

## DOE Pollution Prevention Award Nomination

Category: Waste Prevention

Title: Eliminating Radioactive Wastestreams with Electrolytic Glovebox Decontamination

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### Abstract:

Throughout the DOE's Nuclear Complex radioactive materials are processed in containment workstations (Gloveboxes) that are exposed to transuranic contamination, eventually requiring disposal that creates a radioactive wastestream, or decontamination that is chemically hazardous, expensive, and largely ineffective. Electrolytic Glovebox Decontamination (GB Decon) - developed at Los Alamos National Laboratory- replaces disposal or hazardous cleaning methods with an effective, safe, inexpensive, environmentally benign, closed-loop cleaning system. With over 1500 contaminated gloveboxes in use or in storage at 6 different DOE sites, GB Decon can reduce exposure, recover radioactive material, save millions of dollars, and eliminate- at the source- a persistent contaminant wastestream.

### Nomination: Glovebox Decontamination

Throughout the Department of Energy's nuclear complex radioactive materials pose significant risks to workers and the environment. To safely handle these materials during processing and manufacturing, activities involving radioactive materials are conducted in containment workstations known as plutonium processing *Gloveboxes*. (SEE PHOTO 1) When a glovebox is used for plutonium processing, radioactive contamination accumulates on its interior, stainless steel surfaces. Eventually, a glovebox must be taken "off-line" because it is

either so highly contaminated with transuranic radioisotopes that it constitutes an unreasonable hazard to workers, or it is outdated by design- requiring disposal as radioactive transuranic (TRU) waste.

Currently, over 570 plutonium processing gloveboxes are in use at Los Alamos National Laboratory (LANL). Additionally, 257 outdated, contaminated gloveboxes are also temporarily stored at LANL, awaiting disposal as TRU waste at the Waste Isolation Pilot Plant Geologic Repository (WIPP). Moreover, within the DOE nuclear complex, 5 other facilities- Rocky Flats Environmental Technology Site, Idaho National Engineering Laboratory, Hanford Nuclear Reservation, Oak Ridge National Laboratory, and the Savannah River Site- are temporarily storing over 1000 gloveboxes that are awaiting disposal at WIPP.

To dispose of one TRU contaminated glovebox costs (approximately) \$140,000; to dispose and replace a glovebox costs at least \$490,000. But the economic cost is far exceeded by the environmental costs as each glovebox contains high concentrations of radioactive waste.

Historically, if an operational glovebox was highly contaminated, but not outdated by design, it was taken “off-line” and replaced. The contaminated workstation would be moved to another facility and cleaned as well as traditional cleaning methods would allow. Cleaning consisted of repeatedly scrubbing the plutonium-contaminated surfaces, using environmentally hazardous nitric acid. The cost to clean a glovebox and return it to service is almost \$150,000.

Not only does the nitric acid cleaning technique expose workers to hazardous chemicals, it is also inefficient and largely ineffective- leaving the glovebox only partially decontaminated. Most significantly, the nitric acid cleaning solvent is contaminated with radioactive isotopes and creates an extremely hazardous and persistent wastestream containing radioactively metal in the

acid cleaning solvent. The solvent is then disposed as “mixed low-level” (contaminated) waste. Disposal cost for the glovebox and the cleaning solvent is at least \$55,700.

To create a safe, clean alternative to nitric acid cleaning, Dr. Doug Wedman and the members of LANL’s NMT-15, *Pit Disassembly and Nuclear Fuels Technologies*, developed the *Electrolytic Glovebox Decontamination Process* (GB Decon), which creates a closed-loop cleaning system that efficiently removes radioactive contaminants from a glovebox. This decontamination technology cleans a glovebox effectively, without hazardous chemicals and recovers virtually all radioactive materials. Additionally, the glovebox can be decontaminated on site, avoiding removal and replacement, for a cost of only \$5,000.

The new GB Decon technology is based on electrolysis, which creates a chemical change in the glovebox by utilizing an electrical current in an environmentally benign, electrolytic solution. The solution, consisting of water and sodium sulfate- which is the same type salt used to regenerate water softeners- is brought into contact with the stainless steel surface of the glovebox interior. The radioactive contaminant contained in the metallic surface is quickly and uniformly stripped from the glovebox walls. (SEE PHOTO 2) The radioactive metal- primarily iron rust- in the electrolytic solution is then separated by filtration.

The result of the GB Decon process is a decontaminated glovebox that can be returned to service or, if outdated, disposed safely as “low-level waste.” There is also a small residual quantity (a few hundred grams) of solid radioactive material- in the form of rust- that can be recycled if returned to the radioactive material “vault.” Additionally, the sodium sulfate solution is unchanged and recovered completely, allowing re-use and representing the creation of a closed-loop cleaning system. As a result, GB Decon technology has completely eliminated the source of a hazardous and persistent wastestream consisting of metal, nitric acid, and radioactive

isotopes. Instead, it yields a decontaminated glovebox that can be safely returned to service, or, if out-dated disposed with greatly reduced environmental impact.

