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Brookhaven National Laboratory/National Synchrotron Light Source			
Subject:	SDL Radiological Interlock Test		
Number:	LS-PPS-0014	Revision:	E
		Effective:	8/5/05
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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:

- I. Inform the LINAC operator that the interlock test will be conducted. _____
- II. Verify that the LINAC is in a condition to run. _____
- III. Request a qualified worker to assist in verifying a zero energy state on the applicable modulator equipment. The Interlock tester must then apply LOTO to all modulators. _____

Note: When breaking security for the LINAC area using the switch holders, it is necessary to remove the holder from SW 'A' each time to reset the door guard circuit and LED.

1. Do a complete search of the Gun Hutch. (Radiation interlock - not laser interlock.)
 - The Gun Secure A indicator comes on. (located on logic box) _____
 - The Gun Secure B indicator comes on. _____
 - The Gun Hutch Radiation Interlock sign comes on. _____
 - Gun Doors OK indicator is on. _____
 - The audible alarm sounds for a minimum of 30 seconds. ____ sec. _____

2. Open a door on the Gun Hutch.
 - The Gun Secure A indicator goes out. _____
 - The Gun Secure B indicator goes out. _____
 - The Gun Hutch Radiation Interlock sign goes out. _____
 - Gun Doors OK indicator goes out. _____

3. Do a complete search of the Gun Hutch, press CS-1 close the door and press CS-E.
 - Observe the gun hutch "Interlocked" sign comes on, _____
 - Open a hutch door then close the door, press the Gun CS-E.
 - The gun hutch interlock sign does not come on again _____
 - The Gun Secure A light does not come ON. _____
 - The Gun Secure B light comes ON. _____

Note: This step must be performed within the timeout period.

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4. Place switch holders on Radiation interlock switches for one of the gun Hutch doors.
Search the Gun Hutch.

The strobe light inside the enclosure comes on when CS-1 is pressed.

Observe that the Gun Secure A and Gun Secure B lights illuminate at the control rack, logic box, and the operator console.

The Gun Secure A light comes ON

The Gun Secure B light comes ON

CR	LB	OC
_____	_____	_____
_____	_____	_____

Break gun hutch security.

5. Press the gun CS-1 and begin timing.

The CS-1 light goes out after no more than 20 seconds. _____ sec. _____

Press the Gun CS-E

Gun Secure A light does not come ON

Gun Secure B light comes ON

Gun Doors light comes ON

6. Place holders on the (8) door switches. Search the gun hutch.

Verify the Gun Secure B light at the operator's console and control rack comes ON.

Gun Secure B light at the logic box comes ON.

_____	_____
_____	_____

(Note: Press Gun CSE to reset Gun B)

Remove a holder from a switch B. Repeat for all switches.

Gun Secure B light goes out at logic box

Gun Secure B light at the operator's console and control rack goes Out

The Strobe light remains on.

The Gun Secure A light remains on.

Replace the holder on switch B

Gun Secure B light does not come ON

Press CS-E

Gun Secure B comes ON

DOOR			
1	2	3	4
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

7. Remove a holder from a switch A. Repeat for all switches.

The Gun Secure A light goes out.

The Strobe light goes out.

The Gun Secure B light remains on.

Gun Hutch Interlock sign goes Out

The Gun Secure A light at the operator console goes out.

Gun Secure A light at the control rack goes out.

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

Search and repeat for remaining door switches

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8. Remove all switch holders and close the doors one at a time, listen for the distinct 'click' that each switch makes. _____

9. Secure the Gun Hutch
 The Gun Secure A indicator lights. _____
 The Gun Secure B indicator lights. _____
 Transfer the gun hutch Kirk keys to the key tree transfer.

10. Secure LINAC area.
 The Interlocked indicator comes on. _____
 The LIB indicator comes on. _____
 The Kirk Keys Secured indicator comes on. _____
 The red Doors indicator is out. _____
 The LINAC Warning Beacons Bank 1 indicator is on _____
 The LINAC Warning Beacons Bank 2 indicator is on _____
 13 warning signs come on outside the LINAC area.
 _____ _____
 The Two (2) "Interlocked" signs are illuminated. _____
 The audible alarm sounds for a minimum of 30 seconds. ____ sec. _____
 The LIA indicator comes on after the audible alarm goes off. _____
 LINAC Area Secure light illuminates at the control rack
 and at the operator console _____

11. The keys in the SRU cannot be rotated even if the button is pressed. _____
 Turn the SRU test key to the test position press the SRU button and rotate the keys fully
 CCW
 The audible alarm sounds for a minimum of 5 seconds. ____ sec. _____
 The LIA indicator goes out. _____
 The LIB indicator goes out. _____
 The Kirk Keys Secured indicator goes out. _____
 The LINAC Warning Beacons Bank 1 indicator is on _____
 The LINAC Warning Beacons Bank 2 indicator is on _____
 13 warning signs stay on _____

12. Press the INTERLOCK OFF button. _____
 13 warning signs go out _____

13. Rotate the Kirk Key fully CW.
 The LIA indicator remains off. _____
 The LIB indicator remains off. _____
 The Kirk Keys Secured Indicator comes on. _____
 Press CS-E
 LIB indicator comes on. _____

