Virtual, Immersive and Augmented Reality – Feasibility Study On The Applications Of The HVRC VRdose Planner

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Agenda

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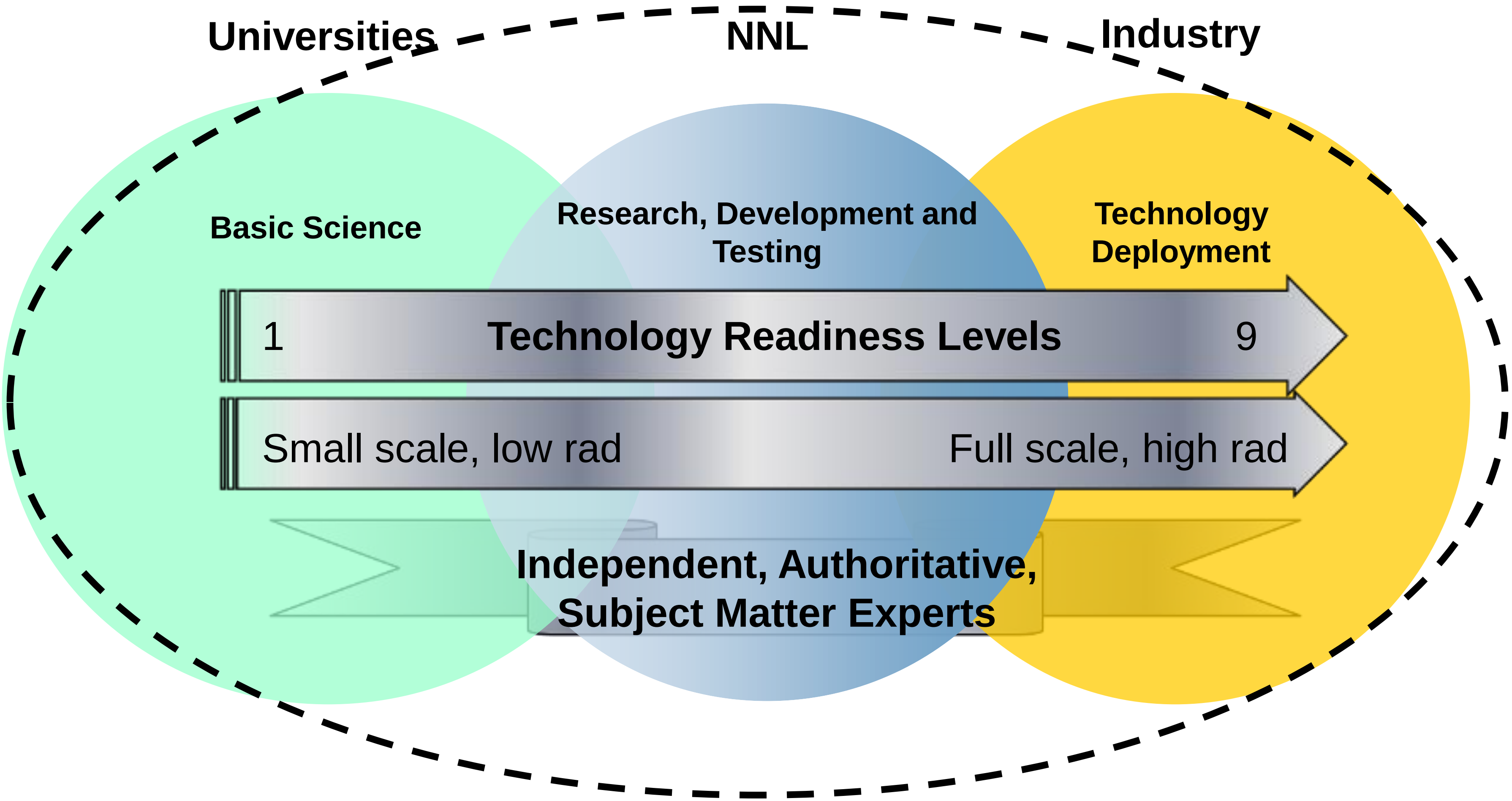
- National Nuclear Laboratory
- Project Scope
- HVRC VRdose Planner
- Design Simulation
- Potential Applications
- Summary

National Nuclear Laboratory

National Nuclear Laboratory



Project Scope

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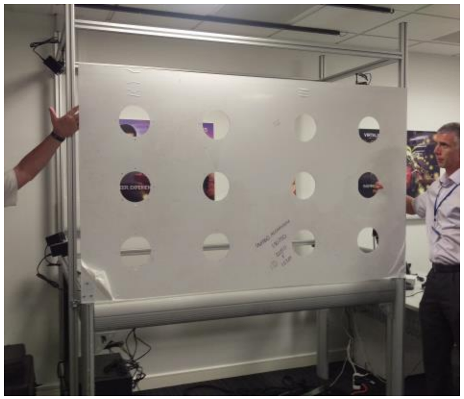
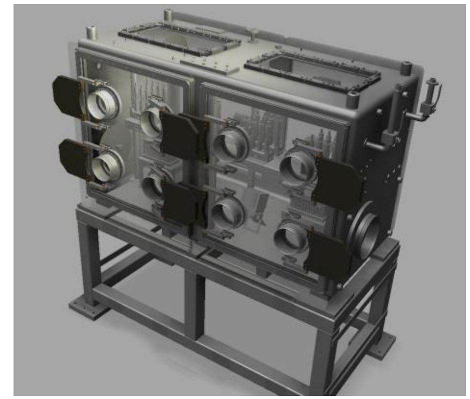
- Nuclear industry is generally resistant when using new technology for the purposes of design and development
- IR&D project focused on developing NNL's immersive and augmented modelling capabilities
- Vision – To develop a state of the art capability applicable to nuclear design and decommissioning
- Two strands:
  - Virtual Glovebox
  - HVRC VRdose Planner

Virtual Glovebox





HVRC VRdose Planner

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- Developed by Institute for Energy Technology at the Halden Virtual Reality Centre (HVRC)
- Simulate and mitigate radiological risks in a 3D virtual environment
- Provide an interactive virtual representation of an active area with all associated radiological risks
- Feasibility study testing software capabilities in an NNL industrial application

Design Scope

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- To develop a radiological assessment of installing a Pneumatic Transfer System (PTS)

- Three studies:

