LASL-77-36

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DO NOT CIRCULATE

PERMANENT RETENTION

REQUIRED BY CONTRACT

LABORATORY ACTIVITIES

Description of Work Done at LASL

by Division, Department, and Group

December 1977

los alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545

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UNITED STATES
DEPARTMENT OF ENERGY
CONTRACT W-7405-ENG. 36

AADP

ADMINISTRATIVE AUTOMATIC DATA PROCESSING

MS-241, ph. (505)-667-5234

Laboratory-wide computer services for administrative and business applications are provided by the AADP Department. The Department uses the CDC 6600 and CYBER 73 computers with the NOS time-sharing system. These computers, located in the CCF, are linked to AADP and to AADP users by a CDC-200 remote job terminal, a PDP-11/40 computer-based terminal, and numerous other ICN terminals, such as TI 700s. Also, an IBM 1401 computer, located in AADP-1, is used mainly for special forms printing and punching. At present, AADP is developing distributive computing concepts for the preprocessing and postprocessing of data. Current plans include the acquisition of intelligent terminals and minicomputers in the user community to provide more timely data and services not currently available.

AADP services are provided by two groups, AADP-1 and AADP-2.

AADP-1—AADP Operations

AADP-1 operates the AADP computing facility. The group provides for the timely processing of existing laboratory-wide AADP systems and the implementation of new systems.

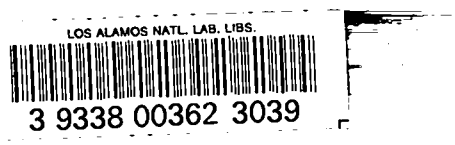
Present responsibilities include:

- data collection by either keyentry or keypunch with verification;
- setting up computer jobs for execution in the CCF by the CDC-200 or the PDP-11/40;
- processing over-the-shelf jobs on the IBM 1401;
- special handling for custom or rush jobs on predesigned forms, cards, and tapes;
- peripheral services such as sorting, interpreting, and bursting; and
- monitoring and controlling the job stream to ensure the accuracy of automated system output.

AADP-2—AADP Systems

The analysis, design, programming, documentation, installation, and maintenance of AADP appplications is provided by AADP-2. The group is divided into sections to provide the expertise and continuity necessary to develop and maintain major systems. Existing systems are as follows: Employee, Financial, Procurement, Property, and Miscellaneous. The sections are also responsible for feasibility studies, proposals, education of users, and administration of data.

The daily maintenance of existing systems requires about 35% of the group's time. Remaining time is spent developing data base management systems, primarily using COBOL and System 2000.



ADWPC

ASSISTANT DIRECTOR FOR WEAPON PLANNING AND COORDINATION

MS-630, ph. (505)-667-6120

The Assistant Director for Weapon Planning and Coordination is responsible for weapon concept and feasibility studies and weapon-development coordination. Technical liaison and systems analysis support these efforts. WPO coordinates the Laboratory weapon-development activities. WPC-1 conducts the concept and feasibility studies and WPC-2 conducts weapon effectiveness studies.

WPO—Weapon Program Office

WPO is responsible for coordinating all weapon development-engineering programs at the Laboratory, as well as certain other weapon programs. Each program has an assigned manager who operates out of this office and is responsible for coordinating his program with the appropriate DoD and ERDA agencies and for bringing all Laboratory capabilities to bear as necessary to assure a successful development program. The office staff performs such management support activities as scheduling, technical and financial planning, and program status review.

WPC-1—Weapon Concept and Feasibility Studies

WPC-1 is responsible for maintaining technical liaison with DoD agencies (including the Armed Services) and their contractors in the advanced stages of weapon development. Group members participate in concept feasibility and weapon feasibility (Phase 1 and Phase 2) studies with the DoD and are responsible for preparing Laboratory warhead proposals for these studies. They coordinate the study efforts within the Laboratory. The warhead proposals prepared for weapon feasibility (Phase 2) studies represent the laboratory's "bids" for these weapon-development programs, and assignment of warhead development to the Laboratory is based in part on these proposals.

WPC-2—Weapon Effectiveness Studies

WPC-2 evaluates the military effectiveness of proposed weapon systems and assists in formulating advanced weapon concepts. The group examines related political and economic issues to assess their influence on development of these systems. The purpose of these studies is to better understand new weapon requirements and to provide management with information needed for proper allocation of resources among Laboratory weapon programs. The group also does some evaluation of Laboratory research and technology programs to assess their effect on future weapon development. Group study efforts use information obtained from ERDA, DoD, and weapon-system contractors as well as information from within the laboratory.

AO

ACCOUNTING
MS-239, ph. (505)-667-4107

AO-1—Accounts Payable

The principal responsibilities of AO-1 are:

Accounts Payable. Cash disbursements of some $100 million annually are made for:

- materials and services,
- transportation,
- travel,
- insurance,
- management fee, and
- other expenses (except payroll) not covered by formal Purchase Orders.

The appropriate cost centers are charged for these expenditures. The group also clarifies payment problems with SP Department and through correspondence with the vendor. In conjunction with the commitment system, AO-1 records accruals on a daily basis and clears closed purchase orders from the system.

Accounts Receivable. AO-1 is responsible for billing, collection, and maintaining subsidiary ledgers for:

- returned merchandise,
- loss and damage claims,
- excess transportaiton charges,
- prepaid cafeteria food inventory,
- miscellaneous services performed for other organizations, and
- advance payments and other suspense accounts.

In addition, reports related to accounts payable and receivable are prepared periodically for ERDA, SP Department, auditors, and others.

Records Room. AO-1 maintains files of purchase orders, control vouchers, and check registers.

AO-2—Payroll

Major functions of AO-2 are to:

- promptly and accurately disburse LASL payrolls (approximately $115 million annually) and maintain associated records;
- maintain accountability for and disburse payroll deductions (Federal and State taxes, retirement and annuity contributions, insurance premiums, savings, and bond purchases);
- maintain sick leave and vacation records;
- answer employee questions on taxes, insurance, and retirement as these subjects relate to the payroll function;
- audit employee travel bills against attendance records and reconcile any discrepancies; and
- prepare payroll-related reports for ERDA, the University of California, LASL management, and other agencies.

To perform these functions, AO-2 maintains a "master file" of all LASL employees on magnetic tape, using data obtained from a variety of sources. A payroll data base is also maintained on System 2000 and updated at least twice a month. This data base provides the capability to interrogate files and generate reports by remote terminal.

AO-3—General Accounting

AO-3 is responsible for general financial reporting and control. The following specific areas are involved.

Coding. The group examines all vouchers, purchase orders, job orders, and other documents to verify that coding is correct. Coding includes

balance sheet, cost center, expense, program, transaction, and source codes. A computerized voucher edit system is used in connection with this function.

Commitment System. Outstanding commitments are maintained on a System 2000 data base and updated daily to permit retrieval of current commitments by remote terminal. A0-3 is responsible for the daily input of purchase orders, as well as the accuracy of purchase order and job order data contained in the system.

General Ledger. The general ledger presents current month and year-to-date accounting transactions by account and cost center. AO-3 is responsible for the preparation, review, and maintenance of this ledger.

Operating Statements. The group is also responsible for preparation of monthly operating statements. Form Bs—which change labor to programs—are reviewed and processed. Based on Form B distribution, all costs not 'direct charged' are distributed to programs. Operating statements are then prepared reporting monthly and year-to-date operating costs by cost center and program code. The operating statement data base, which is also used by the Financial Management Office in the preparation of budget status reports, is monitored and maintained by AO-3.

Financial Reports. AO-3 is responsible for preparing most "official" financial reports submitted to ERDA and the University of California. This includes the Management Information System/Financial Information Subsystem (MIS/FIS) report which converts all LASL costs for the month to ERDA reporting requirements.

Stores Control. The group is responsible for monitoring ADP input related to stores activities and distributing resulting ADP data and reports. In addition, AO-3 is responsible for the accuracy of the detail, daily balances, price updates, and variance levels.

Job Order Control. AO-3 is responsible for maintaining data input to the SD and E Division job order systems and making monthly voucher adjustments to ensure that the systems generate proper management information.

Equipment Budget Control. AO-3 is responsible for recording up-to-date information on equipment allocations, obligations and costs, and for assuring that no budget overruns occur. The group is also responsible for preparing monthly reports in detail and summary form.

Other Reports and Controls. Special subledgers and reports are prepared for bank accounts, returnable container deposits, cafeteries, high explosives, and shielding materials.

AO-5—Property Accounting

The basic function of AO-5 is the financial control of LASL property. The following are specific responsibilities.

Plant. AO-5 is responsible for maintaining current information on additions, deletions, transfers, and reclassifications of plant items (buildings, fixtures, land improvements, and utilities) with a total value of $191 million. In this connection, the group reports budget activity on new construction (valued at $175 million) and general plant projects ($2 million) and is also responsible for classifying and distributing to appropriate fixed asset accounts the costs of completed construction projects transfered to LASL from ERDA.

Equipment. Similar records are kept on 115,000 pieces of LASL capital equipment valued at $287 million. A property management data base is also maintained on System 2000, permitting inquiry and report generation by remote terminal. A related function is the maintenance of the Standard Nomenclature and Code Catalog for Normal Equipment.

Physical Inventories. AO-5 is also responsible for the following physical inventories.

• *Plant and Equipment.* In accordance with ERDA regulations, equipment is inventoried every two years. Under the general direction of AO-5, these inventories are performed by the LASL groups charged with the equipment and are audited by AO-5 upon completion. AO-5 also participates actively in inventories of plant items, which are conducted on a ten-year cycle.

• *Stockrooms.* The group audits inventories of LASL stockrooms, reporting on the accuracy of each inventory and the general effectiveness of stockroom operations.

• *Cafeterias.* Periodically, AO-5 also audits Laboratory cafeterias.

AO-6—Transfers and Special Materials Accounting

AO-6 performs financial accounting functions related to:

• Source and special nuclear material inventories maintained by ADASF.

• Transfer accounts. AO-6 is responsible for management of ERDA field office and contractor transfer accounts, including monthly reconciliation of transfer relationships.

• Precious metals in stores, in use, in scrap and contaminated material inventory accounts maintained by SP Department.

• Reimbursable work. This function includes monitoring of fund authorizations, transferring, billing, and collection responsibilities for work and services performed for Federal agencies, integrated contractors, LAMPF users, and outside organizations.

• Excess property received from, and transferred to, ERDA field offices and contractors, and Federal agencies.

AO-8 Travel

AO-8 is responsible for administering all official Laboratory travel by employees, consultants, short-term visiting staff members, and visiting scientists. Specific duties are:

• review and administrative approval of travel requests;

• obtaining reservations for commercial transportation, rental cars, Ross flights, rail, and ZIA taxi service;

• furnishing travelers with cash advances and airline tickets;

• processing travel expense reports at the completion of the trip;

• handling collection of outstanding travel accounts;

• maintaining records for permits and insurance on private airplanes and automobiles used for official travel;

• processing travel vouchers and petty cash vouchers for one-day travel;

• providing services related to transportation and household goods shipment for employees joining the staff or changing duty stations and payment of associated costs;

• obtaining lodging reservations for official visitors to the Laboratory;

• providing travel assistance for Laboratory-sponsored meetings; and

• administering various travel policies and handling questions and complaints from travelers.

In addition to the above travel services, AO-8 processes fee and honorarium payments for official visitors. The Travel Office also participates in the development of Ross schedules.

AP-DIVISION

APPLIED PHOTOCHEMISTRY

MS-563, ph. (505)-667-6250

The objective of the Applied Photochemistry Division is to develop scientific technology in the area of Laser Isotope Separation (LIS) and laser-enhancement of chemical processes. The planning effort to date has been directed toward the development of an economically competitive alternative to conventional methods of uranium enrichment as well as investigation of laser methods for the separtion of isotopes of other elements and the more general field of laser-induced chemistry. Research in AP Division has generated a strong capability in laser physics, laser spectroscopy, molecular physics, laser photochemistry, fluid mechanics, physical chemistry, and related engineering.

AP-DOT

AP-DOT is a group of specialists who are primarily concerned with the application of analytical models and procedures to evaluate LIS concepts and plant systems. Members of AP-DOT also act as consultants and program advisors to AP-Division management and provide assistance to the various groups on special problems, such as infrared laser spectroscopy, analysis of detection systems, and the precise determination of laser wavelengths.

AP-1—Engineering and Process Research and Development

Group AP-1 is responsible for design, installation, and checkout of experimental systems and apparatus to be used in Laser Isotope Separation. The group also carries out basic research on supersonic flow systems, condensation, collection, instrumentation development, optical cavities, and isotope separation. The following four subsections compose AP-1:

- theoretical support;
- hardware and system design, drafting, and illustration;
- laser engineering; and
- research.

Working closely with groups AP-2,3, and 4, AP-1 designs new laser systems, optical mechanisms, and fluid handling systems for chemical lasers, as well as a variety of other experimental equipment required in various isotope separation schemes.

