

## **Annex G**      Continued Functionality of Emergency Egress

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## 1. Emergency Egress Process

The results shown in this document demonstrate that the inflated HEFS ensure continued functionality of emergency egress from the reference helicopters, taking into account the following scenarios:

- Egress upright position (CS29 reference helicopter, CS27 CAT A reference helicopter)
- Egress fully capsized position (CS29 reference helicopter, CS27 CAT A reference helicopter)
- Egress partially capsized position (CS29 reference helicopter)

The scenario with *all floats intact* is presented in the images as well as the worst-case egress condition which is *HEFS critical float compartment damaged*, as was observed during the full-scale testing. During the *no damage* and *primary EFS damaged buoyancy* cases the emergency exit windows are located above or closer to the waterline, therefore the *HEFS critical compartment damaged* case is the most conservative case.

### 1.1 Emergency Exits Location and Use CS29 Reference Helicopter

Passenger emergency egress from the CS29 reference helicopter is done through the windows highlighted in red in Figure 1. Highlighted in yellow are locations of the emergency handles. In order to egress through the passenger emergency exits of the CS29 reference helicopter the following steps are taken:

1. Pull emergency exit handle/rubber cord located at the bottom edge of the window
2. Push the window out at one of the edges/corners of the window

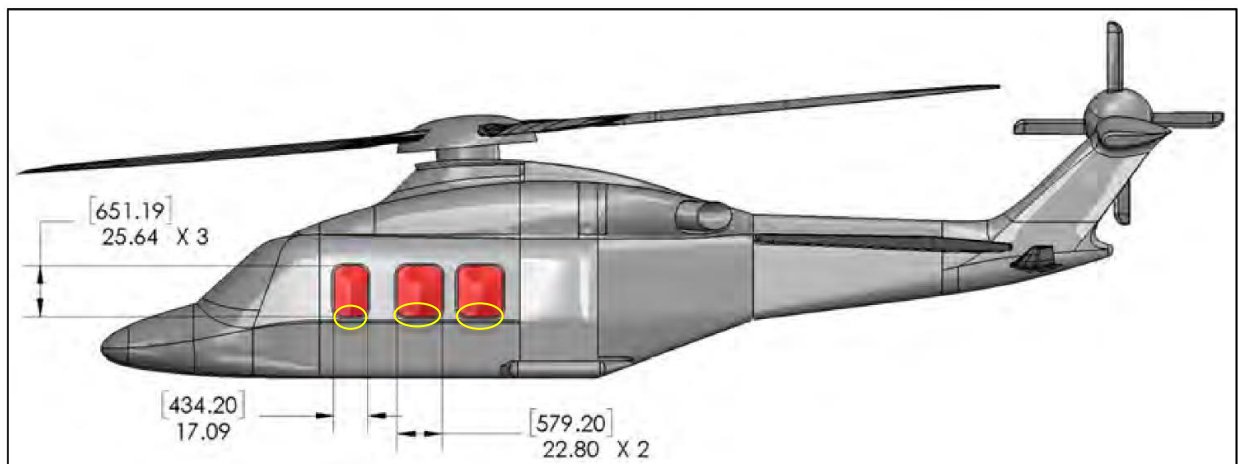


Figure 1 CS29 reference helicopter passenger emergency exits highlighted in red, emergency handles circled in yellow

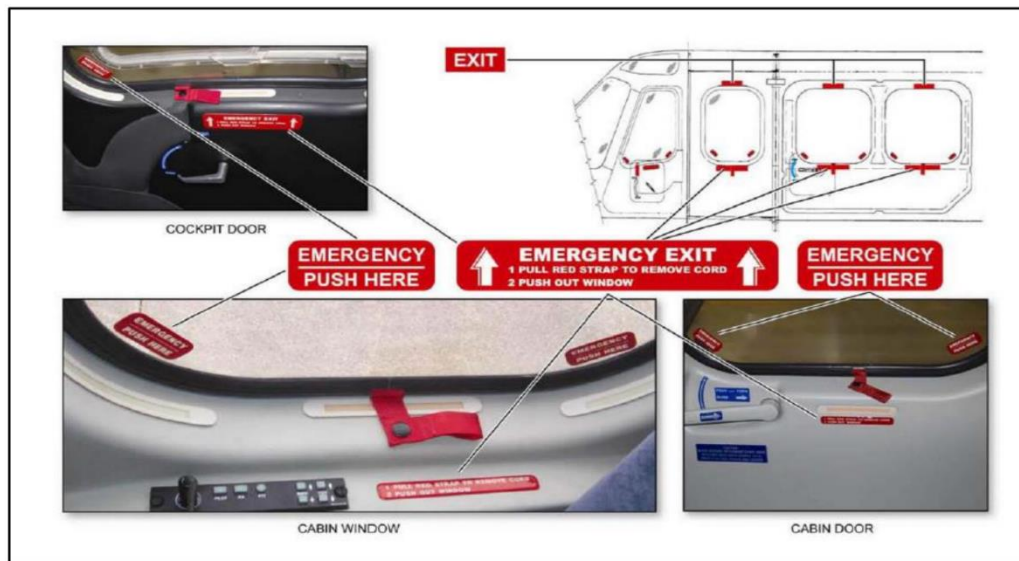


Figure 2 CS29 reference helicopter emergency egress process

## 1.2 Emergency Exits Location and Use CS27 CAT A Reference Helicopter

Passenger emergency egress from the CS27 CAT A reference helicopter is done through the window highlighted in blue in Figure 3 or by sliding the door open. The handle for sliding the door open is placed right under the window, slightly forward (circled in yellow on bottom in Figure 3). The following steps are taken to exit through the window:

1. Remove the cover and pull the handle on the top edge of the window (circled in yellow at top)
2. Push the window out by pressing on the corners of the window

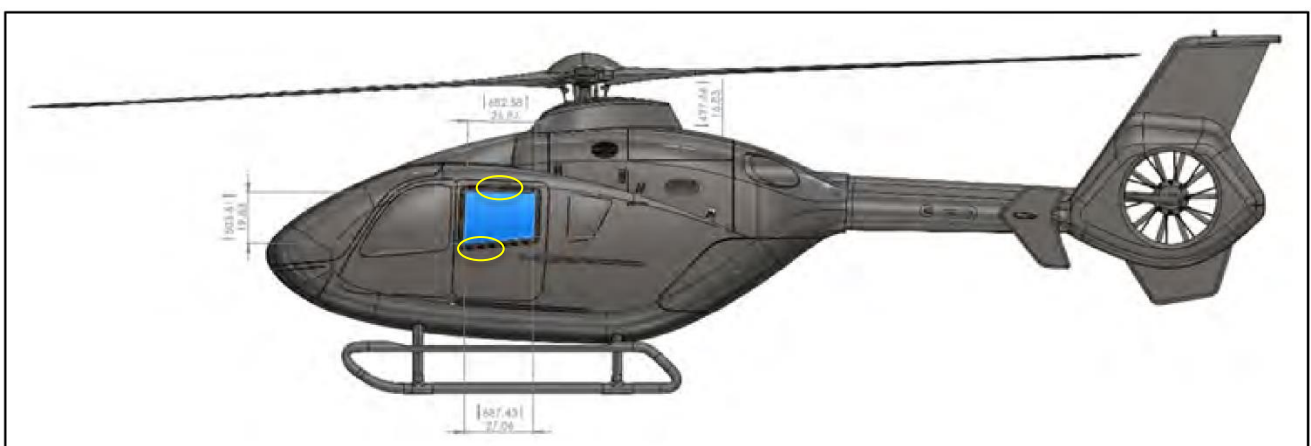


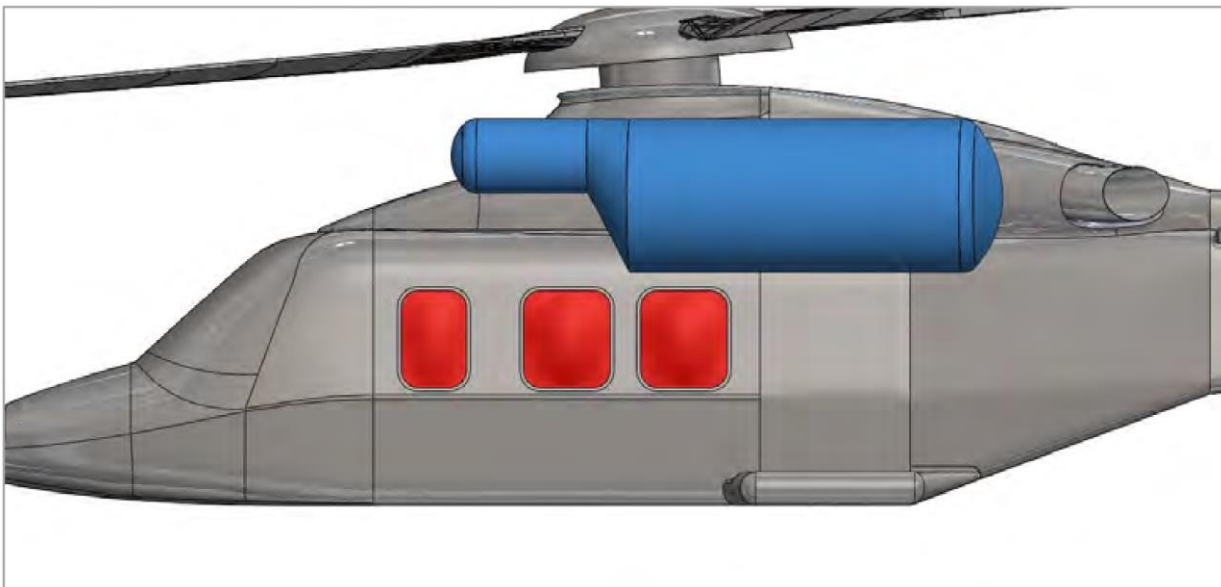
Figure 3 CS27 CAT A reference helicopter passenger emergency exit highlighted in blue, emergency handle (top) and door handle circled in yellow (bottom)



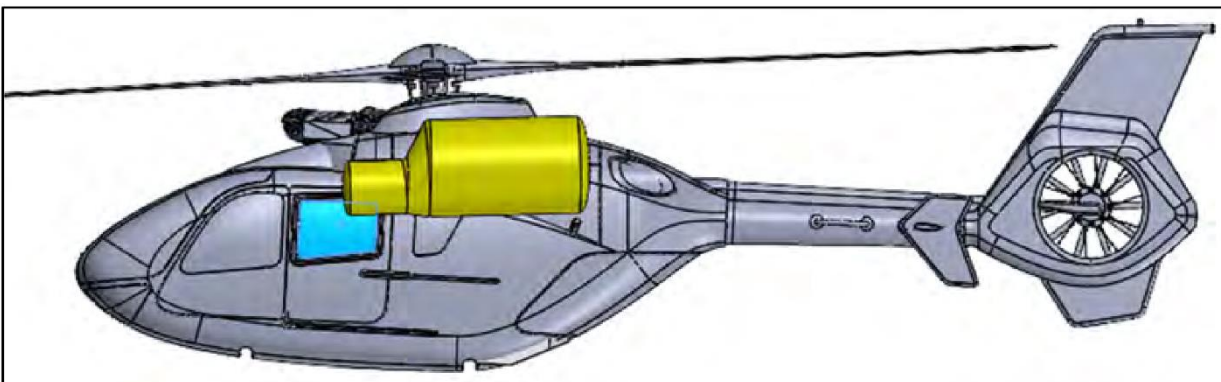
*Figure 4 CS27 Cat A Reference helicopter emergency exit view from cabin, handle at top of window*