  - PTS Design

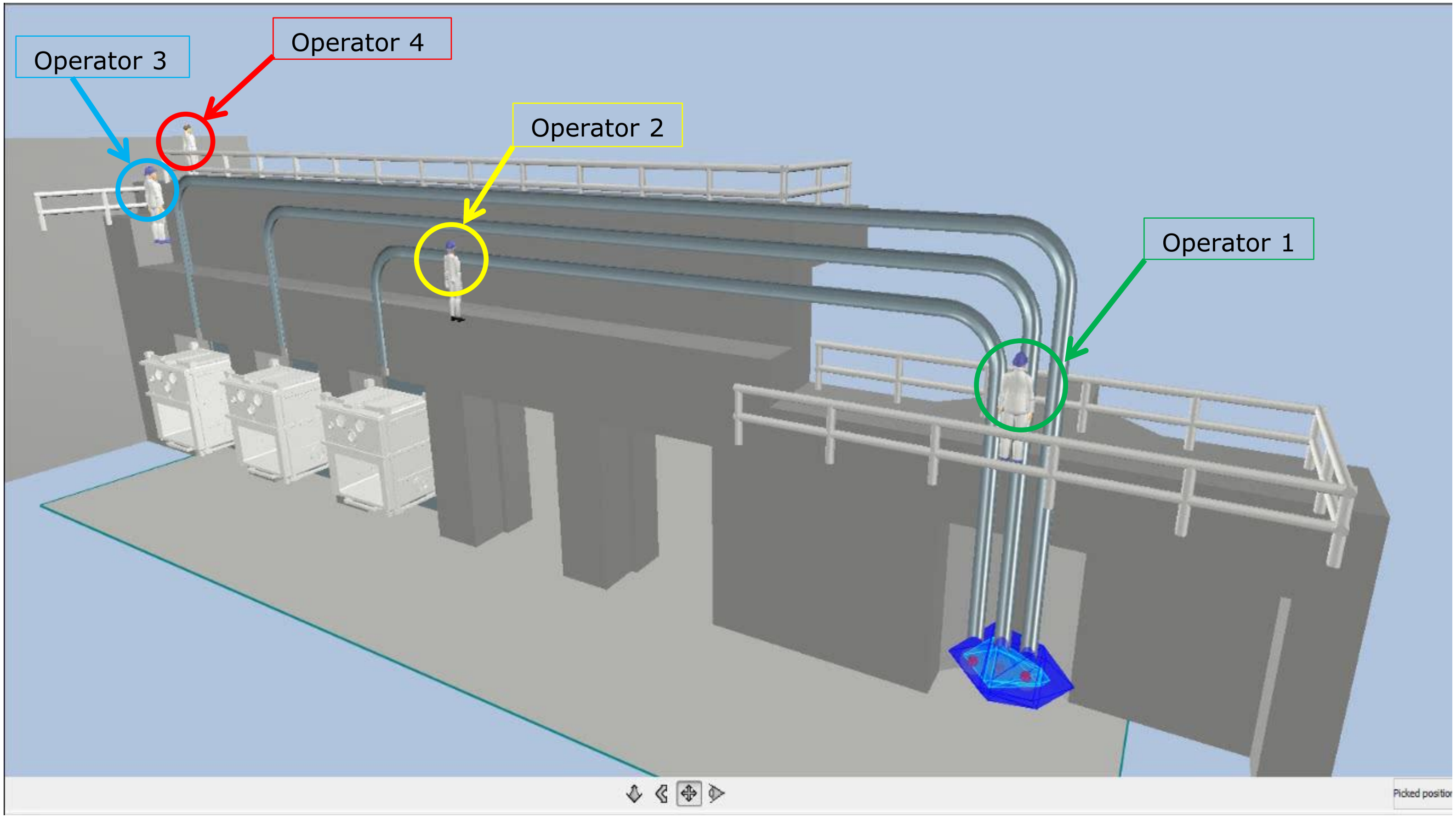
    - Optimum shielding material with respect to dose

    - Optimum pipe thickness with respect to dose

  - Operator Activities

  - Blockage

Simulation



— Operator 1 — Operator 2 — Operator 3 — Operator 4

Simulation Design

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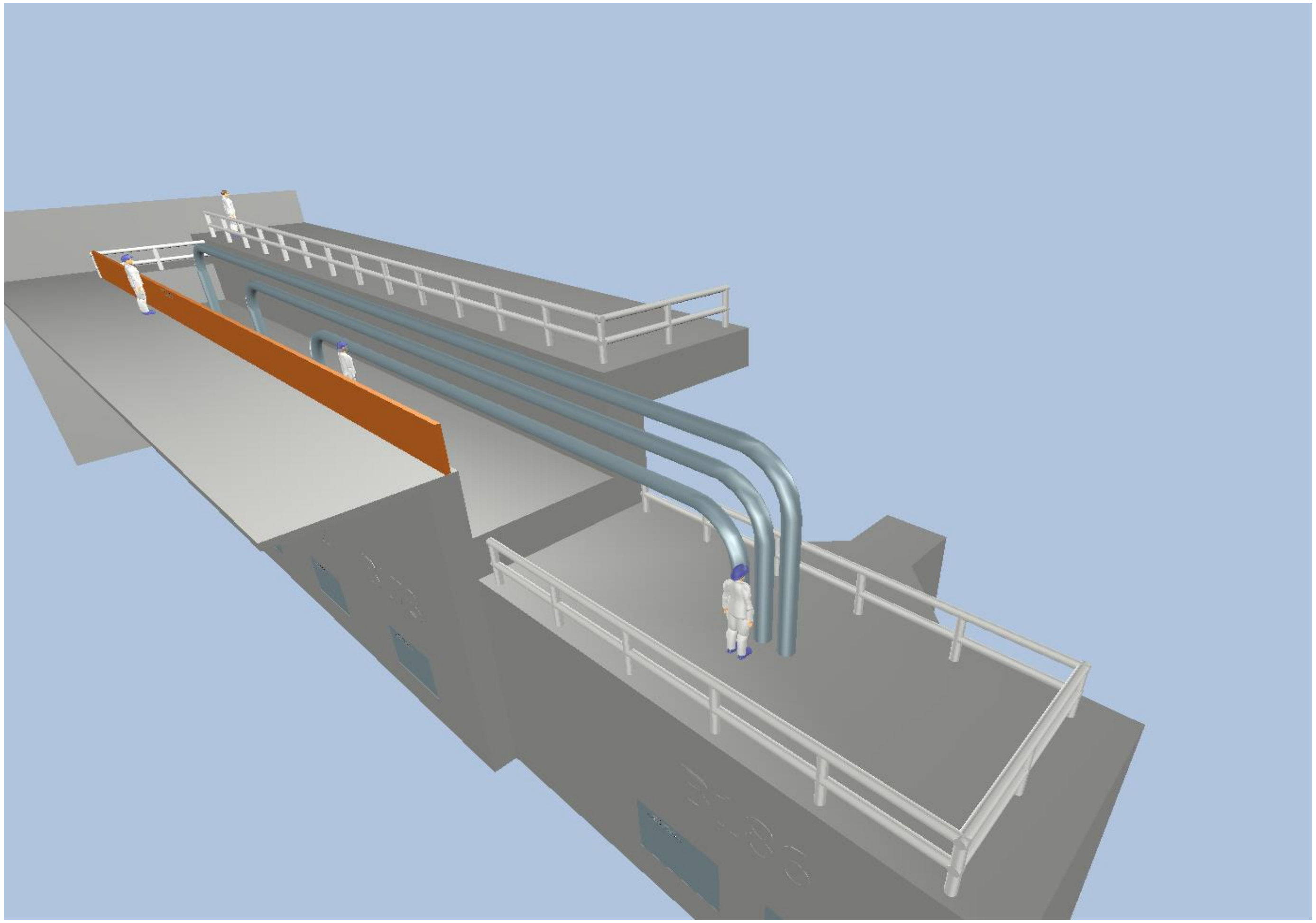

