

## **A New Gantry Crane for Cask Handling at Cherbourg**

*J.L. Charles*  
*COGEMA*

*Ph. Frantz*  
*REEL S.A.*

### **INTRODUCTION**

In the field of nuclear transportation, the industrial maturity of spent fuel reprocessing recycling means :

- a significant maritime transportation flow
- a number of handling operations

For years, spent fuel reprocessing has gained an international dimension, notably with the development of reprocessing contracts between COGEMA and the foreign utilities. This activity has entailed the development of spent fuel sea transportation.

Since the 1980's, COGEMA unloads and reprocesses spent fuels from European and Japanese nuclear power stations in the La Hague UP-3 plant. These spent fuels, are conveyed in specific casks by sea, road or train and unloaded in Cherbourg's harbour. Then they are put on appropriate trucks, assigned to transportation to the plant railway terminal.

### **A NEW GANTRY CRANE FOR CASK HANDLING AT CHERBOURG**

Today, COGEMA's strategic choice has been determined by :

- Safety and security requirements all along the fuel cycle
- Operational feed back including 1991 incident.

Until 1991, COGEMA was using classic harbour crane with an admissible load of 120 ton (SWL) for cask loading/unloading operations.

The lifting kinematic chain was made by two winches, coupled to a manual synchronizing system. Safety was ensured by two disc brakes, working with an overspeed detector.

### **Operational feed-back including 1991 incident**

On December 17, 1991, the Pacific Pintail ship came alongside Cherbourg's harbour to unload TN12 casks of spent fuel.

After 8 casks had been correctly unloaded, the gear box of one unit of the two lifting winches broke while the ninth cask was transferred horizontally to the transportation truck. The overspeed detector did not work and the disc brakes were out of order. It was advisable to notice that the overspeed system was at the end of the driving shaft and could provide indication only if the kinematic chain was intact. This gear reduction unit while breaking, dissociated the winch from the electric motor.

After this day, COGEMA aware of the stakes, decided to safeguard against the repetition of such an incident and to design a new gantry crane for casks loading/unloading operations.

### **A NEW DESIGN FOR THE CRANE**

The REEL company works in the lifting field. Notably it is a specialist in the design and construction of highly safe lifting and hoisting equipment.

REEL has already provided to COGEMA lifting machines with a 130 tonne admissible load, equipped with redundant kinematic chains, for the La Hague plant. So COGEMA orders to REEL company the basic design of the new crane.

### **The solution proposed by REEL**

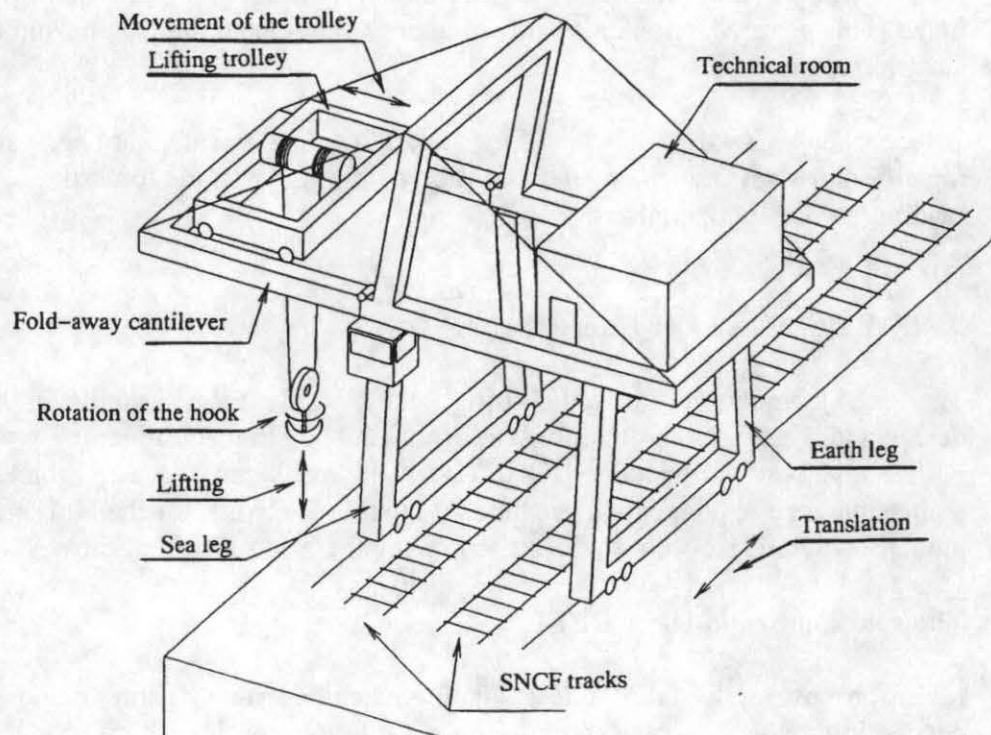
REEL proposes to COGEMA an unloading machine with a « gantry crane » conception, in order to replace the « crane » solution, for the following reasons :

