

# HI-STORM UMAX Dry Storage System



HI-STORM UMAX (Holtec International **Storage Module Underground Maximum Security**), licensed by the NRC under Docket Number 72-1040, stores the canister containing the spent fuel or high level waste entirely below-ground providing a clear, unobstructed view of the entire Independent Spent Fuel Storage Installation (ISFSI) from any location. Each below-ground storage location is engineered and sized to accommodate all currently licensed dry spent fuel storage system canisters, making it possible to store all U.S. commercial fuel in a common storage system. The stored canisters are arrayed vertically inside heavy walled steel containers, which are engineered to provide an essentially rigid and structurally impregnable housing for the canister. The heat produced inside the canister is rejected to the ambient environment by an internal ventilation system that is hardened against external loads and is configured to block the release of radiation to the environment.



Figure 1: HI-STORM UMAX ISFSI at a US Nuclear Plant

An amendment request to the HI-STORM UMAX CoC to store the NUHOMS 24PT1-DSC canister was submitted to the USNRC in August 2016. Future amendments are planned to add canister types supplied by other companies that are presently in use around the U.S. An array of patents assigned to Holtec provide the intellectual property protection on the HI-STORM UMAX technology to the Company (Patent Nos. 8098790B1, 7933374B2, 7590213B1).

## Design and Performance Attributes:

### ■ Minimal Dose in the Vicinity of the Facility:

The minuscule dose, zero effluent release, and extreme hazard-resistance features of the HI-STORM UMAX make its consequence to the environment vanishingly small. *Dose emissions at the inlet and outlet vents of loaded HI-STORM UMAX systems have been measured to be in the .1 - .2 mRem/hr (1-2  $\mu$ Sv/h)*, which is 50-100 times lower than the maximum surface dose of any other storage system with concrete and *more than 1000 times less the dual purpose metal systems* in the market.

- **Security is Maximized:** The HI-STORM UMAX is configured to be visually inconspicuous making it a less visible target from the air and reducing visibility from public land. There are no areas on the ISFSI where a person may hide, making security an easily implemented activity.

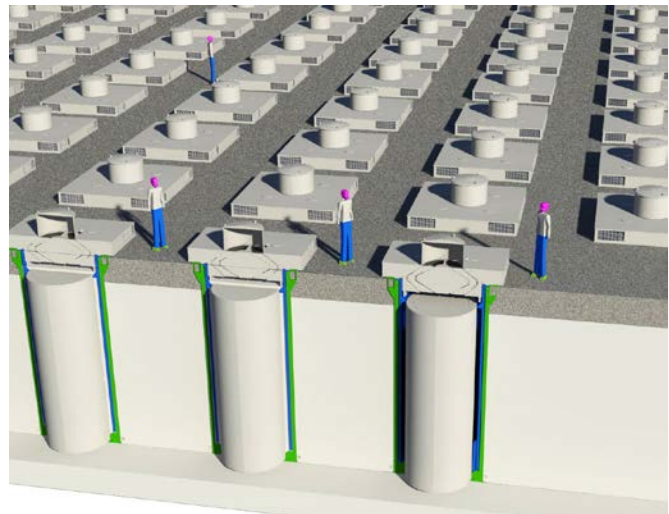


Figure 2: Cut Away View of HI-STORM UMAX

- **Extreme Resistance to Earthquakes:** The canister is stored below-grade and is completely encased in concrete which makes it essentially invulnerable to the various extreme environmental phenomena that arise in nature such as seismic events and tsunamis. The intensity of the seismic acceleration for which the HI-

STORM UMAX system is qualified is 2.5g which far exceeds that of any other licensed system in the world. The canister in HI-STORM UMAX is laterally supported at its top and bottom extremities so that it would not move or rattle under a seismic event.

