Installation of Mercury Shutters at LANSCE

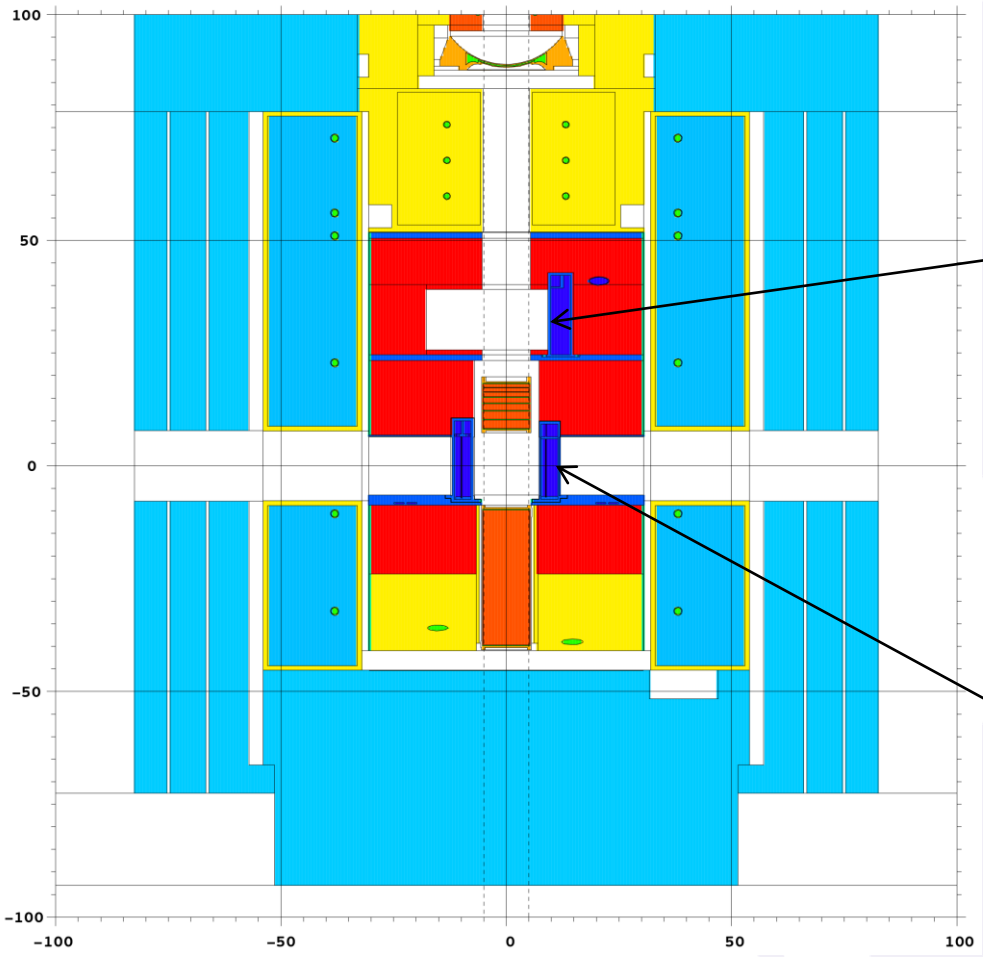
Melvin Borrego
Operations Manager
LANSCE Facility Operations – Experimental Area Operations (LFO-EXP)

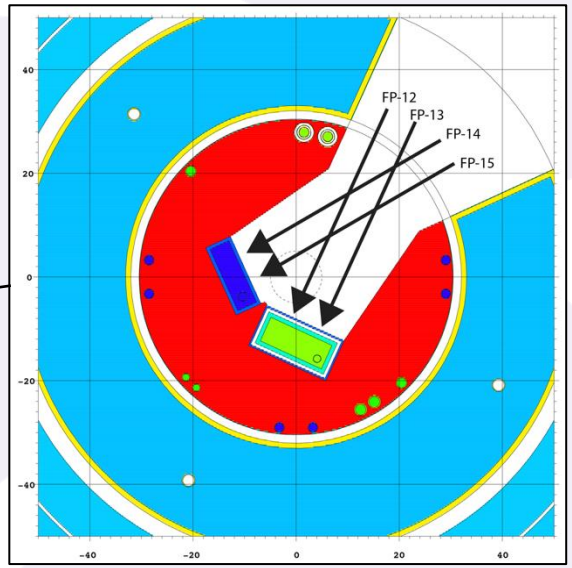
March 16, 2026

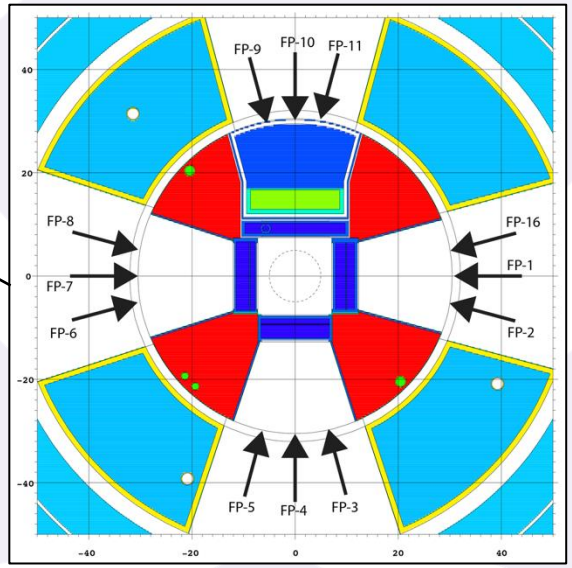
Managed by Triad National Security, LLC, for the U.S. Department of Energy's NNSA.

Why FP-12 and 13 shutter upgrades?

