

# Worldwide Action by the IAEA to Improve the Management of Disused Sealed Radioactive Sources (DSRS)

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WM 2013, 27 February 2013



**IAEA**

International Atomic Energy Agency

# Why is better management of DSRS needed?

- **DSRS in virtually all countries – millions in use and disused around the world.**
- **Some sources not properly controlled – lack of safe, secure, and sustainable management options for the long-term**
- **Loss of control and theft (about 375 sources yearly in the US alone)**
- **Socio-political problems can preclude proper long-term management**
- **Serious consequences of exposures**



# DSRS in the Public Domain



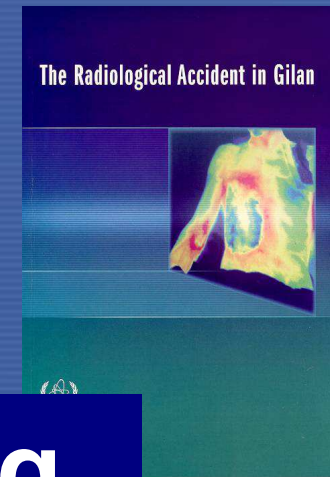
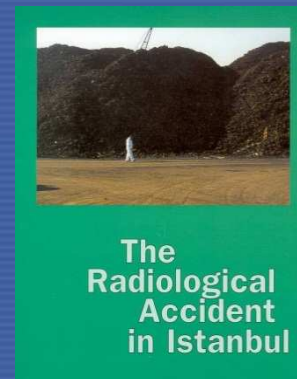
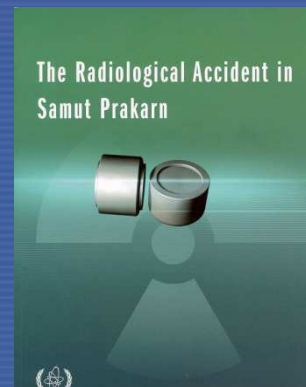
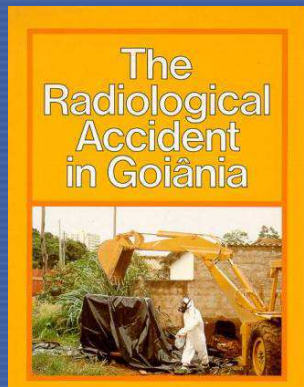
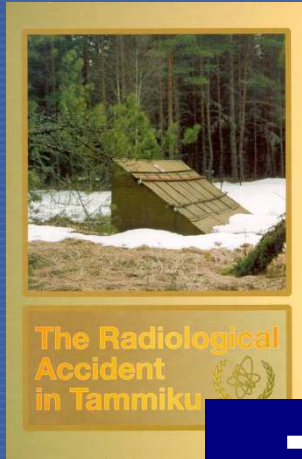
**... completely unsecured! ...**



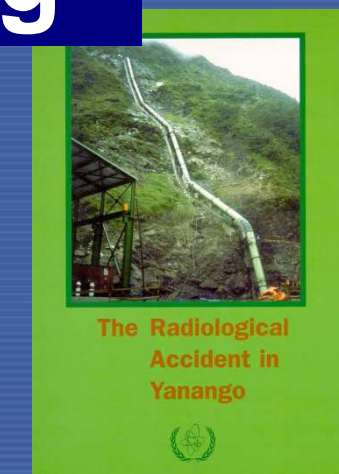
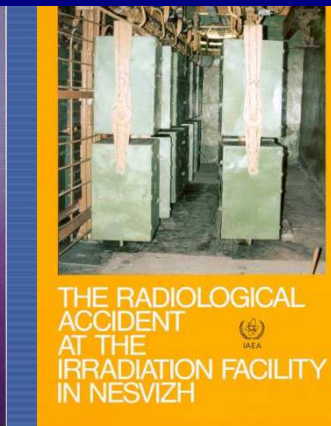
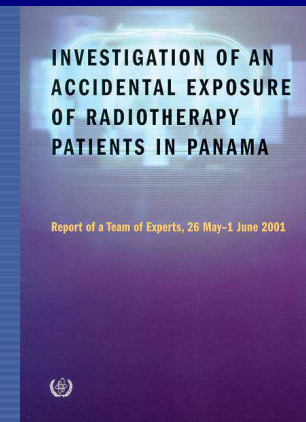
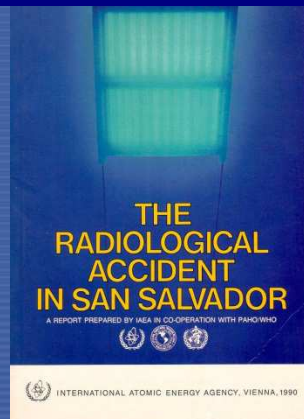
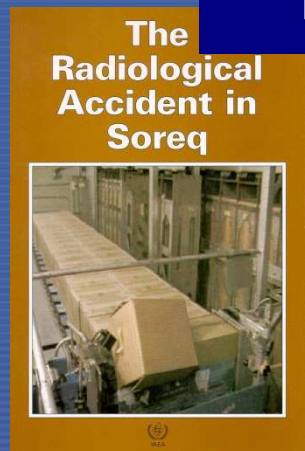
# Loss and theft - Where are the sources?



