Radiation Safety in Practice

Pressurised suit operations

Greg Antill
24 March 2010

Introduction

- **Greg Antill**

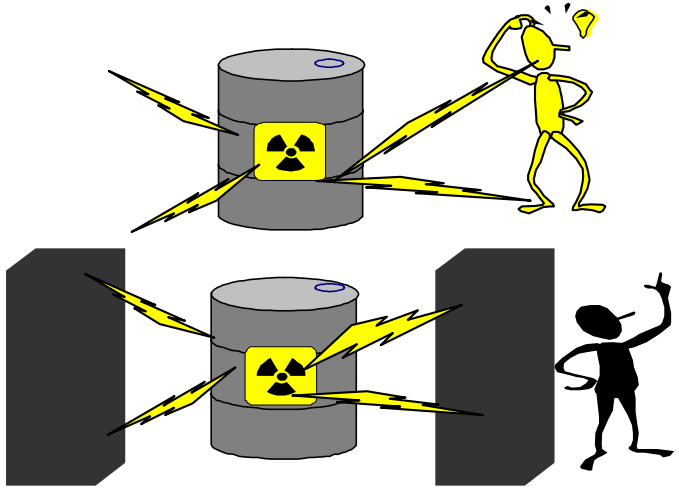
- **RPA for Nuvia Limited**

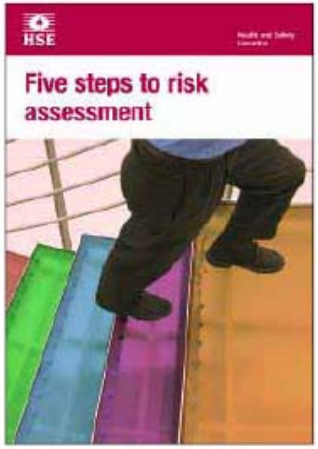
Risk assessment

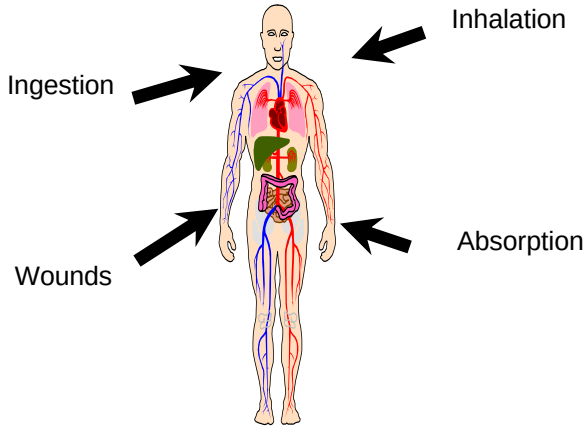
A balance between frequency and hazard

Risk assessment

- **Understand exposures associated with**
  - Normal ops
  - Fault conditions
  - Magnitude and
  - Frequency
    - External exposure – easy
    - Internal exposure – difficult

