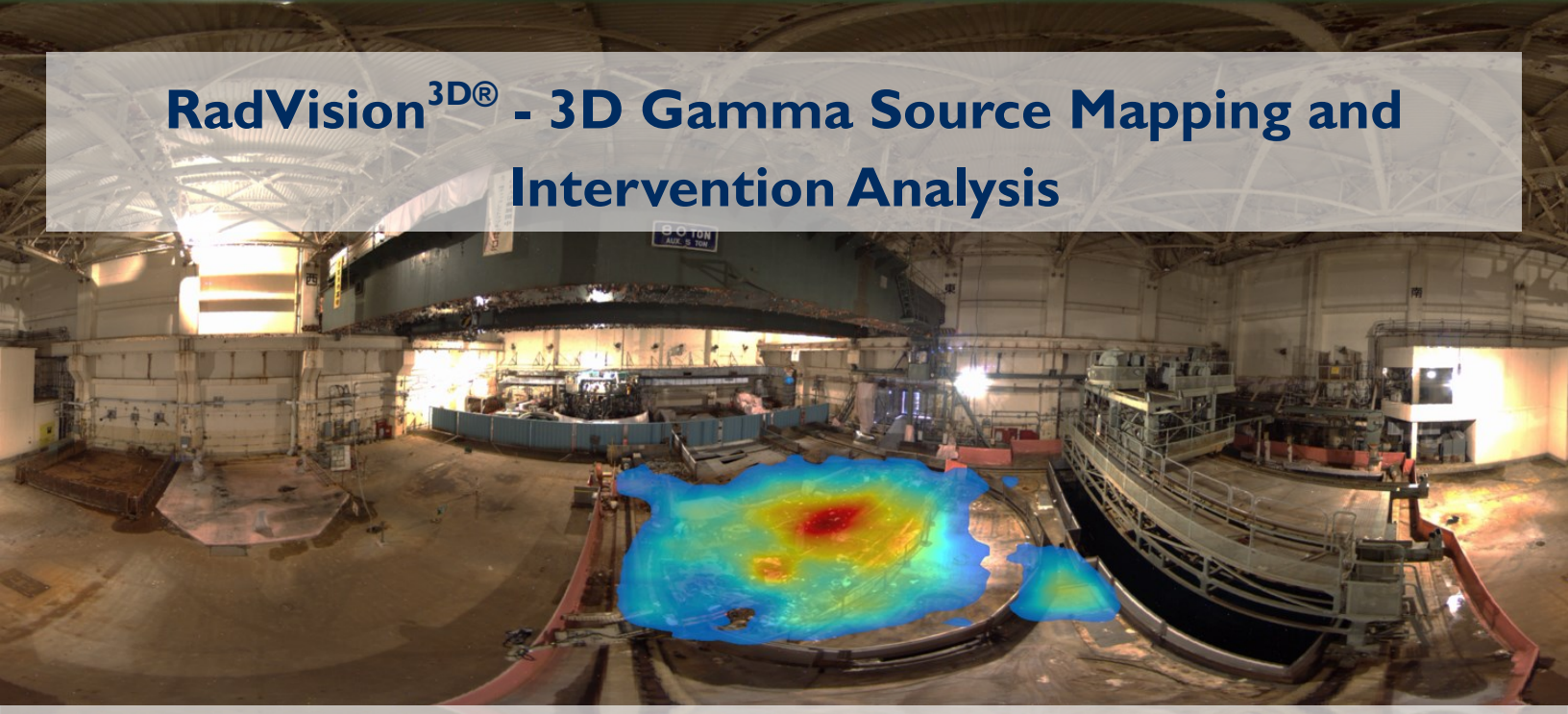
RadVision$^{3D®}$ - 3D Gamma Source Mapping and Intervention Analysis



Maintenance activities at nuclear power stations are often constrained by complex source term conditions. The historical approach has typically involved radiation protection technicians performing manual surveys of the conditions, and then communicating those conditions to station management and the work force through printed (often time hand sketched) dose & contamination survey maps. However, the complexity of both the plant geometry and the radiological conditions limits the information that can be gathered and communicated using traditional survey methods and maps.

