



**A NEW SOLUTION TO**

**DECONTAMINABLE AND INSPECTABLE PACKAGE HANDLING FEATURES**

**THAT CAN BE BLOCKED BY A 90° ROTATION**

**Fabien Girault**  
DAHER CSI 41400 MONTRICHARD FRANCE

**ABSTRACT**

Nuclear industry uses lot of packages to handle, transport and store radiological materials. The large majority of these packages needs to be externally decontaminated and particularly handling features which comes in contact with contaminated handling tools.

The patented invention addresses ease of decontamination and decontamination control for handling features on nuclear packages. This is a very important feature e.g. for avoiding transfer of contamination and release of contamination into the environment. These operations are difficult to perform in a nuclear environment as they are often undertaken remotely and when not remotely they must at least respect the ALARP principle to limit radiological exposure of workers.

The patented solution also improves the quality of the package fixation and its ease of inspection. Handling features are indeed an essential part of the nuclear package. They must be exempt of defects due to the catastrophic consequences their failure would have. Quality must be excellent and this invention makes it easier to control. As a consequence this can also reduce maintenance operation which is in line with the ALARP principle.

Some means will also be presented to adapt certain existing handling devices in order to put such invention in application within existing plants and package stores.

Due to all the described advantages such invention enables manufacturing and operational costs saving and failure and contamination risks reduction.

The presentation will provide an overview of the operational and manufacturing difficulties on standard handling features and will show how the patented invention eases decontamination and implementation on nuclear containers.

**INTRODUCTION**

Nuclear industry uses lot of packages to handle, transport and store radiological materials. These packages need so fully tested and inspected handling features to guaranty lack of shock to the containment barrier. Moreover, remote connection are used when no human access is possible or to respect ALARP principle.

Some nuclear packages are loaded in contaminated environment. The transferred contamination shall not be transferred further. These packages need so an external decontamination which has to be controlled.

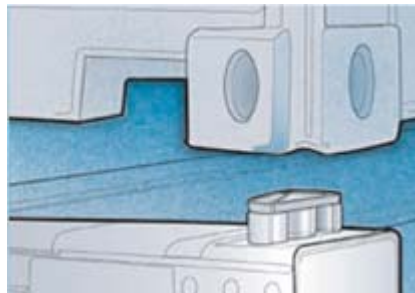
Particularly, handling features are the area of main contamination transfer as it is successively in contact with handling means from the loading cell and in contact with handling means used for transport, storage and associated processes (control, decontamination ...). Handling features decontamination is consequently a sensitive topic in nuclear industry.

### **EXISTING HANDLING FEATURES WITH REMOTE CONNECTION**

There are several kind of handling features depending the necessary movement (translation, rotation) or function (transport interface, stacking ...) during the operating cycle.

#### Twistlock pockets

Containers with such pockets can be easily fixed remotely to grapples by inserting a lock in each pocket and turn it by 90° (see Fig. 1). Twistlock pockets are used for stackable containers (see Fig. 2). Twistlock pockets are mainly used for low level waste (see Fig. 2, left picture) as they are difficult to decontaminate due to poor access to the cavity for decontamination and control systems.



**Figure 1. Twistlock principle**



**Figure 2. Low Level Waste (left) and Intermediate Level Waste (right) Storage Container**

#### Trunnions

Containers with trunnions need sophisticated grapples for remote and safe connection. The trunnion is inserted axially through the larger diameter of the keyhole of a grapple plate and then the plate is translated perpendicularly to the trunnion axis to block the trunnion in the smaller diameter. Some grapples have also a sliding bolt to avoid disengagement of the trunnion. Such handling features enable tilting of the container to allow a vertical insertion of long object like fuel assemblies and to allow horizontal transport (see Fig. 3). Trunnions are mainly used on spent fuel transport cask as they enable tilting and facilitate decontamination.

