Proper Response to Nuclear Safety and Security Accidents
- Nuclear Safety and Security: Definitions
- IAEA Nuclear Safety Standards
- Nuclear Safety Culture
- Nuclear Security Culture
- Safety Culture vs Security
- Roles and Responsibilities Individuals
- Create a Strong Nuclear Safety and Security Culture
- Conclusions

Benefits of Nuclear Energy

Mass - Equivalents



Huge energy in a small Package

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Example: 2 Unit Diablo Canyon Site (2.2 GW_e Total)

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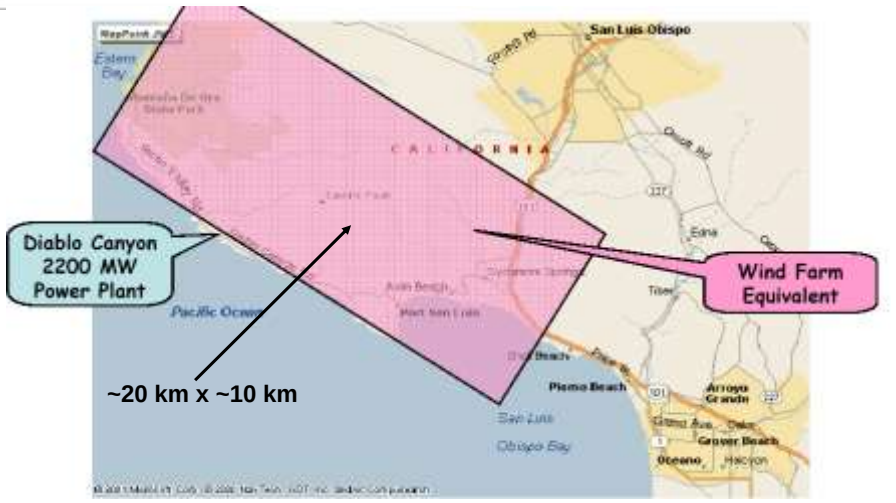
Nuclear Power has a High Energy Density



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Nuclear Energy Challenges –

Nuclear Security Concern: Theft of Nuclear Material (NM)

- **Protect nuclear material from theft that could lead to the construction of a nuclear explosive device by a technically competent group.**

Other example: Radiological Dispersion Device (Radiation Dispersal Device)

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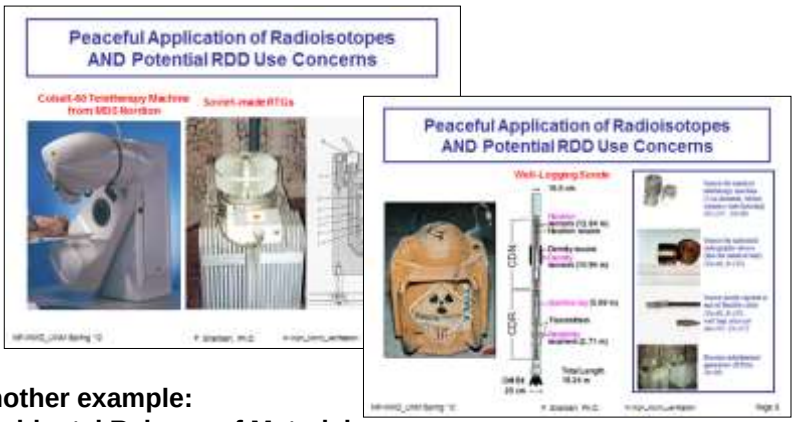
Nuclear Energy Challenges –

Nuclear Safety Concerns: Uncontrolled Release (Dispersal) of Radioactive Material -- RDD



Another example:
Accidental Release of Material

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Nuclear Energy Challenges –

Nuclear Safety Concerns: Uncontrolled Release (Dispersal) of Radioactive Material -- Accidental Release of Material

Illustrative Case Study: Unintentional Dispersion of Radioactive Material
1987 Radiological Accident in Goiania, Brazil

In September 1987, a hospital in Goiania, Brazil, moved to a new location and left its radiation cancer therapy unit behind. Found by scrap metal hunters, it was dismantled and the cesium chloride source containing 1,400 Ci of cesium-137 was removed. Pieces were distributed to family and friends, and several who were intrigued by the glow spread it across their skin. Eleven days later, alert hospital staff recognized symptoms of acute radiation syndrome in a number of victims.