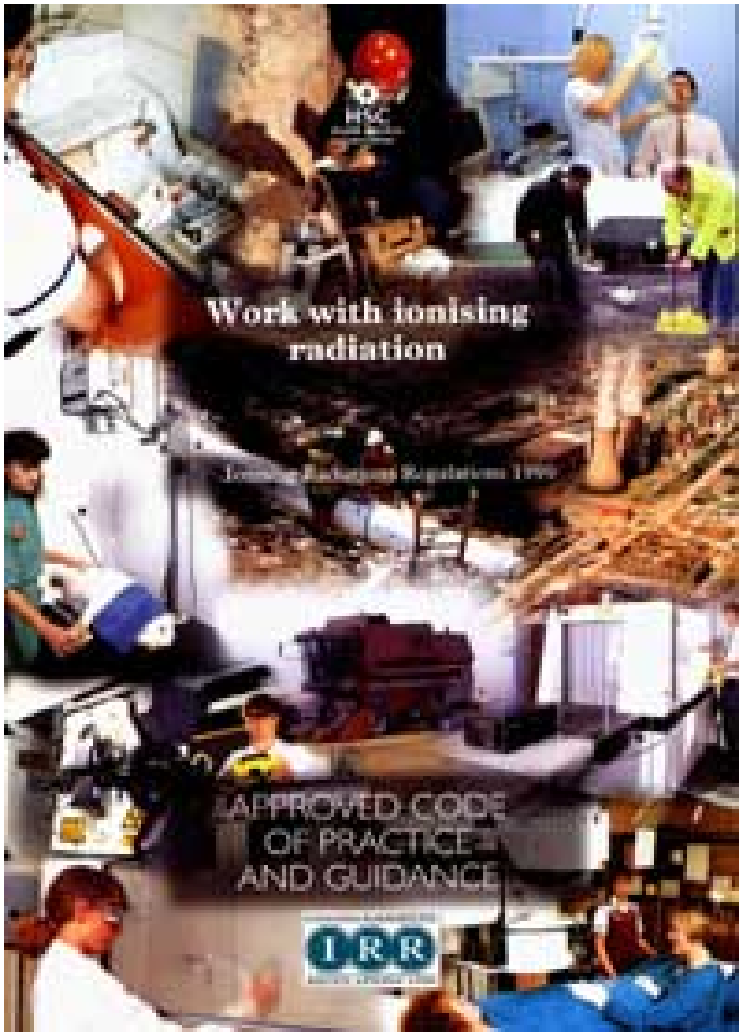






Dose limit

- **Workers:**
  - 20mSv
  - 150mSv and
  - 500mSv
- **MoP**
  - 1mSv
- **ALARP!**
  - Not just coming in below the BSO
  - 0.3mSv (MoP) from HPA



ALARP

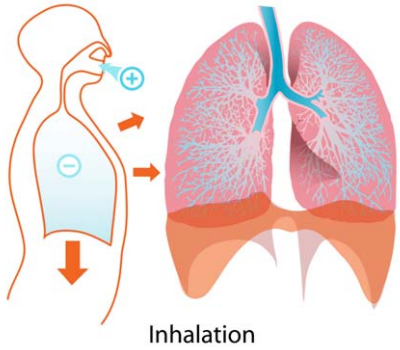
- **How much is ALARP worth?**
  - £1M/ death in general industry, and
  - £2M/ death in nuclear industry (**T/AST/005** - Issue 4 - Rev 1 refers)

- **Gross disproportion (Edwards v. National Coal Board (1949: 1 All ER 743))**
  - Sizewell B inquiry:
    - Factor of up to 3 (i.e. costs three times larger than benefits) for workers
    - Factor of 2 for low risks to MoP
    - 10 for high risks to MoP

- **~£300/mSv for workers (how much are you spending?)**

Hazard

- **Plutonium 239 – 20mSv**
  - Ingestion - 80,000Bq
  - Inhalation - 625Bq, but
  - ***Wound*** – 20Bq (~10ng)



Mitigation

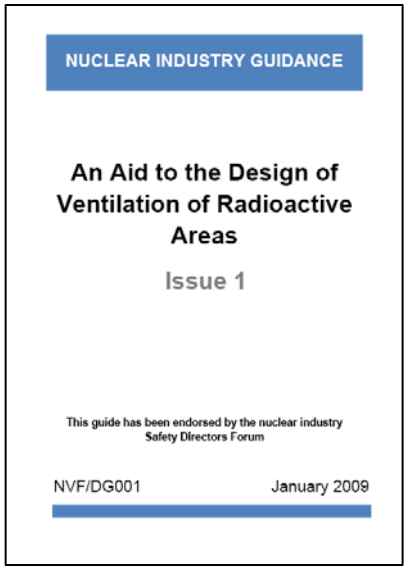
- **Contamination control**
  - Containment systems / warning devices
  - Systems of Work
  - PPE

  - Incorporate relevant good practice (RGP) from company, industry and national standards.

