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In-Device Delay: Introduction to the Obscurants Physcial Protection System

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Sandia National Laboratories

ORS
Office of Radiological Security
Protect · Remove · Reduce

NNSA
National Nuclear Security Administration

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Delay Obscurants

The Office of Radiological Security (ORS) In-Device Delay (IDD) program has undertaken a project to research and develop a novel protection system for industrial irradiators that contain high-activity Co-60 sources. Based on adversary testing conducted by ORS, it is was determined that to successfully accomplish the theft of the target material, the adversary will require visual contact of the sources and source rack located at the bottom of the pool. Therefore, if a means of obscuring or visually hiding the sources in the pool can be achieved (while adhering to facility operations, safety, and regulatory requirements), then illicit source theft will be significantly hindered. This project aims to develop a low-cost, non-propriety obscurant that, when an adversary action is detected, the obscurant will be deployed into the pool quickly, rendering visual observation of the source problematic; however, this obscurant will not otherwise disturb the sources, source rack, and filtration system. The obscurant will remain in the pool until removed by another process.

The proposed system as depicted in the figure below has three primary components:

1. A mechanism (i.e., sensor) that detects malicious activity and activates the dispersal system.
2. A dispersal system that will rapidly deploy the obscurant into the pool.
3. The obscurant.

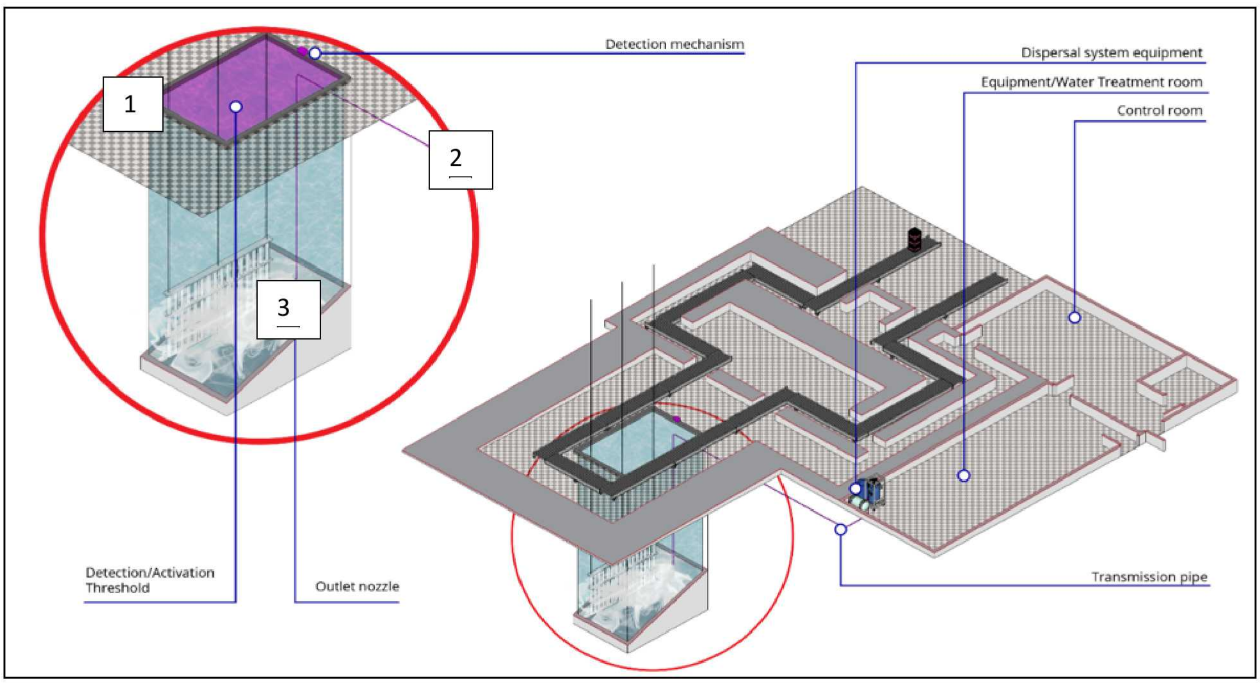

Figure 1: Generic Industrial Irradiator with notational placement of obscurant system

Currently, the ORS-IDD team at Sandia National Laboratories (Sandia) has identified a promising inorganic obscurant that meets the necessary technical specifications. A wide variety of analyses (i.e., water properties, reactivity, and radiation impact) have been conducted to ensure the obscurant does not impact irradiation operations. A prototype dispersal system was designed, built, and tested with promising rapid dispersal of the obscurant achieved beyond the laboratory scale. Potential detection schemes to release the obscurant are currently being developed in order to detect a potential attack with sufficient notice to allow for rapid dispersion of the obscurant materials to complicate illicit removal of the source.

