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RECENT ADVANCES IN REMOTE HANDLING AT LAMPF

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INTRODUCTION

The Clinton P. Anderson Meson Physics Facility (LAMPF) has operated at beam currents above 200 microamperes since 1976. Since then the radiation levels have steadily increased from 100 mR/hr to levels that exceed 10,000 R/hr in the components near the pion production targets. During this time the LAMPF remote handling system, Monitor, has continued to operate successfully in the ever-increasing radiation levels, as well as in more complex remote-handling situations.

This paper will briefly describe the evolution of Monitor and specifically describe the complete rebuild of the A-6 target area, which is designated as the beam stop, but which also includes isotope production capabilities and a primitive neutron irradiation facility. The new facility includes not only the beam stop and isotope production apparatus, but also facilities for proton irradiation and an expansion in neutron irradiation facilities.

BRIEF HISTORY AND DESCRIPTION OF MONITOR

The Monitor system was developed during 1975 and 1976 and was placed in operation in the fall of 1976. It then consisted of a hydraulic servomanipulator and a small electromechanical manipulator mounted on a one ton hydraulic crane. It was totally controlled from two racks and a simple master arm. Although we were able to do useful work with this system, further improvements were made to extend the capability to its present state.

The first major improvement was the acquisition of a pair of electric master-slave servomanipulators with force feedback, which increased both the speed and the dexterity of the operations. The next step was to add a more complete control room, mounted in a trailer, which provides an isolated, relatively comfortable place to do the tedious, demanding job of remote handling. We next added a second identical unit to allow simultaneous work at two of the four target stations. The final step provides a third system with all of the capabilities of the other two, but is totally self-contained and able to do remote handling at any location.

Each of the Monitor systems is composed of a slave unit that places the manipulators at the work location, provides video coverage of the area of interest, and gives audio feedback of the operations being performed. A master station provides control of the manipulators, as well as the video systems, tool operations, and other vital functions necessary to complete various remote tasks. Interconnecting wiring between the master and slave units includes the manipulator closed-loop servo signals, video signals, numerous on-off signals for tools, camera pan and tilt, and the hydraulic crane controls. This cabling is normally about 100 meters long, but can be extended to several hundred meters if required. Each control function has been individually hard-wired between the units, but the operational testing of a multiplexing system for camera controls is presently being performed.

REBUILD OF A-6

The A-6 cell was originally designed with a beam stop, an air-cooled vacuum-to-air window, nine stringers for medical isotope production, and three radiation damage stringers for neutron irradiations to study radiation damage. Eventually a water-cooled vacuum-to-air window and 20 cm water target, to enhance neutrino production, were added. Since access to these components required about ten shifts to move the shielding door and the stacked steel shielding, the turnaround time for repairs was almost two calendar weeks.

In recent years, there has also been considerable interest in developing a larger scale capability to do both neutron and proton irradiations of materials. This has been partly driven by a collaboration between LAMPF and other laboratories around the world.

From October 1984 to early March 1985, the Monitor system was used to remove all items from the A-6 target cell. These included a 100,000 R/hr beam stop, other beam line components with levels up to 8000 R/hr and about 600 metric tons of steel activated up to 1000 R/hr. In addition to the enormous task of removing the items, the original installation included shielding that was not only welded in place, but had no lifting eyes or eyebolt holes. The solution to the required removal was to remotely grind and flame-cut the steel into manageable pieces, then remotely arc weld lifting eyes to each piece.

After removal of all the required items, the area was prepared for the installation of the new system. This preparation included remotely preparing and welding a cap on a vacuum pumpout line, which will not be used in the new arrangement. Also, to provide sufficient room for the new installation, about 15 meters of remote flame cutting of steel up to 0.25 meters thick was successfully completed.

The new A-6 area allows major component replacement in one or two shifts as opposed to the original two weeks. In addition, three proton irradiation and twelve neutron irradiation ports were added.

From March to early May 1985, the successful reinstallation of the new facility was completed and it has been in successful operation since. The first of the experiment exchanges will take place in July 1986.

CONCLUSIONS

With the now routine accomplishments of the Monitor system and the ingenuity of the operating crews in solving the considerable problems of the recent facility changeover, this technology can be extended to other hazardous environments.