AP-2—Tunable Laser Research and Development

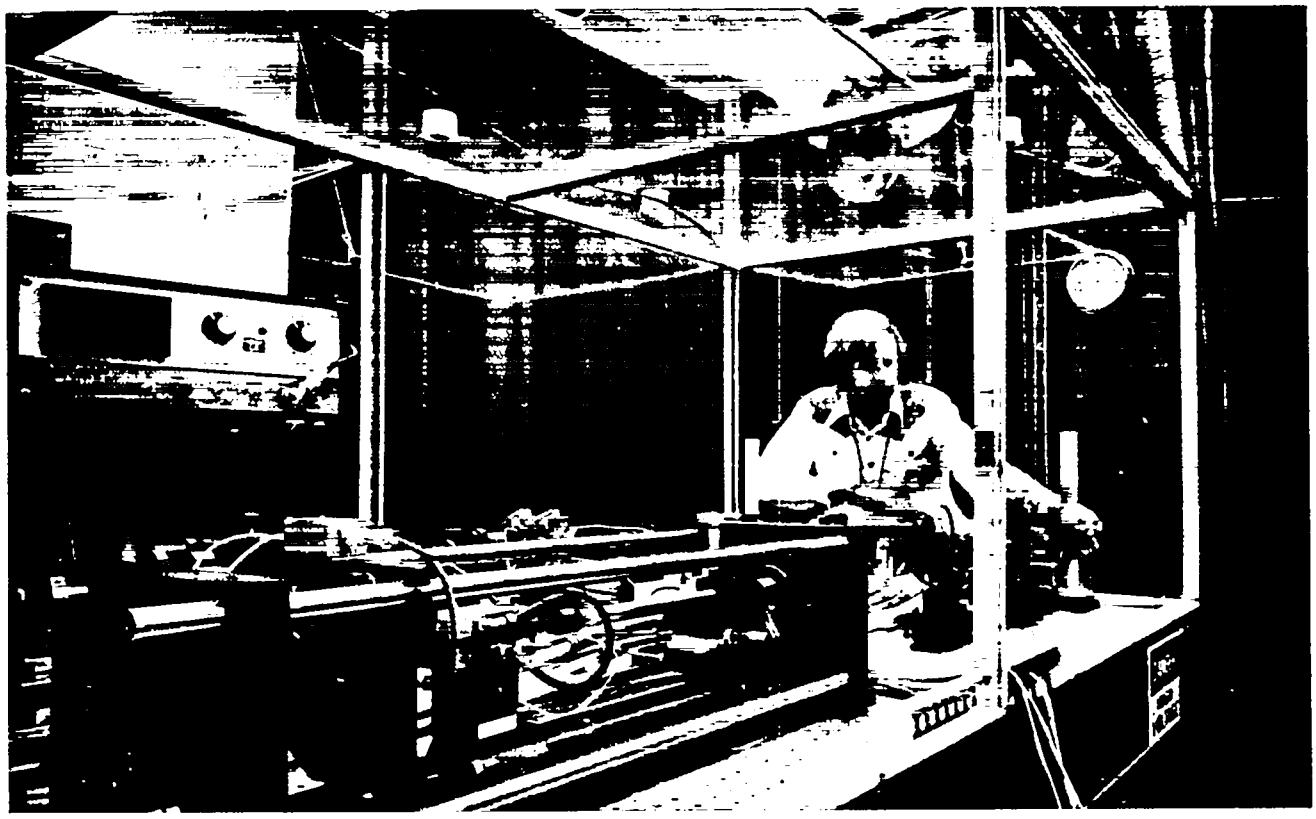
Group AP-2 has as its primary responsibility development of lasers at selected (or tunable) wavelengths to be used in the LASL Laser Isotope Separation Program. Several methods of producing pulsed infrared and ultraviolet radiation of the required wavelenghts and energy are being investigated. The methods involve electrical, optical, and chemical excitation of molecular and atomic species; Raman scattering from high-pressure gases and solids; and nonlinear optical processes, such as difference-frequency generation and optical-parametric oscillation.

AP-3—Laser Spectroscopy and Photochemical Process Research

Group AP-3 is engaged in spectroscopic and photochemical research on Laser Isotope Separation processes. Primary emphasis is on accumulation of the data base needed to demonstrate that laser enrichment of uranium is economically superior to conventioned methods. Spectroscopic information on uranium compounds is essential to define required laser frequencies and powers to effect a viable process. In addition, high-resolution spectroscopy is used to evaluate molecules that have been proposed as the active media for infared and ultraviolet lasers that employ electrical, optical, and chemical excitation.

Working closely with Groups AP-1 and 2, AP-3 conducts experiments in which lasers and diagnostic instrumentation are integrated with supersonic flow systems to carry out basic research on spectral excitation and photodissociation of uranium compounds. These studies are directed toward evaluating performance trade-offs among the important experimental parameters and toward verification of a model of the Mainline uranium enrichment process being developed in collaboration with Group T-12.

As part of this Program, a Laser Applied Spectroscopy Laboratory is being established. The Laboratory consists of several laser systems to provide high-resolution laser radiation with wavelengths from 0.2 to 20 μm. The lasers operate under computer control. Data acquisition and initial processing are also accomplished by the minicomputer that controls the laser. The powerful tunable laser systems are used for excited-state spectroscopy, laser isotope separation studies, and laser-induced chemistry.



One of the current experimental setups in the Laser Applied Spectroscopy Laboratory is the 400 mJ/pulse, 5 pps Nd:YAG pump-source for the $LiNbO_3$ angle tuned optical parametric oscillator. In the foreground is depicted the TEM_{00} mode, Q-switched laser oscillator.

AP-4—Laser Chemistry

AP-4 conducts research related to the applications of lasers in chemistry. Studies in molecular spectroscopy, gas, and condensed phase kinetics and photochemistry, molecular beam processes, and the preparation and reactions of interesting inorganic compounds are currently in progress. The focal point of the group's effort is chemical and spectroscopic research in support of the Laboratory's uranium Laser Isotope Separation Program. Unclassified work on laser enrichment of boron, sulfur, and other nonfissile isotopes is also carried on. These latter projects include detailed spectroscopic measurements, along with studies to elucidate the kinetics and mechanisms of appropriate chemical reactions. Both conventional and laser techniques are used to obtained detailed spectroscopic information in the infrared, visible, and ultraviolet regions. The spectra of various molecules in both gas and condensed phase are being measured. Research in the enhancement of chemical reaction rates by laser-excitation encompasses many types of measurement, including product analysis using time-of-flight mass spectrometry. Reaction rates and mechanisms are studied in static vessels, fast-flow-mixing systems, and, jointly with Group CNC-2, in crossed molecular beams. Excitation of reactants to higher electronic and/or vibration-rotation states is accomplished by various lasers ranging in output wavelengths from ultraviolet to infrared.

C DIVISION

COMPUTER SCIENCES AND SERVICES DIVISION

MS-260, ph. (505)-667-6164

C Division provides computing expertise and services in support of LASL's role as a leader in scientific research. To perform this function, C Division provides cost-effective access to both state-of-the-art large-scale scientific computers and software-rich general-purpose computers; develops and maintains hardware and software components of the Integrated Computer Network; provides support for LASL programs in applications areas closely related to the computer sciences; and conducts research in support of these activities.

C-1—Operations Support

Group C-1 is responsible for the operation of the CCF (Central Computing Facility) worker computers, peripheral equipment, ICN (Integrated Computer Network) computers, and all off-line, input/output equipment. The major computers include one CRI (Cray Research, Inc.) CRAY-1, four CDC (Control Data Corporation) 7600's, two CDC 6600's two CDC Cyber 70 model 73's, an IBM 1360 Photostore, an IBM 3850 Mass Storage System, and an IBM 370/148.

In addition to the major computers, C-1 also maintains the CCF Tape Library with a current inventory of approximately 50,000 magnetic tapes. The Operations Analysis Section of this group provides LASL management with statistics on CCF operations such as job mix, turnaround times, use of various priorities under the CCF allocation system, and accounting data.

C-2—Software Documentation

C-2 generates and supplies user documentation for the CCF systems. The technical writers and editors produce comprehensive user documentation. They work in close collaboration with systems and applications programmers and with members of the Word Processing Center and the Program Library. In addition, they produce publications in direct support of the C Division Office and do many special projects.

In addition to supporting C Division, the Word Processing Center provides education and guidance to the Laboratory in the area of word processing. This section also evaluates new word processing developments and recommends C Division policy for hardware and software acquisitions and enhancements.

The keypunchers are available for punching program and data decks for CCF users. In the near future this section will also provide a data entry service to accommodate the increasing emphasis on remote computing.

The C Division Program Library staff maintains source code, listings, abstracts, and write-ups for several libraries consisting of hundreds of subprograms. The staff also stocks and distributes all CCF documentation.

C-3—Applications Support and Research

Group C-3 is responsible for applications programming support, development and maintenance of mathematical routines in the Program

Library, software utilities, numerical analysis research, and ADP software.

The applications programming function develops software in response to user requests or in areas of interest to C Division or LASL. Typical examples of applications programming are: modifying programs developed at other installations so they will operate on LASL systems; redesigning or optimizing a program so that it will execute more efficiently; application of data base systems to Laboratory problems, vectorization of programs, and consultation with users on programming problems such as numerical abnormalities.

In other areas, C-3 develops and maintains all mathematical subroutines in the Program Library. The group upgrades the quality of these subroutines while emphasizing portability and commonality across all LASL systems. The utility section of C-3 develops and maintains software utilities on LASL systems. Utilities are systems programs that perform specialized tasks for the computer systems and for the users. The ADP section supports and applies software for administrative data processing, data base management, and project management.

C-3's numerical analysis research currently emphasizes the vectorization of algorithms. The group is also interested in the standardization of vector operators and software for their implementation. Other areas of numerical analysis research include: quadrature, numerical solution of nonlinear elliptic and parabolic partial differential equations, solutions of converging shock problems, and applications of multiprocessors.

C-4—Software Support and Services

Group C-4 is responsible for maintaining and upgrading the operating systems in production on the major CCF computers. This includes design, evaluation, implementation, maintenance, and upgrading of software and interfacing with vendors who supply software. The group is also responsible for mass storage system software development, support processor software, and compiler development.

C-4 provides direct user services such as consulting, providing programming assistance for nonmathematical problems, and CCF user education.

C-6—Computer Graphics

Group C-6 is responsible for the development, application, and support of computer graphics systems and techniques. This includes the software support of all microfilm devices, hard-copy plotters, and graphics terminals supported in the CCF. Group members are involved in research, software development and support, investigation and integration of new hardware devices, consultation on computer graphics, and computer graphics applications.

C-9—Computer Systems Engineering

C-9 provides two basic services for the maintenance of the CCF facilities. It supports the ICN (Integrated Computer Network) with integrated systems/hardware/software expertise. The group also is involved in short- and long-term planning for the ICN Coordinating Committee.

The group's responsibilities and functions include:

- hardware engineering for equipment to meet CCF needs, including the design of nonstandard components as well as modifications to commercial equipment;
- CCF hardware support for the construction, checkout, installation, and maintenance of special CCF equipment and systems;
- software engineering for the software support of the ICN including design, implementation, and maintenance;
- coordination of planning, implementation, and operation of the Data Communications Network; and
- computer security management including user validation, maintenance of ICN access controls, security guidance in support of ICN planning, and liaison with ERDA security.

The group office responsibilities include the coordination of these diversified activities and support of planning, simulation, and modeling.

C-11—Systems Software

The systems software group design and develops systems software for major CCF computers. The

group also conducts applied research in the areas of programming languages and operating systems.

A major current effort is the development of systems software for the CRI CRAY-1 computer system. This includes the design and development of a multitasking operating system with a hierarchical file system which will be integrated into LASL's ICN. This operating system will be implemented in the MODEL programming language which was developed at LASL. Another project involves developing a portable MODEL compiler for the CRAY-1.

C-11 is also responsible for the development of an interim production capability for the CRAY-1. This project is being conducted with the C-4 Fortran and LTSS projects, the C-9 software section, and the CRI software team. The project has developed software that provides CRAY-1 users with a production capability while an enhanced operating system is being developed.

CMB DIVISION

CHEMISTRY-MATERIALS SCIENCE
MS-756, ph.(505)-667-4563

CMB-1—Analytical Chemistry

Group CMB-1 analyzes the wide variety of materials arising from essentially all programs in the Laboratory. These materials include fissionable, non-fissionable, radioactive, nonradioactive, neutron irradiated, nonirradiated materials, and natural waters and sediments. Typical materials analyzed are described in the activities of other groups in this Division. Inorganic and organic analyses for microconstituents and major components in ultrahigh-purity metals, alloys, highly refractory materials, and some fossil fuels, and hot-cell analyses of irradiated reactor fuels are important parts of the group's work. Well-equipped laboratories are available for all kinds of analyses: general wet-chemical, gas chromatographic, spectrophotometric, electrometric, radiochemical, emission spectrochemical, x-ray absorption, x-ray fluorescence. electron microprobe, ion probe, atomic absorption, neutron activation, Auger spectrometry, ESCA, and mass spectrometric. These extensive analysis capabilities are also used in characterizing various plutonium materials that the group prepares as primary and working reference materials. These materials are widely used throughout the nuclear industry and especially in nuclear materials safeguards and reactor fuel analysis quality assurance programs. An important part of the work involves research and development on chemical and instrumental methods for all of the above phases of analysis and the design and development of automated analysis equipment especially for Safeguards uses. Other research and development projects include studies of the migration of ^{238}Pu in terrestrial and aquatic environments, and the radiolytic products and corrosive effects of plutonium-contaminated wastes in storage. Fundamental research is done in the field of high-resolution emission spectroscopy, including automated instrumentation, excitation sources, precise wavelength measurements, classification of spectral lines, and opacity measurements.

CMB-3—High-Temperature Chemistry

Group CMB-3 does basic and developmental research on a variety of energy-related programs. These programs are studied by the methods of physical chemistry, including the use of thermal analysis, neutron and x-ray diffraction, and high-temperature mass spectrometry. Basically, the group is studying materials, their characterization, and reactions. For the superconducting power transmission line, we are studying the use of chemical vapor deposition to prepare coatings of Nb_3Ge, a high-temperature superconductor, on metalic substrates. We are developing and testing cycles composed of chemical reactions that will be used in the thermochemical hydrogen program, which will use nuclear heat to decompose water into hydrogen and oxygen. We are developing procedures and techniques for the management of tritium in the Controlled Thermonuclear Reactor. One of our basic research programs is a study of the vaporization behavior of materials with the ultimate goal of applying this knowledge to the behavior of protective coatings in high-temperature applications. Research is also conducted on the vaporization behavior of materials for use as thermionic emitters.

