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Brookhaven National Laboratory National Synchrotron Light Source		Number: LS-PPS-0013	Revision: C
		Effective: 7/11/03	Page 1 of 9
Subject: <u>LINAC-Booster</u> Radiological Interlock Test			
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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:		

Definitions:

CS = Check Station Button	ES = Emergency Stop Button
IP = Test Person Inside Tunnel	SRU = Solenoid Key Release Unit
OP = Test Person Outside Tunnel	DG = Door Guard Button

PREPARATION:

- Inform Machine Operator that test will be done.
- LOTO LINAC low level RF and Low Level Beam Transport (LEBT) valve. Refer to procedure "[LINAC LOTO](#)", [LS-ESH-0012](#)".
- Sign out "SR8 LINAC/Booster Security" key from control room.

In each of the following tests, verify that the stated action occurs, and then check the blank.

1. Secure the LINAC/Booster area.

Search sequence

Close Doors
 Press DG
 Press (Start Search)
 Press CS-1
 Press DG
 Press CS-E (Search Complete)

After the time-out, interlock A is satisfied on all three modulators _____

The modulators do not turn on by themselves _____

On the Control Room Shutter Control Panel, the Green LINAC/Booster Enable light is off _____
 The Red Disable light is ON _____

2. Press the LINAC/Booster Enable Button

The light comes on _____
 The B interlock on the modulators is on _____

3. Send a reset to the modulators via computer.

The three modulators turn on _____

LINAC-Booster Radiological Interlock Test

Number: LS-PPS-0013	Revision: C	Effective: 7/11/03	Page 2 of 9
----------------------------	--------------------	---------------------------	--------------------

4. Break security pressing the Interlock Off button.
Three modulators turn off _____
Press LINAC/Booster Enable button. _____
The Red Disable light stays on _____
The Green Enable light stays off _____
Send a computer reset. _____
The modulators stay off _____

5. Press CS-E (outside access door).
Interlock does not activate _____

6. One person (IP) goes into tunnel. OP Closes access door, places Kirk Keys in SRU, and rotates keys. IP presses the DG button then the Start Search button (inside LINAC bending magnet cave).
The Start Search light goes on. _____
OP presses CS-E. _____
Interlock does not activate _____
OP opens the LINAC Door. _____
Light on Start Search goes out _____

7. Close the LINAC Door remove and place Kirk Keys in the SRU, rotate keys. IP presses DG then Start Search button and notes time. IP then presses CS-1 (on south wall of booster).
All Five strobe lights turn on _____
Time until the light on the Start Search button box goes out is not more than 3 minutes. _____
All Five strobe lights turn off _____
OP presses CS-E _____
Interlock does not activate _____
OP Removes Kirk Keys and opens the LINAC Door. Close the LINAC Door. Remove and place Kirk Keys in the SRU. Rotate keys. _____

8. IP presses DG then CS-1. OP presses CS-E.
Interlock does not activate _____
IP presses Start Search then CS-1. OP presses CS-E _____
Audible Alarm Sounds _____
OP Removes Kirk Keys (using the SRU bypass key) and opens the LINAC Door. _____
Audible alarm stops _____
OP closes the LINAC Door removes and places Kirk Keys in the SRU and rotates keys. OP immediately presses CS-E again. _____
Interlock does not activate _____

LINAC-Booster Radiological Interlock Test

Number: LS-PPS-0013	Revision: C	Effective: 7/11/03	Page 3 of 9
----------------------------	--------------------	---------------------------	--------------------

9. Booster Door test:

Obtain booster door key from SRU, open booster door and place "latch device" on lock so key can be removed with door open. Place a "switch holder" on each door switch. OP returns key to SRU.

Booster Door Closed 'A' light is on _____

OP presses reset button.

Booster Door Latch 'A' light comes on _____

Search LINAC-Booster.

IP removes holder from #2 Door switch.

The Booster Secure B light goes out _____

IP replaces switch holder #2

The Booster Secure B light remains out _____

OP resets the B chain with the RIB Test Key

The Booster Secure B light is on _____

IP removes holder from #1 Door switch.