Introducing Transco's RadVision$^{3D®}$ suite of products and services for gamma radiation source mapping and intervention analysis – the RadVision$^{3D®}$ system (a) captures three-dimension optical, point-cloud (lidar) and gamma radiation data (b) analyzes and merges the data into 3D geometric/radiological models (c) generates interactive visualization tools and (d) employs these visualization tools into practical work applications such as NPO's T-Flex and other shielding solutions.

Case Studies

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RadVision$^{3D®}$ Project Process

1. Capture Data

Data is collected using the N-Visage™ Scanner by Createc, shown to the right. A minimum of 2 scans are required in a room, and scans take about 2 hours each to run—the scanner runs autonomously once started by the user to reduce worker time in radiological areas. The output of each scan is data to be used during the analysis phase, as well as a 360°x360° panoramic image with radiation overlay.

Gamma Ray Spectrometer
- Full 360° gamma image
- Energy resolution: 3% FWHM @ 662 keV
- Energy range: 30 keV to 2 MeV
- Combines CZT with LIDAR and 12 Megapixel camera to build full 3D radiological models.

Packaging
- High dose tolerant: up to 100 Rem/h
- Fits through small apertures: 110mm OD
- Low mass: 15 kg
- Umbilical length up to 125m

2. Analyze Data

Data collected in step 1 is analyzed using N-Visage™ Fusion software by Createc. The analysis combines the point cloud and CZT data to create a full 3D model of the room with a solution showing radiological source locations in the room. The radiation data is then projected onto 2-dimensional dose planes showing the dose rate at any location in the room and interventions can be performed. Interventions are either shielding scenarios or source removal to determine the effect on general area dose rates.

3. Visualize

The analysis output from step 2 is imported into ARGOS PC View software, or ARGOS AR View software for use with Oculus Rift VR headset. These viewers are used for training and work planning applications, where a worker can be fully immersed in the 3D environment without being exposed to radioactivity.

ARGOS
Augmented Reality Gamma Observation System

4. Employ

The final step in the process is to employ the interventions discovered during the analysis phase in the form of the industry's widest breadth of engineered shielding options available from NPO/Transco.

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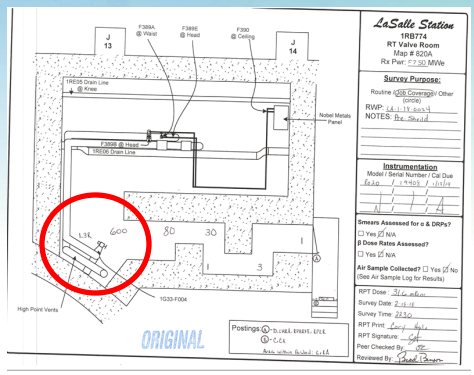
Case 1: LaSalle Generating Station—RT Valve Room Shielding Optimization

Background

LaSalle Generating Station in LaSalle County, Illinois is a 2 unit GE BWR site with Units 1 and 2 beginning operation in August 1982 and April 1984 respectively. During the Unit 1 outage in February of 2018 the Reactor Water Cleanup Valve, an Anchor Darling valve, needed to be breached and have internals replaced. The scope of work was performed in the area circled on the map to the right—general area dose rates prior to shielding were 600—1300 mRem/h.

