E163

Laser Acceleration at the NLCTA

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Subject: Personnel Protection System (PPS) Access Control System for the E163 Experimental Hall

Authors: Eric Colby and Robert Noble

The design specifications for the E-163 Experimental Hall Personnel Protection System described herein have been reviewed and are approved.

Eric R. Colby, E-163 Spokesman — date: 3/1/2006

Robert J. Noble, E-163 Project Manager — date: 1 March 2006

Robert H. Siemann, E-163 Principal Investigator — date: March 1, 2006

Paul Miller, Accelerator Department Safety Officer — date: 3/3/2006

R. Keith Jobe, NLCTA Safety Officer — date: 3/3/2006

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The purpose of this document is to describe the PPS Access Control System for the E-163 Experimental Hall as it pertains to radiation safety. Although the Access Control System also includes laser light hazards, a completely separate, stand alone laser safety system (LSS) will be used to ensure personnel protection from laser light, and details of this function are not addressed in this document. All E163 electrical hazards shall be covered, and therefore not interlocked to the PPS.

Although laser hazards are not discussed in detail here, it is noted that the LSS will make use of the outer doors of the NLCTA and Experimental Hall access modules. The outer door magnalock will be controlled by the LSS under P/A, when a special Laser Test Mode has been enabled. An additional annunciator sign indicating Laser On will be mounted on the outer door of the Experimental Hall. The LSS is not built into the radiation PPS.

The E163 experiment will use electron bunches of maximum energy 70 MeV extracted from the Next Linear Collider Test Accelerator (NLCTA) and transported via a beamline into a separate shielded enclosure (referred to as the Experimental Hall in the following) built alongside the NLCTA (Figure 1). Since this beamline will link the NLCTA (labeled Zone 1 in the figure) to the Experimental Hall (Zone 2), the two PPS systems must be connected. The only source of radiation in the Experimental Hall will be beam originating from the NLCTA.

Beam shall be stopped from entering the Experimental Hall by three beam stoppers. The first stopper will be a bend magnet (BNDS1140), used to kick the beam 25° North of the NLCTA beamline, and into the Experimental Hall extraction beamline. The AC power line to the power supply that drives the magnet will be interrupted by two power contactors placed in series on the line side. The second and third stoppers will be full-power tungsten beam stoppers. The stoppers are driven in under their own weight, and are removed by supplying gas pressure to pneumatic cylinders that lift the tungsten stoppers up out of the beam path. The stoppers are approximately 25 radiation lengths long and completely shadow the available beam tube. Redundant air control valves will supply gas pressure such that both solenoids of the air valves must be powered by the PPS system before the stopper will lift out of the beam path. Beam stoppers are part of the radiation PPS, will be labeled as Radiation Protection Devices, and will require RSWCF's to repair or modify.

The Experimental Hall PPS system shall provide a Beam Permitted signal to the NLCTA PPS that will indicate that it is safe for the NLCTA to generate beam. The presence of this status is required for NLCTA beam. The loss of this status will immediately turn-off NLCTA PPS beam stoppers. The five NLCTA Beam Btoppers are the gun HV power supply and the four power supplies for RF stations 1 through 4, described in NLCTA Note #45 (March 31, 1995). The Beam Permitted state will be logically equal to:

((Experimental Hall Search-Reset=Set) AND
(Experimental Hall access state = No Access) AND
(Radiation warning announcement = Complete))
OR
(All three Experimental Hall Beam Stoppers read valid IN statuses)

There will be Emergency Off buttons in the Experimental Hall. The action of pushing an Emergency Off button in the Experimental Hall when in the No Access state will revoke the NLCTA beam permit, shutting off the electron beam and closing all Transport Line Stoppers thereby disabling the laser hazard in both enclosures.

