DFC-152: The Damaged Fuel Container for Failed BWR Fuel or Fuel Debris

Holtec International's DFC is engineered to store damaged or failed fuel, which is defined as fuel that has greater than pinhole-sized cladding defects or cannot be handled by normal means. (Please refer to USNRC's Interim Staff Guidance #1, Revision 2 for fuel classification guidance.) The Holtec DFC can also be used to store badly dismembered fuel referred to as "fuel debris". The principal objectives for an efficient DFC design are:

1. The DFC should fit in the storage cell with adequate clearance.
2. The DFC should provide adequate neutron absorption to meet regulatory requirements.
3. The DFC should confine the particulates but allow water and gases to escape freely.
4. The DFC should feature a robust means for handling.
5. The DFC should have a smooth external surface to mitigate the risk of hang up during insertion in or removal from the storage cell.
6. The DFC should provide minimal resistance to the transmission of heat from the contained fuel.

The DFC design summarized in this HTB is intended for use with Holtec's MPC-68 or MPC-68 FF canister certified in USNRC Docket 72-1014 for storage in the HI-STORM 100 vertical ventilated system or transported in the HI-STAR 100 dual purpose cask licensed in Docket #71-9261 for transport and in Docket #72-1008 for on-site storage.

The DFC-152 consists of a square prismatic shell made from extruded METAMIC (classic) metal matrix composite material (a Holtec-patented neutron absorber) with a (preferably) cast aluminum base (Bottom Cap) made with a tapered profile as shown in the figure below for ease of insertion in the fuel basket. The Bottom Cap is equipped with laser-made fine flow holes to allow drainage of water without permitting escape of particulates. The METAMIC shell and the baseplate casting are joined by an autogenous welding process that is qualified to produce welds with tensile strength in excess of 80% of the yield strength of the weaker of the two materials being joined.

The Top Cap is a separate structural member designed to lock into the main body by remote means after the fuel has been installed in the DFC. The top cap also has laser drilled holes to permit escape of gaseous matter while confining the particulates (that may be produced by the dismemberment of the pellets and reactor debris) within the DFC's boundary. The Top Cap is made of stainless steel.

The loaded DFC can be handled by a grapple from the Fuel Handling Bridge. All lifting appurtenances are designed to meet ANSI N14.6 requirements with respect to margin of safety in load handling. Specifically, the maximum primary stress in any part of the DFC will be less than its Yield Strength at 6 times the dead weight of the loaded DFC, W, and less than the Ultimate Strength at 10 times W.

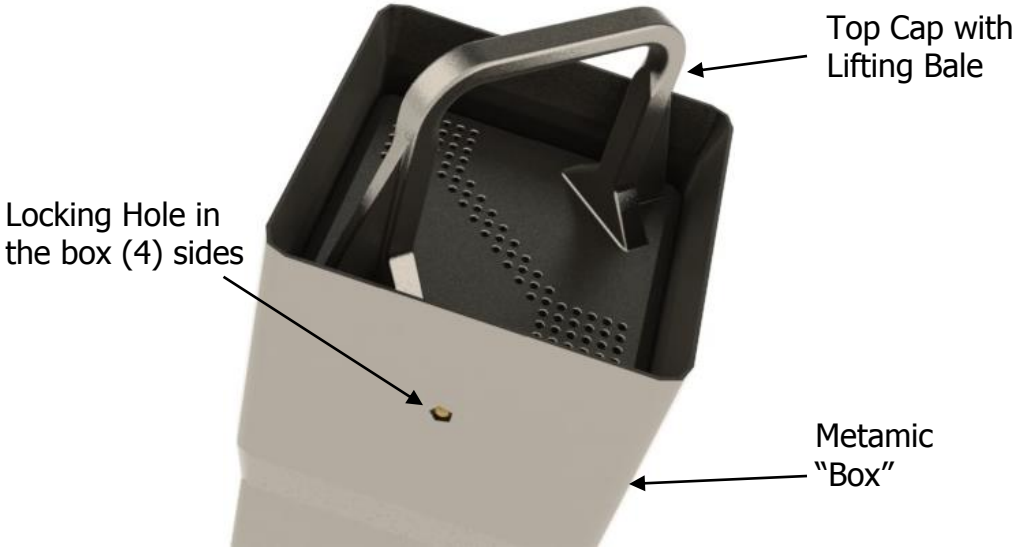
For more information, contact Rick Springman, r.springman@holtec.com; 856-797-0900 Ext. 3716, www.holtecinternational.com.