1L TMRS Mark-3



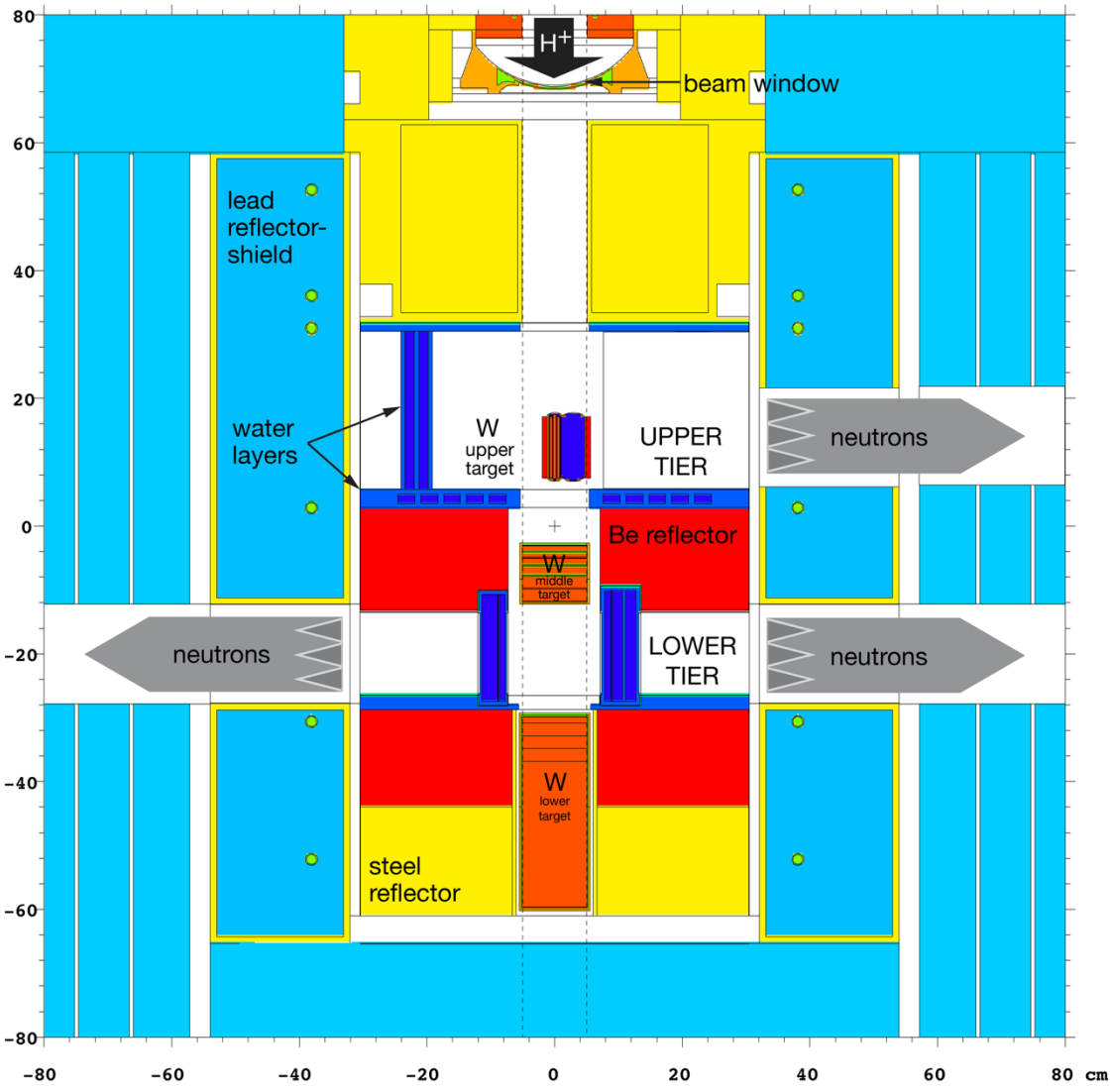


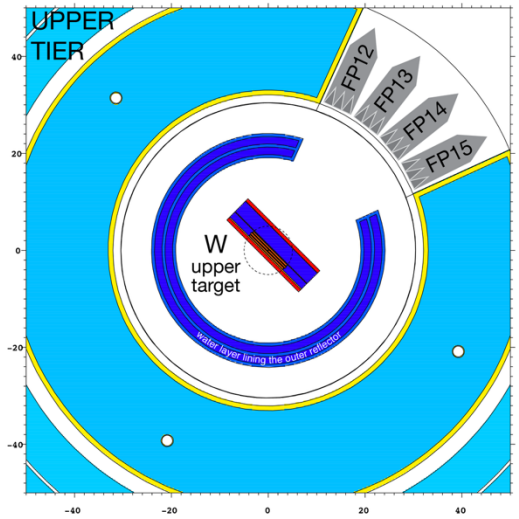


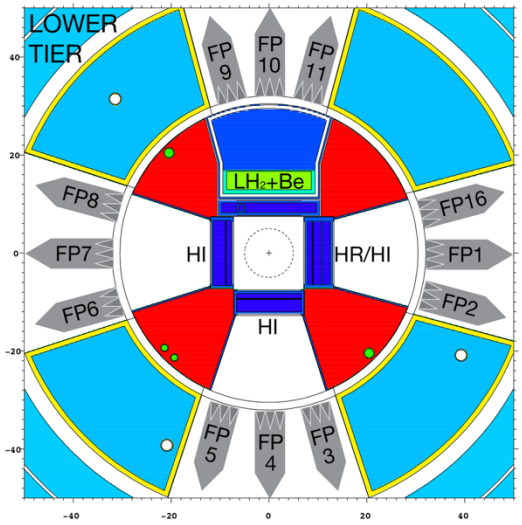
Los Alamos NATIONAL LABORATORY

Why FP-12 and 13 shutter upgrades?

