Perspective on Cesium-137 Supply

CIRMS 2026

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CIRMS 2026 — Need

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Progress in **adpoting an alternative calibration standard to replace or augment Cs-137** is currently blocked because we lack **a coordinated, funded effort to select, develop, and test an alternative technology**, which prevents **having a widespread and agreed upon instrument calibration standard in the near future**.

Purpose Statement

- Outline history of the problem
- Present the current state of supply of ^{137}Cs sealed sources for calibration applications
- Primary focus on ^{137}Cs but may discuss other radionuclides as well
- Quickly losing access to ^{137}Cs
- Still no comprehensive replacement strategy or alternative technology

Company Overview

- Established in 1994 in Atlanta, Georgia, USA
- A small business with a single branch and 30+ employees.
- Modern manufacturing facilities include
  - CNC machining
  - Welding
  - Integration
  - Testing
- HDI designs, engineers, manufactures, and services
  - Calibration irradiator systems
  - High dose and research irradiators
  - Radiation shielding products
  - Automation systems

Background – Why ^{137}Cs became the standard

- Monoenergetic gamma emission at 661.657 keV (via ^{137m}Ba)
- Long half-life of 30.17 years
  - Minimizes replacement frequency
- Stable output
- Energy in a range relevant to occupational and environmental dosimetry
- Reduced shielding requirements compared to ^{60}Co and higher energy sources
- In the past, supply was readily available

Background – Standardization

- Many industry standards based on ^{137}Cs as the reference.
  - ISO 4037
  - ANSI/HPS N323A/B
- ^{137}Cs firmly embedded in the metrological traceability chain to
  - National metrology institutes (NMIs)
    - Secondary and tertiary calibration laboratories

Background – Existing Infrastructure

- Decades of investment and build out
- Calibration wells, beam facilities, irradiators built around ^{137}Cs sources
- Training, procedures, and quality systems based on ^{137}Cs reference fields
- Long history of intercomparison and proficiency studies

Timeline of Events

- Following September 11, 2001
  - Heightened concern about radiological dispersal devices
    - CsCl (cesium chloride) form is water-soluble and dispersible
  - IAEA Code of Conduct on the Safety and Security of Radioactive Sources
  - NRC enhanced security requirements (increased controls/additional security measures) for IAEA Category 1 and 2 sources

	Category 1	Category 2
^{137}Cs	> 100 TBq (2,700 Ci)	> 1 TBq (27 Ci)

- Historical Accidents
  - Goiânia, Brazil (1987) — abandoned ^{137}Cs teletherapy source; 4 deaths, widespread contamination
  - Other orphaned source incidents worldwide
  - Incidents provided the policy rationale for source reduction programs

Timeline of Events – cont.

- Energy Policy Act of 2005
  - provisions for alternative technology development
- 2008 National Research Council report
  - Radiation Source Use and Replacement
- NNSA Cesium Irradiator Replacement Project (CIRP)
  - actively incentivizing removal of ^{137}Cs blood irradiators
- 2019 presentation by Spencer Mickum at CIRMS
- 2021 National Academies of Sciences, Engineering, and Medicine report
  - Radioactive Sources: Applications and Alternative Technologies
- An underlying policy tension: government simultaneously requires ^{137}Cs -based calibrations while working to eliminate ^{137}Cs sources

Blood Irradiators

- Blood irradiation prevents transfusion-associated graft-versus-host disease (TA-GvHD)
- Concerted effort to replace source based with machine generated radiation sources (CIRP)
- Financial incentives from NNSA covered transition costs for many facilities
- X-ray alternatives (e.g., Rad Source RS 3400, Raycell Mk2) promoted through CIRP incentives
- Blood irradiators were the largest volume market for high-activity ^{137}Cs capsules
- Replacement drove decline in commercial demand for ^{137}Cs sources

Production Decline

- As a result of the declining need of ^{137}Cs for the blood irradiator market…
- Broadly speaking, availability of new, high activity ^{137}Cs sources for calibration has ended
- Very few global facilities were capable of production
  (historically: Mayak in Russia and Hanford/ORNL in U.S.)

