



# 3D Virtual Simulation for Radiation Safety and Hazards Identification Training

May 2023

*Changing the World's Energy Future*

Xingyue Yang



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# **3D Virtual Simulation for Radiation Safety and Hazards Identification Training**

**Xingyue Yang**

**May 2023**

**Idaho National Laboratory  
Idaho Falls, Idaho 83415**

**<http://www.inl.gov>**

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Contract DE-AC07-05ID14517, DE-AC07-05ID14517**



May 4, 2023

Xingyue Yang

Visualization Researcher

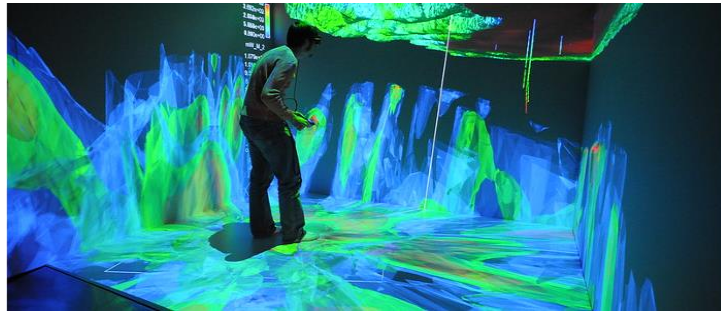
Applied Visualization Laboratory (AVL)

# 3D Virtual Simulation for Radiation Safety and Hazards Identification Training



# Applied Visualization Laboratory (AVL)

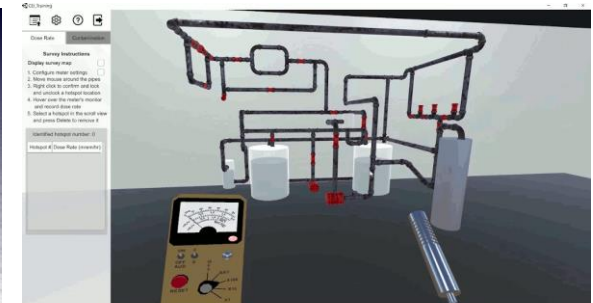
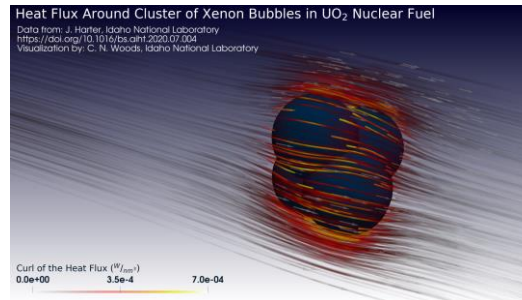
- Center for Advanced Energy Studies (CAES), Idaho Falls, ID
- Contains state-of-the-art visualization technologies and 3D environments





# Applied Visualization Laboratory (AVL)

- Scientific visualization
- Immersive analytics
- Digital twin
- Remote collaboration
- Virtual training
- Graph visualization
- WebXR
- LiDAR





# Virtual Training

- Simulated digital environment
- Real-life scenarios
- Interactive and engaging
- Flexibility





# Virtual Training

- First responder training
- Medical training
- Radiation training
- Military training
- Workforce training
- Interpersonal skills training



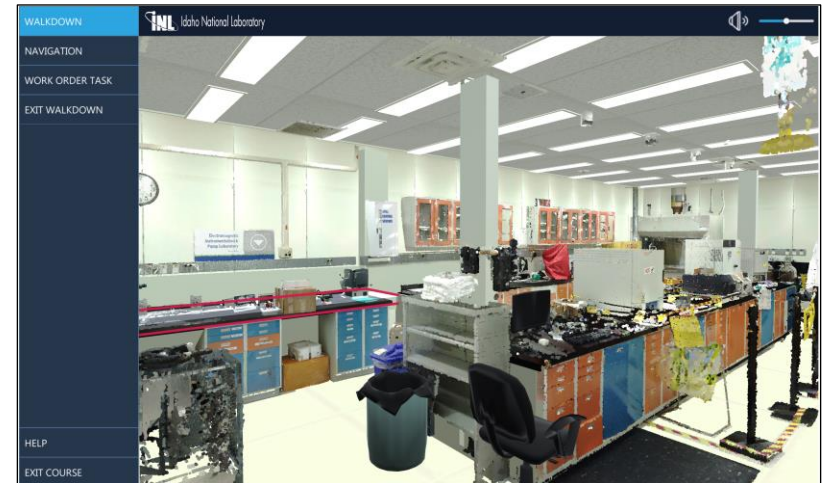
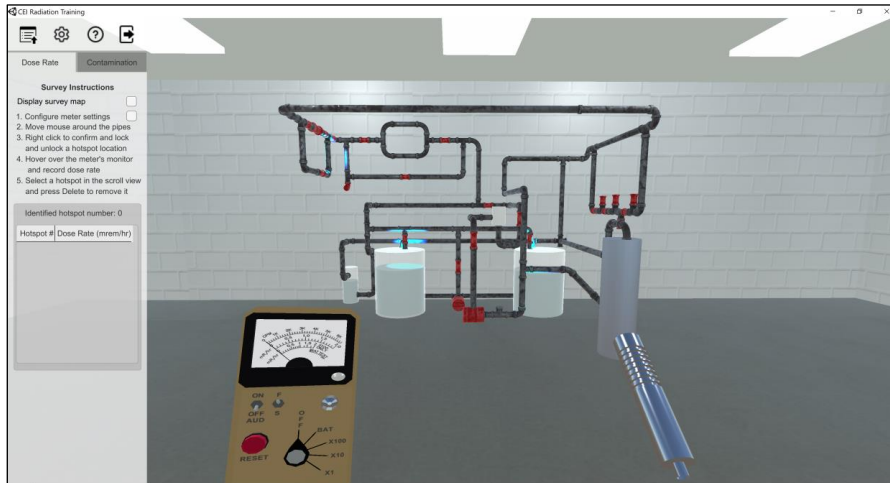
(Xie et al., 2021)



# Virtual Training



- Training 1: Radiation safety and survey
- Training 2: Hazards identification





# Virtual Training - Radiation Safety and Survey

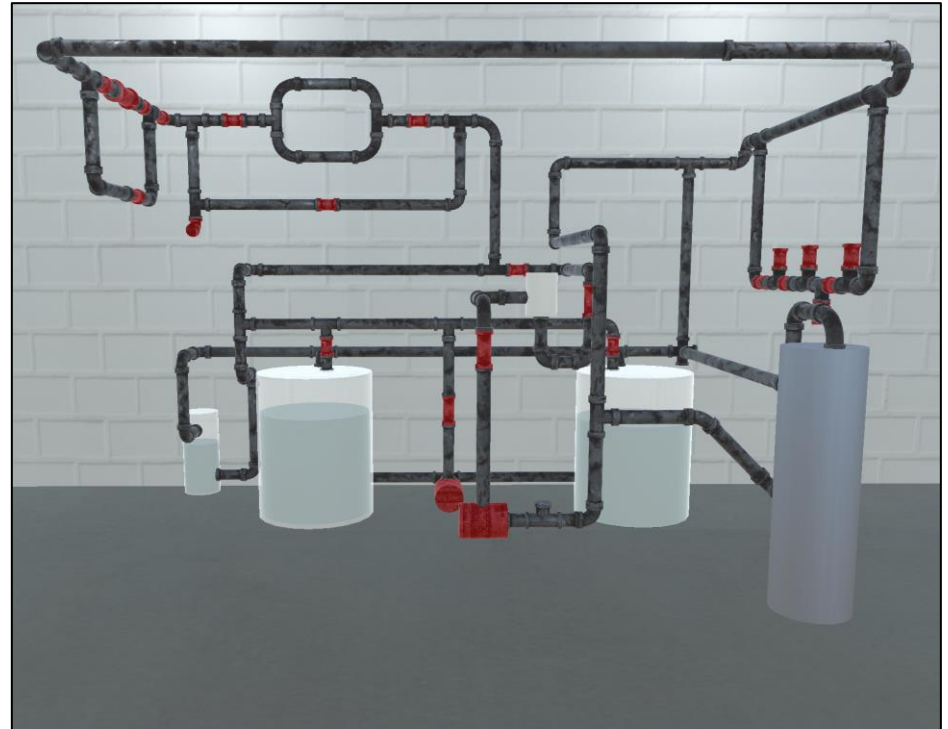
- Collaboration between AVL and College of Eastern Idaho (CEI)
- Virtual training for conducting radiation and contamination surveys





