Phenix Nuclear Power Plant Dismantling Start

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INTRODUCTION

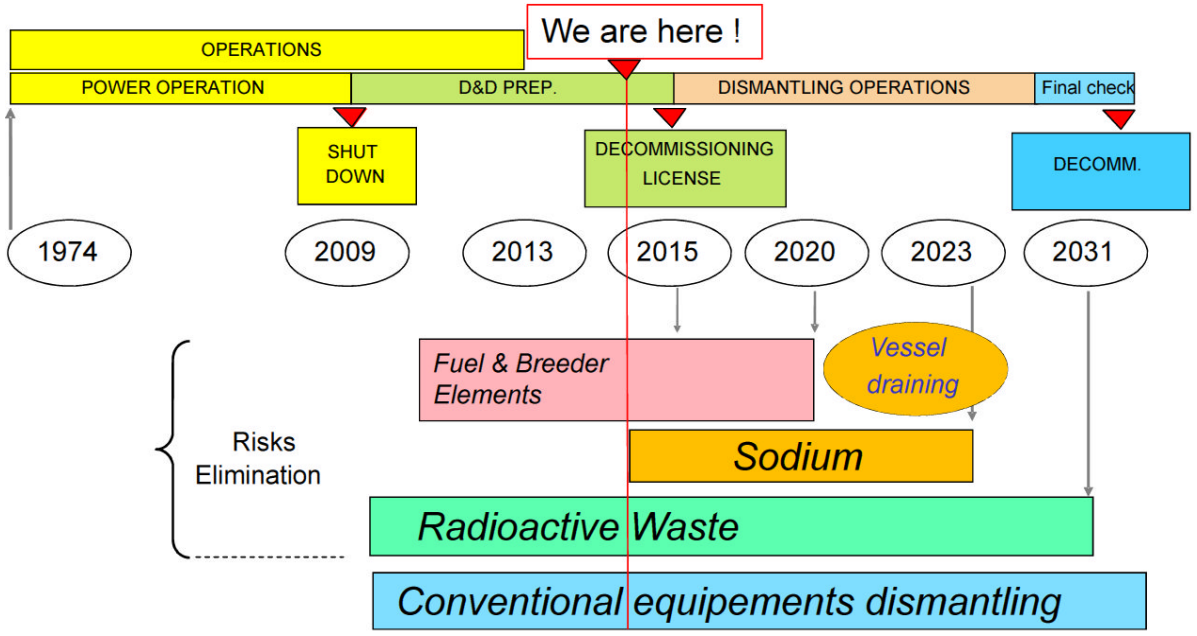
PHENIX is a French fast breeder nuclear power plant which went critical in 1973 and ceased power operation in 2009.
The decommissioning project started in 2005, in order to start immediately after the final shutdown and achieve the dismantling operations as soon as possible in accordance to the French Safety Authorities principals.
The "Commissariat à l'Energie Atomique et aux Energies Alternatives" (CEA) is the PHENIX operator.
The decommissioning project is headed by the CEA.

DESCRIPTION OF THE ACTUEL WORK

The decommissioning final objectives are :
- Regulatory decommissioning of the "Basic Nuclear Installation",
- All zones declassified as non-nuclear,
- Buildings cleaned but not demolished (free for use).

To reach these goals, all radiological and chemical hazards must be eliminated :
- All radioactive materials eliminated,
- All bulk sodium neutralized,
- All sodium contaminated materials treated and send to waste.

The decommissioning's main steps are :
- Defueling of the core and conditioning of the fuel elements in order to send them to AREVA reprocessing facility in la Hague,
- Sodium treatment,
- Radioactive waste evacuation,
- Conventional equipments dismantling.
- In order to treat bulk sodium and sodium contaminated materials two new sodium treatment facilities have to be built (and later dismantled)
  - NOAH : sodium neutralization
  - ELA : sodium waste processing



RESULTS

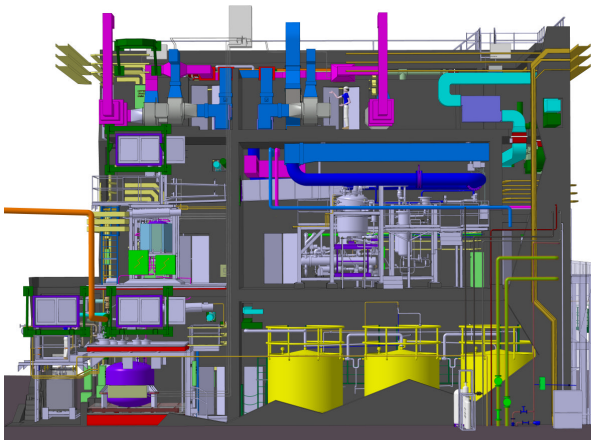
a) Regulatory steps:

