

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 1 of 13

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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.

- Post the "Caution - Do Not Enter" Barrier Tape inside the VUV Ring. _____
- 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 _____

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 2 of 13

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.	_____	_____	_____	_____

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 3 of 13

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

And repeats every 10 - 13 seconds

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.

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 4 of 13

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

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 (if applicable)

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 5 of 13

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. _____ sec.
 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. Turn Entry Permit Switch 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 _____ sec.

Turn Dipole PS OFF

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 6 of 13

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. **CAUTION:**
One person must stand guard at the ring gate entrance and/or place a Caution – DO NOT ENTER Barrier Tape across entrance.

Only Interlock Test and support personnel may enter the ring as approved by the Lead Tester or designee.

22. **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

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 7 of 13

23. Remove the **B switch** holder.
Observe the following:

The modulators 'B' chain drops out momentarily
until the injection shutter closes.
The SR9 VUV Ring Secure 'A' indicator stays ON.
The SR9 VUV Ring Secure 'B' indicator is OFF
VUV Injection Shutter closes

VUV dipole trips OFF

VUV dipole "B chain" indicator is OFF

Q1/Q2 trips OFF

Q1/Q2 "B chain" indicator is OFF

Q3 trips OFF

Q3 "B chain" indicator is OFF

Q4/Q5/Q6/Q7 trips OFF

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

USXD and USXF trips OFF

USXD and USXF "B chain" indicator is OFF

BUIFB1 remains ON

BUIFB2 remains ON

BUIFB3 remains ON

LEBT Valve Closes

Command all power supplies OFF

Replace the holder on the Gate door switch #2.

Use the B Test key (F-300) to reset the B chain

Observe the B secure light is on.

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 8 of 13

24. 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.

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 9 of 13

25. **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.

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
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Power Supply:

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

26. **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.

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 10 of 13

27. **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. _____
28. 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.
29. **Magnet Test Key:** Remove the "Magnet Test Mode key" from SR9
 The Magnet Test Mode indicators change from Normal to Test.
 VUV Ring Security drops out
 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. _____
30. _____
 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. _____
 Remove the Caution barrier tape from the VUV ring entrance, if applicable. _____

