Industry Perspective on Mobile Source Tracking

Brian Higgins, Fred Mauss, Joe Lapinskas and Ron Monteforte

ABSTRACT

The threat of dirty bombs or radiological dispersal devices (RDDs) is real, and while the National Nuclear Security Administration's (NNSA) Office of Radiological Security focuses on this threat as a matter of national security, industry is also concerned with and recognizes the safety, security, and operational risks associated with radioactive sources. Radioactive sources are used in radiography as a form of non-destructive testing to inspect welds and metal integrity. Radiography manufacturers produce devices to allow for safe storage and transport of sources while preforming job duties. Three device manufacturers; Industrial Nuclear Co. (INC), Source Production and Equipment Co. (SPEC), and QSA Global, Inc., make up a significant share of devices used by industry. These manufacturers and industry users have partnered with the Office of Radiological Security to design, test, integrate, and deploy the Mobile Source Transit Security (MSTS) system for use with their specific brands' radiography devices. They have been actively engaged to mitigate the risks associated with mobile sources and the potential threat of these devices falling into the wrong hands, as well as a potential business value in providing additional security features to their end users. The goal of this paper will be to use industry's insight and expertise to illuminate their view of the potential threat of loss, theft, or adversary intent to use this type of source in an RDD. The authors' insights will illustrate their historical and continued support of MSTS and NNSA's mission to protect against the threat of radiological terrorism.

INTRODUCTION

The U.S. Department of Energy/National Nuclear Security Administration Office of Radiological Security (ORS) supports global efforts to combat nuclear and radiological terrorism. The mission of ORS is to reduce, remove, and protect vulnerable radioactive sources and, in so doing, deny potential terrorist access to nuclear and radiological materials. Many of these vulnerable sources are contained in heavy and static self-shielded devices such as blood irradiators, gamma knives, and industrial irradiators. However, there is a significant amount of radiological material used in industry that are mobile in nature that the ORS program has sought to protect.

One key industry that uses mobiles sources, identified by the ORS program, is the industrial radiography business. Industrial radiography companies provide sources and services to conduct non-destructive testing for industrial applications, most notably the oil and gas industries. These industries manufacture and deploy infrastructure such as pipelines, storage containers, pressurized vessels, and other products that rely on quality welds and materials and safely process, store, and transport the resultant energy products for consumption. Performing this critical NDT service requires the management of thousands of hand-carried (mobile) self-shielded Iridium-192 radiological sources which provide the ability to affirm the integrity of critical work on pipelines, containers, vessels, and other critical infrastructure. While Cobalt-60 is also used for these purposes, it requires substantially more shielding and most commonly is used for in-house jobs, so the Cobalt-60 devices are not considered "hand-carry" mobile for the purposes of this paper.

Throughout the process of developing a mobile source tracking system, the ORS Program has worked closely with radiography industry partners to design, develop, and deploy a system that would provide situational awareness and monitoring of these mobile sources through their lifecycle of job use. Due to the loss of assets in the field and during transport, industry first recognized the need for such a system but was unable to develop a system itself due to the burdensome cost of research and development. This is where the partnership between ORS and industry really took root. ORS saw this as an opportunity to meaningfully improve the security and situational awareness of these at-risk radiological sources and began developing a system through its national lab network to address this challenge. This critical partnership has led to the solution that is being adopted today by the end users of these mobile radiography devices; the Mobile Source Transit Security (MSTS) System.

These partners all have valuable perspective on the state of their industry, how they view the need for security, and what they see impacting their business in the future. This paper will provide context for the threat of radiological terrorism, ORS' partnership with industry and detail several key areas that are of interest to the companies that produce and sell radiography devices to end users. These perspectives gained from two partner companies, QSA and SPEC, will help to provide a clearer picture of how they view the industrial radiography industry's reaction to this new technology, how they view the changing regulatory landscape, and provide insight into their end users handling of security for these devices.

INDUSTRY BACKGROUND

For more than 50 years, industrial radiography has been used for nondestructive testing (NDT) for quality assurance across several industries. According to briefings received by the National Academies of Science, Engineering, and Medicine and detailed in a recently released study, there are more than 10,000 radiography sources sold globally annually with approximately 40% of these sources sold just within the United States (National Academy of Sciences, Engineering, and Medicine, 2021).

These sources are primarily hand-carried though some are considered more stationary, such as those that use Cobalt-60 for "in house" jobs where the sources don't typically leave their home base. An example of the Iridium-192 cameras is shown below in Figure 1. These cameras will be usually sold with 150 Ci of source which is then used until its usable material decays away, typically after 6-8 months (roughly 3-4 half-lives).