## 2. Egress Upright Position

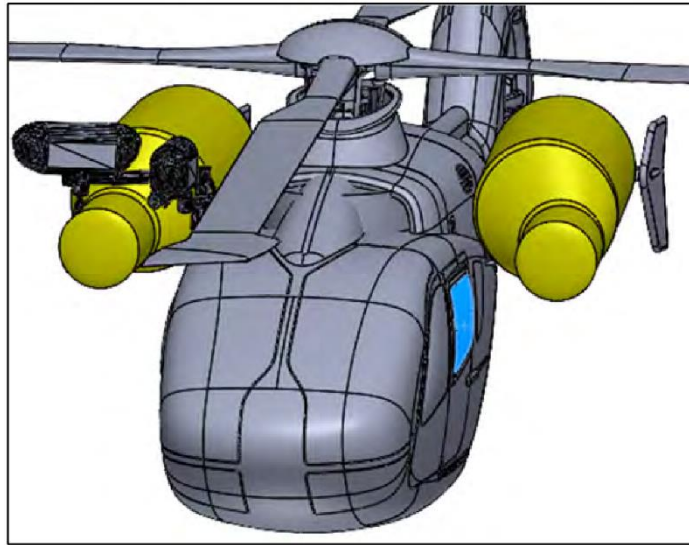
In the upright position, the HEFS will inflate immediately after both EFS deployment and low rotor RPM switch is activated. When HEFS flotation takes place, the restraints of the float bag are already designed at the shortest possible length to avoid deflection into the main rotor. This also would not allow the float bag to deflect downward far enough in an upright position to obstruct safe use of the egress routes, for both the CS29 and CS27 reference helicopters.



*Figure 5 CS29 Reference Helicopter Upright position, inflated HEFS w.r.t. passenger egress routes*



*Figure 6 CS27 Reference Helicopter Upright position, inflated HEFS w.r.t. passenger egress routes*



*Figure 7 CS27 Reference Helicopter Upright position front view, inflated HEFS w.r.t. passenger egress routes*



### 3. Egress Fully Capsized

When fully capsized, the float system will help egress significantly compared to the baseline reference helicopters including only a primary EFS system. The passenger emergency exits of the CS29 reference helicopter (passenger windows) are in fully capsized position with HEFS either above the waterline, or a small distance under the waterline. This is in contrast to the significant distance underwater experienced by in absence of the HEFS.

When the floats are deployed, they are held in place by the girts which means they will not block the emergency exits and the egress of the passengers due to deflection. Figure 8 and Figure 9 show the CS29 capsized scenario with all floats intact. Figure 10 to Figure 13 show the worst-case egress condition of the CS29 reference helicopter: *HEFS critical compartment damaged*.

