CARBOWASTE – Euratom 7th Framework Programme

Retrieval and Segregation

Work Package 2 Legacy Waste

Report for Year 2 2009/10

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Work Package 2 - AGENDA

PROGRESS IN YEAR 2

TECHNICAL REPORT D-2.2.1

FINDINGS, GAPS, ISSUES AND UNCERTAINTIES

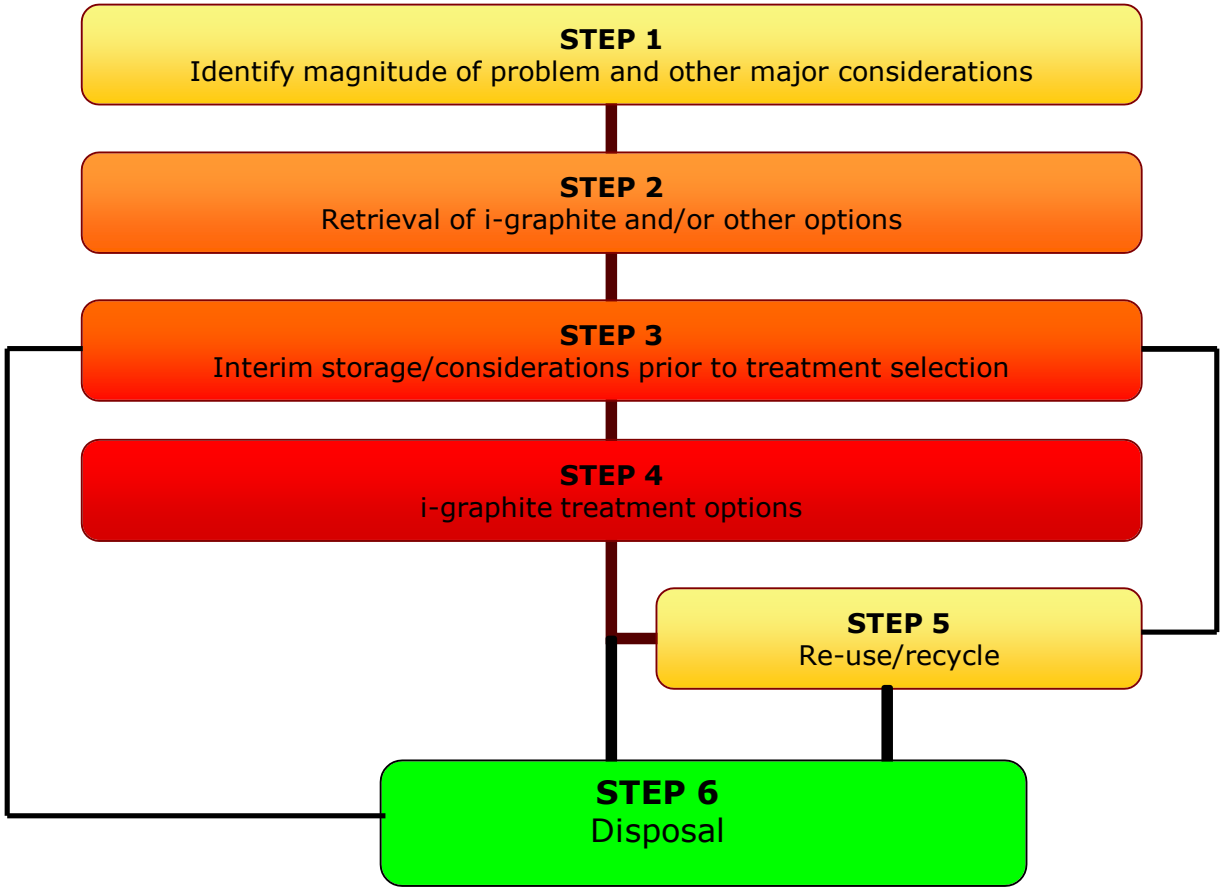
- *Retrieval and Segregation*
- *Other work packages*

