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RECENT ADVANCES IN REMOTE HANDLING AT LAMPF

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Abstract

The Clinton P. Anderson Meson Physics Facility (LAMPF) has operated at beam currents above 200 microamperes since 1976. As a result, the main experimental beam line (Line A) has become increasingly radioactive over the years. Since 1976 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 with more complex remote-handling situations.

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

Monitor has developed from a system capable of simple tasks, such as removing bolts and pipe fittings, to a system capable of performing anything that can be performed by a high-class technician. The recent total rebuild of the A-6 area expanded that capability to include arc welding, with our manipulators, remote welding of vacuum joints, and oxyacetylene cutting of steel structural members up to .25 meter thickness.

Brief History 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 the two racks and a simple master arm as shown in Fig. 1. 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, nearly completed, provides a third system with all of the capabilities of the other two, and is totally self-contained, hence can do remote handling at any location.

The Present State Of Monitor

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. Figure 2 shows a Monitor slave unit in its present form. A master station provides



Fig. 1. Original Monitor systems.

control of the manipulators, as well as the video systems, tool operations, and other vital functions necessary to complete various remote tasks. Figure 3 shows the present control room configuration. 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. At present each control function is individually hard-wired between the units, but development of a multiplexing system is under way.

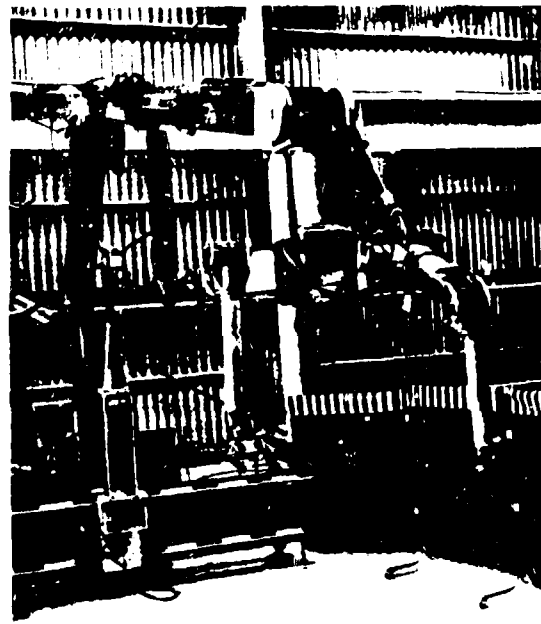


Fig. 2. Monitor slave unit.



Fig. 3. Monitor control room.

Functional Capabilities Of Monitor

Monitor provides the same capabilities as a high level technician, but can safely perform the work in highly radioactive, toxic, and other hazardous environments.

The routine items of work that Monitor can perform are:

- loosening and tightening of bolts, nuts, tube fittings, and bolted flanges using both hand and powered wrenches;
- soldering, soft and silver, using both torch and resistance heating methods;
- sawing with rotary, band, and reciprocating equipment;
- grinding, wire brushing, and polishing with commercial and specially designed equipment;
- welding, including metal inert gas and stud, primarily using unmodified commercial equipment;
- rigging of shielding as well as components, from a few grams to 25 tons;
- vacuum leak checking; and
- drilling and tapping in a variety of materials.

A-6 And New Capabilities

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 up to 8000 R/hr, and about 600 metric tons of activated steel 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 grind and flame-cut the steel into manageable sizes, then arc weld lifting eyes to each piece.

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

From March to early May 1985 the successful reinstallation of the new facility was completed and is just going into operation.

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.