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Brookhaven National Laboratory National Synchrotron Light Source		Number: LS-PPS-0014	Revision: C
		Effective: 7/10/03	Page 1 of 11
Subject: <u>SDL Radiological Interlock Test</u>			
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*Approval signatures on file with master copy.

[Revision/Periodic Review 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 the LINAC operator that the interlock test will be done. _____
- Verify that the LINAC is in a condition to run. _____
- LOTO all three modulator High Voltage Disconnect switches as follows:

 - a. Secure LINAC
 - b. Power on Modulators,
 - c. Verify all three-voltage indicators are ON.
 - d. Switch disconnect OFF for each modulator
 - e. Verify all three voltage indicators turn off _____
 - f. Place lock and tag on each modulator disconnect switch. _____

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 13 - 15 seconds. _____

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. _____

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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.

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. **CR** **LB** **OC**
 The Gun Secure A light comes ON _____
 The Gun Secure B light comes ON _____

5. Press the gun CS-1 and begin timing.
 The CS-1 light goes out after no more than 20 seconds. _____
 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.
 The Gun Secure B light at the operator's console and control rack goes out. _____
 Gun Secure B light at the logic box goes out. _____

(Note: Press Gun CSE to reset Gun B)

	DOOR			
	1	2	3	4
Remove a holder from a switch B. Repeat for all switches.	_____	_____	_____	_____
Gun Secure B light goes out at logic box	_____	_____	_____	_____
The Strobe light remains on.	_____	_____	_____	_____
The Gun Secure A light remains on.	_____	_____	_____	_____
Replace the holder on switch B	_____	_____	_____	_____
Gun Secure B light <u>does not</u> come ON	_____	_____	_____	_____
Press CS-E	_____	_____	_____	_____
Gun Secure B comes ON	_____	_____	_____	_____

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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. _____
- The Gun Secure A light at the operator console goes out. _____
- Gun Secure A light at the control rack goes out. _____
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 15 seconds. _____
 - 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 _____

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- 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. _____
 - 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. _____

- 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. _____

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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. _____
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
21. With door #2 closed and door #1 closed press the door guard button from inside the LINAC area.
- The light on the door guard box lights _____
- Press CS-4
- The light on CS-4 does not latch. _____
- Press CS-3
- The light on CS-3 does not latch. _____
- Press CS2 then CS-1.
- Observe the light on CS-2 does not latch. _____
- Observe the light on CS-1 lights and latches. _____
- 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 stay on. _____
- The Warning siren does not sound. _____

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22. Leave door #1 open and press the door guard button.
 The door guard light does not light. _____
- Press CS-1
 The CS-1 light does not latch. _____
- Press CS-2
 The CS-2 light does not latch _____
- Press the CS-3 Button
 The light on CS-3 does not latch. _____
- Press CS-4
 The light on CS-4 does not stay lit _____
- Press the door guard button.Exit and close door #1.
 Rotate Kirk key and press CS-E.
 The Interlocked light does not activate. _____
 The CS-E light does not latch. _____
 The Warning siren does not sound. _____
- Press the Interlock Off Button and open door #1
23. Complete this step by first tripping the Upper light curtain beam and then repeating the step and tripping the lower light curtain beam. **Upper Beam** **Lower 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. Rotate Kirk key 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.

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24. Search Gun Hutch. One person remains inside and presses an 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. _____

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 located on the operator's console.

The Emergency Stop Fault light comes on. _____

Reset ES fault.

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

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.

	<u>Door #1</u>	<u>Door #2</u>
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.	_____	_____

28. 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. _____

29. 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.

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- 30. 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. _____

- 31. 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. _____

- 32. Press the SPA reset button.
The SPA light does not reset without the SOR key rotated. _____
LIA indicator comes ON _____

- 33. 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. _____

- 34. 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. _____

- 35. Remove Red tags from modulators and turn on modulator disconnect switches.

36. **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.

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

37. Request that the LINAC Operator turn on all three modulators at low power with klystrons pulsing.

	Modulator		
	A	B	C
<p>Three modulators are ON and pulsing. The Radiation Interlock B-Chain AC Contactor Pilot is ON _____</p> <p>The Radiation Interlock A-Chain Modulator Pilot, located on each Modulator is ON.</p>	_____	_____	_____
<p>Remove the holder on switch B. The Radiation Interlock B-Chain AC Contactor Pilot is off _____</p> <p>Three modulators stop pulsing. The Radiation Interlock A-Chain Modulator Pilot, located on each Modulator is ON.</p>	_____	_____	_____
<p>Replace the holder on switch B. The Radiation Interlock B-Chain AC Contactor Pilot remains off _____</p>	_____	_____	_____
<p>Press the CS-E button. The Radiation Interlock B-Chain AC Contactor Pilot is ON _____</p>	_____	_____	_____
<p>A reset of the modulator controls may be required for pulsing to begin. Three 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. _____</p> <p>Three modulators stop pulsing.</p>	_____	_____	_____
<p>Replace the holder on switch A. The Radiation Interlock A-Chain Modulator Pilot, located on each modulator remains off. All three modulators remain off.</p>	_____	_____	_____

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38. 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. _____
39. Inform the LINAC Operator that the test is complete and request that an entry be made in the LINAC logbook.

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