Booster Door Latch 'A' light goes out _____

Booster Door Closed light goes out _____

LINAC-Booster Interlock drops out _____

IP replaces switch holder #1

Booster Door Closed 'A' light comes on _____

The Booster Door Latch 'A' light remains out _____

OP presses the Reset button at LA1SR8

The Booster Door Latch 'A' light comes on _____

10. IP presses DG, Start Search button and CS-1.

Start Search & CS-1 lights come on _____

IP removes holder from the #1 switch and replaces it. OP presses CS-E.

Interlock does not activate _____

Start Search & CS-1 lights go out _____

All five strobe lights go out _____

Reset the Booster Door Latch.

11. Search the LINAC-Booster; IP remains inside near booster door. After completing search and returning key to SRU, OP goes to LINAC modulators.

Interlock light labeled "A Enable" for each mod does not come on until after warning period. _____

IP times audible warning.

Warning sounds properly and lasts for at least 25 seconds. _____

Press the Modulator Enable in the control room.

LINAC-Booster Radiological Interlock Test

Number: LS-PPS-0013	Revision: C	Effective: 7/11/03	Page 4 of 9
----------------------------	--------------------	---------------------------	--------------------

12. Turn all three modulators on if they are not already on. IP removes the holder from booster door switch #2.

All modulators turn off	_____	_____	_____
"B enable" light is out and "A enable" light is on	_____	_____	_____
Booster Secure "B" light turns off	_____	_____	_____
Replace holder on switch #2			
'B' Enable on all three modulators stays out.	_____	_____	_____
Booster Secure "B" light stays off	_____	_____	_____
Reset RIB			
Booster Secure "B" light turns on			_____

13. Turn all three modulators on. IP removes the holder from booster door switch #1.

All modulators turn off	_____	_____	_____
"A enable" lights are OFF	_____	_____	_____
"B enable" lights are ON.	_____	_____	_____

Replace the holder on switch #1 and reset booster door latch at SR8.

14. Obtain Kirk key for booster door. Remove switch holders and latch device from door. Open and close door and observe switches.

Both switches operate freely and each clicks when door is opened	_____	_____	
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15. OP returns key to SRU and resets booster door latch at SR8.

Booster door latch 'A' light comes on			_____
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LINAC-Booster Radiological Interlock Test

Number: LS-PPS-0013	Revision: C	Effective: 7/11/03	Page 6 of 9
----------------------------	--------------------	---------------------------	--------------------

Pull ES-CRX back out

Emergency Stop 'A' and 'B' light at LINAC security rack SR8 comes on
Emergency Stop Latch 'A' Light stays off at SR8
X-Ray system Emergency Stop light comes on at SR100

Press the Reset button at SR8

Emergency Stop Latch 'A' Light comes on at SR8

19. A person must watch the emergency stop light on the UV ring security rack in the UV ring.

Press the ES-CRU (UV-injector crash button in the control room).

Emergency Stop 'A' and 'B' light at LINAC security rack SR8 goes out
Emergency Stop Latch 'A' Light goes out at SR8
Emergency Stop latch 'A' & 'B' light goes out at SR9 in VUV ring.
Emergency Stop 'A' & 'B' light goes out at SR9 in VUV ring.

Pull ES-CRU back out

Emergency Stop 'A' and 'B' light at LINAC security rack SR8 comes ON
Emergency Stop Latch 'A' Light stays off at SR8
Emergency Stop latch 'A' & 'B' light stays out at SR9 in VUV ring.
Emergency Stop 'A' & 'B' light comes ON at SR9 in VUV ring.

Press the Reset button at SR8 at LINAC.

Emergency Stop Latch 'A' Light comes on at SR8

Press the Reset button at SR9 in VUV ring.

Emergency Stop latch 'A' & 'B' light comes ON at SR9 in VUV ring.

20. Search the LINAC-booster. Turn on the modulators. Press the E-Stop on the booster security rack LA1SR8.

All three modulators turn off
"A enable" and "B enable" lights are off

Reset the Emergency Stop and the Emergency Stop Latch.

21. LINAC Door Test:

Open LINAC door. Place latch device on lock and holders on door switches.
Return Kirk key to SRU. Search the LINAC – Booster.

LINAC Door Closed ‘A’ is on

Booster Secure ‘A’ and ‘B’ are on

Turn on the modulators.