The Experimental Hall PPS Access Control System will be a three state access system:

PERMITTED ACCESS	(P/A)
CONTROLLED ACCESS	(C/A)
NO ACCESS	(N/A)

Entry into the Experimental Hall is permitted when the mechanical beam stoppers are In and the bend magnet stopper is Off. If the In/Off status of any radiation stopper is lost when the enclosure is in PERMITTED or CONTROLLED ACCESS, then the NLCTA stoppers will be inhibited, the Experimental Hall PPS Access Control System will not allow transfer to other access states and Experimental Hall keybank releases will be inhibited. If the Experimental Hall is in NO ACCESS and the search reset status is violated when any stopper is Out/On, then the NLCTA stoppers will be inhibited until all Experimental Hall stoppers report In/Off status. NLCTA electrical hazard permits will not be affected by the Experimental Hall PPS.

The Experimental Hall has one entrance point (Fig. 1). However the PPS circuitry is designed to accept expansion to a second entrance if the experimental hall is expanded in the future. The entrance is a standard SLAC entry module located at the west end of the labyrinth for the Experimental Hall. The entry module contains an Outer Door, Inner Gate, Keybank, Access Annunciator panel, Door Control boxes, Emergency Entry/Exit buttons, Search circuit boxes, Telephone, Yellow/Magenta warning lights, and a video camera. The Outer door will use a magnetic lock (magnalock) controlled by the PPS. This device is an electromagnet which secures the door in the closed position.

The PPS Access state sign at the outer door shall be of the standard SLAC type—composed of preprinted translucent panels backlit by conventional lamps.

No flashing blue strobe light shall be installed at the outer door to indicate that the door release button is being pushed. Instead, a "door open" light will be installed near the outer door in a location that is readily visible through the video camera monitoring the PPS entrance.

PPS Control and Status Panels

The Experimental Hall PPS Access Control System will be operated from the SLAC Control Program (SCP), in conjunction with a Hardwired Enable switch, and an Experimental Hall Stopper Disable keyswitch. Status and control functions will be available in the NLCTA Control Room and in building 225, and possibly extended in the future to MCC.

The Hardwired Enable switch is a momentary push-to-make pushbutton in series with a keyswitch that is wired into the PPS. With the keyswitch in the Enabled (and captured) position, pushing and holding the Hardwired Enable switch then permits a SCP command to change PPS states (e.g. change from C/A to N/A or momentarily disable the door magnalock for a C/A entry). With the keyswitch in the Disabled position, the associated Hardwired Enable is inert, and SCP commands to change PPS states are ignored. The Hardwired Enable key is unique, and will travel with the PPS Log when PPS access control is transferred from one control room to another.

The Experimental Hall Stopper Enable switch will be a keyswitch located on the NLCTA PPS console and on the B225 console. Each switch has its own distinct key. With both keys in the "Enabled" (and captured) position, the keyswitches permit the Experimental Hall Stoppers to be pulled out (i.e. the beam hazard can be enabled). With either key removed or in the "Disabled" position, the Experimental Hall Beam Stoppers will be locked "in" (beam hazard disabled) and will not respond to commands to pull out.

Description of the status indicators and control switches is broken down by geographic area:

- **NLCTA Control Room**

The NLCTA control room PPS hardware panel shall have the following items:

1. Hardwired Enable pushbutton and Hardwired Enable keyswitch
2. Experimental Hall Stopper Enable keyswitch
3. Status panel, mounted in or close to the NLCTA PPS Console, showing one LED per state of the Experimental Hall PPS:
    - (NLCTA Beam Permitted)

- (P/A), (C/A), (N/A)
- (Stopper 1 In), (Stopper 2 In), (Stopper 3 In)
- (E/Os OK), (S/R Set), (Door Open), (Gate Open)

- **Building 225**

1. Hardwired Enable pushbutton and Hardwired Enable keyswitch
2. Experimental Hall Stopper Enable keyswitch
3. Status panel, mounted in rack B225-06 (approx 30' to the East of the PPS racks), showing one LED per state of the Experimental Hall PPS
    - (NLCTA Beam Permitted)
    - (P/A), (C/A), (N/A)
    - (Stopper 1 In), (Stopper 2 In), (Stopper 3 In)
    - (E/Os OK), (S/R Set), (Door Open), (Gate Open)

- **MCC (Future)**

1. Hardwired Enable pushbutton and Hardwired Enable keyswitch (future)

A hidden hardware control panel, accessible only to PPS personnel, will be located in the PPS logic racks (B225-02 and B225-03), and will be used by the PPS crew for maintenance and certification purposes only. Standard SLAC best practices will be employed relating to the protection of cable plant, locking of cabinets, redundant logic, etc.

