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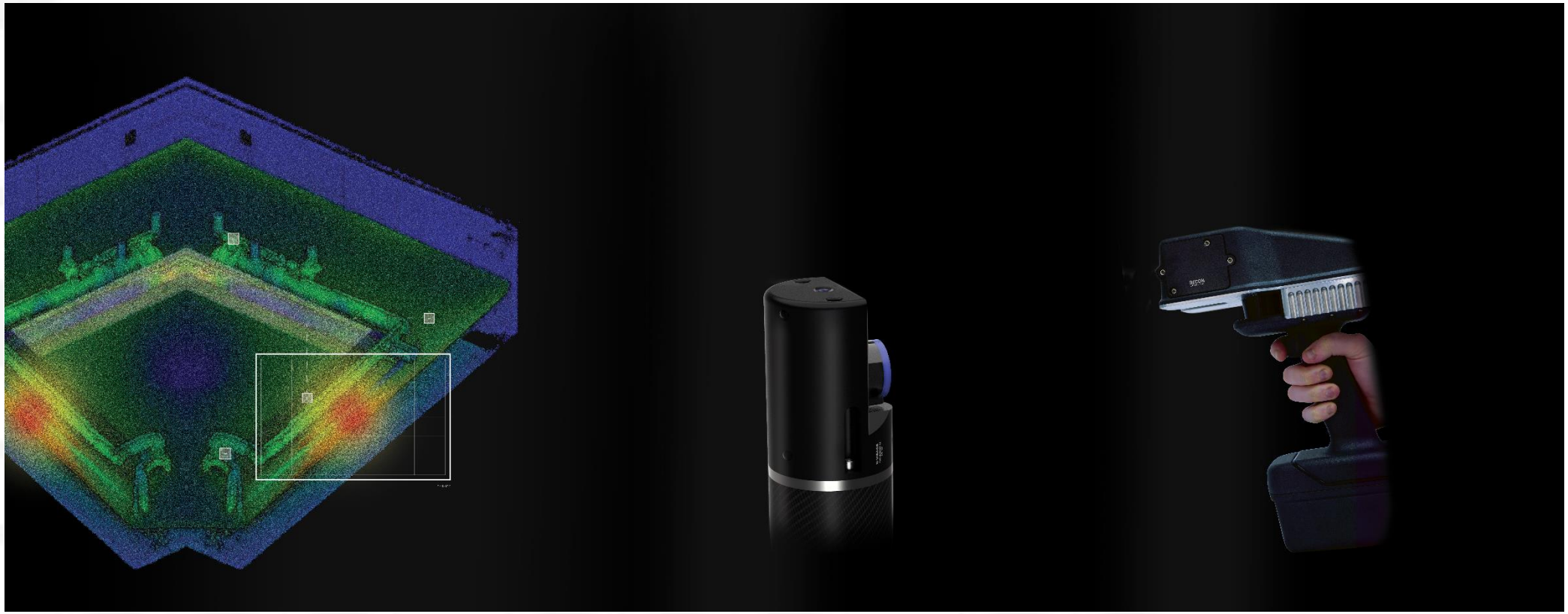

NVisage Fusion® Software

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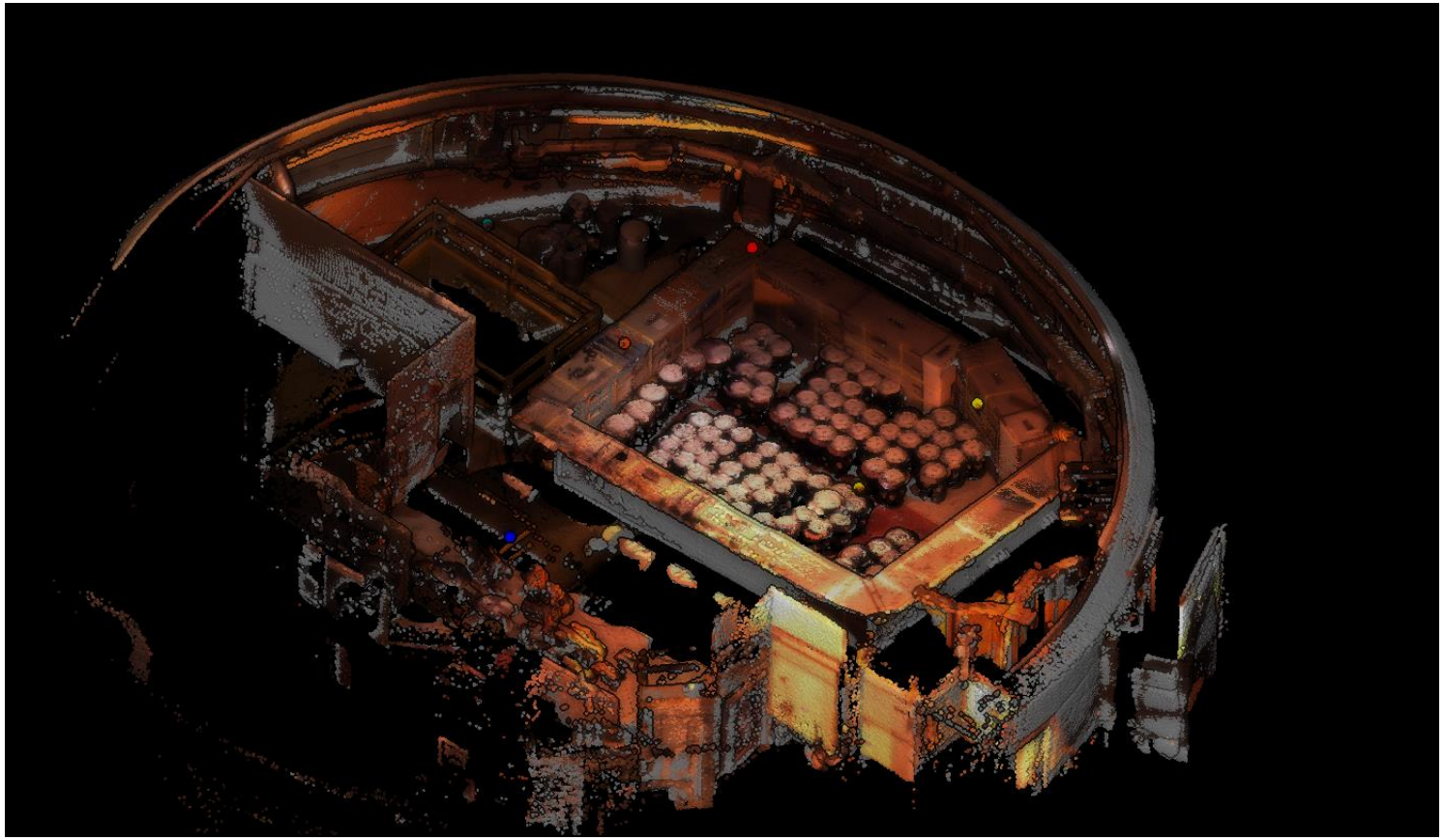
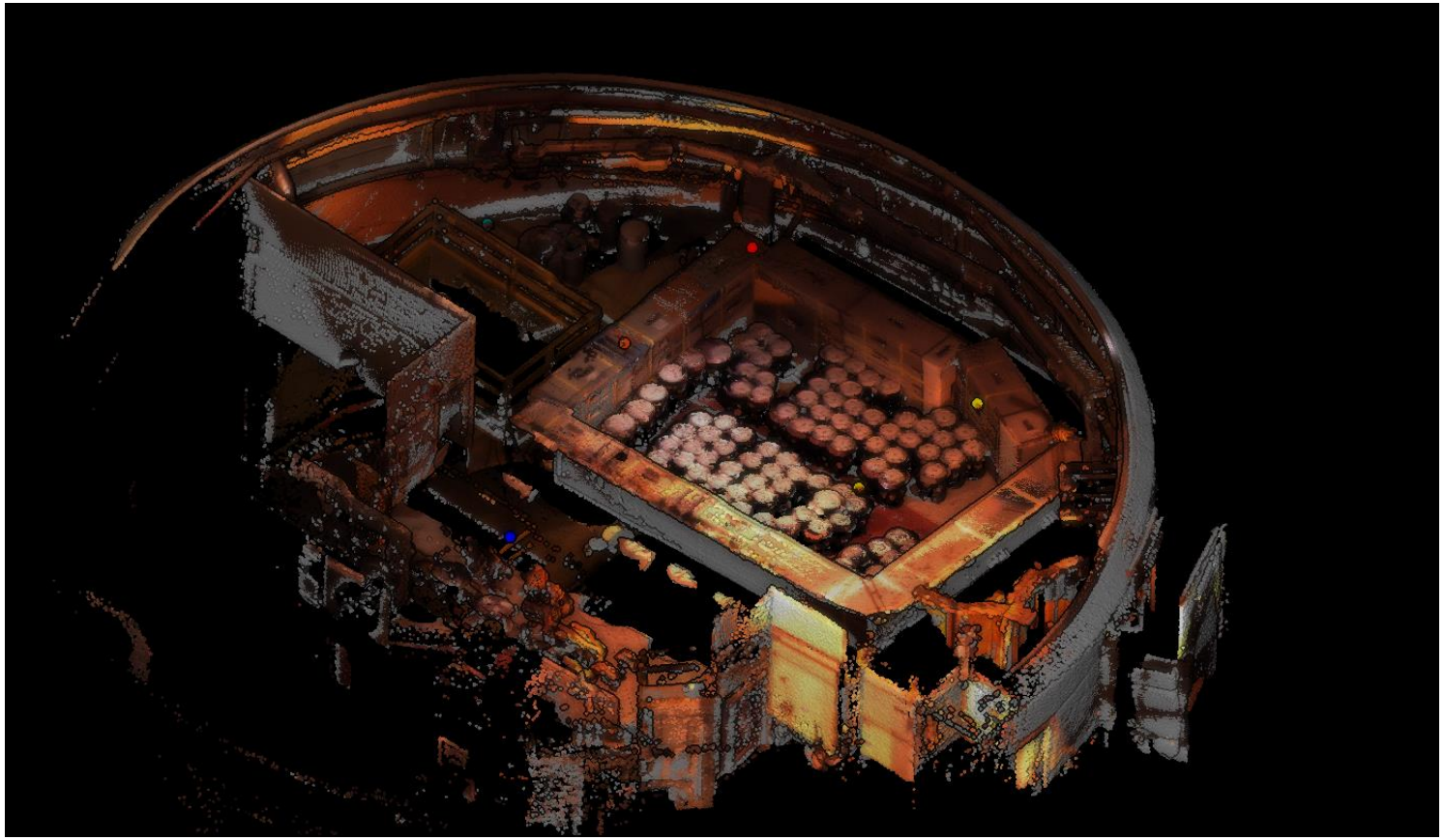
Create Technologies