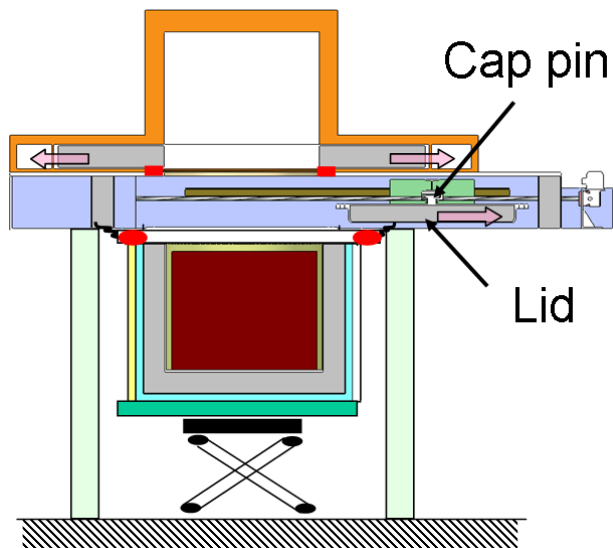


**Figure 3. Tilting and trailer fixation of a cask**

#### Other devices

Some other devices like cap pin, handling pintle, handling eye can be used for remote connection with a hook or a fork. Generally there is only one of these devices placed above the Center of Gravity to facilitate the remote connection. As a consequence, they are mainly used to handle lids (see Fig. 4) or contents (canisters).

Cap pin and handling pintle are easy to decontaminate as they are cylindrical. Nevertheless, these handling systems lack of stability which is also a disadvantage for nuclear container handling



