Nuclear Regulations & Safety

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Contents

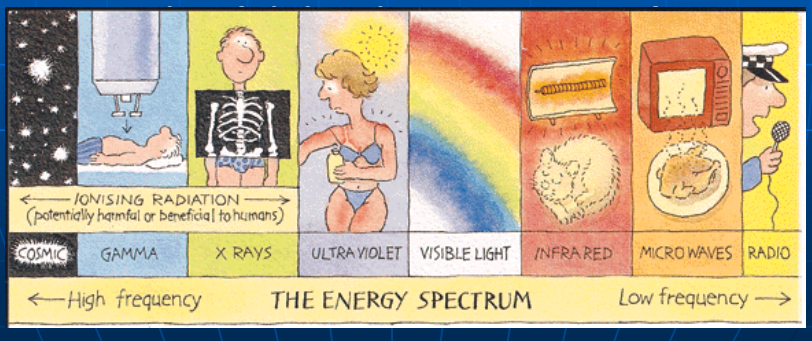
Radiation is all around us

Everything in nature, every creature
and every material contains, and
always has contained, radioactive
substances.

You are radioactive yourself,
and so is your dog,
your car,
your coffee,
and your mother-in-law.

IONIZING RADIATION

- Radiation of sufficient energy to disrupt DNA strands
- photons (X-rays, gamma rays)



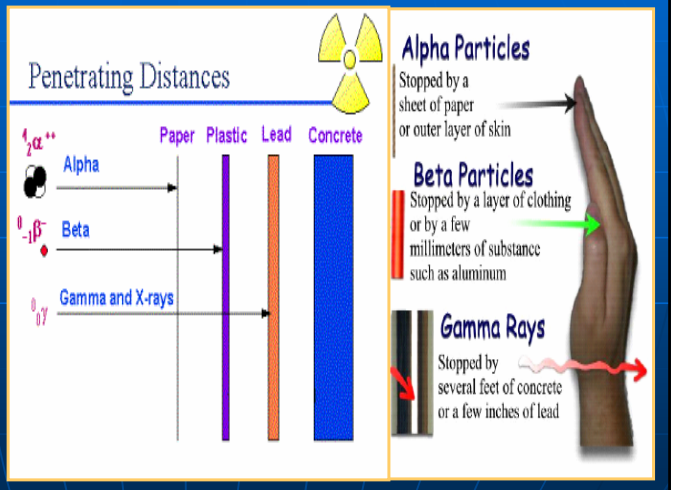
Types of Radiation

Alpha particles
^{241}Am, ^{226}Ra, ^{228}Th

Beta particles
^{3}H, ^{14}C, ^{90}Sr

Gamma rays
^{137}Cs, ^{60}Co, ^{192}Ir

Neutrons
^{252}Cf, ^{239}Pu



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Health effects & risk

The pathological effects of ionising radiation

Radiation

Energy absorbed by cells

Transformation of cells

Death of cells

Stochastic effects
- late
- constant severity

Deterministic effects
- early
- severity related to exposure

Radiation Protection

The basis for all radiation protection activities is the supposition that radiation is harmful and that the smaller the radiation doses we receive, the smaller are the risks.

Types of Radiation Source

- Sealed sources
  - external hazard
- Unsealed sources
  - external hazard
  - internal hazard

Hazards

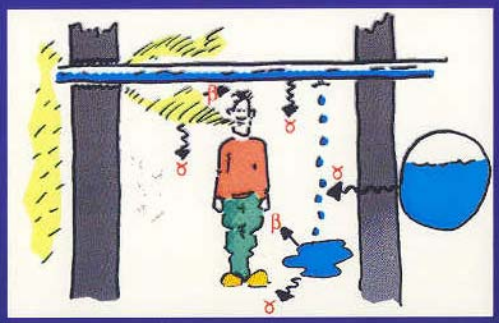
- External Irradiation
  - source
  - time
  - distance
  - shielding
- Internal Contamination
  - through ingestion
  - through inhalation
  - through a break in the skin