Normal Entry & Exit Procedure for CONTROLLED ACCESS

Assuming that the Experimental Hall is in the NO ACCESS state, the following procedural steps will be followed to bail the enclosure to CONTROLLED ACCESS and make an entry:

1) All Experimental Hall Beam Stoppers will be set to their in/off state by the PPS operator.

2) The PPS operator will set the access state of the E163 hall to CONTROLLED ACCESS by pressing and holding the Hardwired Enable button, then pressing the Controlled Access button on the SCP panel. The Hardwired Enable button may then be released.

At this point access to the Experimental Hall is controlled by the PPS operator as follows:

a) Individuals requesting access to the Experimental Hall will be identified and logged in by the PPS operator via visual and audio communication at the point of entry.

b) The operator releases the keybank and, one key will be removed from the keybank by each individual. This key is to be kept in the personal possession of the individual throughout his/her stay in the housing.

c) One individual of the group will insert his/her key into the Door Control box. In concert with this action the NLCTA PPS operator will push and hold the Hardwired Enable button and release the door. The outer door can then be opened and the individual can remove and retain his/her key. Once all individuals have passed through the outer door, and the last individual entering has closed the outer door, the PPS operator can then release the Hardwired Enable push button.

d) To exit the Experimental Hall, an individual must contact the PPS operator, request to exit, and insert the key in the control box. In concert with this action the PPS operator will depress and hold down the Hardwired Enable button and releases the door. The individual exits through and closes the outer door. The PPS operator may release the Hardwired Enable button once the door has closed.

Note:

If for any reason the Hardwired Enable push button is released prior to the closure of the outer door, the search circuit will be faulted requiring a re-search of the Experimental Hall by qualified operators.

At this point individuals have satisfied all PPS controlled access procedures to enter the Experimental Hall. But since the enclosure is also a laser room, access to the enclosure may be determined by the status of the laser. Detailed procedures for making a Laser-On access are described in the Laser Safety System Design Specification for E-163.

Normal Entry & Exit Procedures for PERMITTED ACCESS

Assuming that the Experimental Hall is in the NO ACCESS state the following procedural steps will be followed to bail the PPS system to PERMITTED ACCESS.

1) All Experimental Hall Beam Stoppers will be set to their in/off state by the NLCTA PPS operator.

2) The PPS operator will bail the access state of the Experimental Hall to CONTROLLED ACCESS by pushing and holding the Hardwired Enable button, then pressing the Controlled Access button on the SCP panel.

3) The PPS operator then will bail the access state of the Experimental Hall to PERMITTED ACCESS by pushing and holding the Hardwired Enable button, then pressing the Permitted Access button on the SCP panel.

Setting this state automatically releases the SEARCH RESET status for the hall.

4) At this point, passage into the Experimental Hall through the outer door is uncontrolled, unless the Laser Safety System is set to Laser Test Mode. Procedures for access in Laser Test Mode are described in the Laser Safety System Design Specification for E-163.

PPS Security Fault Violations

A PPS SECURITY FAULT violation can only occur in the NO ACCESS, or CONTROLLED ACCESS states.

A SECURITY FAULT violation in the NO ACCESS state is defined as :

(1) Operating the Emergency entry/exit button at the outer door located at the Experimental Hall Access Module.

(2) The act of opening the inner gate at the Experimental Hall Access Module. Security Faults for this action occur in NO ACCESS only.

(3) The act of opening the outer door at the Experimental Hall Access Module. Security Faults for this action occur in No Access and Controlled Access without a door bypass.