- Specialise in applied imaging and sensing R&D
- Founded 2010 as part of the R3i group, from a nuclear consultancy in the UK
- N-Visage™ nuclear characterisation system
- Developing a range of characterisation tools for a wide variety of challenging applications
- Winner Queen's Award for Enterprise 2018 - International Trade



- Aims
- Case study
- Algorithms
- Equipment
- Further work
- Conclusion

NVisage Fusion topics



- Combines Radiometric data and 3D geometric data (like CAD, LIDAR scanner)
- Calculates dose uptake for any location
- Calculate activities
- Calculate potential shield effectiveness

NVisage Fusion aims

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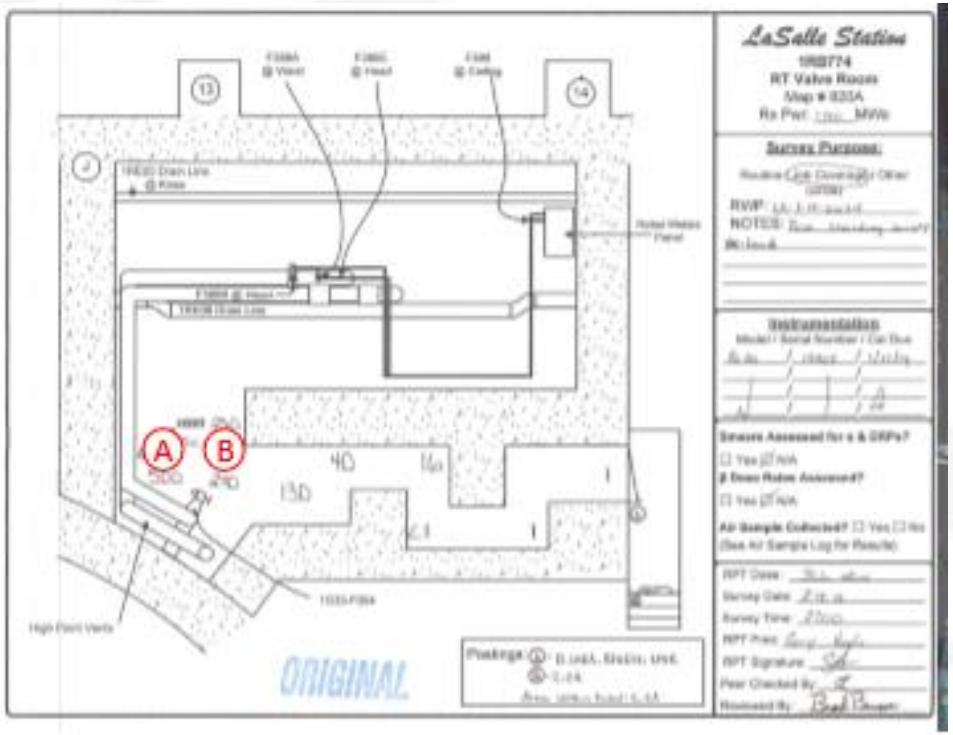
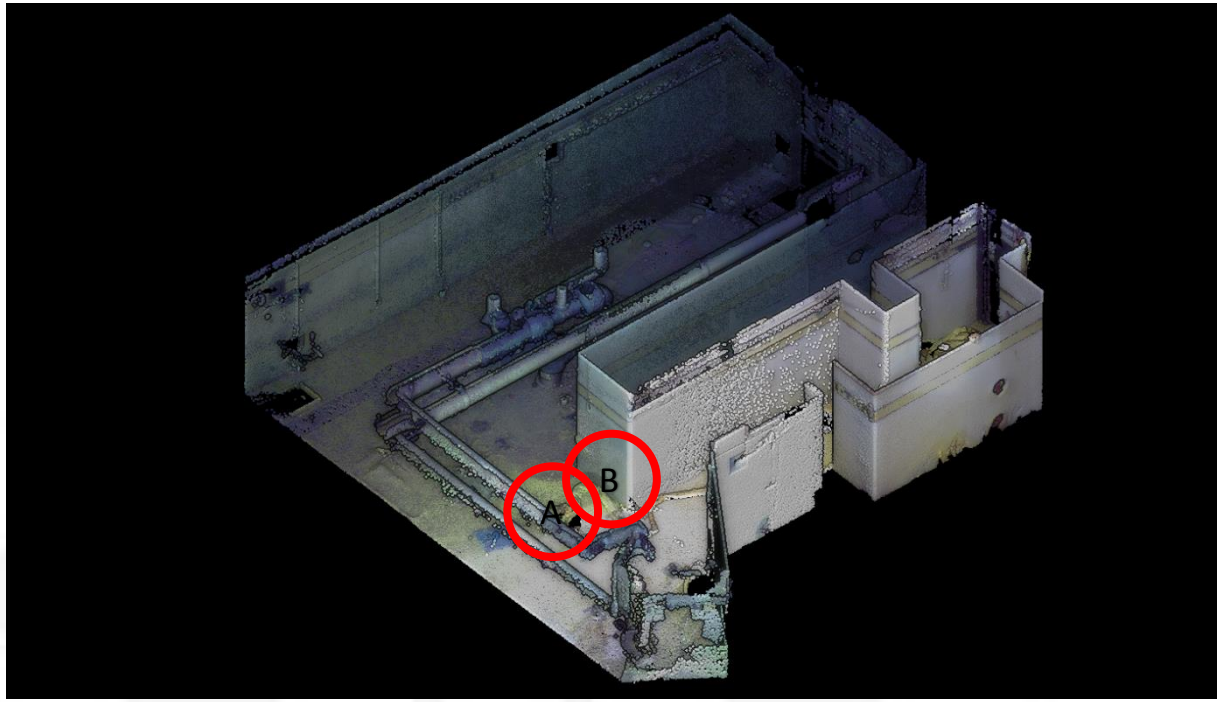
LaSalle case study