CMB-5—Physical Metallurgy

Group CMB-5 is concerned with fundamental and applied physical metallurgy. Plutonium alloys and compounds represent a large fraction of the materials studied but work is also done on uranium

alloys, noble metal alloys, and ceramics. Several programs are represented in CMB-5, including weapons, isotopic power systems, and materials for magnetic fusion reactors.

Techniques available within CMB-5 include mechanical testing over a wide range of temperature and strain rate, thermal analysis, dilatometry, optical and electron microscopy for microstructure determination, x-ray diffraction on either single crystals or powders, static pressure capability to 60 kbar, Knudsen effusion, and mass spectrometry.

Research projects currently in progress include studies of the phase relationships and transformations in plutonium alloys, microstructural effects on the strength of PuO_2 ceramics, radiation damage effects in ceramic insulators, superconductivity of actinide alloys, rapid quenching of actinide alloys to produce metallic glasses or non-equilibrium phases, high-pressure properties of plutonium alloys, vaporization and thermodynamics of metals under complex (biaxial) stress states. Some theoretical work on band structure and cluster calculations is also pursued.

Applied projects include safety analyses for isotopic (Pu-238) power systems, compatibility studies, design of an improved, general-purpose Pu-238 heat source for space or terrestrial use, accident analyses, the conduct of impact or fire tests on isotopic power systems to determine the response to accident environments, and mechanical property determinations of practical alloys.

CMB-6—Materials Technology

CMB-6's primary function is the responsibility for developing special materials and processes for many LASL programs. Metals, plastics, ceramics, graphites, etc., are formulated and fabricated with designated properties to meet specific requirements. The group has a wide variety of materials processing equipment and a professional staff with broadly based expertise in the materials science disciplines. The equipment and technical staff allow us to conduct complete materials development programs including component fabrication using in-house capabilities.

Special equipment and processes routinely used by the group in the materials development activities include high- and low-voltage electron beam welders, laser welding equipment, vacuum heat treating and melting facilities, H_2 brazing and sintering facilities, high-temperature vacuum sintering equipment, all of the conventional plastics fabrication equipment including injection molding, transfer molding, vacuum forming, and casting capabilities. The Ceramics/Power Metallurgy Section has a unique capability for powder characterization on metals, ceramic, and organic powders. The Electro-chemistry/Coatings Section has a strong capability in electroplating and electroforming. A new modern thin- and thick-film laboratory has just been completed providing us with an exceptional capability in these areas using such techniques as sputtering, chemical vapor deposition, and physical vapor deposition. The thin-film laboratory contains unique diagnostic equipment including Scanning Auger Spectroscopy, ESCA, and IMMA for complete characterization of deposited films. We believe this thin-film laboratory is one of the most advanced facilities of this type in the country. The group has both the equipment and the capability for plasma-arc spraying, flame spraying, thick-film technology, and a capability to apply a variety of procelain enamel and glaze coatings. Additional facilities in the group include a 5000-ton hydraulic press for multiple applications and a variety of high-energy-rate forming presses which can be used for many development and fabrication processes. Diagnostic and property measuring equipment available within the group includes scanning electron microscopes (one is equipped with an x-ray energy spectrometer), conventional optical microscopes, and various mechanical testing equipment. The Graphite Section supplies the group, LASL, and the country with a unique capability to make fuel elements of graphite-carbide composites for high-temperature reactor applications.

The multi-disciplinary materials capabilities of the group are used extensively in support of the LASL nuclear weapons program, the laser fusion-isotope separation programs, CTR program, advanced reactor fuels program, electron beam fusion program, energy-related programs, and essentially all of the materials-related projects at the Laboratory.

CMB-7—Instrumentation and Design

Group CMB-7 is responsible for the development, design, and modification of facilities and associated equipment for a wide variety of chemical and metallurgical processes. This equipment includes remote control material handling systems, equipment for processing and fabricating radioactive materials, high-temperature, high-vacuum furnaces, and physical properties testing devices.

The group is also concerned with induction heating methods, equipment, and facilities for all phases of Laboratory activity. Induction heating facilities are available to make ultrahigh purity alloys, and sintering, purifying, heat treating, annealing, outgassing, soldering-brazing, melting, casting, decarburizing, and spherodizing of many varied materials.

CMB-8—Physical Chemistry and Metallurgy

Group CMB-8 does research and development in physical chemistry and metallurgy, as well as chemical processing of uranium. Basic research is done on solid surfaces and their interactions with gases, including catalysis studies, low-energy electron diffraction (LEED), Auger electron spectroscopy (AES), and photoelectron spectroscopy (PES). A proton irradiation port has been built at the Los Alamos Meson Physics Facility (LAMPF) to do proton irradiations on various materials. Radiation damage analysis and computer simulation are done to complement the experimental program. These studies are of general interest to radiation damage, are of specific interest to LAMPF materials, and will provide the background for radiation damage studies of materials of interest to electronuclear fuel production. Solid state studies with positive muons are done using the LAMPF Stopped Muon Channel. Research is done in the following areas of fossil fuels: coal and coal processing wastes, with emphasis on detailed characterization of trace elements; laser pyrolysis of eastern gas shales; underground coal gasification for southwestern coals; gamma irradiation induced hydrogenation of coals; and chemical processes to cleve kerogen. In inorganic chemical research, the group does work in thermochemical hydrogen production, preparation of synthetic mineral standards, and computer calculations of multicomponent phase equilibria in connection with geochemical systems and HTGR safety problems. The above activities are supported by metallography, electron microscopy, x-ray diffraction, and thermo-physical and mechanical properties specialists in the group. The group is also responsible for the production of enriched and nonenriched uranium metal, alloys, and compounds and for the recovery and recycle of enriched uranium from residues generated in the LASL programs.

CMB-11—Plutonium Chemistry and Metallurgy

Group CMB-11 is principally concerned with research and development programs on plutonium and plutonium containing materials. The group is responsible for the recovery and recycle of plutonium and for the production and fabrication of plutonium metal, alloys, and compounds.

The ERDA effort on the overall development and evaluation of advanced, high-performance Liquid Metal Fast Breeder Reactor fuels is concentrated in the group. This project encompasses the preparation of well-characterized uranium-plutonium carbide fuel forms, the fabrication of experimental fuel elements, and the design and evaluation of irradiation performance tests on these fuel element systems. The determination of high-temperature thermophysical, mechanical, and chemical properties of various ceramic materials is carried out as required for the development of new or improved fuel forms. The group also prepares plutonium dioxide for use in the fabrication of Fast Flux Test Facility fuel.

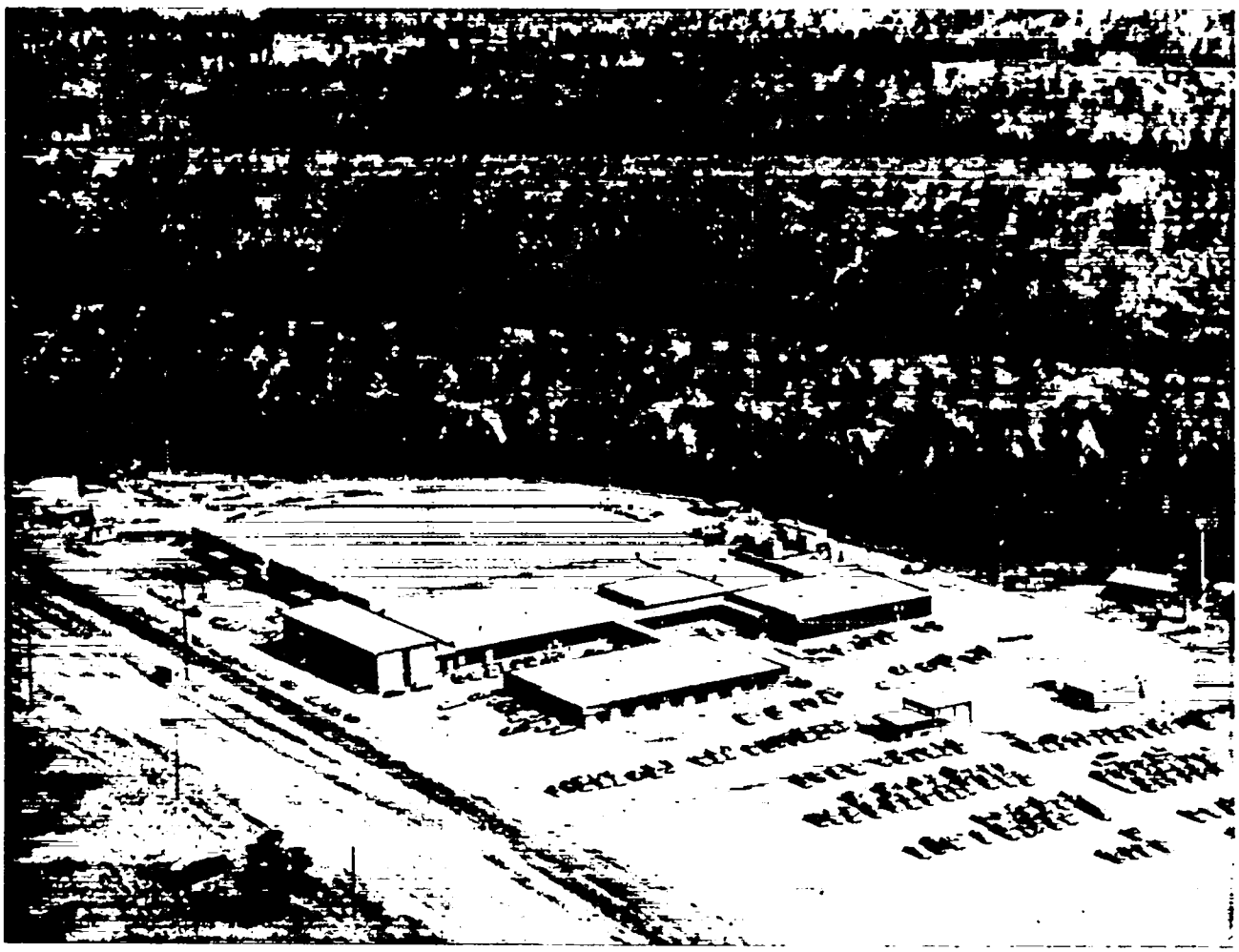
The ERDA effort for the design and development of advanced radioisotopic heat sources is concentrated in this group, together with CMB-5. These heat sources, combined with various electrical generator systems, can be used to provide power for space probes, orbiting satellites, and terrestrial applications. Ceramic and cermet ^{238}Pu-containing

fuel forms for these heat sources are developed and the chemical and physical properties are determined. This project involves extensive interfacing with other ERDA contractors and requires the development of special fabrication techniques applicable to the preparation of large specimens of ^{236}Pu-containing compounds.

Research and development efforts are carried out in the general area of plutonium and plutonium alloy metallurgy. Special alloy preparation and fabrication problems are investigated, and methods development is carried out as required for support of other Laboratory programs. The group is responsible for the preparation of ultrahigh purity electrorefined plutonium metal for use in ERDA basic research programs.

CMB-14—Irradiated Materials, Examination, and Handling

Group CMB-14 operates the Wing 9 and DP West Hot Cell Facilities used in the diagnostic examination of irradiated fuel elements from the ERDA's Fast Breeder Reactor Program. An extensive array of equipment is used in the remote examination and metallography of irradiated U-Pu materials. Assistance is provided to other Laboratory groups in performing a variety of experiments involving high-level gamma radiation. This group also operates a shielded facility for the storage of irradiated U and Pu fuels, ^{60}Co, and other gamma emitters.



New LASL plutonium facility

CNC DIVISION

CHEMISTRY/NUCLEAR CHEMISTRY
MS-760, ph. (505)-667-4457

CNC-2—Chemical Physics, Physical Chemistry

The research activities of Group CNC-2 emphasize molecular dynamics, theoretical chemistry, chemical kinetics, laser spectroscopy, photochemistry, the electrochemistry of fused salt systems, and the thermodynamics and properties of aqueous solutions and molten alloys.

The dynamics of molecular reactive processes and energy transfer processes are studied by both experimentalists and theorists. The goal is to obtain and understand the detailed mechanisms of chemical reactions, and the effect of internal and translational energy on the rates of chemical reactions. This understanding can then be applied to complex systems of practical importance (combustion, the chemistry of polluted atmospheres, laser development, and photochemistry) where these (non-equilibrium) molecular processes govern the overall chemical behavior.

Crossed molecular beam experiments are used to study reactive and energy transfer processes of ground state species, electronically excited atoms and molecules, and molecules vibrationally excited by single photon or multiple photon absorption. Experiments on laser-induced electronic excitation and chemical reaction are in progress. The photodissociation dynamics of UF_6 are studied in single beam experiments. In bulk systems, the chemical reactions of molecules and atoms in specific laser-induced excited states are studied. Supersonic expansions of gases are used to produce unusual "van der Waals" molecules whose properties are determined.

In theoretical chemistry, the structure and reactions of both normal and excited molecules are of interest. Calculations in chemical structure provide information on the spectra and properties (dipole moments, etc.) of molecules and insight into the energetics of chemical reactions. Calculations in chemical dynamics provide reaction cross sections, rate coefficients, relaxation times for energy transfer processes, and insight into the dynamics of molecular collisions.

The thermodynamic properties of metal oxides and natural and synthetic minerals of interest in geothermal energy are being measured. The thermodynamic properties of molten salt emf cells are determined with the goal of developing electrochemical heat engines that can operate in flames at 900 to 1700 K and in solar energy devices at 300 to 650 K. Research on the ionic, molecular, and colloidal species in aqueous silicate solutions and on the solubility of silica in various solutions has as its goal the control of chemical behavior of geothermal fluids. The transport of airborne contaminants is simulated in computer calculations.