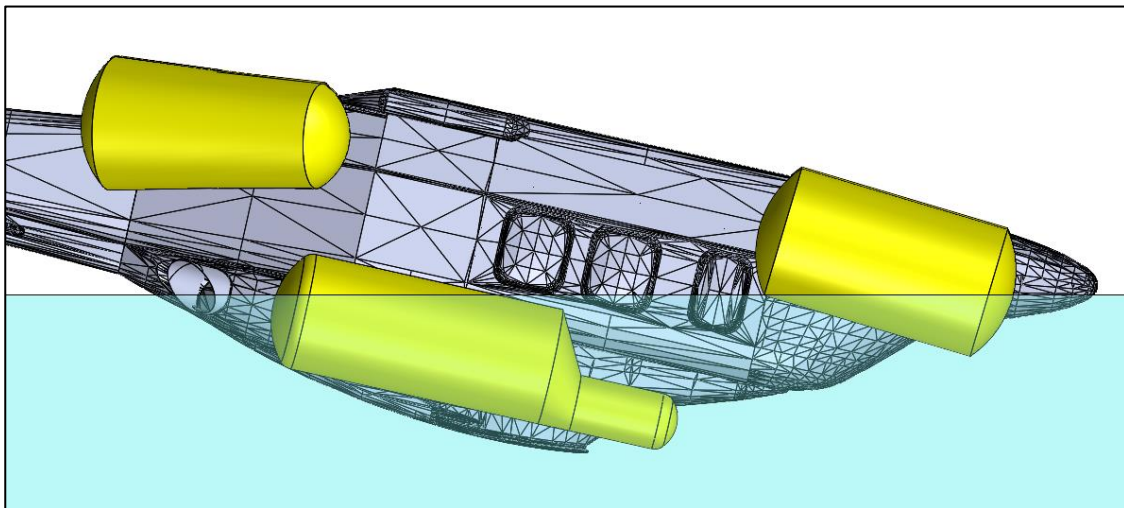


Figure 8 CS29 Reference helicopter capsized with all floats intact LH view

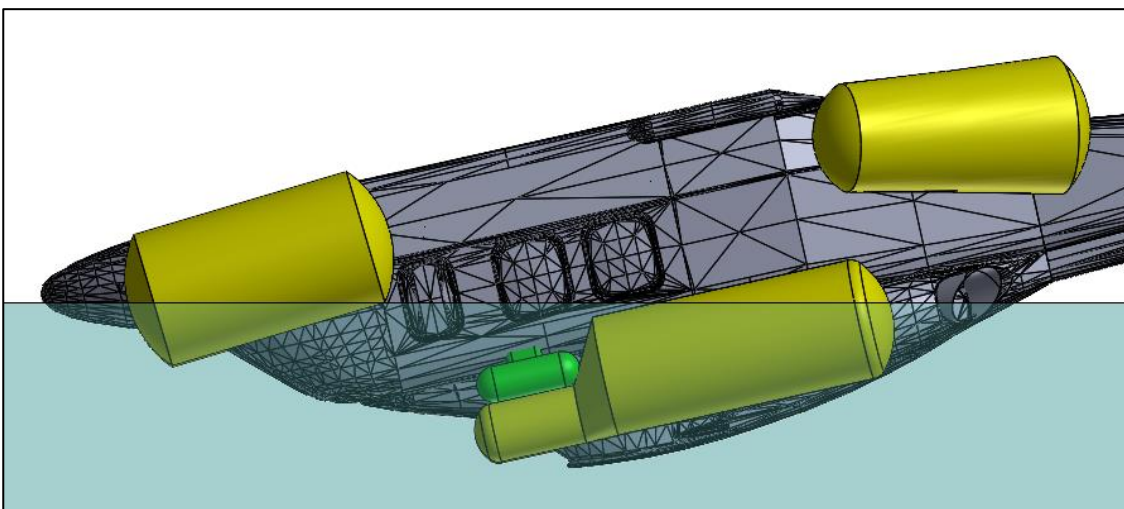


Figure 9 CS29 Reference helicopter capsized with all floats intact RH view

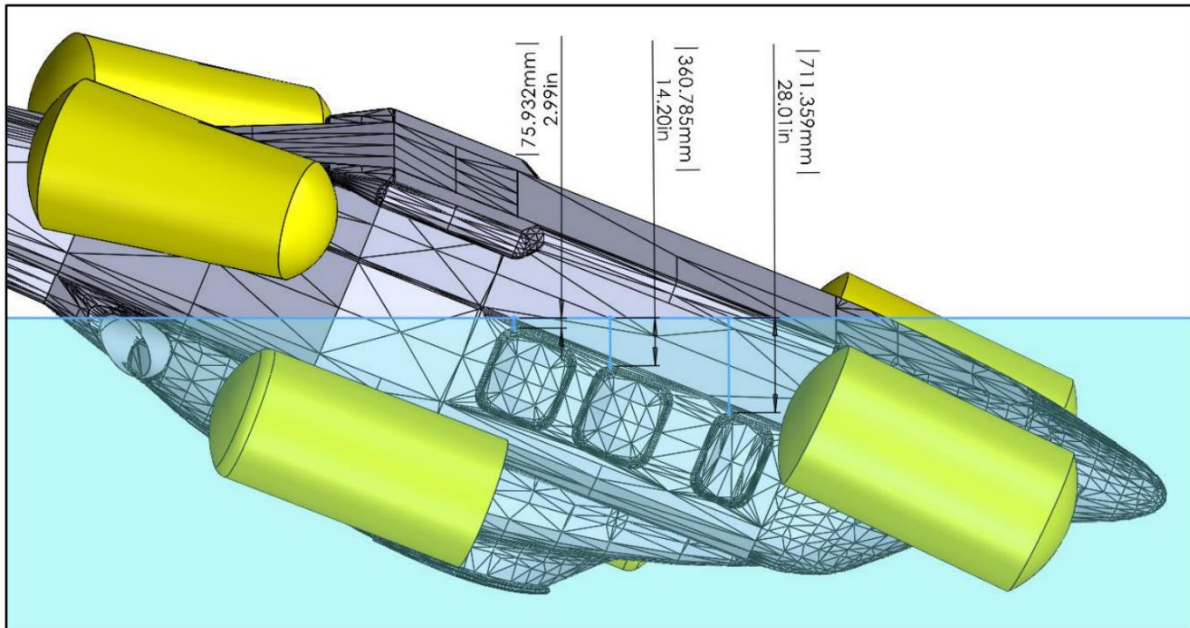


Figure 10 CS29 Reference Helicopter HEFS critical compartment damaged LH view, emergency exit to waterline dimension front to back: 71 cm, 36 cm, 7.6 cm

