Sandia
National
Laboratories

MRDIS
CASE STUDY

Unclassified Unlimited Release

IPO Integrated
Partnerships
Organizations

U.S. DEPARTMENT OF
ENERGY NNSA
National Nuclear Security Administration

BACKGROUND

The Mobile Radiation Detection and Identification System (MRDIS) is a large mobile scanner that inspects containers in transit from cargo ships for radiological materials. The MRDIS platform operates as a two-part system with one MRDIS using a plastic Polyvinyl Toleune (synthetic polymer) for primary detection and another MRDIS that uses spectroscopic detectors for secondary isotopic identification.[1] MRDIS can operate either independently or as part of a team, depending on the needs of the port.

Figure 1: The second-generation of Sandia's MRDIS in the Port of Salalah, Oman.

MRDIS is controlled by a human operator, who searches the computer monitor for any traces of radiological materials when the containers pass through the center of the system. Each MRDIS can also feed data into a central system or collect data on its own for additional material analysis.[2] The system integrates radiation detection, radioisotope identification, an optical character recognition system, occupancy/speed sensors, wireless communications, and data processing capabilities to discern what specific radiological materials are of particular interest.[3] In addition, Sandia engineers created a detailed set of requirements for subsequent models, allowing for faster implementation of additional detection systems.

RETURN ON INVESTMENT

PROGRAM DEVELOPMENT

Sandia staff members first conceived of the MRDIS concept in 2003, as part of the Megaports Initiative, to address the challenges of scanning transshipment containers for radiological materials. The Megaports Initiative was a collaboration between the National Nuclear Security Administration (NNSA) and the Department of Homeland Security to engage with other countries to enhance their ability to screen cargo at major international seaports. At the time, less than 10 percent of transshipped containers were scanned and the scanners themselves were costly to port operations.[4] Through funding from NNSA's Second Line of Defense Program (a capacity building effort that directly contributed to an in-depth defense strategy to combat nuclear and radiological smuggling by providing additional layers of nuclear security to the first line of defense protection of nuclear materials and facilities[5]), under the International Material Protection & Cooperation Office, Sandia developed the first-generation MRDIS platform, which

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[1] https://www.govinfo.gov/content/pkg/CHRG-110shrg80493/html/CHRG-110shrg80493.htm
[2] https://share-ng.sandia.gov/news/resources/news_releases/mrdis_radiation/
[3] https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2018/181713m.pdf
[4] Interview with Sandia PI: Gregory Stihel
[5] https://2009-2017.state.gov/documents/organization/202455.pdf

could scan nearly 100 percent of transshipped containers at a major international seaport with only three systems.

In collaboration with the Pacific Northwest National Laboratory (PNNL), Los Alamos National Laboratory (LANL), and others, Sandia developed the first-generation MRDIS system. Sandia wrote the technical requirements for MRDIS, developed the concepts, oversaw the development of the overall system, created the software to support the system's operations, and leveraged prior Sandia software suites to optimize MRDIS capabilities. In addition, LANL provided expertise in integrating the commercially available radiation detectors onto the platform so that the system would meet mission requirements, while PNNL managed the NNSA contract.

In 2006, Sandia, in further collaboration with PNNL, LANL, and DRS Technologies (who built the physical system and is now called HDT Global), developed two second-generation MRDIS prototypes that were successfully field tested in Oman. The prototypes provided quick, accurate analysis of the transported cargo with minimal to no impact on port operations, which prompted the NNSA to order 12 systems.[6] In 2008, the first production unit of second-generation MRDIS platforms were completed. To date, eight MRDIS platforms have been deployed worldwide; four to Panama in November 2012 and four to Oman in March 2013.[7,8]

LICENSES
There were two licenses for MRDIS from 2011 to 2013.[9]

PUBLIC GOOD
Nearly 90 percent of imported and exported goods travel globally through shipping containers, with roughly 500 million containers traveling by sea each year.[10] Port security is a major international concern; however, port authorities and shippers require timeliness and low costs to operate efficiently. The Sandia-developed MRDIS platform does not disrupt the transportation of transshipped cargo, but rather enables the scanning of containers as they are transported through to the next location. For this reason, the MRDIS platform has had minimal to no impact on shipping operations and remains a quick and cost-effective solution to port security concerns.