CNC-2 has instrumentation in laser, visible absorption, and Raman spectroscopy. Various lasers allow excitation of molecules to specific states. Crossed-molecular beam machines are used to study the immediate products of molecular interactions. A number of calorimeters allow the measurement of a large range of thermodynamic quantities. High-temperatures furnaces and instrumentation developed in CNC-2 allow the study of molten salts, electrochemical cells, and the structure of molten alloys.

CNC-4—Inorganic Chemistry

CNC-4 works in the fields of inorganic and physical chemistry, with emphasis on stable isotope separation, the medical and agricultural applications of the isotopes, and the compound preparation and determination of structures and bonding in actinide and transition element compounds

Preparative techniques using, for example, fluorine and anhydrous hydrofluoric acid, inert atmosphere boxes for air-sensitive compounds, and matrix isolation are being applied to preparation of hard to attain compounds. Recent achievements in the area of the heavy elements include the structure of β-UF_5 and the uranyl nitrate crown ether adduct. Predictions of chemical behavior of superheavy elements are made. The group does a great deal of work in, and is well instrumented for, infrared, Raman, visible, and nmr spectroscopy as applied to the nature of chemical solutions and the structure of inorganic complexes. Intramolecular force fields of isotopically enriched species are determined from infrared and Raman spectroscopy. Fourier transform infrared techniques are being applied to study of photochemically (laser) induced reactions. Single crystal x-ray and nmr techniques are in active use for solid state studies. Energy related research is now being directed toward reversible binding behavior and enhanced reactivity of certain small molecules, e.g., SO_2, CO, NO, in transition element compounds, and the theoretical bonding basis underlying such behavior. The separation of oxygen and nitrogen isotopes by the distillation of NO and of CO to separate ^{13}C, has been successful, and production continues. These light, stable isotopes hold promise for use in medicine and environmental studies, including on-going use in agricultural field studies. The group has been in the forefront in the applications of Fourier transform nmr techniques to the study of biological systems labeled with ^{13}C and ^{15}N isotopes. In these studies it cooperates on a national level with groups in many universities and medical schools, and its research has developed promising, unique approaches for the analysis of metabolic, hematologic, and cellular abnormalities in humans.

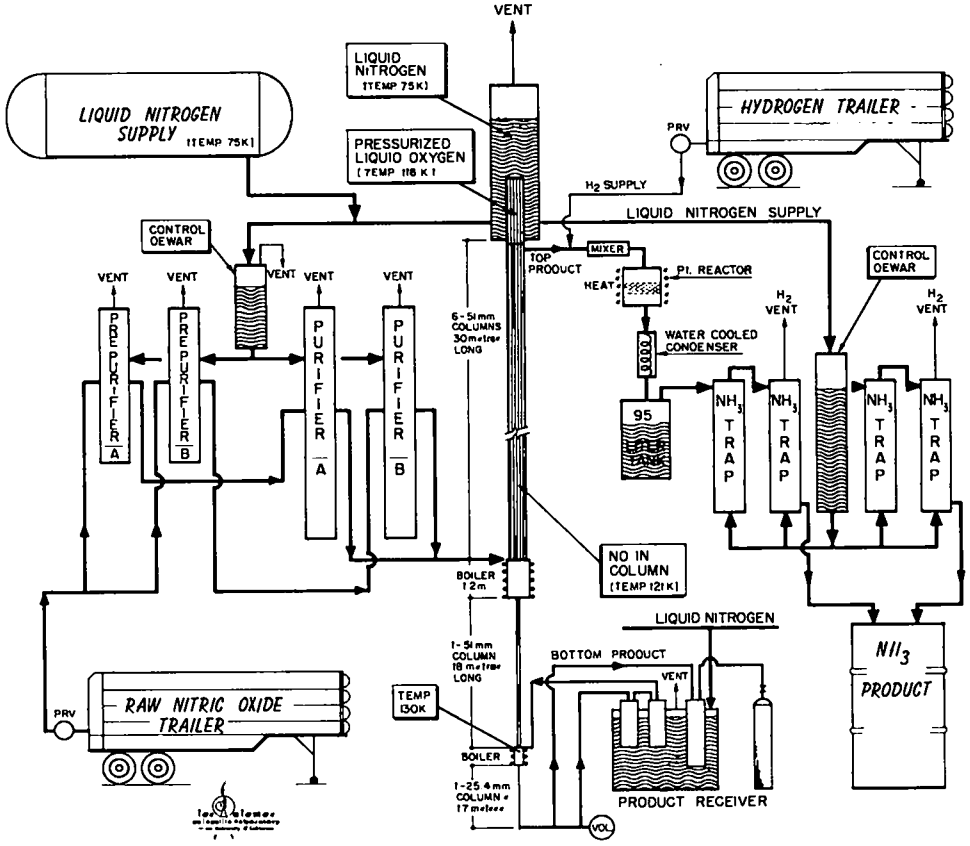
CNC-11—Nuclear Chemistry

Group CNC-11, the nuclear and radiochemistry group, is concerned primarily with the application of radioactivity measurements to Laboratory programs and with the study of nuclear reactions and structure. It obtains information on fission yield and other performance parameters of nuclear test devices by analyses of debris samples collected after the explosions. It provides similar diagnostic services, and sometimes special radioactive preparations as well, for a variety of other research and development activities both within and outside the Laboratory. Support of, and participation in, ERDA's Project Airstream involves collection of upper tropospheric and lower stratospheric samples and data. The data from this project is used in studies of upper atmospheric pollution and provides insights into atmospheric transport mechanisms. Lower tropospheric transport and dispersion questions are studied by the use of unique methane mass-20 and -21 tracers. Scanning electron microscopy, neutron activation, gas chromatography, and extremely sensitive gas-mass spectroscopy are among the laboratory analytical techniques used in these atmospheric investigations. A similar project has been undertaken, in collaboration with other government scientific agencies, to examine and characterize the underground migration of radioactivity associated with past nuclear events at the Nevada Test Site. In support of the geothermal energy program, a team is investigating the chemistry of the hydrothermal processes occurring in heat wells. Laboratory-scale experiments are conducted to study the dissolution, migration, and transformation of rocks and minerals under conditions likely to be encountered in the actual heat-extraction systems. And, more recently, the team has begun to apply some of these techniques and concepts to the problems of efficient recovery of fossil fuels and minerals.

Basic research constitutes an important part of the group's work. At present, problems are under active investigation in the areas of neutron and charged-particle excitation functions, decay schemes and level structure of neutron-rich nuclei, stripping reactions, the distribution of mass, charge, and energy in the fission process, and the synthesis and properties of heavy element isotopes, as well as theoretical analysis of the mechanism of nuclear reactions, particularly fission. Other basic research is underway in geo- and cosmochemistry. Following the discovery of ^{244}Pu in nature in a rare-earth ore, the search has been extended to other ores and to lunar samples. Similarly, with the observation of the very long-lived isotope ^{92}Nb in a sample of natural niobioum, the investigation is being extended to other sources of this potential

cosmochronological tool. The "Natural Fission Reactor Program" (NFRP) has involved analyses of samples from the Oklo site in West Africa to define the fission distribution, neutron spectrum, age, and lifetime of the natural Precambrian reactor discovered there in 1972. Work on this project is continuing with emphasis on waste product migration in geologic environments and on the search for a second example of a natural fission reactor. Still other work is in progress on the analysis of data from the Apollo missions and on a study of cosmic-ray-produced processes at the lunar surface. Preparations are being made for inclusion of radiochemical cosmic-ray dosimetry packages in upcoming Earth-orbit missions. A new and expanding area of interest is associated with LAMPF, where a separate laboratory and sample-handling facilities have been set up for research in nuclear chemistry. Work is now underway on a broad program of nuclear reactions induced by pions, muons, and medium-energy neutrons and protons, the decay of spallation-produced nuclides, muon-induced fission, chemical effects in negative meson capture, production of light and medium-weight nuclei by spallation and fragmentation and the analysis of neutron spectra by activation detectors. One early result of this work has been the discovery of ^{236}Th, the heaviest known isotope of thorium. A new and expanding program is underway in the area of medical radioisotopes, which are made by spallation reactions using the excess proton beam from the LAMPF accelerator. Experimental studies now in progress include medium-energy, proton-induced cross section, nuclear decay measurements, radiochemical recoveries, remote chemical processing, radioisotope generator development, biomedical compound

NITRIC OXIDE DISTILLATION PLANT
ICONS TA 46



labeling, collaborative pre-clinical and clinical research, and in-beam isotope production research. Construction of the Isotope Production Facility is now complete and full-scale production studies are in progress.

Commonly-used equipment includes standard alpha and beta counters with provision for automated sample counting and data recording, trochoidal analyzers for positron counting, low-background beta counters, a varied set of scintillation and semiconductor detectors and associated pulse-height analyzers with computer interfacing and local data processing for collecting alpha, beta, and gamma spectra, a computer terminal connected to the Central Computing Facility, plus other radiation spectrometry apparatus in use at LAMPF, the Van de Graaff accelerator, and reactor sites. Also available and in routine use are two mass spectrometers and an isotope separator; a second isotope separator, presently set up at the radiochemistry building, is proposed for on-line use at LAMPF to isolate highly-unstable spallation-produced nuclides for decay studies. Special radiochemical handling facilities include an "alpha wing" with glove boxes and other containment devices for processing strong alpha sources, and a versatile high-level hot-cell complex, including computerized gamma spectrometry systems, for examination and analysis of posttest samples and for processing production quantities of radionuclides.

CTR DIVISION

CONTROLLED THERMONUCLEAR RESEARCH

MS-640, ph. (505)-667-4483

The CTR Division carries out research and development activities in Controlled Thermonuclear Research (CTR). The LASL program, concentrating in high-beta research, is part of a nationwide program to develop the energy of nuclear fusion of deuterium and tritium for generation of electric power.

CTR-DOT—Technology and Advanced Development

This group performs systems analysis and conceptual design studies of planned fusion devices, including environmental studies, cost analyses, and economic impact studies. The reactor devices of current interest are based on the liner, linear theta pinch, and the toroidal z pinch.

CTR-1—Plasma Physics Research

Group CTR-1 is concerned with basic experimental plasma physics studies. At this time the group's main research interest centers on the study of the ac and dc electrical resistivity of a turbulent plasma; plasma heating by high-frequency fields; the influence of electron drift on the plasma ac resistivity; and the measurement of heat flow in straight plasma columns.

CTR-2—Pinch Experiments

Group CTR-2 is investigating the stability and confinement properties of toroidal, reversed-field Z pinches. The pinch is confined by the self-field of the pinch current and stability is obtained by means of an additional toroidal magnetic field which reverses direction in the outside region of the plasma column. The stability and equilibrium are both also dependent on the presence of a surrounding conducting wall. The stable time of the pinches has been increased in recent years from 3 to 5 μs to ~30 μs. The group is presently investigating the effect of energy losses, field diffusion, and field programming on the lifetime of the pinch in the 15-cm bore ZT-S experiment. A new, larger device called ZT-40 having a 40 cm bore discharge tube is presently under construction and is scheduled to begin operation in 1979. The new experiment is intended to further determine the scaling of lifetime and temperatures of the pinch with size. ZT-40 is designed to have a variable risetime to allow useful information to be obtained regarding the optimum method of producing and sustaining a stable plasma column as the size of the pinch experiments increase toward fusion reactor size.

CTR-3—Theta-Pinch Experiment

Experimental research in CTR-3 is concerned with theta-pinch confinement geometries aimed at controlled fusion power production. Large high-voltage capacitor banks are used to produce plasma with density and temperature very close to that required in a fusion reactor. However, confinement times are limited in linear experiments by plasma instabilities.

Current emphasis is on methods for reducing the loss of plasma and energy from the ends of a linear device. The Scylla IV-P experiment (5-m long, 50-kG field) has been used for detailed studies of the endloss process and will be used to study various proposed methods of reducing the losses.

CTR-4—Engineering

Group CTR-4 employs electrical and mechanical engineers and a number of technicians to perform the hardware engineering necessary to the CTR Experimental Program. The group is responsible for the design of the electronic and mechanical components required for the pulsed, high-voltage power supplies unique to this program. CTR-4 is also responsible for the detail, design, and construction of the large experiments as well as the operation of the megajoule capacitor banks required for these experiments. Currently, the design of ZT-40 is CTR-4's main design effort.

CTR-5—Plasma Research

Group CTR-5 is concerned with experimental investigations of two separate problems of interest to other programs in the Division. In the Implosion Heating Experiment, the physics of the fast implosion initial heating process in theta pinches is studied. A large diameter, high-voltage theta pinch is used to allow spatial and temporal resolution of the imploding plasma sheath which causes the heating. In the Gun Injection Experiment the physics of gun-produced plasmas and of the injection of such plasma into magnetic fields is studied. Possible applications are injection into closed magnetic geometries, injection into a linear theta pinch, and initial plasma preparation for fast-collapsing liner experiments.

CTR-6—Plasma Theory

The mathematical and computational plasma physics group provides analytical and numerical support to all experimental CTR programs at LASL, including the theta pinch, diffuse toroidal z-pinch, and magnetic implosion heating projects. Special emphasis is being placed on the study of plasma equilibrium and stability in straight and toroidal configurations, using MHD, Vlasov, or hybrid models as required by the physics of a particular device. This work is carried on in very close collaboration with the experiment groups. In addition, there is an effort in the numerical simulation of Vlasov plasmas, aimed at obtained a deeper understanding of multidimensional microinstabilities, particularly those acting in high-beta, spatially inhomogeneous systems. This program is complementary to the development of more efficient numerical fluid codes to describe the behavior of MHD plasmas.

The group is pursuing new methods in particle kinetics combining numerical and analytical approaches, as well as studying certain numerical techniques for the solution of partial differential equations. Much of our effort is directed toward gaining an understanding of high-beta plasma confinement systems in general, in deriving scaling laws for describing equilibrium, stability, and loss properties of various straight and toroidal configurations. These investigations are accompanied by studies of heating methods appropriate to high-beta, relatively high-density configurations.

