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Granel for ASTRID fuel assembly fabrication

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Grappel for ASTRID fuel assembly fabrication

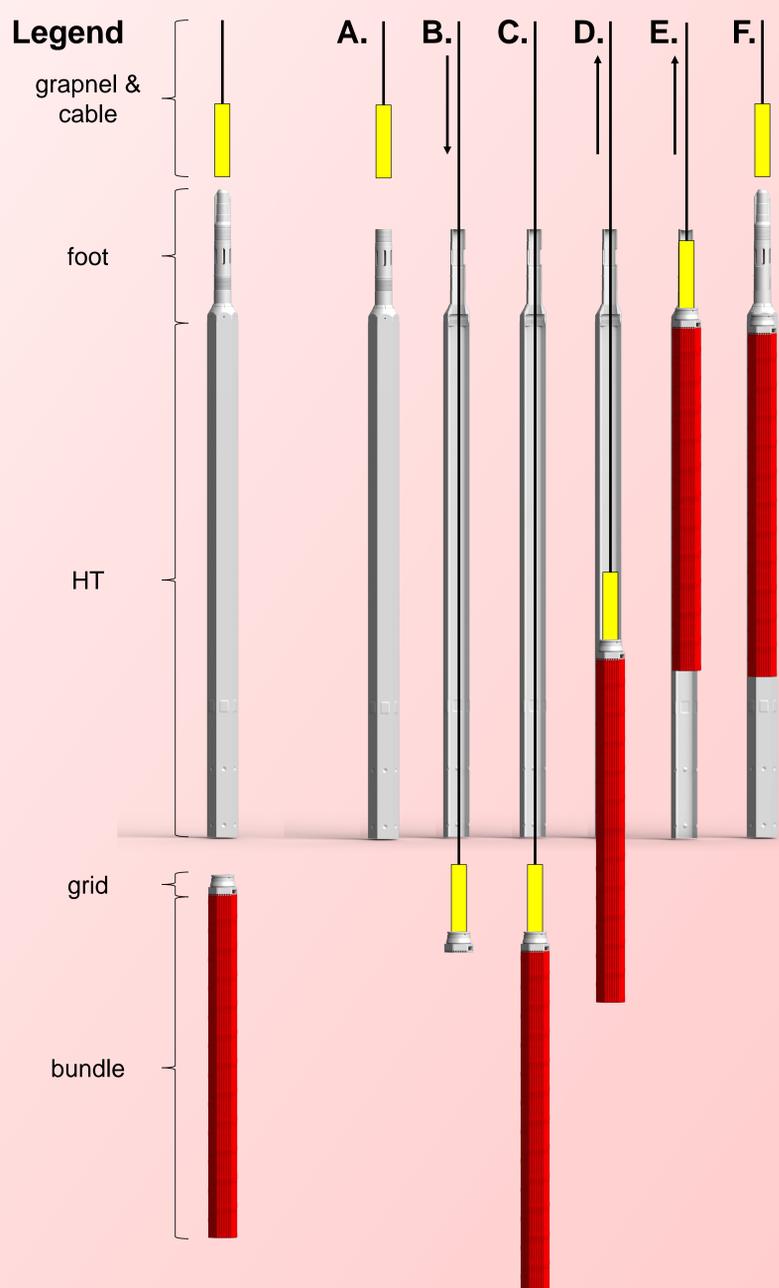
Objectives

In the past, for the PHENIX reactor for example, the fuel assembly fabrication was carried out manually. For ASTRID sodium fast reactor, these operations will have to be automated due to the dose rate and the temperature of the fuel.

While the fuel assembly mounting used to be carried out on horizontal benches, this step is planned to be performed vertically for ASTRID.

The LTAP laboratory has developed a grapnel to enable the bundles of fuel pins to be inserted into a hexagonal tube casing (HT) during the fuel assembly operation.

Functioning



Summary of the assembly procedure:

- Setting up the pre-assembly (base + HT) in a vertical assembly bench in an inactive conventional workshop (not shown)
- Lifting of the grapnel through the pre-assembly, then installation of the grid (system of rails enabling the pins to be set in place) by an operator
- Automated insertion of the pins on the rails, to make up the bundle
- When the bundle is ready, it is lifted into the HT casing using the grapnel
- Fixing the bundle in the pre-assembly, then grapnel removal
- Setting up the laminar flow device and the lock.

Constraints

Requirements for the grapnel included:

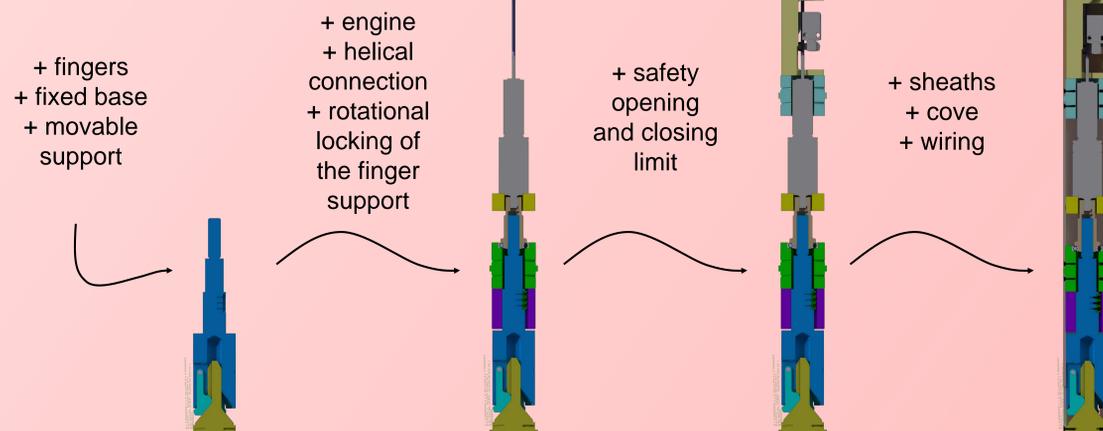
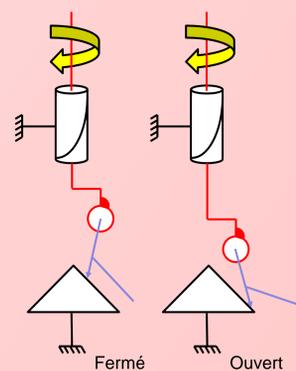
- Grappel closed → Ø 85 mm max
- Grappel open → Ø 110 mm min
- Manipulation possible via a standard hoist
- Zero part marking during use
- Manual handling possible for connection
- Remote handling possible for disconnection
- Oil-free grapnel

Design

The grapnel's design was entirely carried out in a CEA Marcoule design office (DTEC/SDTC/LTAP).

The grapnel principle involves:

- A fixed motor in a housing (in black) drives a screw
- The screw raises and lowers a support (in red) on which the axes of the pivoting fingers (in blue) are attached
- The fingers go in and out by pivoting on a fixed base (in black)



Construction

The LTAP study bureau outsourced the manufacturing of the mechanical parts in conformity with plans drawn up in-house. The assembly was carried out by the LTAP team.



Conclusion & Perspectives

The grapnel works well:

- Grappel closed → Ø 84 mm
- Grappel open → Ø 134 mm
- 500 kg payload (trial carried out on 14/06/2016)
- Semi-automatic

Enhancements to plan for:

- Management of load perpendicularity
- Trials to be carried out with a complete dummy assembly