- Real world study
- LaSalle GE BWR
- Maintenance of a valve during outage
- NVisage Scanner took data
- 3D point cloud radiation model
- Optimised shield package
- Aim: reduce doserate by 50%

LaSalle – RT Valve room



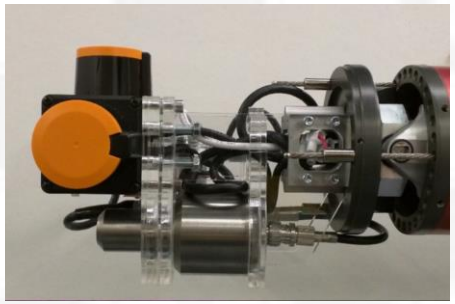


3D Characterisation – The N-Visage Eco System

Scanner

Recon

Riser UAV



Ground Robots

Data Collection

3D Point Cloud

Panoramic Image

Radiation Measurement

RGB PointCloud

2D Visualisation

3D Contamination Model

Local Dose Estimates

Spectroscopic Fingerprint

3D Characterisation

Model Scenarios

Waste Characterisation

Dose Planes

Shielding Design Evaluation

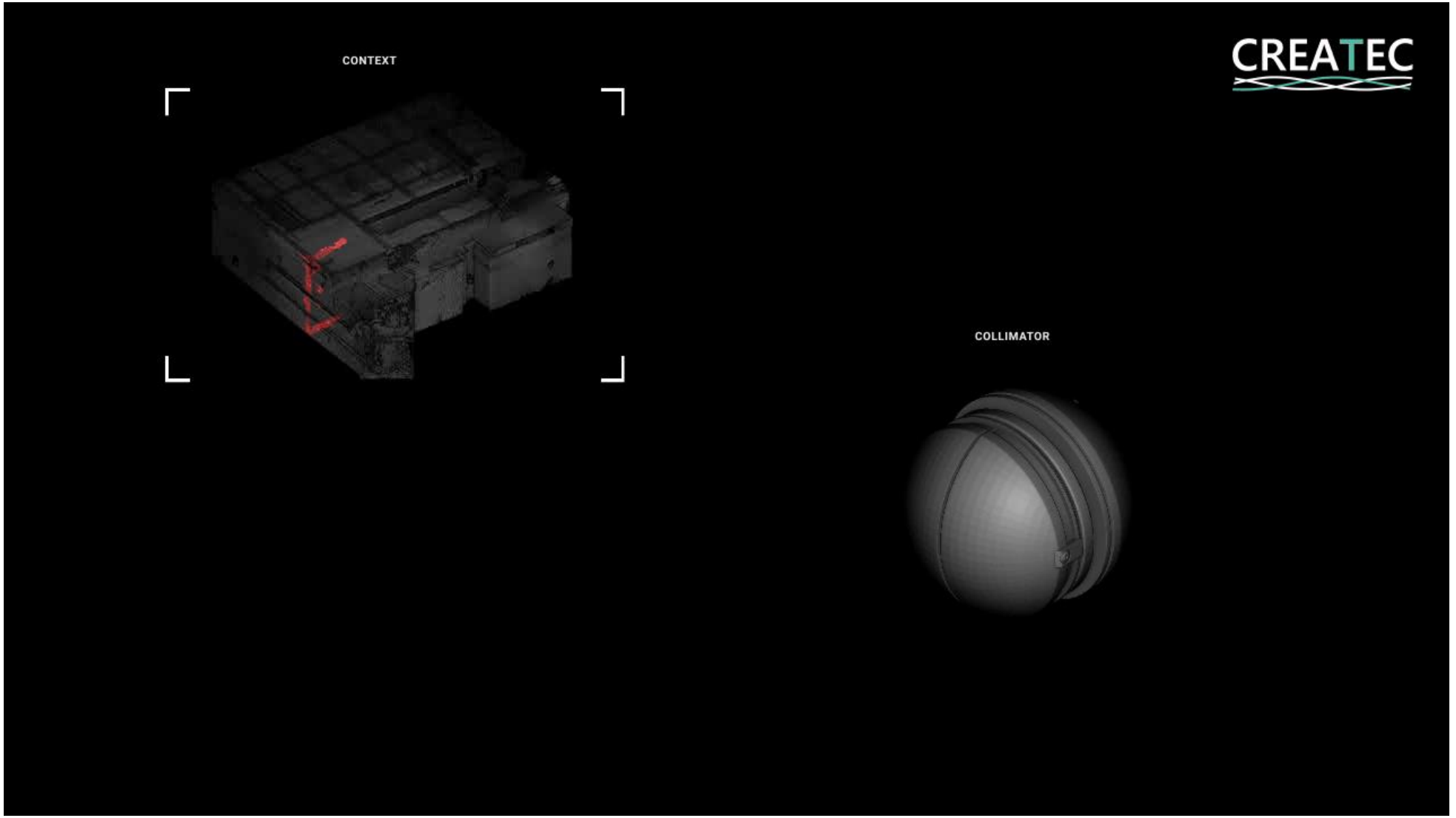
N-Visage Software

VR/AR Plugins

Virtual Planning

NVisage Fusion data sources

- Createc have products to simultaneously get the location, geometry and radiometric data.
- NVisage Scanner® scans the room from a stationary location by moving a collimator around the detector.


CONTEXT
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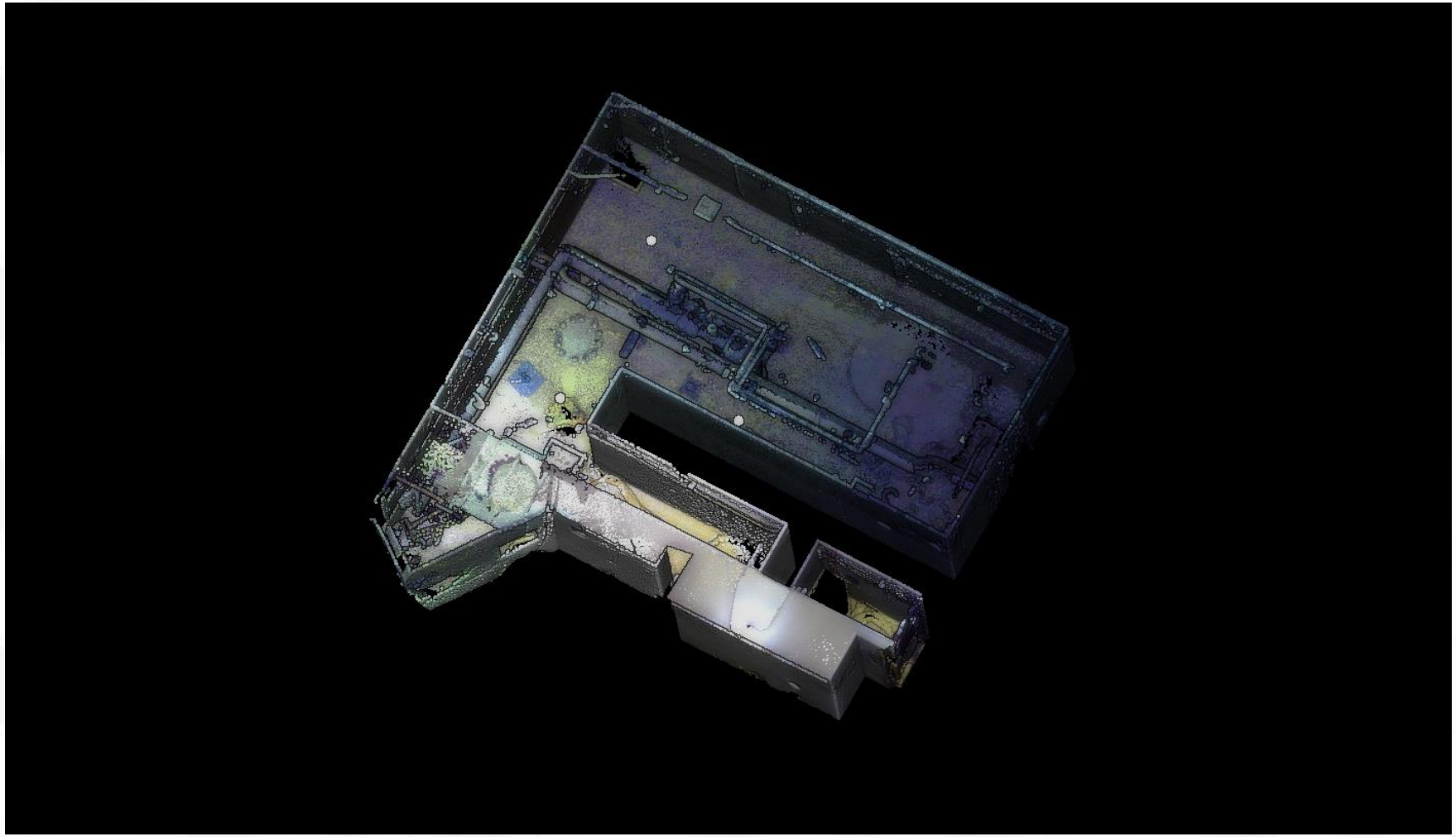
COLLIMATOR

