

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	G
		Effective:	2/6/2008
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*Approval signatures on file with master copy.

[Revision Log](#)

Test Reason:	Test Result:	<input type="checkbox"/> Passed	<input type="checkbox"/> Failed
	Test Type:	<input type="checkbox"/> Full	<input type="checkbox"/> Partial
Test Date:	Start Time:	Finish Time:	
Tester 1:	Assistant 1:		
Tester 2:	Assistant 2:		

PREPARATION:

- Inform Control Room Operator that a VUV Interlock test will be done. _____
 - LOTO the LINAC Gun and the Low Level RF as per, "[LINAC LOTO](#)", LS-ESH-0012. _____
 - OR _____
 - LOTO VUV injection shutter, if X-Ray injection is needed. Refer to "[VUV Injection Shutter LOTO](#)", LS-ESH-0010. _____
 - Verify VUV main power supplies, VUV RF, and LINAC modulators are in a ready state where they can be turned ON. _____
 - Refer to the [Appendix](#) for photos and diagrams that can be used as guidance in the course of the test. _____
1. **Search Sequence:** Search the VUV ring with one person remaining inside at the security control rack. The person outside times the audible alarm. _____
- Audible alarm sounds for at least 30 seconds _____ sec.

The person inside watches the VUV ring Secure 'A' indicator. _____

The indicator lights after the warning sound is complete _____

The "Area Interlocked" indicator in the control room is on. _____

The five beacons surrounding the VUV ring are flashing. _____

2. Open the entry gate. _____
- Observe the Ring Secure 'A' & 'B' indicators go out _____
- The indicator on CS-E goes out _____
- The five beacons surrounding the ring go out. _____
- The Area Secured light in the control room is out. _____
- An alarm is reported to the control room alarm panel/micro. _____

Close the gate. _____

3. Press CS-E (Check station at exit). _____
- Pilot on CS-E does not come on _____
- The ring interlock does not activate _____

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4. Press CS-2, CS-3, CS-4 and CS-E.
 Neither pilot light stays on _____
 Open the gate and then close the gate. _____
 Press in order CS-4, CS-3, CS-2, CS-1 & CS-E _____
 Interlock does not activate. _____
 Open the gate and then close the gate. _____
5. Press CS-1 and start timing,
 The check station pilot lights turn off in ≤ 2 min. _____ min.
 Press in order CS-2, CS-3, CS-4, and CS-E _____
 Pilot on CS-E does not come on _____
 Ring interlock does not activate. _____
6. **Emergency Stops:**
 Test the following emergency stop switches one at a time below.
ES1 - Emergency Stop on VUV security rack
ES2 - Emergency Stop on VUV mezzanine
ES3 - Emergency Stop on VUV wall (near U11)
ES4 - Emergency Stop in control room. Note: ES4 will drop security in LINAC/Booster and VUV ring.
- | | <u>ES 1</u> | <u>ES2</u> | <u>ES3</u> | <u>ES4</u> |
|--|-------------|------------|------------|------------|
| Press an emergency stop. | | | | |
| ES pilot 'A' in security rack goes out | _____ | _____ | _____ | _____ |
| ES pilot 'B' in security rack goes out | _____ | _____ | _____ | _____ |
| Emergency Stop Latch 'A' indicator goes out | _____ | _____ | _____ | _____ |
| Emergency Stop Latch 'B' indicator goes out | _____ | _____ | _____ | _____ |
| Reset emergency stop | | | | |
| ES pilot 'A' in security rack come ON | _____ | _____ | _____ | _____ |
| ES pilot 'B' in security rack come ON | _____ | _____ | _____ | _____ |
| Emergency Stop Latch 'A' indicator remains out | _____ | _____ | _____ | _____ |
| Emergency Stop Latch 'B' indicator remains out | _____ | _____ | _____ | _____ |
| Press the reset switch on the security rack | | | | |
| Emergency Stop Latch 'A' indicator comes ON. | _____ | _____ | _____ | _____ |
| Emergency Stop Latch 'B' indicator comes ON. | _____ | _____ | _____ | _____ |

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7. **Injection Shutter:** Secure VUV ring, with someone inside. Turn on Dipole at injection level.
 - Dipole Current in Range indicator comes ON in the control room and at SR9. _____
 - Request Operator to activate command for "Injection ON" on the Ramp Control Computer page. _____
 - Enable Ready Indicator is ON _____
 - Injection Shutter Disable Button Indicator is ON _____
 - Request operator to open VUV injection shutter _____
 - Injection Shutter Open indicator in ON _____
 - Injection Shutter Enable Button Indicator is ON _____