Current Status

- Many customers reaching out because their existing source has reached or is nearing decay below useful activity
- Laboratories facing a very real and narrow time window to secure a quickly diminishing supply

Current Status - Market Reality

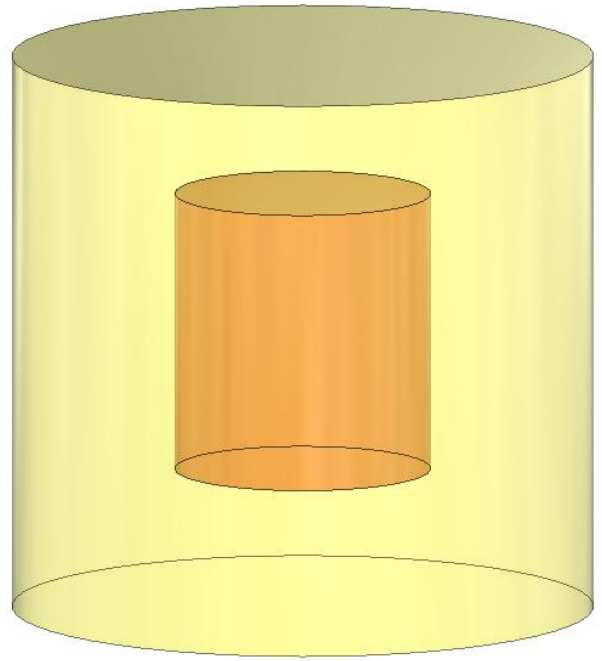
- New production Cs-137 Sources
  - Up to 50 Ci (1.85 TBq)
  - Approx max rate 60 R/hr (600 mSv/hr)*
- Recycled sources
  - 600 to 1000 Ci range (22.2 to 37 TBq)
  - Approx max rate 1200 R/hr (12 Sv/hr)*

** For open beam 30 cm from collimator face*

New ^{137}Cs Sources

- Chemical form: ^{137}Cs-ceramic
- Physical form: Radionuclide is fixed in ceramic
- Specific activity is reduced compared to older CsCl sources