- **Superior Protection of the Stored Contents:** The HI-STORM UMAX storage system provides an essentially inviolable protection to the stored canisters against incident missiles and crashing aircraft. The structural protection provided by the HI-STORM UMAX thick lid made of a steel weldment buttressed by concrete protects the canister lid. The lateral surface of the canister is protected by the concrete buttressed subgrade around each canister and the surrounding expanse of the earth beyond. The HI-STORM UMAX system *protects the spent fuel from fire and flood*. Submersion of the storage facility by flood water will pose no threat to the storage system. Removal of the flood waters and waterborne debris will be the only nuisance. HI-STORM UMAX is engineered to prevent significant deposit of solids in the storage module by the shape of the lid and screens. Combustible material, if introduced in the storage cavity, cannot sustain its burn. Thermal performance is enhanced, not degraded by floodwater intrusion.
- **Flexible Topography:** The ISFSI pad (also called "Top Pad") can be raised by elevating the grade or lowered by removing sub-grade, at the owner's option. Thus, a HI-STORM UMAX ISFSI can serve as a berm, a tsunami barrier, or be founded inconspicuously on flat land.
- **Flexible ISFSI Footprint:** The footprint of the HI-STORM UMAX ISFSI (the photo shows a 6 by 8 cavity array rectangular ISFSI) can be an irregular shape, if needed, to meet the geographical profile of a site.



Figure 3: CLSM Pour at the Approximate Halfway Point on the HI-STORM UMAX Cavities



Figure 4: HI-STORM UMAX Lid

integrity of its confinement boundary shell making its long term monitoring a low dose activity.

- **Zero Risk of Release of Radioactivity under Extenuating Events:** Release of radioactivity from the HI-STORM UMAX by any mechanical means (including crashing aircraft, missile, etc.), which is guarded by a concrete-fortified steel lid weighing in excess of 10 metric tons. The lid design is configured to easily withstand a crashing aircraft and can be further buttressed to withstand more severe battlefield weapons if required for security considerations.

- **Corrosion Resistance & Aging Management:** To address environments deleterious to stress corrosion cracking, canisters can be manufactured from corrosion resistant 316L stainless steel and laser peening can be performed to impart compressive stress states in the weld heat effected zones to mitigate crack initiation. Also, canisters made of highly corrosion resistant duplex steel are being added to the CoC. A canister installed in a HI-STORM UMAX cavity can be readily raised and eddy current tested to assay the state of



Figure 5: Holtec's Underground Dry Storage System at Humboldt Bay

- **Decommissioning Friendly:** The stored canisters are easily retrievable for off-site shipment. The HI-STORM UMAX module is constructed for low-cost decommissioning once the canister is removed at the end of the ISFSI's service life.
- **Compact ISFSI:** The HI-STORM ISFSI requires the least amount of land to store fuel: The areal storage density is approximately 110 lb. of uranium per square foot of the ISFSI pad surface.