8. Listen to and time injection audible alarm.
 - Alarm sounds for at least 3 - 5 seconds _____ sec.
 - And repeats every 10 - 13 seconds _____ sec.
 - The IR4 rotating beacon is on. _____

9. Attempt to Enable the Master Shutters for the VUV ring
 - Observe that the shutters do not enable. _____

10. **Lockout Switch:** Turn off Lockout switch in security rack.
 - Injection Shutter Open light in control room goes out. _____
 - Injection Shutter Closed light in control room comes ON. _____
 - The Injection Shutter Closed indicator on SR9 is ON. _____
 - Dipole Current in Range indicator is OFF in the control room and at SR9. _____
 - Area Interlock indicator is OFF in control room _____
 - With the lockout switch in the off position, attempt to secure the VUV ring. _____
 - Observe the ring does not secure. _____

Rotate the Lockout switch to the ON position.

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11. **Dipole Current in Range:** Turn ON modulators where the H.V. is ON and the MODs are pulsing.

Secure the VUV ring and the LINAC Booster. Have a person posted at the modulators to observe the status of the A & B chains.

Turn on Dipole and set to injection level. Open the Injection shutter.

Adjust the A limit of the dipole current sensor to 2 digits greater than the present setting.

'A' Chain Set point	
Orig.	New

The injection shutter closes.

The Dipole Current in Range light goes out.

The modulators Chain A drops out momentarily until the injection shutter closes.

Return the A limit switch to its original setting.

'B' Chain Set point	
Orig.	New

12. Open the Injection shutter. Adjust the B limit of the dipole current sensor to ~ 2 digits greater than the present setting.

Modulator Chain 'B' drops-out.

Return the B limit switch to its original setting and Reset Modulators.

13. With dipole current in range and other injection conditions satisfied, open the VUV injection shutter. Note nominal injection energy for VUV.

Nominal injection energy _____ MeV

Reduce dipole energy until injection shutter closes. Note dropout energy is not more than 5% below nominal injection energy (e.g. about 40 MeV for 800 MeV injection level)

Injection shutter "OPEN" light is out, and "CLOSE" light is ON _____ MeV

VUV ring energy (more than 95% of nominal) _____ MeV

Return dipole setting back to normal injection level.

14. **Beamline Shutter Test:** Open the Injection shutter.

U1 Safety Shutter Closed indicator in C.R. is ON _____

Manually activate the air solenoid for the U1 safety shutter. _____

Observe the injection shutter closes. _____

The modulators Chain A drops out momentarily until the injection shutter closes. _____

U1 Safety Shutter Closed indicator in C.R. is OFF _____

Reset RIB at U1

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15. Open injection shutter. Manually activate each safety shutter listed and verify that the injection shutter closes:

U7

U13

U15

U16

16. **Entry Gate:** Open the injection shutter. Open the VUV gate.

Observe the injection shutter closes.

Modulators A and B chains momentarily drop out until the injection shutter closes.

An audible warning sounds in the VUV for 5 seconds when the gate is opened.

VUV Security Alarm sounds in Control Room

VUV Interlock drops out

Re-secure the VUV ring.

17. Switch to Access Mode with the control room switch. Press Entry Permit button in control room.

Lock releases on gate and sign changes to green.

Open the gate.

VUV interlock does not dump.

Close gate, release permit button.

Gate is locked

Open gate by releasing lock on inside of gate.

VUV interlock dumps

18. Re-secure the VUV ring. While in Access Mode, DIPOLE ON and injection shutter enable state (i.e. dipole current in range) attempt to open the injection shutter.

The VUV injection shutter does not open.

Turn Modulators ON.

Open the injection shutter using the VUV Injection Shutter Test cable designed for that purpose.

Observe that the modulator A chain drops out while the injection shutter is open.

Disconnect the VUV Injection Shutter Test Cable and reconnect the interlock cable to the shutter solenoid.

19. Switch from Access mode to Normal

Observe an audible warning sounds in the VUV area for 10 to 15 seconds

Turn Dipole PS OFF

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20. **Interlock OFF:** Break security using the Interlock Off button on Mezzanine.
 Observe that there is no audible warning in the VUV ring. _____
- Pilot Light on CSE goes out _____
- VUV interlock drops out _____
- Search VUV ring
- Break security using the Interlock Off button on VUV Security Rack.
 Observe that there is no audible warning in the VUV ring. _____
- Pilot Light on CSE goes out _____
- VUV interlock drops out _____
21. **Gate Entrance Switches:** Place holders on gate switches A and B and then secure the VUV ring. Have a person posted at the modulators to observe the status of the A & B chains.