CTR-7—Staging Experiments and Reversed Field Pinch Experiments

Group CTR-7 is presently concerned with the technological and physics problems associated with new theta-pinch experiments. The primary physics program is the Staged Theta-Pinch experiment which examines the physics of implosion heating and compression in a 4.5-m linear theta pinch with programmed magnetic fields. In the fall of 1977, CTR-7 will transfer its efforts from the Staged Theta-Pinch Program to the Reversed Field Pinch program, concentrating on the construction of the ZT-40 experiment.

CTR-8—Diagnostics and Automation

Group CTR-8 performs optical diagnostic measurements, primarily on theta pinches, and implements applications of computers to experiments for CTR Division. Optical diagnostics include measurements of plasma interactions with probing laser radiation. Typical examples are streak and framing camera photographs, laser scattering, CW and pulsed laser interferometry. Computer applications comprise automated data acquisition, on-line data analysis, monitoring, and increasingly, control of the operation of the experiments.

CTR-9—Energy Storage Systems

The primary efforts of CTR-9 are twofold: first, to provide a superconducting magnetic energy transfer and storage (METS) system which will delivery energy to the plasma compression coils of the LASL pulsed theta-pinch experiments and, second, to develop the superconducting tokamak ohmic-heating (TOH) systems required for the large tokamak fusion reactors. In support of these programs, homopolar storage systems are being designed in conjunction with Westinghouse, The Electrical Power Research Institute (EPRI), and the University of Texas at Austin. The homopolar machines being designed will have superconducting field coils and will be adaptable to fast discharge theta-pinch systems and the slower tokamak systems. Work is also in progress related to the ohmic-heating systems for the General Atomic (GA) and Oak Ridge National Laboratory (ORNL) TNS fusion reactors. All of these programs are basically cryogenic, mechanical, and electrical engineering efforts with support in the field of physics.

CTR-10—Computer Users Service Center

Group CTR-10 is in charge of the CTR-Division DEC-10 User Service Center. The DEC-10 system consists of KI-10 Central processor, 256K of memory, 60M words of disk storage, three tape drives, and facilities to handle 32 (soon to be expanded to 48) users in a timesharing mode. This computer is a node on the National Magnetic Fusion Energy network and as such provides a link via high speed phone lines to the MFE central computer facility at LLL. The USC has three functions:

- it provides a "stand alone" computational facility for the LASL CTR theory effort;
- it provides a data-analysis interface for minicomputers that are used to monitor, control, and acquire data from the CTR experiments; and
- it provides access to the National DMFE computers.

The group is responsible for the hardware and software maintenance and operation of the USC. Collateral to these responsibilities the group provides consulting, software development, word processing capability, and applications programming for the DEC 10 system.

CTR-11—Pulse Power Research and Engineering

The purpose of Group CTR-11 is to provide CTR and other Laboratory programs with the most advanced pulse power technology available. Concepts for future pulse power systems that are to deliver hundreds of kiloamps and hundreds of kilovolts are investigated. Components required for laboratory programs are designed and developed to provide reliable pulse power systems. CTR-11 staff members are available for consultation on other laboratory programs involving high voltage, high current components, and systems.

CTR-11 also operates two small theta-pinch experiments to study the physics of the Field-Reversal Theta Pinch (FRTP). The FRTP configuration has shown unexpectedly long plasma lifetimes, which has direct application in reducing end losses in linear theta-pinch systems.

E DIVISION

ELECTRONICS
MS-450, ph. (505)-667-5974

E Division goals are to provide a high-level, broad-based electronics engineering capability for the Laboratory. This capability provides quality research and development in the field of electronics, and supports the electronics engineering activities in other divisions.

E-DOR—Research

E-DOR is a group attached directly to the Division Office whose function is to conduct broad-based electronics research of relevance to both Laboratory and ERDA programs. The activities include initiating new projects and programs, working with other groups on support projects, and providing consultation on special problems.

Current areas of research include electromagnetic methods of subsurface probing, computational techniques for charge transport problems, physical mechanisms of thermionic and superconducting gain devices, and the development of specialized numerical methods for physical problems.

E-DO—Information and Training Services

This section provides the facilities and coordination for continuing professional development in electronics and related fields and a base of electronics information for the Laboratory. The Training Service administers a video self-study center which includes a videotape library of more than 300 tapes covering topics in electronics and computer science. Laboratory-wide electronics course planning and presentation are responsibilities of the Traning Services. Its personnel strive to achieve effective use of the TV media for training in all areas of interest to the LASL.

Information Services maintains an electronics product and specifications microfilm file (VSMF), a small reference library, journal and magazine subscriptions and routing, and a LASL Electronics Stock Device Data file. The data reference service is available to all LASL personnel for personal use.

E-1—Maintenance and Standards

E-1 provides centralized electronics maintenance and calibration for standard equipment. The capabilities of this group include the maintenance of scientific instruments, vacuum apparatus, and office equipment. In addition, it provides a standards laboratory for instrument calibrations and percision measurements and carries out the administrative functions related to telecommunications.

Group E-1 is staffed with highly trained personnel who use specialized test equipment, service manuals, and a large inventory of spare parts to provide maintenance services for a wide range of electronic instruments. These maintenance services include audio systems, data terminals and transmission systems, equipment surveillance systems, industrial controls, intrusion detectors, research instrumentation, radiation monitoring, radios, teletypes, television, NC machine tools, vacuum instruments, and technician support in the Central Computing Facility.

E-2—Electronics Technician Services

Group E-2 is an electronics service group which makes high-quality prototype and limited quantity electronic assemblies with fast turn-around times not available commercially. This group also supplies electronics technicians on a loan basis to other LASL divisions. In addition, it administers contracts for commercial fabrication of both large quantities and those items that can be more economically fabricated outside.

E-2 has a complete fabrication facility, including printed circuit manufacturing, design and drafting, computerized wire wrapping, silk-screening, hybrid thick film and photo reproduction facilities, cable shop, quality control, and a model shop. A solid state detector service facility is also available.

E-3—Electronics Engineering

E-3 provides an electronics design capability for instrumentation and data acquisition. The group has assembled a variety of engineering specialists who work to find the best solutions whether analog, digital, or a combination of both. The group also pursues an active research program.

E-3's analog engineers undertake instrumentation problems in the nuclear, mechanical, thermal, acoustic, magnetic, and optical fields. The work often consists of perfecting all components of an instrumentation system, from transducer to signal conditioner to data recorder to controller. Typical projects have included extreme environmental well logging instrumentation, cell analysis systems for biomedical research, and systems for image analysis and bandwidth limited image transmission.

E-3's digital engineers have successfully designed complex data acquisition, recording, processing, and control systems. They are familiar with digital logic whether for control, timing, delay, or analysis, and use contemporary components such as microcomputers in their implementation. Computer interfacing is accomplished in the most expedient manner either by custom design, by the use of CAMAC, or by the use of other commercially available components. Typical of the projects that have recently been completed by the digital engineers are a fully automated and interlocked serological analysis system, a data handling and interconnect system for nuclear spectrometry, and a precision 10-ns-increment digital delay generator.

In addition, the group pursues a number of small research programs in medical and nuclear instrumentation, microelectronics, high-temperature instrumentation, and snapshot TV. This effort generates new concepts that lead to future research and development projects.

E-4—Controls and System Analysis

This group provides systems analysis and control systems capabilities which integrate electonics, mechanical, and analytic skills. This unique complementary team provides LASL a complete engineering support function in the design of automatic control systems and the analysis of complex systems.

The systems analysis section is devoted to the modeling and control analysis of dynamic systems usually described by ordinary differential equations. For this purpose, a number of digital computer codes are supported, including the NET-2 network analysis code. A large hybrid computer facility is available for large dynamic models requiring long production runs. Current systems analysis work on both digital and hybrid computers includes modeling and control of solar heated and cooled buildings.

The scope of the engineering support covers analysis, design, and implementation of classical feed-back control systems, computer control systems, simpler open-loop controllers, industrial controls, and transducers. Engineering support can be in the form of project teams devoted to large research programs such as the laser program or of individual engineers assigned to a given task. The support always includes a cooperative design effort of the electrical and mechanical engineers backed up by a diversified, competent technician team.

The group is also involved in energy conservation in commercial buildings, particularly in the area of

control systems and strategies. A program is presently underway to study the application of advanced control techniques to complex heating, ventilating, and air conditioning (HVAC) systems and large solar heated and cooled systems.

E-5—Minicomputer Systems

Group E-5 provides the Laboratory with complete systems capability for minicomputer and microprocessor applications through hardware, software, and maintenance functions. This includes specifications and design of the control and data acquisition hardware, specification and design of the computer and software system, and maintenance of the completed hardware and software systems. The magnitude of the systems varies from programmable calculators dedicated to a single task to redundant computer and data acquisition systems monitoring vital facilities. The group provides Laboratory-wide consulting and information on data acquisition and control systems.

E-10—Detector Research and Development

E-10 does basic and developmental research on a variety of radiation detectors and materials for radiation detection. The work is applicable to a variety of programs including weapons, nuclear physics, high-energy physics, nuclear medicine, laser fusion, geothermal, nuclear safeguards, solar power, and environmental radiation detection.

The detector program interlaces a combination of existing technologies and physics in the creation of new types of detectors. The technologies stem primarily from the semiconductor industry, but as yet have found little application in radiation detection. These technologies are: (1) the production of ultra-thin, self-supporting silicon films (developed for x-ray photolithographic masks and electron microscopy); (2) the production of internally amplifying devices (avalance and transistor gain); and (3) the production of precise geometries (using photolithography).

The physics of the device and that of the application are intimately connected. The present program singles out three areas of physics more closely related to the device: (1) charge transport; (2) energy exchange mechanisms; and (3) new materials.

Current E-10 projects include several detectors based on epitaxial silicon including a high-resolution low-energy x-ray spectrometer and a multielectrode position sensitive detector, beam alignment sensors for high-power-density CO_2 laser beams, liquid noble gas ionization chambers, and a study of electron-hole droplets in semiconductors.

ENG

ENGINEERING DEPARTMENT
MS-610, ph. (505)-667-6131)

The LASL Engineering Department is a service organization generally responsible for: management of the ERDA construction program at LASL; plant engineering and maintenance of LASL facilities; custodial services; research and development program support to requesting LASL technical divisions; and quality assurance of all phases of engineering, construction, and modification of ERDA facilities at LASL. As such, the Department interfaces with all technical divisions and service departments. Engineering and construction projects include modification to existing facilities, as well as budgeting, planning, designing, and constructing new facilities. Satisfactory facility performance for occupational safety and health of operating personnel, to prevent undue risk to the public, and to protect the environment is ensured by a comprehensive quality assurance program and through close cooperation with the LASL Health Research Division and other organizations with highly specialized expertise.

ENG-DO/PL—Facilities Planning

The Engineering Department Office of Facilities Planning is responsible for long-range facilities planning activities, development of conceptual design studies and design criteria for projects to be designed and constructed by outside architect-engineering firms and construction contractors under ERDA prime contracts, and Laboratory space inventory and coordination activities. These facilities planning functions are performed in three groups; ENG-9, ENG-11, and ENG-12. The Assistant Department Head for Facilities Planning serves as Chairman of the Laboratory-wide Facilities Planning Advisory Committee.

ENG-9— Construction Project Development

The Construction Project Development Group is a project oriented group whose primary functions are conceptual design studies and design criteria development of line item construction projects. Conceptual design studies include definition of activities to be accomplished in a facility, determination of space, service and other facility requirements of these activities, and development of design parameters to satisfy these requirements. Conceptual design studies define the scope of each project in sufficient detail that a reliable cost estimate can be prepared for a construction project budget request. After a project has been authorized and funds have been appropriated, design criteria are prepared for the architect-engineering (A-E) firm selected to design the project. These criteria provide the basis upon which design is to proceed. Members of the Construction Project Development Group participate in the design development phase of the project, reviewing the A-E's design effort to assure compliance with the design criteria.

ENG-11—Long-range Facilities Planning

The Long-range Facilities Planning Group is oriented toward Laboratory-wide land use and

facilities planning. The group is responsible for developing and maintaining the facilities Master Plan, determining the long-range physical plant requirements associated with proposed programmatic activities, preparing short and long-range development plans, and developing management plans for natural resources. In addition, the group conducts siting studies for proposed new facilities and long-range studies of support and service systems for the Laboratory. ENG-11 provides staff support to the Facilities Planning Advisory Committee in its ongoing review of Laboratory physical planning. ENG-11 is also responsible for the development of guidelines and plans for visual upgrading of the physical plant, including guidance in site planning and other environmental design considerations for proposed new facilities.

ENG-12—Laboratory Space Coordination

The Laboratory Space Coordination Group is responsible for efficient and effective utilization of space in LASL occupied facilities, including leased space and trailers. The group develops and implements LASL policies and procedures regarding facilities occupancy assignments, personnel relocations, facilities modifications associated with changes in space assignments and the administration of necessary funding; analyzes projected organizational personnel expansion required in planning recommendations for future accommodations; conducts space utilization surveys and audits for inhouse use and in support of Laboratory new construction requests submitted to LAAO, ALO and ERDA Headquarters; and maintains appropriate Laboratory record drawings and computerized space accountability files. ENG-12 is also responsible for formalizing assignments of existing floor space and facilities with the Director's Office; evaluating needs, soliciting justification, making recommendations, and administering payment for LASL use of leased space; coordinating acquisition, and obtaining necessary funds for nonrolling stock trailers, and assisting ENG-DO/PL in developing long-range plans for accommodating projected multiprogram growth.

ENG-DO/DC—Office of Design and Construction

The Assistant Department Head for Design and Construction is responsible for management of the activities of the Facilities Design Group (ENG-2), the Cost Engineering Group (ENG-8), the Project Control Group (ENG-10), and the TA-55 Construction Group (ENG-14). In addition, a staff is available for performing project management functions and for processing requests for Engineering Department services.

