



Nevis Block Packaging and Transportation Project

Fermi National Accelerator Laboratory
Batavia, Illinois

Project Description

- **Fermi Research Alliance, LLC (FRA)**, Prime Contractor for DOE, had approximately 205 Shielding Blocks that require onsite waste characterization, packaging, transportation, treatment, and proper disposal.
- Stored in the Northeastern most area of the Fermilab campus was approximately 2,000,000 lbs. of surplus shielding blocks that originated from the Nevis Particle Physics lab at Columbia University in Irvington, NY.
- The origin of the blocks is largely lost in time as they were shipped to Fermilab in 1982, and any information about them prior to that is scarce at best. The blocks were deteriorating and no longer as effective as modern equivalents for their intended purpose, and therefore declared as obsolete and in need of disposal.



Project Evaluation

- The blocks were considered obsolete and slated for disposal at an approved Hazardous waste disposal facility in Texas.
- Started the 90-day clock for removal from site.
- The system must meet the requirements of 49 CFR 173 for Bulk packaging for low hazard solid materials.



Potential Hazards

- The blocks were constructed using various sizes and shapes of steel boxes that were filled with lead, Zinc and other metals that were used at the lab. The remaining void was filled with concrete, and in some cases, concrete mixed with other materials such as metal shot and shavings.
- The hazards involved exposure to the heavy metals, mostly lead and beryllium. Being stored in a covered shed for over forty years has allowed the concrete to degrade, and the boxes to rust and disintegrate. There was a low-level radioactive component from activation products likely due to exposure during experiments.
- An unexpected hazard discovered upon arrival to the site was the presence of large amounts of Raccoon feces in amongst the stacked blocks. This created an additional hazard for potential exposure to round worm, whose eggs can survive for over a year outside the body.



Problem Statement

- Provide a Compliant, Budget-Minded, Robust packaging solution to be performed on 205 packages in 90 days or less.
 - Must also be easily fitted to odd shapes and sizes.
 - Quickly applied, off-the-shelf material and application equipment.
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Packaging Considerations

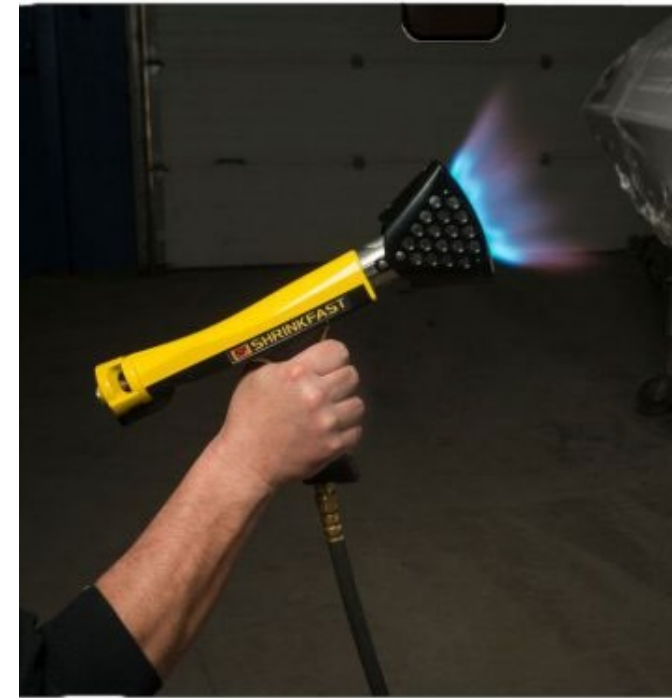
Options Included:

- Rigid packaging such as Cargo Containers, and Intermodal Rolloff Containers.
 - Pros: Steel containers, very strong, resistant to damage, and weather-tight.
 - Cons: Difficult to load and secure blocks inside, very heavy tare weight (up to 8,500 lbs. each), quite costly to rent and repair if damaged.
- Wooden Crates
 - Pros: Can be made to fit every block, much lighter than steel.
 - Cons: Materials are very expensive, must be made very strong to secure such high-density material inside, take a long time to make.
- Soft-Sided Packages
 - Pros: Very light, can be manufactured to exact dimensions and shapes.
 - Cons: Lift-pacs or bags have a very long lead-time (4-6 weeks min), they are quite expensive, difficult to load using a forklift in a storage area and require special devices for lifting and securing.