Optimum Pipe Specification

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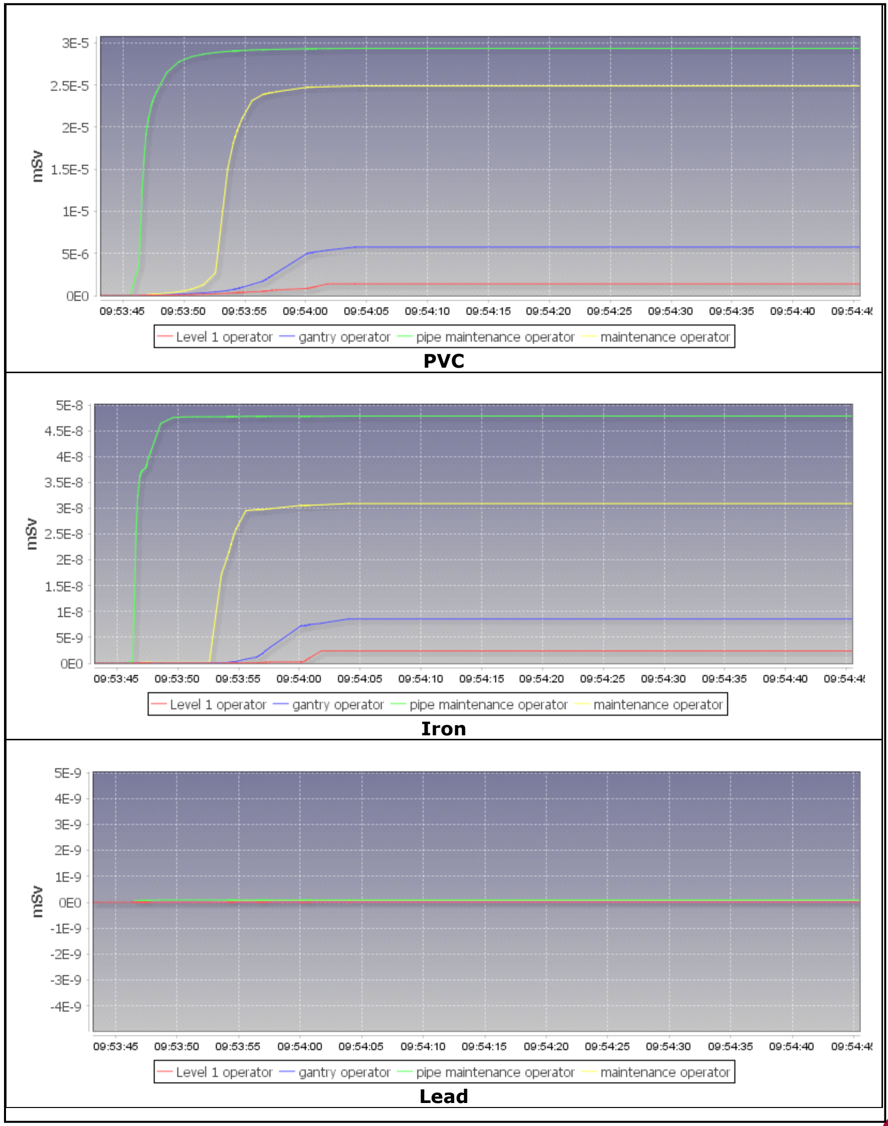
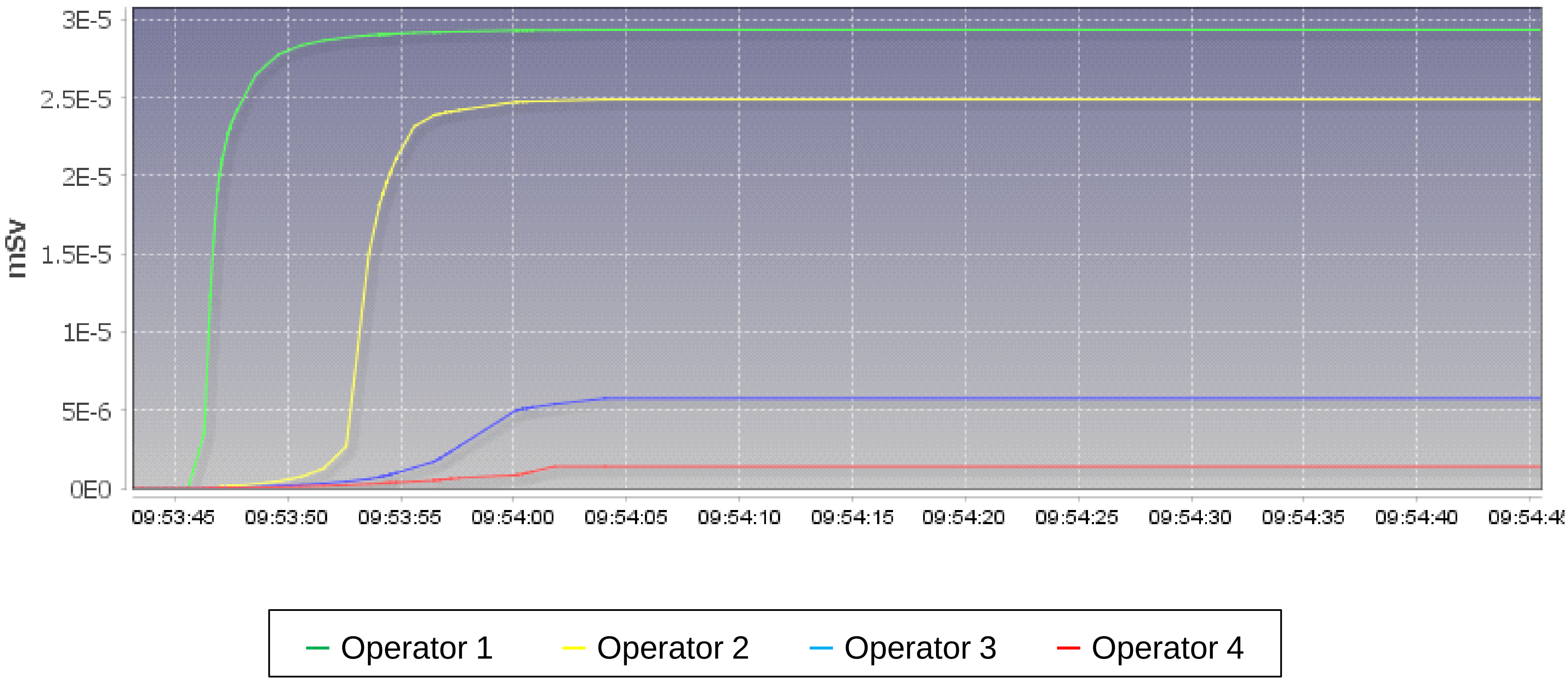
Three common piping materials:

- PVC – simulated by no shielding properties
- Stainless Steel – simulated by Iron
- Lead – simulated by Lead



Optimum Pipe Specification - PVC



Simulation

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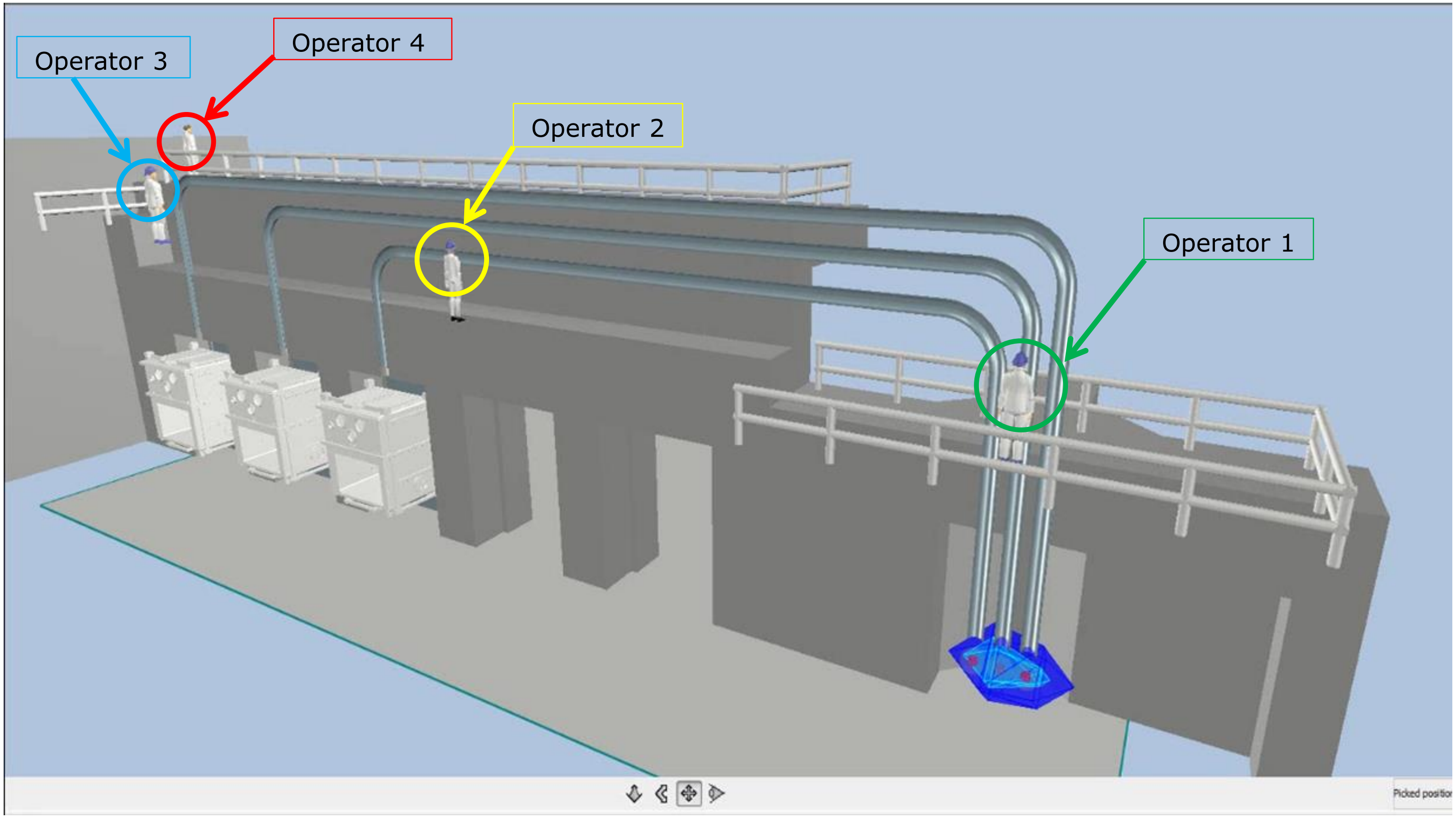
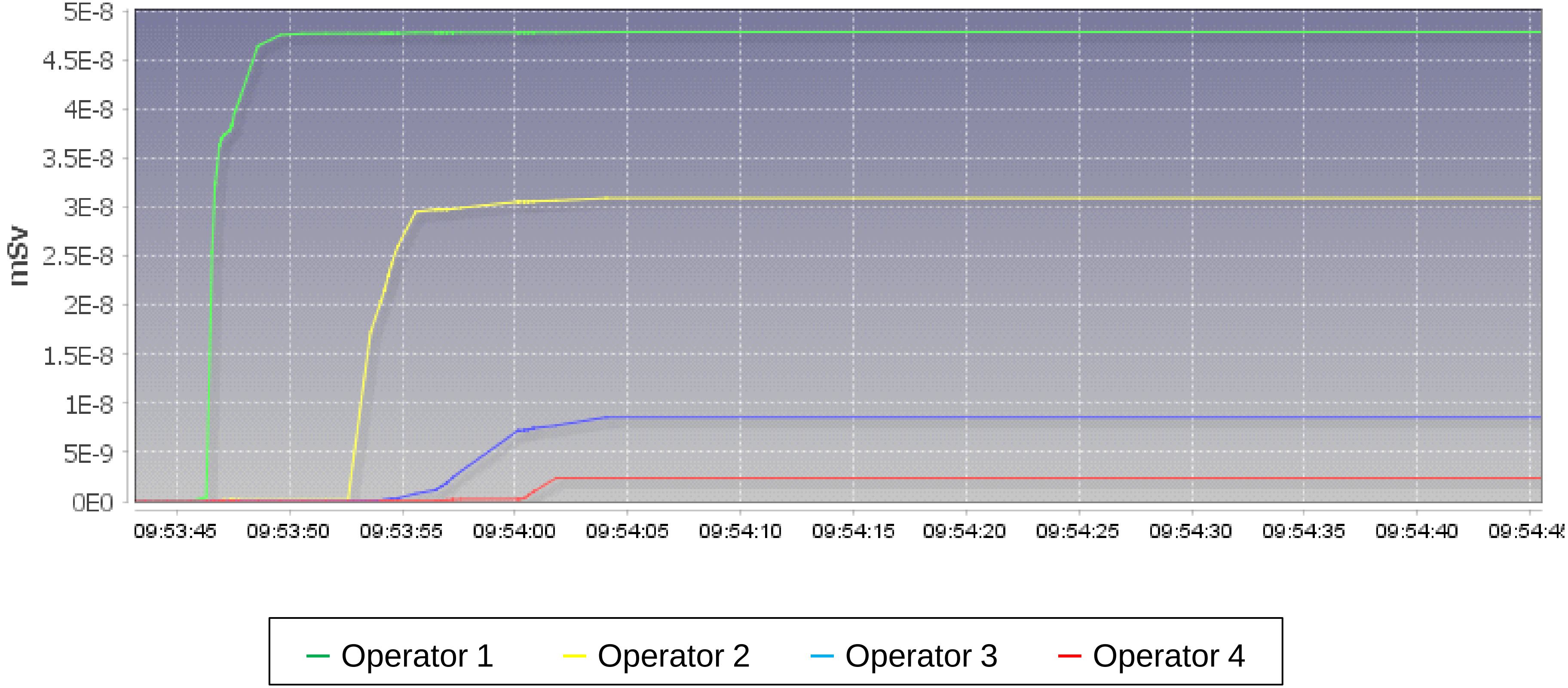


