IGD-TP and SNETP-TP4 meeting Exchange Forum
PRAGUE
October 29th and 30th 2013
• Spectrum of common targets and communalities that a broader trans-national collaboration will be of mutual benefit for similar reactor types like UNGG, Magnox, RBMK, MTR, or similar waste forms (e.g. sleeves) and others need to find co-disposal solutions.

• Confederate around a ‘Programme-related R&D approach’ targeting to near-term national and industrial solutions at the pilot scale (CarboSOLUTIONS). Fully coincides with the ‘Horizon 2020’ FP8 objectives towards programme-related logics.

• The overall funds are based on national programmes, industrial efforts on i-graphite management.
i-Graphite Management Options (FR)

Original Plan

23 Gg of i-graphite in France
Each country is in a particular situation because, at this time, long term intermediate storage inside the reactor may be accepted or not by the national safety authority,

But in all cases, we have to find an industrial solution: treatment versus disposal in a next future,

In parallel, at the end of the Carbowaste project, we have done a great job on:
- Radiological inventory for our i-graphite (calculations cross measurements),
- Graphite treatment: tests done with Julich, CEA, UK, NNL, etc…
- R&D program of each national country,
- Leaching datas etc…

This knowledge give us a good reference to start an industrial treatment process research.
OVERALL GRAPHITE MANAGEMENT PROPOSAL:
Simplified Flow Diagram for Water Management

High Temperature Dryer

Graphite / Water Slurry → Mechanical Separations → 2- Wet Graphite → Dryer → 3 - Dirty Water

Condenser

6 - Water with Cl-36

5 - Water Vapor with Cl-36

Holding Tank with Cl-36

Water Treatment Options

1. Treat all water
2. Evaporate water then treat
3. Separate Cl-36 / Recycle water
   a) Ion exchange / stabilization
   b) Precipitation / filtration / encapsulation

Clean Water
Return or Discharge

Filter / Ion Exch

Off-Gas
Steam, H₂, CO, O₂
Graphite
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OVERALL GRAPHITE MANAGEMENT PROPOSAL : to industrial design

Key technologies required all along the GRAPHITE waste stream

1. Decommissioning

   - Nibble and vacuum or Remote handling & automatisation
   - Radiological characterisation

2. Intermediate storage?

   - Sorting technologies?
   - Intermediate or final storage container?

3. In situ treatment or transport to treatment plant?

   - Transport container?

4. Graphite Treatment Plant

   - Full scale industrial thermal process
   - Crushing and preliminary treatment
   - Effluents management and monitoring
   - Treatment efficiency monitoring...

5. Secondary waste management

6. Final disposal routes

   - Dedicated near surface storage (LLW)
   - Deep Geological storage (ILW)
   - Sequestration scheme
It seems very important to define a **common strategy**

CARBOWASTE has defined the R&D fundamentals, now we have to come to:

- The real industrial needs
- Great interest to rise and study:
  - The main topics,
  - A global design,
  - The project proposal,
  - A time schedule,
  - The cost involved…

- It will be the target of the new proposal ‘Carbo Solution’.
It seems very important not only to work on the core process (ie the modified roasting or decontamination device) but to have a **global assessment of what the design would look like**, this can include:

- Nibble and vacuum for graphite stack,
  - depending of the reference choice for stack decommissioning (in France *water* for Bugey and Saint Laurent (2) *air* for Chinon (3)),

- Crushing graphite,
  - aerosols size what spectrum acceptable?

- Considerations for the **Movement of Radioactive Graphite Particles in a Pipeline**,  

- Roasting (core process):
  - with the ‘good choice’ of purge gas,

- Complete Gasification or not?
  - ie only graphite decontamination or complete destruction?
+ CO2 behaviour:
  - concentration and solidification: France reference?
  - or vacuum on a sequestration site: UK reference?

Tritium trapping and conditioning:
  - What level of possible releases?
  - on what substrate at what level?
  - safety acceptance for disposal

Chlorine 36 immobilisation and conditioning:
  - same questions,

Other gases treatment:
  - What can be a release target?

Water management (may be)

Of course the solution may not be the same for each country but it seems very important to share studies and information on all these 9 (?) topics.
This global design will be the ‘vertebral column’ to define all the R&D topics connected to the graphite treatment.

- It seems very important to start an international cooperative thought on this design depending on the national choice for each country to do the reactor decommissioning itself (in air, underwater?).

- The relationship between crushing, roasting, gasification etc. Are
  - very important and
  - sometime relatively complex but
  - with possible some positive sinergy,

- It seems impossible to do the choice of each sub-item independantly and it is risk connected to the global safety acceptance of the project.
Only this global design could authorise:

- A safety assessment (including for example on a release target for environment, a dosimetric evaluation for workers or a design accident) to see if it will be possible to ask for an authorisation from the safety authority for each country.

- A precise cost evaluation and comparison with direct disposal of i-graphite.