

# Personnel Safety System Operator Training

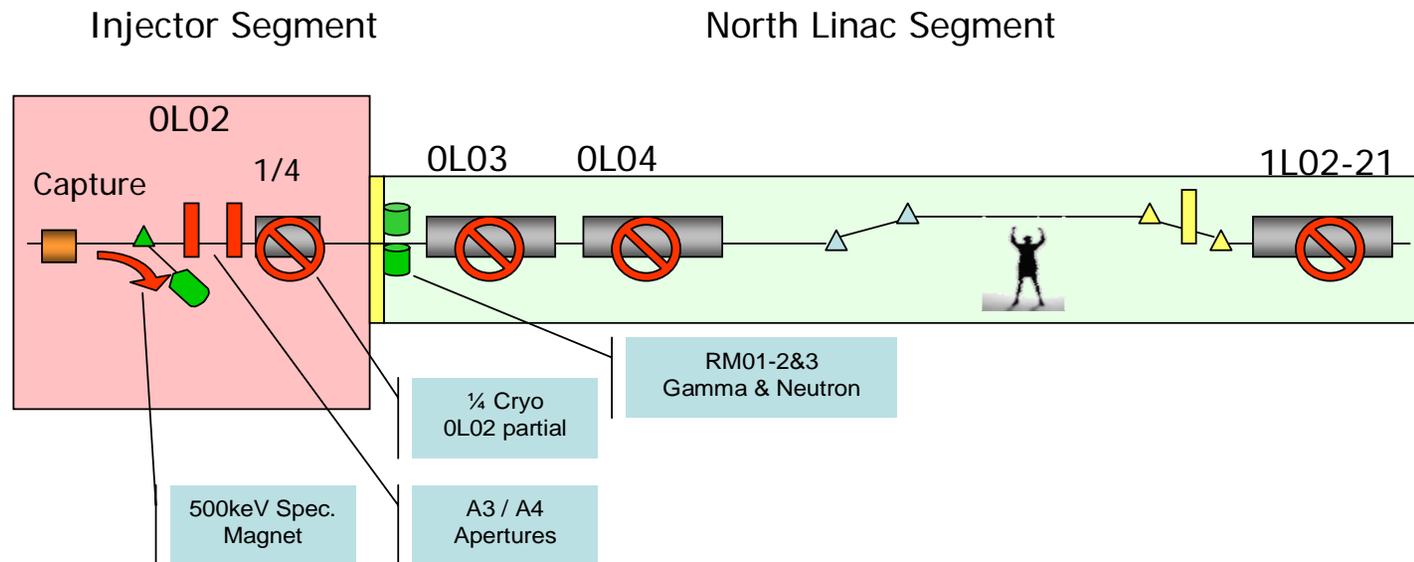
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## Part 2b: PSS Operations