(For additional information see: International Atomic Energy Agency (IAEA), 1988, *The Radiological Accident in Goiania*, Vienna, Austria.)

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Nuclear Energy Challenges –

Nuclear Safety Concerns: Reactor Accidents

- Three Mile Island
  - Multiple small failures, operator error
  - Bad PR, bad for $, no health effects
- Chernobyl
  - Poor design, operator error, no containment
  - 50 deaths, wide contamination, fear
- Fukushima
  - Beyond Design Basis Accident (BDBA) Issues
  - Major Impact on the Probabilistic Safety Assessment (PSA) and Probabilistic Risk Assessment (PRA)
- Connection between safety accidents and Security Issues

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Proper Response to Radiological Incidents --

Safety, Security, and Capacity Building

- Radiological incidents can overwhelm the public Safety resources of any country
- Preparation to respond to such incidents is crucial to minimize their impacts;
  - On the public,
  - On the environment
  - On the infrastructure
- Security Connection: Most importantly, effective response to such incidents relates to national security:
  - Reinforces the public confidence in the country's ability to protect its citizens,
  - Could become a deterrence to a potential adversary,
  - Determines level of impact on natural resources and national economy

Effective Response requires:
- Trained and Skilled Personnel
- Laboratories with Strong Quality Assurance Programs
- Communication – among regional laboratories
- Cooperation and Collaboration – regional labs
- Data Sharing
- Establish the above *BEFORE* an accident or event happens

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Definitions

- **Nuclear Safety**

  Prevention of accidents and mitigation of consequences, resulting in the protection of workers, the public, and the environment from undue radiological hazards.

- **Nuclear Security**

  Prevention and detection of, and response to sabotage, unauthorized access, or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.

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General Nuclear Safety Philosophy

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Nuclear Safety Philosophy – NRC*

- **Safety goals and requirements (for nuclear reactors)**
  "…even in the unlikely event of a release of radioactive materials to the environment, there is reasonable assurance that actions can be taken to protect the population around nuclear power plants."

NRC= US Nuclear Regulatory Commission

See: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/emer-plan-prep.html

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Nuclear Safety Philosophy – US NRC

Pursuit of safety goals via functional methods (also known as "defense-in-depth) - to achieve Safety:

- **Prevention**
  - design, build and operate systems and components to not fail.
  - stop events from occurring by quality control in all phases.
- **Mitigation**
  - limit the consequences of events by providing systems that are redundant and diverse.
- **Containment**
  - limit radioactivity release during events by providing multiple physical barriers.
- **Emergency response**
  - limits consequences of events(through effective mitigation).

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Nuclear Safety Philosophy

- **Safety Culture (INPO definition)**
  - **"An organization's values and behaviors – modeled by its leaders and internalized by its members – that serve to make nuclear safety the overriding priority"**

INPO= Institute for Nuclear Power Operations

Safety Culture – IAEA Definition

- **IAEA Defines Safety Culture as**

"that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance"

References:
1. *INTERNATIONAL ATOMIC ENERGY AGENCY, The Management System for Facilities and Activities, IAEA Safety Standards Series No. GS-R-3, IAEA, Vienna (2006).*
2. *INTERNATIONAL ATOMIC ENERGY AGENCY, Application of the Management System for Facilities and Activities, IAEA Safety Standards Series No. GS-G-3.1, IAEA, Vienna (2006).*

Nuclear Security - Definition

- **Internationally accepted definition:**

  Nuclear Security: "Prevention and detection of, and response to sabotage, unauthorized access, or other malicious acts involving nuclear material, other radioactive substances or their associated facilities."