— Operator 1	— Operator 2	— Operator 3	— Operator 4

Optimum Pipe Specification - Iron



Optimum Pipe Specification - Lead

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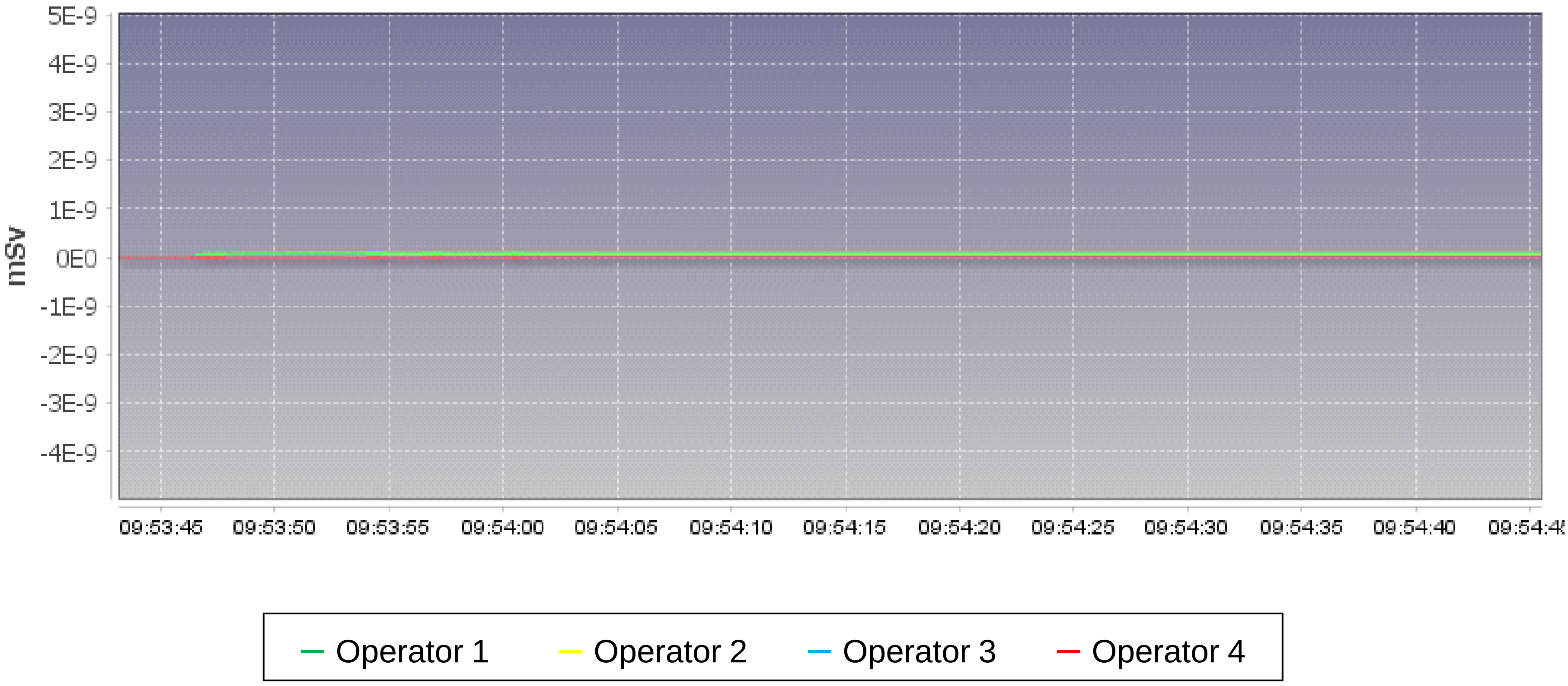

Optimum Pipe Specification

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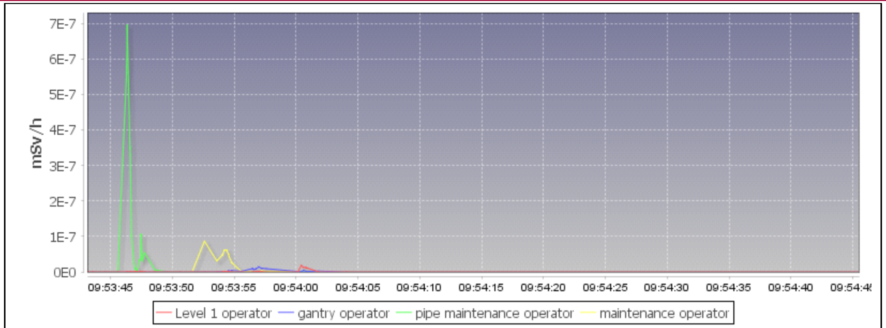
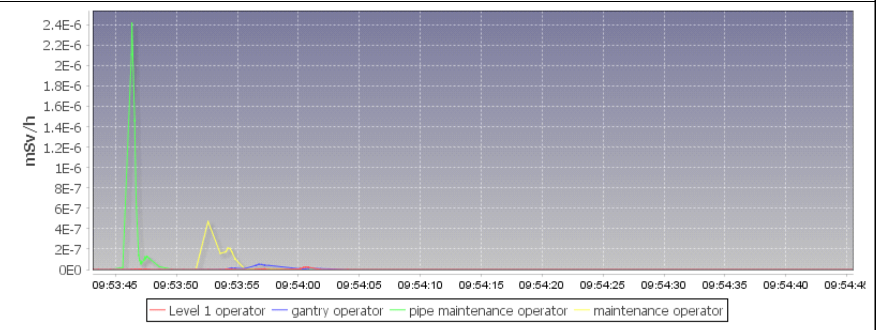
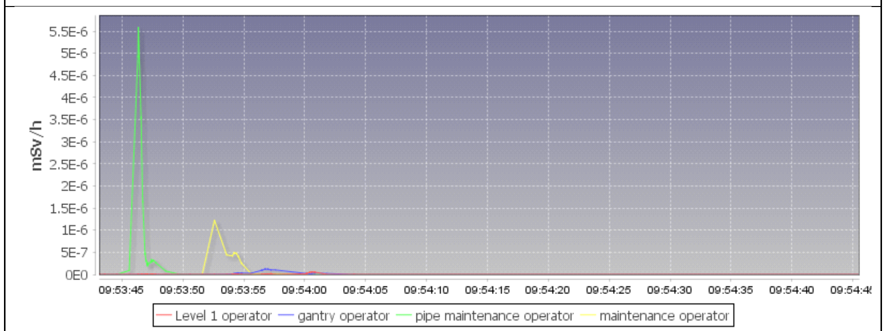
- Three thicknesses:
  - 25 mm
  - 15 mm
  - 10 mm



