OPTIMISING ENVIRONMENTAL STEPS FOR NEW LICENSED NUCLEAR FACILITY PROJECTS
CONTEXT AND METHODOLOGY
In the 90s, environmental questions often felt as an additional new stress for projects.

New regulatory texts
- ISO 14031 standards: environmental directives
- French ministerial order of 26 April 2011: best available techniques
- French ministerial order of 7 February 2012 define the general rules relative to licensed nuclear facilities

Now, it’s a positive way to enhance the value of a project (importance for public opinion):
An effective sustainable development strategy is set on new projects:

“To avoid, reduce and offset the environmental impacts of the project through its whole life cycle”
The presentation will focus about the CEA’s experience as project owner of 3 projects:

- **DIADEM**: Waste storage facility project
- **ASTRID**: Advanced Sodium Technological Reactor for Industrial Demonstration
  - 4th generation reactor (600 MWe)
  - Industrial and experimental purposes
- **RJH**: Experimental reactor (100 MWth)
  - Behaviour studies on irradiated materials;
  - Production of radioelements for medical purposes
ENVIRONMENTAL ASSESSMENT FOR THE PROJECT LIFE CYCLE
Project organization

- Project team: a leader for site and environment matters

- Specification documents: to put environmental requirements in the major structuring documents
  - Functional specifications
  - Project management specifications
  - Performance management plan

- Documents to be produced by engineering firms at the end of conceptual design
  - Principle, quantification and means of minimising waste and effluents
  - Waste and effluent zoning plan
Methodology: to consider the environment as a criterion of choice

Definition of environmental specifications: French ministerial order of 7 February 2012
- The facility operator must ensure that:
  - Its facility is designed, built, operated, maintained, decommissioned and dismantled with the lowest level of risk and environmental impact deemed economically acceptable,
  - The best available techniques are applied whenever possible,
  - All measures are applied to offset any negative impacts that cannot be avoided or sufficiently reduced.

Quantification of environmental performance levels for options

Assessment of the life cycle for different options

<table>
<thead>
<tr>
<th>Impact category</th>
<th>Environmental Performance Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption and use of natural materials and resources</td>
<td>Depletion of raw materials, Energy consumption, Water consumption, Gas consumption,</td>
</tr>
<tr>
<td>Emissions/Releases</td>
<td>Greenhouse gas emissions, Air acidification, Photochemical pollution, Aquatic eco-toxicity</td>
</tr>
<tr>
<td>Waste</td>
<td>Solid/liquid waste, Toxic/eco-toxic waste, Radioactive waste, Recyclability</td>
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<tr>
<td>Pollution</td>
<td>Luminous pollution, Thermal pollution, Olfactory pollution, Noise pollution</td>
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Option selection process

<table>
<thead>
<tr>
<th></th>
<th>Solution 1</th>
<th>Solution 2</th>
<th>Solution 3</th>
<th>Solution 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>19/30</td>
<td>11/30</td>
<td>25/30</td>
<td>30/30</td>
</tr>
<tr>
<td>Cost</td>
<td>10/30</td>
<td>17/30</td>
<td>18/30</td>
<td>16/30</td>
</tr>
<tr>
<td>Global arrangement</td>
<td>13/30</td>
<td>14/30</td>
<td>17/30</td>
<td>18/30</td>
</tr>
<tr>
<td>Inspection</td>
<td>1/10</td>
<td>5/10</td>
<td>6/10</td>
<td>7/10</td>
</tr>
<tr>
<td>Maintainability, Reliability</td>
<td>3/10</td>
<td>5/10</td>
<td>7/10</td>
<td>6/10</td>
</tr>
<tr>
<td>Readiness TRL (Risk level)</td>
<td>6/10</td>
<td>4/10</td>
<td>5/10</td>
<td>5/10</td>
</tr>
<tr>
<td>Environment</td>
<td>3/10</td>
<td>8/10</td>
<td>6/10</td>
<td>6/10</td>
</tr>
<tr>
<td>TOTAL</td>
<td>55/130</td>
<td>64/130</td>
<td>84/130</td>
<td>90/130</td>
</tr>
</tbody>
</table>
Processing of choosing a site

- A previous site (on a nuclear site)
- Site studies to confirm the low environmental impact
  - from an archaeological point of view

- From an ecologic point of view: to preserve wildlife and habitats

CEA | Hotlab Ladurelle 23-27 september | PAGE 9
Process of choosing a site

- Site studies
  - To optimize integration into the landscape

Traditional cooling tower

Lower design with invisible plume

The result of the environmental assessment (and measures to minimise the project’s footprint) is submitted to public acceptance during the public debate (conceptual design) and then public enquiry (basic design).
Green site policy

- Involvement of all partners
- Documents with environmental targets
- Concrete actions in the field:
  - Optimising transport of materials
  - Optimising resources (water, packaging, etc.)
  - Sorting waste for specific recycling
Resource preservation: fast neutron reactors advantages

- Uranium-238 unusable today turns out to be a fuel

- Multi-recycling of reprocessed plutonium

- The 4th generation reactors will be able to burn minor actinides (currently considered as high-level waste)

Part of uranium in the global energy resources

A security of supply for thousands of years !!
Energy management

- Ex: Heating
  - Priority: limit thermal losses: concrete + massive design

- Heat recovery:
  - on a specific building
    ... but also to heat other site’s buildings!
Dismantling strategy must be integrated as soon as possible!

- The earlier you plan the strategy, the more you can reduce the impact.

- During the design phase:
  - To be careful with the choice of materials.
  - To estimate the quantity and radiotoxicity of waste produced during the dismantling phase.
  - To organize dismantling reviews.
The environmental impact of nuclear energy is one of the lowest of any energy source (no CO₂, efficient waste management)

Environmental strategy for new projects:
“to avoid, reduce and offset the environmental impacts of the project through its whole life cycle”

Design: environment as a real criterion in the process of choosing options

Construction: involving every partner of the project: project owner, engineering team and contractors
Thank you for your attention!