



Business from technology

# **Innovative techniques for decommissioning and minimisation (optimization) of the radioactive decommissioning waste**

European Forum for Science and Industry

Roundtable on "Scientific support for nuclear decommissioning"

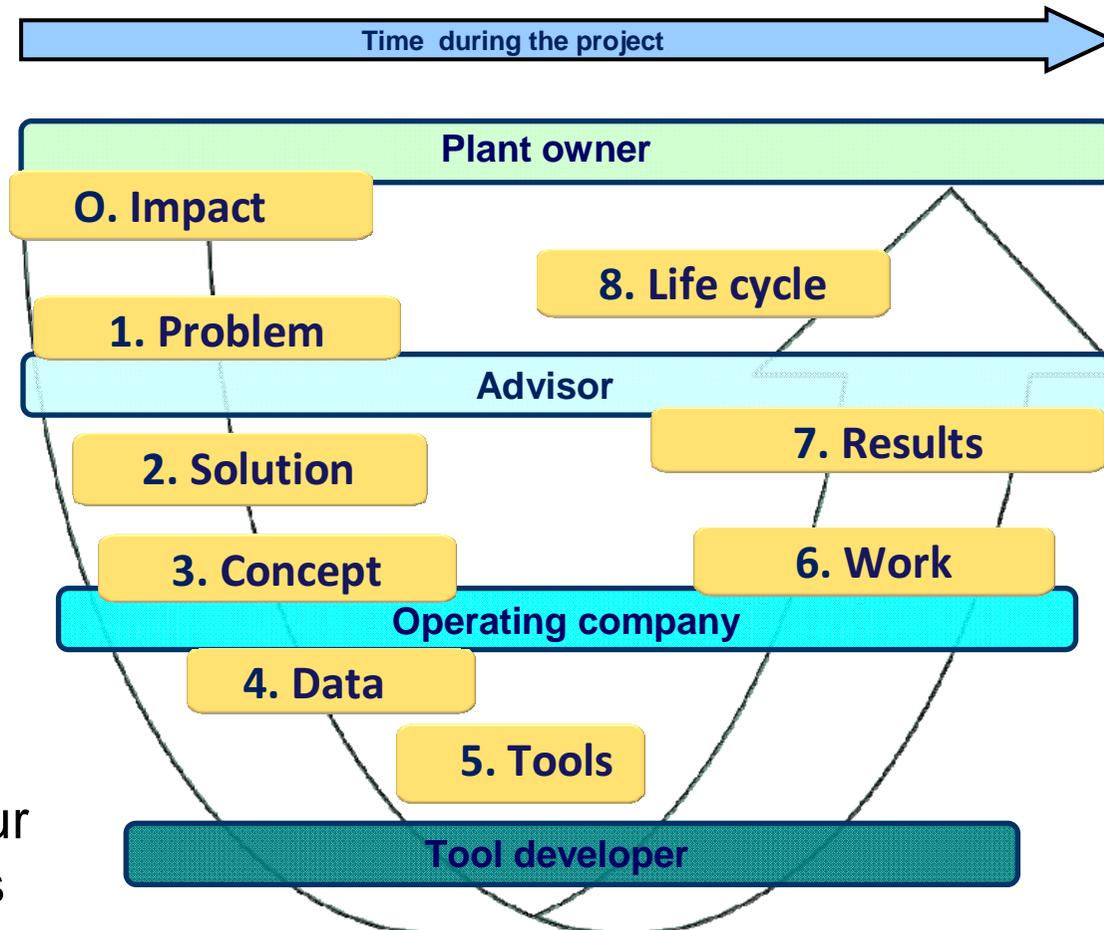
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## Decommissioning step by step

- Impact
- Problem
- Solution
- Concept
- Data
- Tools
- Work
- Results
- Life cycle
- **Innovation** may occur on any of these steps
- Participating organisations may not know enough of the overall concept



## Problem - initial

- How to safely and economically carry out decommissioning?
  - Radioactive components?
  - Final disposal?
  - Safe processes?