Using the scanner



NVisage Fusion method

- *Sources (s)*
  - points in space (xyz) potential sources of activity
- *Readings (d)*
  - Location, pose and dose or net peak area
- **A** is the matrix defining the distance between each *i* and *j* source and reading, the shielding between them and the detector efficiency at that pose.

$$\underline{d} = A\underline{s}$$

NVisage Fusion method

- **A** is the matrix defining the reduction in intensity with the distance between each *i* and *j* source and reading, the shielding between them and the detector efficiency at that pose.

$$A_{ij} = \frac{Ke^{-\lambda_{ij}}}{r_{ij}^2}$$

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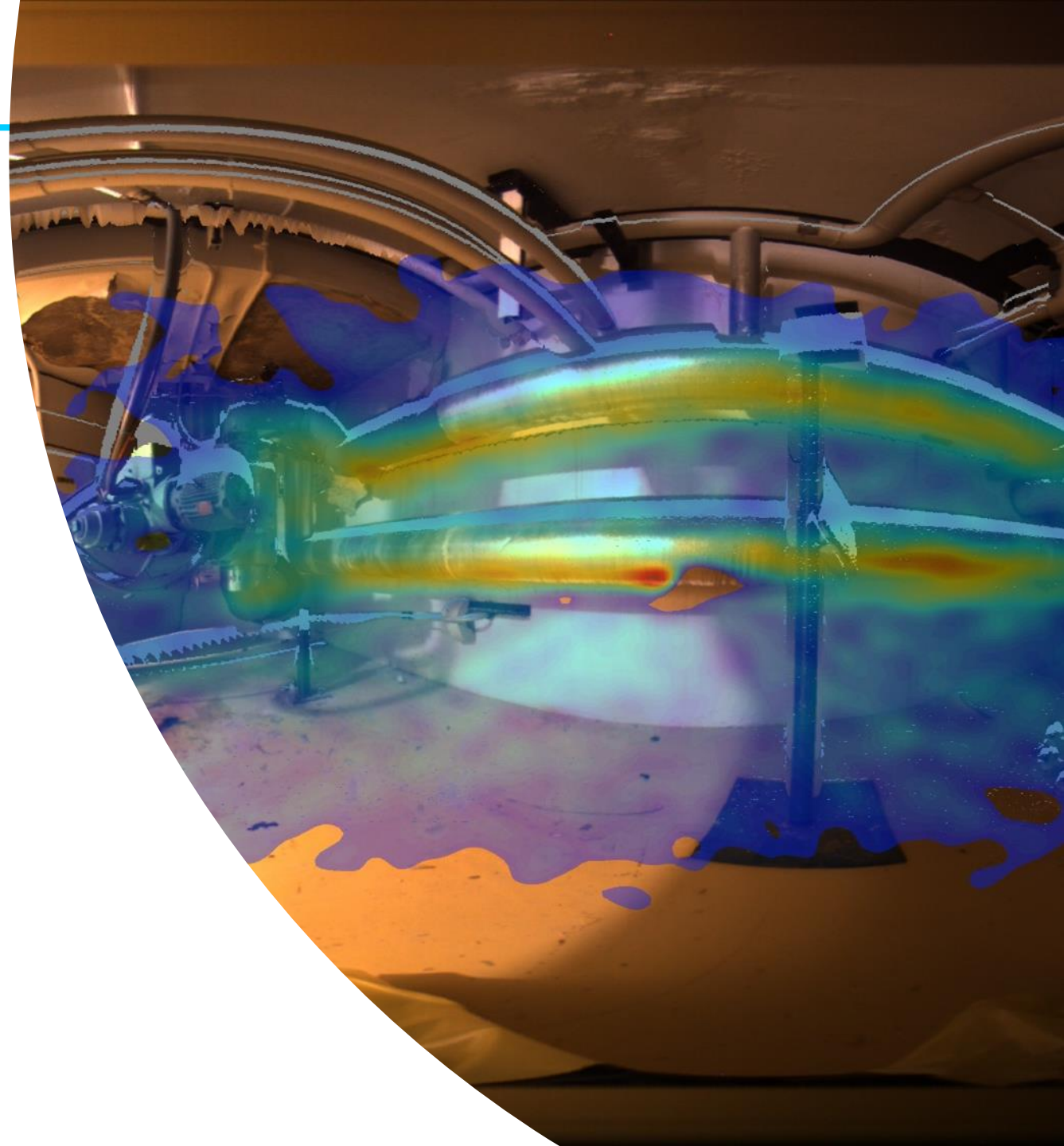
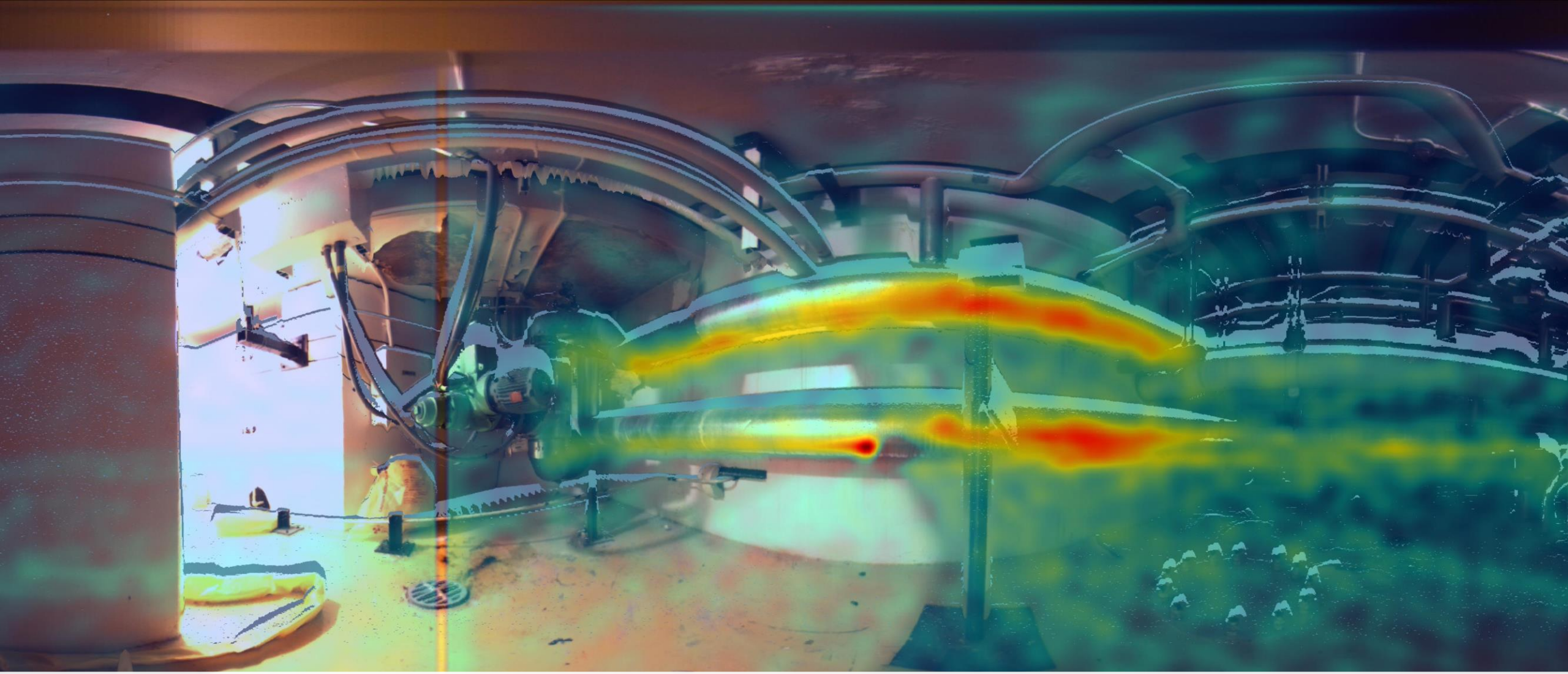
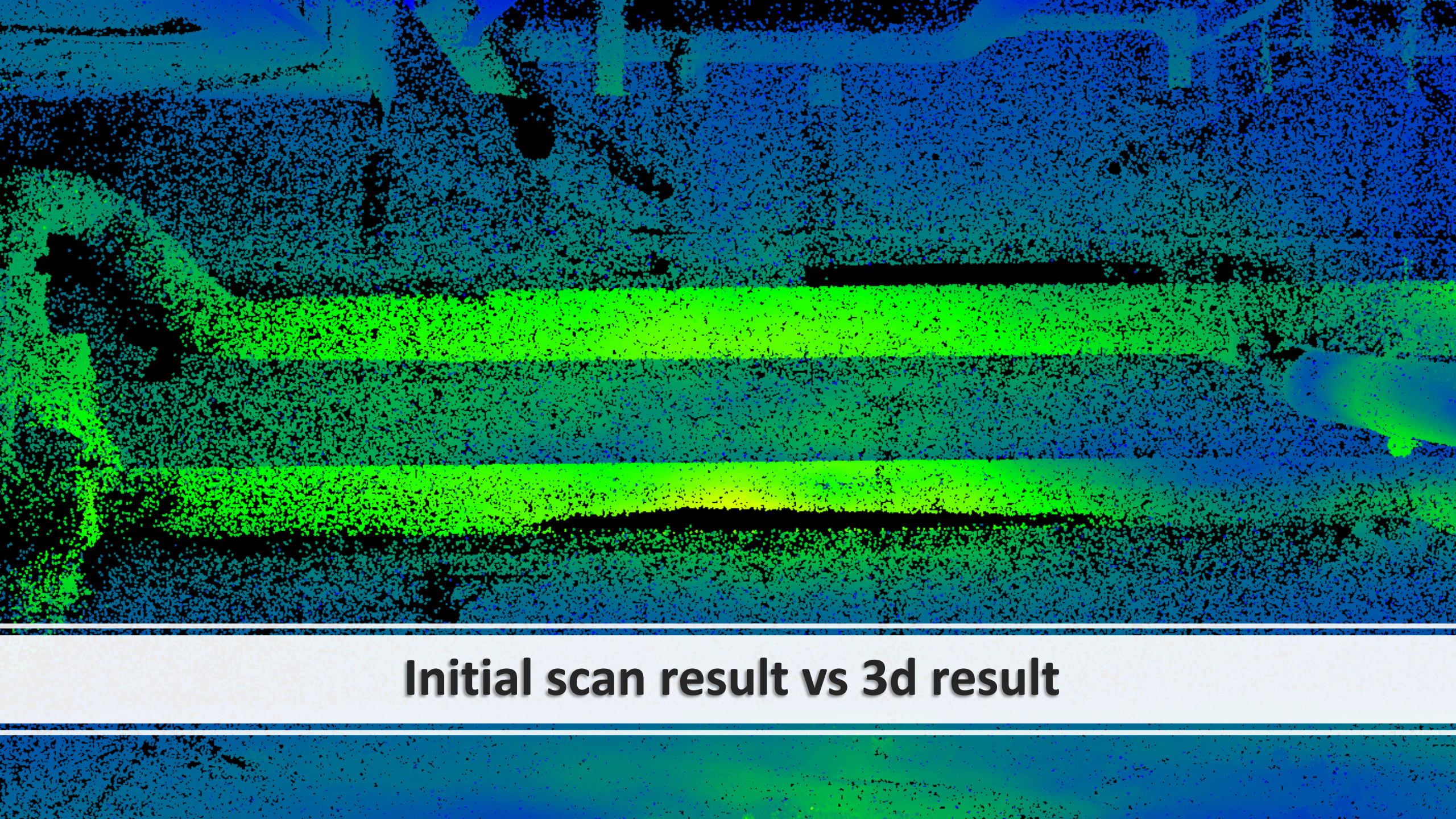
NVisage Fusion method