PLANS FOR YEAR 3

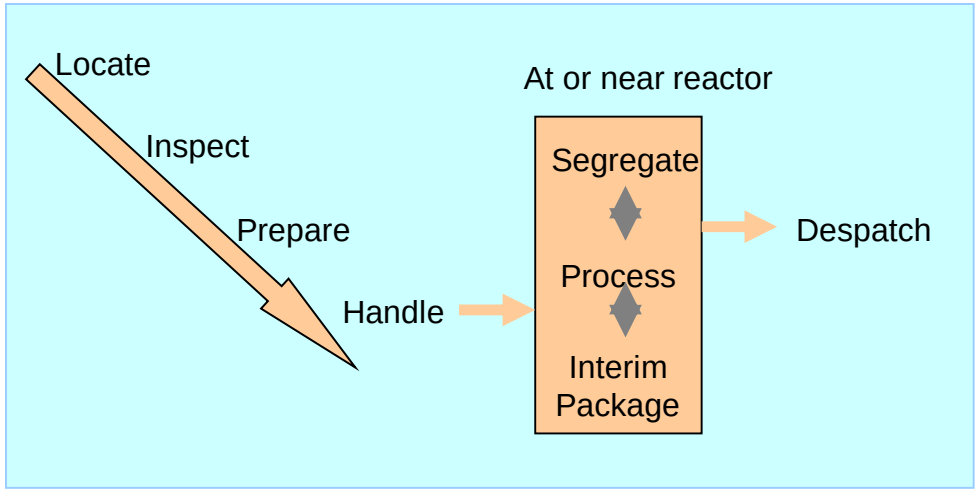
TASK 2.3 DIAGNOSTICS AND MODELLING

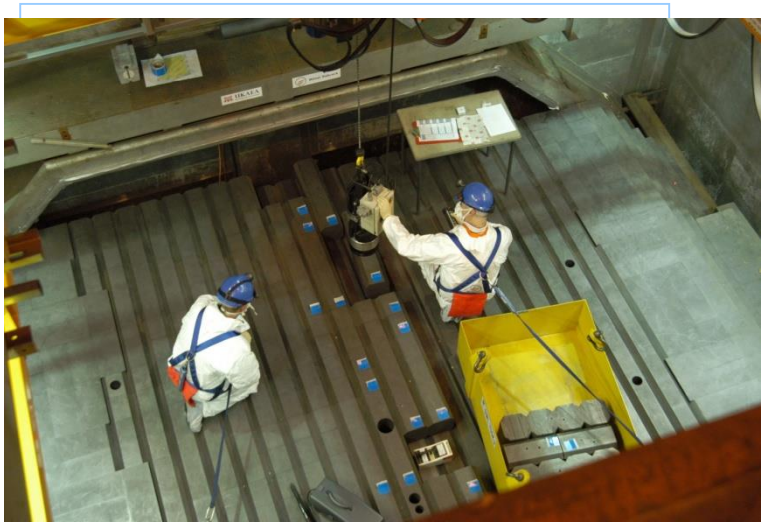
CONCLUSIONS AND RECOMMENDATIONS

CARBOWASTE ROUTE MAP – Integrated Waste Management approach

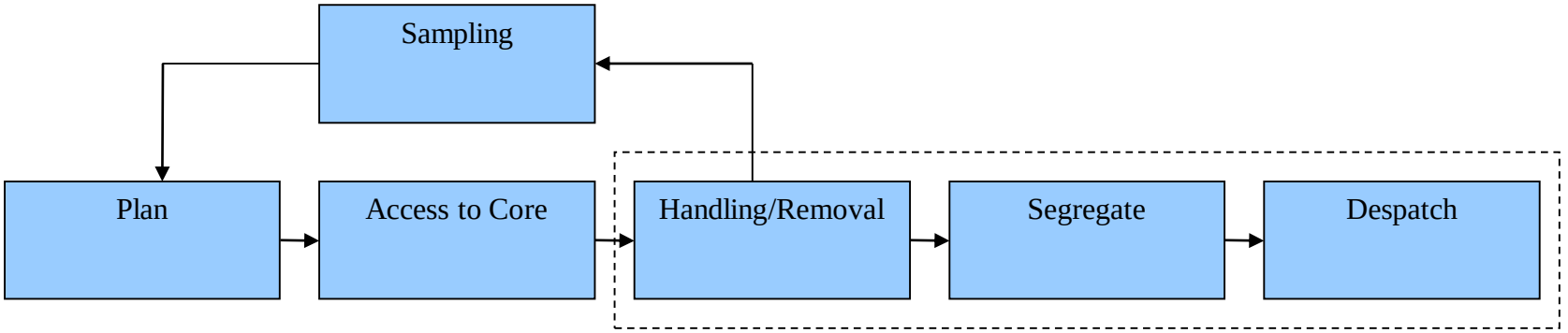


RETRIEVAL & SEGREGATION SCOPE – THE PROCESS





The Generic Process Agreed at the Workshop



WORK PACKAGE 2 ACTIVITIES

WP 1 Specification of Requirement

- **Completed year 2009**
  - Source of experience and data (Fort St Vrain, Windscale AGR, GLEEP, Leningrad and Vandellos Silos)
  - Agreed and reviewed assessment criteria for retrieval for use in WP1 and development in WP2
- **In Progress to 2011/12**
  - Participate in the Multi-criteria Decision Analysis process

WP2 Task 2.1 Radiological, reactor design, graphite integrity – completed year 2008/9

- Starting from WP1 review produced a data pack of information for use at a workshop

WP2 Task 2.2 Examination of Retrieval / Segregation options – complete year 2010/11

- Via a team workshop approach produced a report that is a generic toolbox compartment for *anyone* considering retrieval and segregation of graphite – **completed 2009/10**
- Define needs for modelling in Task 2.3 – **completed 2009/10**
- Finalise reporting on completion of task 2.3 – **complete 2010/11**

WP2 Task 2.3 Diagnostic and Modelling activities – complete 2010/11

- Work is in progress – see later slides

GAP ANALYSIS PRIOR TO WORKSHOP

- UK , Lithuanian and French information is most comprehensive (but gaps)
- UK is best on tooling details of achieved projects
- Information on Fort St Vrain is limited
- Japan outlines a possible method for retrieving blocks in multiples
- Spain has good information on retrieving and segregation sleeves from silos
- Information from Russia on in-situ grouting of reactors
- Retrieval at Leningrad needed to be better understood
- Reasoning behind in-air or underwater needs to be understood