1L TMRS Mark-4







Why FP-12 and 13 shutter upgrades?

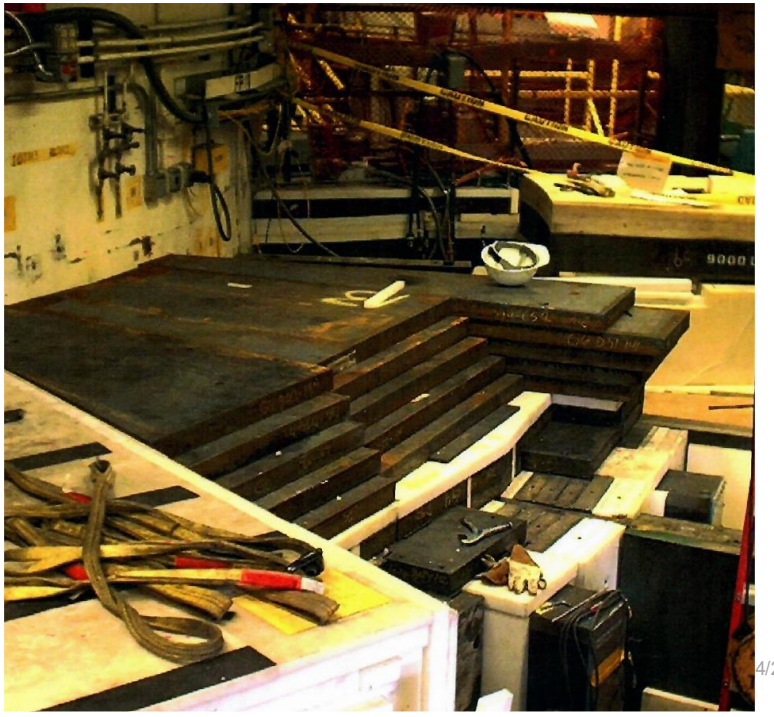
Redesigned upper-tier offers higher fast-neutron flux for FP-12-13

FP-12, 13 Thimble Neutron guide vacuum enclosure

Upgrades on FP-12,13:

- Neutron guide removal and new collimation install
- Lowering dose rate consequences in ER-1 when shutter is closed

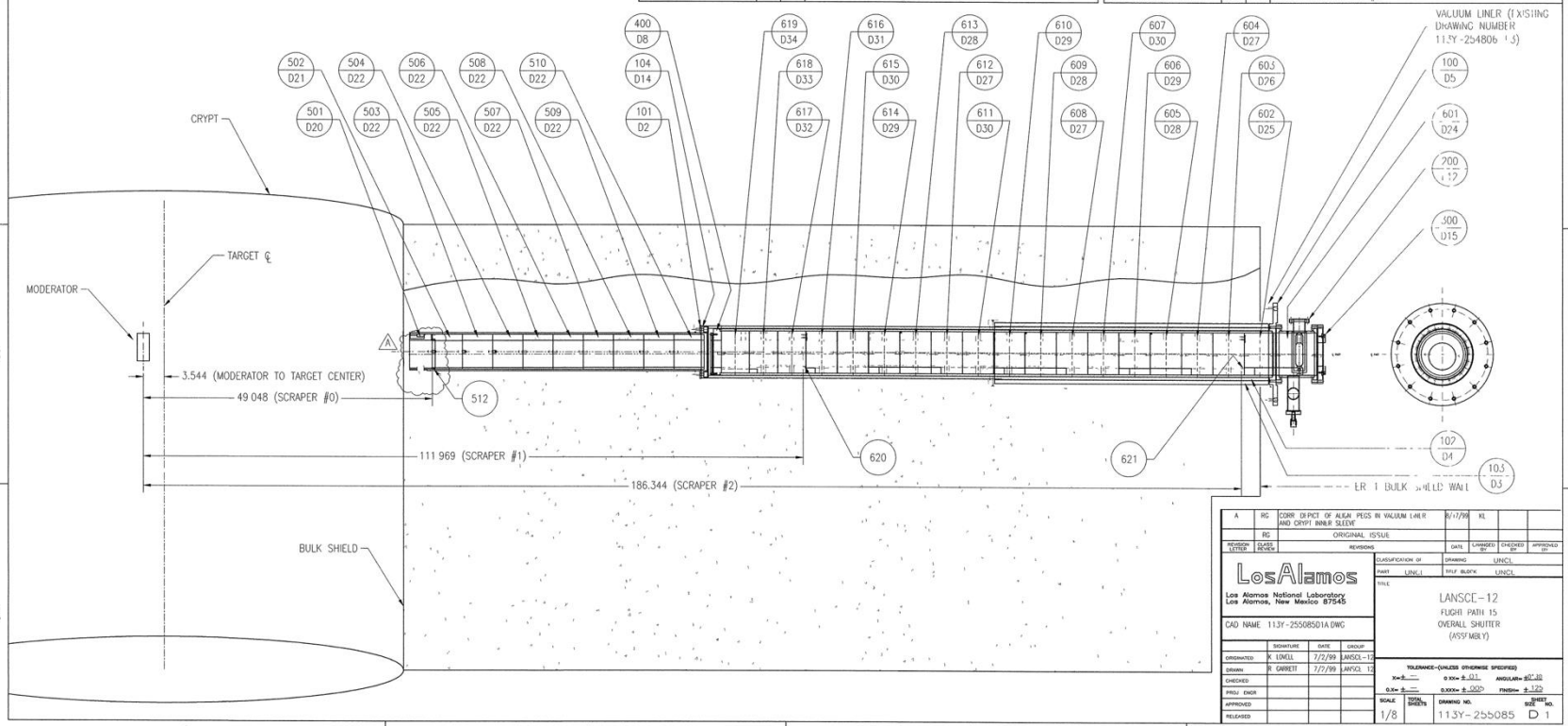
- FP-12 and 13 Mechanical Shutters
- Shielding configuration