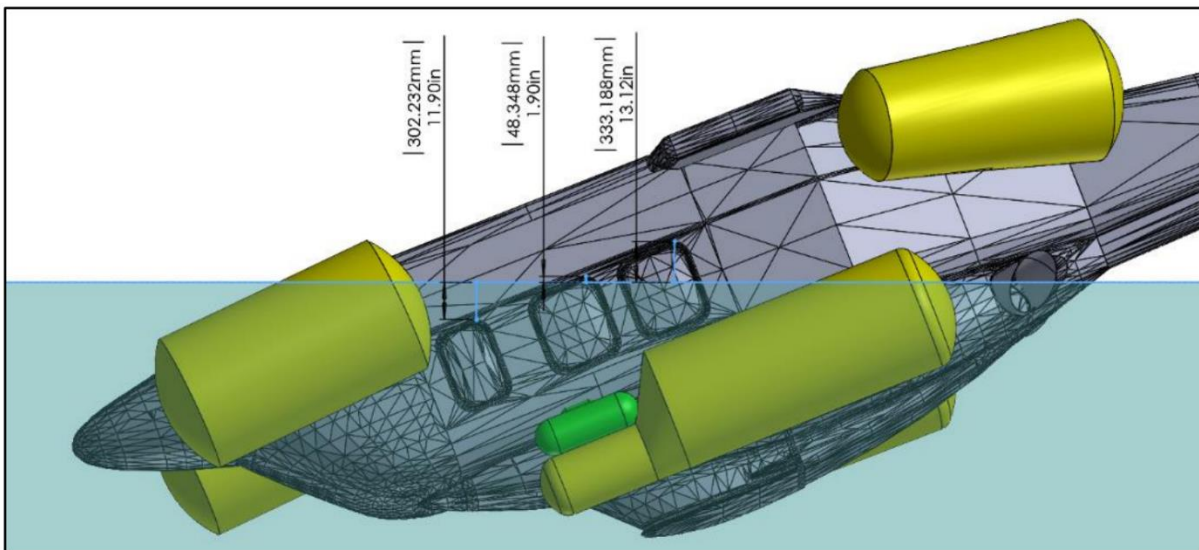


Figure 11 CS29 Reference Helicopter HEFS critical compartment damaged RH view, emergency exit to waterline dimension front to back: 30.2 cm, 4.8 cm

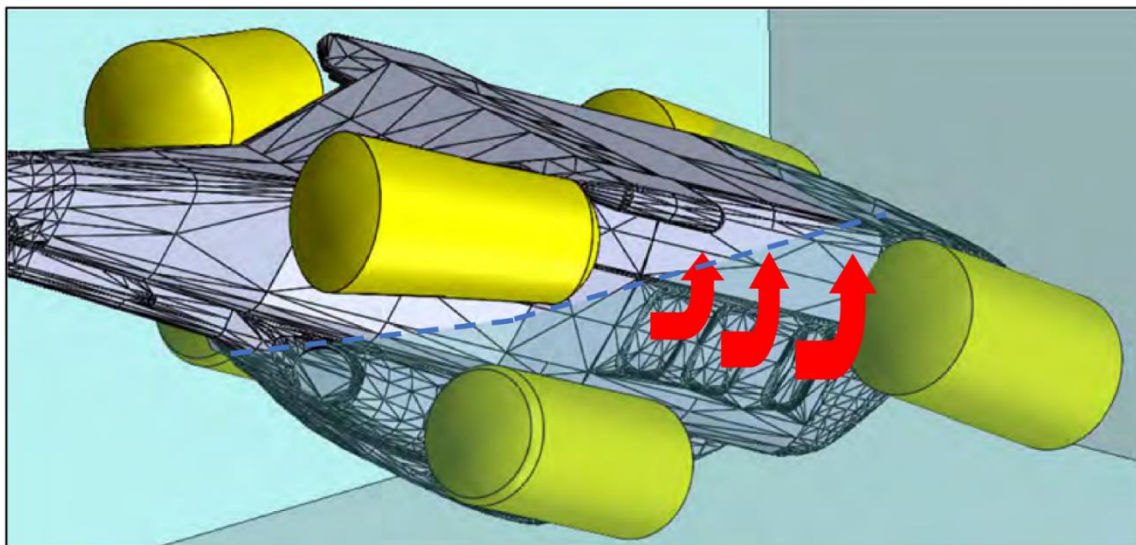


Figure 12 CS29 Reference Helicopter HEFS critical compartment damaged, LH emergency egress

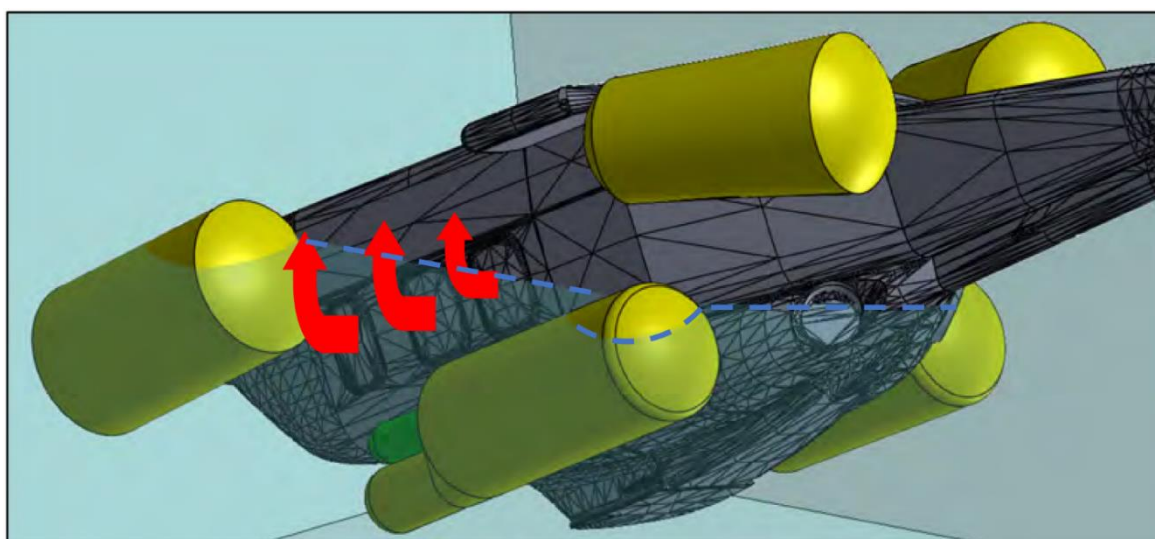


Figure 13 CS29 Reference helicopter HEFS critical compartment damaged, emergency exit RH egress



When the CS27 reference helicopter is in the capsized position the float bags will be in line with the emergency exits as can be seen in Figure 15, however due to the orientation of the float bag there is sufficient space between the float bag's forward chamber and emergency exit window such that the bag will not impede the window's ability to open. The forward chamber's orientation relative to the helicopter is as out board as possible without interfering with the hoist, this design choice gives the emergency exit clearance enough to operate as intended ensuring proper passenger egress in a capsize helicopter position. Figure 14 shows the CS27 fully capsized with all floats intact. Figure 15 to Figure 17 show the worst-case egress condition: *HEFS critical compartment damaged*.