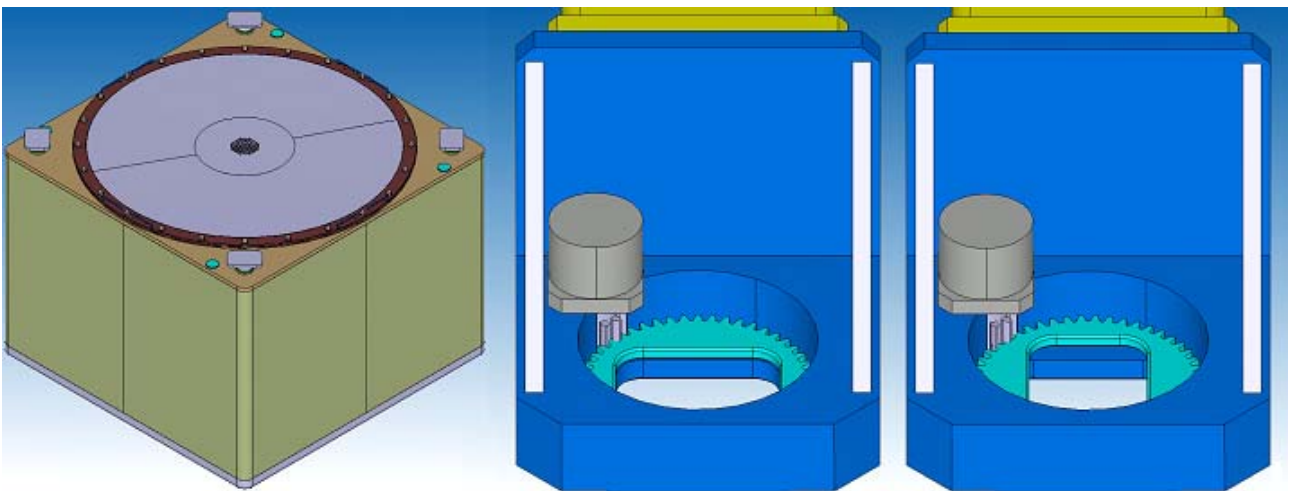
**Figure 4. Caption for figure here**

**NEW SOLUTION PATENTED BY DAHER FOR STACKABLE CONTAINERS**

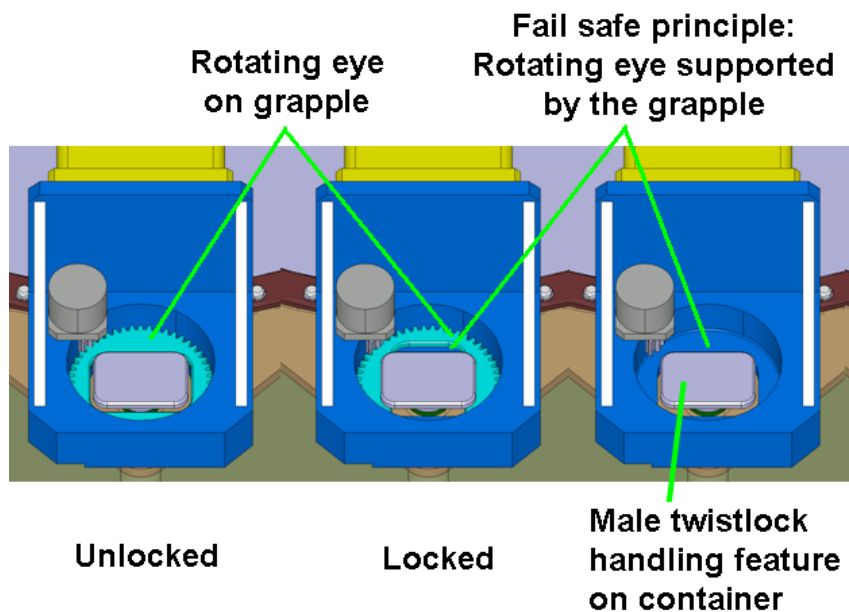
The aim of the patented solution is to facilitate decontamination like trunnions or cap pin, facilitate remote connection like twistlock system, insure handling stability like twistlock system and enable stacking like twistlock pockets.

Principle

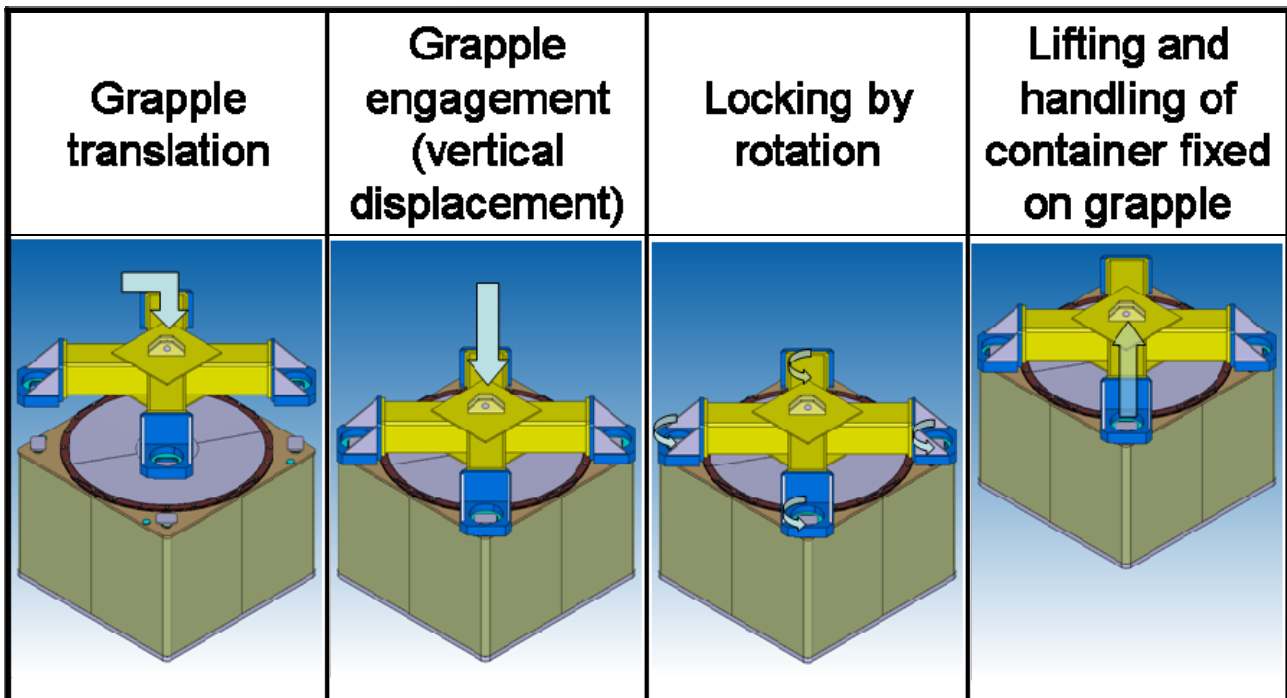
It consists in vertical male features that have a cylindrical trunk and a rectangular head (see Fig. 5, left picture). The grapple has the corresponding rotating eye through which can be inserted the vertical male feature (see Fig. 5, right picture). Once the male features inserted in the grapple eyes, the eyes are rotated by 90° which block the head of the male features (see Fig. 6) and so enable a safe handling (see Fig. 7)