PART NUMBER		PARTS LIST	
PREFIX NUMBER	ITEM NUMBER	NUMBER REQD	DESCRIPTION
113Y-255085-D29	610	1	COLLIMATION SLUG #10
113Y-255085-D30	611	1	COLLIMATION SLUG #11
113Y-255085-D27	612	1	COLLIMATION SLUG #12
113Y-255085-D28	613	1	COLLIMATION SLUG #13
113Y-255085-D29	614	1	COLLIMATION SLUG #14
113Y-255085-D30	615	1	COLLIMATION SLUG #15
113Y-255085-D31	616	1	COLLIMATION SLUG #16
113Y-255085-D32	617	1	COLLIMATION SLUG #17
113Y-255085-D33	618	1	COLLIMATION SLUG #18
113Y-255085-D34	619	1	COLLIMATION SLUG #19
SK 01-99-301-A1-1	620	1	COLLIMATION SCRAPER #1
SK 01-99-301-A1-2	621	1	COLLIMATION SCRAPER #2

PART NUMBER		PARTS LIST	
PREFIX NUMBER	ITEM NUMBER	NUMBER REQD	DESCRIPTION
113Y-255085-D22-7	507	1	BRASS FILLER PLUG #7
113Y-255085-D22-8	508	1	BRASS FILLER PLUG #8
113Y-255085-D22-9	509	1	BRASS FILLER PLUG #9
113Y-255085-D22-10	510	1	BRASS FILLER PLUG #10
SK 01-99-301-A1-0	512	1	COLLIMATION SCRAPER #0
113Y-255085-D24	601	1	COLLIMATION SLUG #1
113Y-255085-D25	602	1	COLLIMATION SLUG #2
113Y-255085-D26	603	1	COLLIMATION SLUG #3
113Y-255085-D27	604	1	COLLIMATION SLUG #4
113Y-255085-D28	605	1	COLLIMATION SLUG #5
113Y-255085-D29	606	1	COLLIMATION SLUG #6
113Y-255085-D30	607	1	COLLIMATION SLUG #7
113Y-255085-D27	608	1	COLLIMATION SLUG #8
113Y-255085-D28	609	1	COLLIMATION SLUG #9

PART NUMBER		PARTS LIST	
PREFIX NUMBER	ITEM NUMBER	NUMBER REQD	DESCRIPTION
113Y-255085-D5	100	1	CANISTER WELDMENT
113Y-255085-D2-101	101	1	CRYPT SIDE INNER SLEEVE WELDMENT
113Y-255085-D4-102	102	1	INNER SLEEVE
113Y-255085-D3-101	103	1	OUTER SLEEVE
113Y-255085-D14-101	104	1	WINDOW, CRYPT LINER
113Y-255085-E12	200	1	MERCURY CANISTER END SPOOL WELDMENT
113Y-255085-D15	300	1	CANISTER WINDOW, SAMPLE SIDE SUB ASSEMBLY
113Y-255085-D8	400	1	CANISTER WINDOW, CRYPT SIDE SUB ASSEMBLY
113Y-255085-D20-1	501	1	BRASS FILLER PLUG #1
113Y-255085-D21-2	502	1	BRASS PLUG COLLIMATOR #2
113Y-255085-D22-3	503	1	BRASS FILLER PLUG #3
113Y-255085-D22-4	504	1	BRASS FILLER PLUG #4
113Y-255085-D22-5	505	1	BRASS FILLER PLUG #5
113Y-255085-D22-6	506	1	BRASS FILLER PLUG #6



REVISION LETTER	CLASS REVIEW	REVISIONS	DATE	LAMINATED BY	CHECKED BY	APPROVED BY
A	RG	CORR DEPCT OF ALIGN PEGS IN VACUUM LINER AND CRYPT INNER SLEEVE	6/17/99	KL		
	RG	ORIGINAL ISSUE				

LosAlamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

CAD NAME 113Y-255085D1A.DWG

	SIGNATURE	DATE	GROUP
ORIGINATED	K LOVELL	7/2/99	LANSCE-12
DRAWN	R GARRETT	7/7/99	LANSCE 12
CHECKED			
PROJ ENGR			
APPROVED			
RELEASED			