* * *

Appendix: Photos and Diagrams



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

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 11 of 13

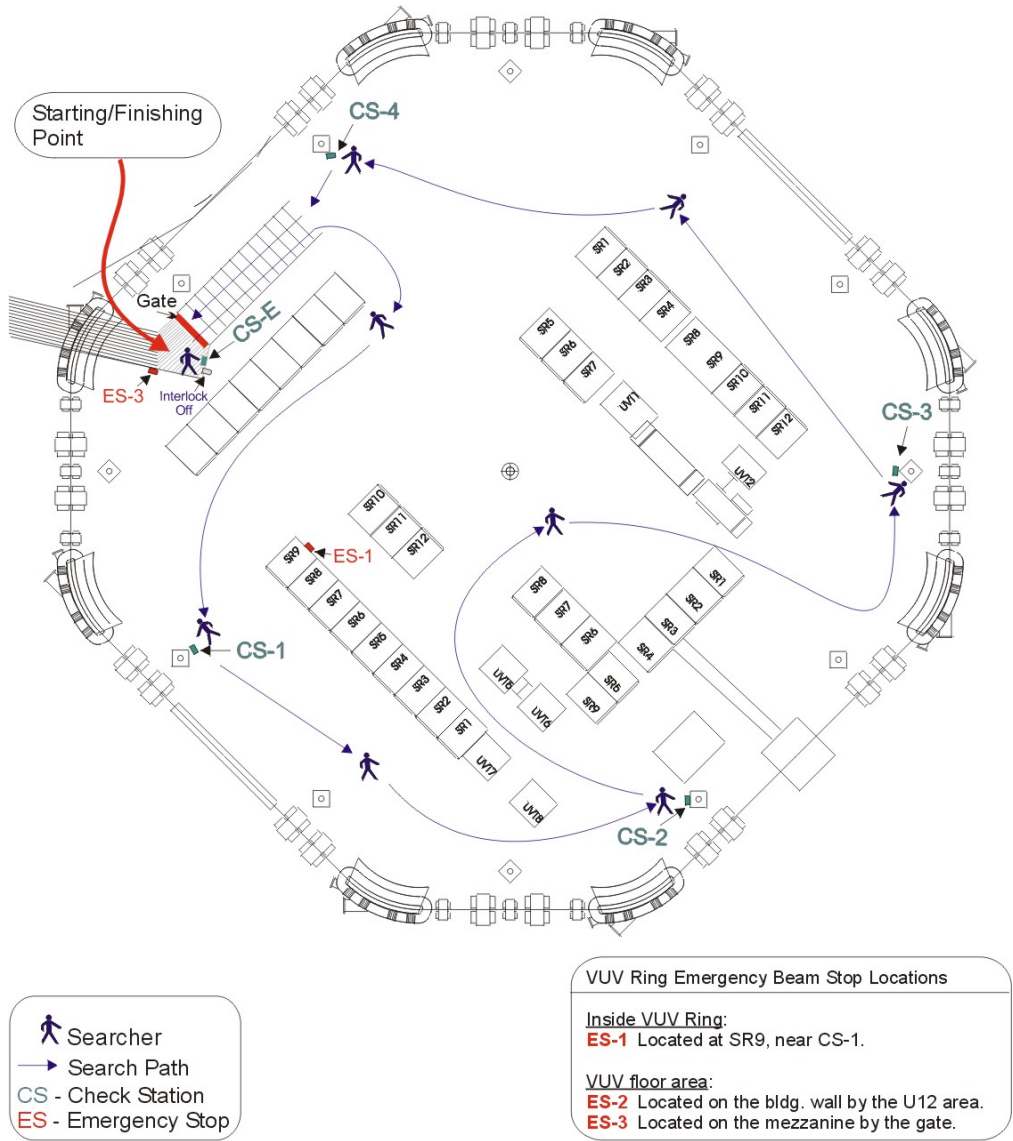


Figure 2: VUV Ring Layout

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 12 of 13

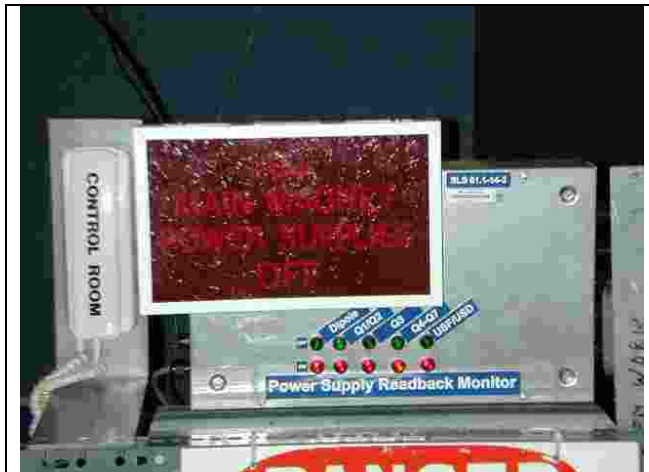


Figure 3: Power Supply Read back Displays



Figure 5: VUV SR9 (partial view)



Figure 6: VUV SR9 (full view)



Figure 7: Power Supply Interface box



Figure 8: VUV Ring Access Control Panel

Subject:	VUV Ring Radiological Interlock Test		
Number:	LS-PPS-0022	Revision:	H
		Effective:	1/5/2009
			Page 13 of 13

Document Review Frequency

3 Years

Review signatures on file
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NSLS REVISION LOG

Document Number:	LS-PPS-0022	
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Rev	Description	Date
B	Document formalized and structure revised for legibility and ease to complete test.	5/10/02
C	<ol style="list-style-type: none"> 1. Changed response from "2 min" to "≤ 2 min." in step 5. 2. Added response step for verification of shutter open light in Control room and added action step "Listen to and time injection audible alarm" in step 8. 3. Moved the action to turn ON the VUV Power supplies before the opening of the injection shutter. 4. Changed the trip response time from 15 ms to 10 ms in step 22. 	7/11/03
D	<ol style="list-style-type: none"> 1. Referenced LOTO procedure in preparation section. 2. Changed step 1 response to 30 second audible to meet lab requirement. 3. Added "Turn on Dipole at injection level" in step 8 for clarity. 4. Removed "momentarily until injection shutter closes" in step 12 – not applicable. 5. Added new test step 15 to capture the testing of individual safety shutters. 6. Added "VUV Interlock drops out" in step 16. 	7/28/05
E	<ol style="list-style-type: none"> 1. Added illustrations of Control Room Injection Panel and VUV Ring layout. 2. Step 7 (lockout switch) combined with step 10. 3. Numerous steps changed to reflect the new control room injection shutter features. 4. Dipole Current in Range test procedure changed to be more precise and to be consistent with method used for X-ray Tunnel interlock test. 	1/10/06
F	<ul style="list-style-type: none"> • Steps 21-24 changed to include new A & B chain indicator boxes as well as PLC watchdog. 	5/21/07
G	<ul style="list-style-type: none"> • Added a reference to photos in Appendix, revised wording for applying LOTO to LINAC. • Added a step test power supply indicators. • Added guidance text throughout the document for the tester. • Added updated and new photos of interlock components for reference. 	2/6/2008
H	<ul style="list-style-type: none"> • Added more guidance for tester. • Added the use of "Caution – DO Not Enter" Barrier tape in steps 21 and preparation section. 	1/5/2009

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