## Machine State Changes

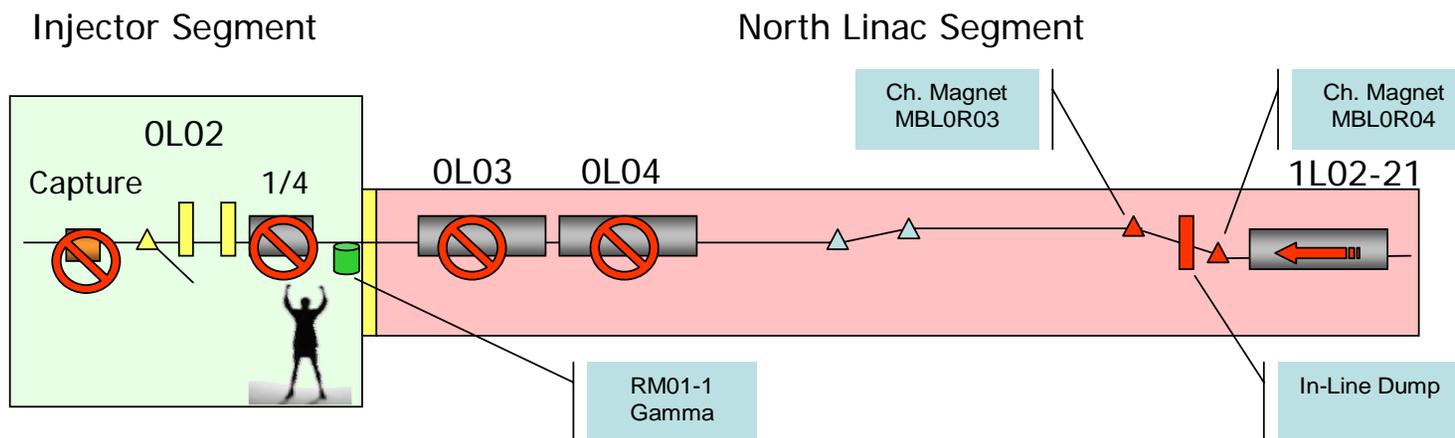
## Injector 500keV Beam Operation



### Injector - in Beam Permit / N. Linac - to an access mode

- Turn off: RF zones 0L02-04 and 1L02 – 1L21, Arc Dipoles and linac Dogs
- Insert: A3 and A4
- Check CARMs RM01-1, 2, & 3 are clear
- PSS turns off 1/4 Cryo Klystrons
- Turn on: RF zone 0L02(capture)

