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UPGRADE OF THE 327 POSTIRRADIATION TESTING LABORATORY AND 324 SHIELDED MATERIALS FACILITY

R. L. Daubert
Pacific Northwest Laboratory
P.O. Box 999
Richland, Washington 99352
(509) 376-3144

D. J. DesChane
Pacific Northwest Laboratory
P.O. Box 999
Richland, Washington 99352
(509) 376-3779

ABSTRACT

The Pacific Northwest Laboratory operates two hot cell facilities in Hanford's 300 Area. The Postirradiation Testing Laboratory and the Shielded Materials Facility are used for the examination and processing of irradiated fuels and materials. Major upgrades have been performed on these facilities to improve cost competitiveness, increase operational safety margins, and improve productivity. Current activities performed include irradiated fuels and materials nondestructive and destructive examinations, irradiated materials packaging and shipping, and fabrication of test specimens from irradiated materials.

INTRODUCTION

The Pacific Northwest Laboratory (PNL) is operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830. The hot cell facilities operated by PNL are located in the Hanford 300 Area laboratory complex near Richland, Washington. The facilities offer a wide range of services including irradiated fuel nondestructive and destructive examinations, irradiated structural materials testing and remote machining, and assembly of experiments containing irradiated components. These services are provided by two facilities, the Postirradiation Testing Laboratory (PITL) in the 327 Building, and the Shielded Materials Facility (SMF) in the 324 Building.

POSTIRRADIATION TEST LABORATORY

The 327 Building PITL[1] consists of three major service areas: the Main Operating Area, the Storage and Transfer Area, and the Basement Area.

The Main Operating Area (Canyon) has ten alpha-qualified steel cells (including one with an inert atmosphere) and three lead brick cells. The cells are free-standing and provide in-cell access via removable interchangeable plugs with plug-mounted equipment and accessories. The smaller cells can accommodate 3×10^3 Ci of mixed fission products and irradiated materials while the larger cells can accommodate 5×10^5 Ci. Adjacent auxiliary areas include a photography laboratory, machine shop, manipulator repair area, and semi-hot metallography facilities.

The Storage and Transfer Area provides for loading and unloading of shipping containers by means of either a 20-ton or 15-ton bridge crane. A Dry Storage Facility in this area provides for the storage of radioactive samples. The Storage and Transfer Area has three interconnected water storage basins and a remote decontamination chamber.

The Basement Area houses hot cell exhaust systems, radioactive liquid waste systems, laboratory power and utility services, and provides storage area for laboratory equipment.

The scope of services currently provided by the PITL are:

- Irradiated material machining (in-cell)
- Destructive examination of irradiated fuel and materials (inert atmosphere)
- Cladding mechanical property tests
- Radioactive (controlled area) machine shop
- Cask loading/unloading (underwater and via cell access)
- Remote tungsten inert gas (TIG) welding (in-cell) of Zircaloy, stainless steel, and refractory metals
- Irradiated material density measurements
- Irradiated material sectioning

- Decontamination of alpha and beta-gamma contaminated materials
- Decontamination of shipping casks
- Waste fuel consolidation and packaging services.

SHIELDED MATERIALS FACILITY

The SMF is located in the 324 building.[1] Shielding consists of 1.22-m (4-ft) thick high-density concrete in a monolithic, interconnected configuration. The airlock connects the south and east cells which have shield doors to allow access to each operating cell from the airlock.

The scope of services currently provided by the SMF are:

- Irradiated materials processing (receipt, inspection, cleaning, examination, sorting, packaging and transportation)
- Mechanical properties testing (tensile, fracture mechanics, creep, and impact, all at ambient or elevated temperatures)
- Transportation cask loading/unloading (offsite and onsite)
- Nondestructive examination (NDE) of irradiated fuels and materials (gamma spectroscopy, profilometry, visual examinations, photography and x-radiography)
- Remote in-cell TIG welding
- Remote wrapping of irradiated fuel pins
- Cask decontamination and maintenance
- Remote hazardous waste packaging services
- Storage for high-activity fuels and materials
- NaK fill station for test loops
- Helium leak testing of containers
- Waste fuel package welding and helium leak testing
- Test specimen disassembly and dosimeter recovery.

