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INDUSTRY COLLABORATION TO ENHANCE SECURITY AT INDUSTRIAL IRRADIATORS - A CASE STUDY

MARTIN COMBEN
International Irradiation Association
Ludlow, UK
Email: mcomben@iiaglobal.com

MICHAL KUCA
Sandia National Laboratories
Albuquerque, USA

PIERRE LEGOUX
World Institute for Nuclear Security
Vienna, Austria

Abstract

The paper shows how the security of radioactive sources can be enhanced through effective collaboration between industry and other organizations with an interest in source and nuclear security. Real life examples of how collaboration has resulted in the development and promotion of security arrangements and practices are described. The paper shows how collaboration results in best practice and security measures that are acceptable to and adoptable by users of radioactive sources. Some initiatives detailed in the paper are on-going or being developed further to best reflect the security requirements of the industrial irradiation industry and the industry feedback received through the collaboration process.

1. INTRODUCTION

The industrial irradiation or radiation processing industry uses Cobalt-60 sources for beneficial applications including the sterilization of medical devices and for improving the safety of food products. These processes offer enormous socio-economic benefits, and the technology will remain critical in the long term.

Industrial irradiators typically contain 0.5-5.0MCi Cobalt-60 each and the security requirements specific to the use of radioactive sources are highly regulated and have been developed by the industry with decades of operational experience. The industry is highly engaged in security matters and recognizes that threats evolve and that new technologies do become available to enhance the security of these irradiators.

The International Irradiation Association (IIA) supports industry's engagement through its Gamma Working Group (GWG) that is made up of leading operators of gamma irradiators. Since mid-2020, the GWG has been working with Sandia National Laboratories (SNL) to develop a new physical security system and also with the World Institute for Nuclear Security (WINS) to support the identification and sharing of best security practices for industrial irradiators and to produce and trial security assessment processes that are tailored to the industry.

2. PHYSICAL SECURITY – A CASE STUDY

This case study shows how collaboration between industry and SNL has contributed to the development of a new physical security system.

Cobalt-60 sources are stored under water within a pool that is integral to industrial irradiators. Testing performed by the US National Nuclear Security Administration's (NNSA) Office of Radiological Security (ORS) had determined that an adversary would require visual contact with the Cobalt-60 sources within the pool in order to successfully accomplish the theft of a target source.

SNL, under the ORS In-Device Delay program, had undertaken a project to research and develop a novel protection system that obscures or visually hides the Cobalt-60 sources in the event of an attack. The project aimed to develop a low-cost, non-propriety obscurant that, when an adversary action is detected, could be deployed into the pool quickly making it difficult or impossible to see the sources. This would therefore delay any attempt to remove a target source.

The GWG provided industry feedback to SNL through a series of webinars as the project developed through its various phases. The focus of this feedback was to ensure that the obscurant system did not introduce any undesirable operating conditions or new safety and security concerns.

The initial proposal by SNL was the introduction of a chemical obscurant into the source storage pool. A full-scale test of the proposed obscurant demonstrated that it would be highly effective and would successfully delay access to the target source beyond the targeted time objective. Feedback from the GWG highlighted concerns about the impact of the obscurant on the chemistry of the pool water in which the sources are stored. The source manufacturers have strict pool water chemistry requirements to ensure and guarantee the integrity of the sources that they supply. Feedback also highlighted the need to develop a means to rapidly remove the obscurant as this itself could introduce new safety and security concerns by hindering authorised access to the sources.

In parallel, SNL had also been developing and testing a system that generates bubbles in the pool to obscure the sources. This system has the benefit that no chemicals are introduced into the pool water and the bubbles could easily be stopped to allow a facility to immediately return to normal operation, for example, following a false alarm. While, during limited testing, this system did introduce some delay in accessing a target source, it did not perform as well as the chemical obscurant.

Based on these tests and results, a hybrid system is under development that would rely on the bubbler system initially, allowing some time for staff at an irradiator to perform an assessment of the alarm, and if it were determined an actual threat was occurring the chemical obscurant could be released.

The GWG continues to provide industry feedback on irradiator design that will enable SNL to design this novel physical security system and a method for rapid removal of a chemical obscurant should this be adopted. This collaboration enables SNL to develop a new system that enhances physical security whilst also meeting the operational needs of the industrial irradiation industry.

3. SECURITY BEST PRACTICE – A CASE STUDY

This case study shows how collaboration between industry and WINS has contributed to the development, publication, and promotion of new security best practice for the industrial irradiation industry.

The GWG, as a highly engaged industry group, had identified the need to develop up to date security best practice that could be shared with the industrial irradiation industry. The group had highlighted that the industry is made up of a wide range of organization types, ranging from sophisticated multi-nationals operating several irradiators to less well-developed single site organisations. These different organisations operate in about 50 countries with varying regulations an expectations of source security.

Work on developing a security best practice guide commenced with WINS that had previously published guides for ensuring the security of sources in medical and other applications as well as for managing and implementing many other areas of source security. The objective was to produce an industry specific guide that built on established radioactive source security practices and was a reference that supplements international recommendations.

During the drafting of the best practice document, regular feedback was obtained from GWG to ensure that the document remained appropriate and specific to the industrial irradiation industry. The real-life experience of leading operators of industrial irradiators was incorporated to ensure that good industry practice was shared widely.

The joint IIA/WINS ‘Best Practice Guide on Security of Radioactive Sources Used in Industrial Radiation Processing’ was published in March 2020. This industry focussed document helps irradiator operators and those that design and manufacture irradiators to understand and manage the security risk and provides practical advice on physical protection systems and security management. The guide recommends further reading and includes a number of industry specific questions to help organizations evaluate the security of their sources and to prompt critical reflection.