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14. Press the Interlock Off button.
LIB light goes off _____

15. With door #2 closed and door #1 closed, press the door guard button while on the inside of the LINAC area.
Door guard light comes on. _____

16. Press CS-1.
CS-1 light on the button box lights _____
4 strobes come on _____

17. Open door #1.
The CS-1 light goes out. _____
The door guard light goes out. _____
The Strobes go off. _____

18. With door #2 closed and door #1 closed press the door guard button from the inside the LINAC area
Observe the light on the door guard box lights. _____
Press CS-1 and begin timing
CS-1 light on the button box lights. _____
The CS-1 light and Strobes go out in ≤ 2 minutes & 30 seconds. _____
_____ min _____ sec.

19. Press CS-2.
The light on CS-2 does not latch. _____
Press the CS-3
The light on CS-3 does not latch. _____
Press CS-4
The light on CS-4 does not latch. _____
The door guard light is ON. _____

20. Press the door guard button, Open door #1, exit and close door #1, rotate Kirk key and press CS-E.
The Interlocked light does not activate. _____
The CS-E light does not come on. _____
The Warning siren does not sound. _____
Kirk Keys Secured and LIB comes on. _____

Press the Interlock Off button and open door #1

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	<u>Upper Beam</u>	<u>Lower Beam</u>
23. Complete this step by first tripping the Upper light curtain beam and then repeating the step and tripping the lower light curtain beam.		
Close door #1 and press the door guard button		
The door guard light on the box lights	_____	_____
Press CS-1.		
The light on the CS-1 box lights.	_____	_____
Press CS-2		
The light on the CS-2 box lights	_____	_____
Press CS-3		
The green light on CS-3 box lights.	_____	_____
Break appropriate light curtain beam.		
The green light on CS-3 goes out.	_____	_____
Press CS-4		
The light on CS-4 does latch.	_____	_____
Press CS-3		
The green light on CS-3 does not come ON	_____	_____
Observe the door guard light is Off.	_____	_____
Press the door guard button.		
Open door #1 exit and close door #1. Insert/Rotate Kirk key in SRU and press CS-E.		
The Interlocked light does not activate.	_____	_____
The CS-E light does not stay on.	_____	_____
The Warning siren does not sound.	_____	_____
Press the Interlock Off button and repeat for the other light beam.		
24. Place switch holders on Gun Hutch Main Door. Search Gun Hutch. Press Emergency Stop button (ES-15).		
The Gun Secure A light goes out.	_____	_____
The Gun Secure B light goes out.	_____	_____
Emergency Stops OK light goes out.	_____	_____
Emergency Stop Fault light comes on	_____	_____
Pull the Emergency Stop button out.		
The Emergency Stop OK light comes on.	_____	_____
Press the Emergency Stop Reset button		
Emergency Stop Fault light stays on.	_____	_____
Press the Emergency Stop Reset button while the SOR key is rotated.		
Emergency Stop Fault light goes out.	_____	_____
The Gun Secured A & B lights remain out.	_____	_____
Remove switch holders on Gun Hutch.		

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25. Secure the gun hutch then secure the LINAC.
 Press the Emergency Stop Button (ES-16) on the logic box.
- The Interlocked light goes out. _____
 - Emergency Stops OK light goes out. _____
 - Emergency Stop Fault light comes on _____
 - ES fault at OC and CR _____
 - LIA light goes out. _____
 - LIB light goes out. _____

- Pull the Emergency Stop button out.
- The Emergency Stop light remains on. _____
 - The Emergency Stop Ok light comes on _____

- Press the Emergency Stop Reset button while the SOR key is rotated.
- The Emergency Stop Fault light goes out at the logic box. _____
 - The Emergency Stop Fault light goes out at the operator console. _____
 - The Emergency Stop Fault light goes out at the control rack SR3. _____

26. Press the other 14 Emergency stops (ES1 - ES14) located in the LINAC area one at a time. The Emergency Stop Fault light comes on. Reset the fault each time.
- | | | | | | | | | | | | | | | |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <u>ES</u> |
| <u>1</u> | <u>2</u> | <u>3</u> | <u>4</u> | <u>5</u> | <u>6</u> | <u>7</u> | <u>8</u> | <u>9</u> | <u>10</u> | <u>11</u> | <u>12</u> | <u>13</u> | <u>14</u> | |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |

27. Press the Emergency Stop (ES-18) located on the operator's console.
 The Emergency Stop Fault light comes on. _____
 Reset ES fault.

28. Press the Emergency Stop (ES-17) located on the control rack.
 The Emergency Stop Fault light comes on. _____
 Reset ES fault.

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29. Place a latch device and switch holders on door #1 and door #2.
Search the LINAC.

While the warning siren is sounding 4 strobes are flashing.

During and after the warning sound 9 beacons inside the LINAC area are ON and flashing.