(4) Operation of any EMERGENCY BEAM SHUTOFF push button inside the Experimental Hall and access labyrinth.

(5) Loss of Experimental Hall Keybank Complete status.

Any of these SECURITY FAULT violations in the absence of valid Experimental Hall Beam Stoppers IN statuses will remove the PPS permits to all NLCTA and Experimental Hall radiation hazards. NLCTA electrical hazard permits will not be affected by the Experimental Hall status. All of the above SECURITY FAULT violations will result in a loss of the SEARCH status thus requiring a re-search of the Experimental Hall. The loss of SEARCH status does not change the access state.

A SECURITY FAULT violation in the CONTROLLED ACCESS state is defined as an Emergency entry or exit through the outer door located in the Access Module. A SECURITY FAULT violation will result in a loss of the SEARCH status thus requiring a re-search of the Experimental Hall.

The act of transferring the enclosure to PERMITTED ACCESS is in itself a security violation of the enclosure. Therefore no further violations are defined.

SEARCH CIRCUIT - Experimental Hall

The SEARCH circuit for the Experimental Hall is comprised of one SEARCH PRESET box located at the east end of the hall. A SEARCH RESET box is mounted outside the Experimental Hall at the Access Module entry. All preset and reset boxes will require a key for actuation. The search logic requires that the Experimental Hall be set to CONTROLLED ACCESS prior to any search activities.

The SEARCH RESET is complete when the following conditions are met.

(1) The SEARCH PRESET for the enclosure is set.

(2) The gate and door are closed.

(3) The Emergency Off buttons are reset.

(4) The Access Module keybank is Complete.

(5) The searcher outside the enclosure at the Access Module, and the PPS operator, at the control room console, push their respective SEARCH RESET button simultaneously to set the SEARCH RESET.

After the SEARCH RESET is set, setting the Experimental Hall back to PERMITTED ACCESS or having a SECURITY FAULT will trip the SEARCH RESET circuit.

Visual and Audio Warnings

Both visual and audio warnings will be activated when the access state of the Experimental Hall is set to NO ACCESS.

When the Experimental Hall is set to NO ACCESS the hall lighting will flash and a recorded warning message will be as follows.

"Attention. The BEAM is about to come on. Press the nearest Emergency Beam Shutoff button and call extension 2189 immediately."

(**2189** = NLCTA control room extension.)

The flashing lights and message will continue for 2 minutes. No permits to radiation hazards will be issued by the PPS until this message has timed out. If a security fault trips the search reset, then the warning message will be terminated, the hall lights will come on full bright, and no permits will be issued.

The PPS will have control of the fluorescent lighting in the Experimental Hall in the No Access state. When the state is (N/A)(Timer Running), the lights will flash; when the state is (N/A)(Timer Complete) the lights will be off; for all other states, the light switch at the entrance of the Experimental Hall shall control the lights.

PPS Keybanks

There is one keybank at the entrance of the Experimental Hall Access Module. The keybank is required to be COMPLETE in order to transfer between access states.

PPS Emergency Off

The EMERGENCY OFF circuit is comprised of at least three push button boxes located in the hall and the access labyrinth. The boxes inside the enclosure will be identified with signs EMERGENCY BEAM SHUTOFF .

With the hall in NO ACCESS, pushing any of these buttons will create a SECURITY FAULT. With the hall in CONTROLLED ACCESS the buttons are not active. Each push button station will be tested by the search team for trip status. The reset function of the EMERGENCY OFF circuit can only be done in CONTROLLED ACCESS.

PPS Emergency Entry/Exit

The EMERGENCY ENTRY/EXIT controls are located on each side of the outer door. Pushing these buttons will release the door magnalock allowing egress. With the Experimental Hall in NO ACCESS or CONTROLLED ACCESS states, making an emergency entry or exit will create a SECURITY FAULT.

Burn Through Monitors (BTM)

There are no Burn Through Monitors required for the Experimental Hall at this time.