**Figure 5. Vertical male handling feature on container (left) and rotating grapple eye (right)**



**Figure 6. Container connection**



**Figure 7. Container connection and handling**

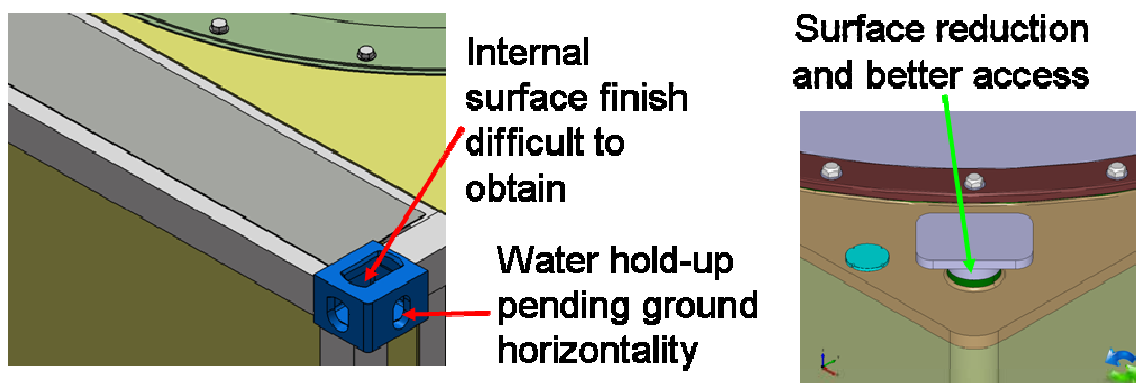
The containers can be stacked on each other with their bottom laying on the head of the male twistlock handling feature. Some feet with a slightly oversized pocket can be put under the container to lock horizontally containers between themselves.

Decontamination

Vertical male twistlock handling features reduce transfer and release of contamination. They facilitate and improve decontamination as they have no cavity but direct access to their complete surface (see Fig. 8).

Indeed DAHER's solution reduces surfaces to decontaminate, enables better surface finish on the handling features and avoid water hold-up.

Consequently they reduce decontamination effluent due to more efficient decontamination. This reduces time process and so increase process availability as well as reduces generated waste (decontamination effluent) to treat.



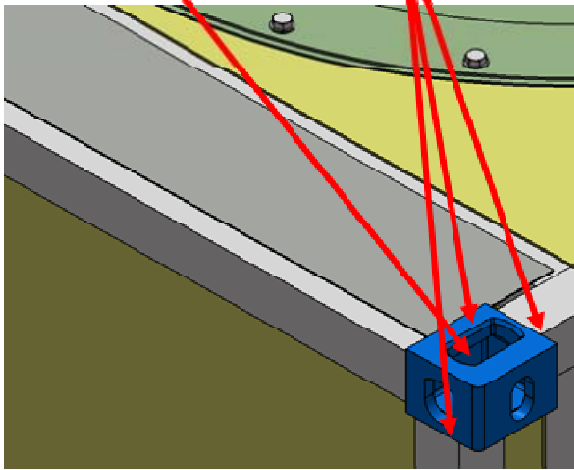
**Figure 8. Decontamination easiness comparison between twistlock pockets and male twistlock handling feature**

