

DREAM Inserts for Enhanced Pool Reactivity Control: *A Solution for Degrading Neutron Absorbing Material or Power Upgrades*



Degradation of many early neutron absorber materials used in the wet fuel storage racks of commercial nuclear power plants is limiting the storage capacities of plants around the world. Fuel storage racks that employ polymeric neutron absorbers (Boraflex and Tetrabor) have proven to be especially vulnerable to embrittlement, erosion, and gap formation under prolonged exposure to radiation. Degradation of these types of neutron absorber materials is continuous with time, resulting in gaps or severe erosion in nearly all fuel racks containing these materials. Additionally, operating the reactor at higher power levels results in discharged fuel that is more reactive (either due to higher initial enrichments or increased plutonium levels associated with higher burnups).

- ✓ More than 2,400 DREAM inserts have been installed in the U.S.
- ✓ Holtec has four DREAM insert designs: DREAM C3, DREAM C2, DREAM C1, and DREAM F1
- ✓ All DREAM inserts are fabricated at Holtec's U.S. based manufacturing facilities.

Holtec has the in-house capabilities to re-qualify the spent fuel pool given the degradation issues or new fuel conditions across all disciplines germane to licensing, including criticality analyses. However, in some cases the reactivity levels in the spent fuel pool may be beyond the moderation capabilities of the installed spent fuel racks, even with increased credit for fuel burnup, resulting in the need for invasive mitigation measures.

Holtec International's **Device for Reactivity Mitigation (DREAM)** insert provides a robust and economical alternative to moderate fuel reactivity and can be implemented on a relatively expedited schedule, without replacing the existing racks. Installing DREAM inserts in the fuel storage pool allows a plant to recover the criticality safety margins lost due to neutron absorber degradation or the enhanced reactivity of fuel following a power upgrade. The DREAM insert serves to replace or augment the neutron attenuation function of the existing racks. DREAM inserts use Metamic® as the primary material of construction. The utilization of Metamic (with up to 32.5% B₄C) as the neutron absorber will ensure criticality control and continued high margins of safety. Holtec currently has four DREAM insert designs, all utilizing Metamic: DREAM C3, DREAM C2, DREAM C1, and DREAM F1.

The number, type, and location of the DREAM inserts are based on detailed criticality evaluations performed by Holtec International for each nuclear plant. Holtec's DREAM insert projects are carried out under the control and surveillance of Holtec's Quality Assurance/Quality Control Program, which conforms to the requirements of 10CFR50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants."



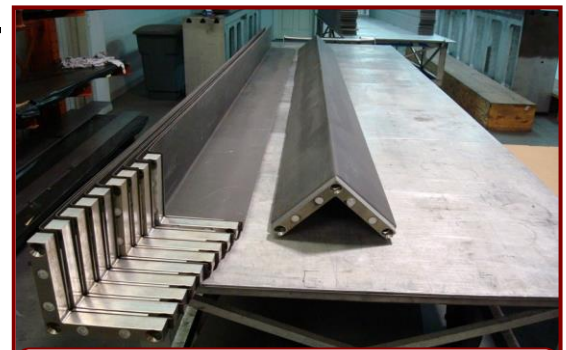
Holtec's DREAM C1 Insert Installation Evolution at FPL's Turkey Point Nuclear Power Plant

Holtec's DREAM Insert Designs

- ✓ **DREAM C3 (Chevron Design, Generation 3) Fuel Rack Inserts**
 - DREAM C3 design is a chevron-type Metamic insert that is based directly on our first generation DREAM C1 insert.
 - Chevron absorber panels formed from Metamic are inserted between the fuel assemblies and the rack cell wall.
 - Dream C3 inserts are designed to be installed without needing to remove and relocate the fuel assembly. Benefits provided include: Reduced time for total insert installation, offering greater project productivity, reducing exposure to project personnel, and reducing impacts to the client's operational schedule; and reducing fuel shuffling planned efforts.
 - The insert is designed for attachment to either Region 1 or Region 2 fuel racks.
- ✓ **DREAM C2 (Chevron Design, Generation 2) Fuel Rack Inserts**
 - Patent pending, chevron-type Metamic insert that is placed into non-flux trap racks and locked into place.
 - The chevron insert is installed without moving the fuel.
 - The tempered steel tab is folded over the top of the cell, essentially becoming part of the rack.
 - The inserts can be removed from the fuel rack without first removing fuel.
- ✓ **DREAM C1 (Chevron Design, Generation 1) Fuel Rack Inserts**
 - Chevron absorber panels formed from Metamic are inserted between the fuel assemblies and the rack cell wall.
 - The insert is easily identifiable from the surface of the fuel pool
 - The hangs over the fuel assembly while in the rack.
- ✓ **DREAM F1 (Finger Design, Generation 1) Fuel Inserts**
 - Spent fuel insert design is inserted directly into the guide tubes of the spent fuel assemblies.
 - The insert design will have *no effect* on the nominal cell opening of the racks, thus not interfering with fuel assembly insertion or removal from the fuel storage racks.
 - Neutron flux is reduced by inserting Metamic rods into the guide tubes already present in the spent fuel assemblies.
 - Deployed for spent fuel assemblies that already have the control rod components removed.

Key characteristics of each DREAM insert are summarized below.

KEY CHARACTERISTICS	DREAM C3	DREAM C2	DREAM C1	DREAM F1
<i>Locks Into</i>	Rack Cell (Region 1 or Region 2)	Rack Cell	Does not lock; "hangs" on the fuel assembly	Fuel Assembly
<i>Must Remove Fuel Assembly for Installation of Insert</i>	No	No	No	No
<i>Must Remove Fuel Assembly for Removal of Insert</i>	No	No	No	No
<i>Must Remove Insert to Move Fuel Assembly</i>	No	No	Yes	No



Holtec's DREAM C1 Inserts Designed, Licensed and Fabricated for Turkey Point 3&4 and St. Lucie 1&2