The Design and Construction staff consists of several engineers, each acting as a project manager, and one senior designer. The project manager's prime responsibility is that of day-to-day contact and decision making with ERDA on all facility design and construction at LASL. Project management decisions include method of accomplishment, scheduling, interpretation of scope, appointment of project representation, and establishment of reporting procedures with ERDA on each project. Their responsibilities also include participation in architect-engineer selection for lump sum contracts, providing information to assist in recommending future projects for GPP funding and maintenance of the Departmental construction project Management Information System (MIS). The project managers also act as key personnel in the Quality Assurance Program and participate in the selection of the Design Review Board for construction projects.

ENG-2—Facilities Design

The Facilities Design Group is a fully integrated engineering design branch of the Engineering Department. The group is composed of five sections primarily concerned with the design of Laboratory facilities. Work performed by the group includes: preparing and estimating Engineering Studies; preparing Conceptual Design Reports; preparation of Requests for Directives and Preliminary Proposals; and preparing drawings, specifications and design calculations for facility projects designed

by LASL. In addition, ENG-2 provides engineering consulting services, technical information, assistance on boards and committees, and quality assurance reports.

Mechanical Section. This section performs mechanical engineering design work for the Laboratory. This work includes design of plant facilities and additions to, or modification of, existing facilities. Heating and ventilating engineering is important because of the unusual materials used throughout the Laboratory, often requiring close tolerance temperature and/or humidity regulation and special air filtration because of radioactive materials. Other work in this section is related to air pressure systems, hydraulic and pneumatic piping systems, equipment control systems, various mechanical equipment installations, and specialized analysis in the field of sound and vibration.

Electrical Section. This section performs electrical engineering design work for the Laboratory. Jobs submitted to this section for design may be concerned with power distribution, motor and motor-control installation, industrial lighting, resistance heating, high-frequency heating, and any other phases of electrical work commonly encountered in an industrial plant.

Many unique and unusual electrical applications are encountered at the Laboratory that require extensive instrumentation and control systems. Whereas the Electrical Section does not normally engage in the actual design of electronic components, it does work very closely with electronic designers in other Laboratory groups and is concerned with the installation of electronic equipment and controls.

Civil and Structural Section. This section performs civil and structural engineering design work for building modifications, additions to existing structures, and special or experimental structures. It also provides civil engineering required for roads, streets, outside utilities, and drainage. The section provides assistance on structural design problems and on structural analysis of existing facilities.

Engineering Studies Section. This section performs the facility engineering studies which eventually become projects for ENG-2 design. This work involves initial contact with the client requesting the project, scoping of the project, review of the scope with the client, budget estimating of the project, and transmittal of scope and budget estimate to the client for approval and authorization to proceed with design. This section also assists ENG-9, Planning, as well as the other groups in the Engineering Department involved in facilities design and the preparation of scopes and budget estimates of facility projects.

Drafting Section This section performs all the drafting support for the engineering design and studies sections. This support includes the initial and finished drawings in a design package, the changes, additions and revisions to these packages, as well as sketches, charts and tables pertinent to the functions of ENG-2. Drafting personnel may accompany a designer or Staff Member on field trips to assist with field data. The drafting section will also be involved in an as-built program.

ENG-8—Cost Engineering

The principal responsibility of the Cost Engineering Group is the preparation of cost estimates, project and funding schedules, cost projections, and cost and productivity analyses for LASL and other ERDA contractors.

The primary functions of the group are to provide cost and scheduling reports for evaluating the costs and work progress of selected projects, to inform appropriate responsible personnel of overruns in time or cost, and to assist in the reevaluation of project scopes in order to remain within funding restrictions.

The secondary functions of ENG-8 include the development of cost and productivity histories for use in evaluating the estimating and scheduling data bases, and a cost awareness program for Engineering Department personnel.

The techniques used by ENG-8 include parametric studies for preliminary cost estimates, detailed take-off and pricing for plant and capital equipment projects and operating expense projects, and the development of PERT/TIME, PERT/COST and EZPERT data to be used for the analyses of selected projects. The equipment used by the group includes the CDC-6600 and CDC-7600 computers.

The Cost Engineering Group has organizational interfaces with several groups in the Engineering Department and the operating divisions and groups for which services are provided. The group provides schedules and related information to ENG-1 to assist in its administration of construction projects. ENG-8 furnishes cost data and estimates to assist various Engineering groups in project planning and to ENG-4 to aid in the installation of new equipment and the maintenance and repair of existing equipment. Both cost and scheduling information are supplied to operating groups to aid in financial management and administration.

ENG-10—Project Control

As part of the administrative function of the Engineering Department, the Project Control Group supports the activities of all Department groups to various degrees. Primary responsibility lies in three general areas: (1) administrative liaison and monitoring of plant maintenance, laboratory services, and construction activities (performed at LASL by ERDA prime contractors through the Engineering Department); (2) funding determination, escalation analysis, construction completion reporting and budget monitoring; and (3) systems design and analysis and administrative data processing.

Activities in the first general area include: work order editing, coding and processing in support of ENG-1 construction and ENG-4 plant maintenance activities; updating of work order commitment system data base; work order cost monitoring; and preparation of form 634 A's.

The second area includes: determination of types of funds (capital plant, capital equipment and expense) for LASL funded projects; in conjunction with ENG-8, establish construction escalation rates used for project cost estimating; construction completion and final cost reports preparation for the Laboratory maintenance contractor (The Zia Company) and ERDA contracted projects; and monitoring and control of the Department equipment budget.

The third area of responsibility includes: specifying and analyzing engineering management systems. These systems include administrative programs for maintenance and construction project cost reporting, work order systems, preventive maintenance scheduling, plant equipment inventory and repair history, and the Engineering Department Management Information System.

ENG-14—TA-55 Construction

This is a Project Management Group organized to manage selected design tasks and complete construction of the new Plutonium Facility. All of the management parameters necessary to complete the assigned tasks are contained in the four sections of the group; Construction, Operations, Cost and Schedule, and Design. The management of the project is also dependent on close cooperation with and support from ERDA, using group, and other contributing LASL groups.

ENG-DO/QA—Office of Quality Assurance

The Assistant Department Head for Quality Assurance is responsible for management and direction of a Quality Assurance Program for Engineering and Construction projects at LASL.

This Program assures the design is adequate to meet operating needs, the prepared drawings and specifications include quality requirements, construction or modification is performed in accordance with design, and tests and inspections confirm the adequacy of design and quality of construction and components. The Program also includes the fabrication of products developed within the Engineering Department through program support.

Quality assurance activities begin during the conceptual design phase and continue through maintenance and operation of the facility or product. Quality administration of each project is performed by the individual Engineering Department project engineer or manager, often with the assistance of the facility operating division project manager.

ENG-1—Construction

The responsibility of the Construction Group is to assure facilities are constructed in compliance with the construction contract documents (e.g., drawings and specifications), are completed on schedule, and are within budget limitations. On larger projects, usually designed by an architect-engineer under direct contract with ERDA and constructed under a competitive bid fixed price contract with ERDA, a project engineer is assigned as early as practicable. One or more construction inspectors are also assigned to the project depending on the nature and magnitude of the project. This project team assures that construction and equipment installation are performed in accordance with the contract requirements and applicable codes and standards. Construction changes, construction schedule and progress, construction budget, and other factors that affect cost, quality, and suitability of the completed project are primary ENG-1 responsibilities, in concert with other Engineering Department groups and the LASL operating group.

In addition to projects designed by architect-engineers, ENG-1 is responsible for construction management of projects designed by the ENG-2 Facilities Design Group and constructed under competitive bid fixed price contract with ERDA or under a cost-plus incentive fee contract by The Zia Company. These projects are usually managed by one or more construction inspectors depending on expertise requirements. In addition to the responsibilities listed in the previous paragraph for fixed price type contracts, the construction inspectors are responsible for cost control monitoring to assure the proper utilization of The Zia Company crafts.

The construction group includes a survey team which is responsible for most of the land surveying performed at LASL. When non-LASL surveyors are employed, the ENG-1 survey team acts in a consulting capacity.

ENG-3—Records Management

The Records Management Group is composed of three sections, each charged with separate responsibilities, yet each depending to a degree upon the functions of the others. These sections and their principal responsibilities are as follows.

Administration Section. This section assigns all new structure numbers, assignment sheets, structure location plan books, and structure records; maintains and updates the History Book on all active LASL structures, and obtains monitoring services for excess structures; administers disposal of real property; updates LASL nomenclatures; and maintains trailer inventories; Word Processing Wang System 20 and IBM Magnetic Tape Selectric Typewriter scheduling, typing, editing, and proofing; and the Engineering Department personnel listing.

Distribution and Engineering Master File Section. This section acts as the Laboratory clearinghouse for processing incoming and outgoing data concerning major engineering design and construction contracts. These duties include reproduction and distribution of engineering drawings and specifications; design calculations; construction descriptive submittals, such as shop drawings and catalog data; contract correspondence, such as design conference reports; and all administrative documents directly concerned with the contracts themselves. This section also distributes and maintains the quality assurance documentation file of review forms with review documents attached, and maintains an up-to-date central file with either a copy or the original of all information on current projects.

Records Section. This section is responsible for filing, retrieving, and reproducing drawings and correspondence; binding; distributing record drawings, floor plans, etc.; and providing plant information to Laboratory personnel. This section also maintains three active microfilm systems, the Engineering Branch Library, and a computerized Engineering Department property accounting system.

ENG-4—Maintenance

The Maintenance Group is responsible for the maintenance of all LASL real property, operation of all plant systems, energy conservation programs, and liaison between LASL and The Zia Company. The group is organized on a geographical basis with

four sections providing technical assistance from maintenance specialists and representatives in each area. The group also provides design services for instrumentation wiring through a fifth section.

Plant Services Section. This section provides technical assistance and manages the maintenance budgets for the Laboratory's physical plant. These budgets cover electrical systems, mechanical systems, industrial water treatment, roads, grounds, roofs, cranes, pest control, custodial services, and various other necessary plant services. The section provides technical assistance for using groups, develops and administers preventive maintenance programs, investigates defective or malfunctioning equipment, initiates projects for upgrading plant facilities, performs quality assurance review, and executes plant engineering assignments as directed.

Maintenance and Operations Sections. The LASL complex is divided into eleven geographical areas, excluding LAMPF. One or more Area Coordinators are assigned to each area. The Coordinators are organized in two sections, one for the TA-3 complex and the other for the outlying areas. The Coordinators manage the building maintenance budgets for their areas, make routine inspections, initiate corrective action for discrepancies, coordinate utility outages, and respond to emergency after-hour callouts for critical systems. The Coordinators prepare work orders for the resident groups and provide liaison between the groups, the Engineering Department and The Zia Company.

LAMPF Plant Engineering Section. This section provides maintenance for LAMPF real property, work control for LAMPF lab services jobs, and design engineering for facility modifications at LAMPF. The section is the principal Engineering Department contact with the LAMPF community and maintains liaison between LAMPF and The Zia Company. The maintenance services include maintenance and repair of plant facilities, plus operation and inspection services on a 24-hour, seven day basis. The work control services include initiating, planning, scheduling, and coordinating all craft work at LAMPF. The engineering services include facilities design, reliability engineering, and maintenance of record drawings.

Wiring Specialists Section. This section provides design services for instrumentation wiring at TA-53, TA-55, and other LASL sites upon request. These services include providing complete installation specifications, initiating material procurement, and supervising and inspecting wiring installations. The section retains wiring data on computer punch cards for future use in modifying or trouble-shooting these systems. The section supplies limited technician services for fabrication and cable installation on selected projects.

G DIVISION

GEOSCIENCES
MS-570, ph. (505)-667-7722

The Geosciences division was established on February 1, 1977 in order to place many of the geoscience activities at the LASL under a single management. This change reflects an appreciation of the growing importance of geosciences in a national environment of increasing shortage of energy and resources. It is anticipated that the growing importance of geosciences will parallel a growing capability at the LASL.

G-DOT

The G-DOT group consists of several senior scientists who as a group constitute a valuable resource in talent and experience. The group, attached to the division office, carries out staff activities, special projects, and research. Present activities include program management, technology transfer, technical writing, technical liaison with industry, interaction with educational institutions, and support of ERDA headquarters. At present, special emphasis is being given to program development by G-DOT. New programs, programs too small to warrant a group, and programs of short duration are handled in G-DOT. In addition, the members of the group act as consultants and advisors to the division office, groups within G Division, and to other divisions of LASL and outside agencies.

G-2—Seismology and Geophysics

Group G-2 is principally concerned with research in various aspects of seismology and closely allied and supporting branches of solid-earth geophysics. Much of the effort is concentrated on the continuous operation of a network of more than 15 telemetered seismic stations in northern New Mexico and northeastern Arizona. The daily analysis and interpretation of the records from this network provide data which are used for research on:

- the crustal structure and tectonics of the region;
- the evaluation of regional seismicity and assessment of long-term seismic risk for LASL facilities in particular and for northern New Mexico in general; and
- source mechanisms for naturally occurring earthquakes as well as those for man-made events such as massive hydraulic fracturing experiments conducted by other groups as part of geothermal energy development.

Mobile telemetry and recording equipment is used in seismic refraction studies for which blasting at several existing mines and quarries in north central New Mexico is used as seismic sources.

A considerable effort is focused on development and field use of portable seismic, gravimetric, and geomagnetic instrumentation which supplements data from the permanent network and is also used for localized special studies.

The techniques of exploration seismology, gravity and geomagnetic field analysis are applied in support of containment evaluation of underground nuclear testing sites. Close-in ground motion measurements and other seismic records of underground explosions are analyzed.

Computer codes are developed and modified as needed for data reduction, digital signal processing and analysis, and theoretical modeling.

Other activities include development of special purpose geophysical instrumentation (e.g., tilt- and earth-strain meters), engineering seismology,

analysis of water wave and tsunami records, and research on seismic techniques of earthquake/explosion detection and discrimination.

