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Next-Generation Tritium Gas Loading Glovebox

PRESENTED BY

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Introduction

In 1993, Sandia National Laboratories (SNL) began work to produce Neutron Generators for nuclear weapons in the US Nuclear Stockpile.

Neutron Generators operate on a Deuterium-Tritium (D-T) fusion reaction, and so requires the capability to load (hydride) a target with tritium. Los Alamos National Laboratory (LANL), loaded targets, and developed several Target Loaders to perform this operation. These Loaders utilized gloveboxes as secondary containment for tritium.

In 2005 SNL began target loading in Albuquerque, New Mexico. LANL transferred two of their Target Loaders ("Loaders A and B") to SNL. These loaders had not yet been contaminated with tritium.

Sandia qualified Loader B for production of targets in April 2006, and it has been in use since then.

Outline

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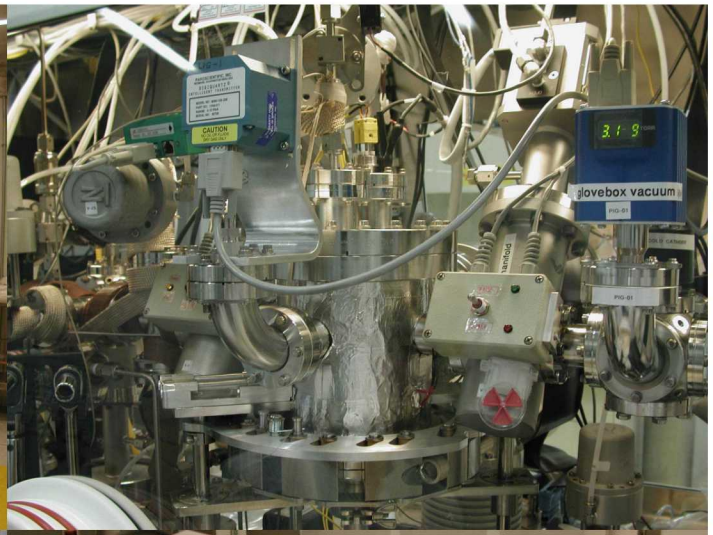
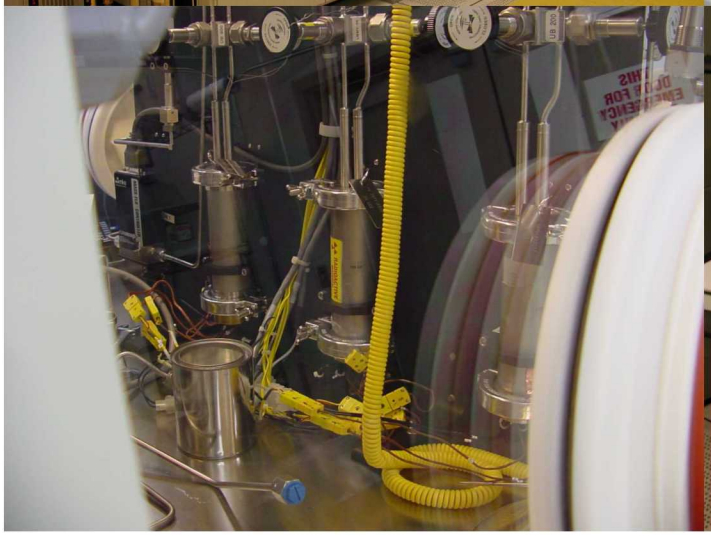
  - Loader Procurement
- Loader Design
  - Design Features
  - Safety Features
- Present State
- Lessons Learned
- Questions
- Future Plans

Loader B





Issues

In 2011, work began on design and acquisition of a new target loader.

- Loader B was approaching end of design life.
- Due to continuing use, levels of tritium contamination were rising inside the glovebox.
- Maintenance of components inside glovebox difficult due to gloves and ergonomics.
- Size of glovebox (10' x 8' x 4') made it difficult to reach components for repair and maintenance activities.
- Loader B was becoming hard to maintain due to age of components and obsolescence.
- Although valve operation was automated (through LabView software interface), process itself was manual, and had to be performed by stepping through a multiple-page Operating Instruction and clicking on individual controls (heaters, valves, etc.).

