Refurbishment of handling equipments in a maintenance cell of Phénix

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INTRODUCTION

- PHENIX is a French fast breeder nuclear power plant which went critical in 1973 and turn off 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 critical path of the plant dismantling is the evacuation of the fuel elements and after the evacuation of the Lateral Neutron Shielding Assemblies.
- The “Commissariat à l’Energie Atomique et aux Energies Alternatives“ (CEA) is the PHENIX operator.
- The decommissioning project is headed by the CEA.
STATEMENT

- The way of evacuation of the fuel elements from the plant called handling route, needs the availability of several equipments, mainly handling equipments.
- This handling route is only at half of its life because the evacuation of the fuel elements and of the lateral neutron shielding assemblies uses the same route to get out of the plant. The analysis of the handling route and the roadmap to increase the reliability of each equipment has been presented in HOTLAB 2015.
- The refurbishment of handling equipments in the maintenance cell located on the upper part of the Irradiated Fuel Cell is the first step to increase the reliability of the handling route.
Refurbishment of handling equipments in a maintenance cell of Phénix
ROADMAP

- The two main handling equipments in the maintenance cell are
  - the overhead crane,
  - the biological shield plug gantry crane.

- The refurbishing of the equipments allows the integration of:
  - the redundancy of the movements translation/direction/lifting,
  - troubleshooting system to return to a safety position,
  - Increased reliability,
  - spare parts available.

- The old gantry crane had an hyperstatic lifting system with 4 jackbolts. It has already broke down with great difficulties to lift down the plug and return in a safety state.
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Top maintenance hot cell

Replacement in 2017

Main Lifting Unit Trolley replacement

Plug Lifting Trolley Important refurbishing

Irradiated fuel elements hot cell
SAFETY

The aim is to ensure at all times to close the biological shield plug. When opened, direct intervention on equipments would be forbidden, due to the irradiation level.

The actions that condition the closure of the biological shield plug are:

- The handling back of a load or the hook of the crane to the maintenance cell during a handling in the fuel cell,
- The movement of translation and put back into place of the plug with the gantry crane.
RESULTS: FOR THE OVERHEAD CRANE

- The equipments replaced to achieve the objectives are:
  - the trolley of the crane,
  - the translation motors of the crane,
  - the entire electrical system including human-machine interface.

- The added features are:
  - A troubleshooting system of the crane translation movement installed through the wall,
  - A trolley running on the crane frame with two winding drums of hoisting cables fully redundant, an irreversible reducer to hold on the load, two redundant motors for direction,
  - Setting up 3 camera to improve vision (vision between cells, control from each cell).
RESULTS : FOR THE OVERHEAD CRANE

- The complementary design requirements are:
  - The new crane trolley has to be lighter than the existing one (no change for safety load calculations),
  - Use of usual spare parts.

Translation movement of 20 cm step to step with a rotating piston pushing

Test of the troubleshooting system of the crane translation movement
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Introduction of the overhead crane by the roof of the maintenance cell using an airlock equipment

Airlock equipment: test of opening the roof of the maintenance cell

Airlock equipment maintained by the main crane of the building on the top of the maintenance cell
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Introduction of the overhead crane by the roof of the maintenance cell using an airlock equipment

Airlock equipment : test of handling of the overhead crane
RESULTS : FOR THE GANTRY CRANE

- The equipments replaced to achieve the objectives are:
  - the lifting system,
  - the translation’s motorization of the gantry crane,
  - the entire electrical system including human-machine interface.

- The added features are:
  - A troubleshooting system of the translation movement of the gantry,
  - Two hoisting cables fully redundant to hold on the load in case of rupture of one cable and to be able to put down the biological shield plug with one cable.

- The complementary design requirements are:
  - Use of usual spare parts.
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RESULTS : FOR THE GANTRY CRANE

Test of the troubleshooting system of the translation movement

Test of the gantry crane (changed part in Yellow)

Two hoisting cables fully redundant
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RESULTS: FOR THE GANTRY CRANE

Final tests of the gantry crane with the plug

Introduction of the gantry crane in the maintenance cell
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Human and organizational factors

The Human and organizational factors have been taken into account from the beginning by:
- Analyses (Human-machine interface, …),
- Using operator feedback,
- Participation of the operator at each step: studies, during factories tests, during plant installation and tests.

RESULTS : GENERAL

All the new equipments were fully tested before assembly in the maintenance cell in order to limit the cell unavailability. The work in the Irradiated Fuel Cell kept ongoing during the assembly in the maintenance cell.
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Next steps:
done in the Irradiated fuel elements hot cell

- Replaced in 2012
  - Main Lifting Unit
  - Heavy Manipulator

- Replacement realized in June 2018
  - Transfer Lifting Unit

- Replacement planned in 2019
  - West Lifting Unit
  - South Lifting Unit

To Auxiliary hot cell  To Washing pit  From fuel storage
CONCLUSION

- The refurbishment of the crane and of the gantry in the maintenance cell was carried out successfully between October 2016 and March 2017. The new equipments were commissioned in March 2017.

- The second step to increase the reliability of the handling route is the refurbishment of the handling equipments in the Irradiated Fuel Cell. It starts in June 2018 with the replacement of the transfer lifting unit.
Thank you for your attention

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