Panama Canal
Approximately 85 percent of containers passing through the Panama Canal are transshipped containers; however, officials have difficulty scanning transshipped containers because of space and operational constraints. Adding the MRDIS platform to international ports like in Balboa, Panama, has helped increase the volume of containers scanned since they were first delivered in 2012 and protect against a nuclear or radiological incident that could take years to clean up and potentially cause worldwide economic repercussions.[11]

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[6] Interview with Sandia PI: Gregory Stihel
[7] https://share-ng.sandia.gov/news/resources/news_releases/mrdis_radiation/
[8] https://www.sciencedaily.com/releases/2013/08/130814190525.htm
[9] https://info-ng.sandia.gov/ESP/output.php
[10] https://www.upi.com/Science_News/Technology/2013/08/15/Giant-mobile-scanner-will-combat-smuggling-of-radioactive-materials/93841376605002/
[11] https://www.gao.gov/assets/650/649759.pdf

Security Applications

While the MRDIS platform was designed specifically to address the security of transshipped containers, the concept has potential uses in security applications for transportation, defense, and public health industries. By transforming MRDIS into a mobile, compact system and integrating a suite of sensors onto the device, the platform would be able to provide additional security to large cargo airports, public events, vehicle checks, etc.; however, work has yet to be conducted in this area.[12]

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[12] Interview with Sandia PI: Gregory Stihel

# MOBILE RADIATION DETECTION & IDENTIFICATION SYSTEM

ORIGIN

- As part of the 2003 Megaports Initiative, Sandia scientists conceived the MRDIS concept to address challenges of scanning numerous transshipment containers for radiological materials quickly.
- At the time, less than 10 percent of containers were properly scanned for these materials, in part, from high costs associated with scanning technology.
- Sandia developed the MRDIS platform as a low-cost, effective solution to quickly scanning transshipment containers for radiological materials.

DEPLOYMENT

- MRDIS integrates radiation detection, radioisotope identification, optical character recognition, wireless communication sensors, and data processing capabilities into a single platform.
- The MRDIS platform was successfully field tested in Oman, which provided quick, accurate analysis of the transshipped cargo.
- To date, 10 systems have been built, eight have been deployed worldwide (four to Panama and four to Oman) and two are under review.
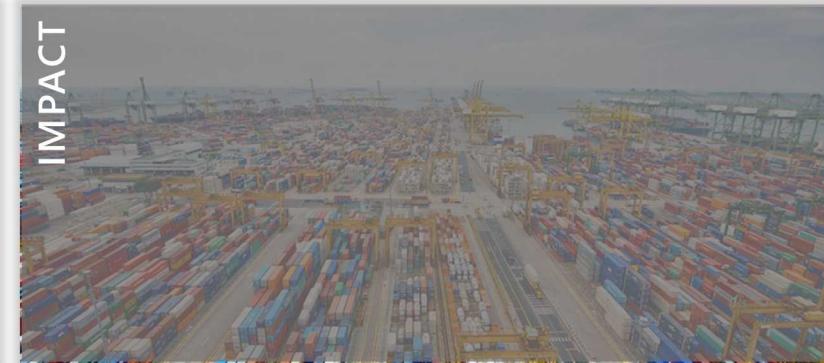
IMPACT

Enhances security in various transportation industries

Prevents & detects potential radiological incidents

Increases port security while remaining cost-effective

Ensures Sandia's global security mission objectives

2003
Sandia staff first conceive MRDIS concept

2003
Part of DHS and NNSA Megaports Initiative

2003
Sandia, PNNL, and LANL develop first-gen MRDIS

2006
Sandia, PNNL, LANL, and DRS Technologies develop second-gen MRDIS

2011
MRDIS is licensed by two companies

2012
4 systems are sent to seaports in Panama

2013
4 systems are sent to seaports in Oman

2014
Sandia continues to make improvements to the MRDIS platform