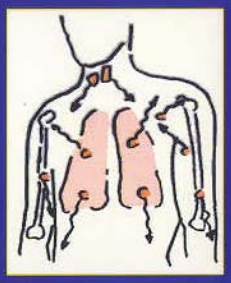
Health effects & risk

Exposure situations

External exposure

- distant sources
- skin contamination

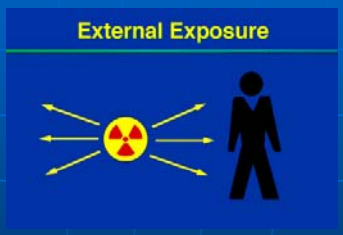




Internal exposure

Basic Radiation Protection Techniques

I. Time
II. Distance
III. Shielding



Reduce Time

Time Relationship

Exposure rate = 1 mR/hr x Time = Total Exposure

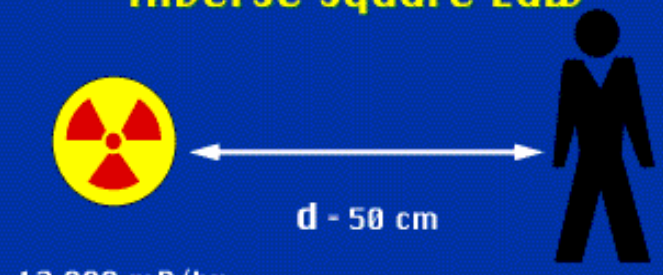
1 hour = 1 mR

2 hours = 2 mR

Increase Distance

Distance Effect

Inverse Square Law



$$D = k\,(1/r^2)$$

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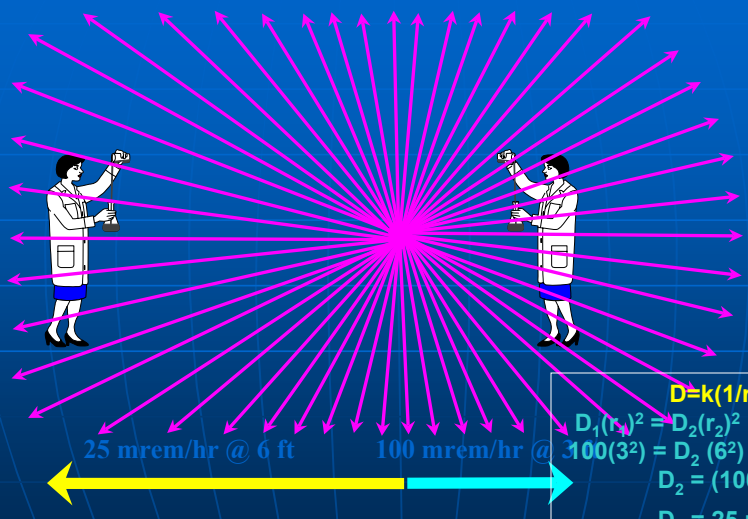
Effect of Distance on Dose Rate



