

Robotics in Decom

Current Status and Future Steps of the R&D Project

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Background

- Buildings and structures of nuclear facilities undergo the measurement and decontamination process for clearance at the end of the decommissioning
 - Nowadays mostly done manually
 - Time consuming
 - Larger volumes of dismantled waste due to conservative characterization of radionuclides
- *Robotics in Decom* R&D project established to tackle this issue
 - 2+ phase project, which goal is to survey robotic installations fit to clearance measurements
 - Inspection of current technology and other robotic installations
 - Arrangement of use case testing in suitable environment

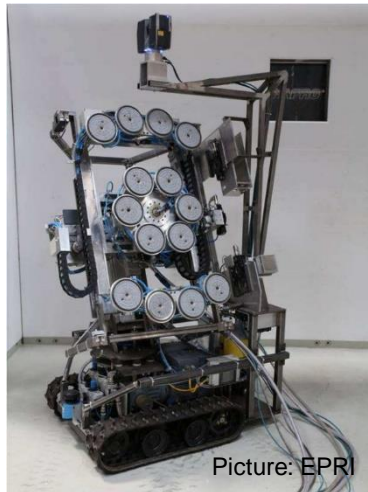
Phase 1 – Preset Goals of the Robotic Installation

- Autonomous operation
 - Adaptability for different environments
 - Tolerance for basic obstacles
- Modularity
 - Broken parts could be replaced at site with minimal delay
- Measurement equipment suitable for clearance measurements
- Possibility to decontaminate surfaces exceeding the clearance levels

Phase 1 – Surveying Technology

Robotic installations

- Treaded and wheeled models
- Four-legged models
- Drones
- Other installations
 - MACS
 - MAFRO



Measurement methods

- Direct surface contamination measurements
- Statistical sampling
- ISOCS
- Mass specific measurements of material from grinded surface layers

Decontamination methods

- Dry ice blasting
- Hydraulic (abrasive) blasting
- Mechanical crushing
- Foaming
- Laser decontamination



Phase 1 – Chosen Features for the Future Inspection (1/2)

- Treaded robot platform
 - Seen as the most all-rounded solution
 - Equipped with scissor lift installation
 - Ability to reach even higher places
- Contamination measurement equipment
 - Surface contamination meter suitable for clearance
 - Primary measurement device
 - Bore drilling equipment + surface inspection camera
 - Seeks for cracks etc. From surface in case of penetrated contamination
 - Magazine with sample vials
- Drawing of 3D map showing contaminated areas and sampling locations
 - Environment scanned separately and downloaded to robot's memory



Picture: IRID

Phase 1 – Chosen Features for the Future Inspection (2/2)

- **NO** decontamination system based on following arguments:
 - No radiation hazard present during clearance measurements
 - Robot-made decontamination could be inefficient
 - Faster operation of the robot
 - Could need more than one decontamination tools/methods
 - Prolonged battery life
 - More compact size

Comparison to Manual Labour and Conclusions

- Estimated measurement speed were compared to the estimated speed of manual labour
 - Robot slightly faster than manual labour when 100 % of the surface is measured
 - Manual labour might be slightly faster when lower portions of the surface is measured
- Robot with chosen features is seen to require less preparatory work
 - E.g. No need for scaffolding to be erected and lowered
 - Lowers the total duration of measurement progress
- Robotic clearance measurement installation not replaces but compliments manual labour
 - Expected to succeed in open and vast areas with high ceilings
 - Anticipated to have challenges in smaller, cramped areas → Manual labour

Phase 2 – Completed and Future Steps

- Completed tasks:
 - Preliminary use case testing plan
- Upcoming and ongoing tasks:
 - More detailed use case testing plan
 - Use case testing
 - Research of authoritative requirements for clearance robot
 - Basic planning of the robot to fulfill set requirements
 - Roadmap of operational use of the robot

Phase 2 – Use Case Testing

- Use case testing to be conducted in cooperation with VTT
- 5 work packages (WP) in total
 - Mobile platform
 - Mission control software
 - Radiation meter interface
 - Use case testing
 - More detailed use case testing plan to be completed prior
 - Reporting
- Inspection of the accuracy and reliability of contamination measurements
- Assessing of the reliability and the accuracy of the data, color coded 3D map included
- Speed comparison between manual labour and robotic installation

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Thank You for Your Attention!

Questions?