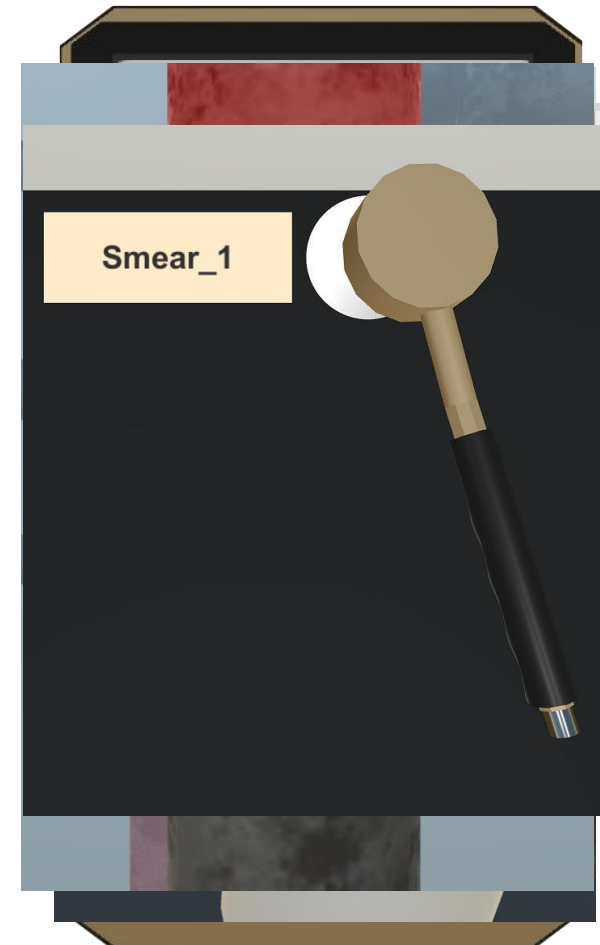
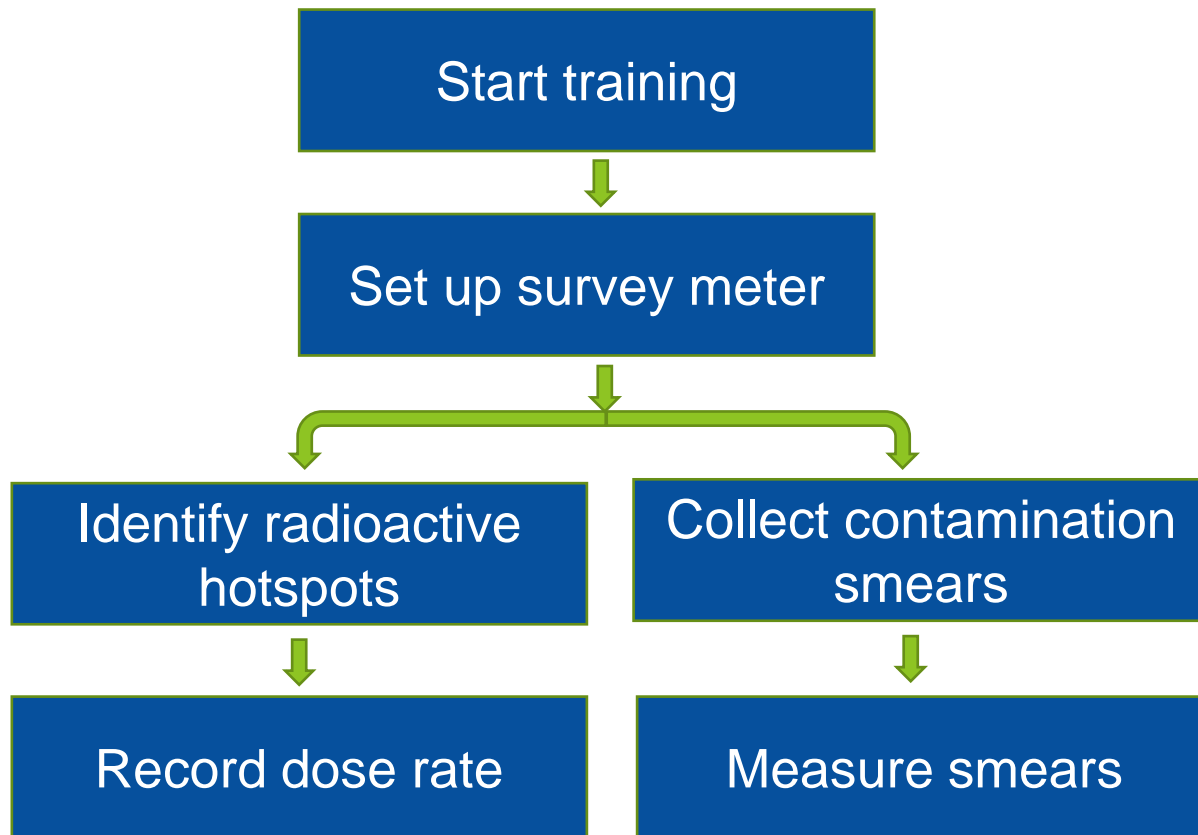
# Virtual Training - Radiation Safety and Survey

- Collaboration between AVL and College of Eastern Idaho (CEI)
- Virtual training for conducting radiation and contamination surveys
  - Pipe scenario