$D=k(1/r^2)$

$D_1(r_1)^2 = D_2(r_2)^2$

$100(3^2) = D_2\,(6^2)$

$D_2 = (100x9)/36$

$D_2 = 25$ mrem/hr

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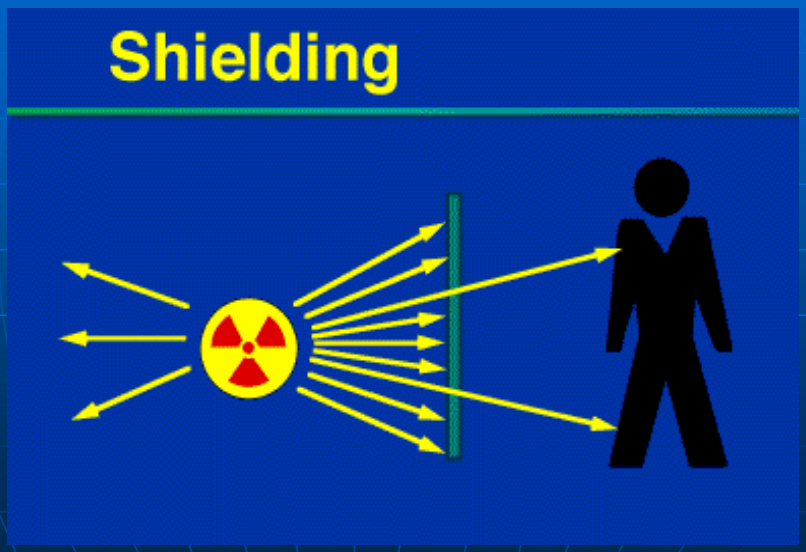
Use Shielding



Safety

- Safety
  - The condition free from harm or risk
- Risk
  - Possibility of loss or injury

Safety is a relative concept.

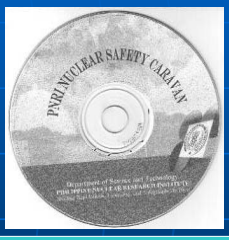
Legislative and Regulatory Framework

- Legislative Requirements
  - A legal framework is required to provide for
    - Regulation of nuclear activities, and
    - Clear assignment of safety responsibilities.
  - Legislation shall be adopted
    - To assign the prime responsibility for safety to the operating organization, and
    - To establish a regulatory body.

Safety & Security National Infrastructures

- Laws are in place, a new comprehensive law undergoing the legislative mill process
- Regulatory authorities exist, to be merged under the new law
- Rules, regulations and standards are consistent with the BSS and international best practices
- Radiation safety training are routinely provided
- Radiation protection services are available on request
- Centralized radioactive waste and spent sources management facility is operational
- Arrangements at the national level for emergency planning and preparedness are established, National RADPLAN under revision
- Linkages with relevant government agencies have been established, currently being strengthened

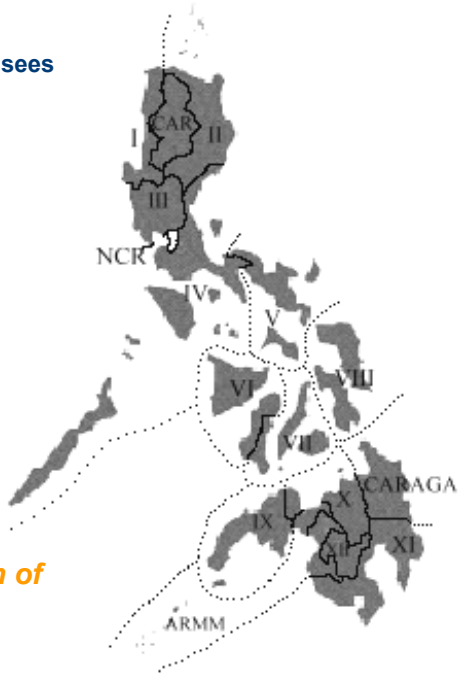
Copies of CPRs and CD



Nuclear Safety Caravan CD

Region	No. of Licensees
I	
III	
IV	
V	
VI	
VII	
VIII	
IX	
X	
XI	
XII	
CARAGA	
CAR	
NCR	
TOTAL	311

Geographical Distribution of PNRI Licenses (as of December 2009)



Nuclear Safety

- Risk Specific to Nuclear Facilities
  - Harmful effects of ionizing radiation
- Nuclear Safety Objectives
  - General nuclear safety objective, supported by two complementary safety objectives.
    - Radiation protection objective
    - Technical safety objective

Nuclear Safety Objectives

General Safety Objective

To protect individuals, society, and environment from harm by establishing and maintaining in nuclear facilities effective defences against radiological hazards