	Door #1	Door #2
Remove the holder on switch B.	_____	_____
LIB indicator goes out.	_____	_____
Replace the holder on switch B.	_____	_____
LIB indicator does not illuminate.	_____	_____
Press CS-E	_____	_____
LIB indicator comes on.	_____	_____

30. Remove the holder on switch A.
LIA indicator goes out.
An audible alarm sounds for 3 - 5 seconds.

	_____	_____
The 9 warning beacons inside the LINAC area go out.	_____	_____

Door #1	_____	_____	_____	_____	_____	_____	_____	_____	_____
Door #2	_____	_____	_____	_____	_____	_____	_____	_____	_____

Replace the holder and press the LINAC CS-E button.
LIA indicator does not illuminate.
The Interlocked light remains out.

31. Secure the LINAC. Rotate the Lockout switch to the OFF position.
The Interlocked light goes out.
SPA light goes out.
Attempt to secure the LINAC.
The LINAC cannot be secured.

Break security for the gun hutch by opening the door.

32. Attempt to secure the Gun Hutch.
The Gun Hutch cannot be secured.
Rotate the lockout switch to ON.
SPA Reset light illuminates.
The SPA light is not lit.

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33. Secure the Gun Hutch and then secure the LINAC area.
 After the warning sound LIA indicator remains off. _____
 LIB and Kirk Keys Secured indicators light. _____
34. Press the SPA reset button.
 The SPA light does not reset without the SOR key rotated. _____
 LIA indicator comes ON _____
35. Place latch device and switch holders on the main gun hutch door.
 Secure the Gun hutch and LINAC area.
 Remove the holder on switch B on the gun hutch door.
 Gun B indicator goes out _____
 LIB indicator goes out. _____
- Replace the holder on switch B.
 Press LINAC CS Exit
 LIB does not reset _____
- Press Gun CSE and then LINAC CS Exit
 LIB resets _____
- Remove the holder on switch A on the gun hutch door.
 LINAC area interlock drops out. _____
 Gun A indicator goes out _____
 LIA indicator goes out. _____
 Gun hutch interlock drops out _____
- Attempt to secure the LINAC area without re-securing the Gun Hutch.
 The LINAC area does not interlock. _____
36. Remove all latch devices and switch holders from LINAC door #2 and the Gun hutch. The latch devices and switch holders remain in place for LINAC door #1.
 Stand on the LINAC side of the door, open and close the door and check that each switch makes a “click” when the door is opened. Repeat step for Gun hutch door. _____
37. Remove Locks & Red tags from modulators and switch modulator disconnect to the ON position.
38. **Search the Gun Hutch and LINAC area. Make sure there are no personnel left in these areas.**

CAUTION!

It is important to search Gun hutch and LINAC area carefully because the LINAC modulators will come on during this part of the test making it possible to produce radiation in the LINAC and Gun Hutch areas!

Post a person outside door #1 and instruct the person **not to allow any personnel inside the LINAC area.** Instruct the person at door #1 not to enter the LINAC area but to take position immediately outside of the LINAC door.

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Note: The modulator “Radiation Interlock A-Chain Modulator Pilot” indicator is located outside each modulator.

- | | | Modulator | | | |
|-----|--|------------------|----------|----------|----------|
| | | A | B | C | E |
| 39. | Request that the LINAC Operator turn on all three modulators at low power with klystrons pulsing. | _____ | _____ | _____ | _____ |
| | All Four modulators are ON and pulsing.
The Radiation Interlock B-Chain AC Contactor Pilot is ON _____ | | | | |
| | The Radiation Interlock A-Chain Modulator Pilot, located on each Modulator is ON. | _____ | _____ | _____ | _____ |
| | Remove the holder on switch B. | | | | |
| | The Radiation Interlock B-Chain AC Contactor Pilot is off _____ | | | | |
| | All Four modulators stop pulsing.
The Radiation Interlock A-Chain Modulator Pilot, located on each Modulator is ON. | _____ | _____ | _____ | _____ |
| | Replace the holder on switch B. | | | | |
| | The Radiation Interlock B-Chain AC Contactor Pilot remains off _____ | | | | |
| | Press the CS-E button. | | | | |
| | The Radiation Interlock B-Chain AC Contactor Pilot is ON _____ | | | | |
| | A reset of the modulator controls may be required for pulsing to begin.
All Four modulators start pulsing. | | | | |
| | Remove the holder on switch A. | | | | |
| | The Radiation Interlock A-Chain Modulator Pilot, located on each modulator turn off.
The Radiation Interlock B-Chain AC Contactor Pilot is ON. _____ | _____ | _____ | _____ | _____ |
| | All Four modulators stop pulsing. | _____ | _____ | _____ | _____ |
| | Replace the holder on switch A. | | | | |
| | The Radiation Interlock A-Chain Modulator Pilot, located on each modulator remains off.
All Four modulators remain off. | _____ | _____ | _____ | _____ |
| 40. | Remove all latch devices and switch holders from door #1.
Stand on the LINAC side of the door, open and close the door and check that each switch makes a “click” when the door is opened.
Remove the test key from the SRU. | | | _____ | _____ |
| 41. | Inform the LINAC Operator that the test is complete and request that an entry be made in the LINAC logbook. | | | | _____ |