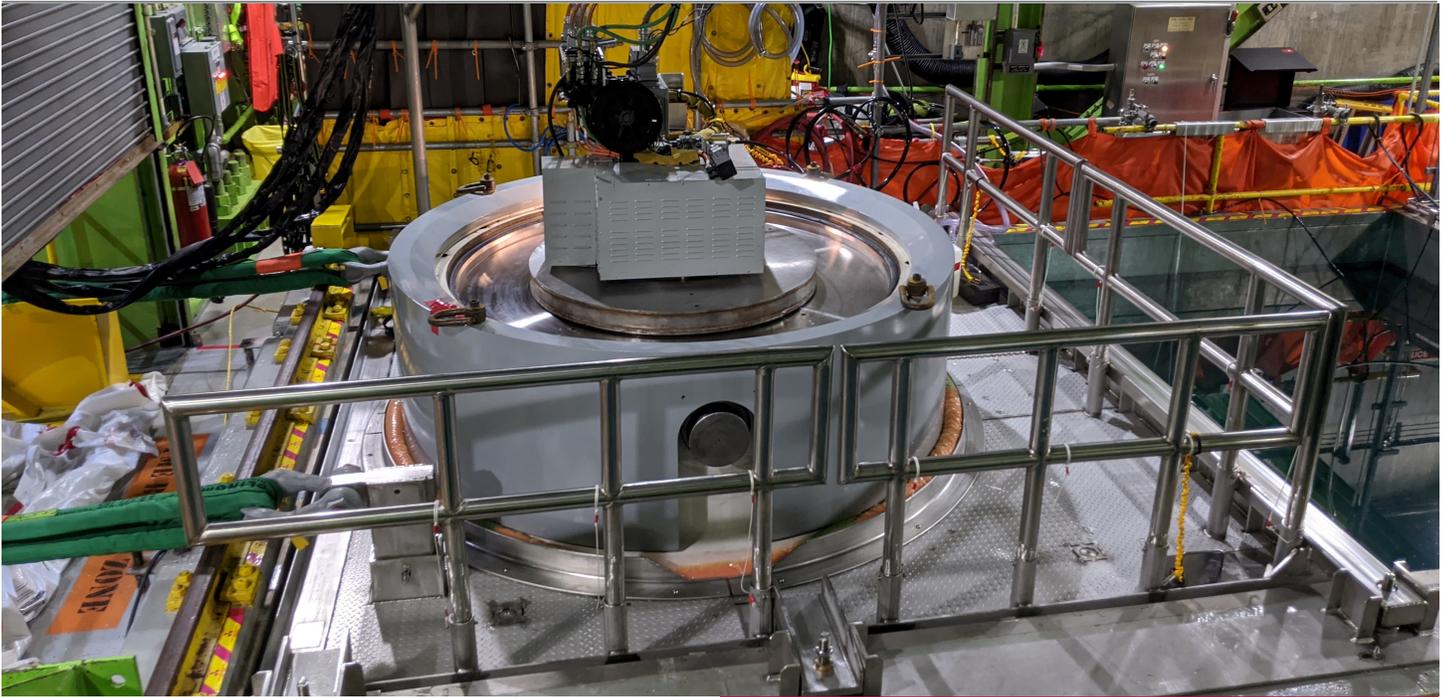


# Dry Cask Operations Shielding

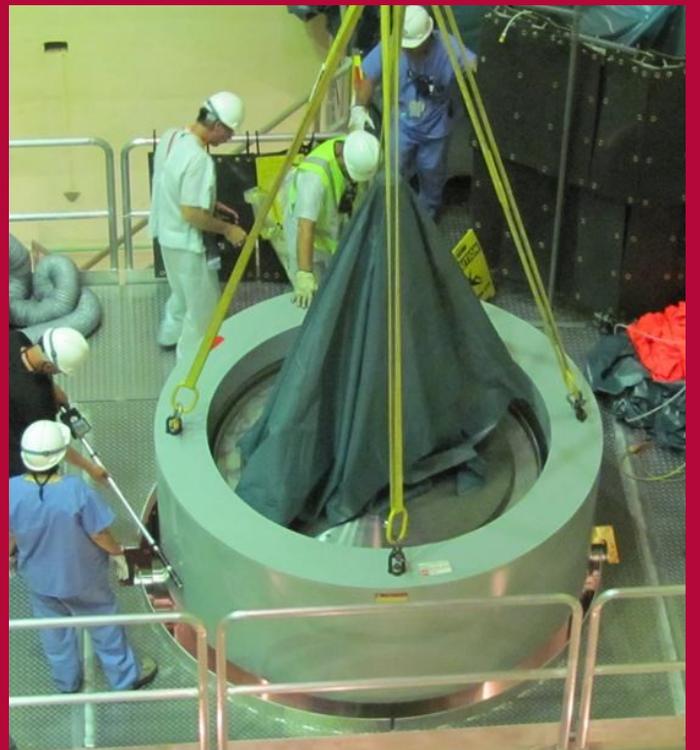
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## Product Description

NPO is the industry leader in spent fuel storage shielding. Each piece and package is specifically designed to handle the unique radiation profile associated with dry cask operations. Materials specifically designed to attenuate neutron radiation such as Borated polyethylene and T-Flex® Boron are combined with traditional gamma attenuating materials like steel, lead, and T-Flex® Tungsten to achieve the optimal dose reduction. NPO has worked directly with the manufacturers of the casks, the crews that move the fuel, and the RP departments to develop the most effective shielding for every scenario.



# Dry Cask Operations

## Typical Shielding Package



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Transfer Cask  
Shield Bell



Canister Lid  
Shielding



T-Flex® Annulus  
Gap Shielding



Outer Canister  
Shielding



Supplemental  
Shielding



# Dry Cask Operations

## Bell Shields



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## Transfer Cask Shield Bell

The transfer cask bell shield provides gamma and neutron shielding during dry cask operations. The shield itself rests on top of the transfer cask and provides shielding around the entire circumference above the work platform. The shielding extends above the top of the cask to reduce shine from the canister lid and annulus gap areas. The amount of Borated polyethylene, steel, and/or lead can be designed to each site's individual needs.

A standard shield bell contains steel, solid lead, and Borated polyethylene which translates into an estimated dose reduction of 80% for gamma and 77% for neutron.