New Loader Design Initiation

With the new target loader, an attempt was made to incorporate the following:

- Glovebox should be narrow to allow easier access for operation and maintenance.
- Operation should be possible from one side.
- Eliminate chain clamp closure for vacuum chamber.
- Minimize equipment inside glovebox (keep instrumentation outside whenever possible).
- No water cooling within glovebox.
- Minimize elastomeric seals.
- Off-the-shelf heater for uranium beds.
- Use of automated processes to support operation (minimal operator interaction).

Loader Procurement

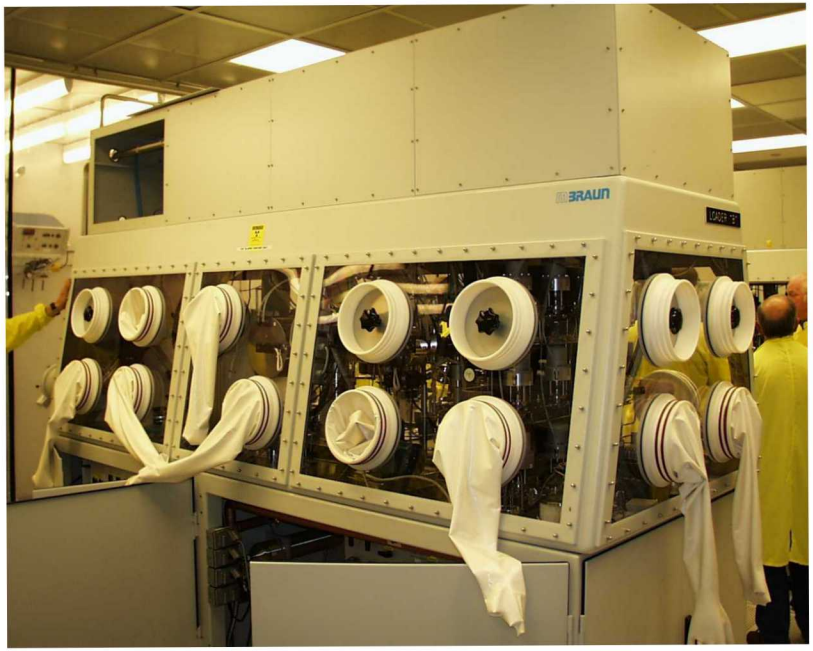
After bid process, contract was awarded to Semicore Equipment Company, Inc.

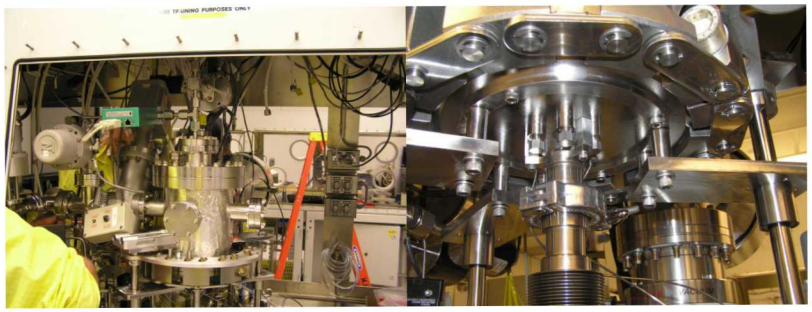
- Glovebox was procured through M. Braun, USA.

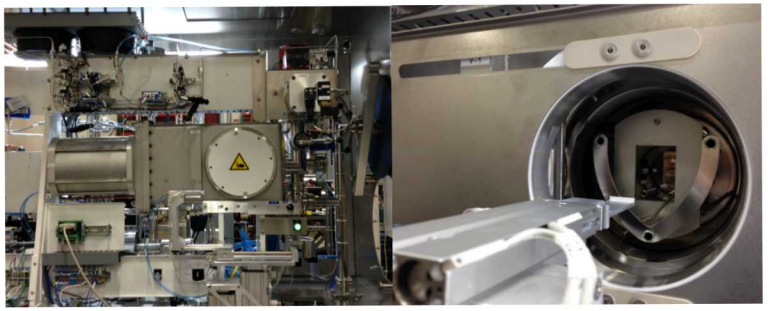
Design varies from Loader B design in the several aspects:

- Glovebox is taller (86" vs. 79") and narrower (40" vs. 48"), to allow improved reach;
- Operations (including introduction of parts into glovebox through antechamber) can all take place from "front" of box;
- 10" Gate Valve used in place of chain-clamp sealed door;
- Air cooled turbo pumps for UHV;
- Uranium beds and heaters from commercial vendor;
- Processing "recipes" possible through software control.