In September 2020, IIA and WINS highlighting the Best Practice Guide to the wider industrial irradiation industry through a webinar that was attended by an international audience of ~300 people.

4. SECURITY ASSESSMENT – A CASE STUDY

This case study shows how further collaboration between IIA, WINS, SNL and industry made possible the necessary steps that resulted in the creation of a tool that enables operators of industrial irradiation to assess the effectiveness of their source security arrangements.

4.1. Development of a security effectiveness assessment methodology

The IIA and WINS continued their collaboration with the publication of the 'Methodology for Assessing the Effectiveness of Security Arrangements at Gamma Irradiation Facilities' in May 2021. This document compliments the best practice guide described earlier in that it enables organizations to evaluate their security arrangements against the industrial irradiation industry best practice. Industry, through the GWG, provided feedback during drafting of the methodology to ensure that it is both appropriate and specific to the industrial irradiation industry.

The methodology gives practical guidance on reviewing and measuring the effectiveness of security. It is a high-level document that gives broad direction that can be tailored to the specific circumstances and arrangements at individual irradiators. The methodology process focusses on a third-party assessment but it can easily be adapted to support a self-assessment of an industrial irradiator.

The methodology covers planning and preparation; conducting an assessment of security areas against performance indicators; reporting key finding and benchmarked security performance; and creating a follow-up action plan to ensure that identified corrective actions are prioritised and addressed on a timely basis. Input from industry security practitioners with real life experience of performing assessments enabled the methodology to include industry specific questions for each security area being assessed.

4.2. Pilot of the security effectiveness assessment methodology

Following production of the first version of the methodology, it was considered important to pilot the assessment process. This pilot would enable experience to be gained on its implementation and, if appropriate, improve the structure and content of the document.

This pilot required the collaboration of a number of organisations, each offering different value to the process. The IIA has good relationship with operators of industrial irradiators worldwide; WINS has expertise in the processes and requirements that make best practice in security; and SNL is able to offer subject matter experts with high levels of knowledge and experience in performing physical security evaluations.

In March 2022 a third-party pilot assessment was performed using the methodology at an industrial irradiator in Europe. This two and a half day event included a walk-through of the irradiator facility with a focus on security, interviews with various levels of staff working at the facility, and it culminated with an out brief to facility management. Prior to the visit, the irradiator operator provided various documents and plans related to their security regime to ensure that the assessment team was well prepared for the visit. The irradiator operator was highly engaged in the process and appreciated the importance of the security assessment and the value that it brings to the organization.

This pilot assessment helped to provide valuable insight into the effectiveness of both the best practice guide and the assessment methodology. Whilst IIA, WINS and SNL are satisfied that the documents do provide industry with a valuable resource and tool for understanding and enhancing irradiator security, input from the trial will be assessed to determine if any updates to the documents would be beneficial.

Later in 2022, a pilot self-assessment using the methodology will be performed at an industrial irradiator in the USA. Discussion with the irradiator operator in preparation for the pilot has highlighted the need to provide additional guidance to those performing a self-assessment. This guidance will be supplied in the form of a list of questions that ensure that all key security areas are assessed. This additional guidance will be refined following the experience of the two pilot studies.

5. FUTURE COLLABORATION INITIATIVES

Future opportunities to strengthen the security of industrial irradiators through collaboration exist due to the willingness of the industry to work with other organizations that can support the process. The irradiation industry is highly motivated and engaged in security matters and regards national security regulation as the minimum standard against which they operate.

Industry, through the GWG, will undertake an initiative to highlight, enhance and promote cybersecurity during 2022. The project is currently being scoped out with support organisations and subject matter experts that have experience in writing guidance around cybersecurity and experience in performing cybersecurity assessments. As has been experienced before, there continues to be a keenness to collaborate on this initiative that strengthen this area of security and help to address this rapidly evolving threat.

In November 2022 the IIA and WINS will work together on hosting a full day workshop on the security of industrial irradiators at the 20th International Meeting on Radiation Processing (IMRP20). This workshop will provide updates on the latest thinking on irradiator security and best practices. The meeting will be held in Bangkok and will be focused on irradiator operators located in South East Asia which, in some cases, is a relatively new audience for this topic. Both IIA and WINS will develop a program aimed specifically at this audience and will work alongside local Thai organizations with which they both have existing relationships.

6. CONCLUSIONS

Industry engagement and collaboration between stakeholders is critical when developing new arrangements to enhance security. It helps to ensure that any new systems are technically acceptable, processes are appropriate, and that unique industry considerations are addressed. This will help to remove any objections to implementation and improve the chance of new systems and processes being adopted by industry.

Working through an industry body enables engagement with focused industry experts and promotion of new security arrangements to a wide international audience from industry.

7. FURTHER INFORMATION

7.1. Author affiliation

7.1.1. *Martin Comben (mcomben@iiaglobal.com) of the International Irradiation Association*

The International Irradiation Association supports the safe and beneficial application of irradiation and promotes the development radiation processing using gamma, electron beam and X-ray technologies.

7.1.2. Michal Kuca (mkuca@sandia.gov) of Sandia National Laboratories.

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

7.1.3. Pierre Legoux (pierre.legoux@wins.org) of The World Institute for Nuclear Security

The World Institute for Nuclear Security is a professional institute committed to building an international community of nuclear security professionals who are demonstrably competent and willing to work together to strengthen the security of nuclear and other radioactive materials.

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