- A logical and generic process for Retrieval and Segregation required

NARROWING THE GAP AT WORKSHOP

- Hold workshop with key specialists and experts to consider
  - The criteria that apply to a retrieval and segregation activity
  - Understand integration with waste management process
  - Knowledge of reactor designs of interest especially access, core design, i-graphite condition and the preliminary waste route.
  - Understand the reasons for choice between alternative retrieval and segregation approaches
  - Understand key areas of hazard and risk
    - *Dose, dust, access and timing issues*
  - Priorities for diagnostics and modelling

WORKSHOP

Agenda

- Reactor review (Magnox, UNGG RBMK)
- Define Generic Process
- Relate and review against Data Pack information and strategy
- Technology Review
- Identify Integrated Processes for Retrieval and Segregation (MCDA development) – feed back to WP1
- Review modelling needs
- Define report content and actions
- Consider Physical modelling

Participants

Doosan Babcock (host and leader) UK

AMEC UK

EdF France

FI Lithuania

FZJ Germany

LEI Lithuania

NNL UK (assisted with facilitation)

Hyder (representing Bradtec) UK

Student/Trainee from University of Manchester and Doosan Babcock

WORK PACKAGE 2 – CONTENTS OF REPORT

- **Pre-requisites, terminal points and assumptions**
- **Define Generic Retrieval and Segregation process (see slide 4)**
- **Use of the Retrieval and Segregation Toolbox Compartment (see slide 10)**
  - **Relate to Integrated Waste Management Solution**
  - **Selection of preferred Retrieval and Segregation process**
  - **The Solution engineering process**
- **Consider criteria and process options**
- **Information and Tools to support the solution and process options**
  - **Previous experience**
  - **Recognised strategies**
  - **Technology and tooling selection process**
- **Decommissioning integration issues**
- **Discussion, Conclusions, Recommendations, Appendices etc**
  - **Over 30 checklists (see slide 11)**

