

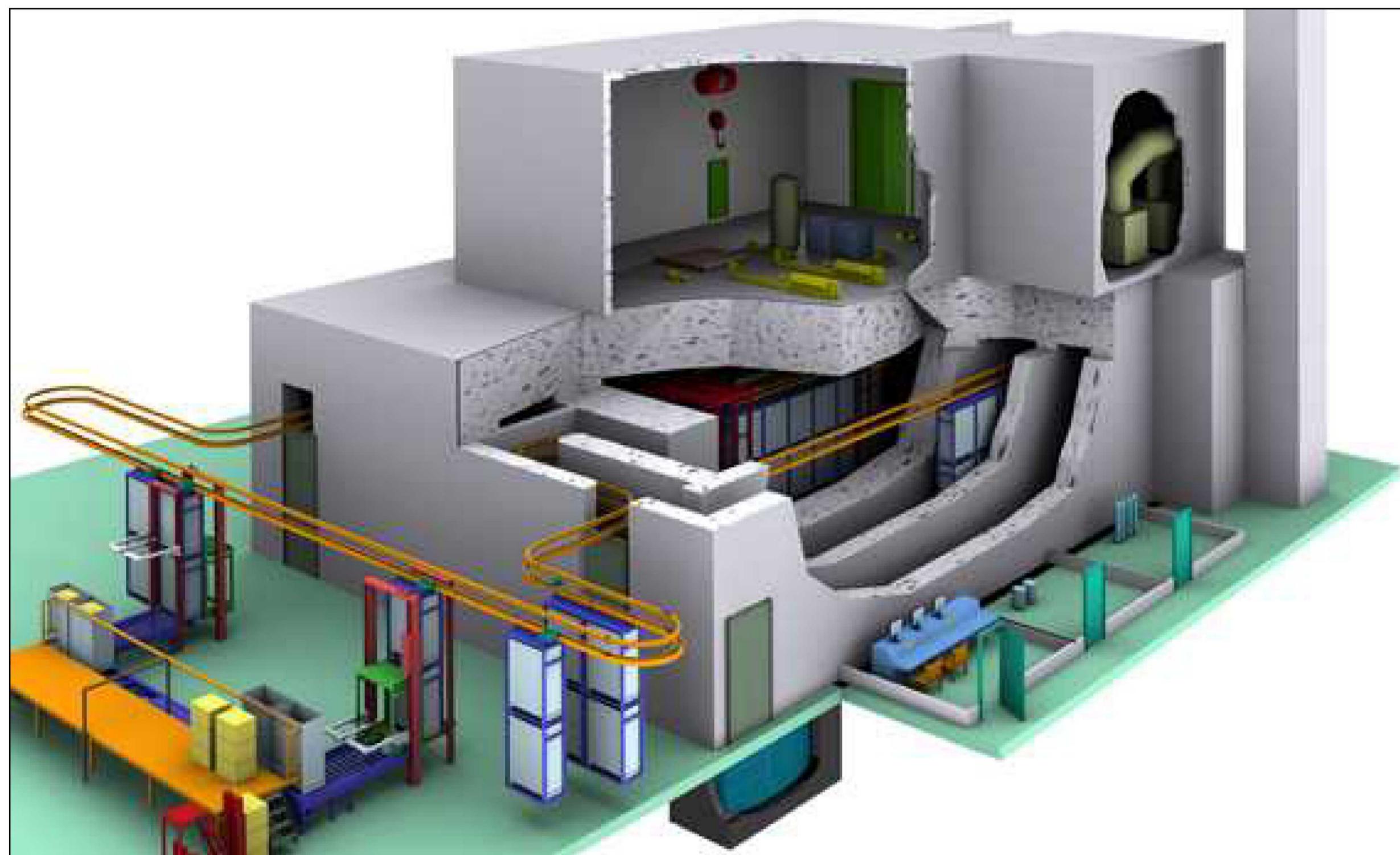
Security-by-Design Project Overview:

A Successful Collaborative Partnership to Protect Industrial Irradiators Against Radiological Theft or Sabotage

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Project Background

The In-Device Delay (IDD) Program, which is funded by the U.S. Department of Energy NA-21 Office of Radiological Security (ORS), seeks to enhance the security of devices and facilities using high-activity radioactive sources by providing security enhancements that reduce the possibility of theft or sabotage of the source. The Security-by-Design:SQHL project, which is part of the IDD program, is a joint venture between Sandia National Laboratories (SNL), Pacific Northwest National Laboratories (PNNL), and SanQiangHeLi Radiation Engineering Co. Ltd. (SQHL) to collaboratively design security enhancements for large industrial irradiators designed and manufactured by SQHL.



