Control of radioactive sources and exposures to ionizing radiation

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**Scope of the presentation**

- **Accidents:**
  - with sources during use
  - with sources not in use (loss of control of sources)

- **Unnecessary exposures:**
  - not justified
  - not optimized

**Legacy activities**

Accidents involving radiation generators and radioactive sources

- Industrial radiography
- Well logging
- Irradiators
- RTG’s
- Industrial gauges

Accidents with industrial irradiators

*El Salvador (1989)*

Workers over-ride safety systems and enter irradiation room when source rack is unshielded and manipulate it.
Orphan source from industrial radiography
Yanango, Peru (2000)

A welder finds unshielded source, picks up source and puts it in the back right pocket of his trousers.

Ir-192 source used for industrial radiography became detached from the camera.

Severe radiation burns and amputation of a leg

Orphan source from teletherapy
Goiania, Brazil (1987)

Private radiotherapy clinic closed down in 1985

1987: teletherapy head stolen and dismantled for scrap

A 50 TBq (1375 Ci) caesium-137 teletherapy machine left abandoned

Cs-137 source capsule ruptured causing major contamination, 4 deaths, buildings demolished and costs US$20 million

Orphan source from RTG
Lja, Georgia (2001)

December 2001: woodcutters find 2 hot 'objects' in the forest. (unshielded Sr-90 sources about 1,000 TBq each)

The back of patient 2-MG on 6 Jan.2002
Radiotherapy patients overexposed
Costa Rica (1996)

Incorrectly calibrated Co-60 teletherapy unit 115 patients affected

Who has been exposed

- Workers
  - industrial radiography
  - irradiators (radioactive sources and accelerators)
- Public
  - orphan sources
- Patients
  - misadministration of radio-pharmaceuticals
  - miscalibration/miscalculation of dose for radiotherapy
  - brachytherapy sources left in patient
  - overexposure during interventional procedures

Unnecessary exposure to radiation (1)

- Whole-body CT scan sold as a "preventative health measure"
- Workers and public scanned for theft (e.g., diamond mines)
- X Ray machine (for shoe fitting 1930-1950)
Unnecessary exposure to radiation (2)

Mismanagement of radioactive effluents and waste, mine residues, consequences of nuclear and radiological accidents

What can be the reasons?

- Human error (complacency)
- Lack of defense-in-depth
- Ineffective safety systems (not provided or not maintained)
- Lack of monitoring
- Lack of procedures (or not followed)
- Poor maintenance of devices
- Lack of supervision
- Lack of education and training
- Lack of safety culture
- Ineffective regulatory control…..

What can be done?

Many accidents and/or unnecessary exposures could be prevent through:
- improved education and training
- fostering a safety culture and raising awareness
  - at the political level
  - among public and workers not normally involved with radiation sources
- strengthening legal and regulatory infrastructures
How can IAEA help?

- Facilitate international undertakings such as the Code of Conduct, Joint Convention
- Develop Safety Standards: Global Safety Regime
- Collect and disseminate information on accidents and unnecessary exposures
  - International Conferences
  - Reports

Code of Conduct on the Safety and Security of Radioactive Sources

- Non-binding international instrument based on International Standards
- Provides recommendations to States on:
  - Legislation
  - Regulations
  - Regulatory body
  - Import/export controls

Political support - November 2008

- Code of Conduct: 93 States have provided written political support
- Import/export Guidance: 51 States have made the additional political commitment for its harmonised implementation
Joint Convention
46 Contracting Parties in 2008

The IAEA Safety Standards

- The safety standards series comprises three levels of documents:
  - Safety Fundamentals
  - Safety Requirements
  - Safety Guides

- Cf. Supporting documents
  - Safety Reports
  - Technical Reports
  - TECDocs

Sharing information
International Conferences
IAEA can also help…

- Assist Member States to:
  - Apply the Safety Standards and Implement the Code of Conduct and imp/exp controls
  - Establish and maintain an effective national regulatory infrastructure
  - Develop sustainable education and training
  - Appraise through review services such as RaSSIA/IRRS
  - Regain control on orphan and vulnerable sources

Strengthening National Regulatory Infrastructures

- Assessment of the status of Member State’s regulatory infrastructure through appraisal missions and self-assessments
- Strengthening the establishment and maintenance of national registers of radiation sources through the Regulatory Authority Information System (RAIS).
- Development of model procedures to be used by regulatory bodies.
- Development of Training material for regulators and organising courses for staff, lawyers, custom officers, etc.

The Nuclear Safety Regime applied to Radioactive Waste Management

The Joint Convention
International Safety Standards
National Policy and Strategy
National Regulator Control
### Peer Review and Appraisal Services

Provide Member States with assurance that their strategies, policies and operations comply with International Standards and Best Practices. Give independent assessments of radiological conditions.

### International Peer Review Service on Decommissioning: Bradwell NPP

- Initiated at the request of Magnox, UK
- Powerful method of self-improvement and sharing experience
- Complementary to OSART, IRRS, WANO services
- IAEA Methodology and supporting documents tested

First “pilot” review mission to Bradwell NPP (UK) June 2008

Joint EC-IAEA-Ukraine project (15 WWERs Units) 2009

### Regain control on orphan and vulnerable sources

- Facilitating multilateral initiatives, such as USA/Russia/IAEA ‘Tripartite’ agreement
- Radiation monitoring at national ‘nodal’ points, such as scrap metal facilities and ports
- 1000’s of vulnerable, orphan and disused sources have been recovered, but...
  - There is a lack of national storage facilities for sources
  - A safe and secure long-term disposal solution is needed
Safety Assessments Intercomparison and Harmonization for RadWast

- **SADRWMS**: Safety Assessment Driving Radioactive Waste Management Solutions (2004-on going)
- **ASAM**: Application of safety assessment methodology—near surface repositories (2002-2007)
- **GEOSAF**: Application of safety assessment (Case) methodologies for geological repositories (2008-)
- **EMRAS**: Environmental Modelling for Radiation Safety (2003-2007)
**Priority Areas**

- Assisting MS for prevention of accidents and unnecessary exposures in medicine
- Assisting MS in the application of safety standards in the U mining industry: from exploration to closure
- Assisting MS to identify and implement solutions to minimize denial and delay of shipment of radioactive material

**Summary**

- Inadequate control of radioactive material has caused many serious accidents and unnecessary public exposure
  - Orphan sources are a major concern
  - Radioactive waste are not always managed up to disposal
  - Contaminated sites are not always remediated
- IAEA helps Member States to:
  - Establish and maintain effective National Regulatory Infrastructures
  - Adopt and apply the International Safety Standards
  - Implement Conventions and Code of Conduct
  - Develop sustainable education and training
  - Increase safety culture and public/political awareness

**Government commitment is Key**