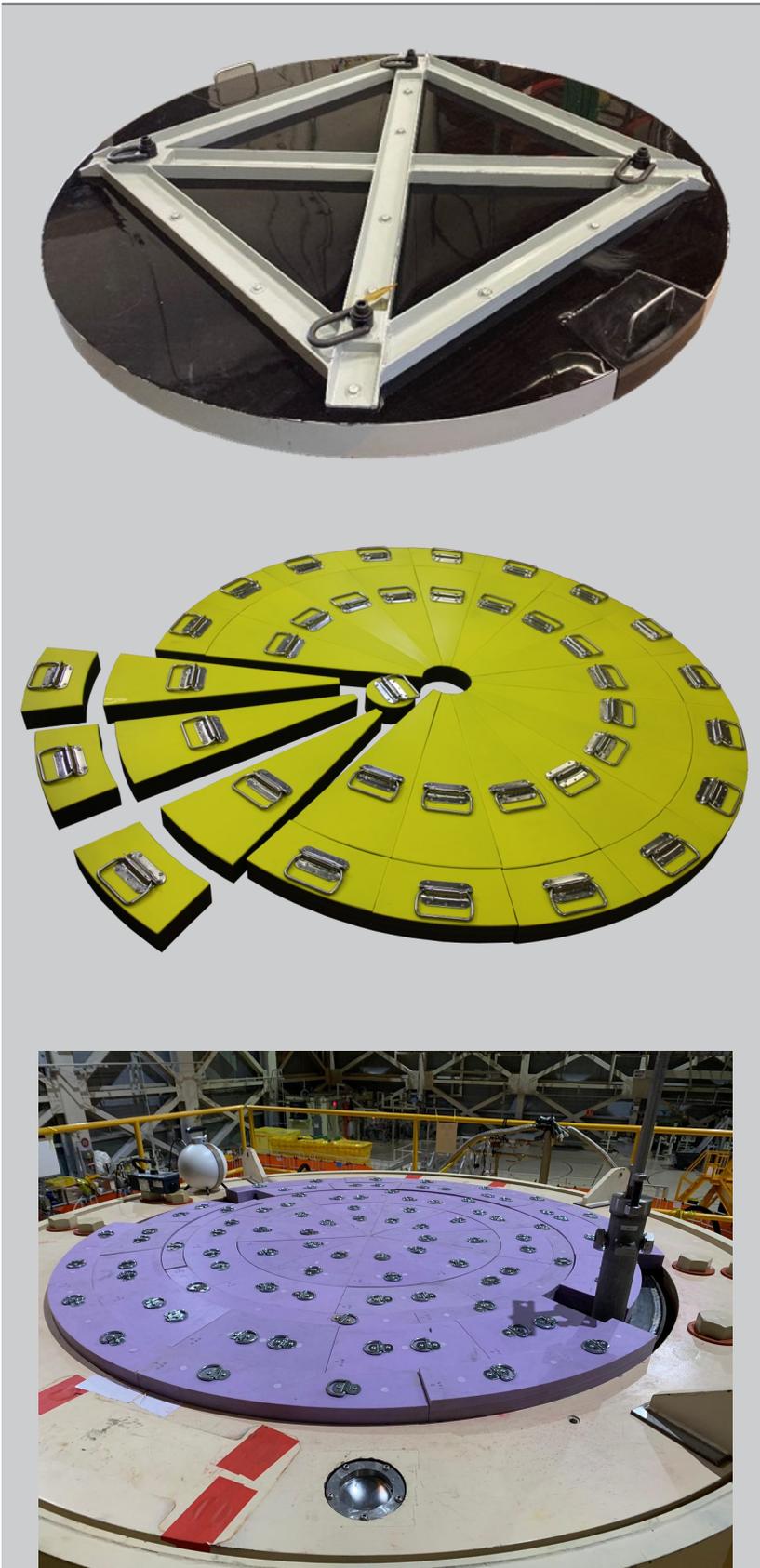
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# Dry Cask Operations

## Lid Packages

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### One-Piece Canister Lid Shield

This one-piece canister lid shield consists of 1" of T-Flex® Tungsten and 2.5" of T-Flex® Boron shielding within a steel frame, providing 64% gamma and 73% neutron attenuation. The shield can withstand +350°F operating temperatures. Removable notch pieces located opposite of one another allow for vent/port access. A high density plastic seating pad at the bottom ensures there is no steel-to-steel contact with canister lid. The entire shield is removed during welding.

### Multi-Piece Canister Lid Shield

Canister lid shielding allows the site to keep shielding on the canister lid during welding and inspection, while strategically moving and removing a few pieces at a time. A worker can benefit from the majority of the shielding while at the same time having access to specific areas of the canister lid. The weight of each individual piece can be easily carried by one person and includes an embedded handle for ease of movement.

Lid shields can be designed in any configuration with a number of different materials adjusted to meet site dose reduction goals.

# Dry Cask Operations

## Annulus Gap Shielding



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### T-Flex® Tungsten Annulus Shields