CLASSIFICATION OF PART: UNCL
DRAWING: UNCL
TITLE BLOCK: UNCL

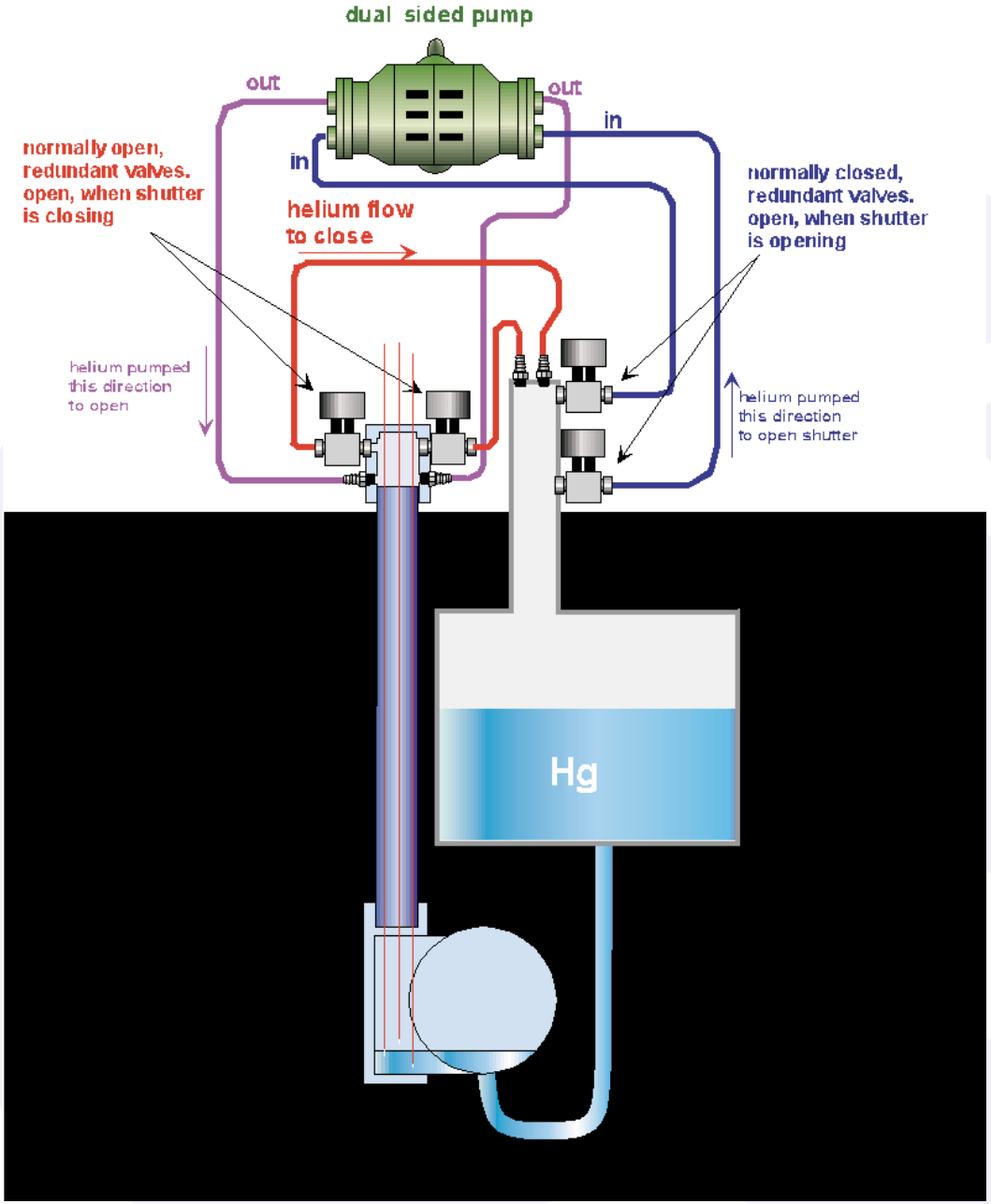
TITLE
LANSCE-12
FLIGHT PATH 15
OVERALL SHUTTER
(ASSEMBLY)

TOLERANCE-(UNLESS OTHERWISE SPECIFIED)
X= ± —
0.XX= ± .01
ANGULAR= ±0° 30'
0.X= ± —
0.XXX= ± .005
FINISH= ± 125

SCALE: 1/8
TOTAL SHEETS:
DRAWING NO.: 113Y-255085
SHEET SIZE NO.: D 1

Mercury shutter

- Closed system
- He gas used to displace mercury
- Stainless steel probes/rods directly detecting mercury level in the shutter tube

