Office of Environment, Health, Safety and Security
Operating Experience Level 3

OE-3: 2024-04 **December 2024**

Enhanced Glovebox Integrity Inspections and Glovebox Community of Practice

Introduction

This Operating Experience Level 3 (OE-3) document is to recommend enhanced integrity inspections for gloveboxes in support of increased mission activity in plutonium production and to raise awareness of a new glovebox Community of Practice (CoP) across the Department of Energy (DOE) Enterprise promoting learning from operating experience related to glovebox hazards.

The recommendations in this OE-3 are based on lessons from a review of events associated with glovebox operations across DOE, including National Nuclear Security Administration (NNSA), in the Calendar Year (CY) 2021-2024 timeframe.

Background

From 2022-2023, Los Alamos National Laboratory (LANL) had ten separate glovebox incidents (not listed in this OE-3) outlined by the Defense Nuclear Facilities Safety Board (DNFSB) in a letter to Secretary Granholm dated April 10, 2024. These ten incidents were directly linked to the expansion of work involving the Plutonium Facility (PF-4), including some incidents resulting in personnel uptake or contamination from glove penetrations. LANL responded to these events from both a technical and operational perspective establishing the Glovebox Safety Committee which serves as a Community of Practice (CoP) to protect workers from glovebox hazards and to share glovebox operational lessons learned across the DOE/NNSA complex.

Prompted by the recent glovebox incidents at LANL, DOE's Office of Environment, Health, Safety, and Security (EHSS) and the NNSA Office of Environment, Safety and Health (NNSA-ESH) collaboratively reviewed Occurrence Reporting and Processing System (ORPS) reports for glovebox incidents from CY 2021-2024 and identified nineteen incidents involving breaches, fires, magnehelic pressure and oxygen sensor failures, inaccurate readings, alarms, calibration lapses, suspected counterfeit parts, etc. across the DOE/NNSA enterprise.

As a result of this review, sites where gloveboxes are used are asked to check gloveboxes comprehensively prior to each use, establish routine maintenance schedules, and join the glovebox CoP to stay abreast of glovebox lessons learned and best practices.

Operational History

The nineteen glovebox incidents identified in this OE-3 occurred at LANL, Lawrence Livermore National Laboratory, Savannah River Site, Oak Ridge National Laboratory, Ames Laboratory, and Idaho National Laboratory, representing sites managed by NNSA, Science, Environmental Management and Nuclear Energy programs:

Event 1: On January 7, 2022, worker skin and Personal Protective Equipment (PPE) contamination reported during glovebox operation where the glove was confirmed contaminated. NA-LASO-LANL-TA55 2022-0002

Event 2: On March 4, 2022, oxygen monitor reading of glovebox insufficient for operation. NA-SRSO-SRNS-TRIT 2022-0003

Event 3: On March 8, 2022, vibration isolator on glovebox failed. NA-LASO-LANL-TA-55 2022-0006

Event 4: On March 23, 2022, oxygen monitor reading of glovebox insufficient for operation. NA-SRSO-SRNS-TRIT 2022-0005

Event 5: On May 3, 2022, oxygen monitor inoperable on glovebox in TA-16 Bldg. 0205. NA-LASO-LANL-TRITFACILS 2022-0002

Event 6: On May 10, 2022, oxygen monitor inoperable on glovebox in TA-16 Bldg. 0205 from loose electrical connections. NA-LASO-LANL-TRITFACILS 2022-0003

Event 7: On July 27, 2022, unqualified worker opening cabinet for access to electrical connections that power a glovebox in Bldg. 2370 HVC. SC-050-ORNL X10 LEASED 2022-0005

Event 8: On October 19, 2022, glovebox in Bldg. 332 unable to provide minimum required quantity of nitrogen gas for operation. NA-LFO-LLNL 2022-0044

Event 9: On December 8, 2022, differential pressure and exhaust on glovebox in Bldg. 7880 inoperable. EM-ORO-ORCC-TWPC

Event 10: On December 26, 2022, exhaust ventilation for glovebox in Bldg. B-2132B inoperable and taken out of service for repairs. EM-ORO-ORCC-TWPC 2023-0001

