NEW PERSONNEL INTERLOCK SYSTEM AND PROCEDURES FOR THE RPI LINAC LAB*

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Summary

Experience indicates that periodic modification to personnel interlock system operating procedures (nuisance modifications) increase user awareness. A modular interlock system which permits easy modification of the forced inspection sequence has been designed and installed at the RPI Accelerator Laboratory. The system provides for forced area inspection within specified time periods. Audible signals alert workers when the inspection is in progress.

Rensselaer Polytechnic Institute's Linear Accelerator Laboratory consists of a nine section microwave electron Linac and support equipment. The laboratory is extensively equipped to do high flux neutron experiments, and its present primary mission is research on fast breeder reactor technology and neutron cross-sections. The Linac is capable of over 50 kilowatts of average beam power output. Peak neutron production is greater than 10^{14} neutrons per second, and gamma dose rates of (10^{9} Rad/s) are normal in the target area. These extremely high radiation field conditions make an effective and foolproof personnel interlock system an absolute necessity.

A new personnel interlock system has recently been installed at the RPI Linac Lab to augment the existing system. The new system's design reflects modernization of the philosophy of personnel protection in two ways:

1. Human safety should not be entrusted to one or more persons following a written routine.

2. Even mechanized systems become routine after a time and hence lose their effectiveness.

The existing interlock system functions as follows:

1. Each experimental group must designate one of its members as "crew chief" for each operating shift. The crew chief is directly responsible for personnel safety.

2. Upon the decision to close the target and accelerator rooms for operation (see Fig. 1), two of the three doors are closed and the interlocks at those doors are completed.

3. The crew chief then enters through the open door and visually inspects both the target and accelerator rooms.

4. The crew chief then leaves via the open door and closes it with the Linac control key. (The motor driven doors may be opened or closed only with the same key which activates the accelerator control console: only one key exists) a loud fire gong sounds as the large concrete doors are closing.

5. When the door is completely closed, the interlock is completed by inserting a plug into a wall socket. The plug is chained to the door and may be inserted only when the door is fully closed. Upon completion of this final interlock a fire siren sounds in the protected area for 30 seconds. As soon as the siren starts, the machine is armed and ready to operate.

The protection afforded by this system is considerable, but there are obvious flaws:

1. There is no way of indicating to Lab personnel that an inspection is in progress and that therefore the target room is not to be entered.

2. Due to the large amounts of equipment in the target room an unconscious person might escape the notice of the crew chief.

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3. It is possible to turn the accelerator on even before the siren stops, without allowing a certain amount of time for a trapped person to pull an interlock plug.

The new interlock system, it is felt, does away with these problems, the operation of the new system is as follows:

1. The crew chief closes two of the three doors as before.

2. He then presses a button at the third door, which starts a sonic alerting system throughout the building to indicate that an inspection is in progress. Also, lights at various locations indicate interlock status, such as through which door the inspection is being performed.

3. The crew chief must then enter the target room and press a number of area interlock buttons at various places in the target and accelerator rooms. The button stations are placed in locations which are most likely to be overlooked. Furthermore, the button stations are capable of being moved to conform with changes in the experimental configuration of the target room areas.

4. The crew chief has a fixed amount of time in which to push all of the buttons. If this time limit is exceeded, the system resets itself and the sequence must be repeated from step 2.

5. Upon completion of the inspection the door is closed and the siren sounds as in the old system. Unlike the old system, however, the machine is not operable until the siren has turned off, thereby affording a trapped person a definite time in which to break the interlock chain.

6. The new system also incorporates a fast entry and exit feature to allow for the changing of experimental samples. The crew chief must stand at the open door and hold down a push button while another experimenter enters the target room. His presence at the door prevents anyone from entering unnoticed. (The accelerator interlock, it must be noted, still prevents operation of the machine with the door open).

The second function of the system is to prevent loss of effectiveness of the inspection procedure. The system is periodically changed by moving the area interlock buttons from place to place; deleting some stations and adding others.

Mechanically and electrically the system is straight forward. Relays and motor driven time delays are used for maximum reliability and simplicity of problem diagnosis and repair. More sophisticated devices might suffer from radiation damage from the high dose rates in the target room. Avoidance of radiation damage problems would necessarily lead to longer cable runs and complication of the system.

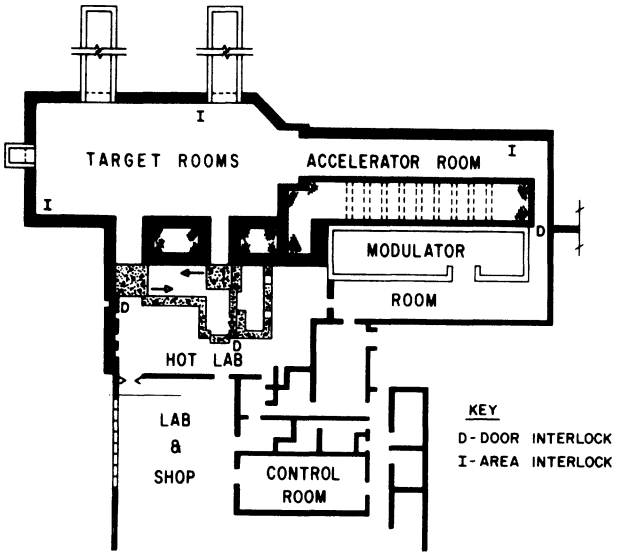

Figure 1. Floor Plan of the Protected Area.