Lead – 25 mm



Lead – 15 mm



Lead – 10 mm

Optimum Pipe Specification

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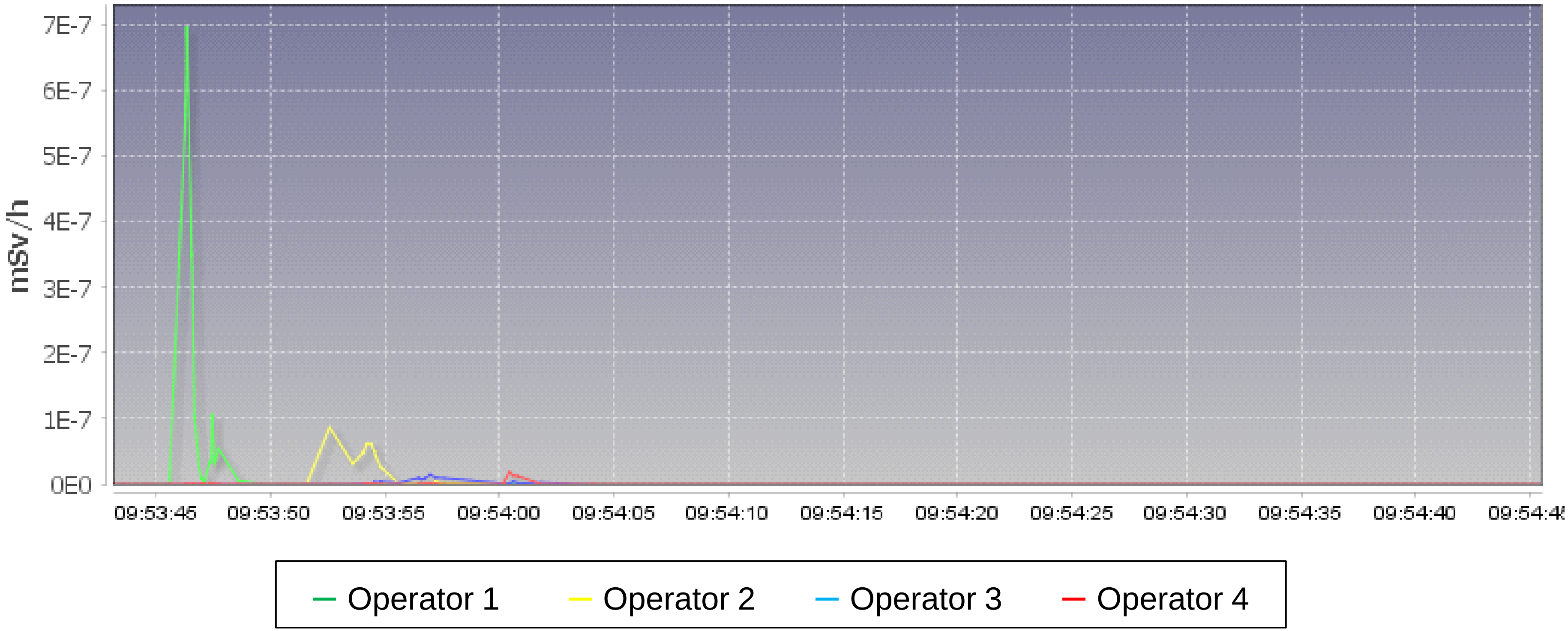
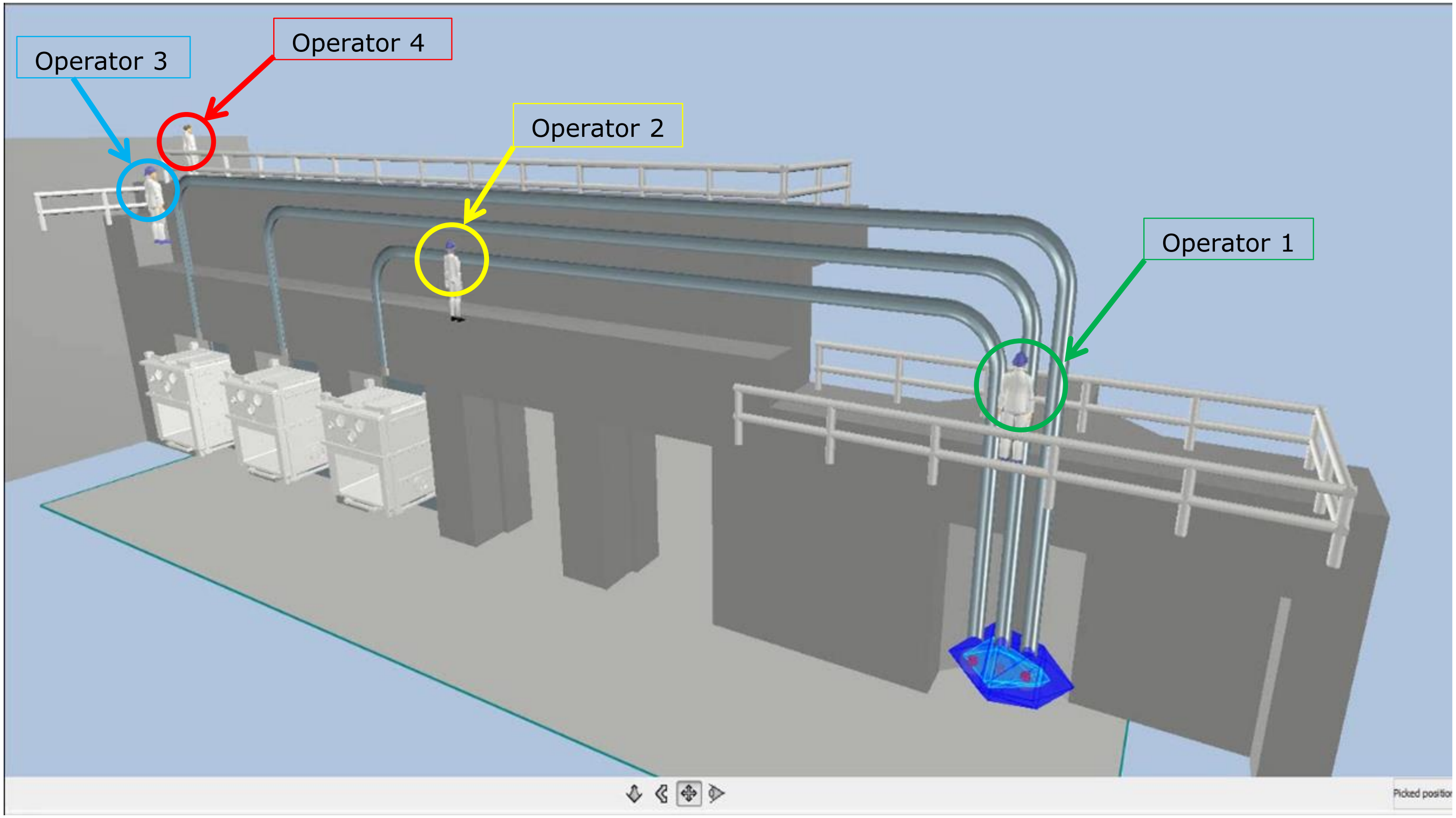


