REPLACEMENT OF A HEAVY MANIPULATOR IN A HOT CELL

Nuclear power plant of Phénix stopped in 2009
The Heavy Manipulator (HM) of irradiated fuel elements cell at Phénix, a French nuclear power plant, broke down in 2010 after 40 years of service.

The PHENIX hot cell allows the reconditioning of fuel elements. This cell is the main piece of equipment for dismantling the PHENIX power plant. Nearly all means of remote operations in this cell were lost. This heavy manipulator failure leads to stop the maintenance of other equipment in the hot cell.

The French Atomic Agency (CEA) operates PHENIX.

This operation was conducted by the CEA (Operating Department and Decommissioning Department), with the engineering tasks by AREVA R&S. The manufacturer is Wälischmiller Engineering company.
SCHEME OF THE CELL

OLD HEAVY MANIPULATOR

SEMI GANTRY Mechanical and electrical Link to the cell

BRACKET

HEAVY MANIPULATOR

ARM

RAILWAYS

GVO

UL50

Liaison barillet

GVS

UL50

SCHEME OF THE CELL
Analysis of the existing Heavy Manipulator

- The existing machine is a semi gantry heavy manipulator with a bracket and an arm.
- It moves from north to south on railways. It had more and more difficulties to move.
- The production rate was half of its objective (1700 fuel or dummy elements already done, the same has to be done). So in 2009 it was decided to change the existing HM. The arm (shoulder) of the heavy manipulator finally broke down in 2010.

Analysis of the existing heavy manipulator’s dismantling

- The existing heavy manipulator is mechanically and electrically linked to the wall and to the translation rails.
- It was introduced at the end of the cell building period without providing possibilities for removal or remote intervention (except for the bracket and arm).
- It was decided to leave it temporarily in the middle of the hot cell. The hot cell is 14 meters long.
EXISTING HEAVY MANIPULATOR IN THE CELL

SEMI GANTRY
Mechanical and electrical link to the cell

OLD HEAVY MANIPULATOR

Work zone in front of the cell

+ 6 m height
+ 14 m long
FUNCTIONAL ANALYSIS FOR NEW HEAVY MANIPULATORS

Two zones were identified:
- The bottom part with recurrent uses of the manipulator for repair or maintenance of lighting, weak manipulators, electrical link, pits, …
- The upper part with exceptional uses for repair or maintenance of two lifting unit.

So it was decided to manufacture two heavy manipulators:
- A Lower Heavy Manipulator,
- A Upper Heavy Manipulator.

Each manipulator:
- using an existing standard arm,
- adapted on a specific trolley,
- able to lift 200 Kg.
FUNCTIONAL ANALYSIS FOR NEW HEAVY MANIPULATORS

Area reached by manipulators

Upper part area

Lower part area

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F. DOMINJON, H. DUPORT, F. LAURENT, P. BRUGUIER
Email: franck.dominjon@cea.fr
FUNCTIONAL ANALYSIS FOR NEW HEAVY MANIPULATORS

The lower heavy manipulator:
- is permanently in the cell,
- moves on the existing railways,
- has a parallelogram to reach the requested area,
- can be removed from the cell for repair,
- is carried out from north to south of the existing heavy manipulator with the lifting unit to bypass the existing heavy manipulator,
- carries a camera to help the operator,
- is used for emergency exit of the top manipulator.

The upper manipulator:
- is introduced in the cell on demand,
- is put on the crane frame and linked to the crane trolley (right or left). The motions are managed by the crane.
FUNCTIONAL ANALYSIS FOR NEW HEAVY MANIPULATORS

Existing heavy manipulator

Lower heavy manipulator in the north area

Bypass of the existing heavy manipulator with the lifting unit

Lower heavy manipulator in the south area
- **Introduction in the cell**: The new manipulators had to get in the hot cell from the maintenance cell through a square hatch of 1.5 meter large in order to get in for implementation and to get out for maintenance.

- **Implementation**: Only the crane can access the implementation zone of the lower manipulator. The put down of manipulator and plug in of power was done by the crane and the manipulator itself finished its establishment. It is linked to the railways by anti-tilting equipment to prevent a seismic hazard and to open the parallelogram.

- **Characteristics**: The movements of manipulators are electrically motorized in order to limit oil in the cell (to prevent criticality hazard). Electrical power, instrumentation and control are the same for both manipulators.

- **Sizing to meet the safety requirements**: earthquake, fall of load, reliability, maintainability, criticality, fire.
DESIGN OF NEW HEAVY MANIPULATORS
DESIGN OF NEW HEAVY MANIPULATORS
- The new manipulators had to be adapted to a rather undefined environment.
- The electrical distribution represented an important difficulty.
- The first implementation was done by the crane, then the manipulator was connected and prepared itself its zone (better implementation of the power supply, cleaning of the zone in order to put on the cable chain, put on the cable chain, …).
- The top manipulator was supplied by a cable from the bottom of the cell (In case of difficulties, a power supply could have been made from the maintenance cell through the hatch).
MANUFACTURING, TESTING AND INTRODUCTION

Electrical cable and plug in of the upper heavy manipulator

Electrical cable chain for lower heavy manipulator

Electrical arrivals from outside the cell
MANUFACTURING, TESTING AND INTRODUCTION

Manufacturing / tests in firm
Introduction of the lower heavy manipulator in the cell
CONCLUSION

- The manufacturing of the new manipulators was carried out between January 2011 and March 2012.
- The new manipulators were set up from March to June 2012.

THANK YOU FOR YOUR ATTENTION