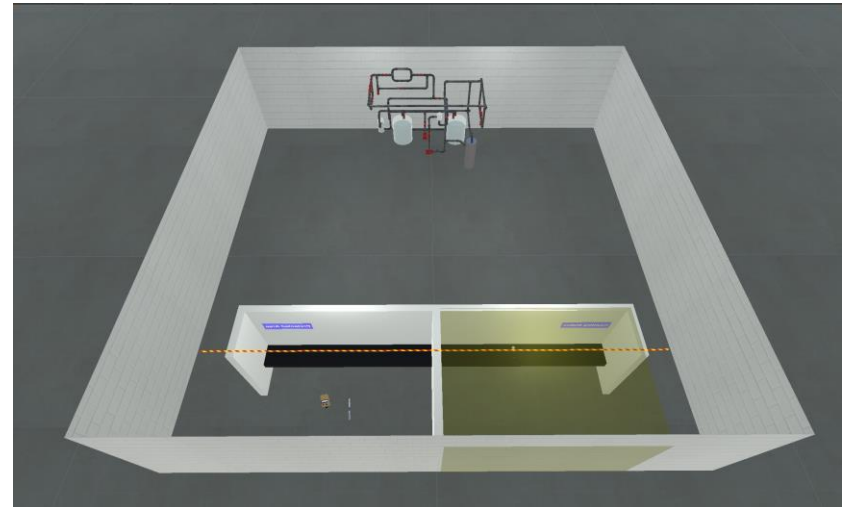
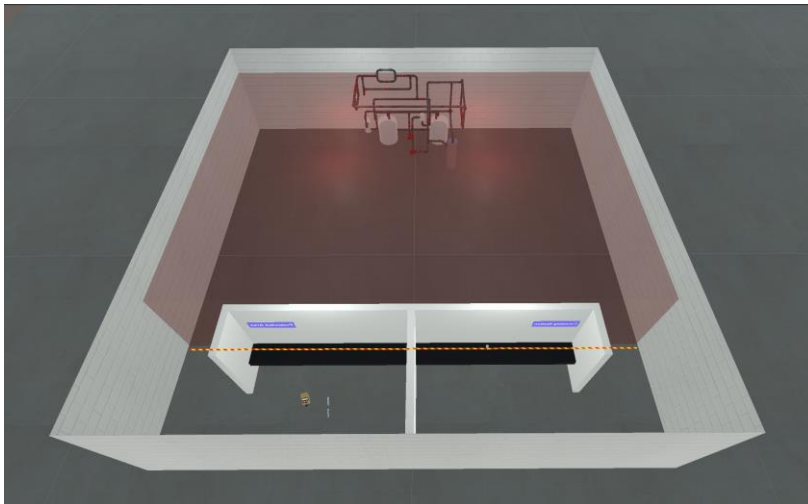
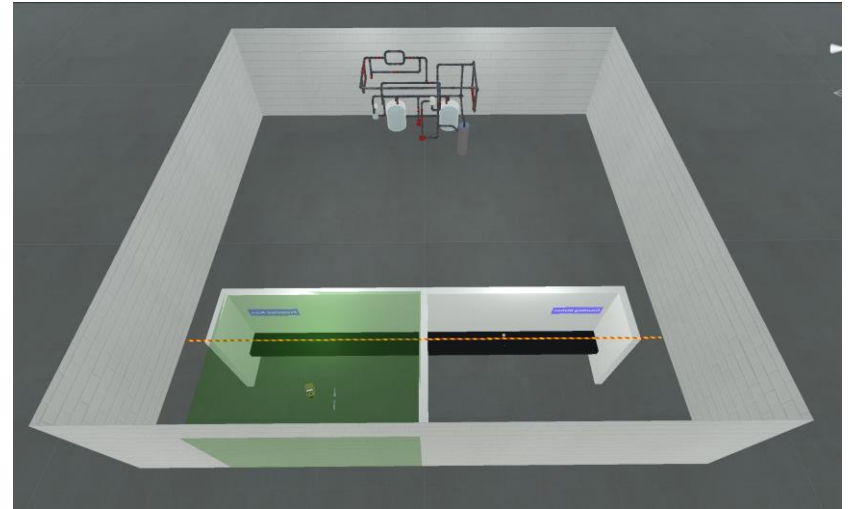
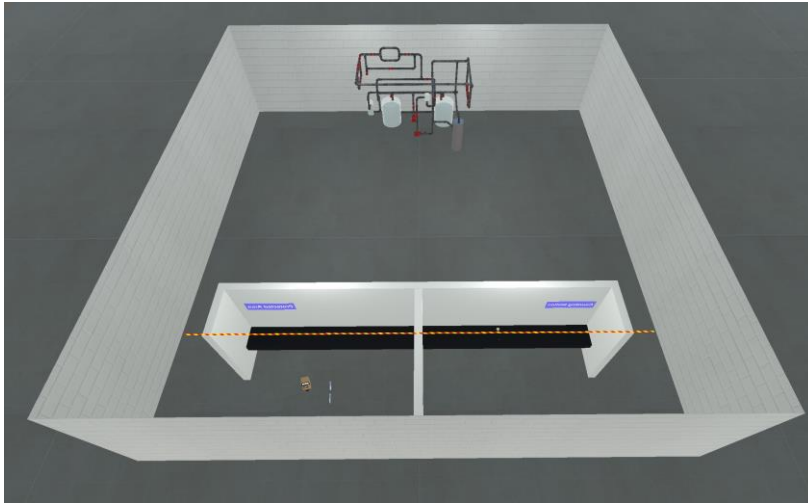


# Virtual Training - Radiation Safety and Survey





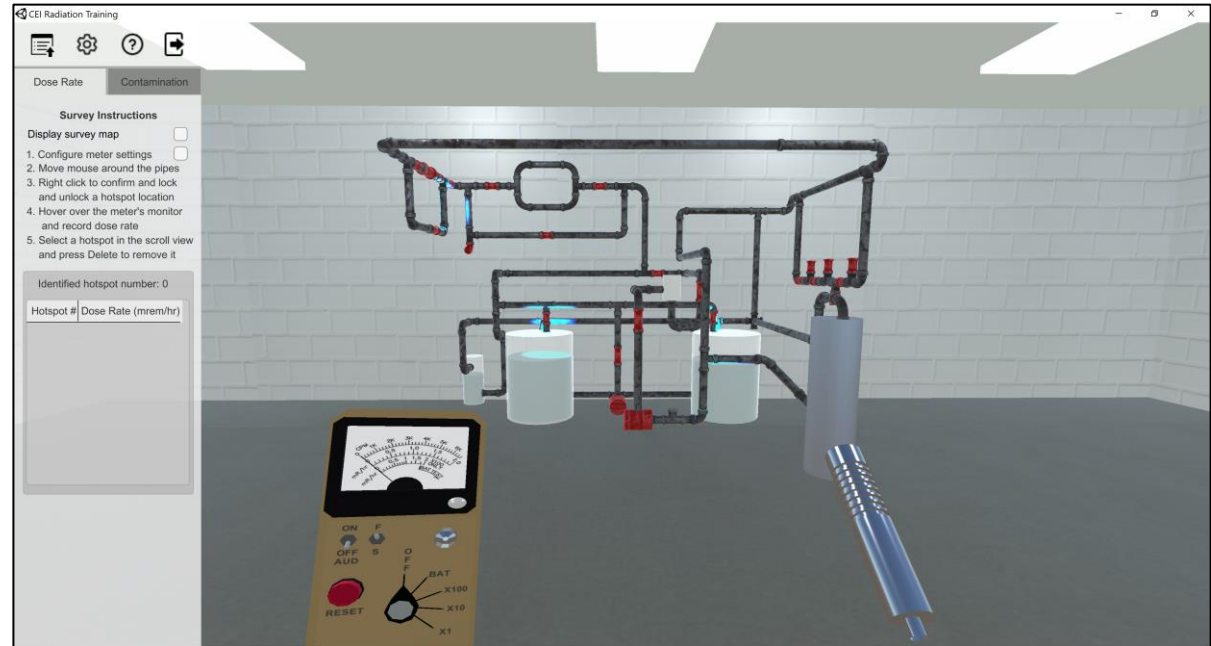
# Virtual Training - Radiation Safety and Survey





