National Nuclear Security Administration

Role of Alternative Technologies and Impact on the Use of Radioactive Sources

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Global Material Security

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Office of Radiological Security

VISION: A world free from the threat of radiological terrorism

MISSION: To enhance U.S. and global security by preventing high-activity radioactive materials from being used in acts of terrorism.

PROTECT

Protect radioactive sources used for vital medical, research, and commercial purposes.

REMOVE

Remove and dispose of disused radioactive sources.

REDUCE

Reduce the global reliance on high-activity radioactive sources by promoting the adoption and development of non-radioisotopic alternative technologies.

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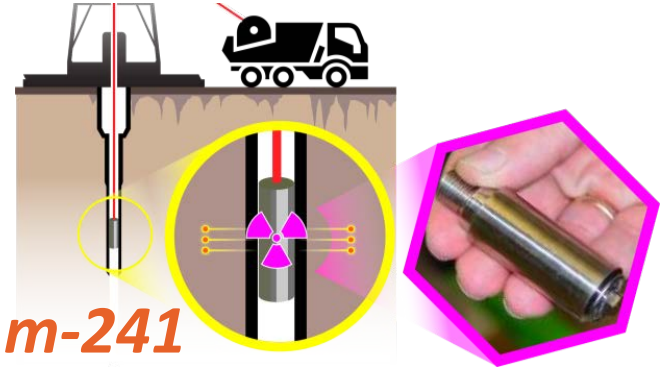
High Activity Sources

- Teletherapy and Stereotactic Radiosurgery units (cancer treatment)
- Self-shielded and panoramic irradiators (research and sterilization)

Co-60

Normal Device Activity
1,000 – 1,000,000+ Ci



Am-241

Normal Device Activity
8-20 Ci

Oil well logging
(industrial imaging)

Radiography
(industrial imaging)

Ir-192

Normal Device Activity
10-100 Ci

Cs-137

Normal Device Activity
1,000 – 50,000 Ci

- Self-shielded irradiators (e.g., blood and medical research irradiators)
- calibrators (dosimeter and detector calibration)

What Are “Alternative Technologies”?

Technologies which **do not contain radioactive materials** and which perform **an equivalent or better function** as a comparable device.

Alternative technologies may use electricity to emit ionizing radiation (**machine-based technologies**, like X-ray irradiators). Some alternative technologies, like UV pathogen reduction systems, may not emit ionizing radiation.

Medical Linear Accelerator (LINACs)

- Radiotherapy

Self-shielded X-ray Irradiators

- Research Irradiation
- Blood Irradiation
- Sterile Insect Technique (SIT)
- Seed Irradiation
- Plant Mutation Breeding

Industrial Electron Beam and X-ray

- Medical Device Sterilization
- Phytosanitary Treatment and Food Irradiation
- Plastics and Material Modification
- Wastewater Treatment

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Alternatives by Application

Commercially available, non-isotopic alternatives exist for most major applications of radioactive materials. The use of **particle accelerators** of varying specifications is key to nearly all radioisotope alternatives.

Application	Typical Isotope	Commercially Available Alternatives
Blood Irradiation	Cs-137	Yes: X-ray irradiators—5 FDA approved devices Partial: UV Pathogen Reduction (UV-PRT)
Research Irradiation	Cs-137 & Co-60	Partial: X-ray Irradiators for most research applications
External Beam Radiotherapy	Co-60	Yes: Linear accelerators (LINACs)
Industrial Sterilization	Co-60	Yes: X-Ray, Electron beam accelerators
Well Logging	Am-241 & Cs-137	Incomplete: Am-241 - alternatives available, Cs-137 – ongoing R&D
Radiography	Ir-192, Cs-137, Co-60, Se-75	Yes: X-ray

ORS is also investigating **new applications of radioisotopes and accelerator-based replacements,** including **environmental remediation and Sterile Insect Technique.**

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Ionizing radiation technologies in non-power applications can address several UN Sustainable Development Goals.

To minimize radiological security risk across various important applications of ionizing technologies, ORS supports the development and adoption of alternatives to high-activity radioactive sources in the United States and internationally.