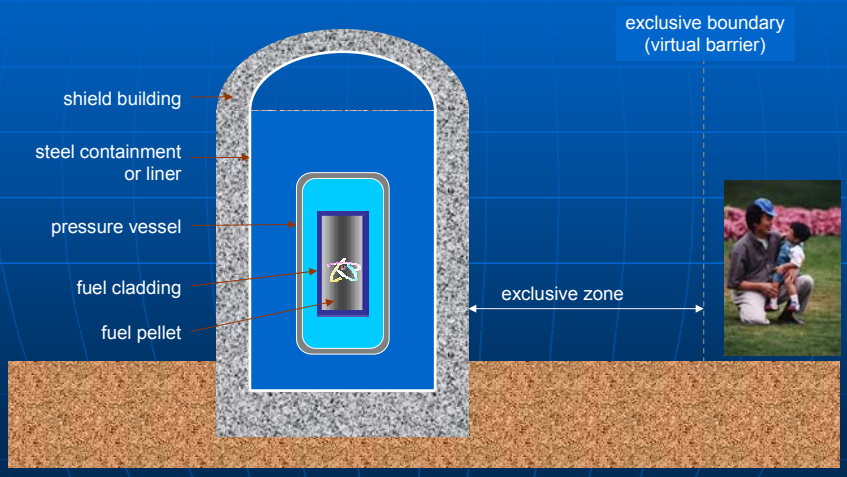
Radiation Protection Objective

- To ensure that in all operational states radiation exposure within the facility or due to any planned release of radioactive material from the facility is kept below prescribed limits and as low as reasonably achievable, and
- To ensure mitigation of the radiological consequences of any accidents.

Technical Safety Objective

- To take all reasonably practicable measures to prevent accidents in nuclear facilities and to mitigate the consequences of any accidents that do occur,
- To ensure with a high level of confidence that, for all possible accidents taken into account in the design of the facility, including those of very low probability, any radiological consequences would be minor and below prescribed limits, and
- To ensure that the likelihood of accidents with serious radiological consequences is extremely low.

Multiple Barriers against Radioactive Release



How to Achieve Nuclear Safety Objectives

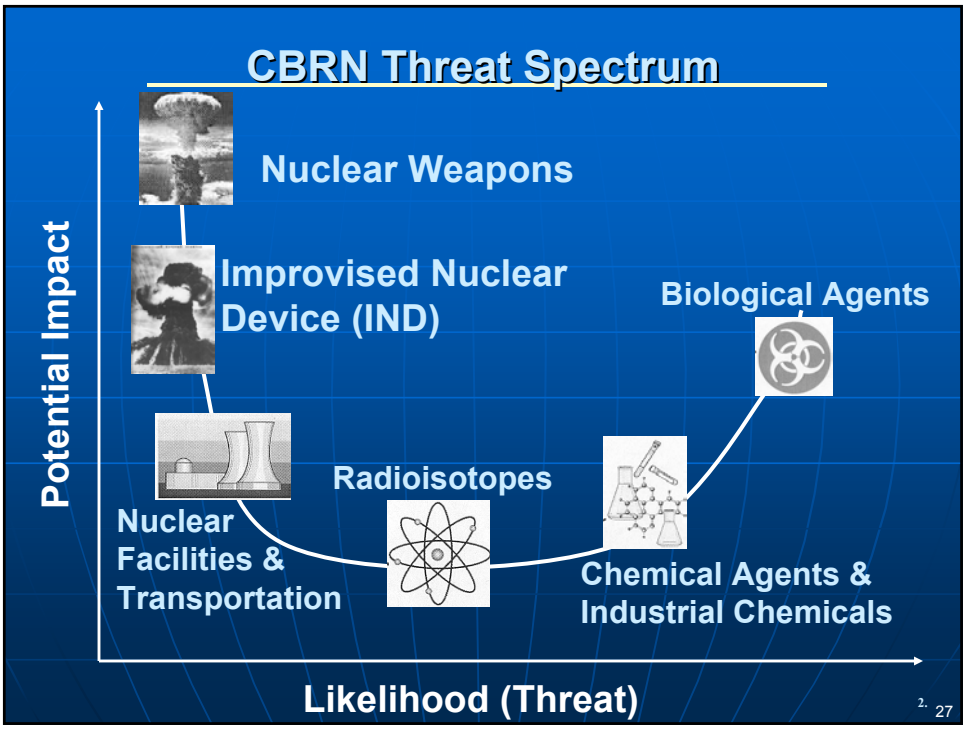
- Fundamental Principles
  - Management responsibilities
  - Strategy of defense-in-depth
  - General technical principles