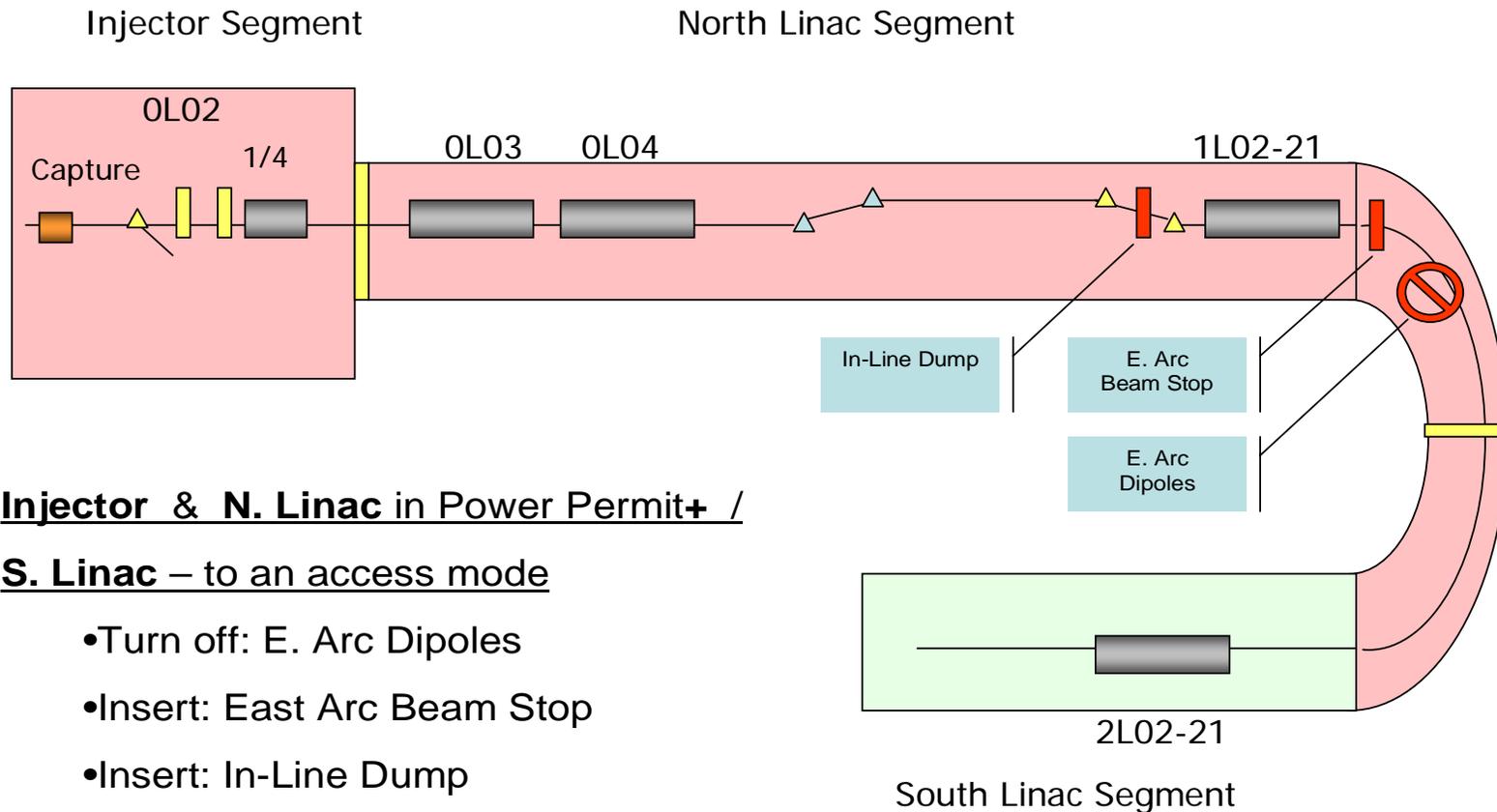
## N. Linac - RF Operation



### N. Linac - in Power Permit / Injector - to an access mode

- Turn off: Gun & RF zones OL02-04
- Insert: In-line Dump
- Check CARM RM01-1, 2, & 3 are clear
- PSS turns off MB0R03, MB0R04