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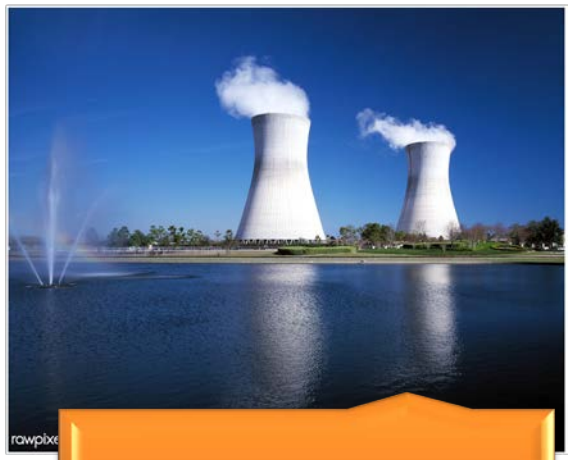
Why Alternative Technologies?



Supply Chain

Financial Considerations

Sustainability

Security

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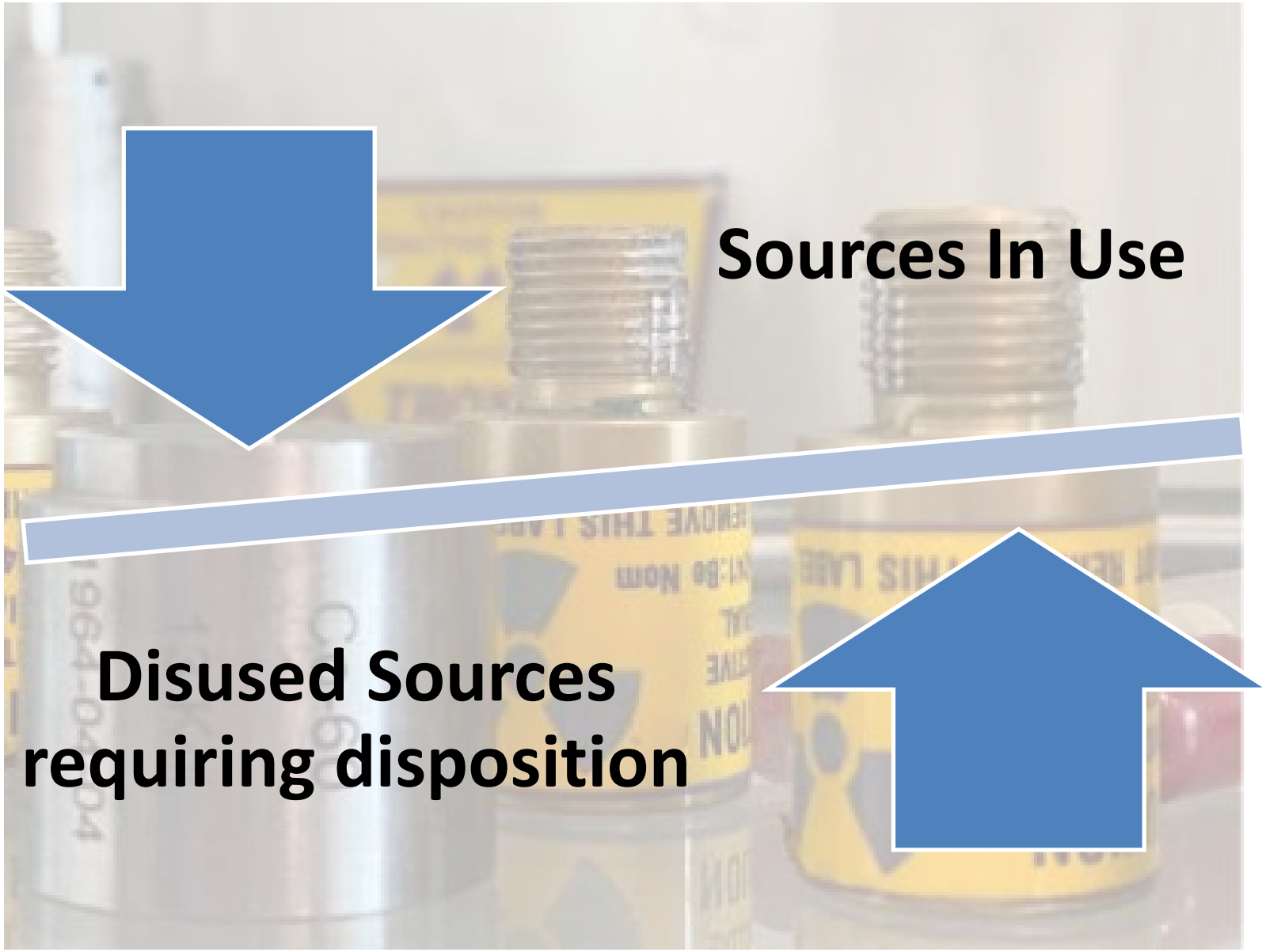
Impact on the Use of High Activity Sealed Sources