PITL UPGRADES

A numerically-controlled (CNC) milling machine (Figs. 1A and 1B) was prepared for in-cell use. The control system, including the programming key pad and the operator interface display, is located outside the cell, while the machining center itself is in-cell. This machine will facilitate the rapid and reproducible preparation of test pieces such as tensile specimens and compact tension coupons. Programmed control of these machining operations is expected to result in faster turnaround time and fewer operator errors. Much of the tedium currently associated with these operations will also be eliminated, thereby resulting in less operator fatigue and improved productivity. An additional advantage of considerable importance is the expected overall reduction in personnel radiation exposure. The reduction is expected because the operator is no longer required to remain in close proximity to the hot cell window throughout the entire machining operation.

Leitz model MM5RT metallographs were installed at the Shielded Environmental Radiometallurgy Facility (SERF) cell (Fig. 2) and C-cell. Leitz metallographs feature enhanced capabilities including 2X and 5X microphotography, microhardness flat field objectives, and large viewing screens for operator and customer convenience. When preparing mosaics and for detailed examination of specific areas of interests, flat field objectives provide increased quality throughput. Initial assessments by equipment operators and customers have been very favorable. The quality of photography provided by this equipment is reported to be greatly improved.

SMF UPGRADES

Software techniques were developed for increasing the throughput of an automated gamma scan system (Fig. 3). The software provides the ability to recover "lost" data after a computer "crash" by recovering data files not closed or recorded on the appropriate data disk directory. Providing this capability to the hot cell operator is particularly valuable during examinations of long-column, low-activity fuel and material sections that may require up to seven days to collect desired gamma ray spectrums. Recovery of "lost" data minimizes the time required to complete lengthy gamma ray profile examinations caused by computer failures. In addition, with specific editing of data files, sequential gamma scan examination data files can be concatenated to either provide the experimenter with true nuclide migration plots radially or over the axial length of sectioned irradiated fuel elements. This attribute is beneficial to experimenters concerned with nuclide migration in varying temperature and neutron flux profiles. In addition, a communications link was installed between the DEC PDP 11/34 computer and the IBM office computers. Analyzed gamma ray spectrometry data files, upon customer request, are transferred from the DEC to the IBM and sent directly to the customer via modems. Immediate data availability upon completion of nondestructive testing (NDT) examinations has significantly increased customer satisfaction.

FIG. 1A. Computer Numerically-Controlled (CNC) Milling Machine Control Console. Neg 8705086-6CN