# Serious Consequences - IAEA Accident Reports



## The Tip of the Iceberg





# Accident Consequences

- 2010 – Delhi, India – Disused irradiator sold as scrap, cut open. One fatality, eight hospitalized.
- 1998 – Turkey – Disused Cobalt-60 radiotherapy sources sold as scrap. 18 hospitalized, including 7 children.
- 1987 - Goiania, Brazil - Disused Cs-137 source stolen, opened. 4 fatalities, 20 hospitalized, 113,800 examined. Cleanup cost > US\$20 million.



# Inadequate Source Stores



Eventually, sources became *unnneeded* and *disused*; where no disposal path exists, thousands have been simply *abandoned!*



# Acknowledgement of the Problem

*“Taking into account that radioactive sources are widely used and can be vulnerable to malicious acts, we urge States to secure these materials, while bearing in mind their uses in industrial, medical, agricultural and research Applications.” Nuclear Security Summit Communique, Seoul, 2012*

*"There is nothing [terrorists] would like better than to cause the panic that the detonation of a radiological dispersal device would create. We know from experience with accidental releases of radiological sources that they can cause widespread panic, economic hardship, and significant health concerns.... It is our responsibility to determine how to prevent such an attack in the first place..." – US Energy Secretary Spencer Abraham, IAEA Conference 2003*

*Some sealed sources could be used “...as dirty bombs, resulting in economic impacts in the billions of dollars and significant social disruption. ...the longer sources remain disused or unwanted, the chances increase that they will become unsecured or abandoned.” “Sealed Source Disposal and National Security,” Removal and Disposition of Disused Sources Focus Group (US DHS), 2009.*



# IAEA Mandate to Address Problem

- UN Security Council (UNSC) resolutions 1540 (2004) - refers to the Convention on Physical Protection of Nuclear Materials (CPPNM) and the IAEA Code of Conduct - sets out State obligations to address weapons of mass destruction, including securing weapons-usable material “in production, use, storage or transport.”
- Article III of IAEA Statute - authorizes IAEA “to establish or adopt standards of safety for protection of health and minimization of danger...and to provide for the application of these standards.”
- Code of Conduct on the Safety and Security of Radioactive Sources - Major non-binding instrument covering sealed source topics
- Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management – requires that parties “ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner” and “allow for reentry into its territory of disused sealed sources” under certain conditions.
- 2012 NSS - reaffirmed “the essential responsibility and central role of the IAEA in strengthening the international nuclear security framework” and encourages “States...and the nuclear industry to increase voluntary contributions to the IAEA’s Nuclear Security Fund.” Urges IAEA/states to secure sources and cooperate to “recover missing sources...and to maintain control over disused sources.”