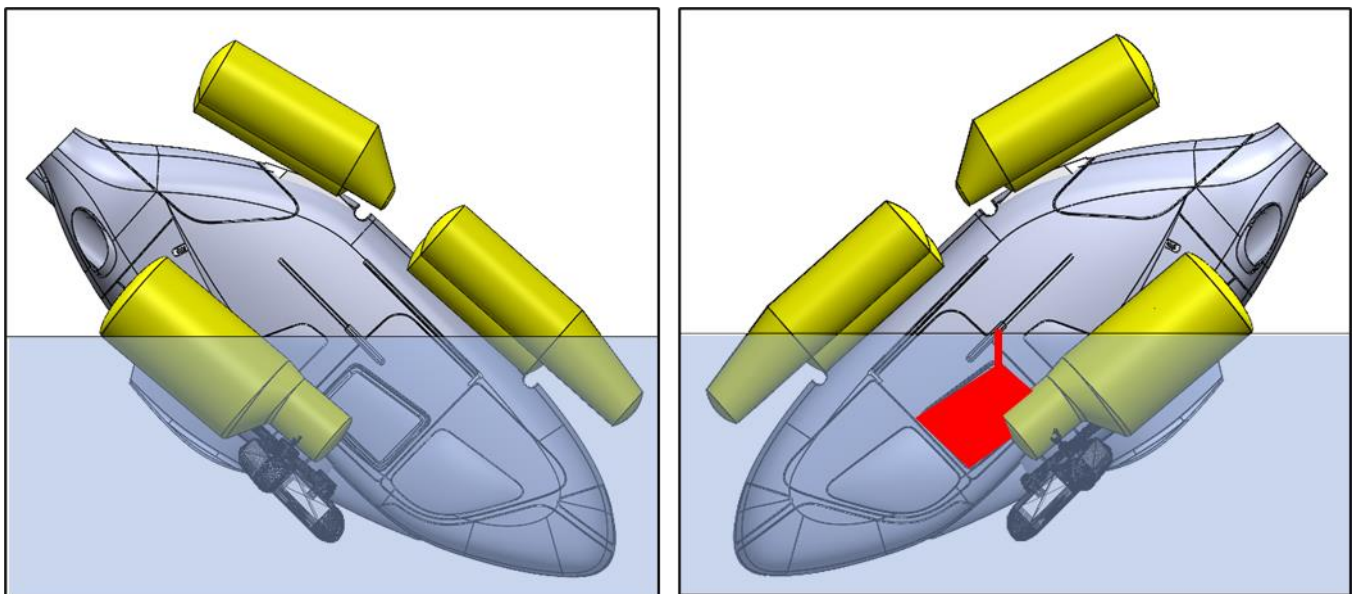


Figure 14 CS27 Reference helicopter fully capsized with all floats intact, emergency exit to waterline dimension: 29 cm

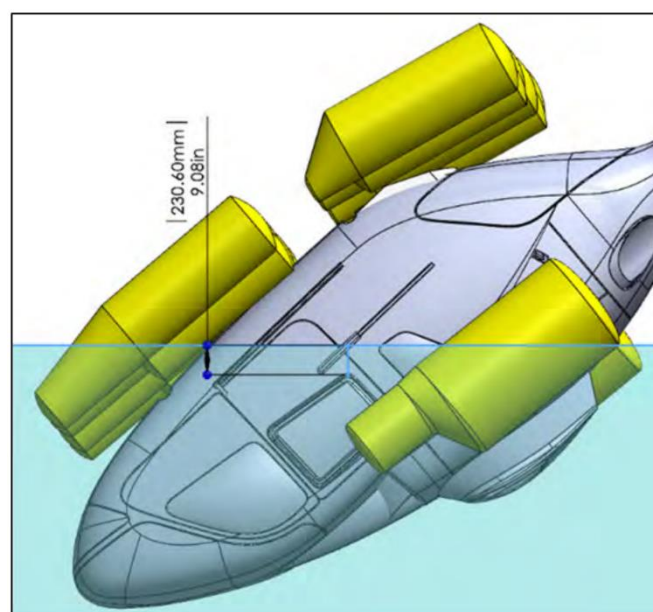


Figure 15 CS27 Reference helicopter HEFS critical compartment damaged RH view, emergency exit to waterline dimension: 23 cm