### GENERAL INFORMATION FOR HI-STORM UMAX (CURRENT COC)

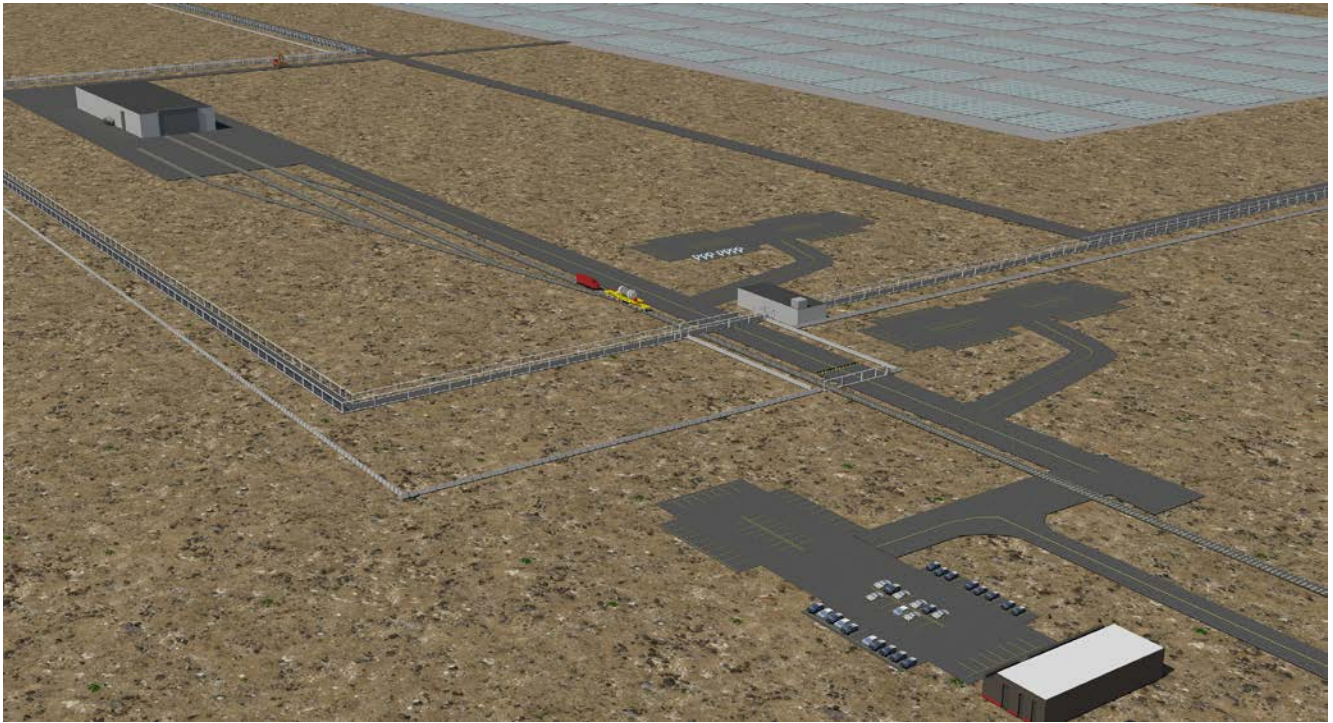
Characteristic	Details for PWR System (MPC-37)	Details for BWR System (MPC-89)
Maximum Canister Heat-Load	37.06 kW	36.72 kW
Maximum Assembly Heat-Load	1.89 kW	0.607 kW
Maximum Initial Enrichment	5 w% U-235	5 w% U-235
Maximum Acceptable Fuel Burnup	68,200 MWD/MTU	65,000 MWD/MTU
Minimum Fuel Cooling Time	3 years	3 years
Number of Assemblies	37	89
Non-Fuel Hardware Approved Contents	Burnable Poison Rod Assemblies (BPRAs), Thimble Plug Devices (TPD), Control Rod Assemblies (CRAs), Axial Power Shaping Rods (APSRs), Wet Annular Burnable Absorbers (WABAs), Rod Cluster Control Assemblies (RCCAs), Control Element Assemblies (CEAs), Instrument Tube Tie Rods (ITTRs), water displacement guide tube plugs and orifice rod assemblies.	N/A
Damaged Fuel and Fuel Debris	Up to 12 damaged fuel assemblies per system	Up to 16 damaged fuel assemblies per system
License Status	Licensed under U.S. NRC CoC 72-1040 Revision 0, effective April 2015	Licensed under U.S. NRC CoC 72-1040 Revision 0, effective April 2015

Holtec International has launched the design and licensing of an autonomous consolidated interim storage facility on ELEA, LLC's property in southeastern New Mexico. The Eddy-Lea Energy Alliance, LLC [ELEA] is a long-standing consortium of the Cities of Carlsbad & Hobbs and the Counties of Eddy & Lea, formed under New Mexico's Local Economic Development Act (LEDA) in 2006. This facility will be called HI-STORE CIS (consolidated interim storage).

The HI-STORE CIS will be sited on 1,000 acres of unused land approximately halfway between the cities of Carlsbad and Hobbs, N.M. The geologically stable, dry, elevated land is located 35 miles from nearest human habitat and features a well-developed transportation infrastructure, including rail access. The land was studied extensively for its environmental characteristics during the Global Nuclear Energy Partnership (GNEP) process.

Holtec will license the facility with the USNRC and build and operate the HI-STORE CIS facility with the anticipated support of the US Department of Energy. HI-STORE will employ the HI-STORM UMAX technology (NRC Docket No. 72-1040), which stores the loaded canisters in a subterranean configuration.





**Figure 6: HI-STORE: A Consolidated Interim Storage Facility for Used Nuclear Fuel and HLW  
75,000 Metric Tons Uranium Occupies Land Area of 32 Acres**