Insert the Test Keys in the NSLS Power Supply Interface Boxes on the VUV Dipole, Quadrupole, and Sextupole power supplies and switch to Interlock Test mode.

Turn ON all main VUV power supplies and VUV kickers **BUIFB1, BUIFB2, & BUIFB3. Open the injection shutter. Open LEBT Valve.**

Note: The gun trigger must be ON for the kicker supplies to come on.

Record the original setting and then adjust the A limit of the dipole current sensor to "zero".

'A' Chain Set point	
Orig.	New
	0

Record the original setting and then adjust the B limit of the dipole current sensor to "zero".

'B' Chain Set point	
Orig.	New
	0

CAUTION:
One person must stand guard at the ring gate entrance. Only Interlock Test and support personnel may enter the ring as approved by the Lead Tester or designee.

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23. Turn ON all main VUV power supplies and VUV kickers **BUIFB1, BUIFB2, & BUIFB3**.
Open the injection shutter.
Open LEBT Valve.

Remove the **A switch** holder.
Observe the following:

The modulators 'A' chain drops out momentarily
until the injection shutter closes.

The 'A' Chain trips first

The SR9 VUV Ring Secure 'A' indicator is OFF.

The SR9 VUV Ring Secure 'B' indicator remains
ON.

VUV Injection Shutter closes

VUV dipole trips OFF

VUV dipole "A chain" indicator is OFF

Q1/Q2 trips OFF

Q1/Q2 "A chain" indicator is OFF

Q3 trips OFF

Q3 "A chain" indicator is OFF

Q4/Q5/Q6/Q7 trips OFF

Q4/Q5/Q6/Q7 "A chain" indicator is OFF

USXD and USXF trips OFF

USXD and USXF "A chain" indicator is OFF

BUIFB1 turns OFF

BUIFB2 turns OFF

BUIFB3 turns OFF

LEBT Valve Closes and then reopens

Command all power supplies OFF

Replace the holder on the Gate door switch A.

Return the A and B limit switch to its original setting.

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24. **Power Supply Status Indicators**

Assure VUV Ring is secured.
 Turn each PS indicated below ON one at a time and verify the conditions listed exist.
 When completed Turn off the PS and move to the next PS listed. Repeat test until all supplies are tested.

Power Supply:

- VUV Dipole
- VUV Quadrupoles 1 & 2
- VUV Quadrupole 3
- VUV Quadrupole 4 - 7
- VUV Sextupole Focusing (USF)/ Sextupole Defocusing (USD)

PWR Supply ON			PWR Supply OFF		
PWR Supply Display Panel "PS ON"			PWR Supply Display Panel "PS OFF"		
Red light is ON	PS is ON	"ALL MAIN Magnet Power Supplies OFF" Sign is OFF	Green light is ON	PS is OFF	"ALL MAIN Magnet Power Supplies OFF" Sign is ON
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

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25. **PLC Watchdog:**

Secure VUV Ring. Turn On Modulators, Dipole, Sextupole, and Quadrupole supplies.
 Open Injection Shutter.
 Press Watchdog test button in SR9 (for ~ 3 sec.).

- Watchdog ok indicator Turns OFF _____
- Dipole turns off and "A chain" indicator is OFF _____
- Q1 & Q2 turn off and "A chain" indicator is OFF _____
- Q3 turns off and "A chain" indicator is OFF _____
- Q4, Q5, Q6. & Q7 turn off and "A chain" indicator is OFF _____
- Sextupole turns off and "A chain" indicator is OFF _____
- Modulator Turns OFF on "A an B-Chain" _____
- Modulator "A-chain" trips first _____

Request for Machine Operator to command all power supplies OFF

Press Watchdog reset in SR9.

Watchdog ok indicator is ON _____

Remove all Test Keys from the NSLS Power Supply Interface Boxes on the Dipole, Quadrupole, and Sextupole power supplies.

26. **RF:**

Secure the VUV Ring.

Turn ON RF Systems 1 & 2. Monitor the cavity field. Pull Switch A holder.

RF1 **RF2**

Observe that RF1 goes OFF for a minimum of 75 ms and RF2 goes OFF for a minimum of 10 ms. _____

27. Press the Interlock Off button. Remove the switch holders and check that each switch "clicks" when making contact with the gate upon closing. _____

Search ring.