- Linear equation of underdetermined system
- multiple solutions
- Searching for best solution
- Positive constraint
- Minimise L2-norm.
- ART/ projected Landweber



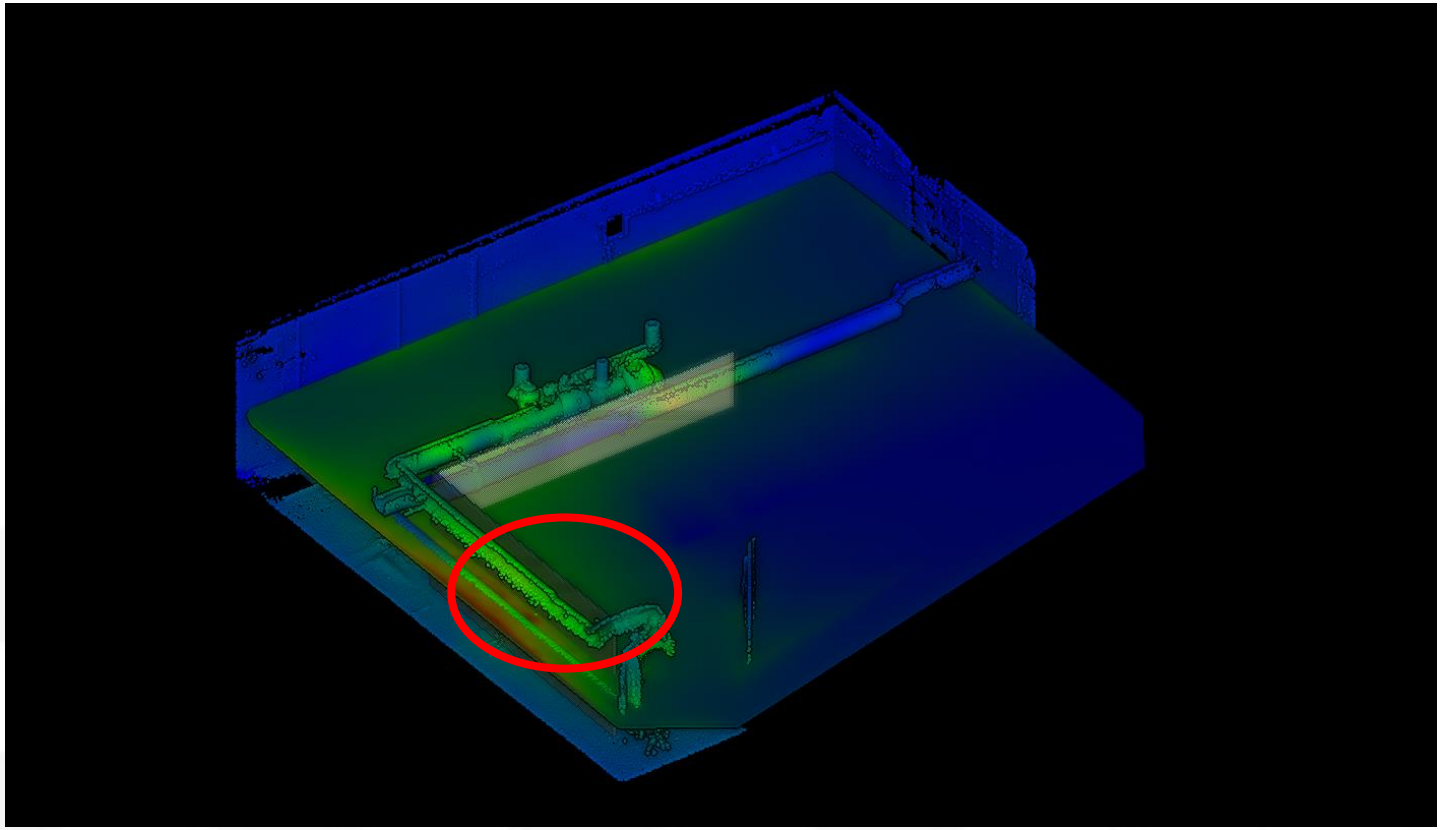
Initial scan result vs…



Initial scan result vs 3d result

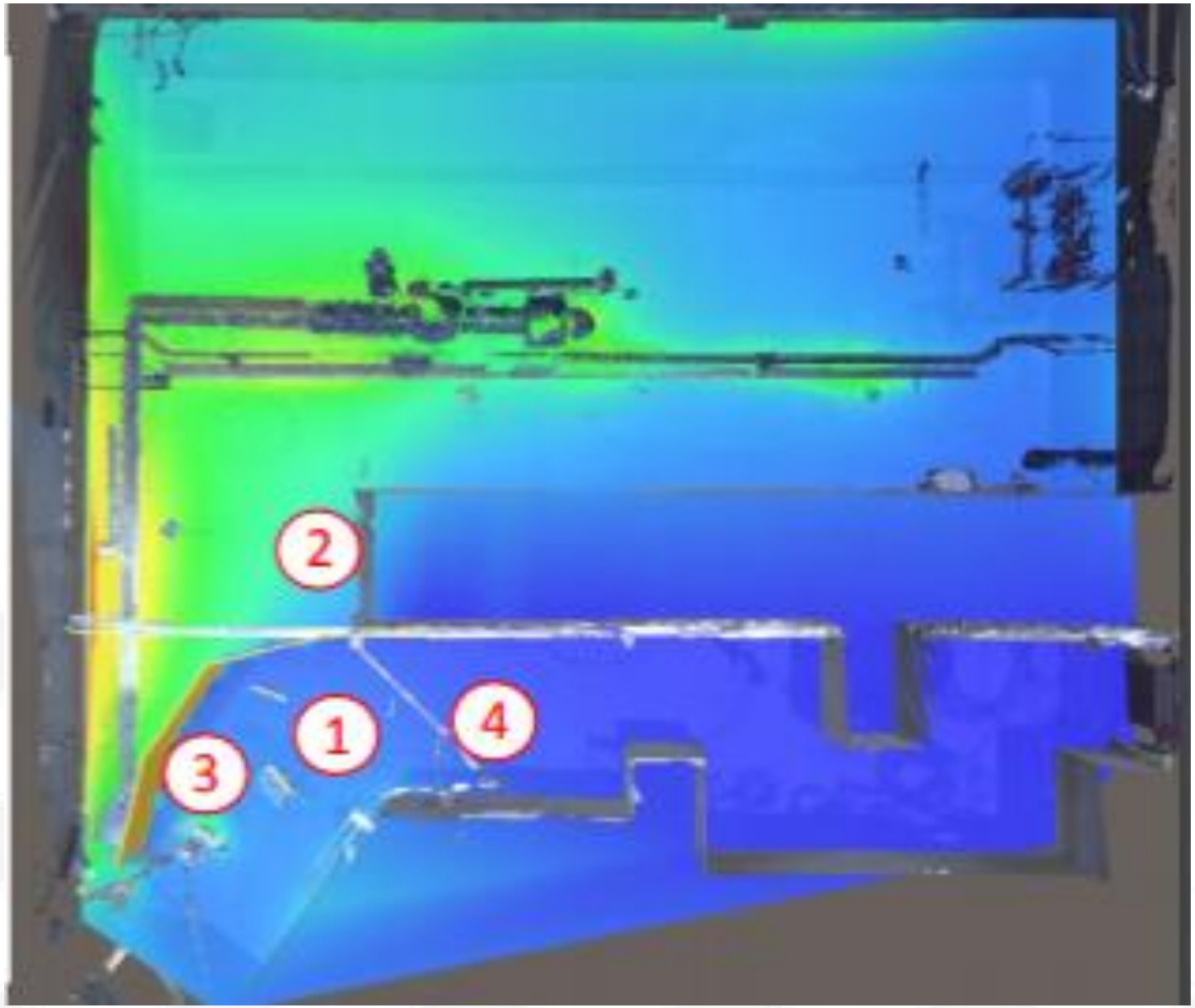