Decontamination control

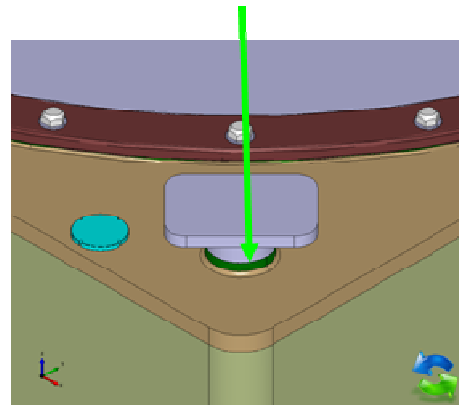
Vertical male twistlock handling features improve decontamination control as there is direct access to the complete surfaces. Indeed this solution enables direct visual inspection and facilitates swab tests (see Fig. 9).

Consequently this respects ALARP principle as it reduces radiological exposure of workers due to more efficient decontamination and reduces inspection and maintenance operations.

**Several areas to control & shadow zones**



**Direct visual access & single area to control**



**Figure 9. Decontamination control comparison between twistlock pockets and male twistlock handling feature**

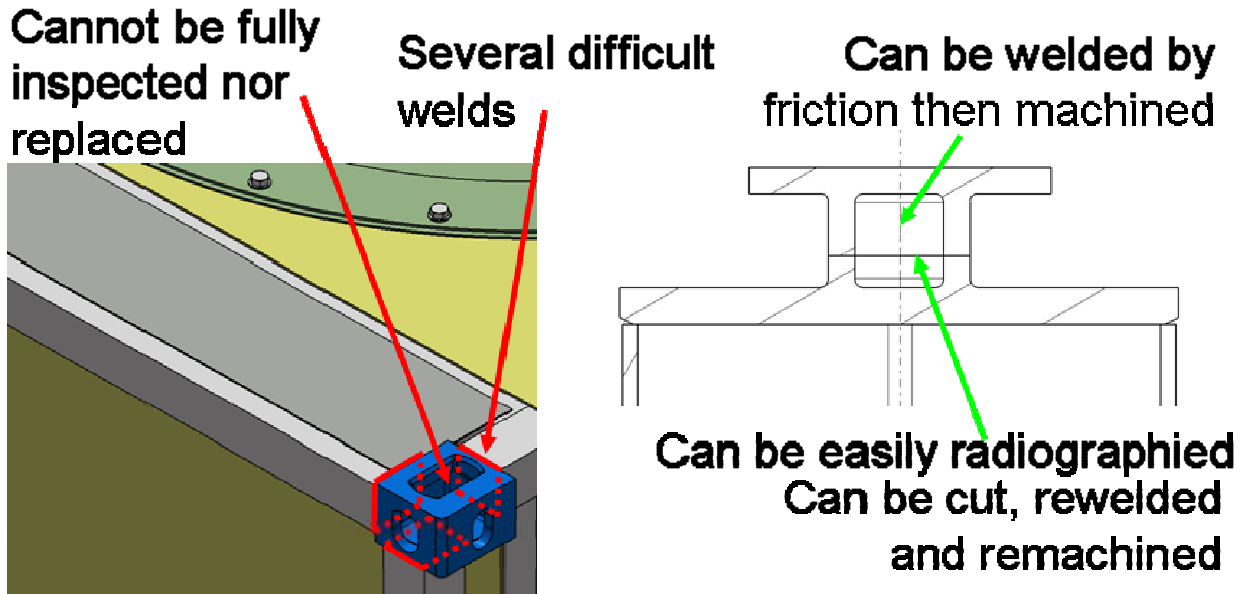
Manufacturing

Vertical male twistlock handling features simplify drastically manufacturing and enable improvement of the fixation robustness.