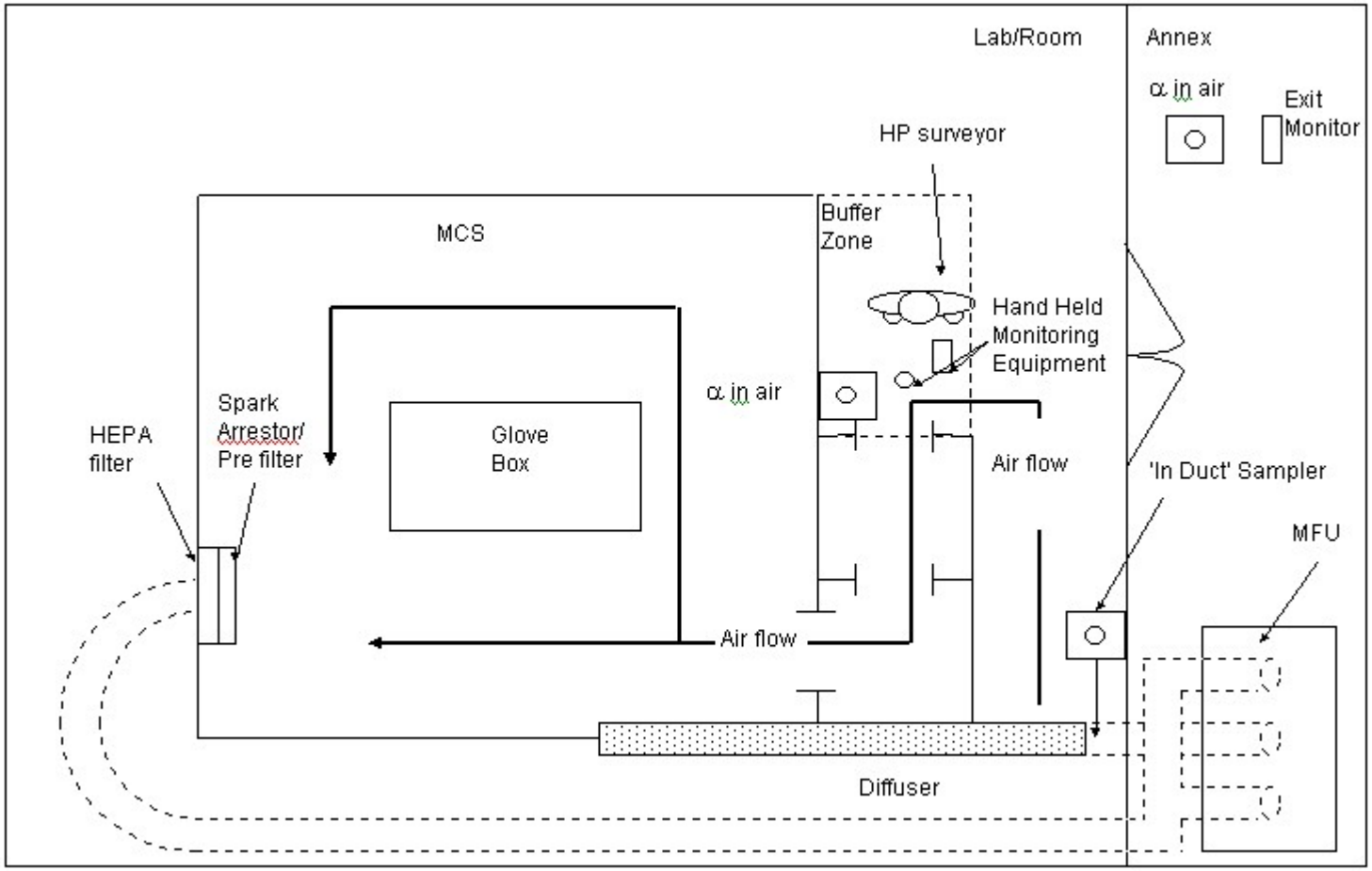
Engineered means

- **Physical**
  - ModuCon / tent
  - Taped joints
  - Flooring
  - Strippable coatings
  - Tie-down coatings, and
  - Monitoring systems

- **Dynamic**
  - NVF/DG001 (updated AECP1054)
    - Re-circulatory systems (IRR99), and
    - Once through (BPM)



Engineered means



System of Work

- **Procedures – to control safety and quality critical issues**
  - These should include:
    - Pre-checks (including worker ‘well-being’)
    - Dressing
    - Undressing
    - Maintenance
    - Emergencies