- 2008 → 2011 : discussions with Safety Authority on the D&D subject,
- Safety report sent to the Safety Authorities by the end of 2011 to apply for decommissioning license,
- July 2013 → April 2014: instruction phase → 400 questions and 20 meetings with safety authority technical support,
- Public inquiry : June to September 2014, favourable opinion,
- Decommissioning license expected for 2015.

b) Sodium treatment:

- **Sodium treatment facility NOAH**

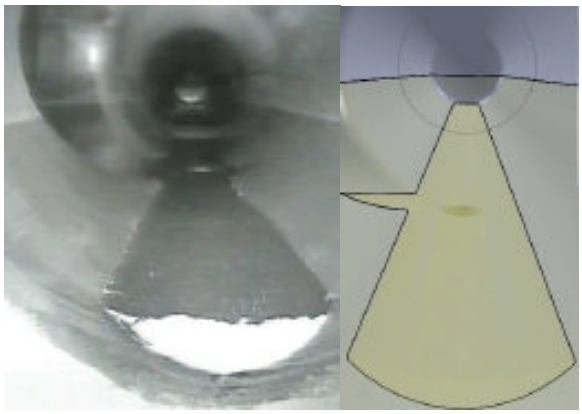
- In Noah facility bulk sodium will be neutralized by hydrolyse : Na + H2O→ NaOH + ½ H2
- All subcontractors have been chosen,
- The foundations are in progress.



- **Additional draining of the sodium loops and preparation of carbonation,**

- After the operation final draining, there was still sodium remaining in the secondary loops in two physical forms :
1/ Sodium films
The best estimate thickness is 1 mm for horizontal surfaces and 30 µm for slope surfaces. The amount of sodium in film is **80 kg per loop**. These Na films will be directly treated by carbonation.
2/ Retentions
Due to counterslopes in the pipes, there were large retentions remaining in some parts of the loops. They were treated additional draining.
The sodium amount estimate after additional draining is **17 liters** (1063 liters at the beginning).

Small retentions (10 mm thickness in average with a maximal thickness up to 23 mm) will be directly treated by carbonation. This thickness allows a carbonation time of 20 days
The sodium amount estimate in small retentions is **12 kg** per loop.
Other retentions identified in the loops (sodium valves …), not drainable, will be separated from loop and treated separately.
Before carbonation, the draining was verified by video inspection and 3 dimensions modeling for the sodium rest.



Video inspection 3D modeling

- Carbonation and water washing to suppress sodium hazards is expected in 2015 for loop 1.

c) Dismantling of the turbine hall:

The turbine hall is the first building which have been treated (2009-2013).
It is a "conventional" building without radiological risk.
- The turbine hallcontained the electricity generating facilities and the grid connection :
  - 2,200 tons of metal equipment: 900 tons for turbine, 300 tons for condenser, 1,000 tons of other equipment (electrical couplers, steam piping, tanks, heat exchangers, etc.).
  - Length 50m X width 40m X height 38m on 8 levels (from -10.5m to + 28m).
  - Fluids: water, oil, acid, sodium hydroxide, hydrazine, mercury, hydrogen, nitrogen, propane, etc.
- Turbine hall dismantling target was to disassemble the equipment with keeping the building structure (civil engineering, walls, roof, etc.) in optimal security conditions.
- Dismantling took place in 3 steps:
  - 1/ Inventory/studies (2008-2009)
    - Identifying the systems to be removed or to be kept.
    - Inventory of materials to be recycled.

    - Waste inventory.
    - Asbestos and lead diagnosis
- 2/ Equipment make-safe operation prior to dismantling (2009-2011)

The Objective of make-safe operation is to reduce risk at the minimum before dismantling (mechanical, electrical, fluid, asbestos, chemical, pressure, etc.).
It consisted after having drained all the fluids and rinsed all the pipes to make a physical separation of all the systems and equipment in the turbine hall from the remaining part of the power plant.

- 3/ Equipment dismantling (2011-2013)

The objective was to dismantle metal equipment (2,200 tons) and all equipment while keeping the building structure (civil engineering, walls, roof, etc.) taking into account the risks (fire risk, residual asbestos risk, lead risk, mechanical cold-stressed piping, mechanically taut spring packs …). Waste was recycled.
The turbine hall dismantling price was around 8 million Euros without CEA staff.
The turbine hall dismantling was a good training for the staff on dismantling methods and management of classical industrial risks without nuclear risks.

d) Conclusion

Phenix nuclear power plant ceased operation in 2009.
The first step in the dismantling of the plant was to dismantle all the equipements in the Turbine Hall.
The sodium secondary loops have been drained of sodium. The safety authorization is expected this year to realize the carbonation of the first loop.
The NOAH facility for sodium treatment is under construction.
The decommissioning license is expected for mid-2015.