RETRIEVAL SOLUTION PROCESS

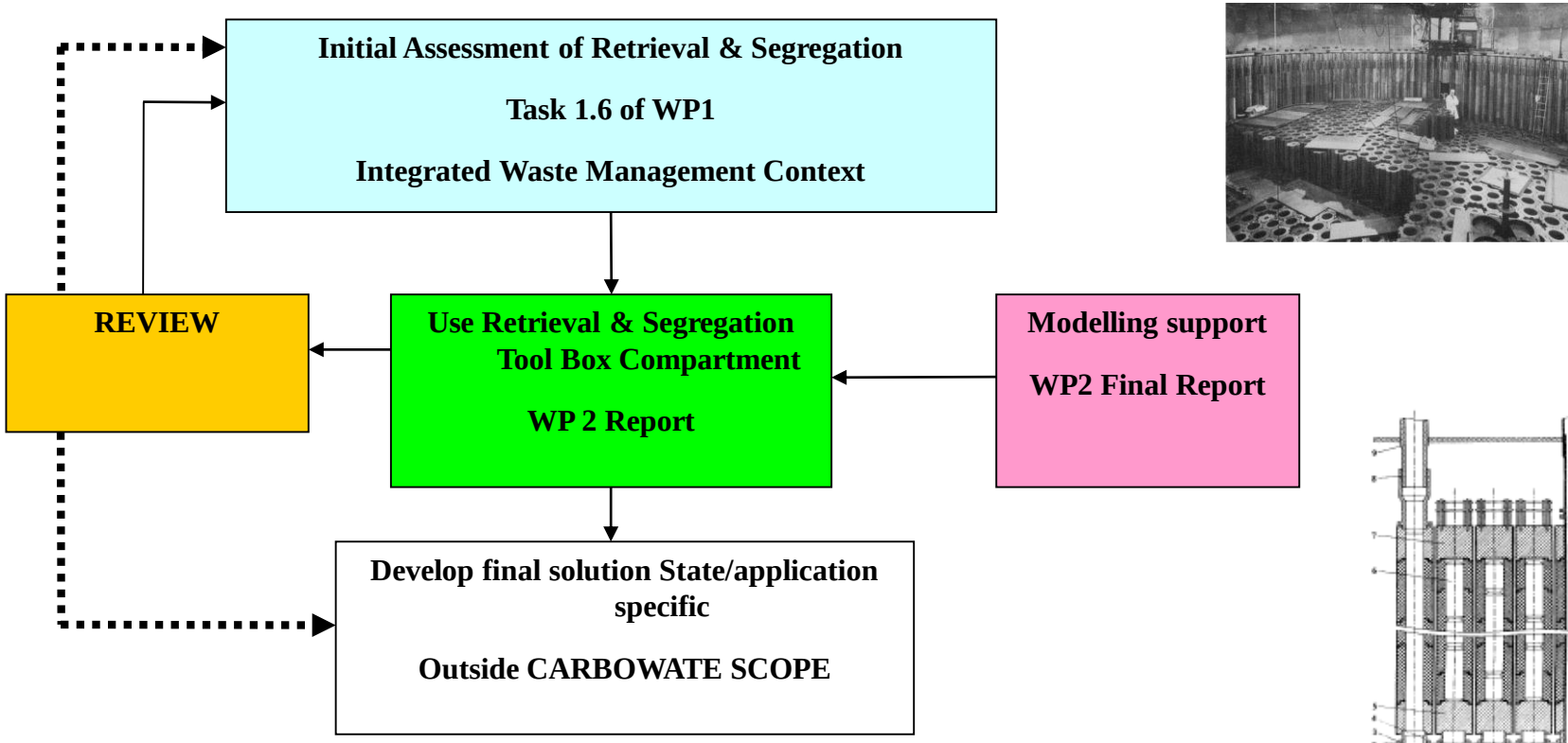


Fig. 4.3 Segment of the graphite stack
1 - top ring, 2 - diaphragm, 3 - bottom ring, 4 - bushing, 5 - steel support plates, 6 - graphite rods, 7 - shield plates, 8 - standpipe, 9 - guide pipe, 10 - reinforcing tube (reflector cooling channel), 11 - outer steel shell, 12 - ring plate