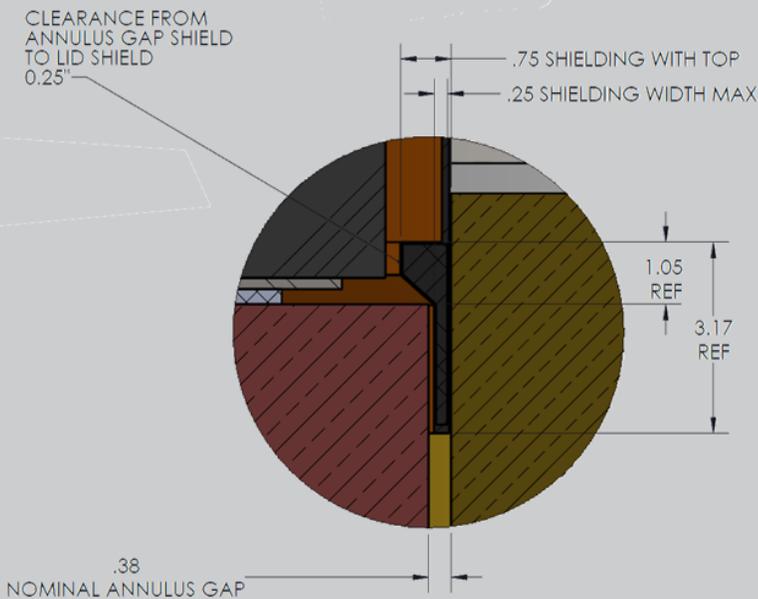
Thanks to its silicone and Tungsten composition, T-Flex® Tungsten is both an excellent gamma and neutron radiation attenuator.

The annulus gap between the canister and the transfer cask is a major source of streaming and difficult to avoid. The wedge and tail shape of the T-Flex® extends into the gap at the bottom snugly pressing into the gap at the top. The width of the wedge provides a secure fit, ensuring the annulus shield stays in place.

To protect the shielding from welding operations, each annulus gap shielding is covered in a high temperature silicone coated fiberglass. Optionally, a grommet can be added to either or both ends for ease of installation and retrieval.

An improvement over lead wool snakes, T-Flex® Annulus Gap Shields provide better attenuation while proving to be more being more durable.

NPO has supplied effective annulus gap shielding for ORANO and Holtec systems.



# Dry Cask Operations

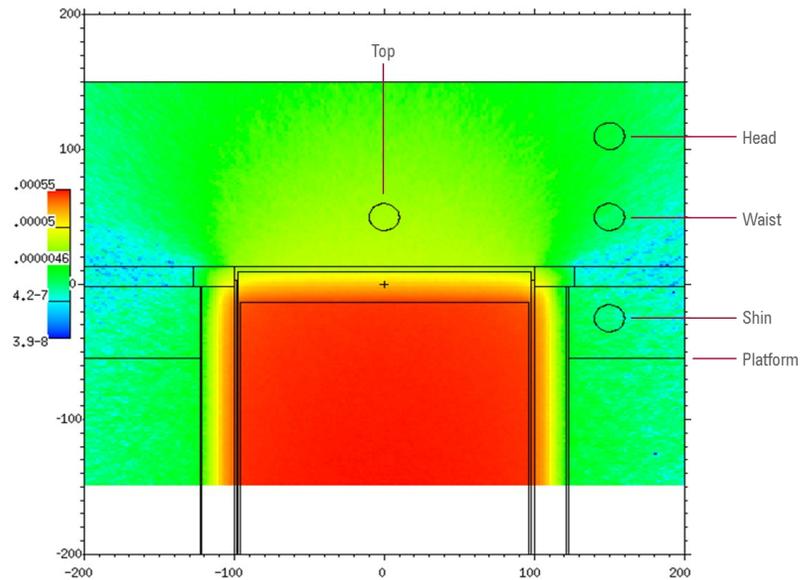
## Monte Carlo N-Particle Simulation



Monte Carlo N-Particle (MCNP) is a software package used for simulating nuclear processes. Lines of code are entered into the program with information on the source and environment. The program can be used to determine shielding effectiveness, calculate dose, and visually depict dose fields. NPO utilizes MCNP to evaluate shielding materials and placement, supplement experimental shielding data, and engineer effect shielding solutions. The example below depicts a spent fuel canister and transfer cask with a typical spent fuel neutron emission profile. The table shows the conditions around the cask with and without an NPO dry cask shield bell present.