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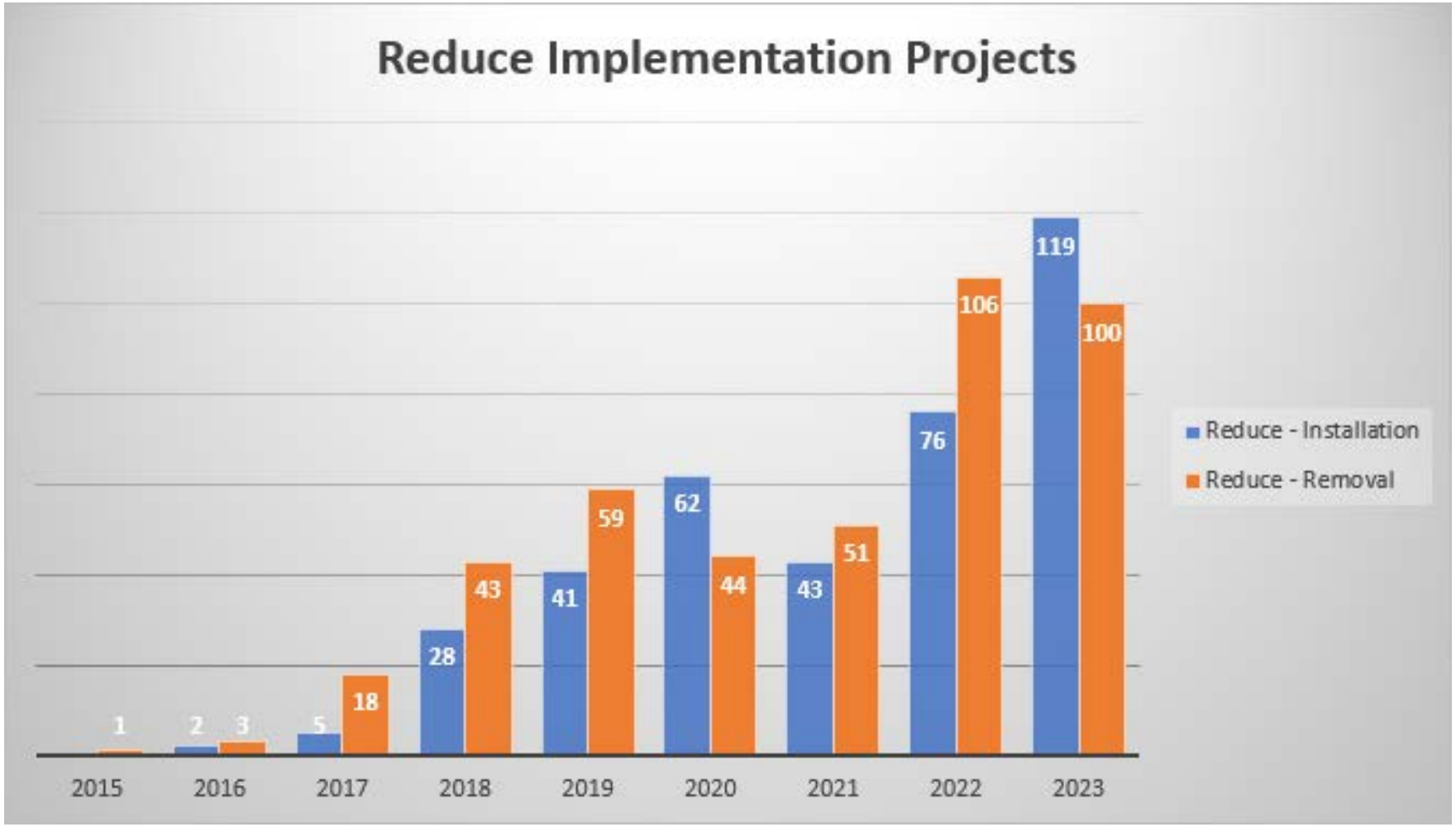
ORS-Supported Technology Transition by the Numbers