Management Responsibilities

- Safety Culture
- Legislative and Regulatory Framework
  - Legislative requirements
  - Responsibility of the operating organization
  - Responsibility of the regulatory body

Good Safety Culture

- When any possible conflict in priority arises, safety and quality take precedence over schedule and cost.
- Plant changes or activities are conducted in accordance with procedures.
- When problems are identified, the emphasis is placed upon understanding the root cause of the problems and finding best solutions.
- Feedback is solicited from station personnel and contractors to help identify concerns, impediments, and opportunities to improve.



Responsibility of the Operating Organization

- The prime responsibility for safety
  - To specify its safety criteria,
  - To assure proper design, construction and operation of the facility,
  - To establish necessary procedures and fully trained staff, and
  - To control of radioactive materials.

Although the operating organization may delegate authority to carry out functions on its behalf, it cannot delegate their prime responsibility for safety.

Responsibility of the Regulatory Body

- Major Functions
  - To set safety objectives and standards,
  - To monitor and enforce them within the established legislative and statutory framework,
  - To communicate independently its regulatory decisions and opinions and their bases to the public.

An important condition is its effective independence from organizations or bodies that promote nuclear activities.

Defense-in-Depth

- Several Levels of Protection
  - Including successive barriers preventing the release of radioactive material to the environment.

- Defense-in-depth is the key concept on which all of nuclear safety is based.
- The independence of different levels of defense is a key element.

Radiation Protection

- Principle
  - A system of radiation protection practices, consistent with recommendations of the ICRP and the IAEA, is followed in the design, commissioning, operational and decommissioning phases of nuclear power plants.
- Implementation
  - Provide measures for radiation protection in normal, abnormal, and accident conditions
    - Radiation protection is considered in the design process.
  - Prepare guidelines and procedures for radiation protection
  - Monitor plant conditions and the maintenance of a clean orderly plant.

Technical Aspects of Nuclear Safety

- Siting
- Design
- Manufacturing and Construction
- Commissioning
- Operation
- Radioactive Waste Management & Decommissioning
- Accident Management
- Emergency Preparedness

Verification of Nuclear Safety

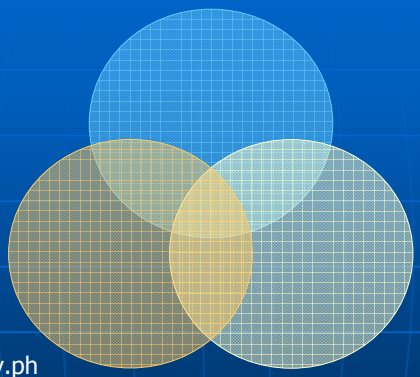
- Related Activities over a Nuclear Facility's Lifetime
  - Application of quality principles at all stages,
  - Independent assessment of the safety of the design
  - Review of site related factors,
  - Review of tests during construction and commissioning,
  - Continuous monitoring and inspection,
  - Assessment of the hardware modification, and
  - Review of failures/events important to safety.

Verification of Nuclear Safety

(Cont'd)

- Responsibilities of the Operating Organization
  - Perform activities to verify safety, and
  - Carry out systematic reviews of safety
    - To confirm that the safety analysis for the facility remains valid, and/or
    - To implement safety
- Responsibilities of the Regulatory Body
  - Review the program for systematic safety assessment of the operating organization, and
  - Monitor that the facility is operated within the bound of its safety analysis at all times.

Thank you for your attention



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