## Solution

- Separation of radioactive components from others (clearance)
- New problems
  - Which components need special attention?
  - How to carry out the work?
  - What to do with the radioactive waste?
- New set of solutions
  - Data collection
  - Innovative ways of working
  - Transport, and both interim and final disposal
- All solutions create new problems, which have solutions, etc.
- Note: one can operate and construct the plan so that decommissioning is easier

- **decontamination and cleaning**: reducing radiological contamination level of disused installations
- **dismantling**: dismantling of installations, segmenting large components, and demolishing buildings
- **treatment of waste**: infrastructure for the volume reduction of waste (e.g. incineration, melting, compaction) for its conditioning, and for its packaging

## Impact of decommissioning

- Minimisation of any problems coming from shut down nuclear power or research plants
- Proving that nuclear power plants can be decommissioned
  - by present level of technology
  - cost effectively
  - causing only very limited risk
    - during the operation
    - over the disposal period

## Concept

- All solutions need some concept how to really carry out the process
- Iteration between the top topics (impact, problem, solution) and more practical topics (data collection, development of tools and actual work)
- Innovation organisations are often well aware of the practical topics

## Data

- Need of many kinds of data or information
- Innovative is not only based on bright ideas, but also on the economical benefits (how much waste, how much cheaper the new method is etc.)
- Radiation protection and other legislation limits the freedom of innovators, who are not always familiar with these topics
- Regular data collection and dissemination of all that to innovators also

- **waste management:** estimation of waste streams, accounting and registration of waste packages
- **characterisation and measurement of waste:** strategies for packaging and measuring waste, in view of potential treatment and disposal as waste or clearance

## Tools

- Tools include everything which enables doing
- Examples
  - Measurement of radioactivity during dismantling
  - Minimisation of waste
  - Transport of waste
  - Disposal facility for waste

- **radiation protection:** monitoring equipment, shielding, dose estimation and measurement, protective equipment, and measures for preventing spread of contamination
- **site characterisation and land remediation:** devices and strategies for radiological characterisation of site, methods for land remediation, including its management and disposal as waste, and landscape restoration
- **safe and efficient radioactive waste transport:** vehicles and adequate handling infrastructure in the plant and in the radioactive waste storage or disposal facility

## Examples from Finland

- Decommissioning plans will have to be updated every six years by the power companies
- TVO
  - New steam dryers (beneficial effects both for operating time radiation protection and radiation doses during decommissioning, and also in minimisation of waste)
  - Up to date decommissioning plans, which form basis for considerations of minimisation of waste and other topics
- Fortum
  - NURES products for removal of radionuclides from liquids  
<http://www.fortum.com/en/products-and-services/power-solutions/products/nures/pages/default.aspx>
- VTT
  - VTT develops a new innovation to reduce volume of organic radioactive materials to 1/10 from the original volume.
  - Radioactive material can be ion exchange resins or organic material in nuclear accident areas.
  - Annual global saving potential in nuclear industry is in the level of billions

## Radiation protection and some other topics

- The dismantling personnel is probably not so well aware of radiation protection as the operating personnel, therefore radiation exposure of both personnel and environment is an essential topic
- How the periodical planning of decommissioning will **be** done, e.g. in Finland in six years cycles including costs?
- How the experience of operating personnel can be included? Time after operation is stopped and decommissioning is not yet started, may be used for innovation of methods

## Conclusions

- Innovative methods and ways of working needed in many areas
- Tight regulation of nuclear plants and radiation safety set certain limits for idea developing
  - Collaboration between different groups
  - Dissemination of knowledge
- Overall optimisation and planning needed in order to avoid useless innovations
  - For example, how much costs can be decreased by reduction of volume; and when the reduction is causing some additional limitation compared to initial waste
- Some final disposal site and repository needed in all cases



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