Pipe Thickness (mm)	Dose Rate (mSv/h)	Dose Rate (mSv/y)
25	7.00E-07	6.13E-03
15	2.40E-06	2.10E-02
10	5.50E-06	4.82E-02

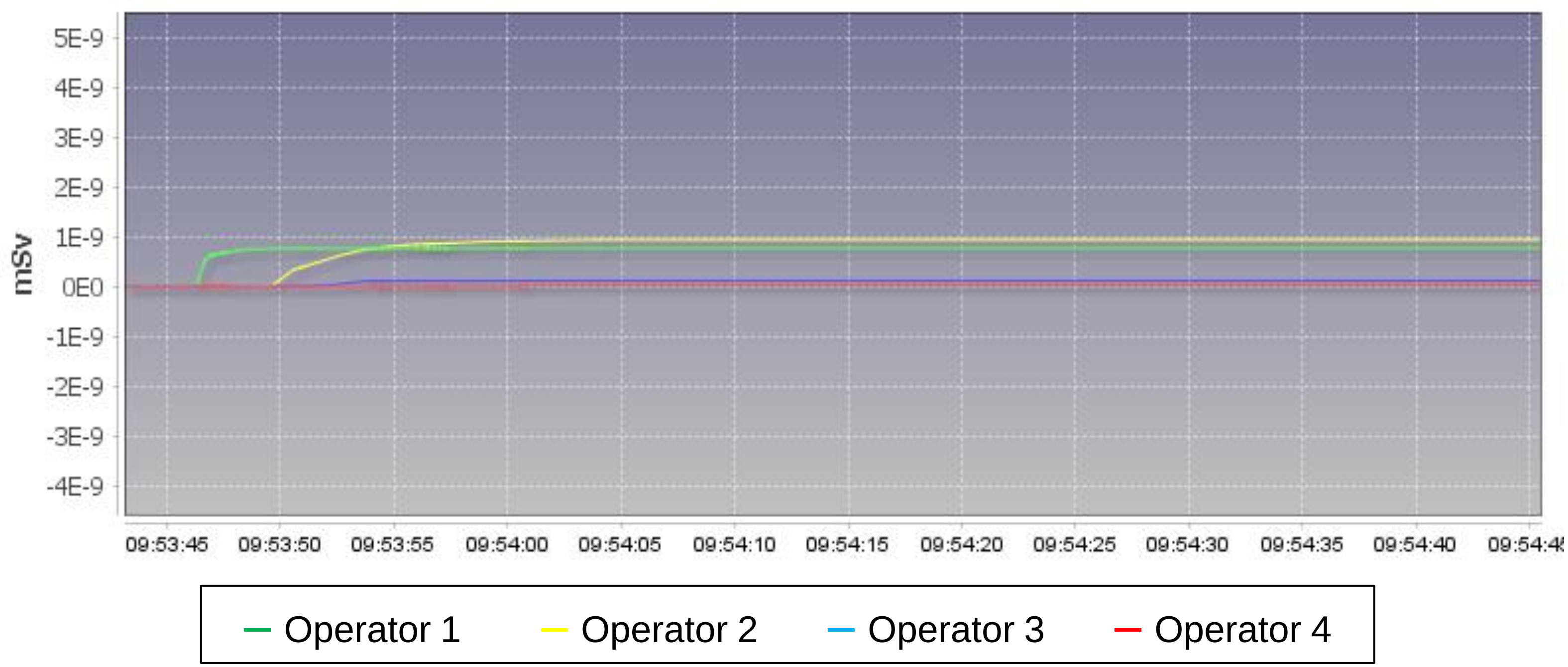
Simulation



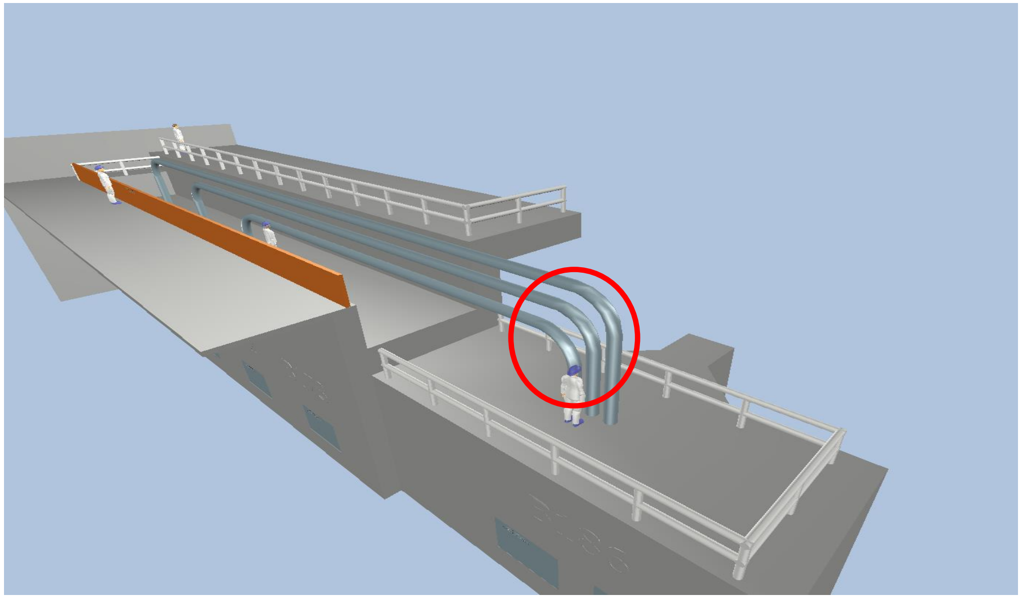
— Operator 1 — Operator 2 — Operator 3 — Operator 4