LaSalle – RT Valve room

- Solution shows activity on pipes and valve
- Doseplane shows higher rates (circled red) for workers



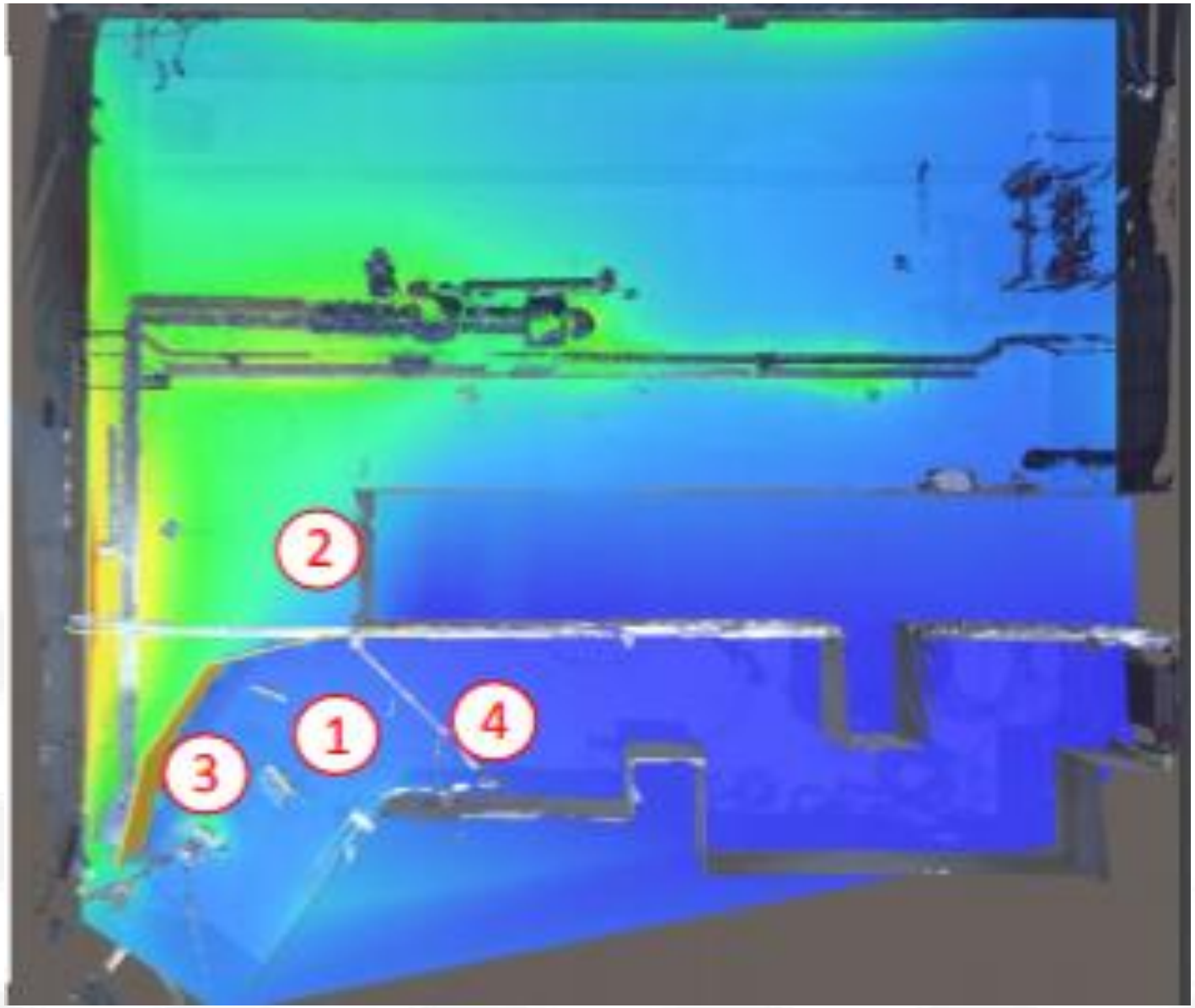
LaSalle – RT Valve room

- Several different shield arrangements were tried to reduce worker dose
- Curved shield optimal