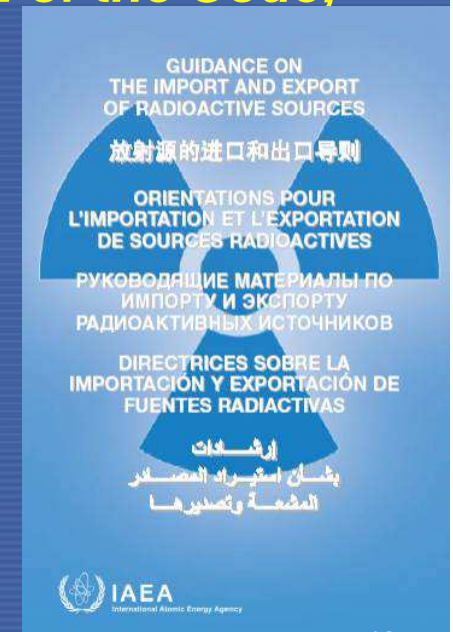
# Code of Conduct - Basic Principles

States should take appropriate measures to ensure that radioactive sources are kept safe and secure throughout their whole life-cycle (recognizing that the prime responsibility is with the authorized user)

This requires:

Effective national legislation, regulations and a regulatory body **paragraphs 7–22 of the Code;** and

Effective import/export controls **paragraphs 23-29 of the Code + supplementary Guidance**





# IAEA Safety-Related Activities

- Develop guidance documents published in the IAEA Nuclear Safety Series. To date, 9 Safety Series documents addressing safety for sealed radioactive sources (both in use and disused)
- Conduct conditioning operations on Cat 3-5 sources for safe and secure longer-term storage
- Assist regulatory bodies in strengthening their activities. Examples are:
  - Self-Assessment of Regulatory Infrastructure for Safety (SARIS) - to facilitate States' compliance reviews with IAEA Safety Standards;
  - Regulatory Authority Information System (RAIS) - to maintain the national register of sources and related regulatory information;
  - Control of Sources Network (CSN) - designed for regulators to enhance the sharing of knowledge and experience in maintaining effective systems for regulatory control of sealed sources
  - Regulatory review services, including Integrated Regulatory Review Service (IRRS) and advisory missions, and review of radiation safety regulations
- Legislative assistance and international teams of experts with advice and services to facilitate adherence to international legal instruments and support States in adopting implementing legislation.

# IAEA Security-Related Activities

- Secures, removes, or “...returns to original supplier radioactive sources which are outside of regulatory control” (2010-2013 NSP) and vulnerable sources. Conditions and removes higher-activity sources and aggregations (Cat 1-3) – funded by contributions to the NSF;
- Evaluates security systems using International Physical Protection Advisory Service (IPPAS) missions, other vehicles. Tailors services to State needs and “synergies between the regulatory aspects of safety, security and safeguards will be taken into account.”
- Develops with MS and uses Integrated Nuclear Security Support Plans (INSSPs), which delineate major security actions to be implemented, generate resources for implementation, and contain activities needed for infrastructure-building, as well as addressing sustainability (2010-2013 NSP);
- Provides direct assistance to strengthen physical protection of existing facilities;
- Develops State systems for accounting/registry of “other radioactive material”;
- Initiated new international Radioactive Source Security Working Group (IRSSWG) to “foster better coordination of assistance related to protection and control of radioactive sources” under bilateral/other programmes with IAEA Nuclear Security Plan actions.
- Published 3 guidance documents for radioactive sources in IAEA Nuclear Security Series.
- Training – As of 2012, “IAEA has trained over 10,000 people in more than 120 countries in nuclear security and helped to improve security at around 110 facilities”



# IAEA Information and Technology in Development

- Published 11 technical documents on proper management and conditioning of sealed sources, particularly DSRS
- Annual “Code of Conduct” meetings to exchange information on implementation
- Maintained the International Catalogue of Sealed Radioactive Sources and Devices (<http://nucleus.iaea.org/CIR/CIR/ICSRS.html>)
- Compiled data offered by manufacturers and countries on location and characterization of possible DSRS
- Developed new technologies to improve management of DSRS, including mobile hot cell and storage shield for higher activity DSRS and borehole disposal concept