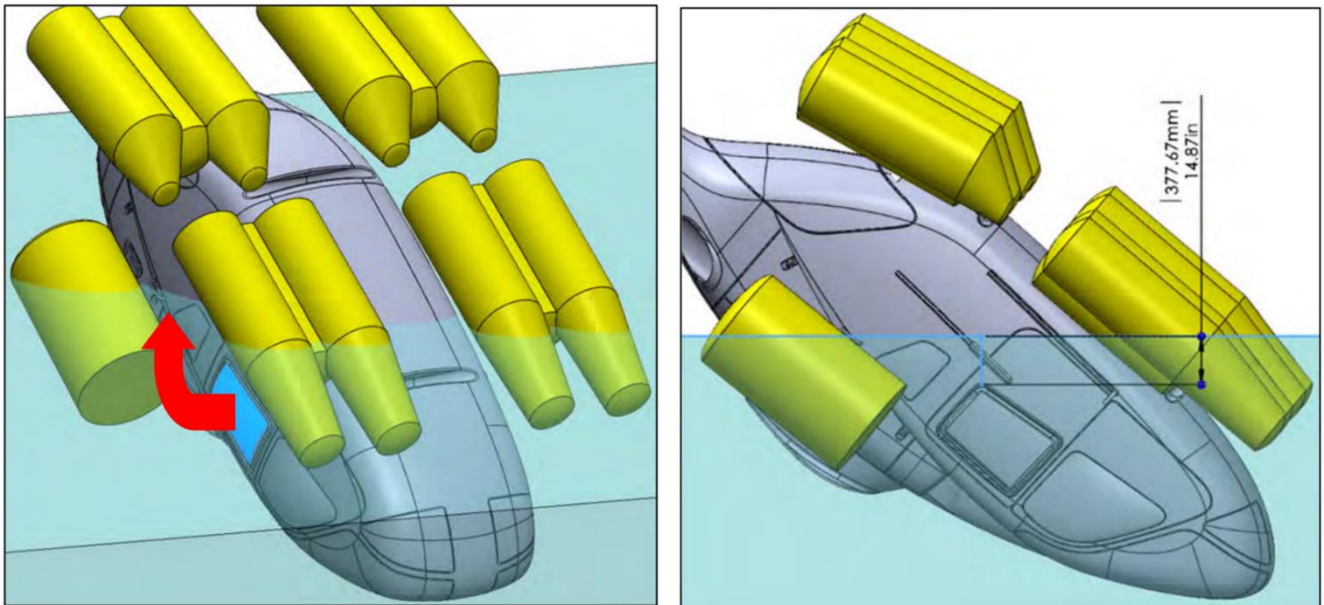


Figure 16 CS27 Reference Helicopter HEFS critical compartment damaged, egress route and emergency exit to waterline dimension: 37.7 cm

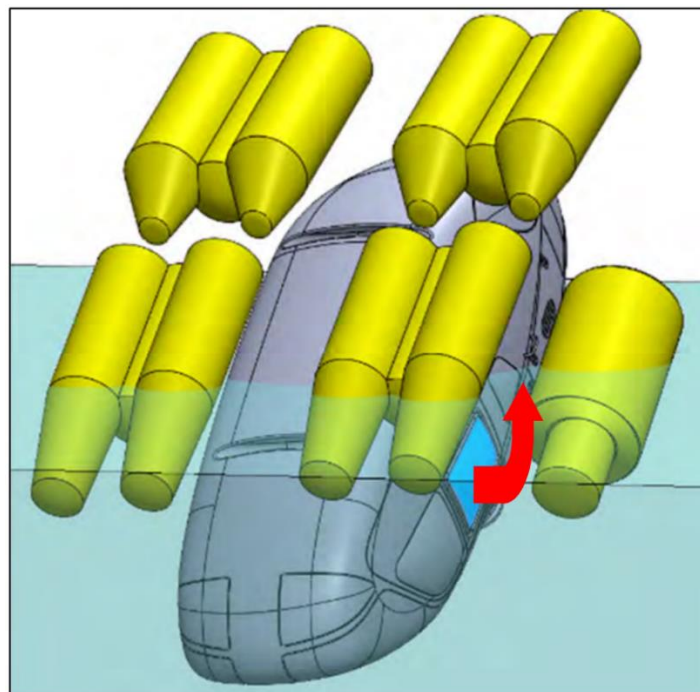


Figure 17 CS27 Reference Helicopter HEFS critical compartment damaged, RH emergency egress

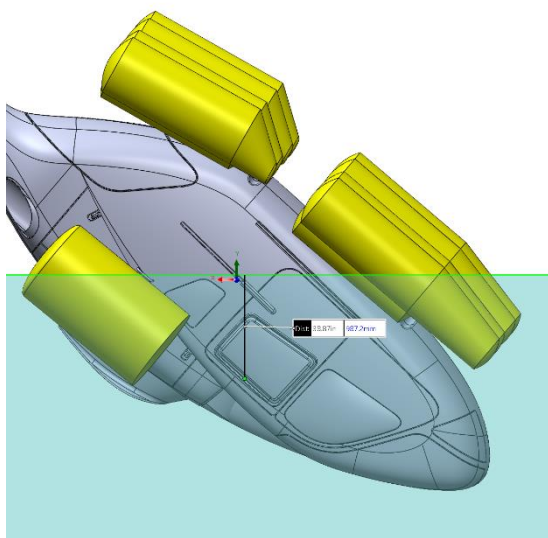


Figure 19 CS27 Cat A reference helicopter,  
HEFS critical compartment damaged, LH  
distance emergency exit handle to waterline  
99 cm

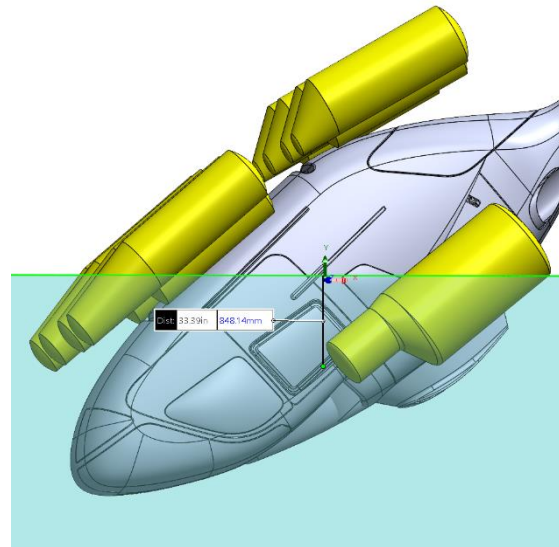


Figure 20 CS27 Cat A reference helicopter,  
HEFS critical compartment damaged, RH  
distance emergency exit handle to waterline  
85 cm