- A gantry crane permits to unload with only one movement- which is a lifting movement- whereas a standard harbour crane needs two movements- which are the boom lifting and the load lifting.
- A gantry crane presents less risks and a higher accuracy of positioning.

## Description of the gantry crane proposed by REEL

Therefore, REEL proposed COGEMA to use a gantry crane, designed to lift a load of 140 tons whose lifting movement is obtained by using a winch with a redundant « closed » kinematics chain. This trolley, previously designed by REEL, is already used at the La Hague plant for cask handling in the spent fuel pools building, with a probability of breaking risk inferior to  $10^{-7}$  a year. Besides the new elements mentioned above, the admissible load was increased of 20 tons and a supplementary room to maneuver was added. This new lifting capacity was part of the framework of the future increase in cask load.

The following diagram describes the main elements of the gantry crane :



The gantry crane is composed of two legs, on the sea and land side, which have two articulated and motorized bogies, rolling on the two tracks. These legs ensure thus a translation movement to the gantry crane along the wharf and allow it to be positioned at the base of the unloaded ship decks.

The legs are joined by a horizontal quadrilateral which has a retractable U shape cantilever to the sea, allowing thus the easy coming alongside of the ships.

In order to ensure the stability of the whole, a counterweight (not visible on the diagram) is located at the rear of the quadrilater. The lifting trolley unloads the casks by translating them perpendicularly to the wharf, from the decks of the ship to the transportation trucks parked on the two SNCF tracks between the legs.

The gantry crane has also a monitoring cab on the sea side, which ensures for the crane operator an easy view and monitoring of the handling movements.

There is also a technical room which shelters a trolley out of order, the wiring system and the fold-away mechanism of the cantilever.

It is advisable to stress that COGEMA wants the gantry crane to integrate itself perfectly into its surroundings.

#### *Technical characteristics*

General characteristics	Total height (lifted cantilever)	35 m
	Height of the trolley	18 m
	Total length	40 m
	Total width	21 m
	Lifting capacity	140 tons
	Empty load	450 tons
Speed of the movements	Lifting	2 m/min.
	Moving of the trolley	10 m/min.
	Moving of the gantry crane	15 m/min.
	Cantilever lifting	5 min.

By means of safety, two movements cannot be ordered at the same time. The installed power is of 100 kW, under average tension from the wharf. In the event of a network failure, the gantry crane is linked to an auxiliary generator.

#### **The utilization of the gantry crane**

After the gantry crane was switched on, the cantilever was pulled down and the wagon positioned. Then the cask is lifted and transported alongside with its transportation frame. Because of the presence of this frame ( needed for sea transportation), the cask is first put down on a truck whose rôle consists of desolidarizing the cask from its frame. The frame is put down on the railway transportation truck. The operation lasts 45 minutes and the whole unloading lasts 8 hours. The apparent slowness of the unloading is part of the safety objective, in order to control the movements and to avoid any risk of load collision.

After utilization, the gantry crane is brought to the north of the wharf, where it is immobilized in its anchorages with 16 jacks, which ensure good resistance to the strongest tempests.