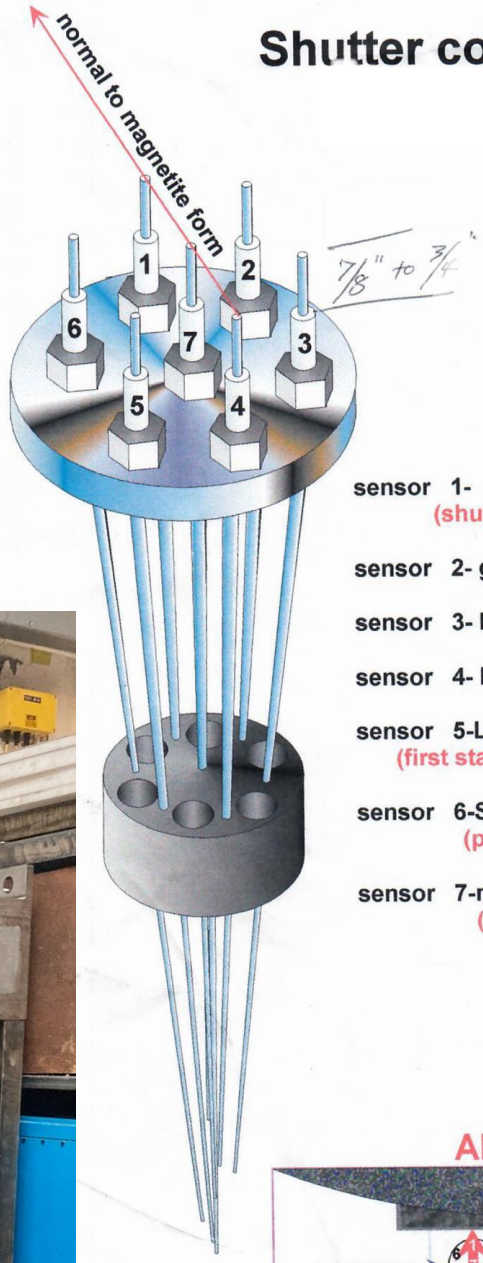



FP11

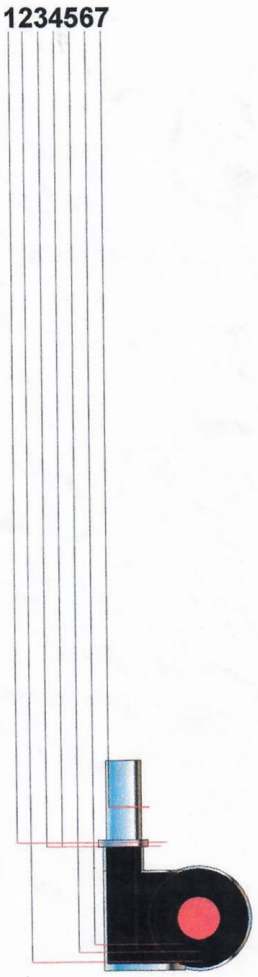

1FP11
SHUTTER OPEN
LIGHTS FLASHING
SHUTTER MOVING
120 208 VOLTS
1FP13
SHUTTER OPEN
LIGHTS FLASHING
SHUTTER MOVING
SHUTTER CLOSED
INSTRUMENT SECURE
ACCESS PROHIBITED
1FP12
SHUTTER OPEN
LIGHTS FLASHING
SHUTTER MOVING
SHUTTER CLOSED


1FP11
SHUTTER OPEN
LIGHTS FLASHING
SHUTTER MOVING

Shutter control sensors



1234567



sensor 1- Hi control (57.5" long)
(shutter closed indicator)

sensor 2- ground (66" long)

sensor 3- RSS (57.75' long)

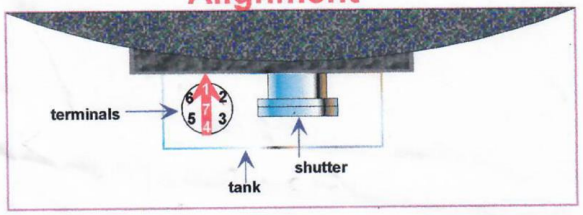
sensor 4- RSS (57.75" long)

sensor 5-Low trigger (65.25" long)
(first stage to open pump relay)

sensor 6-Shutter open (65.75" long)
(pump relay open)

sensor 7-mercury full (55" long)
(shutter full indicator)

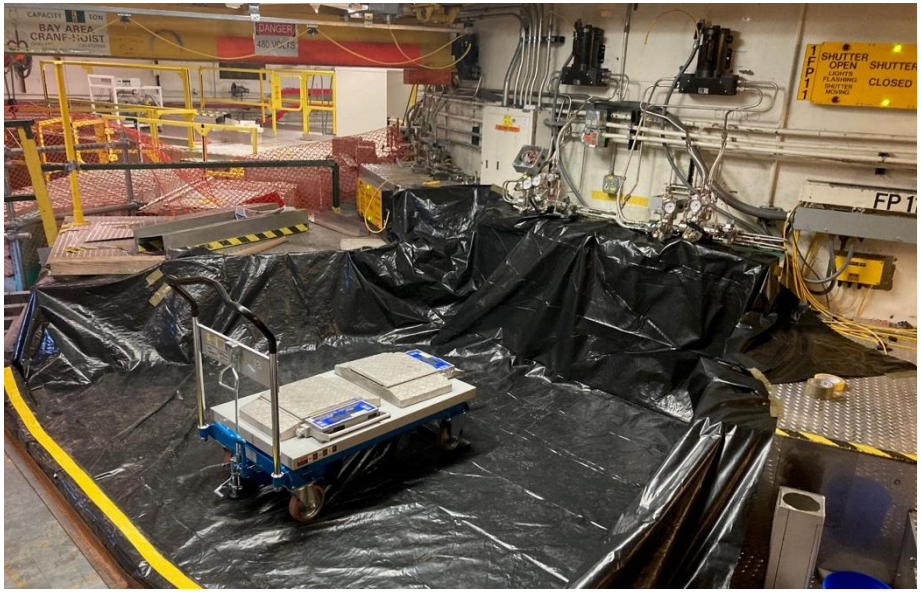
Alignment



Los Alamos
NATIONAL LABORATORY

- Installation of collimation beam pipe and beam pipe stands where the external mechanical shutters were located
- Reinstallation of shielding
- Accelerator Safety Envelope (ASE)
  - minimum layer of shielding installed to ensure mercury is protected by a two-hour rated fire barrier (Shielding or fire blanket) in the event of a postulated fire event.
- Working platform for mercury transfer operations

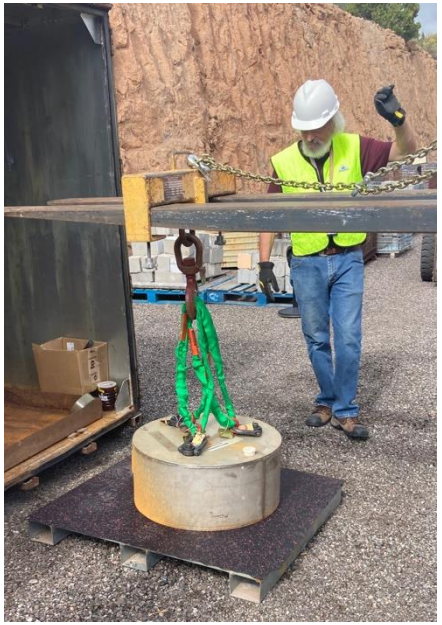

WARNING


BAY AREA
CRANE HOIST
DANGER
SHUTTER
OPEN
CLOSED
FP1

Integrated Work Document

- P-2-044 Filling Newer Style Mercury Shutters Systems
  - Hazard Analysis
  - Procedural Steps
  - Hazards
  - Controls
  - Training
- Dry- Run
- Rehearsal of Concept (ROC)
- Authorized to Perform the Work

Dry Run / Rehearsal of Concept (ROC)