Polyethylene Film (Heat Shrinking)

- The material selected was heat-shrinking, 8-mil Polyethylene film.
 - Meets requirements in 49 CFR 173 for Bulk packaging for low hazard solid materials and is approved by DOE for this application.
 - Durable, strong, lightweight, and can be applied quickly with repeatable results.
 - Inexpensive to purchase and apply, Readily available, and in-stock at a nearby supplier.
 - Can be applied with simple off-the-shelf equipment, and without expansive training.
 - Can be shaped and molded to almost any size or shape.
 - Easily patched or repaired if damaged.



- 206 blocks dose-rated, characterized, and sorted into shipments.
- 206 packages wrapped, labeled, loaded and shipped.
- 89 shipments in 71 working days.
- 3.1 million pounds of low-hazard, bulk packaged waste removed from site, and disposed.
- Zero accidents, illnesses, injuries, or non-conformances.





LOGISTICS
PACKAGING
TECHNICAL SERVICES

Procedure



Set-up for Packaging

- Locate block and supports away from combustibles and other obstructions.
- Put thought into having room to work from a distance to the surface, much like shooting pool.
- Be aware of snags or things in the space that could catch the torch hose and possibly cause damage.
- Read and follow all manufacturer's written instructions and know what to do before operating equipment.
- Have proper PPE, a fire extinguisher, and a fire watch present as with any permitted hot work.
- Ensure adequate supply of materials, fuel and tape prior to commencing.





Pad Corners and sharp edges

- Use tape or scrap pieces of shrinkwrap film to cover protrusions, corners, or sharp edges.
- Fold to create multiple layers.
- This adds protection from being breached from within.
- Take time to create a clean look, it will show through at the end of the process.



Install a cap for
weather, and tiedown
protection (optional)

- Measure and cut a piece, or a scrap to fit as a cover for the top.
- This doubles the thickness of the top and mitigates water infiltration.
- The same can be done with the bottom to eliminate wrapping the entire block with a single piece

Measure for cutting film



- Decide based on the size of the block and the direction you plan to wrap, which way to best cut the film to avoid excess waste.
- Depending on the size of the roll of material, E.G 20' x 100' you determine which way to roll the film out and cut.
- In this particular instance, we decided to cut the film based on the 72" length of the block, and additional length to fold over each end.



Cutting and laying out film

- Cut film as described, ensuring overlap, and excess to remove forklift forks while avoiding damage.
- Making sure the surface is fairly clean and dry prior to unfolding.
- Do not cut excess material until block is set in-place and overlap is ensured.
- Sometimes it can be simpler to use a bottom pan, and a separate larger piece over the top to wrap objects. This application shows a single-piece encapsulation.



Layout and setting the block

- Ensure enough loose material between supports to remove forks or rigging if using a crane
- Fold leading edge of film to avoid driving on it when setting the block on supports.
- Choose a support with enough height to access the bottom for shrinking. This application is 6"



Wrap and fold film



- It is important to wrap the film and fold corners and edges fairly neatly, it will make for easier and better seam welding.
- This particular process created the main seam near the bottom of the long side, providing a seamless top.
- Overlap of seams should be top-down to mitigate any infiltration of moisture from the outside, like roofing shingles.
- Hospital corners aren't just to make the bed look nice, it makes for easier corner welding and consistent seal.