Loader Design

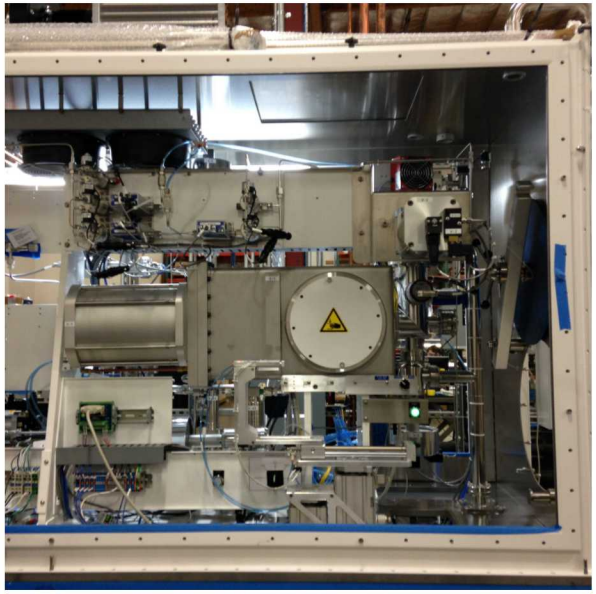






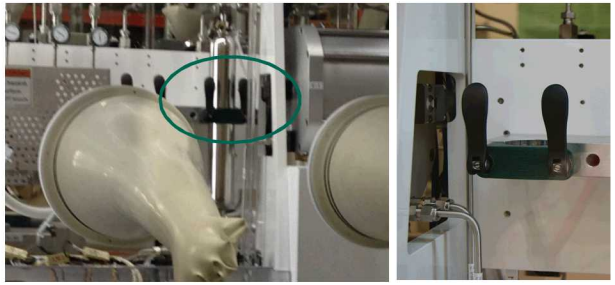
Design Features

- Eliminated smaller antechamber from Glovebox
  - Not found to be useful for Production Operations
- Incorporated a CRL-Destaco Bag-Out Port into Glovebox
- Roughing pumps located in lower enclosure, which is exhausted to Tritium Exhaust System for safety.
- HEPA filter removed from Glovebox interior (freed up space inside box)