Hazardous risk for workers is reduced; transuranic material is fully recovered and, with the exception of the small filtration unit, recycled as a plutonium resource. Hazardous cleaning solvents are eliminated and the environmentally benign electrolytic “saltwater” solution circulates in a closed loop system where it can be reused indefinitely.

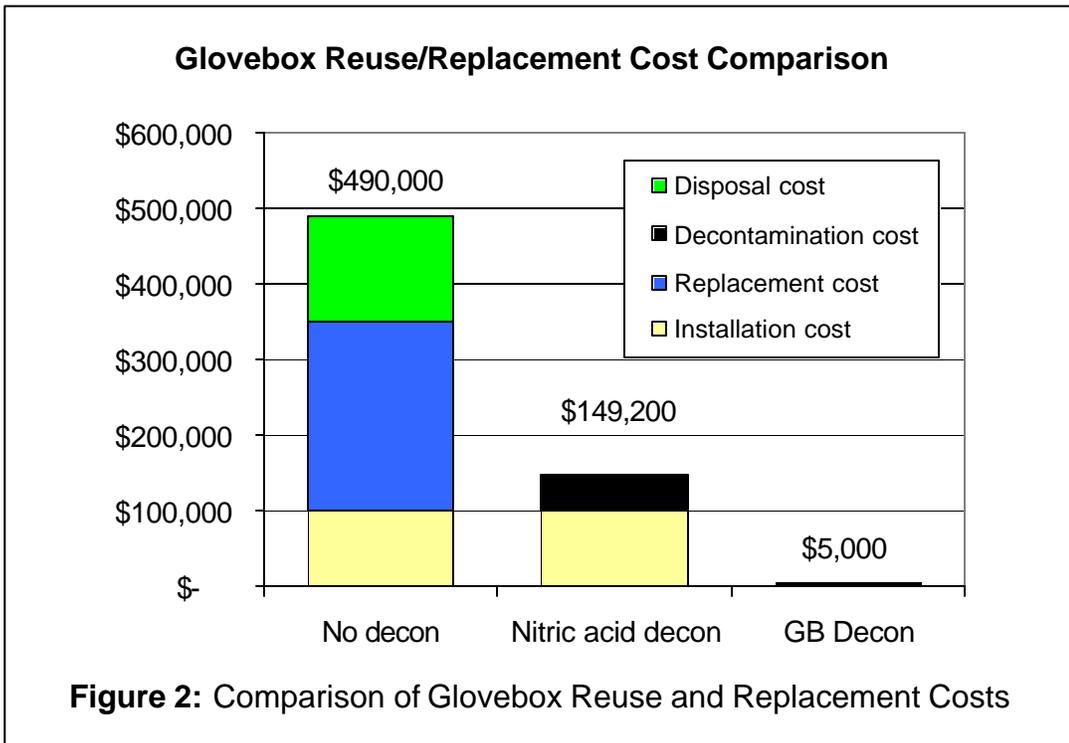
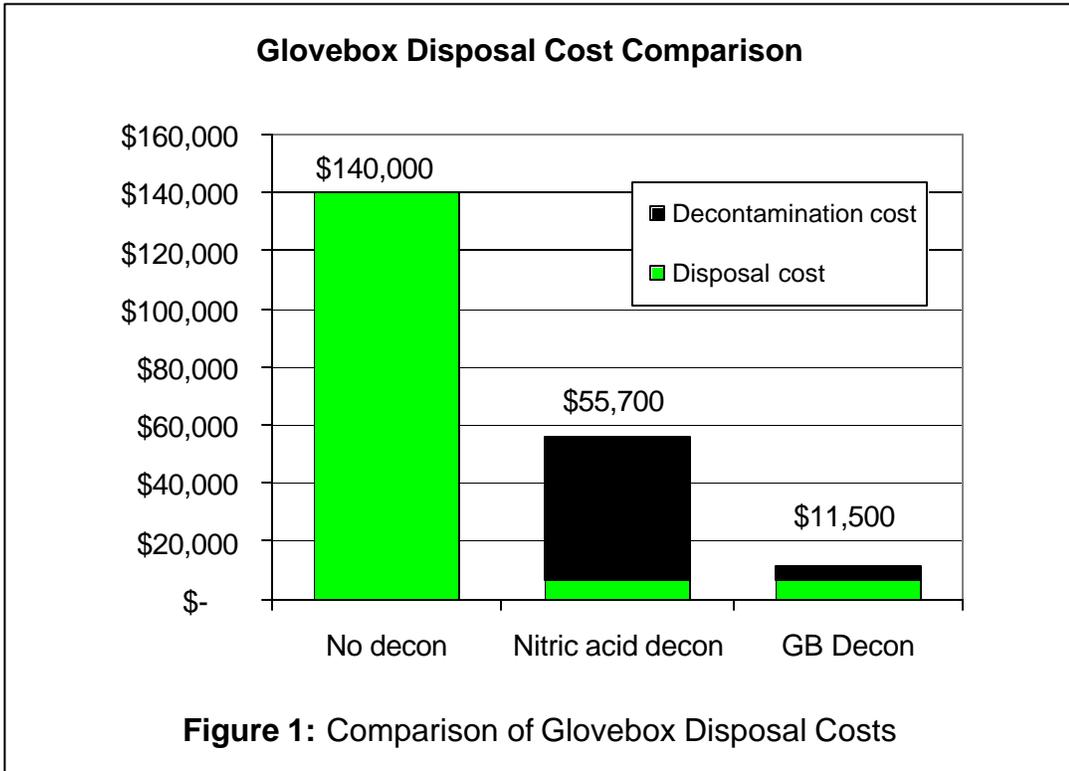
Electrolytic decontamination of gloveboxes allows their re-use; labor and production costs are reduced as the glovebox can be cleaned on the processing line, rather taken off line, replaced, cleaned, and returned to service. Costs associated with radioactive TRU waste disposal are virtually eliminated. Rather than costing \$140,000 to dispose of the glovebox, the “clean” glovebox can be disposed as low-level waste at a total cost of (approximately) \$11,500. (SEE GRAPHS 1 & 2)