Figure 1 - QSA Radiography Cameras

The industrial radiography industry consists of three primary sets of stakeholders: source providers, source licensees, and source end-users. Source providers, such as QSA, SPEC, and INC who were interviewed for this paper, handle the procurement of source material, primarily Iridium-192, and the manufacture of the final shielded source device that licensees and end-users will use. These are the primary manufacturers of radiography cameras and with whom the ORS program has collaborated to begin integration of tracking technologies into their products.

Source licensees are the primary caretakers of these devices. They maintain the licenses with the Nuclear Regulatory Commission (NRC) or their state regulators to possess, use, transport, and maintain the sources as part of their business requirements.

Finally, source "end-users" are the technicians that perform NDT analysis with these devices, manage the transportation of the radiography device, and ensure it is being handled safely and securely per company and regulatory requirements.

Each of these stakeholders has a part to play in the security of radiography devices and each is impacted by the implementation of new technologies to track and secure them while at each stage of their lifecycle. While this paper primarily focuses on the perspectives of the source manufacturers, their sentiments are largely shaped by their interaction with their customer base. All parties are forward looking and help the ORS Program to continue shaping its security strategies for these mobile and at-risk radiological sources.

UNDERSTANDING THE RISK & THE THREAT

The concern around the malicious use of these radiological sources involves the theft of these materials and intent to use them in either a radiological exposure device (RED) or radiological dispersal device (RDD). Both involve different methods, and both are of concern as they can cause public panic, health issues, and cost substantial sums of money to respond and address the issues presented.

Per the World Institute of Nuclear Security (WINS) guide "Security of Radioactive Sources Used in Industry", an RED is created by concealing a strong gamma-emitting source in a public place or within the general area of a specifically targeted individual in order to cause harm through radiation. As an example, the small Iridium-192 capsules used in industrial radiography devices could be placed in high traffic areas like mass transit or stadiums where people would be unknowingly exposed to radiation. Immediate health effects from this would range from minimal to life threatening depending on peoples' proximity to the source and time spent within the affected area. Additionally, the potential for creating significant public concern and even panic are high in this scenario (World Institute for Nuclear Security, 2018).

RDDs, more commonly referred to as "dirty bombs", are the result of combining radioactive material with conventional explosives. Would-be bad actors may find these particularly attractive due to how easy it is to acquire the raw materials for such a device and the relative ease of their construction.. While these are not considered weapons of mass destruction, they still have the potential to widely disperse radioactive materials over a broad geographic area. People within that area would be exposed to radiation and the surrounding buildings or environment would become contaminated with radioactive particles, potentially denying their use for long periods of time. This would necessitate a large response effort, expensive decontamination processes and would ultimately result in billions of dollars in economic damage (World Institute for Nuclear Security, 2018).

When the broad availability of material in mobile sources is considered, the threat of it being used for malicious application begins to become clear. Without sufficient situational awareness,

these radiography devices can be stolen from an end user's truck overnight and it would take several hours with no alarms before this theft is reported. With no way of tracking its whereabouts, response would be significantly hampered.

INDUSTRY PERSPECTIVES ON SECURITY

Background & Engagement

The ORS program began engaging with industry partner stakeholders in 2014 to get input from manufacturers, end users, and regulators to address the needed improvements to mobile source security and situational awareness. Initial discussion with these key stakeholders helped to establish the core system requirements that are being implemented and deployed at present. These requirements were largely driven by industry desire to improve situational awareness of their devices, especially while in-transit or at remote job sites given that they wouldn't otherwise have any reporting on their devices in the field. In continuing this engagement, the ORS program determined that a technology to meet these requirements was not commercially available so began technology development efforts. Development of such a system required addressing the impact to the end-user and their ability to perform work, regulatory and safety requirements, and direct partnerships with device manufacturers to integrate tracking systems into their products.

As these tracking technologies matured and have been shown to meet the overall requirements, the ORS program reached out to the partnering device manufacturers for their perspectives on the program, how they became engaged with the program, and how this has impacted their own organizations stance on security. Responses were received from representatives of QSA and INC to a series of questions to provide insight on these areas. Common themes that drive initial engagement have centered around their recognition of the need to partner with the agencies driving change to their business to stay at the forefront of what may be standard industry practice in the future.