LaSalle – RT Valve room

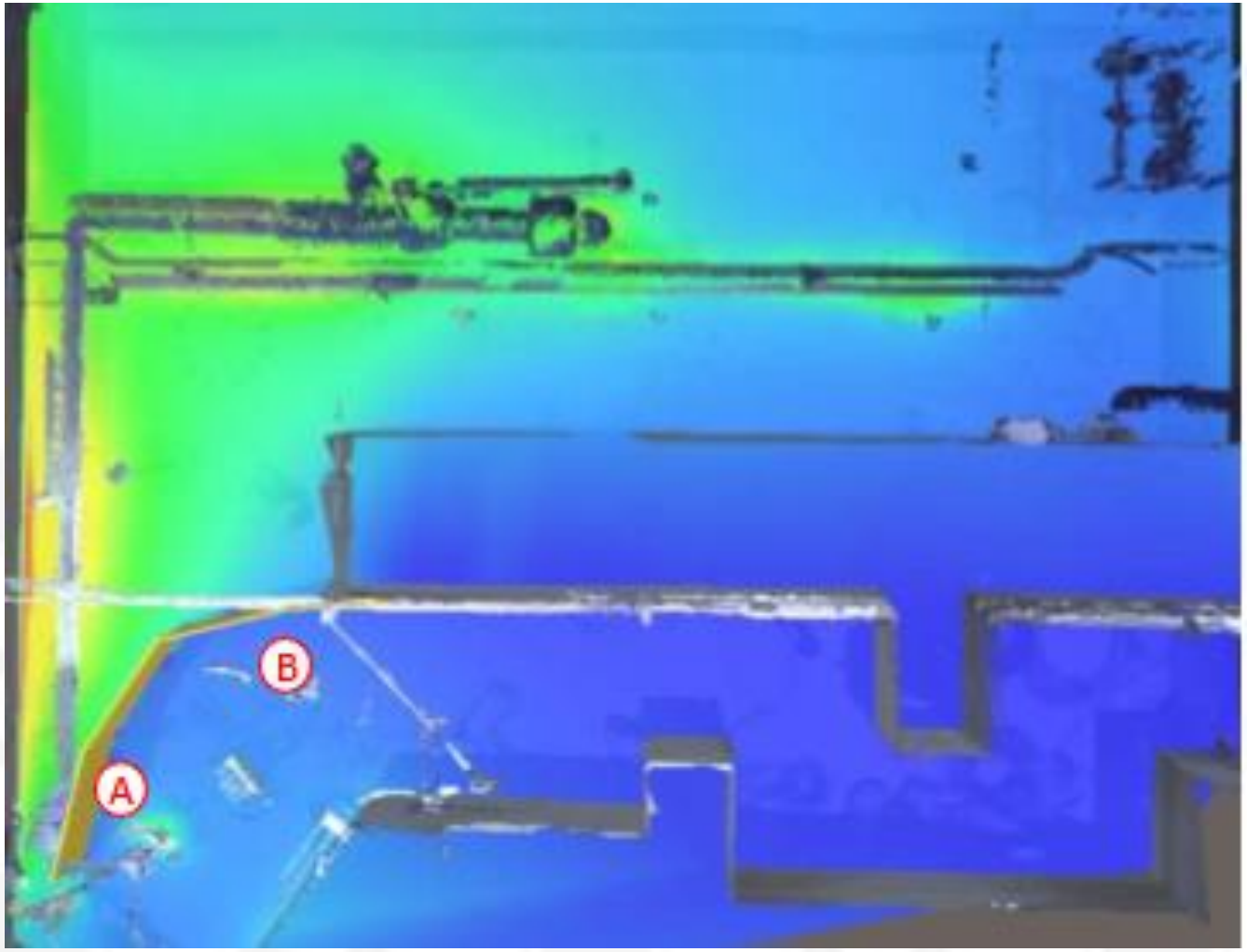
Location	Hot Spots	Optimized Shielding	
	mRem/h	mRem/h	% Reduction
1	756	422	45%
2	901	824	10%
3	1242	414	68%
4	286	169	42%



LaSalle shielding solution

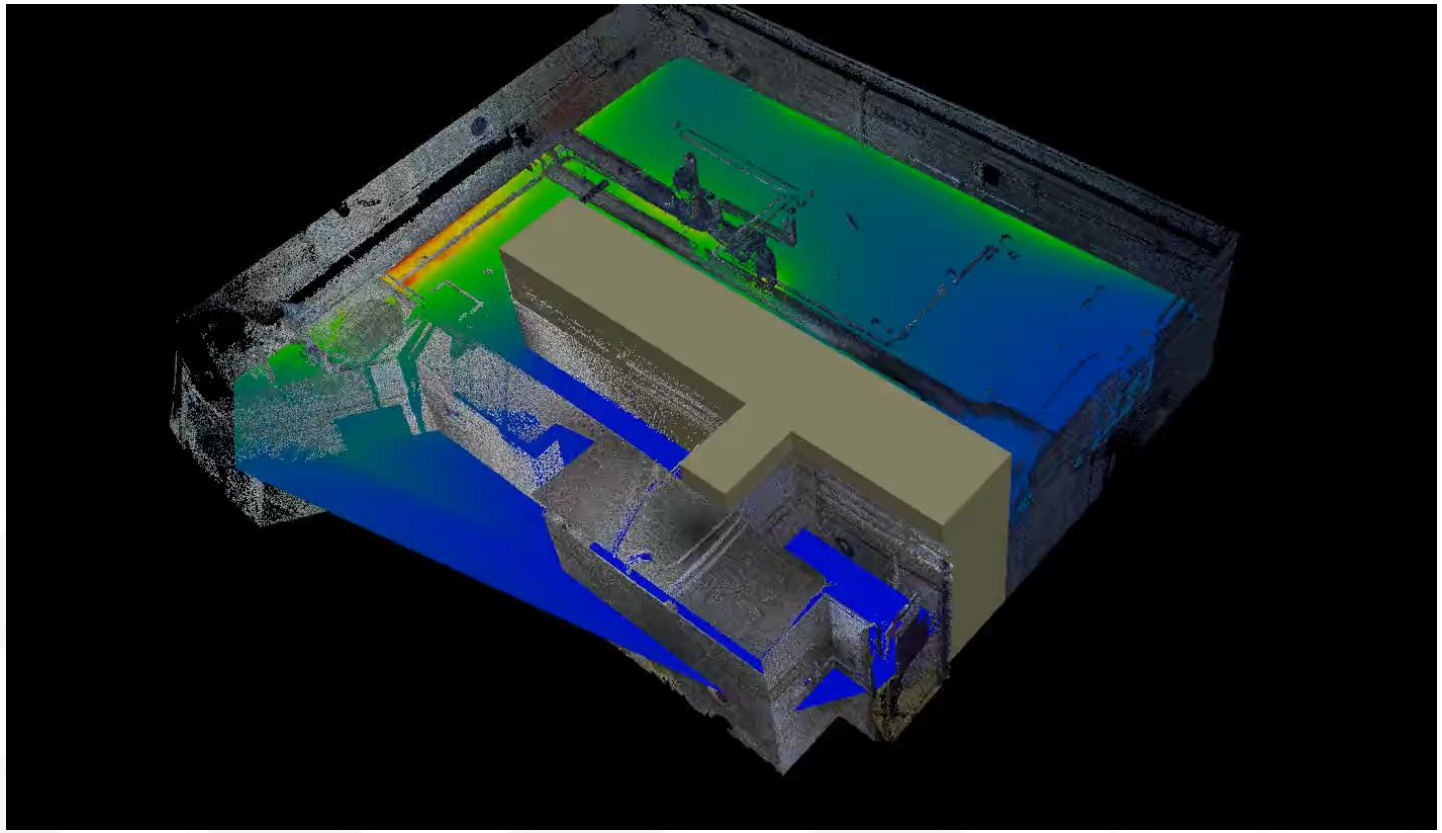
- Reduction in doserates with a shield added
- The shield was added and comparison between calculated and survey shows good agreement

Survey Location	Survey Data	RadVision3D® Data	% Error
A	500 mRem/h	483 mRem/h	3.5%
B	290 mRem/h	270 mRem/h	7.4%



