

Radiological Protection
2022

Building a Framework for Post-Nuclear Accident Recovery Preparedness

National-Level Guidance



NEA Workshop on Preparedness for Post-Nuclear Accident Recovery

Decontamination, Recovery & Waste Management

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Themes

- What is decontamination?
- Strategic and tactical options
- Understand situational constraints
- Importance of waste
- Quantifying risk
- Plant example



What Is Decontamination?

Put simply;-

- “Mobilisation or removal of a contaminating species from a substrate in part or in full in a controlled way to support a **Safety, Business or Recovery** requirement.”
- Many other permutations and **not** restricted to radiological contamination

NB Decommissioning is the removal and disposal of items.

Strategic Drivers / End States

The situational constraints inform the likelihood and type of methods to meet the following;

- Restricted reuse – initial restricted use for essential services,
- Institutional controls – maintain controls until hazard has decayed by either natural processes or simple treatments. (Only for short half life isotopes.)
- Reuse / reoccupation – return to normal
- Enable alternative reuse – building is used but for a different purpose
- Demolish / dispose – remove material to release for future uses

This level of assessment can be made quickly by an expert to inform potential direction(s) and duration for senior sanction e.g. Minister, Safety Committee.

Understand The Situational Constraints

- What is the scale of the decontamination requirement?
- How urgent is the decontamination required?
- What type of environment? Open, agricultural, low density or high density buildings?
- What can be used for containment to prevent spread of contamination?
Only consider techniques that are compatible with the containment.
- Access, utilities, transport etc...
- Availability of skilled resources and equipment.

Typical Tactical Approaches

Hierarchy of approaches;

- Early Phase – stabilisation
 - **CONTAIN** – Containment of contamination to prevent (primary & secondary) spread e.g. Tenting, covers, coatings
 - **CONTROL** – Restrict access to the heavily contaminated areas to minimum
- Later Phases – controlled decontamination
 - **REMOVE** – Complete removal of contamination
 - **REDUCE** – Bulk removal of contamination
 - **INACCESSIBILITY** – Rendering the contamination inaccessible

Associated Factors

Characterisation:

- Knowing how much of what, is where?

Deployment:

- The tools needed to access contamination site and deliver the required technology / technique

Decontamination

- Which technique e.g. water jetting, fixing, chemicals, scabbling...

Waste Routes:

- What waste routes are available? Will the wastes generated be acceptable?

UK Nominal Waste Classifications

LLW

<4,000 Bq/g Alpha
<12,000 Bq/g Beta/Gamma



ILW

>4,000 Bq/g Alpha
>12,000 Bq/g Beta/Gamma



HLW

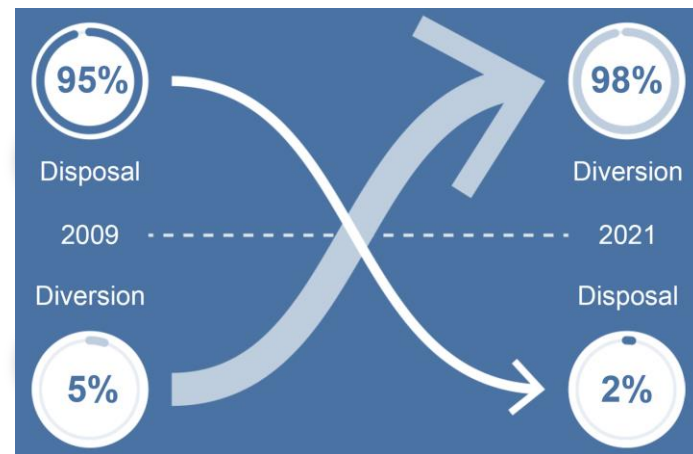
>4,000 Bq/g Alpha
>12,000 Bq/g Beta/Gamma
+ Heat generating



Waste Management Approaches

In addition to the Waste Management Hierarchy, the following approaches may be considered;

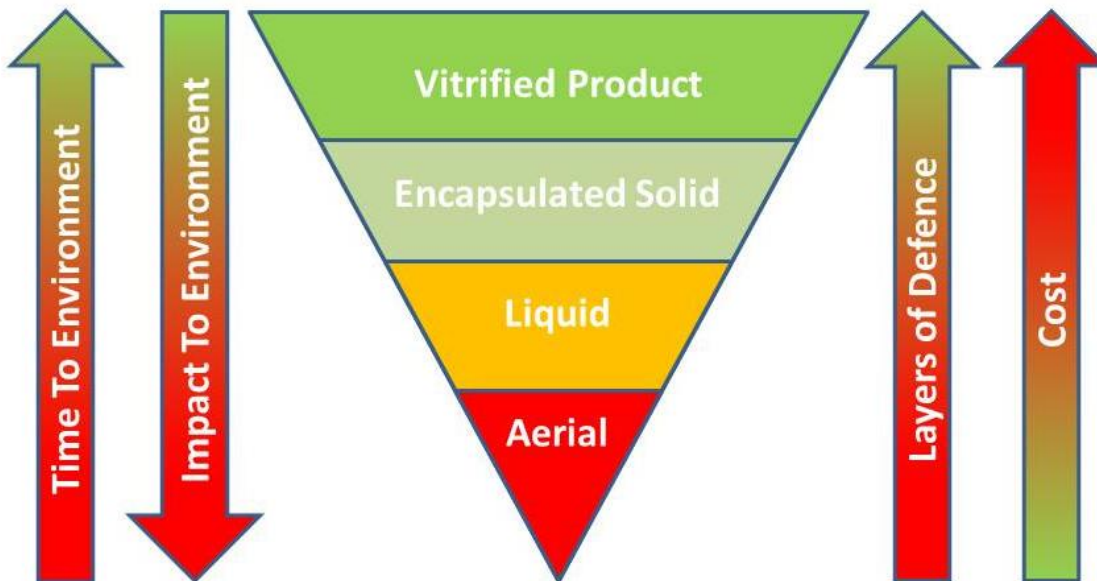
- Waste Re-categorisation – Create high volumes of a lower classification waste, that may include a much small quantity of higher activity waste
- Size Reduction – cut wastes to suit waste packages
- Re-use – decontamination of equipment / selected PPE
- Diversion of wastes to most appropriate route / facility, e.g. smelting of metals



Courtesy of Nuclear Waste Services, UK.