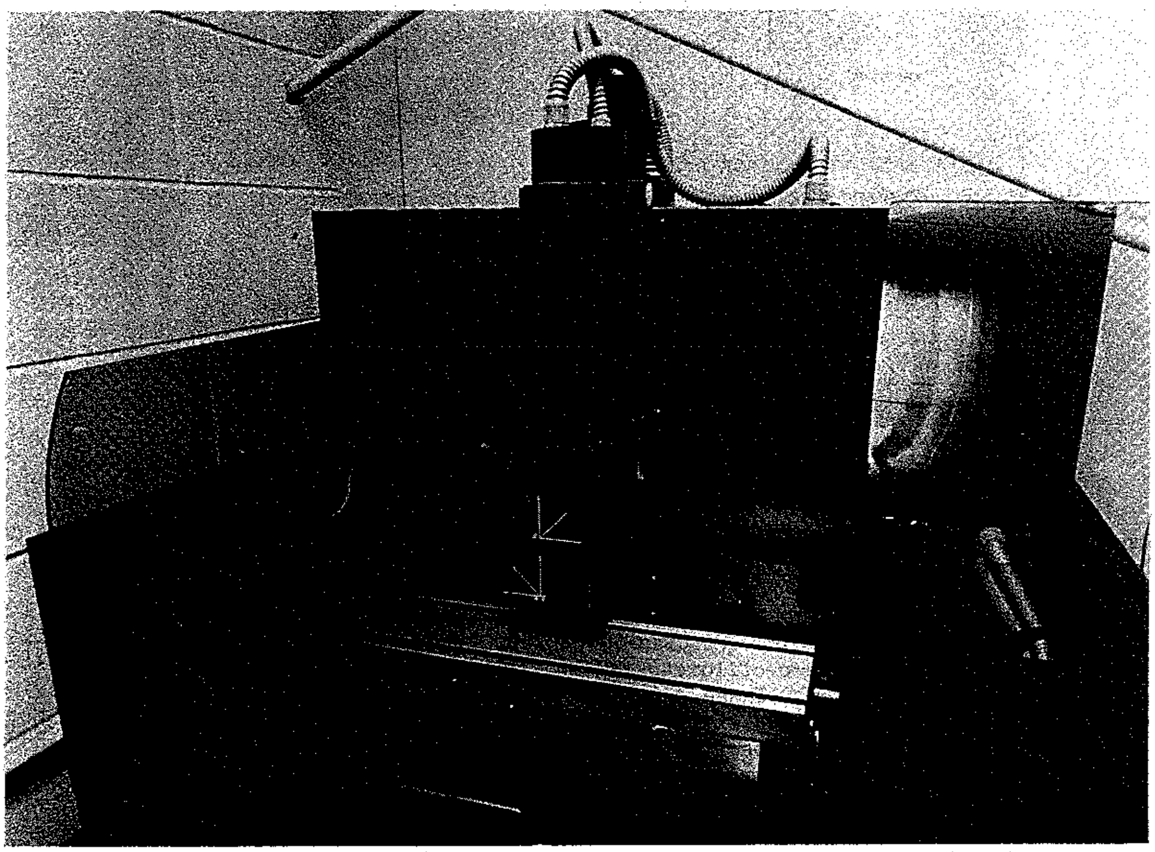

FIG. 1B. Computer Numerically Controlled (CNC) Milling Machine. Neg 8705086-8CN

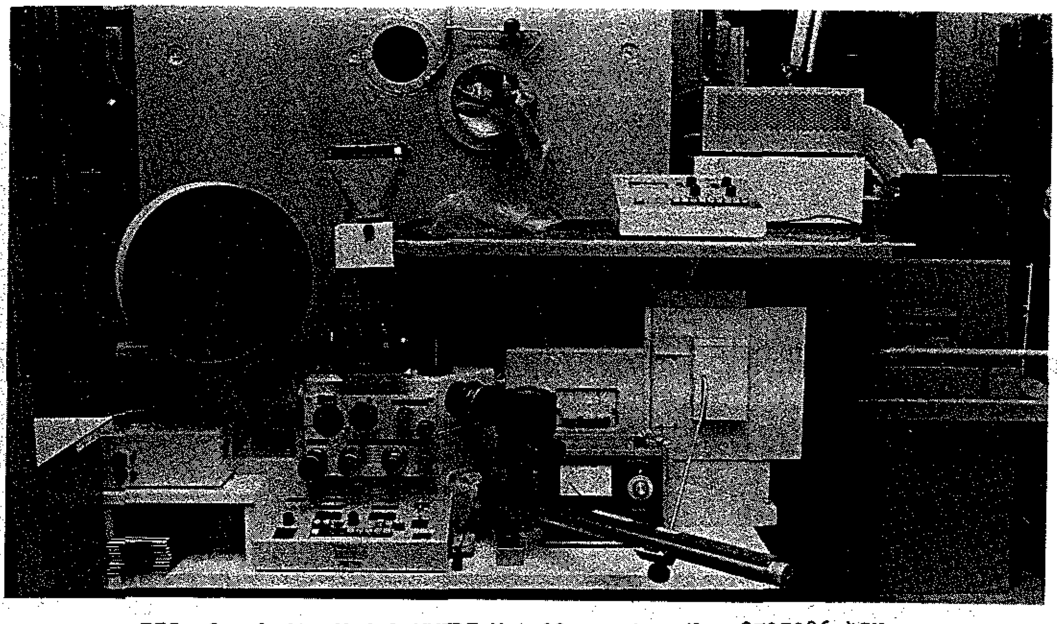

FIG. 2. Leitz Model MM5RT Metallograph. Neg 8705086-4CN

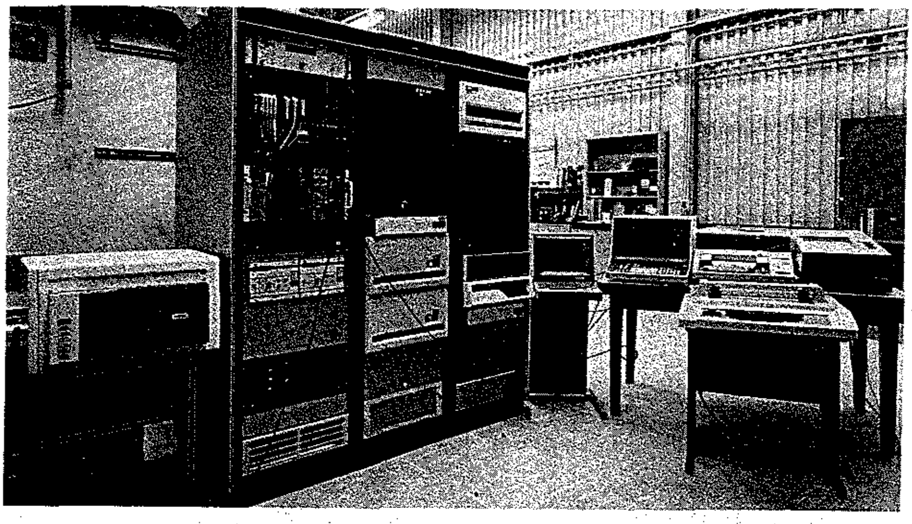

FIG. 3. Upgraded Automated Gamma Scan System. Neg 8101229-2CN

Computer systems were developed using the IBM XT and AT computers as defacto standards. The new systems have replaced data loggers in profilometry examinations (Fig. 4). The new systems provide technicians with hardware diagnostic capabilities and immediate profilometry plots upon examination completion. These enhanced features improve examination throughput, data reliability and provide experimenters with data analysis capability via computer systems capable of reading ASCII data. As previously mentioned, examination results can be sent immediately to any customer worldwide who has a telephone, a modem, and a receiving device.

Additional software programs were developed on the IBM for the inventory and disposition tracking of nuclear fuel and materials. The programs use a spreadsheet (LOTUS) to identify and track all entries on