

# ARGONNE NATIONAL LABORATORY

## HIGH ENERGY PHYSICS DIVISION



### ARGONNE WAKEFIELD ACCELERATOR

#### AWA VAULT SAFETY SYSTEMS

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**AWA LINAC TUNNEL SAFETY SYSTEMS**

**I. INTRODUCTION**

The AWA accelerator facility in Building 366 is a pulsed-electron accelerator, which generates a 20 MeV beam with a pulse width of a few picoseconds.

Since the accelerator can accelerate high current pulses at high energy, it is capable of producing intense radiation fields. In addition, a laser hazard exists due to the laser beam directed onto the photo cathode electron source. To protect the personnel from these hazards, the accelerator is housed in a shielding enclosure.

The safety systems are designed to prevent access to the enclosure while the RF system is operating and allow only limited access to the area while the laser is operating.

In order to allow for tuning of various components the safety system is designed to operate in three modes:

- A. Laser Only Mode allows the laser shutter to be opened while preventing the accelerator from operating. Personnel have access to the tunnel, under controlled conditions, to make adjustments to the laser system in this mode.
- B. RF Only Mode allows the RF system to operate while preventing the laser shutter from opening to prevent any possible beam acceleration while tuning and/or testing the RF system. Personnel are denied access to the tunnel in this mode.
- C. Beam Mode allows the RF system to operate and opens the laser shutter. Personnel are denied access to the tunnel in this mode.

The mode of operation is selected by a rotary switch located in the control room. An individual must assure that this switch is set to the proper mode before attempting to secure the tunnel.

**II. DESIGN PHILOSOPHY**

The safety system for the AWA Linac Tunnel is designed to protect personnel by:

- A. Assuring that any occupant of the tunnel is given a warning before the accelerator can begin operation or the laser beam is allowed into the area, depending on the mode of operation selected.
- B. Providing the means for someone in the tunnel to prevent either mode of operation from starting.

- C. Controlling personnel access to the tunnel during “laser only” operation.
- D. Preventing personnel access to the tunnel during “RF only” and “beam” operation.

### III. HARDWARE

The safety system for the AWA Linac Tunnel consists of:

- A. Interlock system - the main purpose of this system is to control access to the tunnel during “laser only” operation and to prevent access to the tunnel during “RF only” and “beam” modes. Access to the tunnel is through either of two doors. The doors use a key operated electro-mechanical lock and switch. The doors must be closed and locked in order to satisfy the switch. The key is captive on a ring with the accelerator RF lockout key and the laser shutter control key, assuring that these systems must be off in order for the key to be available to open the doors. A timed electrical door release is provided, which will allow door #2 to be opened briefly in “laser only” mode, to allow personnel to access the tunnel to make adjustment to the laser system. In addition, magnetic switches are mounted at each door. Opening either door will de-energize one of these switches and provide the same type protection as the key operated switches.
- B. Safety Switches - placing any safety switch in the SAFE position will prevent the RF system from operating and the laser shutter from opening. Boxes containing six safety switches each are located adjacent each of the access doors. All switches must be in the RUN position for any operation to occur.
- C. Survey and Closure System
  - 1. Laser Only Mode - once entrance to the tunnel has been made, except during the timed release mentioned above, a SURVEY must be made in order to secure the tunnel and allow the laser shutter to be opened ALL safety switches must be in the RUN position. Door #1 is closed and the individual making the survey proceeds through the tunnel, checking that no personnel are in the area, to door #2 which he immediately closes. Closing both doors will activate a rotating light and audible alarms (Sonalerts). This warns all personnel that the area is going to become a hazard area.

Once the warning system begins operating, all personnel have 30 seconds to leave the area or pull the EMERGENCY OFF CABLE before the laser shutter is opened. Once the warning sequence is completed, the key operated laser shutter control switch may be activated. Since the laser shutter key, the access door key and the RF lockout key are on the same ring, the RF system cannot be operated or the door unlocked with the key.

Typical laser system area access is possible by pressing switches inside and outside door #2 which activate a timed electrical door lock release. An individual may open the door and exit or enter and reclose the door during this period without interrupting laser operation. This electrical door release is operational only in "laser only" mode.

2. RF Only Mode - once entrance to the tunnel has been made a SURVEY must be made in order to secure the tunnel and allow the RF system to operate. If all safety switches are in the RUN position, pressing the START SURVEY button adjacent to the closed door will activate a rotating light and audible alarms (Sonalerts). This warns all personnel that the tunnel is going to become a hazard area.

Once the START SURVEY button is pressed, all personnel have 30 seconds to leave the area and close the remaining door. If the tunnel is not secured within the 30-second period, the survey will cancel and a new survey will be required to restart the sequence. Once the survey is completed with the doors properly closed, the interlock system is complete and the RF system can be activated. A SURVEY can be canceled, and RF operation blocked, at any time by pulling the EMERGENCY OFF CABLE. Since the RF lockout key and the access door key are on the same ring, the door cannot be unlocked with the key while the RF system is operating.

3. Beam Mode - the "beam" mode sequence is identical with the "RF only" mode except that when the SURVEY is completed the laser shutter will automatically open.

#### IV EXTERNAL WARNING LIGHTS

- A A rotating red light is mounted adjacent to each access door indicating the tunnel has been secured for hazardous operation.
- B. An illuminated sign is mounted adjacent to door #2 indicating that the laser shutter is open.

#### V. TESTING PHILOSOPHY

A successful test of the AWA Linac Tunnel Safety System should consist of a meaningful attempt to prove the mechanical/electrical functions of the hardware used in both the manual safety devices and automatic safety devices.