# Virtual Training - Radiation Safety and Survey

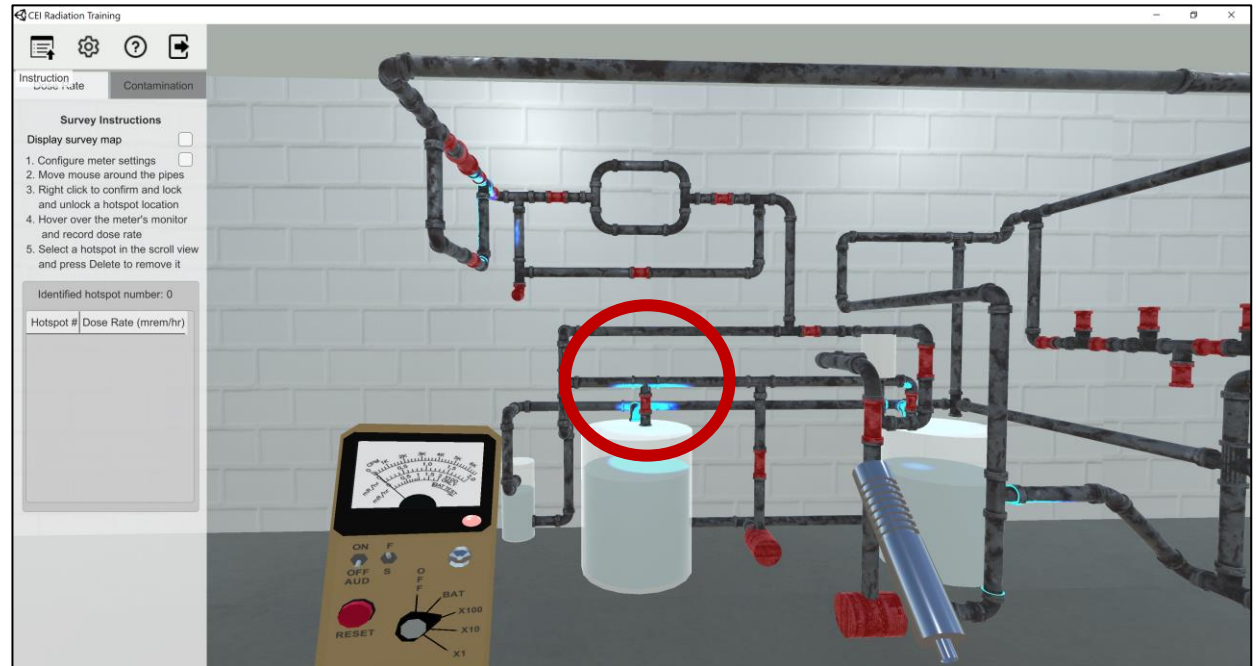
- Random scenarios
- Guided instructions
- User Interactions
- Sound and visual feedback
- Survey data storage





# Virtual Training - Radiation Safety and Survey

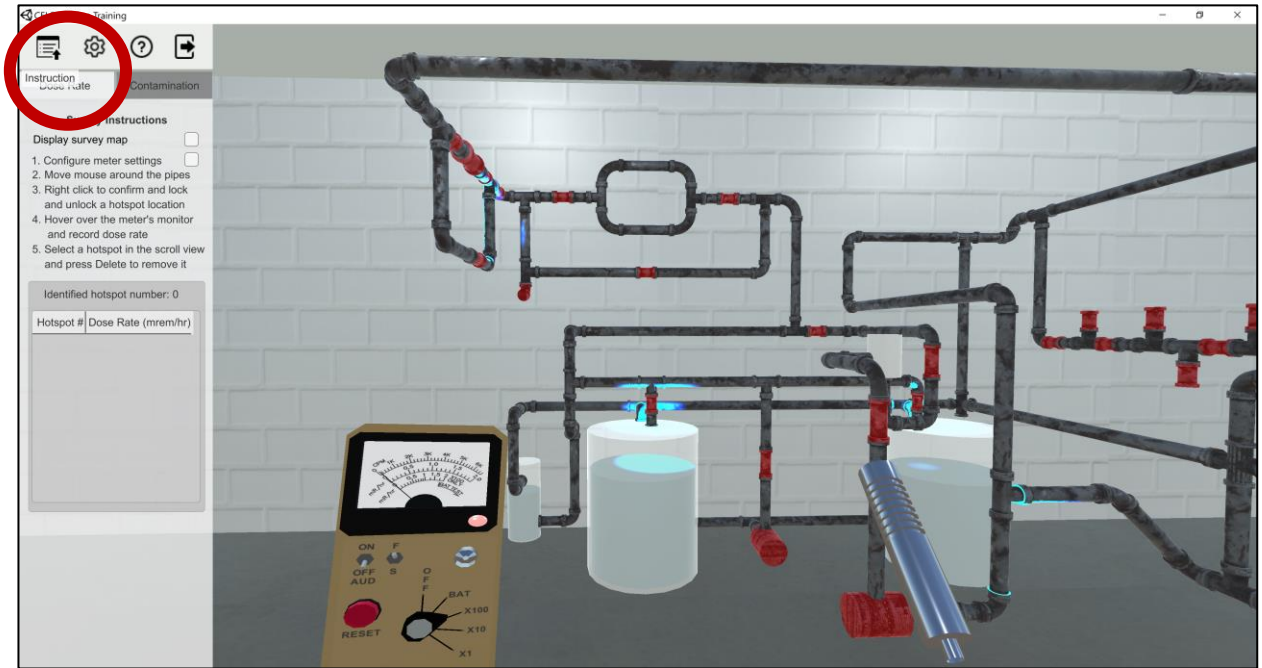
- Random scenarios
- Guided instructions
- User Interactions
- Sound and visual feedback
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# Virtual Training - Radiation Safety and Survey

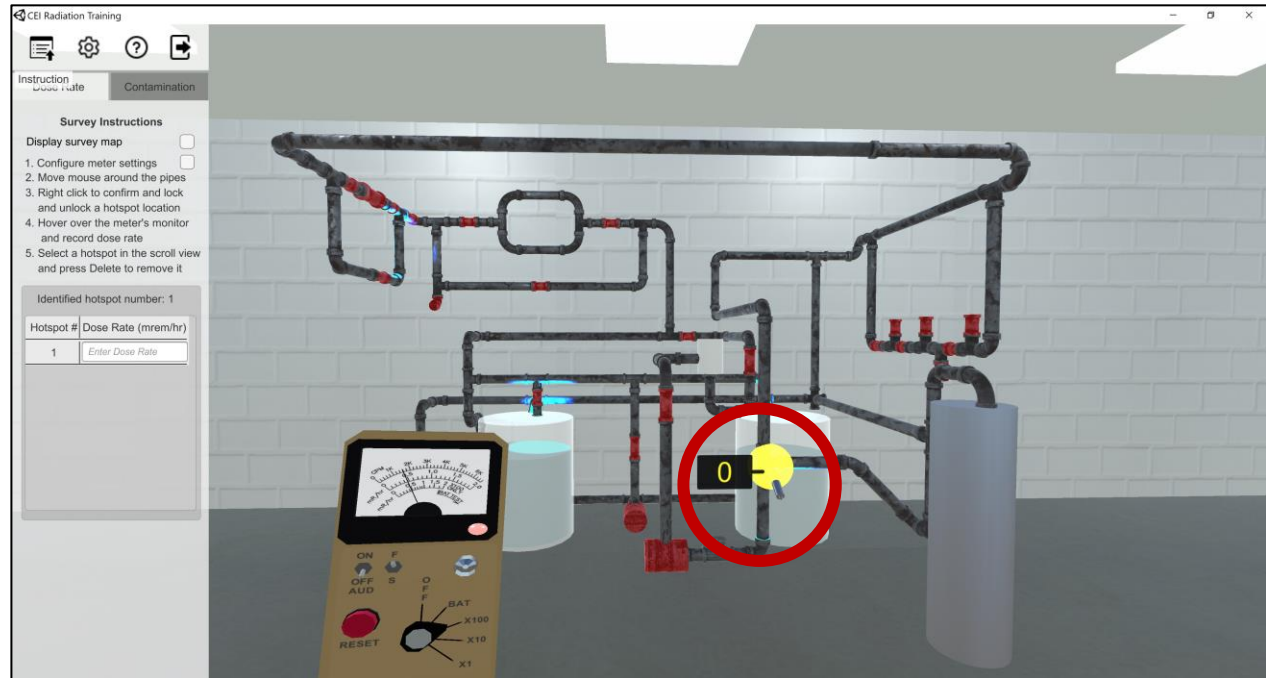
- Random scenarios
- **Guided instructions**
- User Interactions
- Sound and visual feedback
- Survey data storage