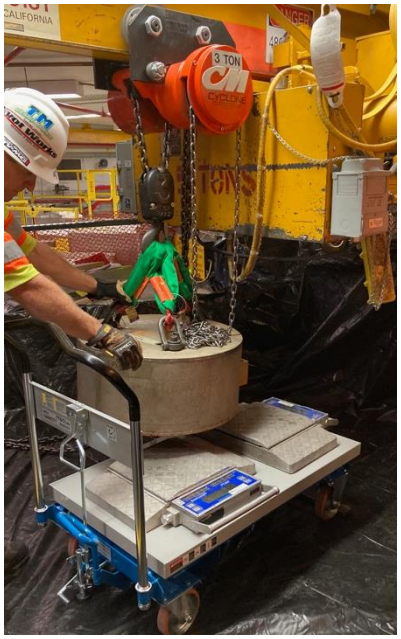


Figure 7: Mercury transfer area in Bone Yard.

Figure 8: Mercury storage reservoir (Pig2).

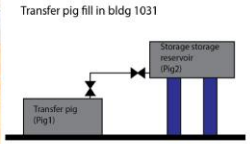


Figure 9: Transfer reservoir fill (Pig1) from the storage reservoir (Pig2).

Procedural Steps

Step 1---Pre-job Brief
Step 2---Staging of Equipment / Work Area Preparation
Step 3---Relocate Mercury Transfer Reservoir "Pig1" from Mercury Storage Area 530-747 in the Bone Yard to ER1
Step 4---Relocate Mercury Transfer Reservoir "Pig1" on top of FP-12 and 13 shielding platform
Step 5---Prepare and add mercury to the shutter system - testing the system
Step 6---Returning shutter system to normal operating conditions
Step 7---Prepare Mercury Transfer Reservoir "Pig1" to be transported out to boneyard
Step 8---Move Mercury Transfer Reservoir "Pig1" to Mercury Transfer area in Bone Yard
Step 9---Mercury Transfer from "Pig2" to "Pig1" in Bone Yard
Step 10---Move Mercury Transfer Reservoir "Pig1" to Mercury Storage Area in the boneyard
Step 11---Bring work area to a safe condition / Post Job cleanup

Step 1: Pre-Job brief

- Check of work area conditions and readiness of workers
- Detailed description/explanation of work activities, steps, hazards and controls
- Clear designation of personnel to particular tasks (including alternates)
- Pause work policy
- Evacuation instruction in case of ER-1/2 evacuation alarm (active oxygen sensors in the area)
- HFM use during the job
- Rest point discussion (High Level Activity Steps)
- Re-emphasizing relevant SCOR principles:
  - Everyone is personally responsible for ensuring safe operations
  - A questioning attitude is cultivated
  - A healthy respect is maintained for what can go wrong

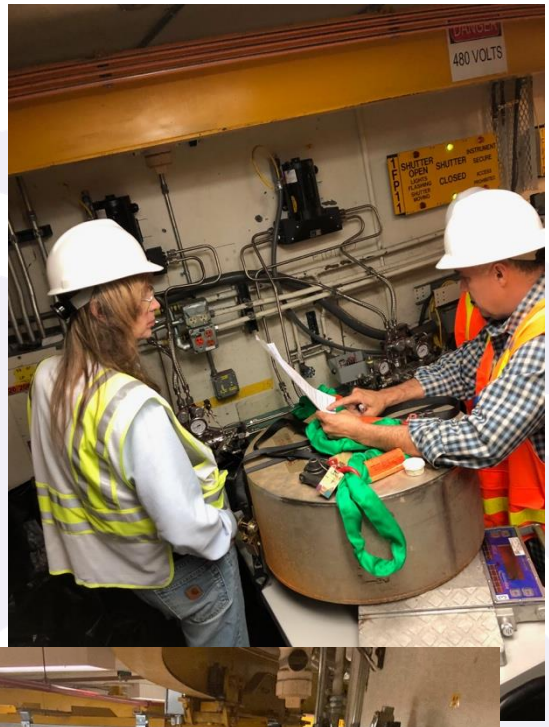
Step 5: Prepare and add mercury to shutter system

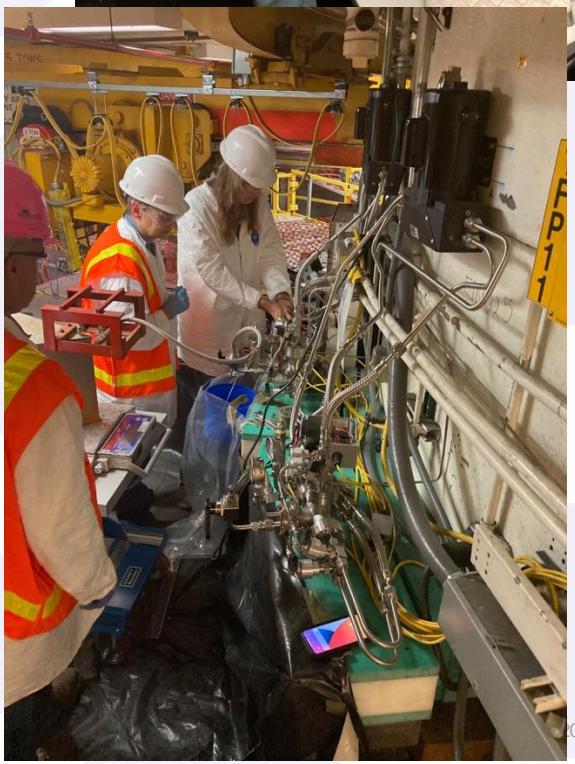
- ☐ **1.** OM lockout on shutter inhibit (configuration control lock)
- ☐ **2.** Notify CCR of mercury shutter operations in progress on the specific flight path being worked on
- ☐ **3.** Don PPE determined by the IH and or PIC (typically safety glasses, Nitrile gloves and lab coat at minimum).
- ☐ **4.** Verify Fill Valve (V1) and Drain Valve (V2) are closed *(Drain Valve (V2) was confirmed closed and capped prior to shielding restacking)*
- ☐ **5.** Connect Vacuum pump (P1) to valve (V3)
- ☐ **6.** Open valve (V3) and evacuate the system to 20inHg as indicated on dial gauge (G1) - once vacuum is established close (V3) – Figure 5.
- ☐ **7.** Ensure valve is closed on Mercury Transfer Reservoir (T1) and remove plug from fill tube - ensure secondary containment is in place prior to removing plug.