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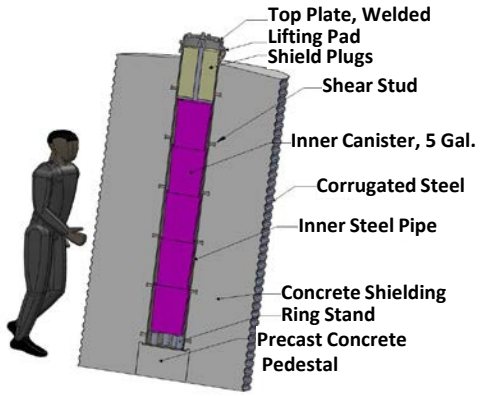
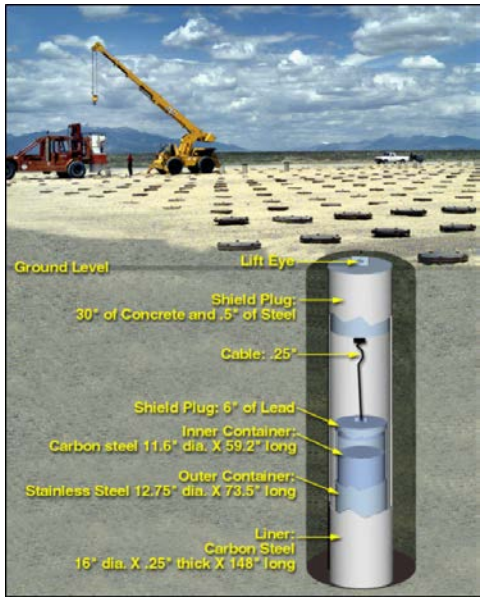
Investment in New Storage Solutions

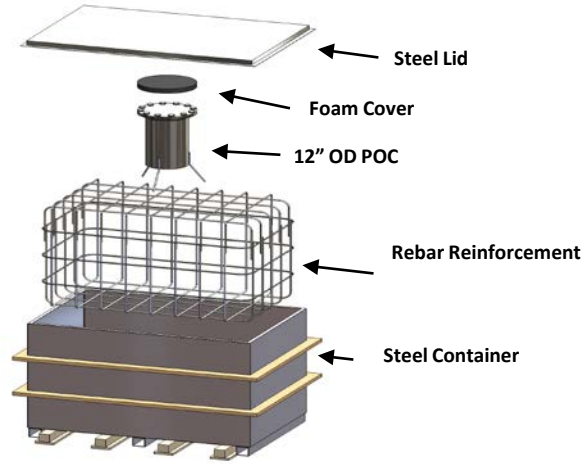
PROBLEM—Lack of Secure Storage Options

- In many countries there is a lack of cost effective safe and secure storage options for disused sources
- Need low-cost, versatile, easily deployable, low-tech, and secure options that allow sources to be retrievable for future disposition