Joe Lapinskas, the Innovation and Marketing Director for QSA, leads their new product development efforts using a customer-backed approach to identify and address industry trends and customer pain points. This gives him a unique perspective of the end-users' needs and issues as they buy and use these radiography sources. He stated that he saw regulatory needs as one of their major drivers of change in the industrial radiography industry. Joe stated that, "as the worldwide leader in supplying gamma radiography sources and equipment to the NDT industry, QSA recognizes the need to be a partner with agencies potentially driving change in our industry." In partnering with the ORS program, Joe stated that a lot has been learned about the value that end users see in source tracking technology and he sees the benefit for continued support. Similarly, Ron Monteforte, an Independent Quality Consultant with INC, shares this viewpoint that it is an opportunity to remain competitive in an ever-evolving industry and regulatory landscape.

These industry responses demonstrate the business value of tracking systems that both the manufacturers and end users see. Both recognize the importance of remaining on the cutting edge of this type of technology and have committed to continuing to work with the ORS program as the MSTS system is refined and continues to be implemented.

Regulatory & Policy Considerations

Industrial radiography devices are considered self-shielded containers and formally classified as a "package" by the Nuclear Regulatory Commission. A package is any container used to transport materials of concern, which include radiological material. Package requirements and approved usage are defined by the NRC and certified for safety to be used for transport. This places a requirement on device manufacturers and end users to ensure that the radiography device is designed in such a way that won't affect the integrity of the packaging and the sealed source contained within. Because the licensing requirements are controlled, it was quickly found the close coordination with the authorizing agency of the NRC and, by extension, the Agreement States that independently handle regulatory matters was required to ensure that those needs are being met while the program pursued changes to those containers as part of its implementation of source tracking technology.

In supporting this engagement, Ron Monteforte of INC considered the question of how regulatory changes in the future might drive security enhancements for mobile sources. To this point, he stated that he sees laws changing over time to support these types of systems. Joe Lapinskas of QSA agreed. He sees the landscape moving that direction but noted that while it's "good in theory", these regulatory changes often come without plans or the technology to implement them. This further drives their engagement with the ORS program to be part of the solution of these changing requirements.

Radiography has been utilized for NDT testing for more than 50 years. Over that time industry has adapted to changes in regulations. Safety has been the primary driver for changes in regulation; more recently security improvements are being addressed. Currently, detailed specifications and timelines for regulatory change as they pertain to mobile source tracking are unclear. In general, domestic and international interest to address and improve security is supported. Regulatory compliance is the primary concern for source manufacturers and licensed source users as noted by industry partners. With existing controls in place, any additional security practices are taken on voluntarily. Adoption of new tracking technology would benefit from; defined regulations, specific tracking/technology requirements, and an understanding of the cost burden to support new technologies (costs of; equipment, installation, maintenance, and compliance).

End-User Interest

End-Users are the primary users of radiography devices. They are the ones performing jobs, the check-ins, and maintaining the safety and security of the device at all stages of a given job. As such, it was considered of interest how ORS industry partners view their customers' takes on implementing or being required to implement this type of source tracking technology.

What was found was mixed. Joe, with QSA, stated that there is an increasing interest because of ongoing discussion amongst regulatory and security bodies to enhance tracking requirements. Meanwhile, Ron with INC stated that he's seen a desire from end users to not see this requirement go into effect. There is a sense of eagerness to have increased situational awareness of their assets but reluctance to adding additional components to their work processes. Given that

users are currently meeting their regulatory requirements, there is a noted concern that additional equipment would add undue burdens to their business.

These challenges in security culture are not impossible to overcome but it does speak to the critical need for source tracking technologies to be effective, financially sustainable, and not impede end-users' ability to perform their duties.

Threat Reduction Through Security

The overall goal of the ORS program is to reduce the threat that radiological material falls into the wrong hands and is used with malintent. Source tracking is one such mitigation that is being pursued in this industry along with complementary security enhancements at end-user home-base facilities. While the threat can't be brought to zero without the complete removal of the radiological material from sites, efforts to enhance security are taken seriously by industry and they do see a benefit to these undertakings.

QSA, for instance, sees the biggest threat to mobile sources as "insider threats." These are threats that come from within an organization. These people have intimate knowledge of business processes, have access, and means to easily get these sources and misuse them. They go on to state that the single biggest threat is simply an "unintended" insider, where processes are not properly followed that lead to the theft of a device.