Figure 3 – Hierarchy of the Retrieval & Segregation Toolboxes

TOOLBOX/CHECKLIST APPROACH

Project Management & Process Integration

Data Acquisition

Access to the Core

Handling and Removal

Segregation

Preliminary Waste Route

Other site reactor/specific requirements

WORK BREAKDOWN STRUCTURE

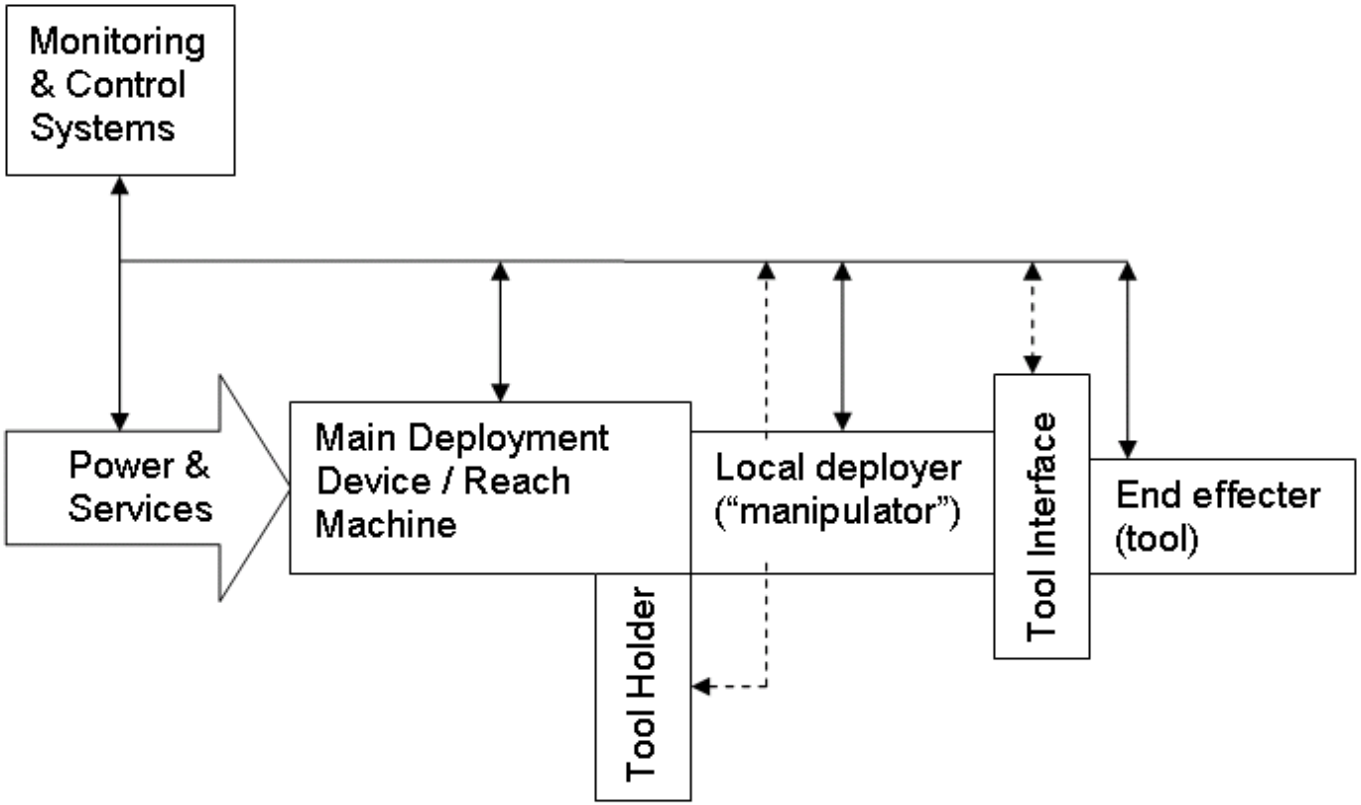
Level 1 of the work breakdown structure.