G-3—Geothermal Technology

In its broadest sense geothermal energy is all of the heat in the Earth's interior. Group G-3 is one of the principal LASL groups participating in a project to demonstrate the feasibility of energy extraction from a form of this energy source called hot dry rock. This resource is characterized by essentially dry rock at usefully high temperatures, at depths that can be reached by conventional drilling methods. In the LASL concept, energy will be extracted from the rock by circulating pressurized water down one deep borehole, through a very large hydraulically-produced crack system in the basement rock (where heat will be transferred to the water), back up a second borehole, through a surface heat extraction system, then down the first hole again to complete a closed loop. Field experiments using the initial elements of such a system are now being conducted in an area of relatively recent vulcanism on the Jemez Plateau, at a site near Los Alamos on Fenton Hill.

The activities of Group G-3 include studies of geothermal reservoir engineering and energy extraction technology; design of field and laboratory experiments to measure properties of the Fenton Hill geothermal reservoir, and the analysis of these experiments; computer modeling of reservoir and surface heat exchanger properties; preliminary design and evaluation of heat extraction systesm; and general analysis of dry hot rock geothermal energy systems.

G-4—Geothermal Operations

G-4 is the operations and instrumentation group for the LASL hot dry rock geothermal energy project. Its major responsibilities include:

- the design, construction, maintenance, and operation of the major facilities at the Fenton Hill Geothermal site;
- the design, fabrication, procurement, testing, and operation of instrumentation and equipment associated field and laboratory experiments; and
- the development of advanced drilling technology for application particularly at the Fenton Hill site.

Present plans call for initially establishing a reservoir and heat extraction system capable of operating at a 10-megawattt (thermal) energy extraction level. Following a series of flow tests and other detailed studies, a decision will then be made on whether to proceed with the establishment of a 100-MW (thermal) system.

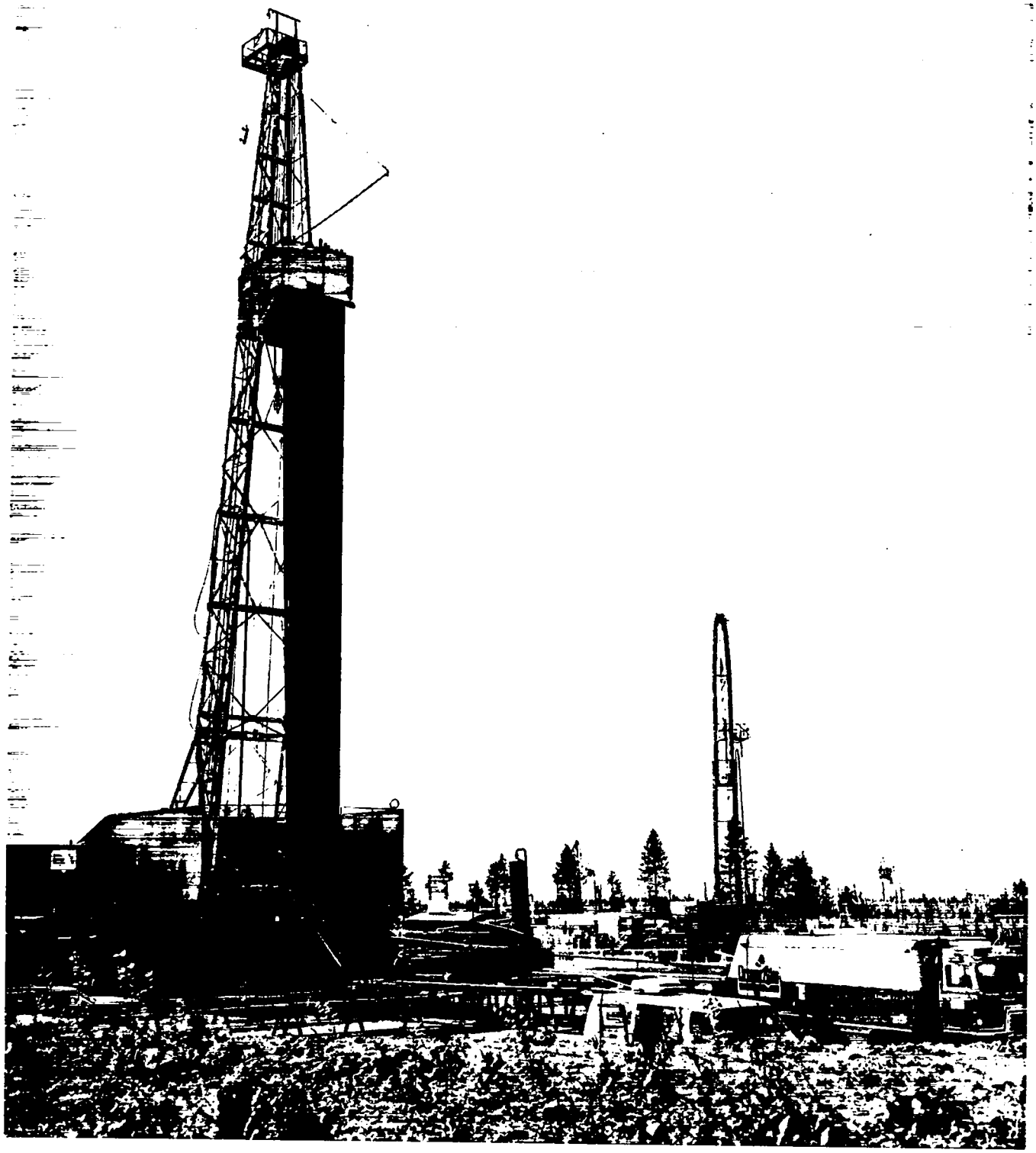
In addition to the above responsibilities this group manages environmental monitoring activities at the geothermal site, and monitors subcontracts for services and equipment development.

G-5—Geochemical Applications

Group G-5 is primarily involved in carrying out LASL's portion of the national Hydrogeochemical and Stream Sediment Reconnaissance. This project is part of ERDA's National Uranium Resource Evaluation (NURE) Program. The program has the ultimate goals of assessing the uranium resources of the United States, identifying areas favorable for uranium exploration, and helping to assure that the projected uranium demands for electrical power generation are met over the next several decades.

The basic mechanism of the reconnaissance survey is the collection of small samples of surface waters, well waters, and stream sediments from all over the United States and analysis of these samples for uranium. This will involve a total of about one million samples, each of which will likely be analyzed in the laboratory for levels of concentration of several associated elements as well as for uranium. When the analytical data are evaluated and plotted on maps, high concentration levels will indicate favorable areas for industry to explore further for uranium ore districts and deposits. The work involves applied geology, ground and surface water hydrology, geochemistry, geophysics and climatology, as well as extensive field operations.

Group G-5 has the responsibility for organizing, planning and completing the portion of this survey involving the states of New Mexico, Colorado, Wyoming, Montana, and Alaska. The effort is supported from within the Laboratory by Groups CMB-1 and P-2, which do the analyses of samples, and by



Drill rigs operating at both EE-1 and GT-2 at Fenton Hill.

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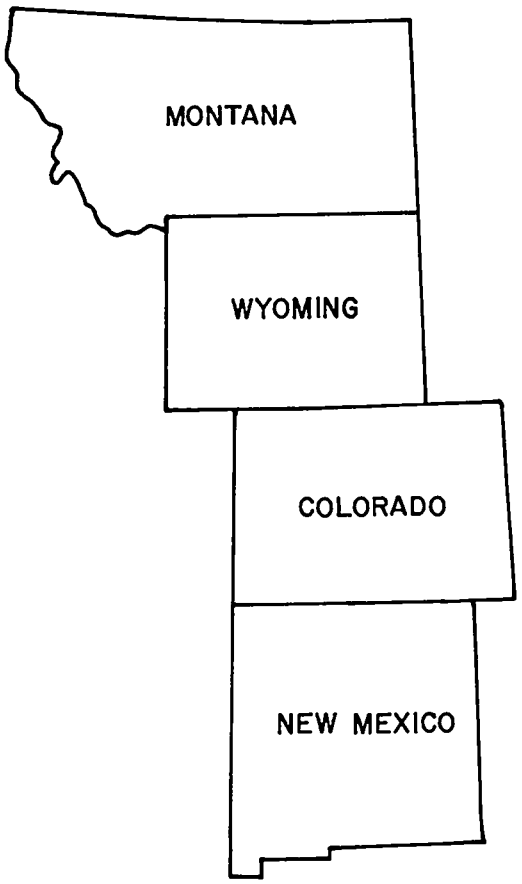


THE LASL AREA
OF RESPONSIBILITY IN THE
NURE HSSR PROGRAM

Group Q-12, which compiles and plots data for reporting to the ERDA Grand Junction Office where all information is open-filed for public use.

In addition to the Hydrogeochemical and Stream Sediment Reconnaissance work directed at uranium, the Group has proposed applied research programs to the ERDA Grand Junction Office for multi-element analyses aimed at over twenty elements of commerce and the development of bore hole logging tools. The Group also has a strong capability in the areas of geological engineering, applied rock mechanics, site selection and foundation studies, as well as in other fields of applied earth science.

G-6—Geological Research

The principal concerns of the Geological Research Group are energy and the environmental problems associated with its production. Geothermal energy from LASL's experimental HDR (Hot Dry Rock) process remains a primary focus, but new initiatives have begun in fossil fuels and waste management. Geothermal research activities focus on understanding structure, tectonics, and evolution of HDR resource regions. Field geological and geophysical data, and laboratory analytical and computational facilities are employed to understand, characterize, and evaluate HDR potential. Of primary concern are the Jemez Mountains, but other western U.S. areas are also under study. Coal research centers on characterization of minor and trace elements and minerals by electron microprobe, scanning electron microscope, and x-ray diffraction. The occurrence and distribution of organic sulfur in coal is determined by electron microprobe. Cooperative efforts with scientists in Group H-8 involve evaluation of the Bandelier ash flow tuff deposit and its structural units regarding environmental consequences of depositing small quantities of nuclear waste. Results of this program will be applied to waste management problems in other localities.

Research techniques employed by Group G-6 include:

- field and laboratory geology and petrology;
- electron microanalysis, electron microscopy, and x-ray diffraction;
- transport properties of rocks and minerals;
- rock behavior under static and dynamic loading;
- numerical modeling of physical and chemical processes; and
- data provided by other LASL groups and from contract laboratories supplement G-6 efforts.

H DIVISION

HEALTH RESEARCH
MS-690, ph. (505)-667-4218

The primary mission of Health Division is to protect the health, safety, and well-being of LASL employees and all individuals who could be endangered by the LASL activities inside or outside the Laboratory area. This protection is accomplished by programs in health physics, occupational medicine, industrial safety, industrial hygiene, fire and explosive safety, industrial waste control, and environmental protection. Members of the Division participate in all of LASL's major programs and enjoy a high degree of cooperation in ensuring that these programs are conducted safely. These basic programs are supplemented by extensive biomedical and environmental research programs in energy-related areas.

H-1—Health Physics

Group H-1 is responsible for the maintenance of a Laboratory-wide radiation protection program that meets applicable standards and keeps personnel exposures to radiation as low as practicable. Extensive operational health physics, personnel dosimetry, radiation instrumentation and measurement, decontamination, training, and radiological engineering programs are maintained to achieve a high degree of radiation protection.

Operational health physics programs are made up of many closely related functions, all with the primary purpose of furnishing and documenting an appropriate radiation protection program for workers and the public. A primary operational function is commonly referred to as radiation monitoring, that is, the measurement of radiation and radioactivity levels. Measurements performed for routine and special radiation monitoring require a wide variety of techniques to determine worker radiation exposure levels, detect unwanted radioactivity (contamination) in work spaces, and perform work space air sampling. A continuing program assures that shipments of radioactive material meet the applicable regulations pertaining to allowable radiation and radioactive contamination levels. A similar program assures that salvaged or excess materials are free of radioactive contamination. A stack sampling program is maintained to measure and document radioactive effluent release levels from laboratory facilities. A program is maintained for review and approval of all Standard Operating Procedures (SOPs) required for radiation work. Related functions include reviewing Laboratory construction jobs for radiation safety, providing Laboratory-wide inventory, storage, and leak testing of certain encapsulated sources, and performing regular radioactive evaluations of x-ray machine installations. Similar monitoring activities are coordinated by Group H-1 for LASL activities at the Nevada Test Site. In general, operational health physics services are provided by dedicated sections based at major LASL facilities, e.g., DP Site, CMR Building, LAMPF. Other important non-routine monitoring activities include investigating and reporting of unusual radiation occurrences and providing a rapid response for Laboratory or other radiological emergencies.

A Laboratory-wide personnel dosimetry program is provided for measurement of worker exposure to external radiation and internally deposited radioactivity. In addition to the familiar "film badge" worn by all radiation workers, external measurement techniques include pocket dosimeters, TLD badges, and extremity dosimeters. An active dosimeter

development program is maintained and current efforts will result in replacement of the present film badge with a TLD dosimeter. Internal dosimetric procedures include the evaluation of bioassay results and performing *in-vivo* chest, whole body, and wound measurements. Dosimetry records are made a part of an elaborate data handling system which facilitates producing a wide variety of ERDA required and informational reports for the use of LASL supervisions as well as becoming a part of permanent employee medical records.

Portable and fixed radiation monitoring instrumentation used by H-1 personnel and throughout the Laboratory are specified, evaluated, purchased, and maintained directly or as directed by Group H-1. Development of new or special purpose radiation monitoring instrumentation is an important function of the Group. Well equipped nuclear counting and analysis laboratory capabilities are maintained at LASL and the NTS for identification or evaluation of radioactive contaminants.

The Group provides or supervises decontamination services that range from high value or special equipment decontamination to large area cleanup and decommissioning of unneeded facilities.