## N. Linac 45MeV "Straight" mode

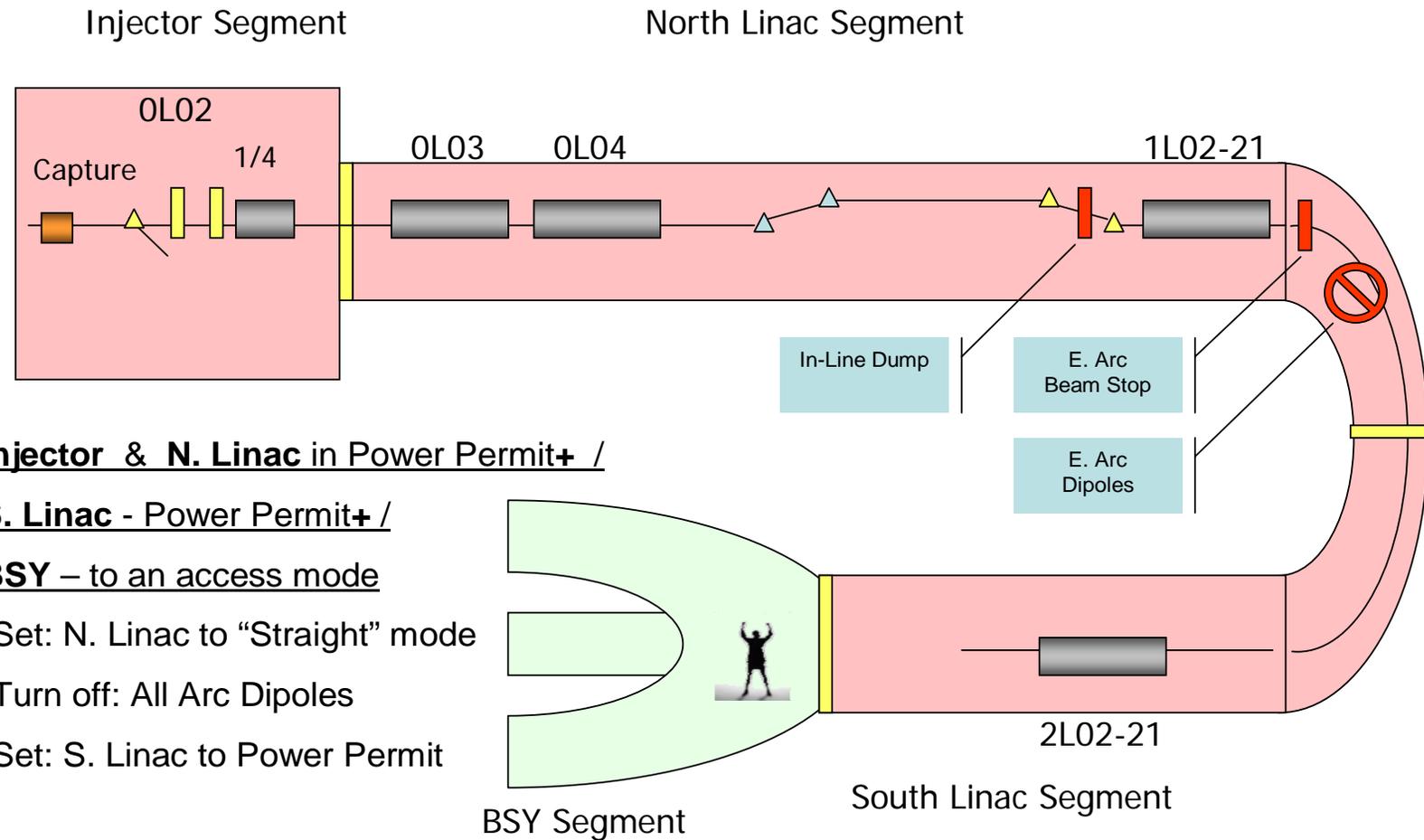


**Injector & N. Linac in Power Permit+ /**

**S. Linac – to an access mode**

- Turn off: E. Arc Dipoles
- Insert: East Arc Beam Stop
- Insert: In-Line Dump

## BSY Access



**Injector & N. Linac in Power Permit+ /**

**S. Linac - Power Permit+ /**

**BSY – to an access mode**

- Set: N. Linac to “Straight” mode
- Turn off: All Arc Dipoles
- Set: S. Linac to Power Permit

## ***Taking an Endstation to Controlled Access (one hall ops):***

- Turn off the gun high voltage
- Switch the Injector to Power Permit
- Switch the BSY to “Power Permit”
- Switch the Endstation to be accessed to “Power Permit”
- Using the EPICS “Controlled Access” screen, switch off the appropriate dipole
- Insert the appropriate beam stoppers
- Switch the endstation to Controlled Access
- At this time the BSY and Injector may be returned to “Beam Permit” if beam is to be run to another endstation or the BSY dump.

## ***Taking an Endstation to Controlled Access (multi-hall ops):***

**To go from “Beam Permit” to “Controlled Access” in an Experimental Endstation when running beam to multiple endstations:**

Insert the Chopper slit that controls beam to the endstation to be accessed. (EPICS)

Wait for the BSY transport line CARM at the shield wall of the area to be entered to go out of alarm. *(Not doing this will cause the Hall to drop to Restricted Access when the key is turned to the Controlled Access position.)*

Switch the Magnet string to the endstation OFF (EPICS)

Check that the magnet string HV reads “OFF” for the endstation to be entered.

Insert the Beam Stoppers for the Endstation to be accessed

Switch the Endstation access control key to “Power Permit”, then to “Controlled Access”

**To go from “Beam Permit” to “Controlled Access” in an endstation while redirecting beam to the BSY dump:**

Switch the Magnet string to the endstation OFF

Resteer the beam to the BSY Dump (Hall C beam line)

Wait for the BSY transport line CARM at the shield wall of the area to be entered to go out of alarm. *(Not doing this will cause the Hall to drop to Restricted Access when the key is turned to the Controlled Access position.)*

Turn the Gun High Voltage OFF (EPICS)

Switch the Injector access control key to “Power Permit”

Switch the BSY access control key to “Power Permit”

Switch the Endstation access control key to “Power Permit”

Insert the Beam Stoppers for the Endstation to be accessed (EPICS).

Switch the Endstation access control key to “Controlled Access”

Switch the BSY access control key to “Beam Permit”

Switch the Injector access control key to “Beam Permit”

At the Discretion of the Crew Chief Turn the Gun High Voltage ON

Restore Beam to the BSY Dump

## ***Special Hall B Controlled Access***

When accessing Hall B, special procedures are in place that allow for Controlled Access without performing a radiation survey.

### **Procedure:**

Switch Hall B to Controlled Access.

Have controlled access personnel contact you from outside the Hall B Access Room.

Have the team observe the radiation monitor beacon that is mounted to the left of door 1. If the beacon is energized, do not allow access. A survey by a qualified ARM or a member of the RadCon group is required before allowing the team to enter.