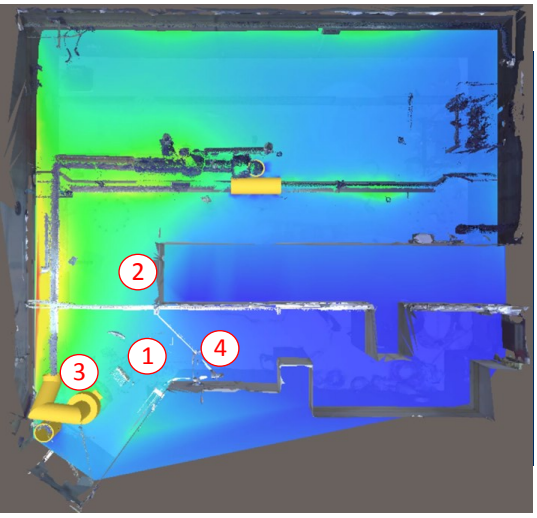


Objective

LaSalle's goal for the project was to obtain an optimized shielding package which reduced dose rates in the area of concern by 50% while minimizing cost and complexity.

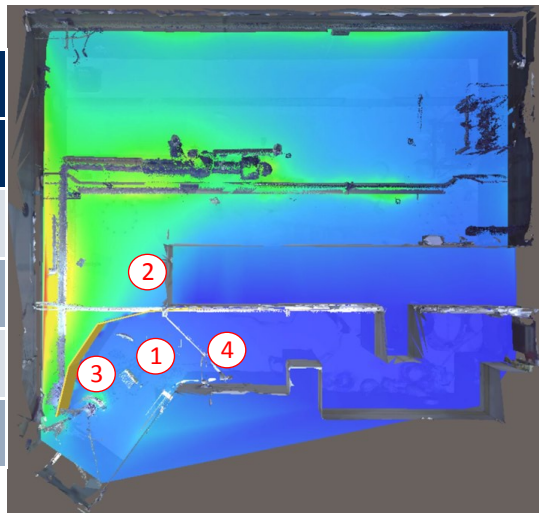
Output

Several iterations of shielding interventions were performed to evaluate different options, the results shown below compare the traditional "spot" shielding LaSalle would have used with the optimal solution found using RadVision[3D®].



"Hot Spot" Shielding Solution

Location	Hot Spots	Optimized Shielding	
	mRem/h	mRem/h	% Reduction
1	756	422	45%
2	901	824	10%
3	1242	414	68%
4	286	169	42%



Optimal Shielding Solution

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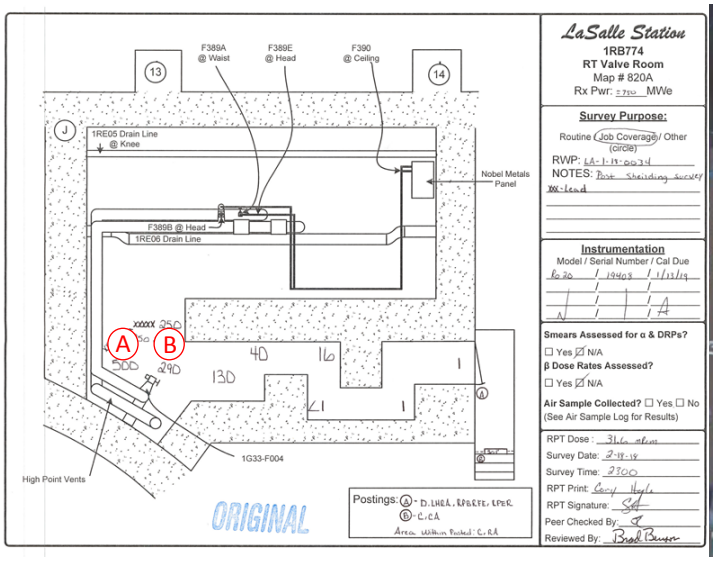
Case 1: LaSalle Generating Station—RT Valve Room Shielding Optimization