Future developments

- VR – worker training
- Aim to put the worker in the environment
- Give them training on where to work, how long they have
- Perhaps even virtually move shields in or cut items out in real time and see the effect on the doseplanes



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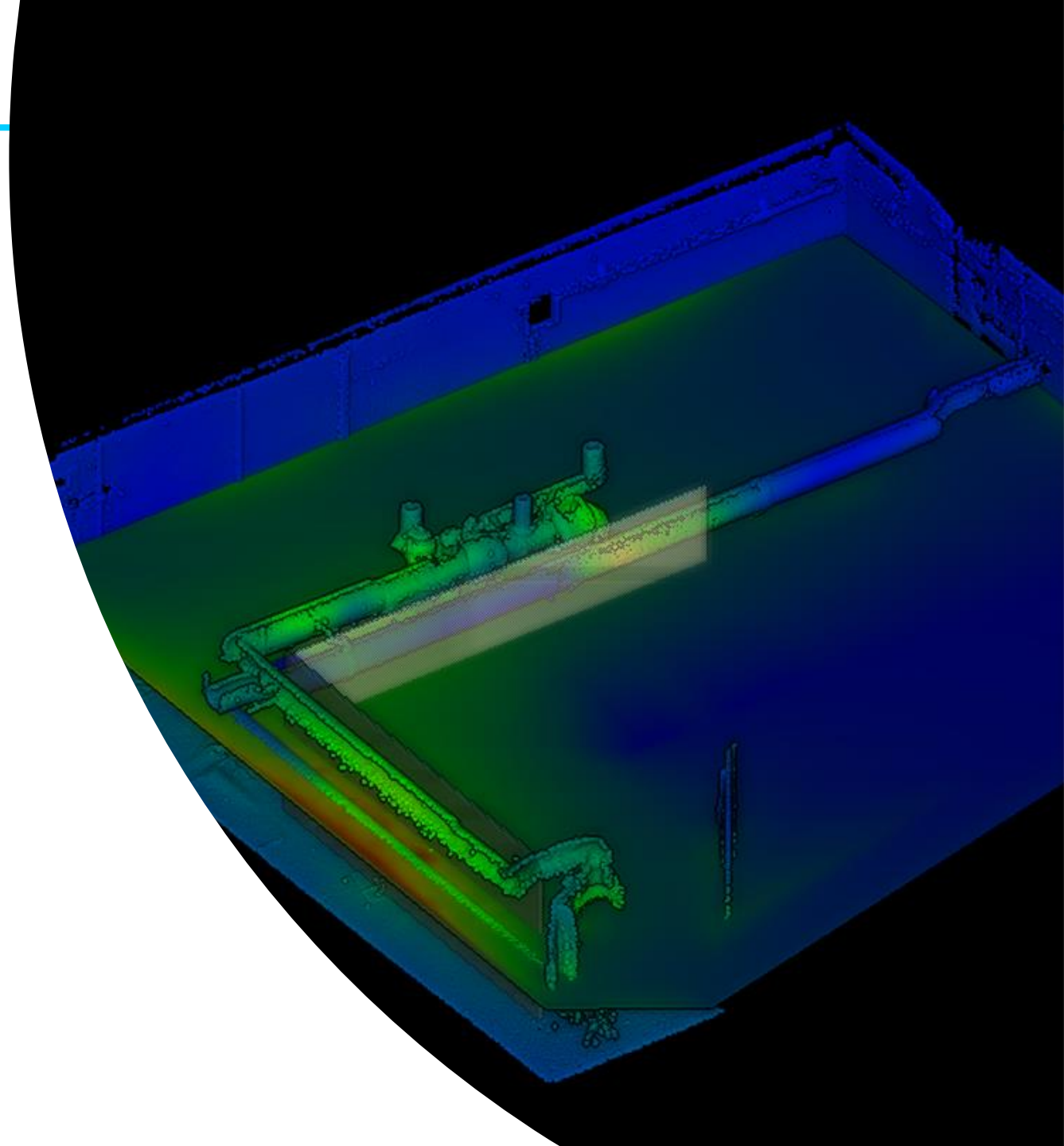
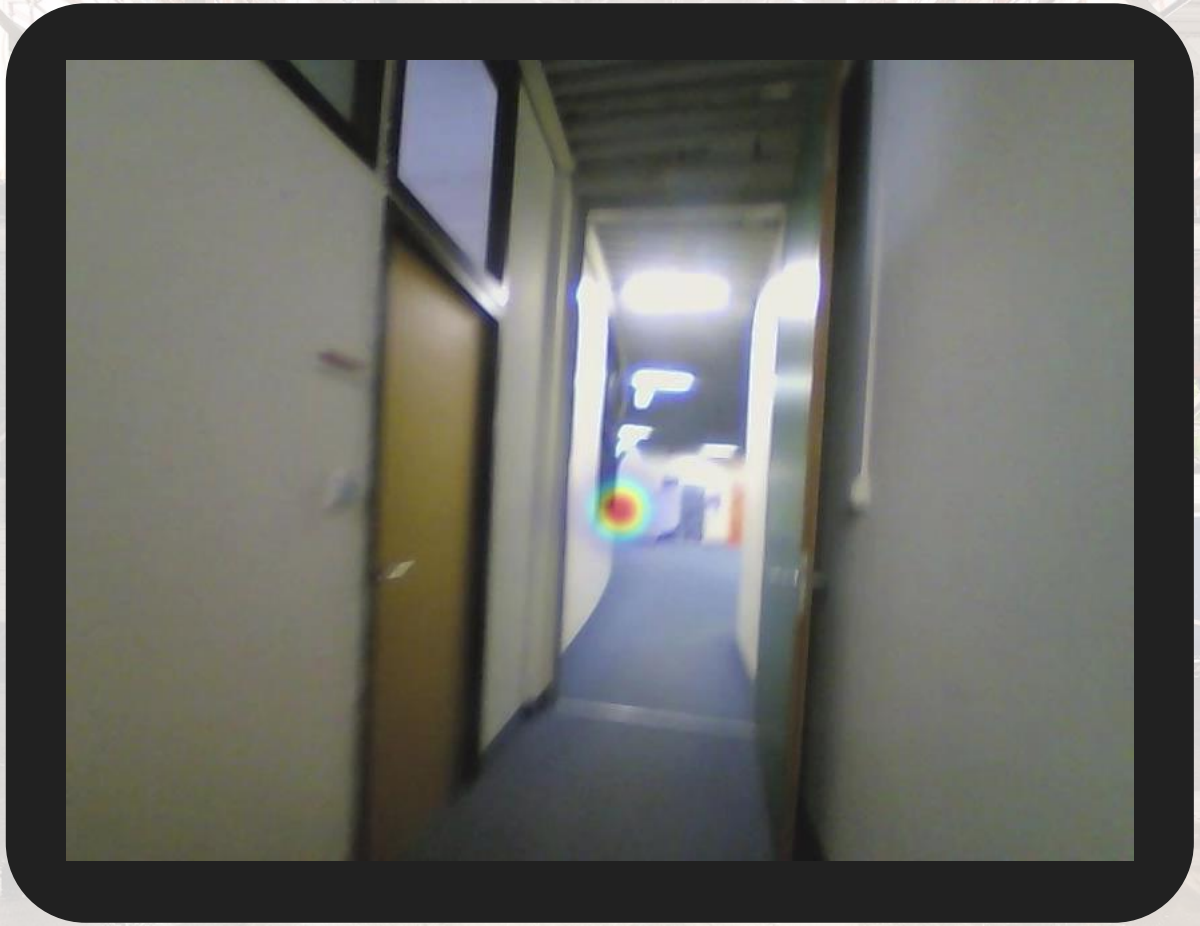
Conclusion

- NVisage Fusion can take multiple radiation readings,
- Geometry in CAD or LIDAR measurements
- Shielding structures from CAD
- Analyse to locate the source of radiation
- Solve to calculate dose rate anywhere
- Add shielding in the model to work out the effectiveness.



NVisage RECON®

- Cost saving by reducing survey times
- Guided route plan shown on display
- Minimise human exposure to radiation
- Simple intuitive user interface for non-expert users
- Accurate record of user route and movements
- Plan of survey area produced
- Location of contamination can be shown on 2D plan or 3D model



Post processed video, not real time

Prototype display