Scalable Long-term Storage



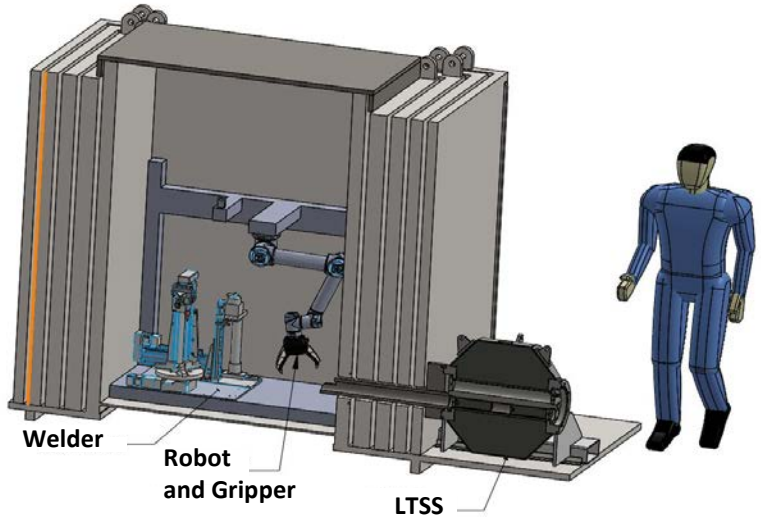


Low-cost Storage Unit

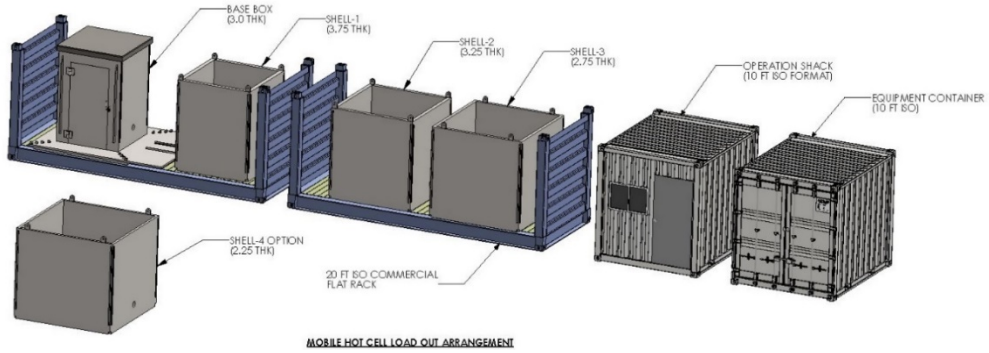
Investment in Equipment for Operations

PROBLEM— Lack Equipment for Operations

- Currently only two field tested mobile hot cells exist in the world, which results in remove project delays and dependency on third parties
- Mobile hot cell set-up time typically 2 weeks, complex deployment
- Need a more cost-effective option that increases the safety of operators, reduces deployment time and failure points, and simplifies transportation



Mobile Hot Cell



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Investment in Transportation

- The 435-B, ancillary equipment, and operating tools have been procured. Awaiting the delivery of the associated spare parts
- currently working on export control approval for the package and equipment.
- Anticipating shipping the 435-B and associated equipment late in the first quarter of 2019.
- Training IAEA personnel the week of May 13 on the operation of the package

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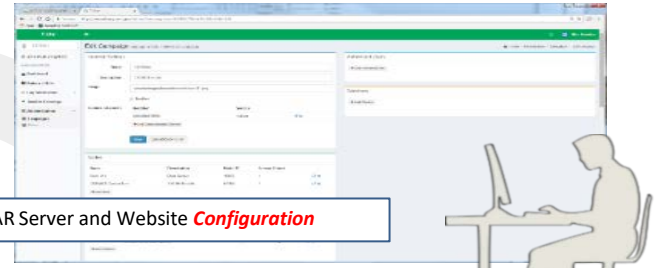
Investment in Transportation Security

ORS supports the security of high activity sources in transit

- National assessments
- Secure trucks and transportation security enhancements
- Transportation security regulatory development support
- Training and tabletop exercises

