

The 2021 National Academies' Study on Radioactive Sources: Applications and Alternative Technologies

Council on Ionizing Radiation Measurements and Standards
“Mitigating Challenges in Radiation Technologies”
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About the Study



- Carried out by the National Academies of Sciences, Engineering, and Medicine, an independent non-governmental organization based in Washington D.C.
- Funded by the National Nuclear Security Administration (NNSA) through a contract with Sandia National Laboratories.
- Goal to support NNSA's efforts to reduce use of high-risk radiological materials and promote use of alternative technologies.

Authoring Committee

- Independent committee of experts screened for conflicts.
- One in-person and several virtual meetings to receive information and deliberate.
- Report released June 2021.



Situational Comparison in the U.S.

RADIATION SOURCE Use and Replacement ABBREVIATED VERSION



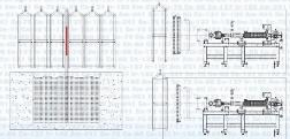
2008

- 54,000 Category 1 and 2 sources
- Interim database
- Standards for radiation protection
- Federal source recovery program
- No source replacement program
- Government did not promote alternatives

2021

- 80,000 Category 1 and 2 sources
- National Source Tracking System
- + standards for physical protection
- Federal and State programs
- Cesium Irradiator Replacement Project
- NNSA promotes alternatives

RADIOACTIVE SOURCES Applications and Alternative Technologies



Applications Examined

Medical

Blood irradiation

Research irradiation

External beam therapy

Stereotactic radiosurgery

High dose rate brachytherapy

Sterilization

Medical device sterilization

Food irradiation

Insect sterilization

Industrial

Industrial radiography

Industrial gauges

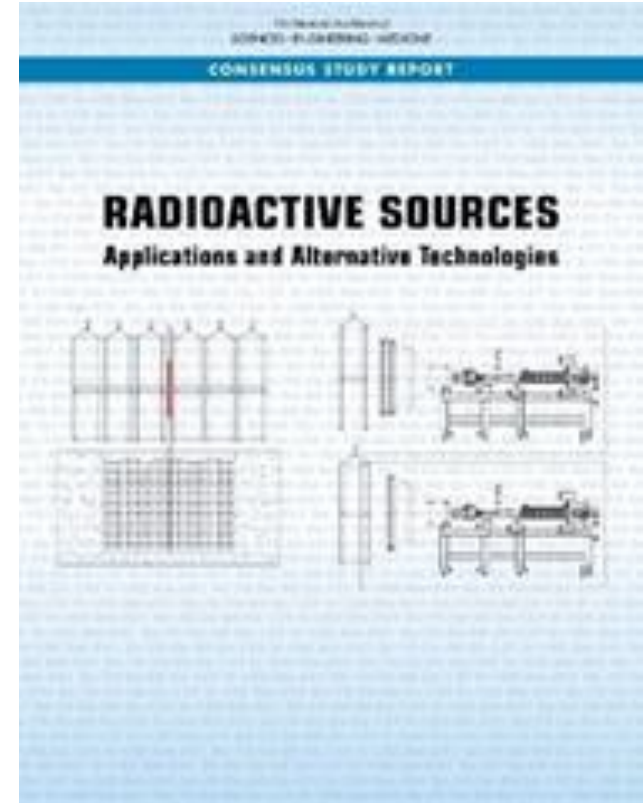
Well-logging

Calibration systems

**Radioisotope
thermoelectric generators**

The Report

- Supports national and international focus on phase out of cesium-137 in the form of cesium chloride.
- Does not attempt to prioritize replacement.
- Does not take the position that possession of *any* Category 1 to 3 radioactive sources pose an unacceptable risk to society.
- Does not endorse specific technologies or products discussed in the report.



Findings and Recommendations at a Glance

- **Reframing the IAEA radioactive source categorization system** to account for both (a) probabilistic health impacts such as development of cancer later in life and (b) economic and social impacts.
- **End-of-life management** of radioactive sources crucial for risk reduction goal of replacement of radioactive sources with non-radioisotopic alternatives.
- **Prioritization of funding for research and development** projects that aim to develop alternatives and support for equivalency studies for replacing radioactive sources.
- Research on alternatives to cesium chloride for **calibration applications**.
- Examination of the **local infrastructure and needs** prior to promoting alternatives.

About reframing the IAEA radioactive source categorization system

Recent modeling analyses of radiological events concluded that small radiation releases and small radiation exposures of populations below the levels that can cause deterministic effects may have serious and long-term economic consequences.

Various real life radiological events are supportive of this conclusion.

A safety system that is based solely on deterministic effects of radioactive sources may provide an inadequate level of protection to society.

End-of-life management

The U.S. government's risk reduction goal of replacement of radioactive sources with non-radioisotopic alternatives will not be realized until disused sources are properly removed and disposed of.

The high costs of disposal and the limited options, resources, and guidance for disposal domestically and internationally, may be prohibitive both for adoption of alternatives and for appropriate end-of-life disposal of radioactive sources.

Calibration sources and cesium chloride

The National Institute of Standards and Technology should engage with the research community as well as federal, industry, and international partners to initiate research on alternatives to cesium chloride for calibration applications.

This engagement should start immediately to prepare for the possible future elimination of the use of cesium-137 in the form of cesium chloride.

Case Studies Illustrate Challenges with Adopting Alternative Technology in LMICs

Ethiopia, Ghana, Guatemala, Nigeria, Senegal, and Zambia

Alternative technologies do not provide a “one-size-fits-all solution,” and this is particularly evident in medical applications because of the **stark disparities in access to healthcare and resources.**

Adoption of alternative technologies for cancer therapy in some low- to middle-income countries **has had unintended negative impacts on patient care** because of lack of a trained workforce, required resources, and infrastructure to make these alternatives viable options.

Promoting Alternative Technologies

- **Several organizations have raised awareness on risks and liabilities** related to radioactive sources; facilitated dialogues about performance data, costs, and challenges of adopting alternatives; and provided tools to support informed decisions.
- **No “one-stop shop” provides access to complete information on alternative technologies for different applications.**
- The IAEA has technical capabilities and access to contacts and data and *could* establish a successful alt-tech program.
- Unclear whether promoting alternative technologies is currently within the IAEA mission.

Report's Dissemination

As of early 2023
over 2300 downloads (English)
in 98 countries

<https://www.nap.edu/catalog/26121>

Translated in official UN languages