Caution: *When disconnecting any fitting from the mercury shutter system or transfer equipment, ensure secondary containment is in place to capture any residual mercury droplets that may be released.*

Note: *At this point Mercury Vapor monitoring of worker Breathing Zones (BZ) and work area will begin and continue until mercury transfer is complete (only trained personnel may perform monitoring) ensure readings are logged in the Mercury Shutter Logbook.*

- ☐ **8.** Secure secondary containment (plastic bag) around valve (V1) - Connect fill tube to valve (V1)
- ☐ **9.** Slowly open valve (V1) and then slowly open Valve (T1) and observe mercury flow into the system. Mercury flow into the system will be observed by:
  a) Platform scale decreasing in weight
  b) Listening for mercury splashing in the Shutter reservoir





Step 5: Prepare and add mercury to shutter system

c) Reading of the probes (1-7) with Multi-meter as mercury is filling the shutter **(See attached Shutter Control Sensor Diagram in Figure 6)**

Note: If vacuum is lost and desired mercury level is not achieved, "STOP" – Close V1 and T1 and begin to evacuate the shutter to 20inHg with the vacuum pump designated for mercury work Step 5 – item 5-6. Close V3 when vacuum pressure has been achieved and continue with the mercury fill Step 5 - item 9.

☐ **10.** When desired mercury level is achieved (Mercury contact on Probe 7 indicating Shutter Full - **Closed)** Close valve (V1) and then close valve (T1)

☐ **11.** Pressurize the system to 3psi with Helium UHP gas.

a) Attach He transfer line to (V3) *(ensuring to purge transfer line prior to fill)*

b) Pressurize system to 3psi with Helium UHP

c) Once He pressure is achieved as indicated on Pressure/Vacuum gauge (G1) Close (V3)

☐ **12.** OM unlock shutter inhibit

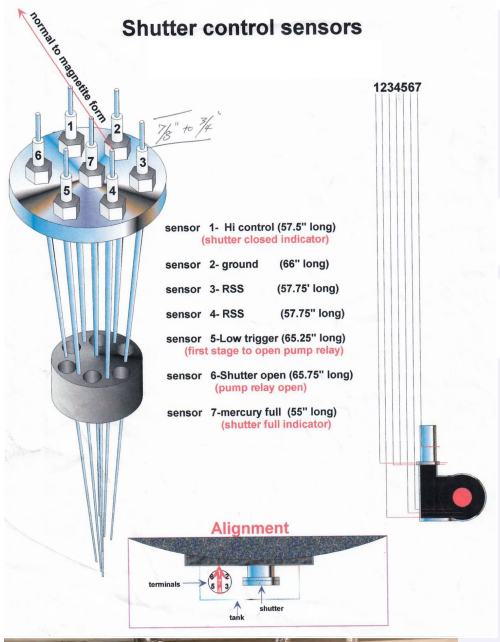
☐ **13**. Attempt to cycle the shutter verifying shutter open and shutter closed positions are achieved. Protective systems will be bypassing the EPACS at the shutter control panel in ER2 in order to cycle the shutter open and closed. This will be communicated via two-way radio

Note: (If shutter open position is not met "STOP" – attempt to Close shutter. OM Lockout shutter inhibit and reassess.

Attach vent filter to (V3) and open Valve to vent the system. Once vented, proceed to Step 5 – item 5-6. Close V3 when vacuum pressure has been achieved and continue with the mercury fill Step5 – item 9 until mercury contact on Probe 7 indicating shutter full – Shutter Closed).

Once testing is complete and RSS makeup is satisfied, Mercury filling operations is complete

☐ 14. OM lockout shutter inhibit (configuration control lock)



High-Level Activity Steps

Rest points

- High-level steps offer natural break/rest points for workers
- Before starting step #5 (prepare and add mercury to the shutter system)
  - If the mercury transfer does not start by 10:30 take lunch break and regroup at 13:00
  - Rest point after initial mercury fill and continue on testing work evolution after lunch
  - If the mercury transfer does not start by 15:00, secure the work area and continue the following day
- Before starting step #8 (move ”Pig1” to mercury transfer area)
  - If the move does not start by 16:00, secure the work area in ER-1 and continue the following day
- Before starting step #9 (transfer from “Pig2” and ”Pig1”)
  - If the transfer does not start by 15:00, secure the work area in 53-1031 and continue the following day
- Pre-Job brief conducted at least daily, briefing workers on the steps in work evolution for that day

Final Shielding configuration

Final Shutter Helium Manifold

Los Alamos NATIONAL LABORATORY

Summary

- Understanding requirements for “High Hazard” work
- Well documented Integrated Work Document (IWD) and Procedural Steps
- Conduct Dry-Run and Rehearsal of Concept (ROC)

Overall this allowed our seasoned and newer workforce to build on past experiences, sustaining our safety culture at LANSCE, setting High standards, and develop a skilled workforce for safe, efficient, and mission-ready operations for years to come