Beam Shutoff Ion Chambers (BSOIC)

There are plans to use 3 BSOICs for the Experimental Hall. At the present time, at least two of the BSOICs will be existing NLCTA BSOICs moved to new physical locations (pending Radiation Physics evaluation and approval). There are presently 10 BSOICs assigned to various locations around the NLCTA housing and 2 unused channels available. If radiation levels exceed their preset threshold, the units will shut off all radiation hazards. Analog readout and reset function will be on the NLCTA control system. BSOIC analog levels will also be in the NLCTA Control System history buffer.

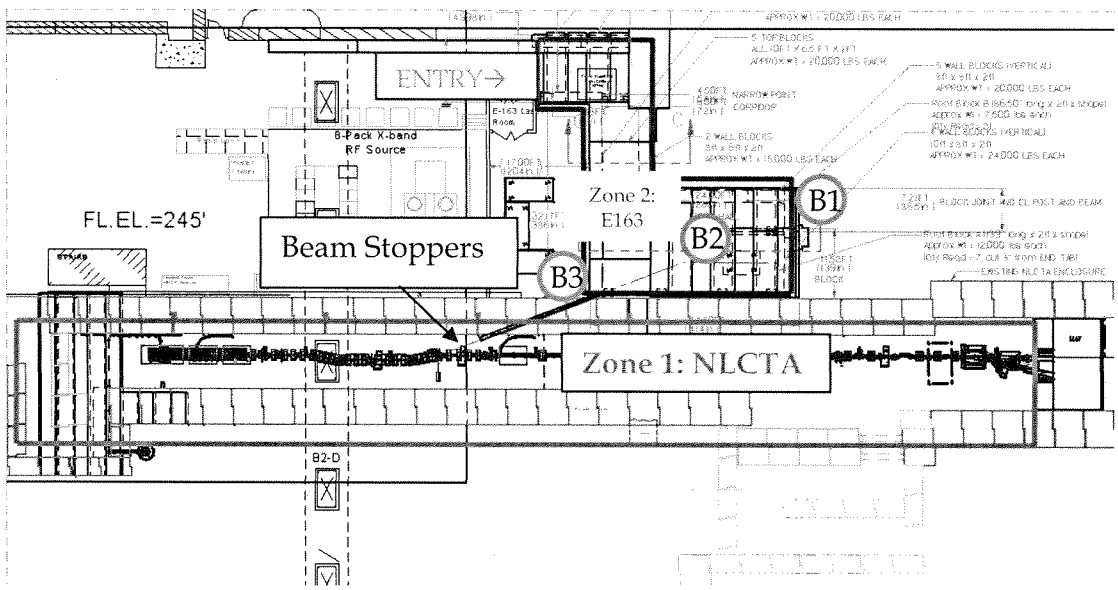

FIGURE 1. NLCTA and E163 Experimental Hall and PPS zone designations, and BSOIC locations. B1—outside at ground level, B2—outside, on the Experimental Hall roof, B3—inside Laser Room at Southeast corner.

Appendix: Radiation PPS interfaces with the E163 Laser Safety System

The NLCTA PPS system shall provide an Emergency Off Button Reset status signal to the E163 Laser Safety System (LSS). The loss of this status will result in the closure of all Transport Line Stoppers leading out of the

E163 laser room, and stop any laser light from reaching either the Experimental Hall or the NLCTA enclosure.

The NLCTA PPS system shall provide an NLCTA Ready for Laser Beam status signal to the E163 LSS that will be used to permit remote enabling of laser beam stoppers that protect personnel in the NLCTA enclosure. This status shall be logically equal to:

((NLCTA enclosure Search-Reset=Set) AND

(NLCTA enclosure access state = No Access) AND

(Radiation warning announcement = Complete))

The E163 PPS system shall provide an Experimental Hall Ready for Laser Beam status signal to the E163 LSS that will be used to permit remote enabling of laser beam stoppers that protect personnel in the Experimental Hall. This status shall be logically equal to:

((Experimental Hall Search-Reset=Set) AND

(Experimental Hall access state = No Access) AND

(Radiation warning announcement = Complete))