If the beacon is not energized, have a team member push the red “self test” button. The beacon should rotate. If the beacon does not rotate, then a survey is required before the team can enter.

If the beacon self test passed, instruct the access team that access past the posted boundaries is not permitted without a radiation survey. This includes the beam transport tunnel and the beam dump areas.

Unlock Door 1. Allow the controlled access team to enter the access room.

Access to Hall B from this point on follows the normal controlled access procedure.

## ***FEL Controlled Access Procedure – Laser Alignment***

Qualified laser workers use the Drive Laser Alignment controlled access procedure for testing and aligning the gun photo-cathode drive laser. Only qualified and properly equipped personnel may enter the enclosure in Drive Laser Alignment controlled access mode.

**THE SSO SHALL ONLY ALLOW PERSONNEL WITH LASER SAFETY TRAINING IN THE ENCLOSURE DURING A LASER ALIGNMENT CONTROLLED ACCESS.**

When in laser alignment mode the yellow laser warning beacons in the access room and the injector area will remain flashing.

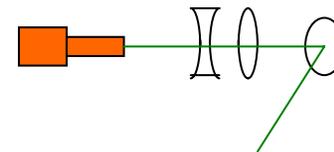
The laser shutter bypass key is located on the laser shutter interface chassis in the upstairs laser clean room.

### **Special Procedure:**

Unlock door 1 (outer door) and allow the group to enter.

Lock Door 1

Establish contact with the controlled access group using the phone.



Record the names of each member of the group

## **Special Procedure (cont.):**

Verify each person has dosimetry.



Verify that each person entering has on a pair of laser safety goggles.

Ask each person if they have current laser safety training. Deny entry to anyone that does not.

Ask each person if they have current ODH training.

Release the Master controlled access exchange key

Ask the team to verify that the yellow laser warning beacon is ON. (1)

## **Special Procedure (cont.):**

Ask each person entering to take an exchange key.

Verify each person has an exchange key. Record the key number.

Unlock Door 2 and allow the group to enter.

Lock Door 2.

Record the time that personnel entered the tunnel.

(1) As soon as the exchange key is released the yellow warning beacon will start flashing and the 30-second timer for the laser shutter permit delay will start. At the end of 30 seconds the PSS laser shutters will open.

## **PSS Trouble Shooting**

Operator troubleshooting of the PSS is limited to determining the cause of a fault and determining if a problem with the PSS exists.

If there is a perceived problem with the PSS

Don't touch anything!

Call The PSS On-Call personnel immediately.

PSS problems are usually easy to determine

Keep in mind the concept of Fail-Safe - no power to an input will read back as "unsafe"

## ***Fault Diagnosis***

When a PLC drops from one mode to a lower mode all inputs and outputs are copied to a storage register. This is called the “First Fault” Register.

For every icon on a PSS screen there is a first fault indicator (except for the Run/Safe Sweep Sequence).