As part of the ORS-IDD program, Sandia evaluated a variety of potential obscurants that were commercially available to determine their efficacy. These small-scale tests included an initial screening of their effect on water quality (pH and conductivity), dispersibility (i.e., turbidity), radiation stability, corrosion of surrogate samples, heat testing. Once established, mid-scale dispersal testing in a 1000-gallon tank was also evaluated. Through these tests, Sandia has identified several materials that could potentially be used as a visual obscurant within the irradiator pool in order to protect the sources from theft.

Figure 2: Obscurant test systems (a) 150 mL beaker, (b) 70 g aquarium, and (c) 1000 g plastic tank.

Initial testing began in a beaker, then shifted to an aquarium with a scaled recirculation system, and ultimately to a 1000-gallon plastic tank (mid-scale test) with a tailored delivery system for the obscurant. These systems were used to examine the effects the candidate obscurants had on the water quality, the dispersal properties, and impact on simulant pencil source rods. The water characteristics monitored were the recommended water quality requirements from Nordion Inc. based on the short-term deviation values, including turbidity, conductivity, pH, halide content, silicon content, and reactivity with 316L stainless steel. Only the pH parameters were tightened based on specifications received from Beijing SanQiangHeLi Radiation Engineering Technology Co., Ltd. (SQHL).

The effects of the obscurants on the filtration system were also tested during these studies. Small pore filters easily clogged during water recycling, but the high cost and time associated with changing out the media led to a more fieldable solution, the use of a precipitating additive. These tests showed promising results using methods and chemicals commonly used in water treatment facilities to purify water. Additionally, it was of interest to determine the radiation properties of the down-selected obscurants. In collaboration with Sandia's Gamma Irradiation Facility (GIF), a series of obscurant samples were exposed to radiation from Co-60 sources. No observable change in appearance was noted on the samples. Results of these tests were provided to our industry partners to review. Based on their feedback, additional tests were executed concerning corrosion (see Figure 4), heat, and obscuring of lettering on the test rods.

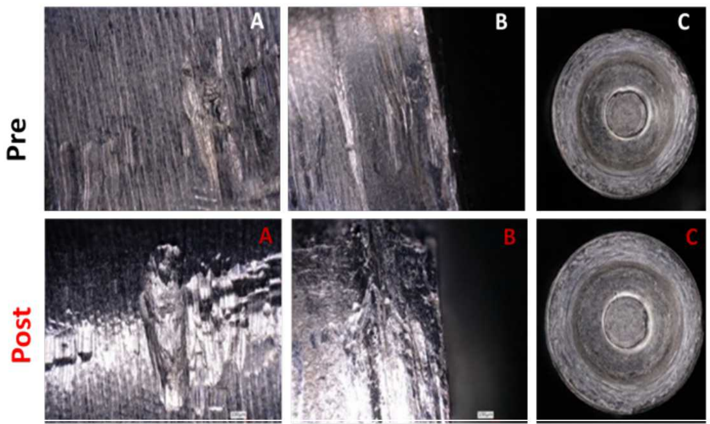

Figure 3: Inert Source Rod Before and After Exposure to Candidate Obscurant.

For the mid-scale test, a prototype dispersal system was developed and tested that would be capable of delivering enough obscurant for a full-scale irradiation pool. This system is compact and only requires electricity, an air supply, and a cable to carry the signal to activate the system. The obscurant tanks can be placed out of the irradiation chamber with plumbing used to deliver the obscurant near the bottom of the pool, and the system can easily be scaled to fit a wide range of pool sizes.

Next Steps

Moving forward, Sandia will perform a full-scale test of this system in an inactive pool that is comparable to an actual irradiation facility. This test will consist of deploying the obscurant to examine dispersal and resistance to attack as well as the efficiency and effectiveness of the clarifying agents. An initial list of potential sensors may be field tested as well. Key criteria for the sensors will be their ability to detect an adversary in the irradiation chamber, minimal false alarms, and survival in the environment including water, radiation, and heat depending on placement.

What Did We Miss?

Because these tests appear to provide promising results, we are interested in reaching out to iia members to better understand if there are any additional requirements that might not have been considered. What else would be need to be investigated to build confidence that releasing this obscurant, in the case of an attack on the facility or in the case of an inadvertent release by a system malfunction, would not cause harm to the irradiator?

The objective of these webinars to gather industry feedback on any additional requirements individual manufacturers or operators may have for their facilities or concerns that may exist that have not yet been adequately addressed.

During the iia webinars please keep in mind the following:

1. What other testing or data is needed in order to successfully develop a deployable obscurant system?

2. What would an operable industrial irradiator facility need in order to utilize this system as a means of protecting radioactive sources?
3. What regulatory or operational requirements should the Sandia IDD team be aware of in order to successfully deploy this system?
4. Is there a facility where this system, once completed, can be piloted?