# Virtual Training - Radiation Safety and Survey

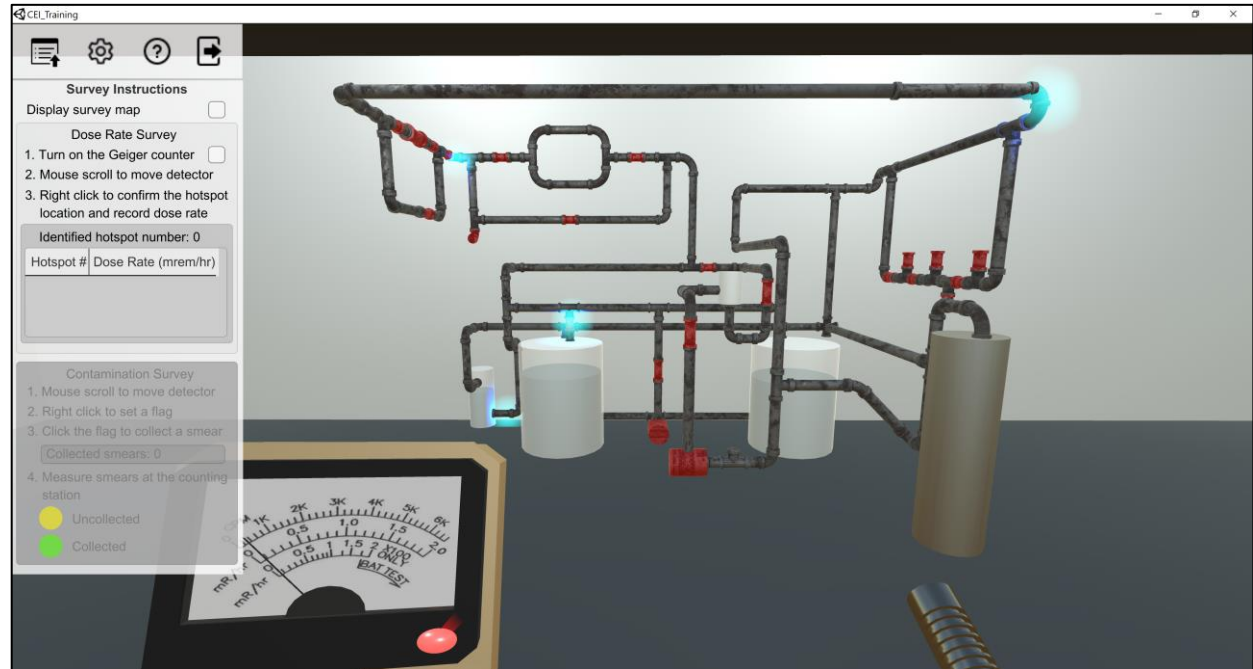
- Random scenarios
- Guided instructions
- User Interactions
- Sound and visual feedback
- Survey data storage





# Virtual Training - Radiation Safety and Survey

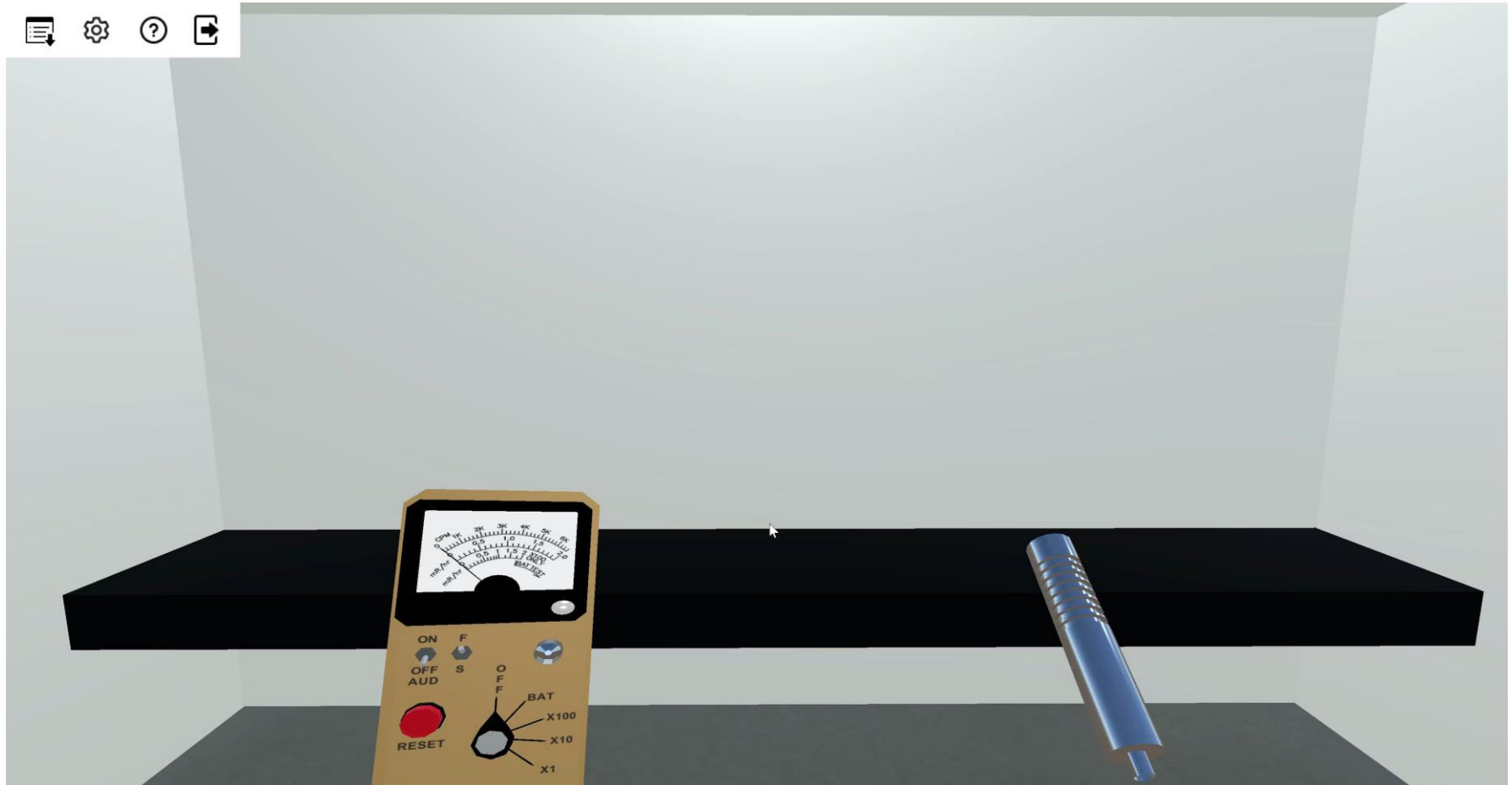
- Random scenarios
- Guided instructions
- User Interactions
- Sound and visual feedback
- Survey data storage