- **Includes:**
  - **Nuclear Security Culture**
  - **Human Reliability Programs**
  - **Physical protection systems (PPS)**
- **Will briefly discuss the first two**
- **Consider impacts on – and synergies with – nuclear safety…**

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IAEA Guide: Nuclear Security Goals

- **One of the goals of the IAEA nuclear security program is to provide guidance and assistance to help Member States establish a strong nuclear security culture**
  - **Facilitate and optimize human aspects in national nuclear security programs of Member States**
- **Enhanced nuclear security culture**
  - **Provide greater assurance that the entire nuclear security system will accomplish its functions**
    - Prevent, detect, delay and respond to
      - **theft, sabotage, unauthorized access, illegal transfer or other malicious acts**

Reference: IAEA NUCLEAR SECURITY SERIES No. 7; Nuclear Security Culture, Implementing Guide; September 2008.

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Nuclear Security Culture

- IAEA Guide explains the basic concepts and elements of nuclear security culture and how they relate to arrangements and policies for other aspects of nuclear security
  - Provides an overview of the attributes of nuclear security culture,
  - Emphasizing that nuclear security is ultimately dependent on individuals: policy makers, regulators, managers, individual employees and - to a certain extent — members of the public.

http://www.canberra.com/products/730.asp

Reference: IAEA NUCLEAR SECURITY SERIES No. 7; Nuclear Security Culture, Implementing Guide; September 2008.

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Nuclear Security Culture - Definition

- **IAEA Guide Definition**

"The assembly of characteristics, attitudes and behavior of individuals, organizations and institutions which serves as a means to support and enhance nuclear security."

Nuclear security: The prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear or other radioactive substances or their associated facilities. It should be noted that 'nuclear security' includes 'physical protection', as that term can be understood from consideration of the Physical Protection Objectives and Fundamental Principles, the CPPNM* and the Amendment to the CPPNM.

*** CPPNM: Convention on the Physical Protection of Nuclear Material**

Reference: IAEA NUCLEAR SECURITY SERIES No. 7; Nuclear Security Culture, Implementing Guide; September 2008.

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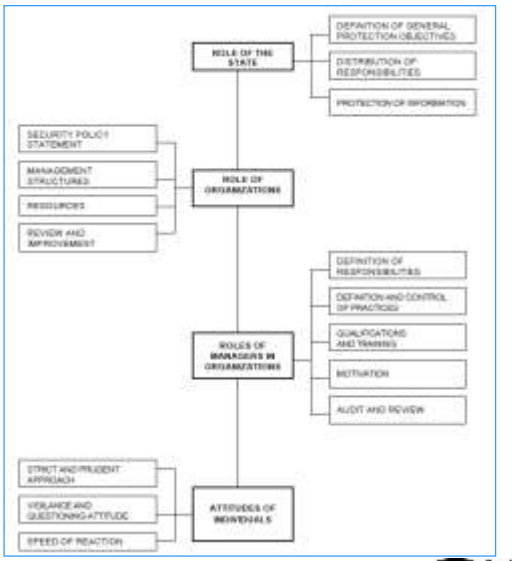
Nuclear Security - IAEA's Perspective

Features of Nuclear Security Culture

Universal Features of Nuclear Security Culture



Reference: IAEA NUCLEAR SECURITY SERIES No. 7; Nuclear Security Culture, Implementing Guide; September 2008.

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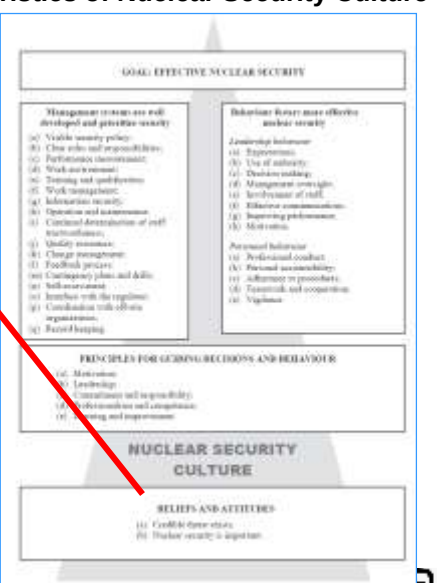
Nuclear Security - IAEA's Perspective

Characteristics of Nuclear Security Culture

Characteristics of Nuclear Security Culture

BELIEFS AND ATTITUDES
(a) Credible Threat Exists
(b) Nuclear Security Is Important

Individual Safety and Security Culture



Reference: IAEA NUCLEAR SECURITY SERIES No. 7; Nuclear Security Culture, Implementing Guide; September 2008.