An additional challenge to reducing the threat of loss or theft for mobile sources was noted by industry when considering the changes in chain of custody from manufacturer to the end-users. These events present a risk of loss or theft with little to no situational awareness, similar to these radiography devices being used at remote job sites. It is recognized that implementing some measure of source tracking from manufacturer to end-user can work to provide valuable information to mitigate these risks associated with changes in custody.

Overall, industry acknowledges that source security threats can come in the form of theft, negligence, or insider attack. Theft could come in the form of targeting or convenience access to equipment or devices. Negligence by users of controls or equipment maintenance could reduce a source's security profile. The possibility of an insider accessing devices with ill intent is possible even with staff access managed through trustworthy and reliability (T&R) assessments.

Threat Reduction Through Use of Non-Ionizing Technology

Technologies that have been around awhile and new ones have been under consideration for some time to replace the use of radiological material for conducting NDT work. The National Academies of Science, Engineering, and Medicine has conducted a deep dive study in this and ultimately found that, while in many cases they have their use, the non-ionizing technology just isn't mature enough to be used in many of the same use cases as standard Ir-192 based radiography devices (National Academy of Sciences, Engineering, and Medicine, 2021).

QSA does see a role for it as a complement to standard NDT practice. Joe Lapinskas stated in response to this question, "time is money – the act of performing inspections is becoming a commodity so services providers are always looking towards technologies that enable them to be

more efficient and get their clients up and running or back online." Where these alternate technologies can be useful, they are being heavily weighted. In contrast, INC doesn't see a big impact to their business. Ron Monteforte stated that non-ionizing technologies have known limitations where they could be applied, so see a continued need for the standard radiography device.

In general, the use of non-ionizing technologies is increasing but they still have limitations that prevent a broad scale adoption leading to reduced dependence on radiation sources. Some applications lend themselves to these different technologies, while other applications and image specifications require the use of radiography equipment. Adoption of non-ionizing technologies is driven primarily by cost associated with inspections. These technologies are being chosen when it is possible to perform inspections more efficiently or improve equipment maintenance and/or operations.

Security System Sustainability Needs

Sustainability is a driving need for any new technology that is implemented. A system that provides situational awareness would need to be simple to use and inexpensive to maintain for the foreseeable future for industry to continue to have buy-in for its use. This was one of the driving factors behind the ORS program's requirements and is a large driver in its effort to eventually transfer this new technology to the commercial sector. Having scaled production and private business pathways to its ongoing sale and maintenance will factor heavily into providing a system to this industry that is effective, cost conscious, and sustainable.

On this point, both industry partners agreed completely. They are both concerned with the maintenance and sustainability of source tracking technologies. The value of a source tracking system can only be observed if it is functional, reliable, and provides actionable information in the long term and not add substantially add to end-users' costs.

CONCLUSIONS

In general, the risks of these mobile devices are the forefront of industry's thinking and a great deal of consideration is placed on the mitigation of these safety and security risks. While meeting regulatory requirements, ORS industry partners are going above and beyond to engage the ORS program to integrate tracking technology that enables situational awareness because they ultimately see the benefit to be on the forefront of technologies that may become more common and required globally.

Industry also recognizes the need for continued sustainment of any such tracking technology and recognizes the potential impacts to work processes and cost can have an adverse impact on adoption. Any solution must address risk tolerances, budgets, sustainability needs, and be maintainable in the long term. Additionally, as the technologies improve over time, more common deployment of mobile source tracking systems will continue to become a more attractive option.

The ORS program's engagement with industrial radiography stakeholders has spanned several years and worked from the initial collection of requirements up to initial deployments of source

tracking that is integrated with radiography devices. These partnerships are expected to continue as adoption expands and evolves. Working directly with manufacturers to meet this need has allowed the ORS program to gain insight into the industry and its varied stakeholders to deploy both integrated technology solutions and security enhancements that demonstrate the value of source tracking technologies for mobile radiological sources. These key stakeholders all contribute to the future of source tracking. As efforts continue, these partnerships at all levels will be essential to meet the ORS program's mission to protect against the threat of radiological terrorism.

ACKNOLWEDGEMENTS

REFERENCES

National Academy of Sciences, Engineering, and Medicine. (2021). *Radioactive Sources: Applications and Alternative Technologies.* Washington, DC: The National Academies Press. Retrieved from https://doi.org/10.17226/26121

World Institute for Nuclear Security. (2018). *Security of Radioactive Sources Used in Industrial Radiography and Well-Logging Applications.* Vienna, Austria: WINS. Retrieved from www.wins.org