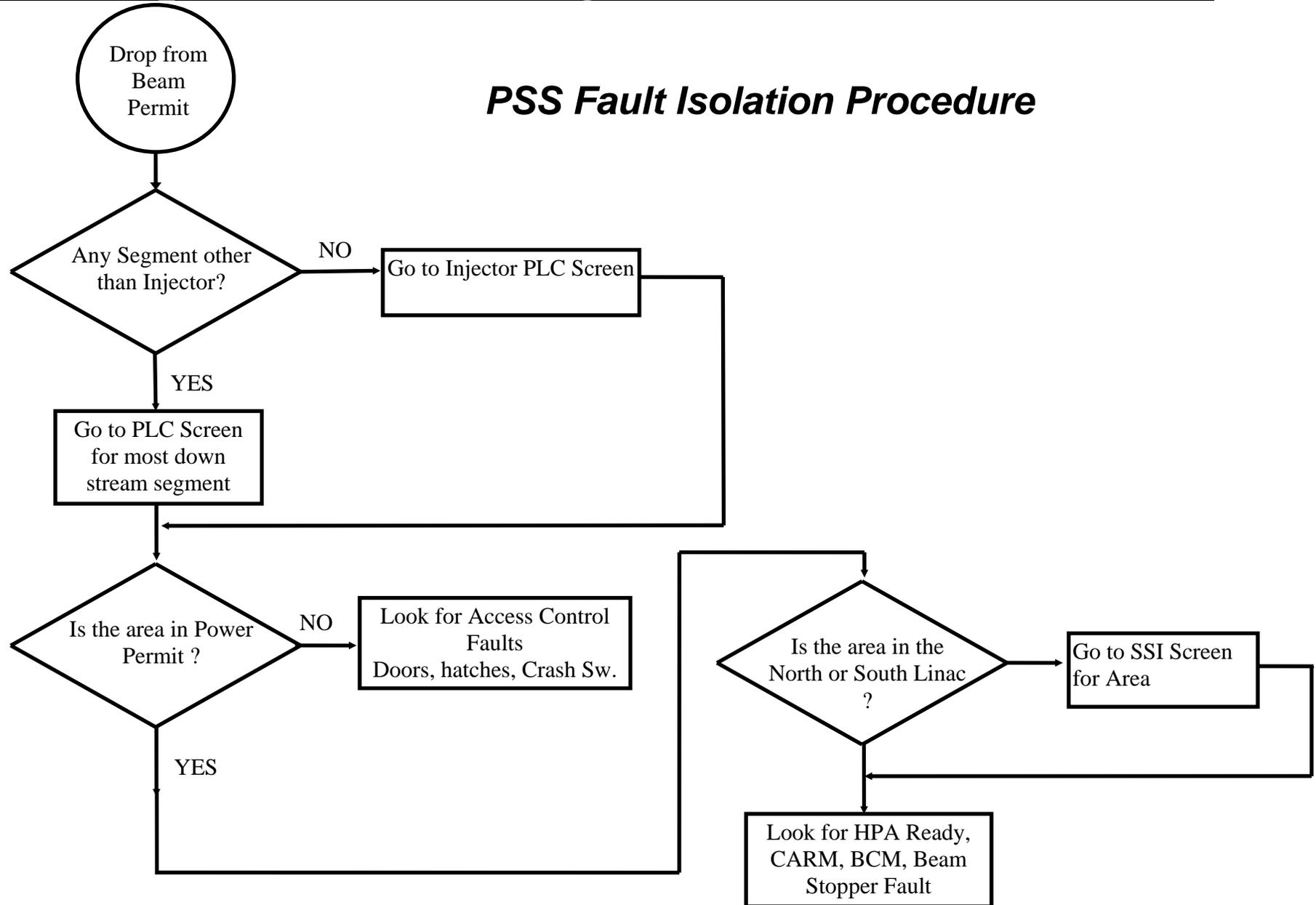
On the PSS display, a first fault shows up as a dark ring around the edge of the status indicator.

*A sequence of Run/safe "Crash" indicators show red, others do not.*

If only one system (A or B) shows up faulted this usually indicates that either a power supply has failed or a PLC has stopped.

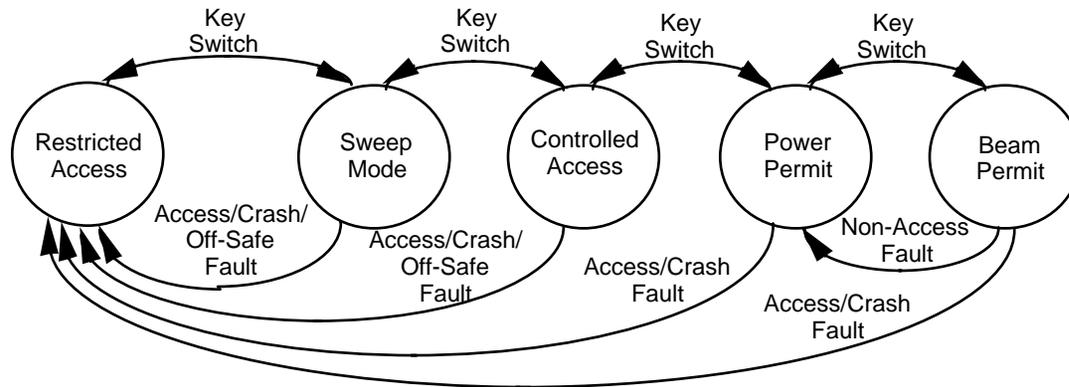
If both show up with multiple failures then it is probably an AC power failure.