1. Project management and process integration
2. Data Acquisition
3. Access to the Core
4. Handling / Removal
5. Segregation
6. Preliminary Waste Route
7. Other site/reactor specific requirements

WORK PACKAGE 2 – LESSONS LEARNED

- General need to fit in with overall decommissioning plan
- Reactor design specific issues
- Make use of existing experience
- Have a clear selection strategy
  - Note the EdF approach to selecting a process
- Importance of the preliminary waste route
- Issues with dust
- Need to understand WBS and use checklists
- Tooling selection has both graphite specific and generic issues

TOOLING SELECTION PROCESS



SELECTION OF INTEGRATED PROCESSES

Option	Retrieval Medium	Delay	In-Situ Treatment	Disposal Conditioning	Disposal	Operator at Workface
1	Air	75 Years	No treatment	Condition (grout)	Deep disposal	Low dose rate
2	Water	<25 Years	In-situ chemical treatment	Condition (grout)	'Shallow' disposal	Low dose rate
3	Air	<25 Years	None	Grout	Intermediate Depth Disposal	High dose rate
4	Air/Inert	50 Years	Size reduction	Gasification	Capture	Low/medium dose rate

Workshop Generic Options

WORK PACKAGE 2 - UNCERTAINTIES

- Characterisation and Properties of i-graphite
  - Encountered status throughout reactor
  - Bulk versus particulate removal
  - Expansion versus contraction
- Dust (graphite or graphite stone)
- User data may become available from prior private studies
  - Understand overall reactor decommissioning methods and tools
- Output of modelling activity
  - Await completion of Task 2.3
  - Input from WP3/other date and use of Data Base

WP 2 Planned Modelling Work

- Review of modelling techniques
- Radioisotope inventory
  - Activation modelling
  - Mass balance modelling
  - Chemical modelling of impurity location
- Feasibility of lifting blocks
  - Modelling lifting methods
  - Impact of graphite oxidation on vacuum lifting

WP2 Modelling Programme

- Completed
  - Review of modelling techniques
- 2010-11
  - Diagnostic modelling
    - *Inventory for graphite / local environment*
    - *Lifting*
- 2011-12
  - PhD “Characterisation of reactor graphite to inform strategies for the disposal of reactor decommissioning waste”

WP2 Modelling Output

- Radioisotope inventory
  - Differences between reactors
  - Location within the core and within bricks
  - Comparison between graphite and metals
- Structural
  - Feasibility of lifting and the lifting technique alternatives
- Other areas where modelling could assist in strategy and detail decisions

INTEGRATION OF WORK PACKAGES/ISSUES

- WP1 feed back of information to MCDA
- WP3 properties and characteristics and data base for i-graphite awaited
  - Attendance at WP3/4 and WP1 meetings to understand the issues.
  - Is important to relate to modelling in Task 2.3
- WP4 should be aware of the specification of the preliminary waste route, may require segregation at the reactor
- WP5 as for WP4
- WP4, WP5 and WP6 requirements will influence the preliminary waste route. (relate to MCDA)

WORK PACKAGE 2 PRESENTATIONS

- 2009/2010
  - EPRI Workshop
  - Nuclear Industry Association Decommissioning Working Group
- 2010/2011
  - 13th April 2010 IChemE Chester Branch
  - 2nd/3rd November 2010 UKDWM10 Decommissioning and Waste Management Conference, Rheged, Penrith, England joint paper M Grave, A Banford, J Hill & J Montgomerie
  - Others

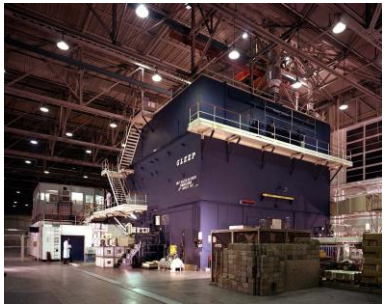
RECOMMENDATIONS

- Continue defined Modelling programme
- Obtain user group input to relate to
  - National strategies
  - Specific decommissioning programmes
  - Specific reactor challenges
- Consider input to TecDoc
- Update report as modelling work finalises
- Establish data transfer from WP3

WORK PACKAGE 2 BENEFITS

- Generic retrieval and segregation process has been defined
- The criteria for assessing each aspect of the process have been considered
- Key solution constraints are preliminary waste route, dose rate in area, control of dust and visible access to the graphite. Focus on risk reduction.
- A solution engineering approach has been created for a wide range of users
- A tooling selection process has been developed that relates the graphite / tool interface to the generic overall process.
- Potential users need to develop national or local specific processes to interface

CONCLUSION



How?
Why?
When?
What?

Summary

- Technical Report
- Use of the report
- Modelling
- Integrate Task 2.2 and 2.3 reports together with results from WP3.
- Interface with MCDA and Integrated Waste Strategy

Thank you for listening