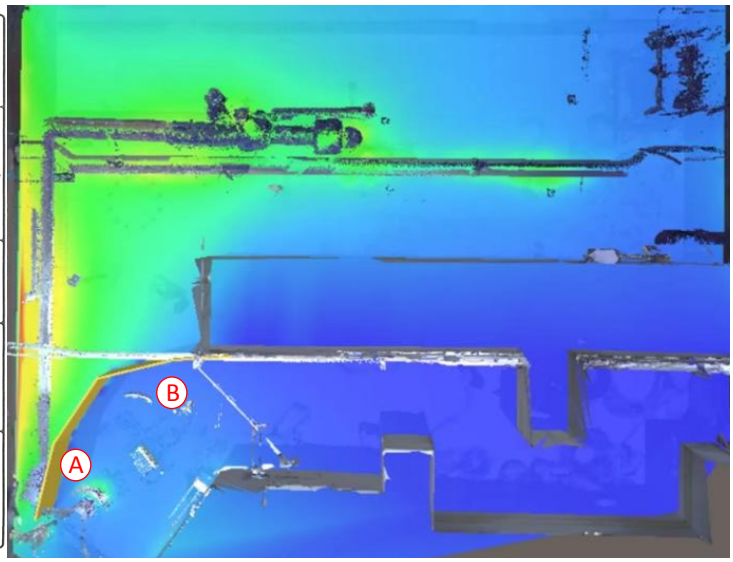
Results

LaSalle installed NPO Serpentine Racks with 1″ solid lead equivalent shielding in the optimized configuration shown below. The projected dose reduction using RadVision$^{3D®}$ was 55% - detailed results were as follows:

* RadVision$^{3D®}$ Scan Dose: 30 mRem
* Shielding Installation Time: 20 minutes
* Shielding Installation Dose: 163 mRem
* Total Job Dose: 11,900 mRem
* **Total Dose Savings: 12,000 mRem**



Shielding Post-Install Survey from LaSalle



RadVision$^{3D®}$ Shielding Calculation

Survey Location	Survey Data	RadVision$^{3D®}$ Data	% Error
A	500 mRem/h	483 mRem/h	3.5%
B	290 mRem/h	270 mRem/h	7.4%

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Case 2: Argonne National Lab—Waste Storage Source Identification and Reduction

Background

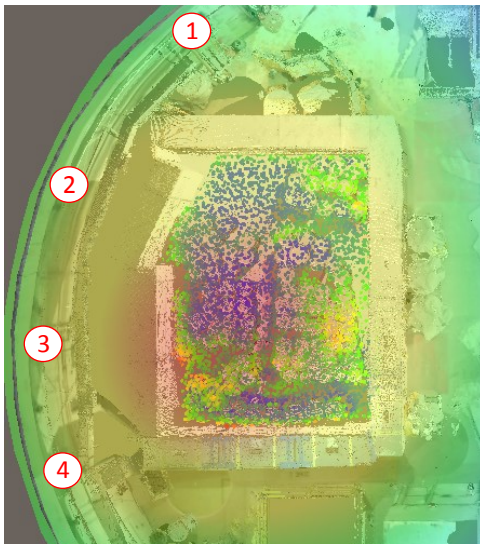
The 331 Shell building at Argonne National Lab, formerly the Experimental Boiling Water Reactor (EBWR), was the forerunner to Dresden Unit 1. Reactor decommissioning was completed in February 1996, the shell of the building is still standing today and is used to temporarily store drums with radioactive waste. A polar crane in the shell is used to move barrels and needed to be inspected for recertification in order to continue to use the crane going forward.

Objective

Argonne's goal for the project was to better understand the dose rates where workers would be performing inspection activities and to reduce those rates as much as feasibly possible.