The table below provides key design data for DFC-152.

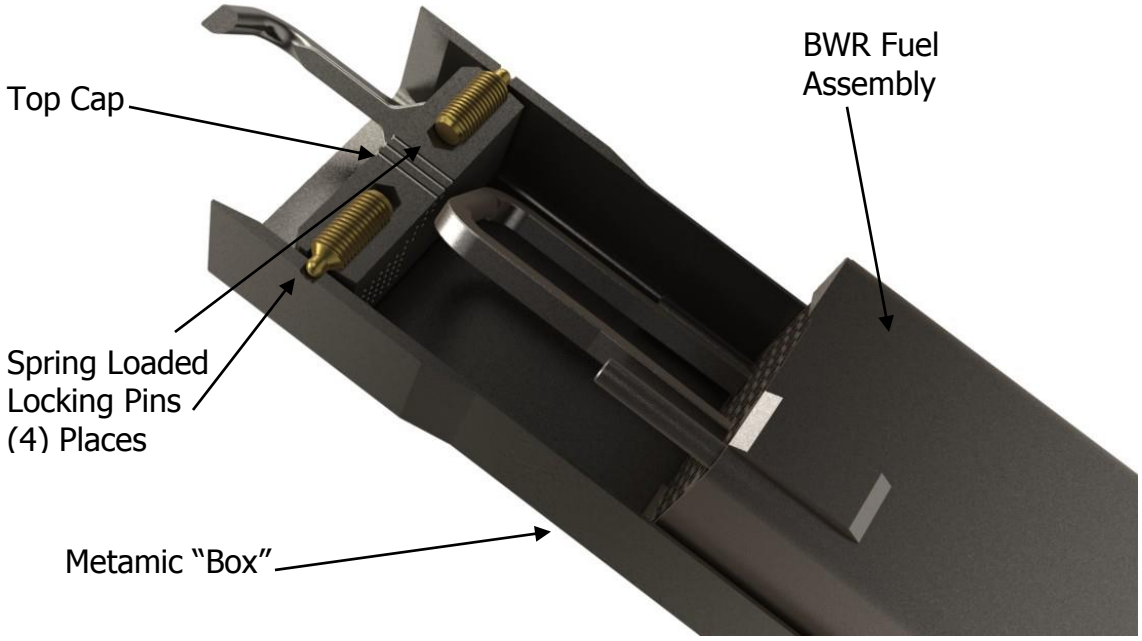
DFC-152 Design Data	
Outer Dimension (Metamic box)	152mm (5.99”)
Corner Radius (Metamic box)	6mm (0.24” nominal)
Wall Thickness (Metamic box)	2.0mm (0.079”)
DFC Cell I.D.	148mm (5.83”)
Total Height (including Lifting Bales)	4680mm (184.25”)
Boron Carbide Concentration (Metamic box)	32% (nominal)
Empty Weight, Kg	25 (55 lbs)
Permissible Planar Average Enrichment	4.8%