System of Work

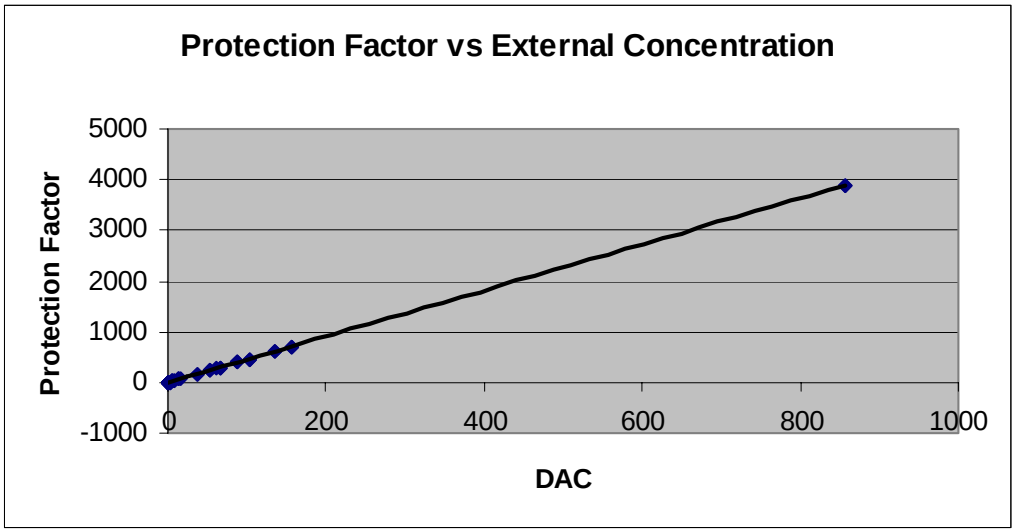
- **Controlling at source:**
  - POCO / decontamination
  - Tie-down coating:
    - Initial application to protect surfaces or reduce non-fixed contamination
    - Subsequent applications to keep undress times down, also ensures fault doses are ALARP
  - Type H vacuum (criticality)

System of Work

- **Controlling at source:**
  - Tool selection (re-suspension / wounding)
  - Sleeving operations for areas of known high hold-up (waste containers)
  - Minimise size-reduction of highly contaminated plant (waste containers again)
  - Size-reduction enclosures with re-circ HVAC within larger exclusion zones (also reduces the challenge to the final discharge filters)

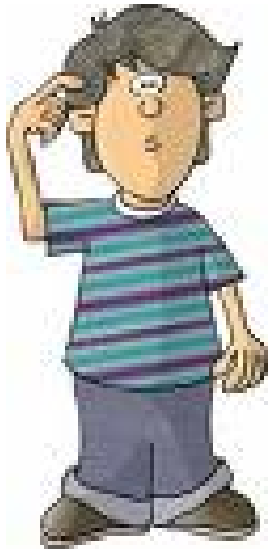
Did RGP work?

- **Airborne**
  - Normal concentration - a few tens of DAC, but
  - Highest concentration - 80,000 DAC
- **Why?**
  - No clear reason.
- **No contamination measured inside the suits!**



How much benefit do we get from RGP?

- **Difficult to define**
- **Net effect is nobody can engineer out the entire hazard**
- **What next?**