# Virtual Training - Radiation Safety and Survey

CEI Radiation Training





# Virtual Training - Radiation Safety and Survey

## Current and Future Work

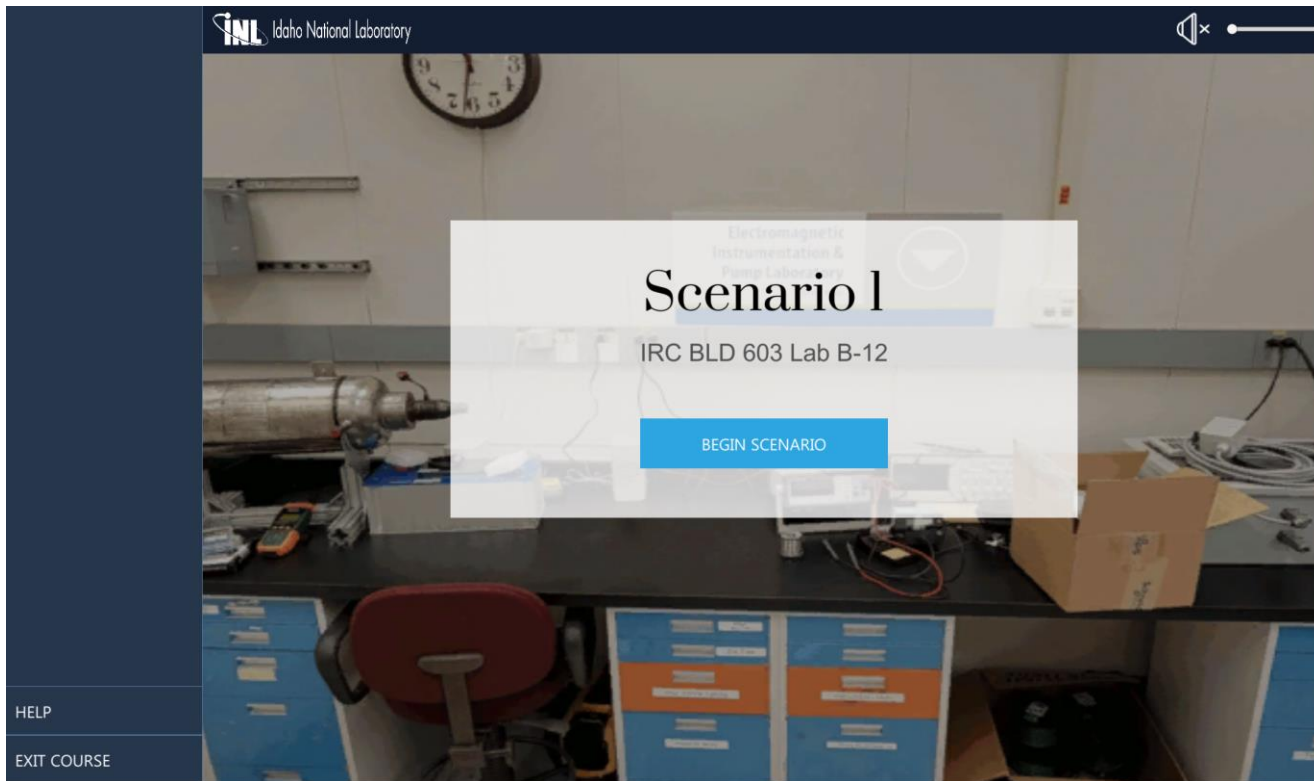
- Save training progress
- Tutor/student mode
- Evaluation and feedback
- More scenarios
- VR simulation
- Industrial training





# Virtual Training – Hazards Identification

- Safety training for personnel working at IRC, MFC, and ATR facilities
- Virtual training for learning and identifying workplace hazards





# Virtual Training – Hazards Identification

Choose character



Schedule walkdown



Click hazard hotspots  
for more information



Training results



Receive credits



The screenshot shows the 'Schedule Walkdown' interface. At the top, there's a header with the INEL logo and 'Idaho National Laboratory'. Below the header, a sidebar on the left contains links for 'INSTRUCTIONS', 'WORK ORDER TASK', 'SCHEDULE WALKDOWN' (which is highlighted), 'HELP', and 'EXIT COURSE'. The main content area is titled 'Schedule Walkdown' and includes instructions: 'Select the calendar icon next to each representative position below to schedule them for the walkdown. Select the detail icon to get a description for each position. When you have scheduled all relevant positions, select **BEGIN WALKDOWN**.' Below the instructions, there are two columns of positions, each with a calendar icon and a detail icon (a circle with an exclamation mark). The positions are: Work Performer, Fire Protection, Cognizant Systems Engineer, Industrial Safety, Lab Space Coordinator, Environmental, RadCon, Industrial Hygiene, and Electrical Safety. At the bottom right of the interface, there is a blue button labeled 'BEGIN WALKDOWN'.

Position	Schedule Icon	Detail Icon
Work Performer	Calendar	Exclamation Mark
Fire Protection	Calendar	Exclamation Mark
Cognizant Systems Engineer	Calendar	Exclamation Mark
Industrial Safety	Calendar	Exclamation Mark
Lab Space Coordinator	Calendar	Exclamation Mark
Environmental	Calendar	Exclamation Mark
RadCon	Calendar	Exclamation Mark
Industrial Hygiene	Calendar	Exclamation Mark
Electrical Safety	Calendar	Exclamation Mark



# Virtual Training – Hazards Identification

Choose character



Schedule walkdown



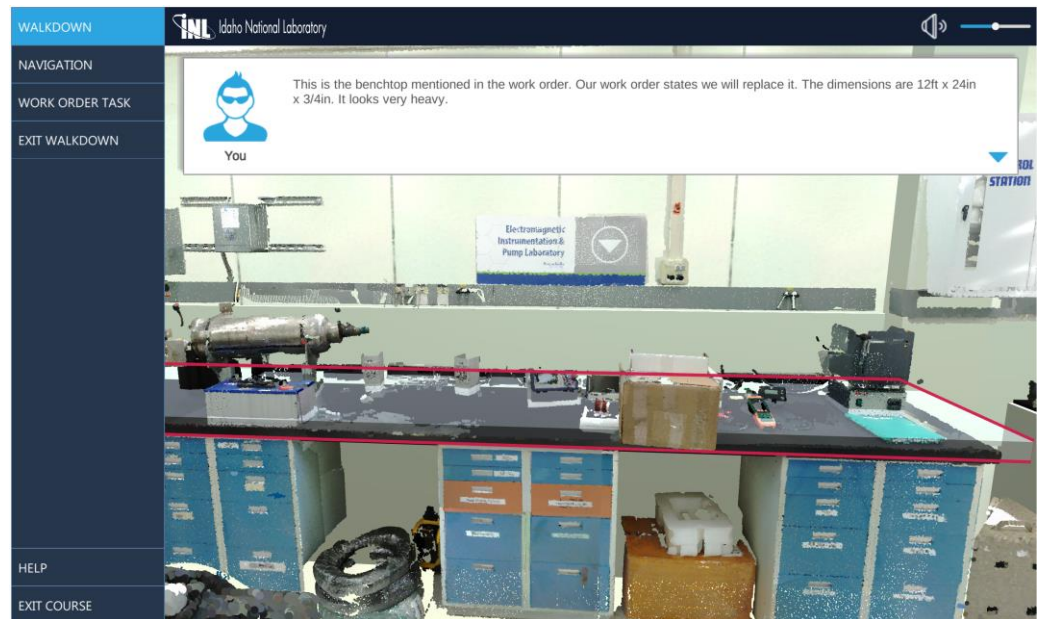
Click hazard hotspots  
for more information



Training results



Receive credits





# Virtual Training – Hazards Identification

Choose character



Schedule walkdown



Click hazard hotspots  
for more information



Training results



Receive credits



**INL** Idaho National Laboratory

## Your Results

Criteria	Performance	Target	Feedback
Hazards found	100%	100%	It is CRITICAL that you find all primary hazards.
Selection of participants	## invited	8 needed	You should schedule a walkdown with all ESH&Q personnel and others applicable to the walkdown hazards. It is okay to schedule more for safety, but make sure you have a good reason for scheduling more.
Walkdown efficiency	1 walkdown	1-2 walkdowns	Use as many walkdowns as it takes to do the job right. However, try to get everyone in the same walkdown if possible. This will save your time and enrich the conversation.