28. **Magnet Test Key:** Remove the "Magnet Test Mode key" from SR9

The Magnet Test Mode indicators change from Normal to Test. _____

Attempt to secure the VUV ring

Observe that the ring does not secure. _____

The five beacons that surround the ring are on and flashing. _____

The Do Not Enter sign at the gate is on. _____

Replace the "Magnet Test Mode Key" and turn to normal position. _____

29. In control room, set shutter command to "close" and return access switch to normal. _____

Remove red tag from either the LINAC Gun and low level RF. _____

Inform the control room operator that test is complete and request an entry in operations shift log. _____

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Appendix: Photos and Diagrams



Figure 1: Injection Control Panel (located at Operator's Console)

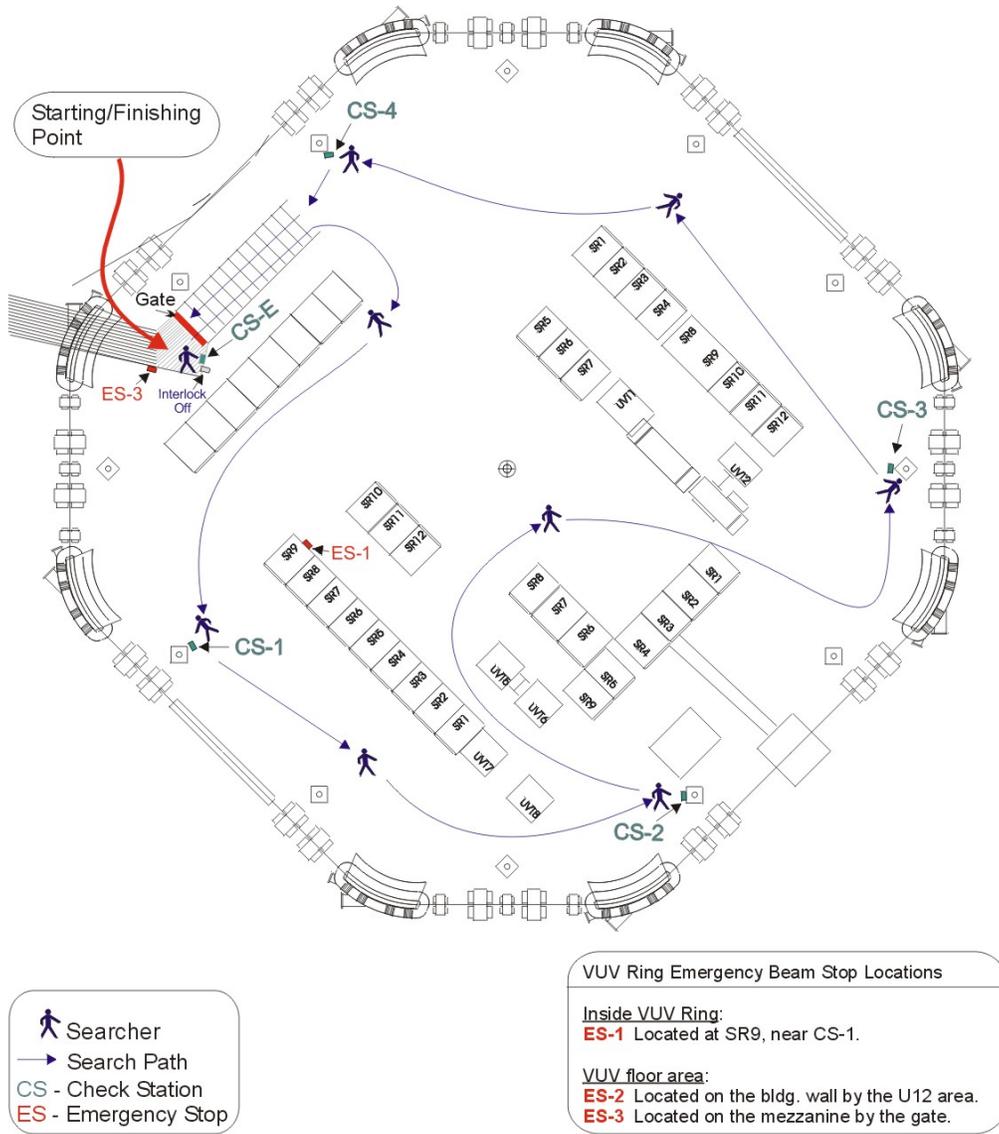


Figure 2: VUV Ring Layout

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Figure 3: Power Supply Read back Displays



Figure 5: VUV SR9 (partial view)



Figure 6: VUV SR9 (full view)



Figure 7: Power Supply Interface box

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