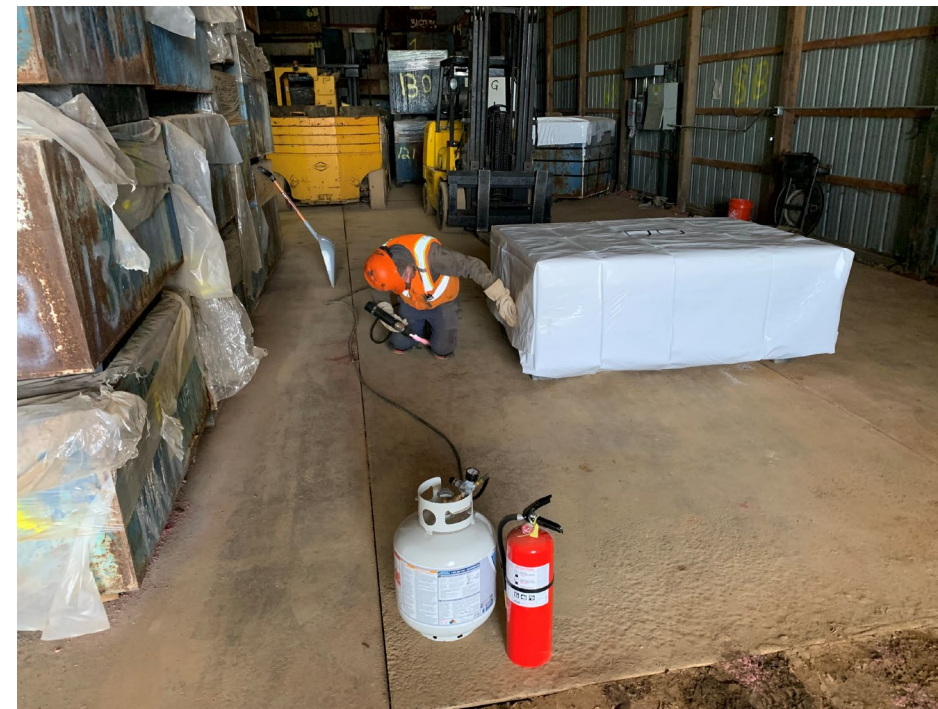


Ready to shrink

- Film should be pulled fairly tight during wrapping to prevent over-shrinking.
- Leave tabs on the tack-tape for easy removal during welding. Tape can be left in-place but creates a less desirable appearance and odd seams when tape-sealing welds later.

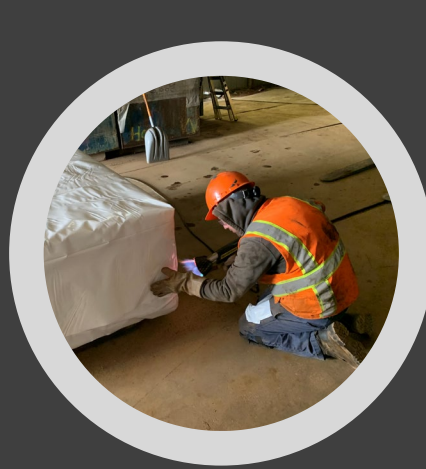
Set-up for heating

- There are many torch choices, this one was recommended by the vendor for this application.
- Maintain a safe distance from the flame and the gas bottle.
- Recommended min. 10-lb. ABC extinguisher and 30-minute post-work fire watch; not in picture (camera shy).
- All connections shall be leak-tested prior to use, and torch disconnected and bled-down when not in-use.



Heating and welding to seal seams

- Seams should be near the bottom when applicable.
- Start by applying some heat to the underside and pre-shrinking it a little.
- Practice is best; apply short bursts of heat, and press with gloved hands to seal-weld the film to itself.



Welding complete

Inspect all seams for seal-welding, reapply heat as necessary.

Small pieces of film can be used as patches where holes form or material separates.

All seams will be taped after shrinking is completed.

This is not a good time to find out you forgot the block I.D. or other information to be transferred to the outside of the film, we suggest phone pictures!!!!



Shrinking

- Start underneath and work around the block from the bottom-up.
- This is where you will appreciate taller support blocks.





Shrinking cont'd

- Work bottom-up all the way around.
- Pay attention to seams, take care not to overheat.
- Film will sometimes form a large bubble underneath, especially when multiple layers are being heated. Stop and go back after material cools a little to avoid over-shrinking or creating holes.

Hole repair

- Holes sometimes do appear, even when operator is quite experienced.
- This particular hole appeared in a multi-layer area.
- Allow film to cool, and weld the area creating a seal.
- As with any seam, cover welded area with tape.
- Single-layer holes can be welded with scrap material then taped.
- Material will self-fuse and seal allowing even seemingly large holes to be repaired.



Shrinking complete

- Finish by shrinking the top.
- Be careful as material will form large bubbles which are easy to melt through.
- Stop and let areas cool if necessary prior to completely shrinking to prevent creating holes.





Touch-up work as necessary

- Walk around several times and look for areas to be reheated or repaired.
- Sometimes bubbles and wrinkles will form between multi-layer areas due to the underneath material not stretching at the same rate. These can be “popped” and re-welded as desired or left alone if sealed.



Final step

- Tape over all welded seams for added protection from separating and sealing out moisture.
- Surface should be clean and dry before applying tape. Movement around the block, and the torch usually kick-up dust that will interfere with adhesion.
- This is the final opportunity to create a nice appearance, and sealed package.

Another example

- This is another example of just how well this system works.
- Sealed, slick, and tough.
- Use corner protection for straps and chains as you would with any package.
- Any holes can be sealed with the tape as long as the surface is fairly clean and dry.