Because the walls of the DFC-152 are a neutron absorber, the Fuel Basket in the MPC-68 or 68FF can be stripped of the METAMIC plates and stainless steel sheathing, leading to an increased cell cavity size which is large enough to enable free insertion or extraction of the DFC into and from the Fuel Basket. In MPC-68 and MPC-68FF Fuel Baskets, the cell opening, after removal of the neutron absorber, is 6.24 inches, which means that there is a ¼ inch lateral gap between the DFC and the storage cell. Because the DFC is an extruded shape and the Fuel Basket cell walls are of honeycomb construction made of thick plate stock (1/4 inch wall), the DFCs can be inserted into the storage cells with minimal interference. Furthermore, because the DFC wall is made of METAMIC, and the storage cell walls are made of stainless steel, there is no risk of binding from the cohesion effect of materials of identical genre. The areal density of B-10 in the DFC cell walls is adequate to ensure that the reactivity will meet the USNRC criteria (k_{eff} less than 0.95 at 95% confidence and 95% probability under optimal moderation condition).

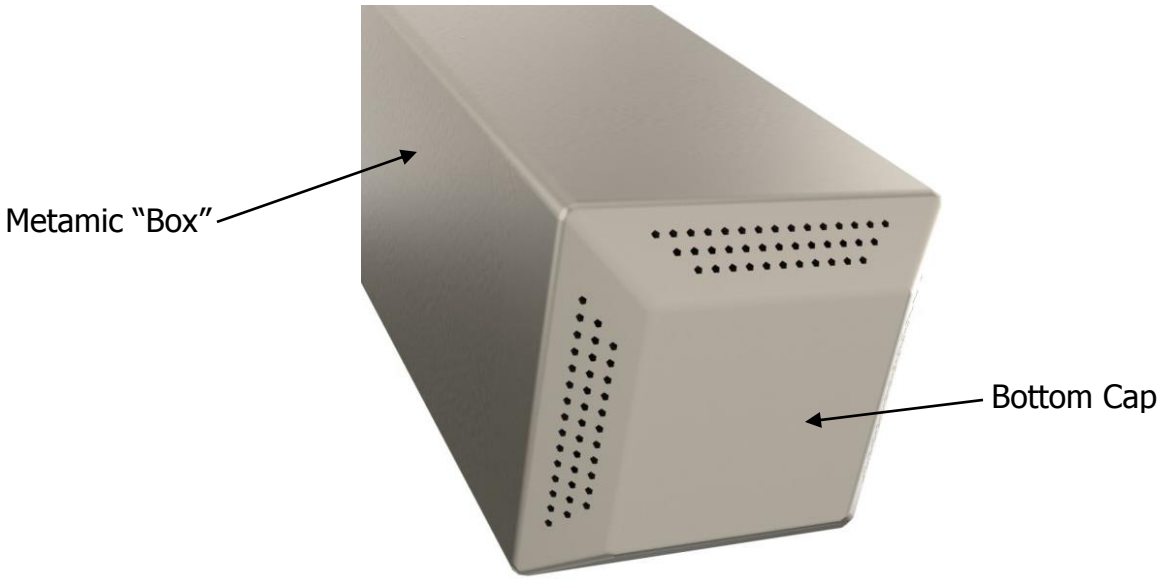
The DFC-152 design, illustrated in the figures below, is the intellectual property of Holtec International and protected by the U.S. and international patent laws.