50 Ci Active Volume	
CsCl	Cs Ceramic
11 mm dia x 12 mm height	25 mm dia x 24 mm height



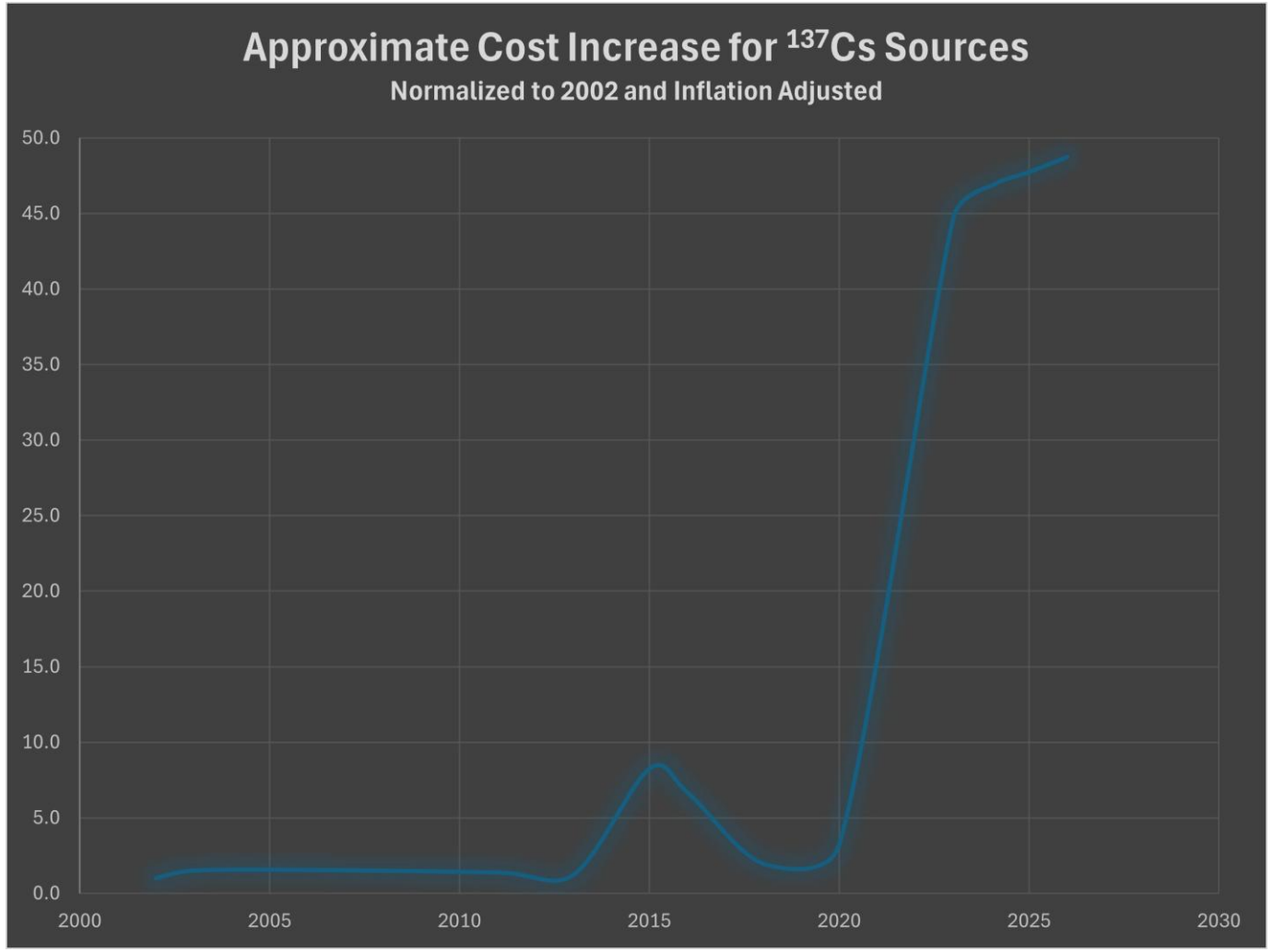
Recycled ^{137}Cs Sources

- CsCl source capsules repurposed from decommissioned irradiators
- Managed depletion
  - Limited supply currently less than 20 sources available
  - More open proposals than sources available
- Limited selection — you take what's available, not what's optimal
  - Reduced specific activity
  - Less than ideal geometry
  - Further from point source approximation
- Random variation in sizes results in increased cost for system customization
  - Custom source holders
  - Modified collimators
  - Change in shielding dimensions
  - Larger aspect ratios affect field flatness

Price Escalation

Factors

- Source material scarcity
- Consolidation/reduction of suppliers
- Increased production cost
- Increased regulatory compliance
- Source loading must be done on site
- Increase freight cost
- Reduced supply of approved Type B packages



Ageing Systems

Concerns

- Source encapsulation integrity
- Loss of special form certifications
  - > 16 Ci (0.6 TBq) ^{137}Cs in normal form capsule requires expensive Type B package for shipment
- More difficult and expensive to decommission

NASEM Findings (2021)

Report summary specific to calibration

- Highlighted the unique needs of the calibration community
- Noted that removing ^{137}Cs without validated alternatives could compromise measurement traceability and instrument performance verification

CCRI Task Group Report (2025)

- Consultative Committee for Ionizing Radiation (CCRI) at BIPM formed a dedicated Task Group on Radioactive Sources and Alternative Technologies
- Tasked with reviewing the NASEM study from the perspective of metrology and calibration
- International membership — reflects global concern

Key CCRI-RS-TG recommendations

- "Identify state-of-the-art radiation delivery capabilities within the NMI community and expand access to this technology (i.e., duplicate what is already achievable)"
- "Investigate the possibility of using kV x-rays as a reference beam – acquire, collate and analyse data from multiple systems"
- "Continue investigations of high-energy x-ray systems (as a potential alternative to Cs-137) and share information with community"
- "Liaise with international bodies and professional associations to develop a long-term vision for dosimetry protocols"

Needs Summarized

- Coordinated management of source capsules that remain in use within the calibration community
  - Transfer rather than dispose
- Urgent to find an alternative calibration standard and begin work towards standardizing and performing parallel testing

Questions?

Thank you!

References and Further Reading

1. National Research Council, "Radiation Source Use and Replacement: Abbreviated Version". Washington, DC: The National Academies Press, 2008. [Online]. Available: https://www.nationalacademies.org/projects/NRSB-O-05-03-A
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3. Consultative Committee for Ionizing Radiation (CCRI), "Report of the CCRI Task Group on Radioactive Sources and Alternative Technologies (CCRI-RS-TG)," Bureau International des Poids et Mesures (BIPM), Sèvres, France, Rep. CCRI-RS-TG, 2025. [Online]. Available: https://www.bipm.org/documents/20126/285667933/CCRI-RS-TG_report_FINAL/2d7fa4c1-0c6b-b525-8ecd-475d052fb2bb