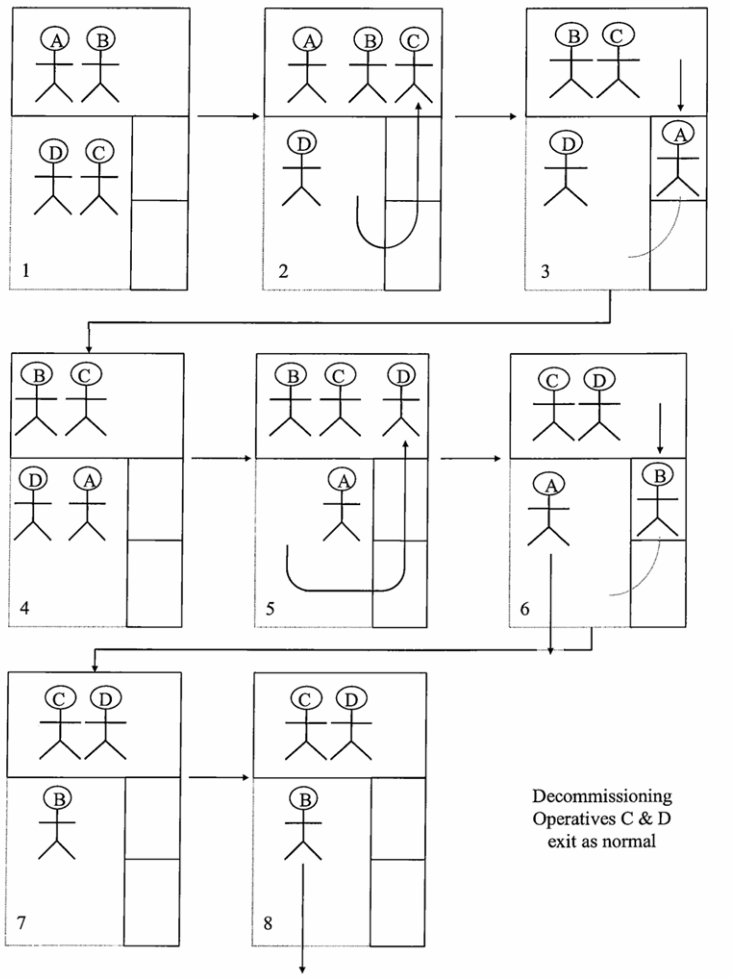
Our last line of defence - pressurised (frog) suits

- **Only after exhausting all other reasonable engineering and procedural controls!**
  - *'Highly'* contaminated environments
  - Combined hazard environments (Pu/Be/Asbestos)
- ***High?***
  - APF 200
  - Inward leakage factor 1 in 10,000

1997 to 2000

- **4,000 hours of frogging**
  - 35 glove boxes decommissioned
  - 10 fume cupboards decommissioned (4 of which were beryllium contaminated), and
  - 12 MCSs constructed, commissioned and used for decommissioning operations.
- **Too slow!**

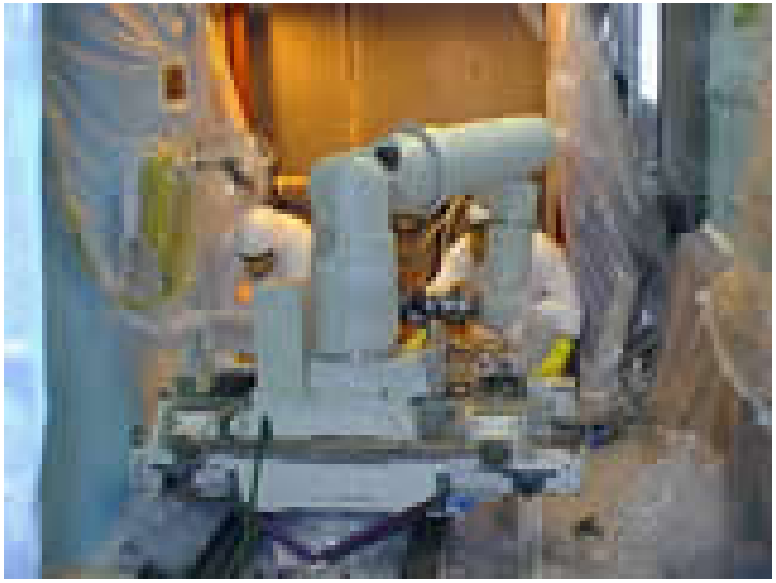
Rolling entries – more time at the work face!



Still too slow

- **Back to basics, risk reduction should result in greater efficiency**

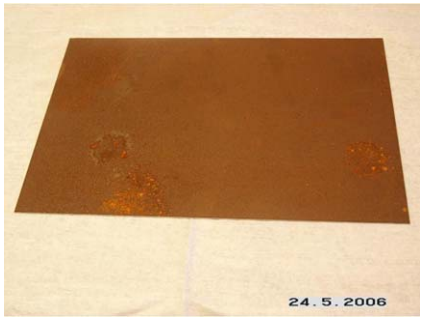
- **Risk, a function of *frequency* and *hazard***
  - Alternative tooling had some success (but didn't eliminate need for frogging), so
  - Focus now on decontamination to reduce hazard (and therefore risk) so work can be conducted with less restrictive safety requirements.