## PSS Fault Isolation Procedure



## *Things that shut off the Beam*

### **Any Fault**



## PSS States

## ***Faults which drop from “Beam Permit” to “Power Permit”***

<u>Device</u>	<u>Fault</u>
Gun	HVPS Fault
Kicker	Kicker Fault Bias Fault
RF HPA	“Ready” = Waveguide Pressure
Beam Current Monitor	BCM Fault
Beam Stopper	Beam Stopper “OK” (Pressure, Ambiguous Status)
Controlled Area Radiation Monitor (CARM)	CARM High <u>Dose Rate</u> NOT ACCUMILATED DOSE CARM Power Fail (optional, set by Radcon group)

## ***Other Faults:***

### **Things which drop an area from “Power Permit” to “Restricted Access”**

- Any Door opened including an access door

### **Things that will drop an area from “Controlled Access” to “Restricted Access”**

- SSI controlled device reads NOT “OFF/Safe”
- Access Door 1 and 2 open at the same time

### **Things that drop an area from “Sweep” to “Restricted Access”**

- Access Doors 1 and 2 open at the same time
- Access Door 2 opened during sweep

### **Things that will drop from any mode to Restricted Access”**

- Any door open other than a designated access door
- Any hatch Opened
- Elevator Door Opened
- Run/Safe Crash Switch
- TOP STOP Crash Switch
- SSI interface chassis “Chain Intact” fault

## Safety System Certification

- Objective

The objective of the PSS certification is to functionally test all PSS inputs and outputs as well as the operation of the PSS logic. The test separates the response of the A and B chains to ensure that each channel responds properly.

- When is certification required.

A partial certification is required for any device or subsystem which has been modified. Modification includes temporary disconnection and/or replacement.

The partial certification must include all components affected by or connected to the device/system replaced. For example, if an interface chassis is disconnected the entire interface chassis must be recertified. If a run/safe box is disconnected the run/safe box must be recertified.

Partial recertification of PLC components is allowed with the exception of the CPU module.

## ***Full Recertification***

A full recertification of a segment is required if any part of the PLC interlock logic has been changed or if the PLC CPU has been removed from the crate.

A full recertification of the complete PSS is done semi-annually.

An operations crew chief serves as the certification Test Director.

## ***Typical Certification Tests***

- Run/Safe Box Tests
  - Tests the sweep sequence
  - Reset position of the R/S key switch
  - Crash switch function
  - Safe/Operational/Unsafe lamps and logic
  
- Reset/Sweep Sequence Test
  
- Door/Gate Test
  - Tests interlock function of doors, gates, hatches.
  
- Access Room Tests
  - Tests controlled access keys, intercom, keypad, video, exit request

- Radiation Monitor Test
  - Tests dose rate alarm function of CARM. Usually done by dosing CARM with neutron and gamma radiation sources.
  - Tests bypass function of CARMs located in tunnel or endstations
- Interface Chassis Test
  - Tests
    - Power Permit
    - Off/Safe
    - Interlock Ready input
- Beam stopper test
  - Tests
    - Beam stopper inputs
    - Beam stopper permissive
    - Beam stopper logic

- Segment Interface Test
  - Tests interdependence of beam states
  - Tests injector logic
- Functional Test
  - Test special operating modes or combinations of device states. One example is the Hall C detector hut.
  - Test actual ability of PSS to shut off power supplies.

## **PSS Configuration Control**

The PSS Configuration Control Policy describes in detail the process of making changes to the PSS.

Most Operators will not need to make a change to the PSS

When PSS devices are not in place or are bypassed, an OSP or TOSP is required.

The (T)OSP must spell out:

1. What is the Hazard.
2. What are the equivalent measures taken to provide the same level of protection as the PSS device being bypassed.

Other requirements for the (T)OSP are given in the EH&S manual.