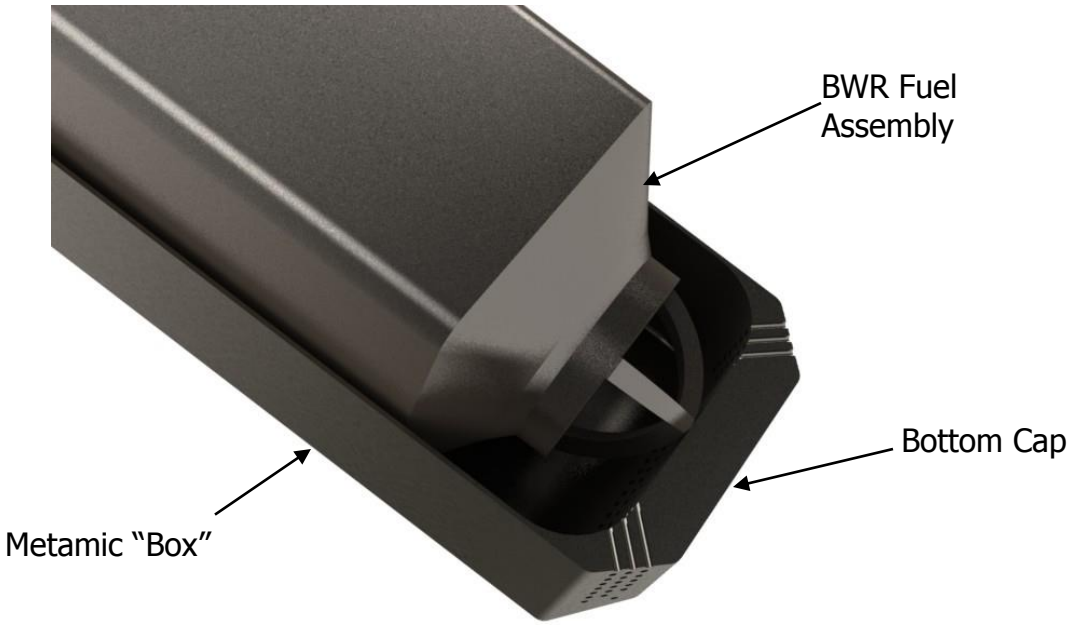
Top Isometric View DFC-152



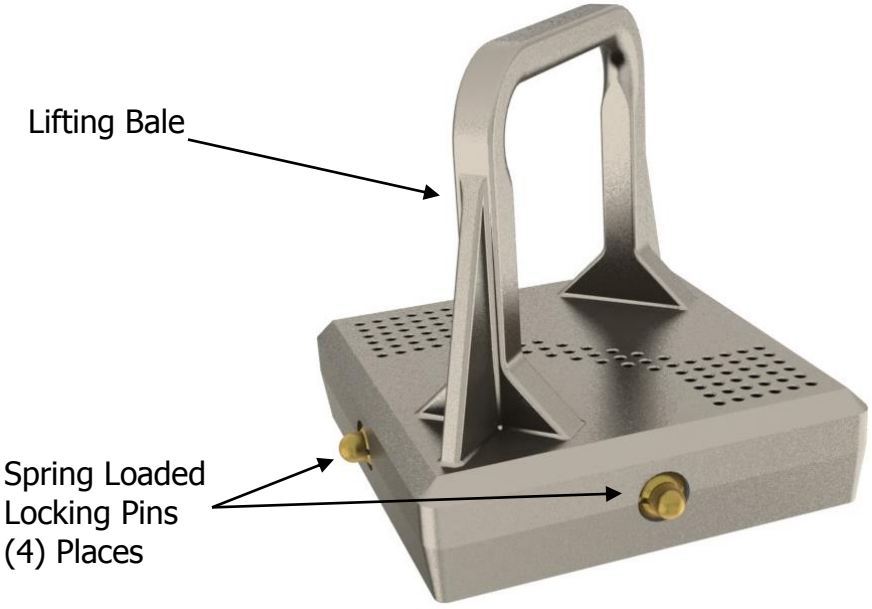
Top Isometric Cut-Away View
showing BWR Fuel in the DFC-152