In 2016, baseline security performance testing was performed on a simulated SQHL-designed irradiator. The results of the baseline performance testing were used to develop prototype delay and detection enhancements for an SQHL facility. The goal of the enhancements is to increase an adversary's attack timeline by creating physical obstacles that must be overcome to access sources while providing early detection of the attack. The engineered enhancements were then proof tested in November 2018.

SNL, PNNL, and SQHL are now planning to perform a pilot installation of the enhancements at an SQHL facility.

Security-by-Design Project Goals

The primary goal of a Security-by-Design project is to integrate delay and detection enhancements into industrial irradiator facilities in a way that:

- Does not significantly increase cost
- Does not significantly affect facility performance or operation
- Does not affect manufacturer warranty
- Is consistent with and complementary to existing regulatory security requirements
- Mitigates illicit source removal from both the outsider and insider perspective
- Does not affect safety of the device

Baseline Performance Testing

The Security-by-Design project started with an assessment to characterize the SQHL facility design and to identify threats and attack pathways. After performing this assessment, baseline performance testing was conducted to characterize the difficulty of removing a source in the baseline configuration.



When the source of an industrial irradiator is exposed out of its shielding pool, the irradiator is generally considered to be self-protecting as the radiation levels in the chamber are high enough to rapidly incapacitate an attacker. When the source is lowered into the bottom of the shielding pool, however, an attacker could potentially enter the chamber and remove material before being incapacitated by the radiation. ORS has performed several studies to examine the feasibility of this attack, including testing on the SQHL design.