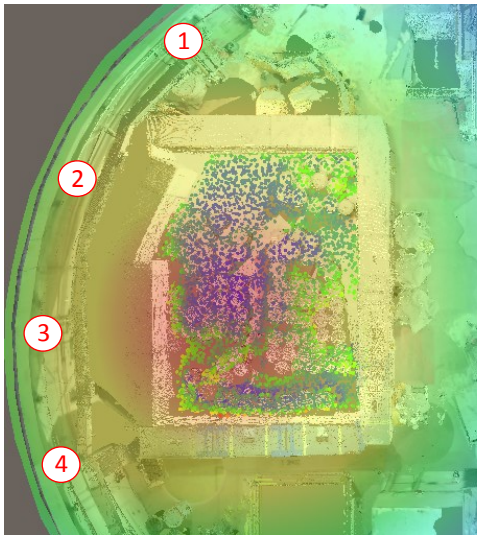
Output

The 8 drums with highest activity were found using RadVision$^{3D®}$ - those drums were removed from the model to reduce dose rates at the level of the crane.



As-scanned Solution

Location	As-Scanned	Barrels Removed	
	mRem/h	mRem/h	% Redux
1	218	156	28%
2	347	279	20%
3	380	301	21%
4	351	258	26%



Barrels Removed Solution

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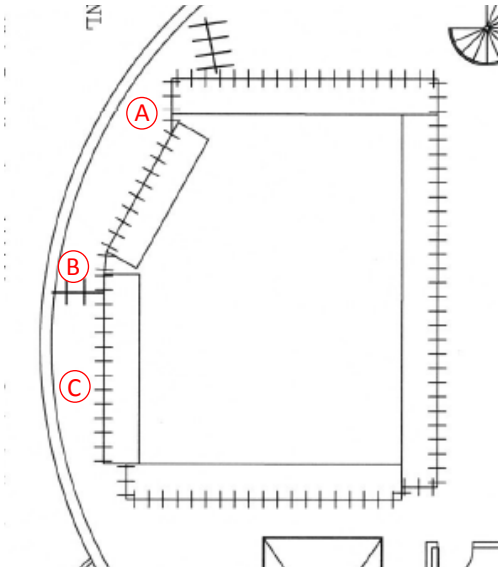
Case 2: Argonne National Lab—Waste Storage Source Identification and Reduction

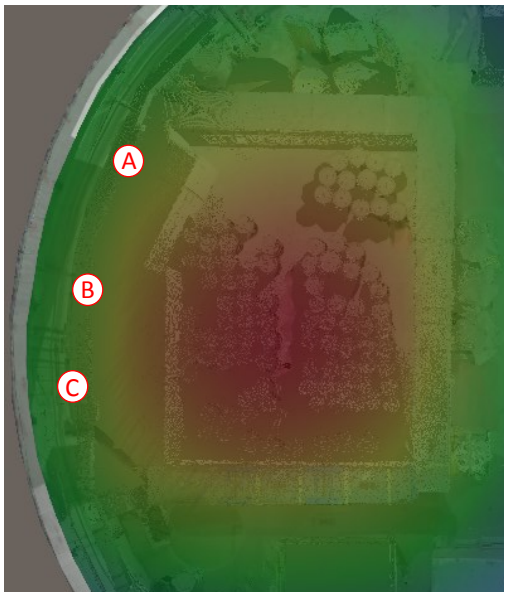
Results

Argonne removed the 8 drums recommended using the RadVision$^{3D®}$ analysis, no other interventions were implemented. The projected dose rate reduction using RadVision$^{3D®}$ was about 24% - detailed results were as follows:

* Planned Dose for Project: 450 mRem
* Actual Dose Received: 159 mRem
* Total Dose Savings: 291 mRem
* **Total Dose Savings (%): 65%**



Post Barrel Removal Survey from ANL



RadVision$^{3D®}$ Calculation

Survey Location	Survey Data	RadVision$^{3D®}$ Data	% Error
A	285 mRem/h	279 mRem/h	2.0%
B	320 mRem/h	301 mRem/h	6.0%
C	275 mRem/h	258 mRem/h	6.1%

This is a presentation of factual findings only. Nothing herein constitutes an endorsement of any kind by Argonne National Laboratory, the U.S. Department of Energy or UChicago Argonne, LLC.

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