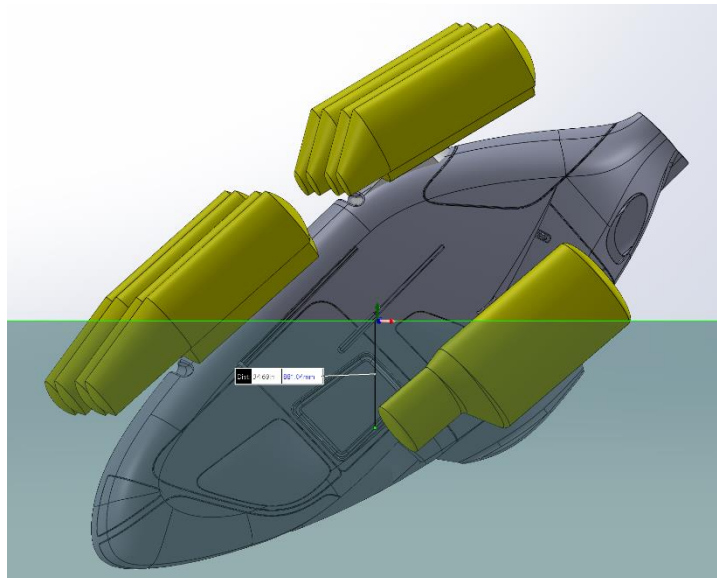
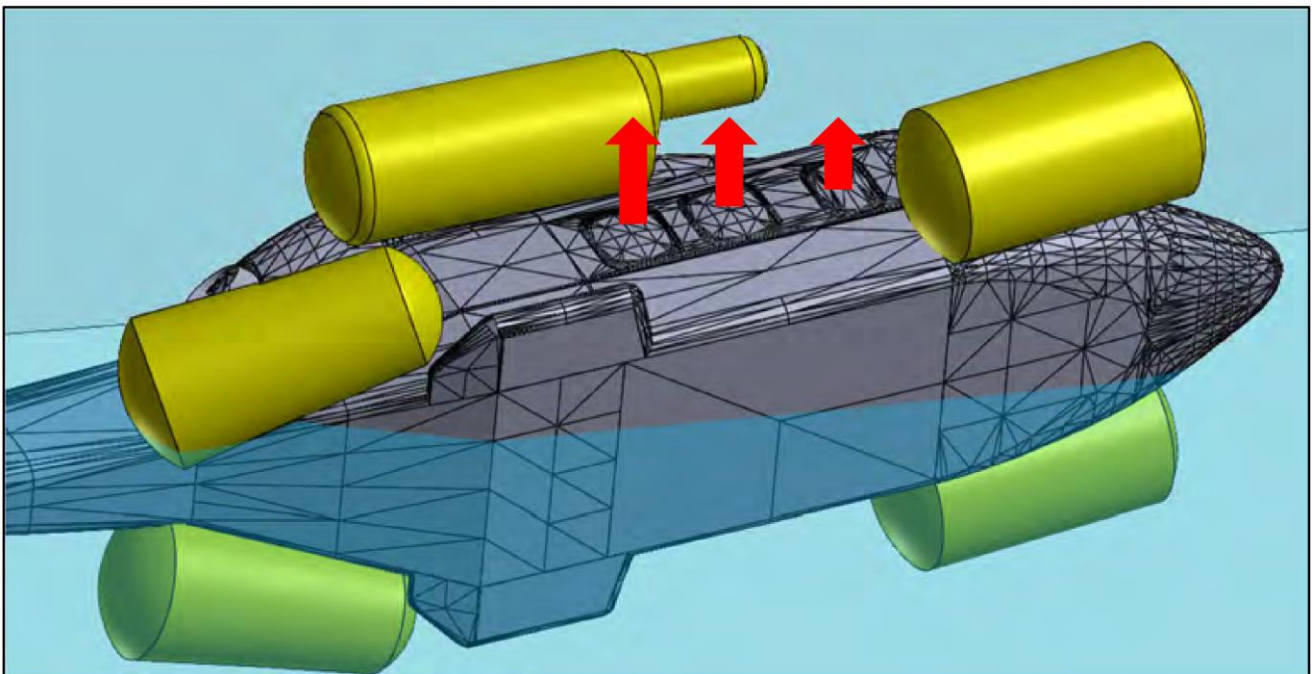


Figure 18 CS27 Cat A reference helicopter, all floats intact,  
distance emergency exit handle to waterline 88 cm



## 4. Egress Partially Capsized

During the full scale tests performed for Work Package 1, it was found that the CS27 reference helicopter including HEFS does not have a stable side float, in contrast to the CS29 reference helicopter. While in the partial capsize position as seen in Figure 21 half of the passenger windows which serve as the emergency exits are above the waterline. Egress through these exits is easier compared to full capsize attitude since the passengers can move through the cabin air pocket and exit through the windows. When compared to the significant distance underwater experienced by all the emergency exits in a capsized primary EFS only system, the HEFS offers a likelihood of ending up in a more favorable partial capsize attitude which has a safer passenger egress.



*Figure 21 CS29 reference helicopter HEFS critical compartment damaged, partial capsize RH emergency egress*



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