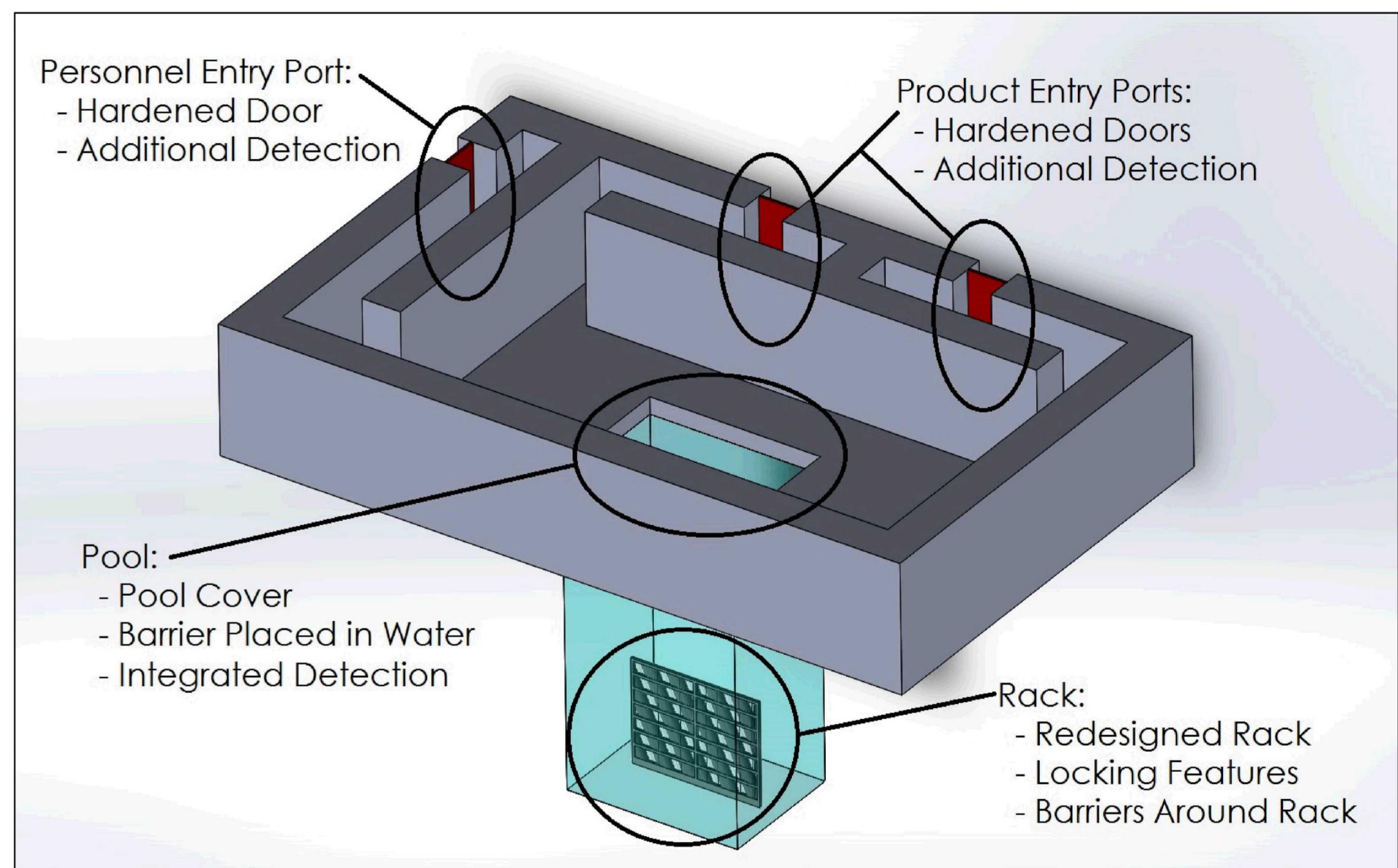
Enhancement Development

Once the initial assessment and baseline performance testing were complete, the process of developing security enhancements began. The engineering process requires a high degree of collaboration between SNL, PNNL, and SQHL. SQHL's integration into the design process is important in order to:

- Ensure the enhancements are fully compatible with the facility
- Ensure safety of the facility is not compromised
- Ensure operational impact to the facility is minimized
- Facilitate obtaining any needed certifications for the enhancements
- Ensure end users of the facility understand the enhancements

The security enhancement development process involved multiple iterations of developing concepts for enhancements, discussing them amongst stakeholders, and subsequently refining those ideas into workable prototype solutions based on input from all parties.

The delay enhancement consists of a locking device added to the source rack. This lock was designed to significantly impede accessing the source during normal operation of the irradiator while minimally impacting the reload operation. It was designed with multiple methods of removal to minimize the chances of lock binding.



The detection enhancements consist of a number of different commercial sensors and cameras that are assembled into a cohesive system for the SQHL irradiators. The sensors are strategically placed such that they cover all avenues of approach into the irradiator. Of particular interest is an underwater camera system that is located at the bottom of the shielding pool. This camera can detect intrusion into the pool regardless of the attack pathway used by the adversary.

The output alarm of the detection system can be fed in a number of different ways to proper authorities.

Enhancement Performance Testing

Once prototype enhancements had been engineered, an additional series of performance testing was performed to determine the security performance of the enhancements, demonstrate functionality, and identify any refinements needed to the designs before proceeding with a pilot installation. This testing was performed in late 2018 at Sandia National Laboratories and was attended by all stakeholders.

The enhancement performance testing demonstrated that the delay solution met the design goals of being highly effective against adversary attack while minimally impacting the reload process and other operations. Likewise, the intrusion detection system added robust facility- and target-level detection as well as access control.

Conclusion and Next Steps

The Security-by-Design project showcases a successful partnership between ORS, the National Laboratories, and SQHL. The final step for the project is to perform a pilot installation of the security upgrades. SQHL has identified a potential partner facility for a pilot installation of the enhancements and planning for the installation is underway:

- Final versions of the enhancement designs are being completed based on lessons learned during testing
- SNL, PNNL, and SQHL will visit the pilot installation site to determine any adjustments that will be needed to the designs for the particular site
- Enhancement components will be procured
- Contractors will be identified to perform installation services
- Pilot installation will be completed

ORS and SQHL are excited to provide an option for enhancing the security of radioactive sources used in industrial irradiators!