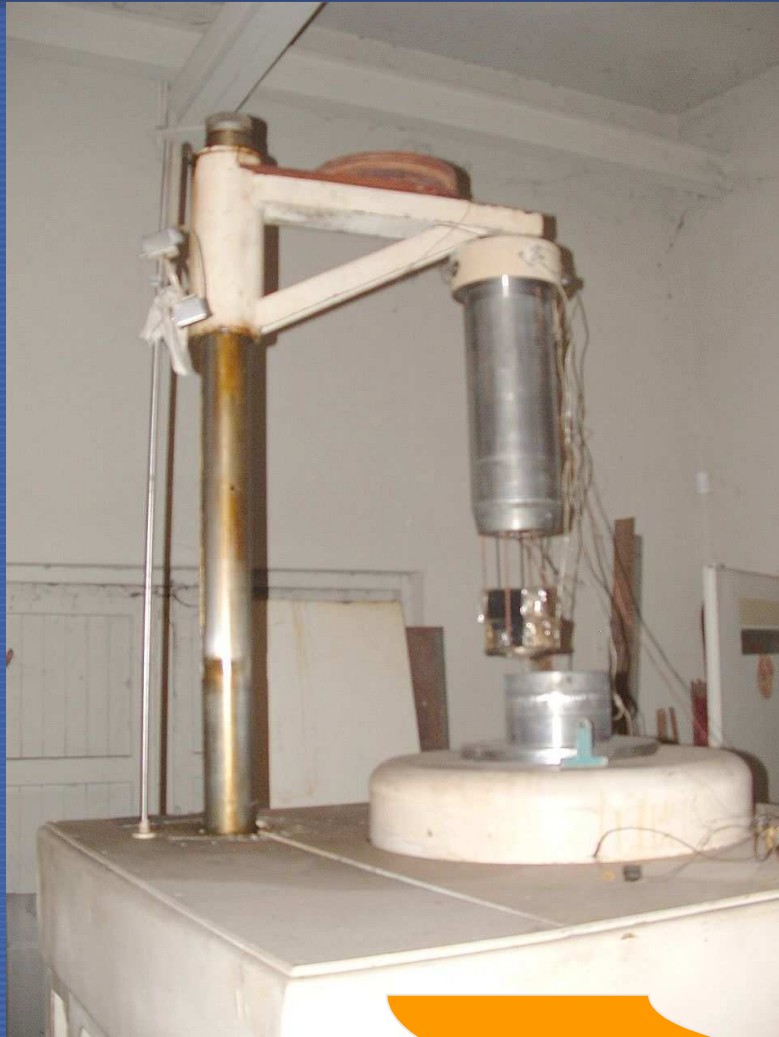


# Research Irradiator Body being moved





# Dismantling, Transport and Storage



Apartments nearby



Near the centre of a major Capital City

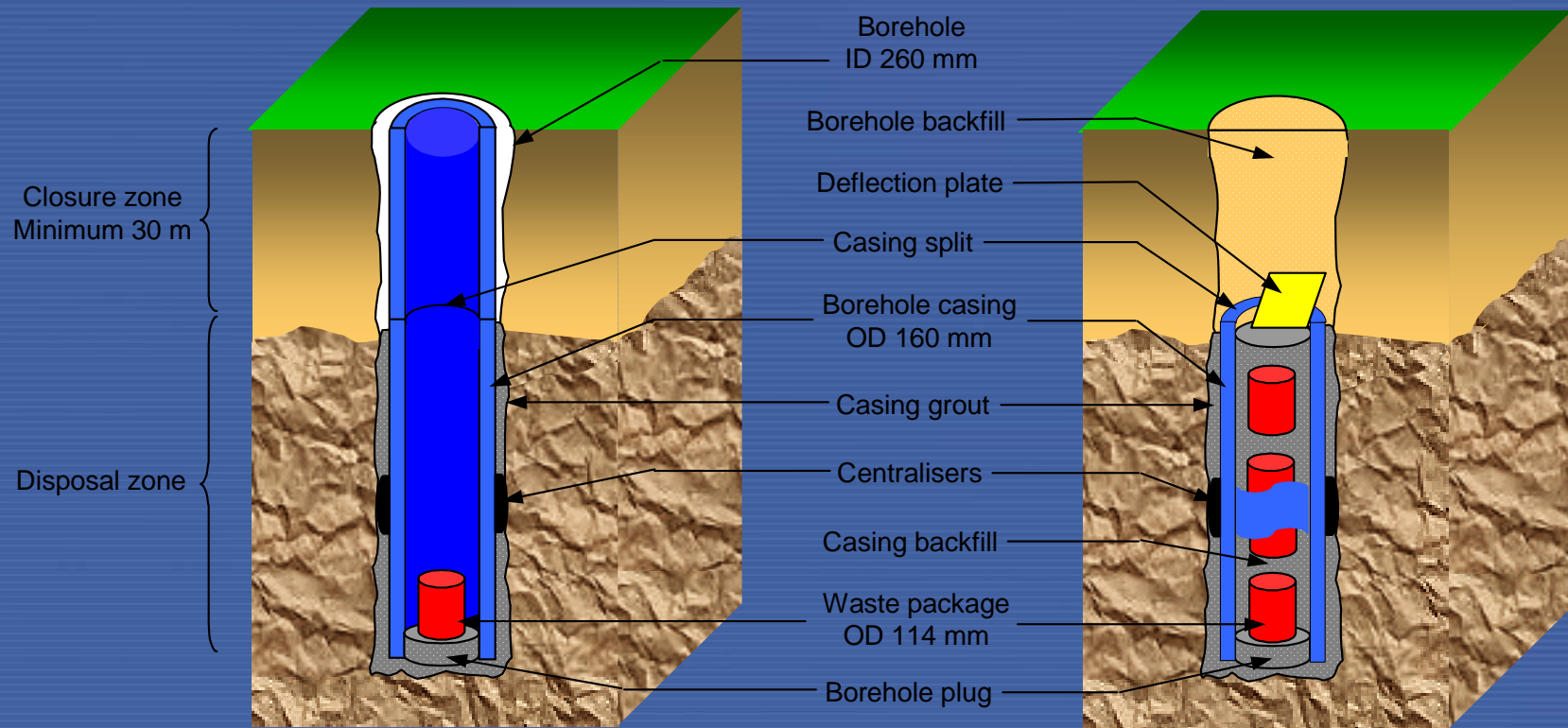
# Technologies developed through IAEA – Mobile Hot cell



Mobile Hot Cell – used to remove and condition high activity sources in devices



# Technologies, cont'd – Borehole Disposal



**Generic Post-Closure Safety Assessment demonstrated that the concept provides an appropriate degree of long-term safety for the vast majority of systems, scenarios, and radionuclides**



# Results of Source Recovery Activities

- Following the 9/11 terrorist attacks and increased recognition of security threats posed by DSRS, the Tripartite Initiative secured about 60,000 Ci in 6 FSU countries;
- Since 2006, 238 DSRS (80 Cat 1-2) sources removed to country of origin from 13 countries;
- Since 2006, more than 8,400 DSRS conditioned in more than 20 countries for storage, including more than 100 Cat 1-2 sources;
- Conditioning/removal projects currently underway in 8 countries (Middle East, southeast Asia, Africa, and Central and South America)

# End of Life Challenges

- Loss of institutional knowledge leading to orphaning of source
- Knowledge management - identification of source supplier, country of origin, characterization data
- High costs of transport and availability of containers (for Type B quantities)
- Sustainability of management option (for how long?)
- Choosing best option for DSRS management - Long term storage? Disposal? Return to manufacturer?