Waste Constraints

- Is there a valid waste route available? – No solution without a waste solution
- Alongside the Waste Management Hierarchy, is an informal “*Waste Acceptability Hierarchy*”
- If the waste is solid, keep it solid
- Don't ‘over process’ the waste.



Classes Of Decontamination Technique

Chemicals	<ul style="list-style-type: none">•Mild, Medium,•Aggressive•Foams•Gels
Abrasives	<ul style="list-style-type: none">•Wet and dry•Sand•Garnet•Bead
Mechanical / Physical	<ul style="list-style-type: none">•Scabbling•Needlegun•Laser•Microwave
Fixatives & Strippable Coatings	<ul style="list-style-type: none">•To fix for handling (short term) or long term operation requires a recognised coating.•Peel off for re-use / contamination control
Water Jetting	<ul style="list-style-type: none">•Blockage removal•Coatings removal•High Pressure and Ultra High Pressure Water Jetting•Cutting

Quantifying Risk

- Risk Level weighting to reflect situation specific criteria
- Quantifying risk to illustrate benefits of single and compound approaches;
 - Remove
 - Contain
 - Reduce
 - Control
- Mobility of the contamination
- How clean is safe? & how safe is clean?

	Green	1				
	Yellow	2				
	Amber	10				
	Red	100				
			From	To	Man Hours / m2	Risk Score
STANDARD APPROACH	R	G (Y)			2	200
REDUCE ONLY	R	A (Y)			0.02	1.67
CONTAIN ONLY	R	Y			0.02	1.67
REDUCE & CONTAIN	R	Y			0.03	1.83
REDUCE, CONTROL, REMEDIATE	R	G			0.73	3.29

Plant Example

Strategic Options

1) Operate and control the whole plant with gross contamination in enhanced PPE and RPE

2) Gross removal of loose contamination on essential equipment only to enable an early restart

3) Gross removal of loose contamination on all surfaces but maintain plant as higher contaminated level operating area

4) Remove gross loose contamination, in normal work areas and sub-changerooms, for a restart of plant.
Followed by a progressive period of phase decontamination

5) Plant-wide decontamination of accessible areas to previously designated contamination levels where practicable.
Some items placed into special controls

Tactical Approach

Phase 1 - Create Human Access

- Identify the critical items, decontaminate as required
- Vacuum, survey and contain contamination on floors with strippable coatings

Phase 2 - Improve Working Environment

- Vacuum, survey, wipe and cover items and surfaces (including walls and cell windows) up to head height
- Remove and reapply strippable coatings to contain residual contamination
- Create access towers to cranes and assess contamination levels at upper levels

Phase 3 - Reduce Contamination In Rooms / Higher Designated Areas

- Make progressive entry into sub-changerooms and infrequently accessed areas
- Methodology based on contamination levels

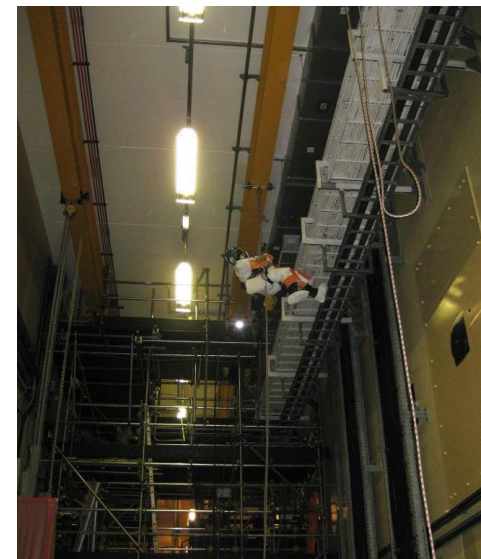
Plant Example



Phase 1 - Strippable Coatings



Phase 2 – Mobile access platform



Phase 2 – Rope access to cables

Plant Example - Completed

- Took 11 months
- 33,000 man hours to decontaminate
- No contamination incidents
- Plant is working better than before
- Demonstration of what an adaptable workforce can achieve.



Contamination Fixed *In-Situ*



Recovery Completed

Plant Example – Waste Management

Waste Form	Management Strategy	Disposal Route
PVC based PPE	Re-use	Re-Use via Site Laundry
Other PPE (e.g. gloves, Tyvek suits)	Segregate and Diversion	Off Site Incineration
Vacuum Wastes	Compaction & Disposal	Low Level Waste
Recovered Strippable Coatings	Segregation, Diversion & Compacted Disposal	High Activity – Compacted Low Level Waste Low Activity – Off Site Incineration
PVC Sheets / Bags	Compaction & Disposal	Very Low Level Waste & Low Level Waste
Sisal-Kraft Paper, decon wipes	Segregate and Diversion	Off Site Incineration
Higher Activity Waste	Compactions & Disposal	Low Level Waste

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Thank you
Merci
Danke
Gracias
ありがとうございます

Aide Memoir