- **Decontamination = less bulk ILW = less cutting to fit in standard waste containers = lower risk and cost!**

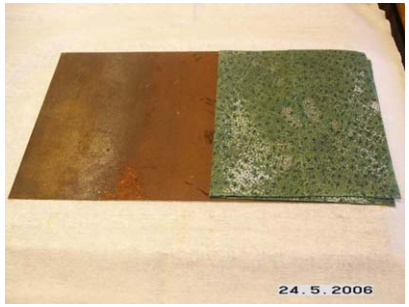
Current plan – be safer to be faster

- **Chemical decontamination - proving trials being planned at AWE**
  - Reached back to French parent companies for proven CeIV technology
  - Liquid



Before treatment

FORAC spraying on one part



With FORAC impregnated wipe on the second part

After treatment

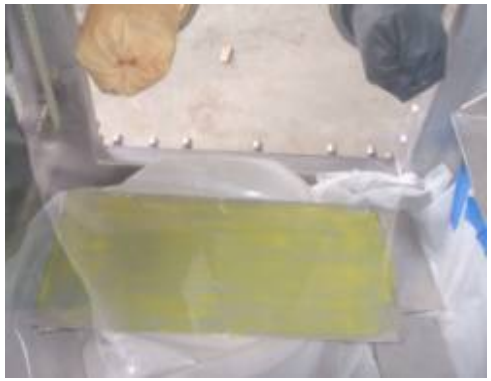
Current plan – be safer to be faster

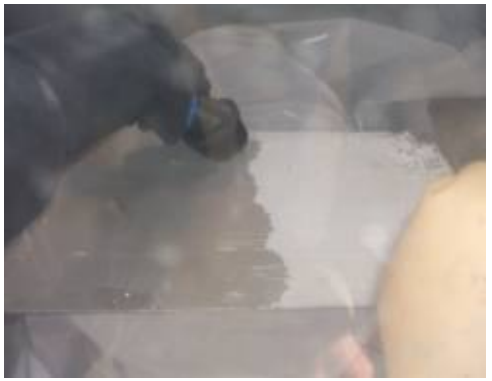
- Dry gel - apply and walk away for 24 hours

After application

After drying

After vacuum



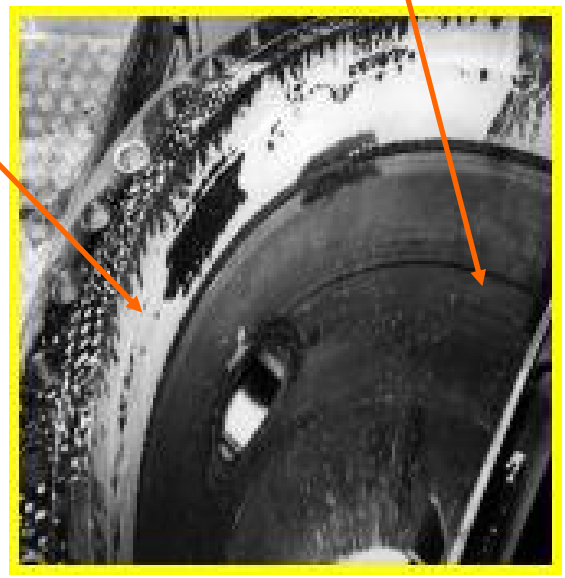


Current plan – be safer to be faster

- Foam – spray on and wait a short while before sending in the workers

Persistent foam indicates level of contamination is below 200 Bq.cm^{-2}

Foam quickly degraded on the more contaminated zones



Or could the answer be this simple?

- **Doesn't eliminate the need for workers to touch contaminated items**

- **AWE making trial data available to sub-contractors.**

Summary

- **Track record of safely conducting operations in high hazard, combined hazard operating environments**

- **Improve techniques to reduce risk and yield benefits in cost and safety**