

AWE Robotics Safety Philosophy – Glovebox Operations

The AWE is assessing the technical viability of using robotic manipulators within gloveboxes for radioactive material operations. In particular to assess the implications of using robotics to support the demonstration of the as low as reasonably practicable (ALARP) solution as well as the subsequent generation of the Safety Case.

The Haptic Controlled Remote Operations (HCRO) project is investigating the technical viability of using a haptic interface to remotely operate robotic manipulators within gloveboxes for radioactive material operations.

Current operations using radioactive materials require an operative to put their hands in thick rubber gloves, which reduces the dexterity of the operator, and directly handle the radioactive material. This exposes operators to radiological hazards such as contaminated cuts, burns and radiation. Using a remote system will reduce the radiological hazards to the operator but controls would be required to ensure that the manipulator could not damage the glovebox and access was restricted into the operation environment during use. To mitigate the hazards caused by the robotic system a defence in depth approach will be used to support the safety case.

The robotic manipulators could be used for a variety of operations such as: unloading material, processing materials, reprocessing materials, treating residues and loading materials. The operation that will be demonstrated by the HCRO project is removing material from a container and loading material into a crucible. The material being used will be stainless steel made into assorted shapes such as cylinders and nuggets.

The HCRO system does not currently have any automation but some functions that could be automated could be movements to specified locations 'Home' or automatic grasping.

The demonstrator will not be used in an active environment, but the ease of maintenance and replacement of the system has been considered as part of the project because it will show if the technology is practical to use.

Hardware:

- Workstation – multiple screen setup + desktop
- Manipulator arm – Kuka LBR IIWA 14 R820
- End effector - Schunk EGL-90 gripper and FT force/torque sensor
- Vision system – RealSense D435 (end effector) + IP cameras (glovebox)
- Control Interface – Omega.7 Haptic interface and custom keyboard
- Programmable controller – Kuka Sunrise controller and Industrial PC
- Access control – Key interlock system, card access and light beam/safety mat

