

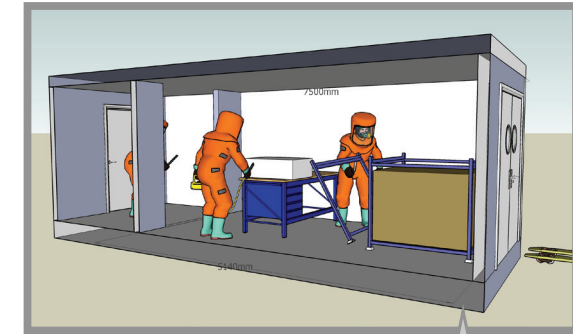
## An ALARP approach to Human Factors and Ergonomics

### 1 Introduction

An ALARP Optioneering, Prior Risk Assessment and Human Reliability Study was carried out for the processing of 30-year old HEPA ventilation filters wrapped in PVC. The chosen option was to overpack the filters. Task analysis and consideration of Performance Influencing Factors were used to consider and minimise the opportunity for human error in the operation.

### 2 Objectives

To optioneer and assess an ALARP option for processing filter stillages, to optimise the associated radiological risks for the chosen option, and to mitigate against the potential for human failure in the planned operation.



The operation is undertaken in a rigid, ventilated containment facility.

### 3 Methods

#### The problem

Approximately 266 stillages each containing a number of plutonium-contaminated ventilation filters wrapped in PVC. The filters began to show signs of deterioration due to their age (30-year old) and the storage condition of the buildings. A leaking filter was identified in 2007 prompting the need for remediation.



A breach in containment of the filters could result in an internal dose uptake and if left in situ a seismic event could have significant dose consequences.

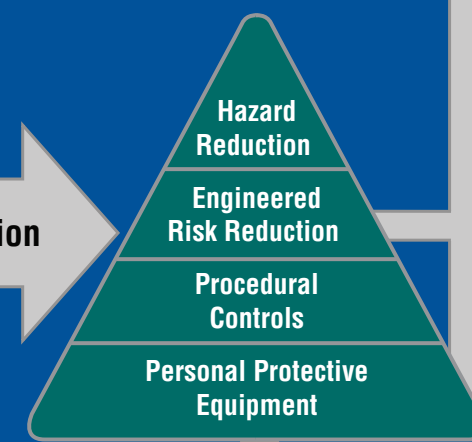
#### Optioneering

#### Stakeholder engagement

#### The solution

To remove the filters individually from the existing stillage, place within a steel box and re-stack within a new stillage. The new stillage will then be transported to a more modern, fit-for-purpose storage facility.

#### ALARP optimisation



- Dose uptake ALARP
- Opportunity for human error minimised

### 4 Human Factors

Two distinct human factors methodologies were used to consider and minimise the opportunity for human error throughout the operation. Some examples of this are shown below.

#### Task Analysis

A trial of the overpacking operation was undertaken using a temporary facility. The working instruction for the trial was analysed to identify potential human errors.



#### Activity in air monitors

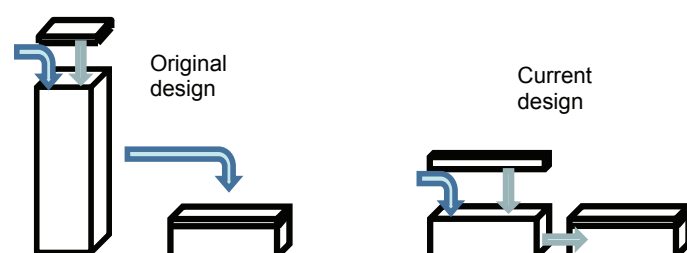
The monitors must be running in the correct locations - at breathing height in positions specified by the RPA. The pre-job checklist requires a worker to check this. *The addition of dedicated port-holes in the facility, through which the monitor sniffer pipes are fed, ensures they remain fixed in the correct locations.*

#### Air extract unit

The safety of the workers relies on air flows reducing airborne contamination. During the trial there was no alarm to indicate a fault condition on the air extract - reliance was placed on the Job Controller to monitor its status. *An alarm was incorporated into the design for the permanent facility.*

#### Fitting filter into steel box

During the trial it was identified that the filters are different sizes, not all of which fit comfortably into the steel box. The original box design was loaded and lidded on its smallest surface area side then laid flat for storage. *This has been changed so that the lid is on the top, bringing an ergonomic improvement.*



#### Performance Influencing Factors

Performance Influencing Factors (PIFs) are taken from HSE guidance and are the characteristics of the job, the individual and the organisation that influence human performance. Optimising PIFs will reduce the likelihood of human failure.



#### Physical capability and condition (person factor)

Repacking the filters places a physical demand on the worker. *A height-adjustable table allows individuals to work at a height comfortable for their stature.*

#### Peer pressure (organisation factor)

At Sellafield, the established 'peer to peer' behavioural safety observation process reverses the element of peer pressure so that it drives an effective safety culture. *Unsafe behaviours are readily challenged.*

#### Difficulty/complexity of task (job factor)

The operation is a simple one but difficulty is introduced by the use of restrictive personal protective equipment. During the trial a 'Proban' protective apron was worn at all times over the air-fed suit. Feedback was that this introduced discomfort. *The risk assessment was amended - requiring the Proban to be worn only where a specific risk of cuts and wounds was identified.*



### 5 Conclusions

Basic ergonomics and human factors have been incorporated into risk assessments and ALARP for the processing of 30-year old HEPA filters. The approach taken resulted in a holistic assessment which determined and justified a suitable method to accelerate significant hazard reduction whilst protecting the workforce.



The repackaged filters represent a significant hazard reduction.