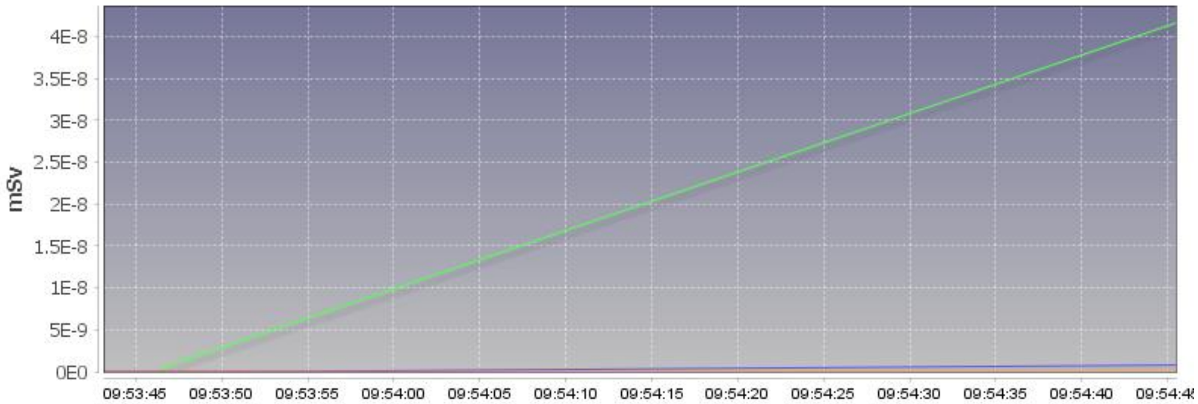
Operator Activities

- Operators have been programmed to simulate maintenance work in PTS vicinity
- Present accident scenario whereby sources travel during maintenance



Mal-Operation





— Operator 1 — Operator 2 — Operator 3 — Operator 4

Potential Future Design Process

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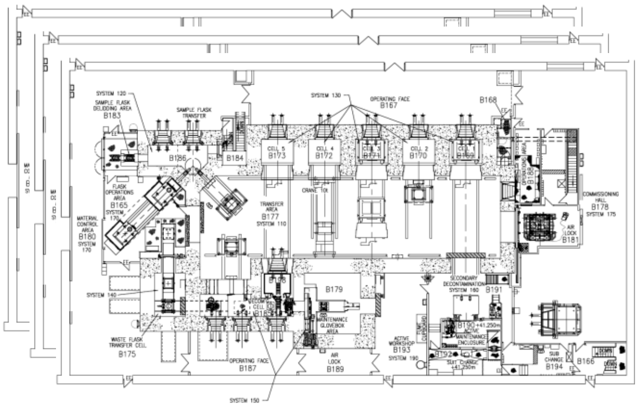

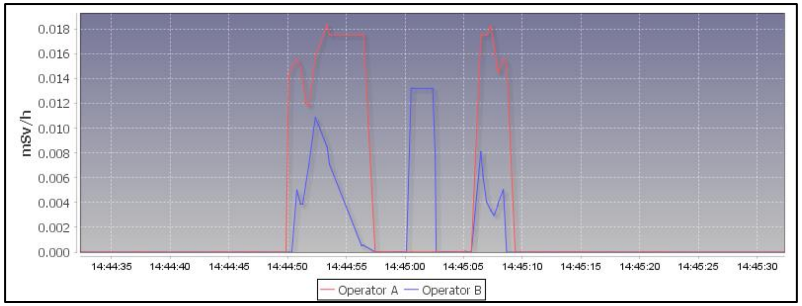

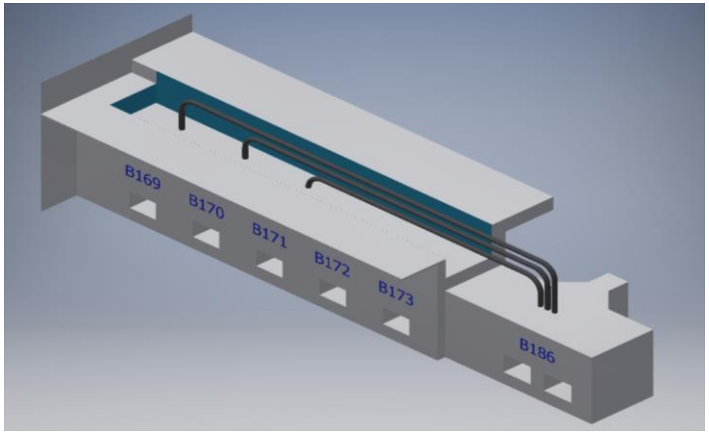

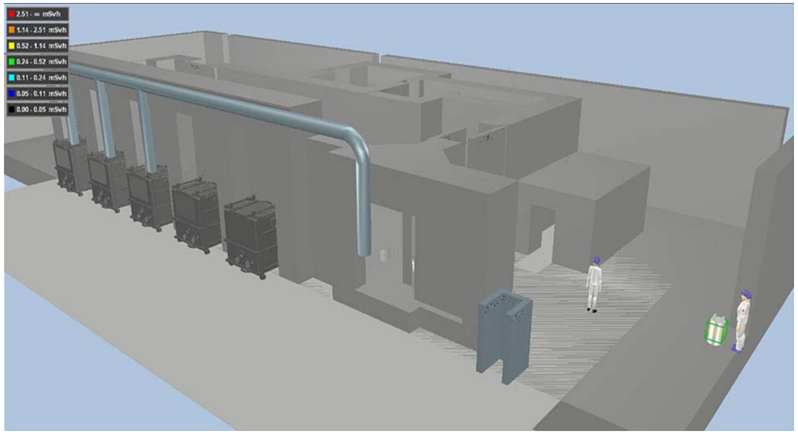

Potential Applications

Design

- Most engineering drawings are 2D isometric drawings which are not ideal for representing complex structures

- Operators and engineers rely on past experience and complex dose calculations during the design process which may be overly pessimistic

- Simulating the experiments and analyse ergonomic/ dose effects in a 3D virtual environment enables assessors from any discipline or background to interface with the virtual design and identify areas of concern with ease

Potential Applications

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Safety Case

- Developing a safety case relies on the HAZOP process and multi-disciplinary teams sharing a common understanding of the designers vision for the process

- Most HAZOPs are undertaken with 2D technical drawings, complex calculations and operator experience input which can be subject to pessimistic assumptions and overinflated figures which need to be scaled down

- Inclusion of advanced simulation software has been ‘proven’ to speed up the process as the models make a system easier to understand, which speeds up safety case work and reduces scope for human error

Applications

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Decommissioning

- Ability to map out radiation and simulate dose uptake to an operator in dynamic conditions is particularly beneficial in decommissioning existing facilities
- Current practice involves the use of pessimistic assumptions and previous experience which often lead to inflated dose uptake values
- The software's ability to simulate dose in a 3D virtual twin of an active facility, place sources in the correct positions and simulate an operator route whilst recording dose uptake data is a powerful

Summary

- IR&D project focused on developing NNL's immersive and augmented modelling capabilities
- Allows NNL to accurately analyse the risks & constraints involved with working with radioactive material and develop effective safety procedures in a safe environment
- NNL can use the capabilities of the software to reduce costs, improve safety, streamline the design process and enhance public awareness
- Future applications of the programme requires building up NNL's capabilities via use on other projects (such as decommissioning)

Acknowledgements

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- Chris Rhodes, Brendan Perry from NNL
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THANK YOU FOR LISTENING

ANY QUESTIONS?

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