# Conclusions and Future Work

- Much more needs to be done! Sustainable solutions and predictable funding needed
- Improve interdisciplinary problem-solving through working-level coordination group within IAEA and with donor countries through IRSSWG
- International Conference on the Safety and Security of Radioactive Sources: Maintaining the Continuous Global Control of Sources throughout their Life Cycle – 27-31 October, Abu Dhabi, UAE
- International Conference on Nuclear Security: Enhancing Global Efforts – 1-5 July 2013, Vienna  
(Security only - includes 1 session on sources)



# Additional Information

- NEFW Waste Technology Section Source Management Team:  
[http://www.iaea.org/OurWork/ST/NE/NEFW/Technical\\_Areas/WTS/sealedsources.html](http://www.iaea.org/OurWork/ST/NE/NEFW/Technical_Areas/WTS/sealedsources.html)
- Department of Nuclear Safety and Security  
<http://www-ns.iaea.org/tech-areas/radiation-safety/source.asp?s=3&l=22>
- International Catalogue of Sealed Radioactive Source and Devices  
(<http://nucleus.iaea.org/CIR/CIR/ICSRS.html>)
- Documents (see Safety and Security Publications link):  
<http://www-ns.iaea.org>
- Illicit Trafficking: The Office of Physical Protection and Material Security  
<http://www-ns.iaea.org/security/default.asp?s=4&l=33>

# Published DSRS-Related Documents

Year	Publication	Number	Series
1990	<b>Handling, Conditioning and Disposal of Spent SS (Tech Manual)</b>	<i>TECDOC Series No. 548</i>	Tecdoc
1995	<b>Methods to identify and locate spent radiation sources</b>	<i>TECDOC No. 804</i>	Tecdoc
1995	<b>Reference design for a centralized spent SS facility</b>	<i>TECDOC No. 806</i>	Tecdoc
1996	<b>Conditioning and Interim Storage of Spent Radium Sources</b>	<i>TECDOC No. 886</i>	Tecdoc
2000	<b>Handling, Conditioning and Storage of Spent SRS</b>	<i>TECDOC No. 1145</i>	Tecdoc
2001	<b>Management for the Prevention of Accidents from DSRS</b>	<i>TECDOC No. 1205</i>	Tecdoc
2002	<b>Management of Spent High Activity Radioactive Sources (SHARS)</b>	<i>TECDOC No. 1301</i>	Tecdoc
2003	<b>Management of Disused Long Lived SRS (LLSRS)</b>	<i>TECDOC No. 1357</i>	Tecdoc
2003	<b>Safety Considerations in the Disposal of Disused Sealed Radioactive Sources in Borehole Facilities</b>	<i>TECDOC No. 1368</i>	Tecdoc
2004	<b>Code of Conduct on Safety and Security of Radioactive Sources</b>	<i>None</i>	None
2005	<b>Disposal Options for DSRS</b>	<i>Technical Reports Series No. 436</i>	Tecreports
2005	<b>Regulatory Control of Radiation Sources</b>	<i>Safety Standard No. GS-G-1.5</i>	Safety Standards
2005	<b>Categorization of Radioactive Sources - Safety Guide</b>	<i>Safety Standards No. RS-G-1.9</i>	Safety Standards
2006	<b>Safety of Radiation Generators and Sealed Radioactive Sources</b>	<i>RS-G-1.10</i>	Safety Standards
2007	<b>Identification of Radioactive Sources and Devices</b>	<i>NS Series No.5</i>	NS Series
2007	<b>Notification and Authorization for Use of RS- Supplement</b>	<i>ITECDOC-1525</i>	Safety Standards
2009	<b>Security of Radioactive Sources</b>	<i>NS Series No.11</i>	NS Series
2009	<b>Locating and Characterizing DSRS in Historical Waste</b>	<i>NE Series No. NW-T-1.17</i>	NE Series
2011	<b>Radiation Protection and Safety of Radiation Sources</b>	<i>GSR Part 3 (Interim)</i>	Safety Standards
2011	<b>National Strategy for Regaining Control over Orphan Sources and Improving Control over Vulnerable Sources</b>	<i>SSG-19</i>	Safety Standards
2011	<b>Nuclear Security Recommendations on Radioactive Material and Associated Facilities</b>	<i>NSS-14</i>	NS Series
2012	<b>Code of Conduct, Guidance on the Import and Export of RS</b>	<i>None</i>	None
2012	<b>Control of Orphan Sources and Other Radioactive Material in the Metal Recycling Industry</b>	<i>No. SSG-17</i>	Safety Standards