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Relationship Between Nuclear Security and Nuclear Safety Culture – IAEA Perspective

- "Both nuclear safety and nuclear security consider the risk of inadvertent human error.."
- "The principal shared objective of security culture and safety culture is to limit the risk resulting from radioactive material and associated facilities."
- "This objective is largely based on common principles, e.g. a questioning attitude, rigorous and prudent approaches, and effective communication and open, two way communication."

Reference: IAEA NUCLEAR SECURITY SERIES No. 7; Nuclear Security Culture, Implementing Guide; September 2008.

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Security vs. Safety 'Culture'

Security

- **IAEA Definition:** ***the assembly of characteristics, principles, attitudes and behaviour of individuals, organizations and institutions which serves as a means to support and enhance nuclear security***
- **Emphasizes:**
  - **Deliberate acts**
  - **Involves a wider range of organizations**
  - **Considers deterrence**

Safety

- **IAEA Definition:** ***that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance***
- **Emphasizes:**
  - **Health protection of workers, public, and environment**
  - **Considers non-deliberate accidents**
  - **Transparency**

They both share the key principal of *limiting the risk resulting from radioactive materials and their associated facilities.*

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Nuclear Security
Introduction – Human Reliability

- **Nuclear energy programs are strategic interests (assets) of nations**
- **Security of such strategic assets includes technical systems *AND* human performance considerations**
  - **Such human performance considerations are an extension of nuclear security culture often referred to as "*human reliability programs*" (HRP) or "*personnel reliability programs*" (PRP)**

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Nuclear Security –
Definition of Human Reliability Program (HRP)

- **No international standardized definition exists, but most HRP definitions include the following concepts:**
  - **a safety and security program**
  - **designed to ensure highest standards of reliability and physical and mental suitability**
  - **in individuals who occupy positions affording access to**
    - nuclear materials
    - nuclear-related facilities
    - nuclear-related programs/information
- **HRPs safeguard personnel, information, and operations through continuous evaluation, review, instruction, and assessment**

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Nuclear Security –
Human Reliability Programs (HRPs)

- HRPs are designed to evaluate the reliability and suitability of individuals in job functions that afford access to:
  - nuclear materials
  - nuclear-related facilities
  - nuclear-related programs/information
- HRPs offer continual observation and awareness in order to provide security against the insider threat
- Both employees and managers have unique HRP responsibilities
- HRP-certified individuals are *critical elements* in nuclear security

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Nuclear Safety and Security Culture
Roles and Responsibilities of Individual

Proposed approach to impact Safety and Security Culture is based on a model developed by Dr. Ghanbari for the Gulf Nuclear Energy Infrastructure Institute (GNEII) Curriculum:

Individual Safety and Security Culture

BELIEFS AND ATTITUDES
(a) Credible Threat Exists
(b) Nuclear Security Is important

Approach:
- **Develop a strong Individual Safety and Security Culture, through**
- **Practicing Fair-Minded Critical Thinking, and**
- **System Analysis / Solution Approach, and**
- **Utilization of Scientific Method (of inquiry and assessment)**

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How to Impact the Nuclear Safety and Security (S & S) Culture?

- **Must impact individual's culture at the Basic Assumption level (deepest level);**
- **Make a positive impact on individual's "values, beliefs and assumptions"**
- **Utilize Fair-minded Critical Thinking to provide a process for consistent evaluation of thought process and examination of values, beliefs, and assumptions**
- ***Use Systems thinking / Approach* to develop the complex mental models required to analyze the mutual interaction of elements and components.**