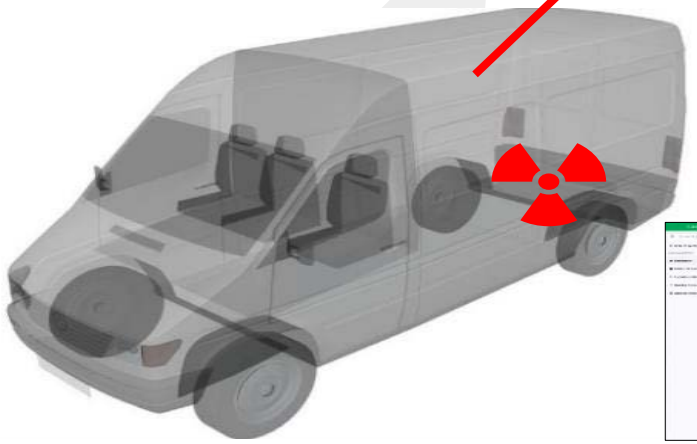
ORS developed T-STAR - sustainable transportation security tracking and reporting system

- Near-real-time tracking of shipments
- Intrusion detection systems designed for conveyance compartments
- Modular wireless sensor system to provide intrusion detection and cargo removal detection on a wide variety of conveyances



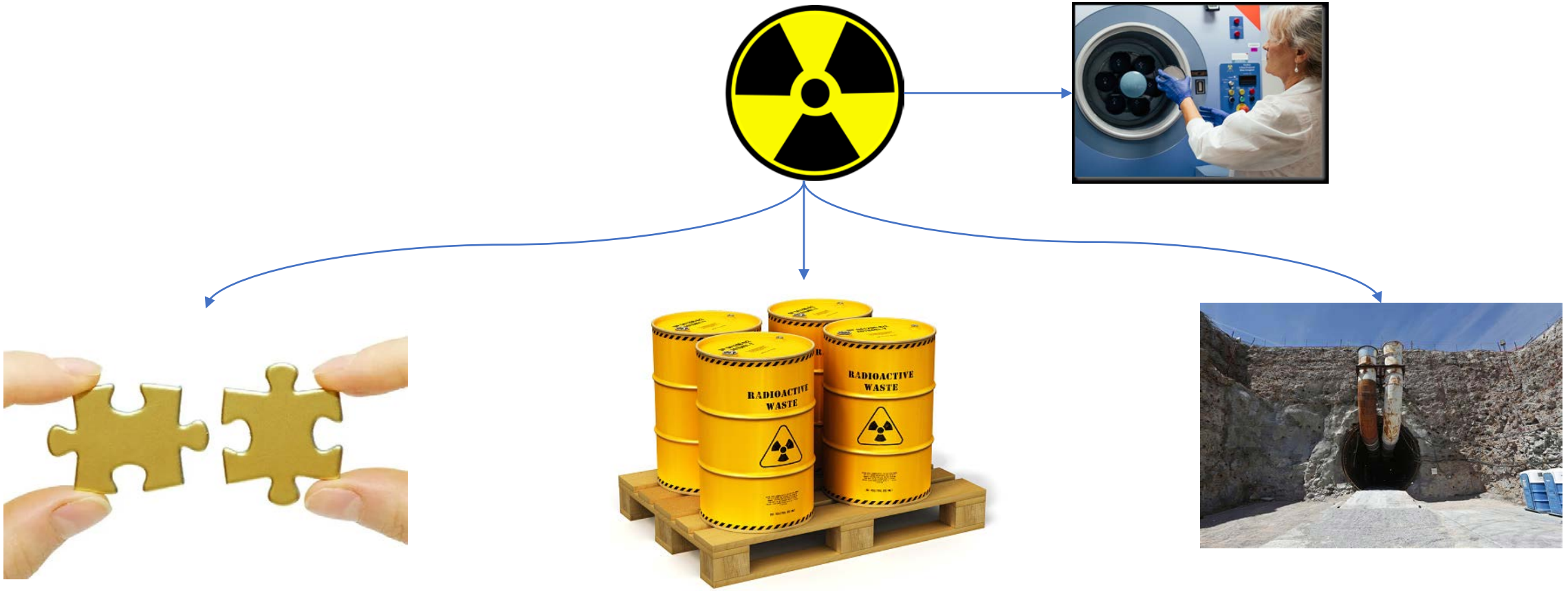
T-STAR Server and Website ***Configuration***

T-STAR Server and Website ***Response***



T-STAR Server and Website ***Monitoring***

Managing DSRS in Technology Transition



Managing DSRS in Technology Transition