All three modulators are ON

Remove the holder from switch #2

All three modulators turn OFF

‘B Enable’ goes out on all three Modulators

Booster Secure ‘B’ light goes out

Replace the holder and press CS-E

Attempt to reset the modulators

‘B Enable’ stays off on all three Modulators

Booster Secure ‘B’ light stays out

Reset the 'B' chain with the RIB Test Key

Booster Secure ‘B’ light comes ON

Turn on the modulators.

Remove the holder from switch #1

All three Modulators turn off

‘A Enable’ light goes out on modulators

Booster Secure ‘A’ light goes out

LINAC Door Closed ‘A’ is out

Replace the holder and press CS-E

‘A Enable’ stays off on all three Modulators

Booster Secure ‘A’ stays out

LINAC Door Closed ‘A’ is on

Booster Secure ‘B’ is on

22. Replace switch holder. Search tunnel. Guard the access door to ensure that no one enters tunnel and contacts magnet conductors. Turn on modulators and booster dipole, quadrupole, and sextupole power supplies.

Remove holder from switch 1.

All three modulators turn off

"A enable" lights are out

"B enable" lights are on

Dipole supply turns off

Quadrupole supply turns off

Sextupole supply turns off

LINAC-Booster Radiological Interlock Test

Number: LS-PPS-0013	Revision: C	Effective: 7/11/03	Page 8 of 9
----------------------------	--------------------	---------------------------	--------------------

23. With Kirk keys captured in SRU, turn key and observe where the solenoid stops key rotation. Press solenoid release button and turn key just past this point, but not far enough to actuate "key removed switch". Release button and leave key in this position.

Search LINAC-booster and guard access door to prevent anyone from entering and contacting magnet conductors.

Turn on modulators and booster dipole, quad, and sextupole power supplies.

Turn the Kirk key fully CCW and remove.

All three modulators turn off

'B Enable' lights turns off on modulators

"A enable" lights stay on

Dipole supply turns off

Quadrupole supply turns off

Sextupole supply turns off

The Booster Secure 'B' light is out

The Kirk Keys Secured light in the control room and the security rack are out.

Rotate the Kirk Key CW fully and press CS-E

The Booster Secure 'B' light stays off

The Kirk Keys Secured light is on in the control room and at the security rack

Reset the B chain using the RIB Test Key.

The Kirk Keys cannot be removed with Booster B chain secured.

Turn on the modulators.

Remove holder from switch #2

'B enable' turns off on all three modulators

Replace holder on switch #2.

Reset the B chain using the RIB Test Key.

24. Turn on modulators and power supplies.

Magnet Test Kirk Key Normal light is on

Remove "Magnet Test" Kirk key.

Three modulators turn off

"A enable" and "B enable" lights are off

Dipole supply turns off

Quad supply turns off

Sextupole supply turns off

Magnet Test Kirk Key Test light is on

Booster Secure 'A' and 'B' are out

Attempt to secure the Booster.

The area does not secure.

Replace the "Magnet Test" Kirk Key.

Booster Secure 'A' and 'B' remain out

The Magnet Test Kirk Key can only be removed in the TEST position

LINAC-Booster Radiological Interlock Test

Number: LS-PPS-0013	Revision: C	Effective: 7/11/03	Page 9 of 9
----------------------------	--------------------	---------------------------	--------------------

- 25. Search the LINAC area and turn on the modulators.
Rotate the lockout switch to OFF.
 - All three modulators turn off _____
 - Booster secure 'A' and 'B' are out _____
 - "A enable" and "B enable" lights are off _____Attempt to secure the booster with the lockout switch in the OFF position.
 - Booster does not secure _____Attempt to turn on the modulators
All three modulators remain OFF _____
 - Rotate the lockout switch to 'ON'. _____
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- 26. Remove latch unit and switch holders from LINAC door. Open and close door and observe switches.
 - Both switches operate freely and each makes a click sound when door is opened _____
 - Take custody of the KK Test/RIB reset Key _____
-
- 27. Remove red tags and turn on pulsed amplifier and open LEPT valve. Inform Machine Operator that LINAC-Booster test is complete and request that a notation be made in the shift log. _____

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