an accountability system. The system has demonstrated itself to be an invaluable aid to accountability personnel and is being further developed using conventional software (Symphony). The spreadsheet program approach is also used to locate a specimen stored in one of the hundred locations in the SMF or PITL. These office software tools were chosen for development over specific high-level language software programs for the following reasons:

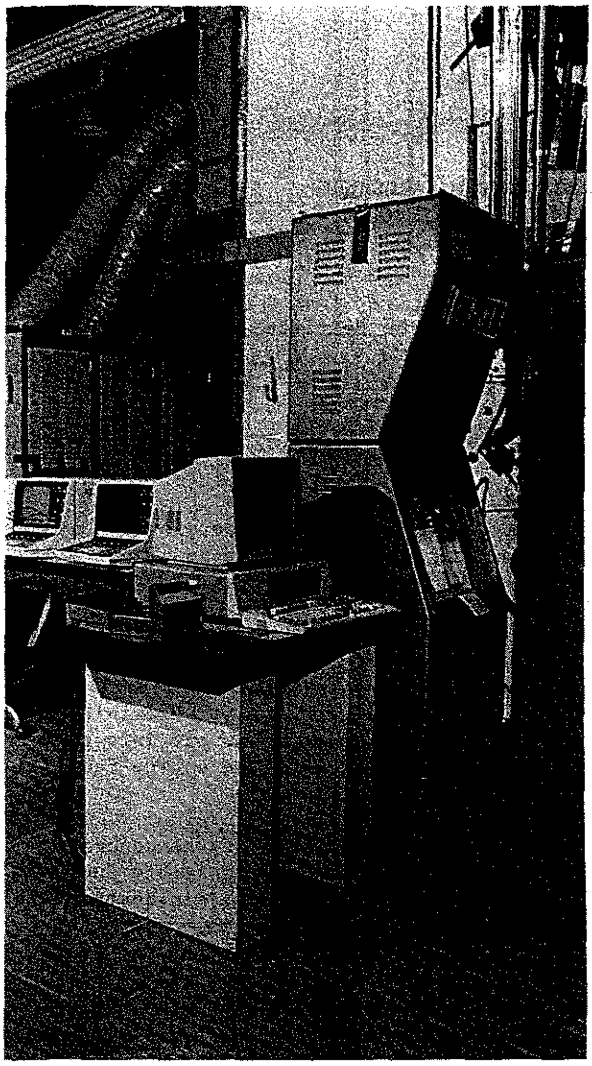

FIG. 4. Profilometer System Upgraded with IBM XT Data Acquisition System. Neg 8703084-15CN

1. Commercial software programs are inexpensive, readily available, and adaptable to many applications

2. Training of new personnel is straightforward

3. Modification of specific programs for new applications can be performed by staff personnel (not dependent on nondepartmental support).

Computers schedule equipment and facility preventive maintenance, personnel training, and program tasks. Automation of the administrative functions is increasing productivity by minimizing schedule conflicts and equipment downtime.

REFERENCE

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