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LABORATORY INSTRUMENTATION MODERNIZATION

AT THE WPI NUCLEAR REACTOR FACILITY

A Report to the Department of Energy

Office of University and Science Education

University Reactor Instrumentation Program

DOE Contract No. DE-FG02-93ER79214

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DISCLAIMER

INTRODUCTION

With partial funding from the Department of Energy (DOE) University Reactor Instrumentation Program (DOE Grant No. DE-FG02-93ER79214), several laboratory instruments utilized by students and researchers at the WPI Nuclear Reactor Facility have been upgraded or replaced.

Designed and built by General Electric in 1959, the open pool nuclear training reactor at WPI was one of the first such facilities in the nation located on a university campus. Devoted to undergraduate use, the reactor and its related facilities have been since used to train two generations of nuclear engineers and scientists for the nuclear industry. The low power output of the reactor and an ergonomic facility design make it an ideal tool for undergraduate nuclear engineering education and other training. The reactor, its control system, and the associate laboratory equipment are all located in the same room.

Over the years, several important milestones have taken place at the WPI reactor. In 1969, the reactor power level was upgraded from 1 kW to 10 kW. The reactor's Nuclear Regulatory Commission operating license was renewed for 20 years in 1983. In 1988, under DOE Grant No. DE-FG07-86ER75271, the reactor was converted to low-enriched uranium fuel. In 1992, again with partial funding from DOE (Grant No. DE-FG02-90-ER12982), the original control console was replaced.

DESCRIPTION

As with most small university research reactors, the WPI reactor operates with a very limited budget that provides little revenue for new equipment. Prior to obtaining the DOE grant for the reactor control console replacement, any equipment funding available in the reactor operations budget was utilized for repair or replacement of reactor control instrumentation. For over a decade, funds spent on equipment related to the reactor were unfortunately at the expense of peripheral laboratory equipment. With the exception of two germanium detectors, the newest equipment used to teach students the principles of radiation detection and analysis had been 15 yr. old.

Beginning in 1991, one year after DOE funding became available for reactor control instrumentation, the limited equipment funding available in the WPI reactor operations budget was appropriated to replace aging laboratory equipment. Over a two year period, approximately $4,000 per year was expended to upgrade five student-utilized single channel analyzers. In addition, four previously owned multichannel analyzer (MCA) cards and software for computer-based multichannel analysis were purchased.

With funding from this most recent DOE grant, several additional laboratory equipment purchases were made. In order to maximize use of the DOE funds, prices from various vendors of each item were compared to obtain the lowest cost. The following equipment was purchased to complete and augment the upgrade of four student-utilized laboratory stations: memory upgrades from 1000 to 2000 channels for two of the aforementioned MCA cards, four personal computers (386SX - 33 MHz) were purchased for use with the MCA cards to establish PC-based MCAs, and two NaI crystals with P-M tubes. Two personal computers (486DX 50 MHz) were purchased to replace two aging computers (8086 - 8 MHz) used with germanium detectors for neutron activation analysis performed by both students and researchers. A malfunction-prone 20 yr. old gas proportional alpha-beta counting system used by both students and researchers was replaced with a new low-background model. Lastly, a portable neutron radiation detector was purchased to replace a malfunctioning unit used for radiation survey measurements. A cost breakdown of all items is presented in the appendix.

With the funding from this grant, the first phase of modernizing the rector facility laboratory equipment has been completed. A second phase will be required to fully modernize the educational capabilities of the facility. For example, the acquirement of technologies related to environmental monitoring and remediation (alpha spectroscopy, thermoluminescent dosimetry, etc.) would help train students for the emerging employment opportunities in this vital area.

CONCLUSION

It has been increasingly difficult to convince both potential students and visitors that nuclear engineering is a vibrant discipline with strong growth potential or that nuclear technology is safe and beneficial. This task becomes even more difficult when these individuals observe a nuclear facility that utilizes vintage equipment. It is indeed far more effective to teach students and make presentations to visitors using the technology of today. Unfortunately, training reactors such as the one at WPI cannot depend on research dollars for purchasing new equipment, nor can they rely on the host institution for major modernization investments. With the progression of instrumentation funding from the DOE, the smaller nonpower reactors will continue to fully modernize and proceed with their mission of meeting nuclear personnel needs.

Budget removed JK