HELP  
EXIT COURSE

[VIEW HAZ ID CHECKLIST](#) [CONTINUE](#)



# Virtual Training – Hazards Identification

Choose character



Schedule walkdown



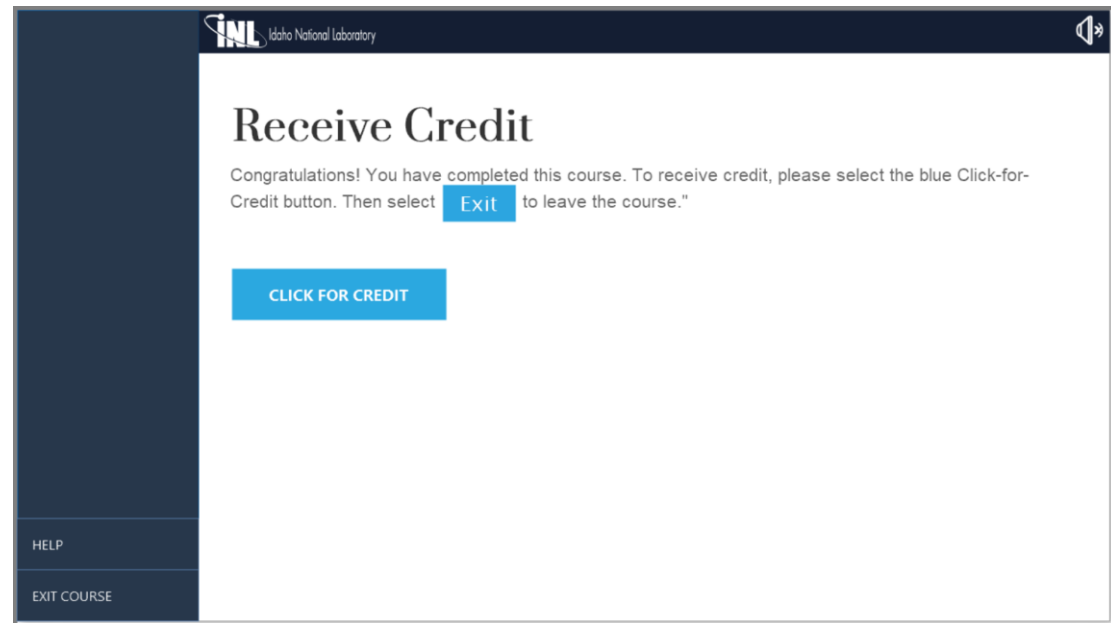
Click hazard hotspots  
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Training results



Receive credits

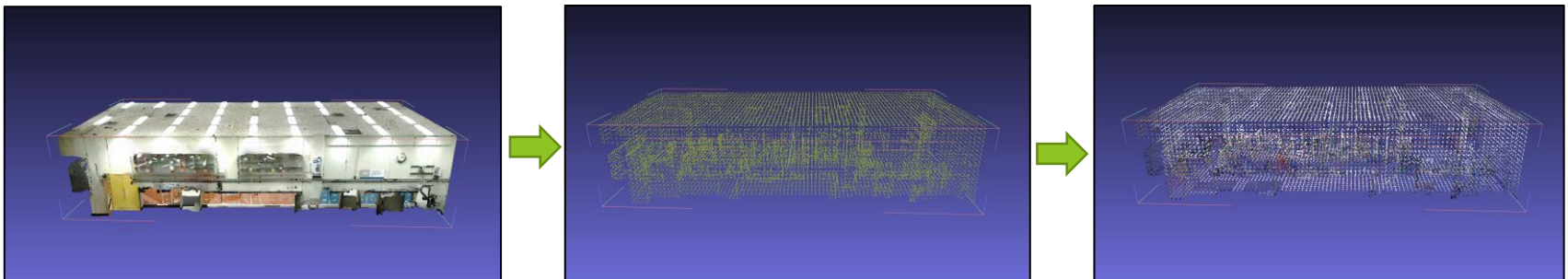




# Virtual Training – Hazards Identification

Challenges: LiDAR scan processing and application performance

- Data capture: Faro scanner
  - Point cloud data
  - Vertex render
- Data processing
  - MeshLab
    - Point cloud simplification
    - Cluster vertex sampling





# Virtual Training – Hazards Identification

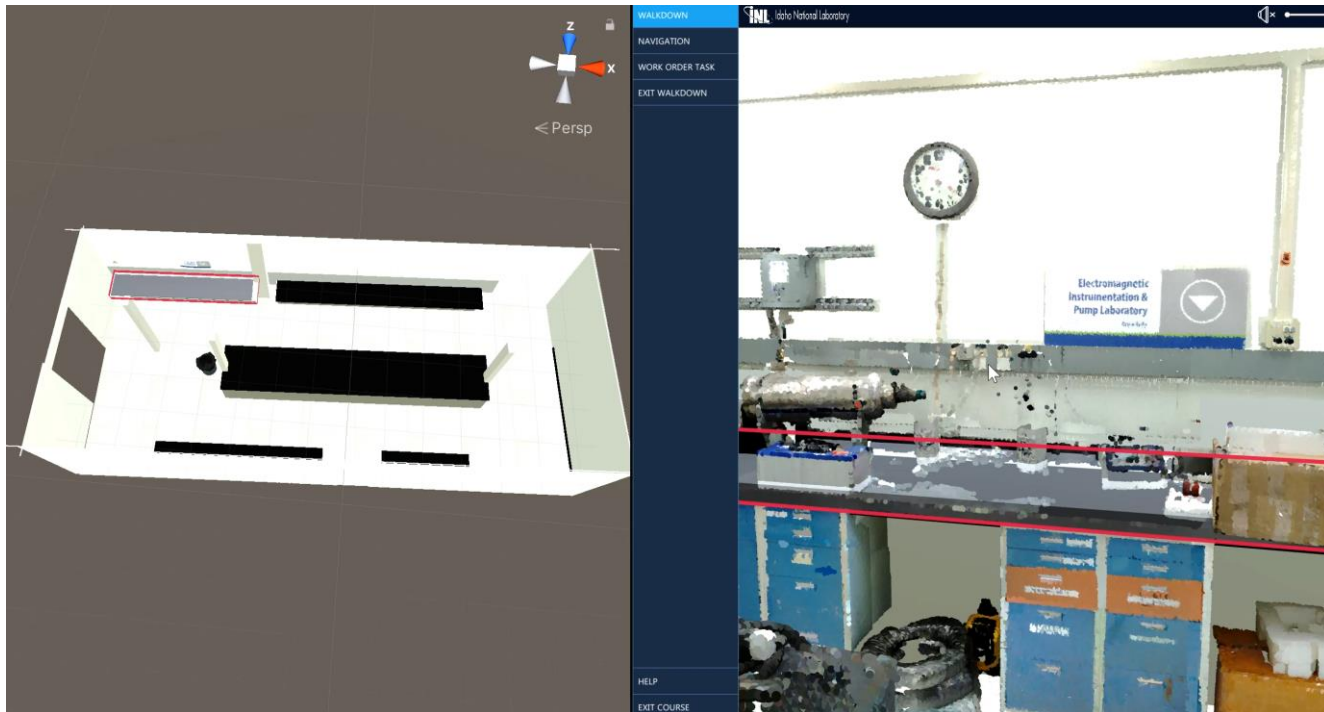
- Improve Application performance
  - Reduce the build size
    - Remove replaced sections: walls, ceiling, floor, etc.
    - Compress point cloud in Unity
    - Compress the build project in Player settings