Event 11: On February 1, 2023, inoperable glovebox oxygen sensor provided inaccurate readings from May 1- May 4 without detection. NA-SRSO-TRIT 2023-0003

Event 12: On February 21, 2023, three inert gas glovebox safety incidents reported resulting in building evacuation due to fine oil mist, activation of smoke detectors. SC-AMSO-AMES-AMES 2023-0001

Event 13: On February 22, 2023, Protective Force Officer responded to two after-hours alarms for low differential pressure and inoperable exhaust for glovebox. EM-ORO-ORCC-TWPC 2-23-0002

Event 14: On May 5, 2023, glovebox failure during span gas test of RA-02. NA-SRSO-SRNS-TRIT 2023-0002

Event 15: On October 4, 2024, lapse of calibration of the photohelic gauge at glovebox workstation 1312. NA-LFO-LLNL-LLNL 2023-0031

Event 16: On November 6, 2023, fire in glovebox resulting in building evacuation, dispatch of the LANL fire department, and a declared PISA. NA-LASO-LANL-TA55 2023-0032

Event 17: On December 20, 2023, suspect counterfeit bolts used in an operating glovebox. NE-ID-BEA-FCF 2024-002

Event 18: On March 19, 2024, gauntlets on a glovebox had pin holes resulting in worker PPE contamination. NE-ID-BEA-FCF 2024-003

Event 19: On July 31, 2024, employee performing work on a lathe cracked the glovebox enclosure window with plyers. NA-LASO-LANL-TA55 2024-0024

RECOMMENDATIONS

Listed below are the recommendations based on the ten events that occurred at LANL outlined in the Board's letter to Secretary Granholm dated April 4, 2024, and the nineteen glovebox events identified by EHSS/NA-ESH in their collaborative review of ORPS reports across the DOE/NNSA enterprise.

- **Recommendation 1.** Survey hands for radiological contamination upon removal of hands from glovebox gloves.
- **Recommendation 2.** Conduct routine glovebox inspections of glovebox enclosure and glove integrity from sharps.
- **Recommendation 3.** Establish and review change-out schedules to ensure prevention of glove failure.
- **Recommendation 4.** Collect and trend glovebox failure data to prevent glovebox failures.
- **Recommendation 5.** Install color coded magnehelic gauges to alert operators of fluctuating glovebox pressures and provide operators more indications of potential breaches.
- **Recommendation 6.** Increase training and sharing of operating experience throughout the glovebox CoP and across the DOE/NNSA enterprise.
- **Recommendation 7.** Check glovebox calibrations and assure accuracy of sensor readings.
- **Recommendation 8.** Join the glovebox CoP for lessons learned and best practices.

SUMMARY

Gloveboxes are engineering controls used across the DOE/NNSA Enterprise to protect employees as they conduct mission critical work in support of national security. Engineering controls are only as protective as the physical integrity of the enclosures, seals, gloves and vigilance of the workers. Gloveboxes must be routinely inspected, inspection records maintained, and calibrations conducted. With the incidents that have occurred, LANL has enhanced their glovebox integrity efforts and developed unique and innovative solutions to the glovebox incidents and is establishing a Glovebox CoP for sharing lessons and best practices across the DOE/NNSA Enterprise.

To join the Glovebox CoP, contact Tolani Owusu at Tolani.Owusu@nnsa.doe.gov or 505-667-6830.

Contact information for DOE/NNSA CoPs on other topics and functional areas can be found at: DOE / NNSA Communities of Practice - Home.

REFERENCES

American National Standards Institute, *Standard Guide for Design Criteria for Plutonium Gloveboxes*, ASTM C852/C852M, 2022.

American Glovebox Society, *Guidance for Gloveboxes*, AGS-G001-2007, February 2007

American Glovebox Society, *Standard Practice for Specification of Gloves for Gloveboxes*, AGS-G005-2014, June 2014.

Los Alamos National Laboratory, *Glove Safety Program,* P101-28, R4, November 1, 2018.

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This OE-3 document requires no follow-up report or written response.

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Operating Experience Level 3 (OE 3) Document

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