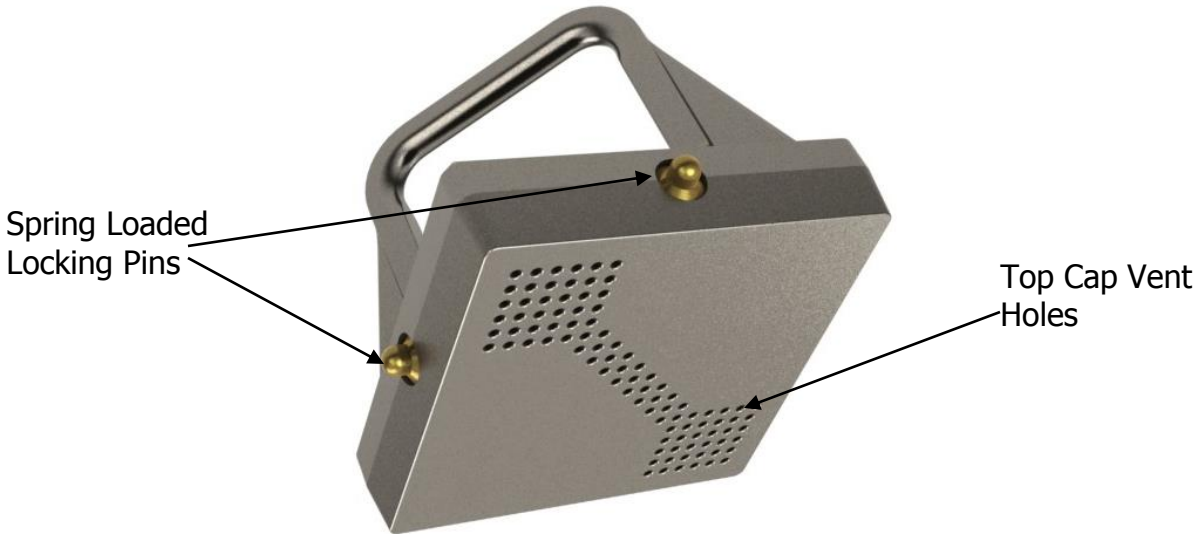
Bottom Isometric View of DFC-152



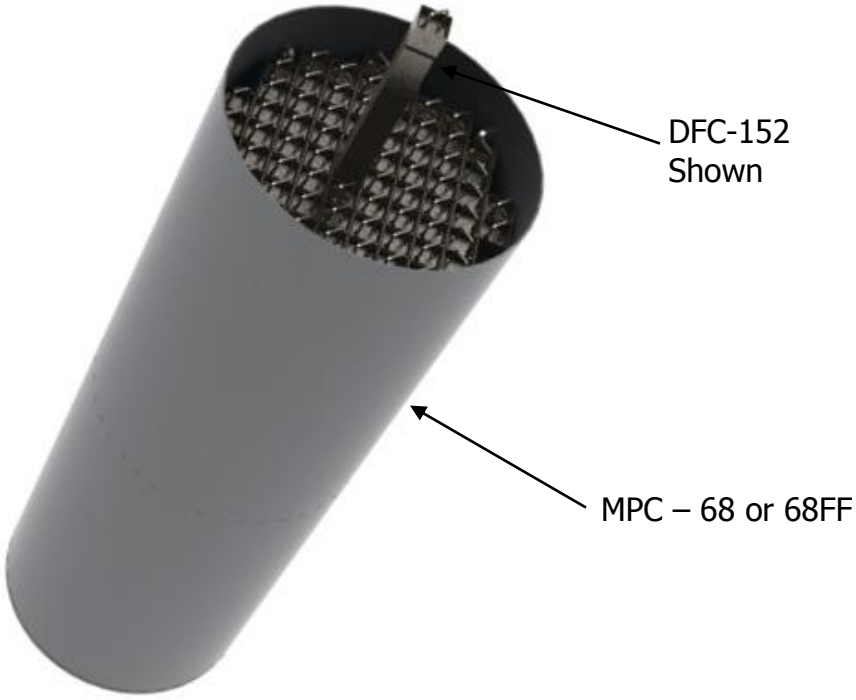
Bottom Isometric View of DFC-152



Top Isometric View DFC-152 Top Cap



Bottom Isometric View DFC-152 Top Cap



Isometric View DFC-152 Loaded into MPC – 68 or 68FF