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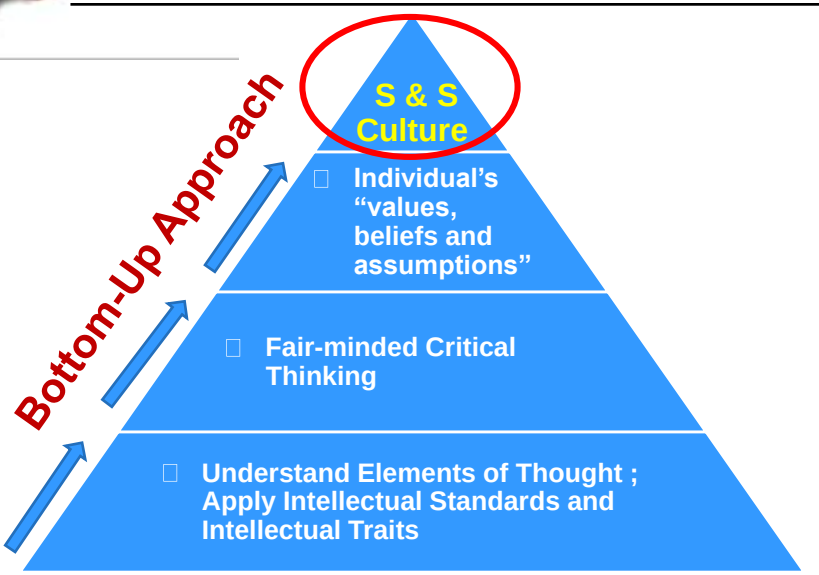
To Impact the S & S Culture



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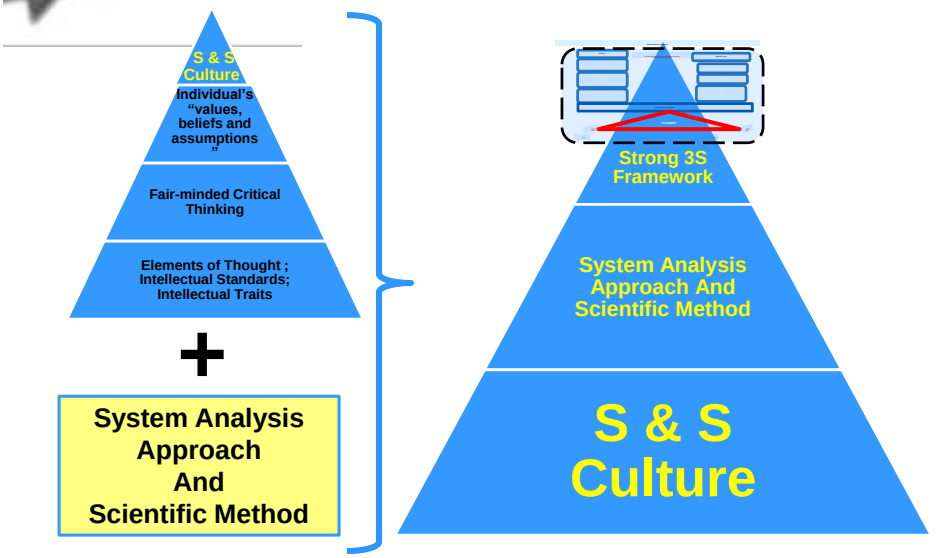
Create a Strong S & S Framework



Conclusions & Applicability to RMCC

Nuclear Safety and Security, and Capacity Building are Crucial Aspects of any nuclear program:

- **Radiological incidents can overwhelm the public safety resources of any country**
- **Preparation to respond to such incidents is crucial to minimize their impacts**
- **Most importantly, effective response to such incidents relates to national security**

RMCC's Contributions to Effective Safety & Security and Capacity Building:

- **Trained and Skilled Personnel**
- **Laboratories with Strong Quality Assurance Programs**
- **Communication – among regional laboratories**
- **Cooperation and Collaboration – regional labs**
- **Data Sharing**
- **Promotion of Strong Individual Safety and Security Culture**

References

- IAEA, *Milestones in the Development of a National Infrastructure for Nuclear Power*, NG-G-3.1, 2007
- IAEA, *Evaluation of the Status of National Nuclear Infrastructure Development*, NG-T-3.2, 2008
- IAEA, *Maximizing the Contribution of Nuclear Technology to Society While Verifying its Peaceful Use*, IAEA Primer, 08- 34361/Fact Sheets / November 2008 / E

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Shukran

Thank You

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