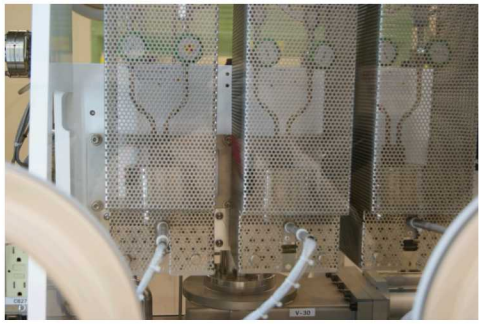
Design Features

- Introduced Glove-friendly Construction inside Glovebox

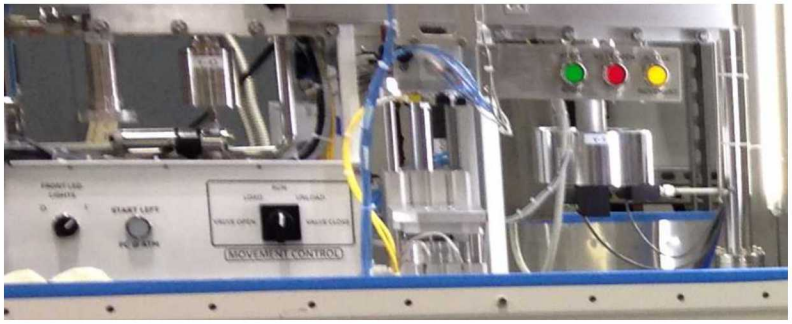


Cam Handle Fasteners

Easily Removable Heater Assembly



Heat Shields over Heaters



Large Knobs and Buttons with Lighted Indicators

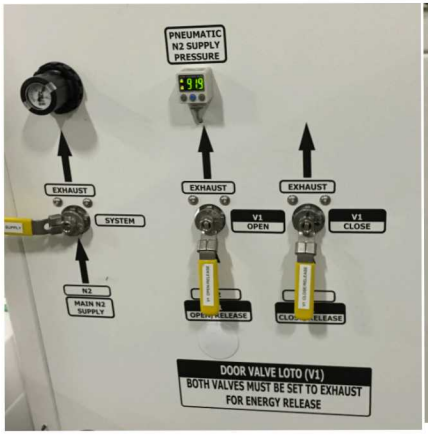
Safety Features

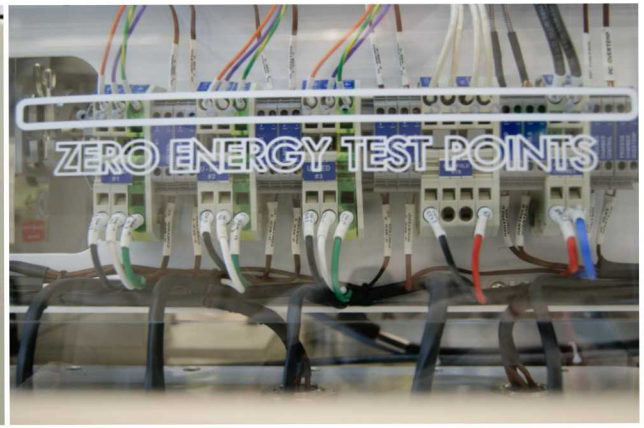
Breach Protection System – Connected to Tritium Exhaust System

Vented Lower Enclosure – Connected to Tritium Exhaust System (Can be directed to Tritium Capture System in case of tritium leak in system)

Overpressure Bubbler System – Connected to Tritium Exhaust System

LOTO and Zero Energy Verification Test Ports





Safety Features

Interlocked Antechamber Doors

- Doors can't both be opened at the same time
- Opposite door can't be opened unless auto evacuation/purge process has been completed.

Tritium Monitoring (Femto-Tech)

- One monitors internal contamination level of Glovebox
- Second one monitors room contamination level

Software Interlocks

- Software monitors valve position of U-beds.
- If any U-bed valve is opened, manifold is tagged as "hot" and a programmed Gas Recovery and Sweep to TCS (Tritium Capture System) must be performed prior to starting any other manifold process.
- If isolation valve between "hot" manifold and Process Chamber is opened, Gas Recovery and Sweep to TCS sub-routines must be run to clean Chamber prior to venting and opening.

Two-Hand Anti-Tie Down Buttons for Valve Closure, plus Pneumatic Load Stage to place parts into Process Chamber.

Present State

Glovebox

- Operational, currently valved to Tritium Exhaust System
- Have not started working with Tritium yet; loading with Deuterium off of U-beds.

U-beds

- Conditioned using Deuterium only.

Process

- Initial Characterization done using Argon in lieu of Deuterium.
- Development using multiple runs of Deuterium prior to going "hot".

ALARA Review completed.

Lessons Learned

Glovebox Training would have been a plus!

Standards (AGS-G001-2007, Guideline for Gloveboxes; AGS-G006-2005, Standard of Practice for the Design and Fabrication of Nuclear-Application Gloveboxes) is a very useful reference guide.

Antechamber button inside glovebox would have been useful for operations.

Tool needed to place loaded parts container onto Loading Mechanism.

Ambidexterous gloves should be specified for ease of use.

Questions?

Future Plans

Complete Characterization and Qualification Activities of Loader.

Operate for several months to gain operational knowledge on system.

Prepare modified design document, incorporating Lessons Learned from use.

Order second new system to allow older loaders to be retired.