Generally, twistlock pockets need several difficult welds. The difficulties come from the back shielding on complex geometry, weld health control due to multi layer of material and fillet welds (see Fig. 10, left picture)

Vertical male twistlock handling can be welded on the top face by friction and the weld control can be made easily by radiography (see Fig. 10, right picture). Moreover, the interface location between this new handling feature and the container enable complete replacement. Indeed it can be cut perpendicularly to its axis. Then a new one can be welded by friction and then its head can be finally machined.



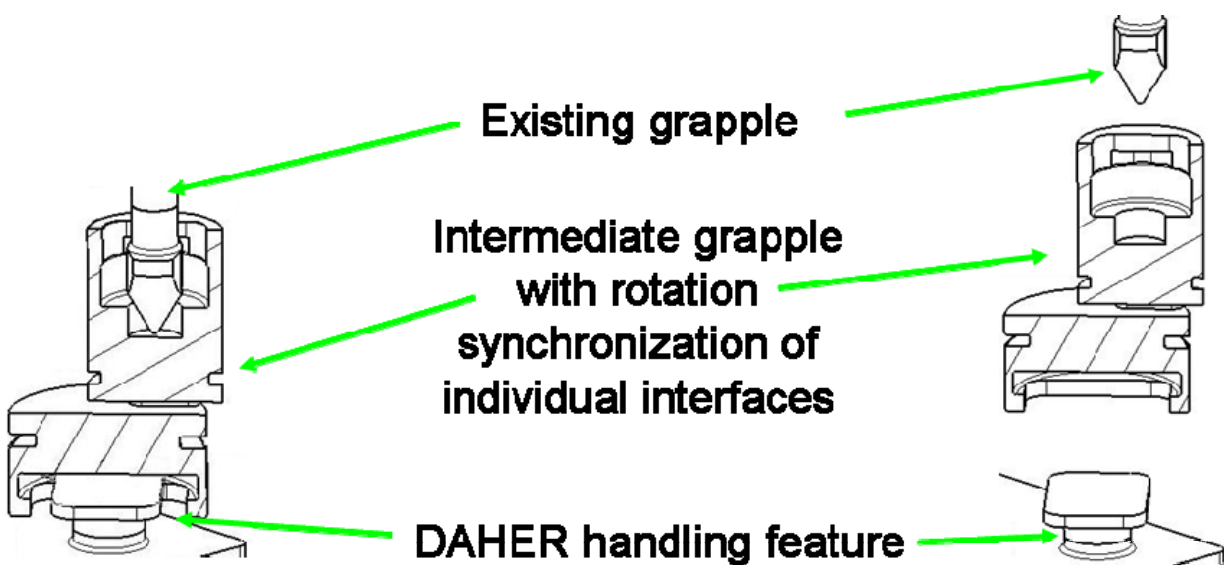


**Figure 10 Comparison between twistlock pockets and male twistlock handling feature**

Adaptation possibilities to existing interfaces

Some facilities use already grapples for containers with twistlock pockets. Most often these grapples cannot be changed as they still need to handle existing containers with twistlock pockets and also simply as there is no access to change them. Nevertheless, some removable intermediate grapple can be used and even can be motorised by existing motorised grapple (See Fig. 11). This intermediate grapple can even compensate designed misalignment between the locking system of the existing grapples and the vertical male twistlock handling features.

In the same way the use of removable locking devices is possible for fixation on trailers of containers for low level waste.



**Figure 11. Intermediate grapple for handling with existing twistlock grapples of container with DAHER handling features**



## **CONCLUSIONS**

Patented vertical male twistlock handling features improve decontamination efficiency and control as they have direct access to their surface and better surface finish compared to twistlock pockets. They also facilitate also manufacturing and control by reducing the weld length (at least 60%) and by use of friction welding. They can be replaced if damaged.

Particularly vertical male twistlock handling features are adapted for storage container of intermediate level waste as they enable stacking, facilitate mass production and improve decontamination efficiency.

## **ACKNOWLEDGMENTS**

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