To date thirteen TRU contaminated gloveboxes have been cleaned at LANL with GB Decon: 5 of these have returned to use; 8 have been discarded as “low-level” waste. When compared to nitric acid cleaning this represents savings of \$1,074,600.

GB Decon is not limited to use at Los Alamos, but is applicable for use throughout the DOE nuclear complex- where over 1,500 gloveboxes are currently located at 6 different facilities. GB Decon technology can also be utilized internationally in nuclear facilities and in medical technology production facilities to clean gloveboxes, reduce hazardous wastestreams, protect workers from hazardous exposure, and realize cost savings. Additionally, GB Decon technology has the potential to be applied to other contaminated plutonium processing materials including hand tools, machinery, piping, and metal components, thus extending the useful life of these products.

Through its development and use at Los Alamos National Laboratory, GB Decon technology has proven to reduce hazardous exposure, recover radioactive material, save millions of dollars, and eliminate- at the source- a significant, persistent radioactive wastestream.

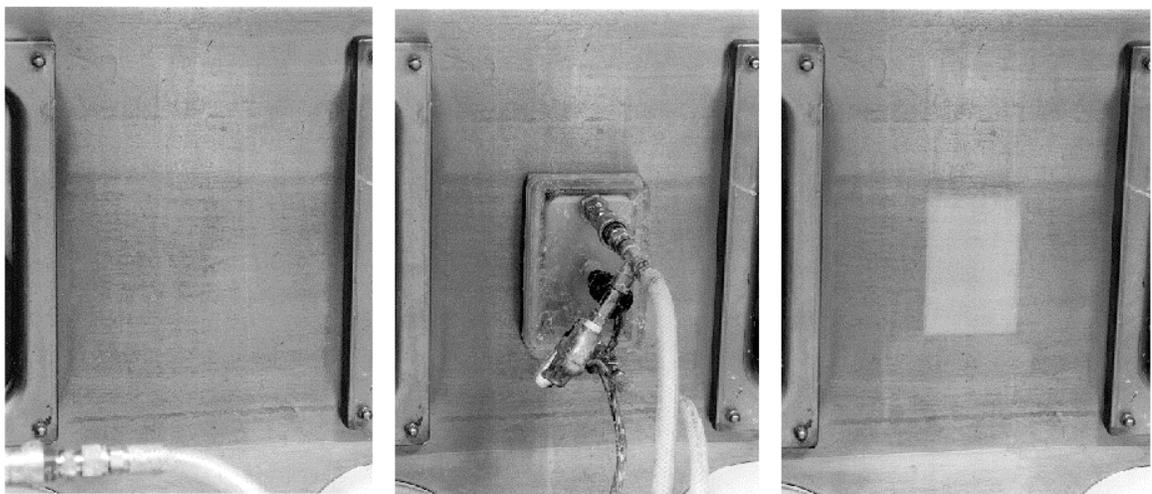
# Elimination of Radioactive Wastestreams With Electrolytic Glovebox Decontamination



## Elimination of Radioactive Wastestreams with Electrolytic Glovebox Decontamination



**Photo 1:** A glovebox on the plutonium processing line



**Photo 2:** Before, During, and After Electrolytic Glovebox Decontamination.