## AN INCREASING RELIABILITY AND SAFETY

### Principle

The new gantry crane ensures a very high reliability and operation safety. Two basic new elements guarantee an increasing safety :

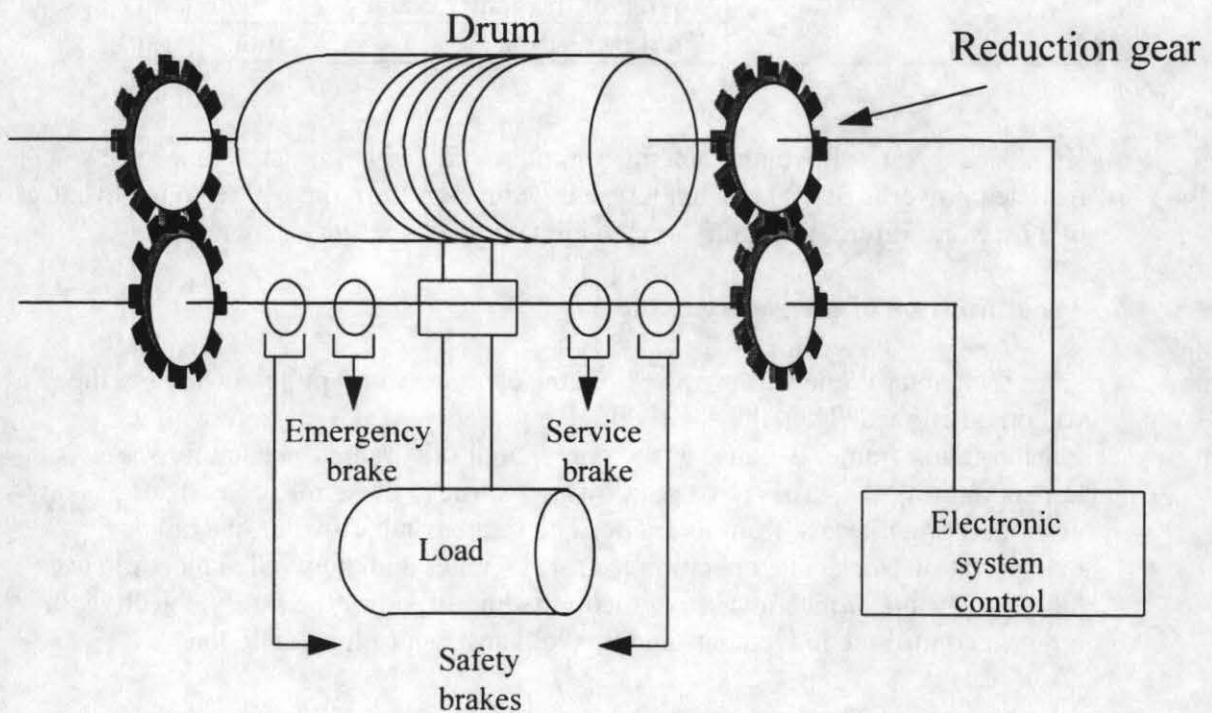
- the conception of the gantry crane type
- the redundancy of the lifting and monitoring systems described afterwards,

### Lifting kinematic chain

Two cables hang the load, but their arrangement is such that the breaking of one of them does not throw away the balance and does not cause any accident. Moreover, an absorber of energy has been set when the cables were hung in order to limit the dynamic effects in case one of the two cables breaks.

The lifting of the loads is ensured by a «closed» type kinematic chain where are electric motor power and two gearboxes of the same type. Those two gearboxes move the same drum. Each driving shaft has two brakes. This type of assembly prevents the load from dropping in the event a gear reduction unit breaks. These are the main mechanical features.

The following diagram describes the lifting kinematic chain.



Moreover the lifting motion is controlled by two electronic systems instead of one before. The first one performed the following functions : power misfit, sensor fault, drum rotation fault, low speed and high speed overspeed, low speed and high speed redundancy, failure in kinematic chain, static veering and dynamic veering.

The second measures the balance of reaction induced by load on the two gear reduction units.

A specialized staff ensures the different maintenance and handling operations in optimized conditions. In particular, the crane operator has a perfect view for the control of the gantry crane movements, thanks to a conception which has been studied for the ergonomics of the driving cab.

Finally, the gantry crane which was protected against marine corrosion, has been designed in order to be used for 30 years.

## **CONCLUSION**

REEL's proposal has met :

- COGEMA's expectations,
- The safety requirements,
- The requirement of the development of COGEMA's activities,
- The increase of Cherbourg's harbour traffic.

Safety and security requirements all along the fuel cycle have led COGEMA to adopt the best technology available in the heavy and highly safe lifting field.

The equipment proposed by REEL offers a reliable solution to the loading/unloading operations of spent fuel casks.