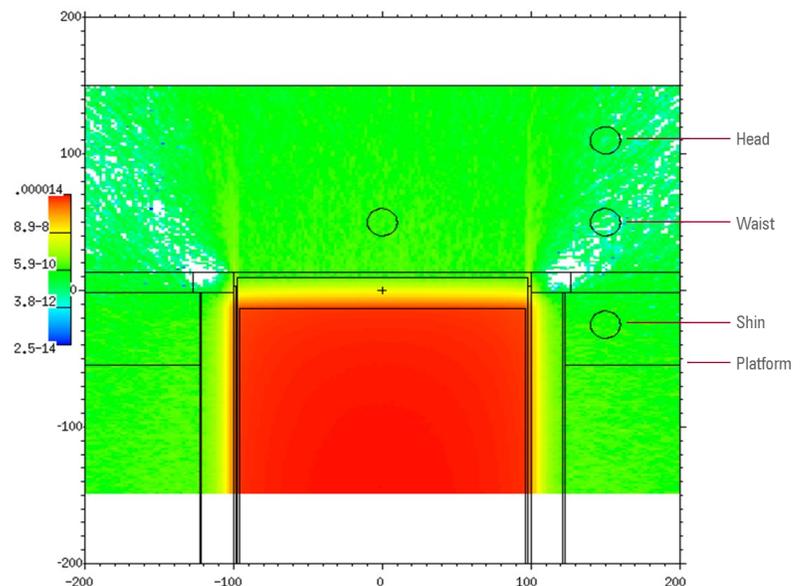
Neutron Dose - mRem/hr

	Unshielded	w/ Shield Bell/Floor	w/ Shield Bell/Floor + Lid
Shin	280	53	50
Waist	392	230	17
Head	566	484	29
Top	3533	3533	221



Gamma Dose - mRem/hr  
(Includes gamma emitters and gamma produced from neutron - gamma reactions)

	Unshielded	w/ Shield Bell/Floor	w/ Shield Bell/Floor + Lid
Shin	700	222	222
Waist	55	31	21
Head	89	69	24
Top	578	578	193

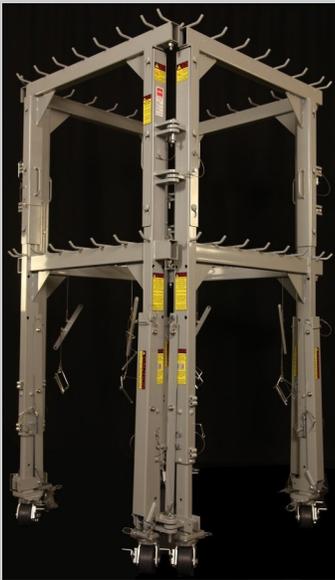


# Dry Cask Operations

## Shield Walls

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## Serpentine Rack

NPO's serpentine system is designed to provide virtually any shielding wall configuration, including low dose waiting areas, portable frisking caves, shadow shield walls, and shields for rad materials transfers.

This sturdy and adjustable system was designed to replace scaffolding, currently used to hang lead blankets. By placing the installation process in the hands of the RP department, setup time and potentially critical path time is saved.

NPO serpentine racks are compatible with 10#/sq. ft. and 15#/sq. ft. blankets, up to six layers and totaling 3,060 pounds per three-foot wide section.

## H-Frame Rack

H-Frame racks can be assembled as a single- or double-tiered support rack, including telescoping options. These racks are constructed to hold three layers of blankets—3', 4' and 6' per side. Staggered leg heights permit "L-shaped" shield walls. All legs include provisions for outriggers (optional).

## Borated Polyethylene Sheets

Solid shield panels with mitered edges to eliminate streaming gaps and holes for attachment via tie-wrap / carabiner / S-hook to hand rails, etc. Typical 2" thickness provides approximately 61% neutron attenuation.

# Dry Cask Operations

Contact Us

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As a 35+ year veteran company to the shielding industry, employees at NPO attribute a great deal of our success to the partnerships established with our customers. At NPO, we work synergistically with our customers, adapting product designs that conform to their specifications. In fact, over the last three years alone, NPO has customized hundreds of new product parts to meet the unique ALARA challenges our customers have faced. We would like to extend this partnership to your team as well. Please contact us today to discuss how NPO can support you.

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