# Virtual Training – Hazards Identification

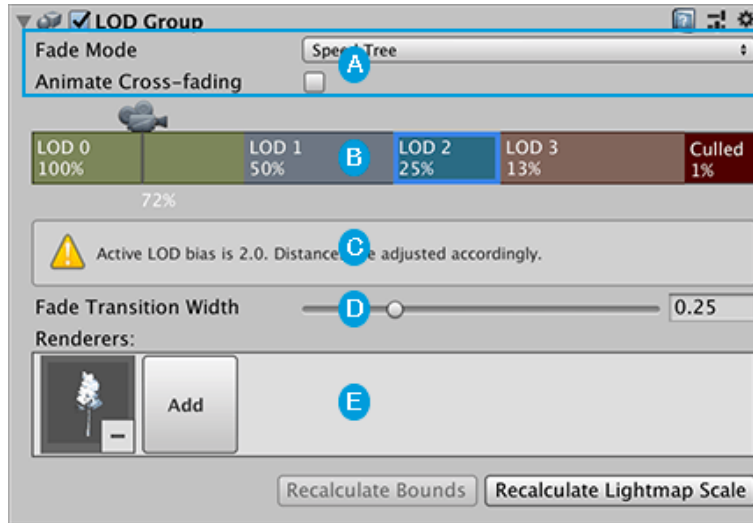
- Improve Application performance
  - Camera visibility
  - Level of details (LOD) group





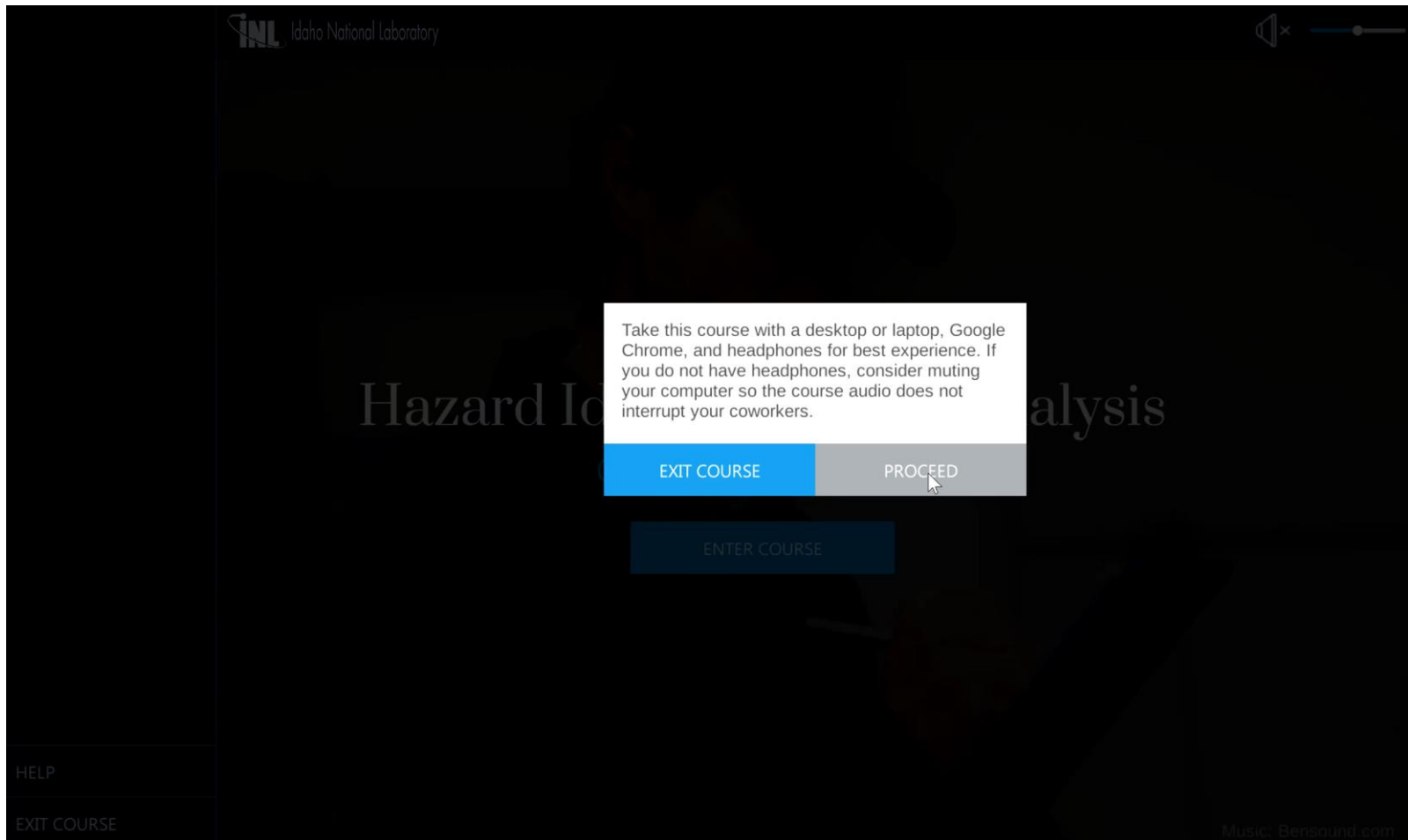
# Virtual Training – Hazards Identification

- Improve Application performance
  - Camera visibility
  - Level of details (LOD) group





# Virtual Training – Hazards Identification





# Virtual Training



Simulate conditions that are difficult to create in the lab environment



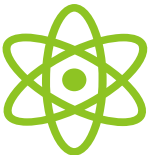
LiDAR scanner provides a realistic and accurate simulation



Promote virtual and remote training for education outreach and industry training



Minimize hazards exposure during training



Apply the simulation methods to other laboratories



# References

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- <https://www.thevirtualtrainingteam.com/virtual-training-everything-you-need-to-know>
- [https://www2.learnbrite.com/wp-content/uploads/2019/04/smartmockups\\_learnbrite\\_scenario\\_oculus\\_quest.png](https://www2.learnbrite.com/wp-content/uploads/2019/04/smartmockups_learnbrite_scenario_oculus_quest.png)
- <https://www.wearable-technologies.com/wp-content/uploads/2019/02/Microsoft-HoloLens-Event-1.png>





# Thank You

Contacts: Xingyue.Yang@inl.gov

Applied Visualization Laboratory (AVL)

<https://caesenergy.org/caes-lab/applied-visualization-laboratory/>