An important activity is the training of Laboratory radiation workers as well as health physics surveyors. A variety of radiation safety training programs designed to meet the various needs of the Laboratory are maintained.

A radiological engineering section provides health physics review and radiological engineering support for new LASL facilities from conceptual design on and is currently preparing safety documentation for selected existing LASL facilities. The section also reviews commercial plutonium facility license applications for the Nuclear Regulatory Commission and prepares the associated safety evaluations and environmental assessments.

H-2—Occupational Medicine

Group H-2 is primarily oriented toward preventive medicine and health maintenance. Preemployment examinations are administered which include medical history and physical examinations with a wide range of ancillary studies, including hematological and urine examinations, chest x-ray, comprehensive chemical profile, electrocardiogram, visual examination, and pulmonary function tests. Periodic examinations are performed at varying intervals depending on the individual's area of work, age, or specific hazard which may be encountered in the individual's employment. For those employees who are terminating their employment a physical examination is provided to establish the status of their health. This examination is similar to the preemployment examination in scope and content.

Radiation records and chemical analyses from Industrial Hygiene are included in the patient's medical record. All this information will be included in a computer data base for each individual so that the information will be more readily available, and so that a general medical and occupational profile of each individual will be more closely monitored and early abnormalities more readily followed and corrected. Through these studies, the Occupational Medical Group tries to assure that the employee's physical and mental health are suitable for the occupation he or she is pursuing and that early deviations from the normal can be observed and properly treated.

The primary function of the Occupational Health Group is to prevent occupational illnesses or injuries, but emergency capability is maintained. One of the functions of the Group is to assure prompt treatment either through their own facilities or through the services of competent specialists, hospitals and consultants as appropriate.

Treatment of non-occupational illness never has been and is not now considered to be a routine responsibility of Occupational Medical Health Program.

However, physicians and nurses are available for personal counseling, advice and guidance on medical problems, and emergency treatment.

Four First Aid Stations staffed by registered nurses are maintained at outlying sites. The Group maintains a small clinical laboratory to do hematological studies employing automated equipment as may be directed by occupational health physicians. Facilities are available for computerized electrocardiography and pulmonary function studies.

A program of employee counseling has been established headed by a clinical psychologist. This

program will address itself to the problems of the troubled employee by working closely with the employee and interacting closely with supervisors as indicated where job performance has fallen off, either due to emotional, personal or alcohol/drug problems. This is not a program aimed at long-term individual counseling, but rather a source of help toward referral for definitive help or treatment. The psychologist will provide assistance and guidance to supervisors in their relations to those under their supervision. At the present time the Occupational Medical Group is involved with the medcal care of approximately 6500 employees which includes those of the University of California, the Zia Company and the local ERDA employees.

Since 1952, LASL has maintained a small program to follow the health of plutonium workers exposed at Los Alamos in 1944-45. In late 1975, this study was expanded to provide a national epidemiological study of plutonium workers and controls at six ERDA plants throughout the U.S.

H-3—Safety

Group H-3 extends its range of interest beyond that of corresponding groups in industry. Because of the extraordinary range of materials, equipment and procedures employed at the Laboratory, H-3 is concerned not only with the usual personnel and property protection considerations but also with problems of high explosives and rockets, transportation by all modes, lasers, high temperatures and pressures, large impulse currents, hydrogen, and cryogenics. Increasingly, this group has been contributing to, and consulting on, a broad range of new safety problems of national interest, such as laser safety standards, guides for electrical safety in research, protection of electronic equipment and clean rooms, studies of nonnuclear aspects of criticality, low-temperature engineering, hazardous material handling, analyses of large scale, planned, accident-like events such as hydrogen releases and reactor safety experiments. The Laboratory has earned several national citations for outstanding safety experience.

Life safety and property protection, including fire risk analysis and programmatic importance, are considered in fire protection reviews by H-3. Computer protection, pyrophoric metals, contamination control by physical means, flame spread and smoke evolution aspects of facility materials, detection and suppression systems, and fire department interaction are of prime concern. Particular emphasis is given to the one of-a-kind experiment that requires unique protection methods.

Members of the group actively contribute to programs of the National Safety Council, the National Fire Protection Association and similar technical associations. The group is also active in collecting and disseminating safety and fire protection information outside the Laboratory.

H-4—Mammalian Biology

The primary efforts of the Mammalian Biology Group are oriented toward determining the toxicity of various potentially insulting agents on the mammalian system. Soluble forms of radionuclides at the tracer level have been administered by various routes to rodents, monkeys, and dogs, and the retention, tissue distribution, and excretion patterns measured with time. Using body weight as a denominator, extrapolations to standard man have been made and the results used successfully by such bodies as the NCRP and ICRP in setting regulatory standards. Monkeys, dogs, and rodents have been exposed to either x rays or ^{60}Co gamma rays with the primary goal being determination of life-span shortening and certain gross pathological changes such as those associated with the hemopoietic system. Emphasis has been shifted recently from the larger species to the mouse, and a study is in progress to observe the long-term biological effects as a function of dose rate, total dose, and age at exposure. Chromosomal changes and microscopic pathology are being studied. A third effort in the group is concerned with the biological damage of diffuse vs localized radiation, with emphasis on lung tissue. Ceramic (ZrO_2) plutonium-containing microspheres have been intravenously placed into pulmonary capillaries of Syrian golden hamsters, in precise numbers and specific activity, enabling a unique estimate of the localized radiation dose to surrounding tissue. The fraction of lung irradiated has been varied from less than 0.01 to almost 1.0 to elicit the potential focal vs diffuse response. Tumor incidence (gross and microscopic) has been the primary end point in these studies.

Two new efforts have flourished during the past year: namely, our immunological studies and those associated with the biological effects of inhaled oil shale. An immunological model using rats and hamsters has now been perfected and can be used routinely for assessing the potency of suspected chemical compounds. The oil shale-toxicity effort has been primarily directed toward inhalation exposure of hamsters to aerosols created from source material derived from the Anvil Points, Colorado, retorting and mining site. This program represents a sizable reprogramming effort from the group's radiation-oriented research to nonnuclear-directed experimentation.

H-5—Industrial Hygiene

Members of Group H-5 are primarily concerned with the recognition, evaluation, and control of health hazards throughout the Laboratory. Beginning with the usual concern with toxic and potentially carcinogenic chemicals, the Industrial Hygiene Group extends its range of interest to processes and materials frequently unheard of in industry. The Engineering Section concerns itself principally with hazard evaluations and control including air sampling, noise surveys, effectiveness of respiratory protective equipment, and advisory design, technical review and evaluation of ventilation and air cleaning equipment. They are also concerned with informing employees of potential health hazards, documenting potential exposures, and monitoring the quantities of non-radioactive materials released to the atmosphere. The Bioanalytical and Chemical Section is responsible for developing analytical procedures and assaying radioactive and non-radioactive materials in biological, air and water samples, trade name products, etc.

In addition to its primary responsibility for Laboratory occupational health problems. Group H-5 does research on related problems of interest to the ERDA and other governmental agencies.

The Aerosol Section investigates the properties of finely divided material suspended in air with reference to its effects on air samplers and air cleaners, deposition in the lungs, and general contamination using light and electron microscopes, light scattering instruments, and particle counters. This Section conducts training classes in particulate matter air sampling techniques for ERDA employees and ERDA contractor employees. The Respirator Research and Development Section investigates and evaluates all types of respiratory protective equipment to determine the degree of protection afforded in actual work situations. They also conduct respirator training courses available to government and inudstry in various cities throughout the country.

A continuing program is directed at quantifying plutonium in various organs obtained at autopsy from individuals potentially exposed to plutonium in the course of their work experience, as well as members of the general population. Other active programs include the development of air sampling and analytical chemistry procedures for gases and vapors of significant occupational health concern, as well as for the special cancer-suspect agents recently designated by the Occupational Safety and Health Administration.

H-6—Agricultural Biosciences

This multidisciplinary group is engaged in applying physical and biological science to general problems of agriculture. The primary effort is directed towards improving some of the different aspects of animal disease control. The Enzyme Labeled Antibody (ELA) test is being developed to improve disease detection. This test is being applied to viral, bacterial, parasitic, and toxic diseases. Small amounts of antibodies or antigens are detected in one or two drops of blood. An electronic identification and temperature monitoring system for animals is being developed in cooperation with the Electronics Division. This system will be used to provide an improved means of recording animal movements and sales transactions. Automatic recording of animal identification into computer records will greatly speed up the traceback of diseased animal movements through commerce and the subsequent control of disease. This new system will make it

possible for the livestock industry to practice individual animal management rather than group management. This will make it possible to identify the production quality of each animal and take the appropriate action.

Members of the group work closely with USDA personnel to supply complementary expertise to each other. As the technology is developed, exchange visits are made to transfer the technology to the eventual users. Commercial organizations are encouraged to use the techniques and to manufacture appropriate equipment.

H-7—Industrial Waste

Group H-7 is responsible for assuring that radioactive and chemically toxic liquid and solid wastes generated by the Laboratory do not contaminate the environment. For liquids, this is accomplished through processes that remove radioactivity from the waste solutions and dewater the concentrate as a solid to permit its burial or storage for ultimate disposal. The toxic components of chemical waste are treated to render them harmless followed by proper disposal.

Solid radioactive wastes are disposed of by burial or retrievable storage in approved Laboratory areas. Waste management operational personnel continually interact with Laboratory groups to assure compliance with ERDA and LASL waste management policies. Other primary objectives of this interaction include reduction of both the volume of radioactive waste and its radioactive content. Other activities include modified treatment methods to reduce the volume of waste requiring disposal or storage.

The group is currently involved in research related to more efficient methods of concentration and removal of radioactivity from liquid wastes. The work is directed toward development of waste management systems that would eliminate discharge of radioactivity, heavy elements, and organic constituents to the environment.

Waste management research and development programs include all phases of the management path from point of generation to disposal. Improved volume reduction methods, radioisotopic assay, waste sorting techniques, and waste container integrity are all subjects of current development efforts. Improved plutonium recovery and the relative risks involved in waste storage are also being investigated.

Other studies include formulation of waste management plans for both ERDA and the anticipated wastes from various alternative commercial fuel cycles. The long-range objective of these efforts is the attainment of optimum environmental protection, dollar economy, and safety in the handling of all radioactive wastes.

The group also consults with the Zia Company and the LASL Engineering Department on sanitary sewage treatment problems and monitors the safety of the water distribution systems by plan checking, inspection, and advisory services. The group interacts with the United States Environmental Protection Agency through the local ERDA offices in establishing and managing the mandatory LASL NPDES Permit System.

H-8—Environmental Studies

Group H-8 has two primary responsibilities:

- monitoring, documenting and evaluating the environmental effects of the Laboratory's activities at Los Alamos; and
- conducting environmental research and development projects involving both nuclear and nonnuclear materials associated with energy development and waste disposal operations.

The environmental surveillance activity includes collecting and reporting results of a systematic sampling and measurement program for air, water, soil, and other environmental media. The environmental research program includes evaluation of environmental aspects of existing radioactive waste burial and monitoring practices, and research directed toward determining the behavior of both radioactive and stable elements in a variety of ecosystems that are impacted by several energy resource developments. Field oriented environmental studies are being pursued in the areas of atmospheric transport of pollutants in complex terrain, hydrological transport of materials and ecological fate and effects of effluents associated with uranium mining and

milling, geothermal energy extraction, nuclear materials handling, coal combustion, oil and gas, and solar energy collection operations. The Group's interdisciplinary programs involve the disciplines of meteorology, geology, hydrology, ecology, analytical chemistry, environmental engineering, and radiation biology.

H-9—Cellular and Molecular Biology

The research program of Group H-9 addresses the major physiological processes required by the mammalian cell in culture for normal growth and proliferation. These studies provide a necessary frame of reference within which the effects of physical and chemical agents associated with energy generation are evaluated and the ameliorative responses of the cell are understood. Emphasis is placed on those aspects of cell biology dealing with the perpetuation of genetic continuity. Our molecular biology effort synthesizes DNA polymers of defined size and sequence and uses these polymers as targets for the effects of ionizing radiation and or organic and inorganic agents. The chemically altered DNAs are ideal substrates for the isolation and characterization of enzymes that repair defects and for the examination of errors introduced into newly synthesized DNA and RNA when unrepaired polymers act as templates. Our cell biology studies examine

- the regulation of deoxynucleotide pool levels;
- the polymeric intermediates in DNA synthesis;
- the effects of histone modification on chromatin structure;
- the consequences of perturbant-induced DNA-protein cross lining;
- the relationship of the nuclear envelope to DNA suprastructure;
- the synthesis of RNA and its assembly into functional structures required for the controlled production of protein; and
- the analysis of chromosome karyology and those mechanisms which lead to abnormalities in chromosome number and type.

A number of these biochemical studies have taken advantage of our ability to measure the position of a cell within its proliferative cycle and to accumulate cells reversibly at specific cycle positions. As a result, we can now pinpoint certain biochemical events to unique cycle phases. At a more complex level of organization, the mammalian cell as a whole is studied as a genetic entity. Our somatic cell genetics program has isolated a number of mutants that are temperature-sensitive with respect to their ability to divide as well as others that exhibit alterations in their strength of attachment to substrate. The latter class has been shown by our cell surface biochemistry program to have an alteration in its extracellular matrices. The temperature-sensitive mutants are being used to measure increases in back-mutation rate caused by pollutants and by high-LET radiation. In addition, support is provided for studies of effects of negative pions on cell survival as part of the preclinical trials conducted at LAMPF.

H-10—Biophysics and Instrumentation

The Biophysics and Instrumentation Group (H-10) conducts interdisciplinary research in several areas:

- development of instrumentation for rapid analysis and sorting of biological cells;
- development of the support biology required for preparation of material used in these systems;
- development of techniques to apply these systems to biological problems;
- application of flow systems to biological problems; and
- radiobiological experiments related to therapeutic pion and heavy ion beams.

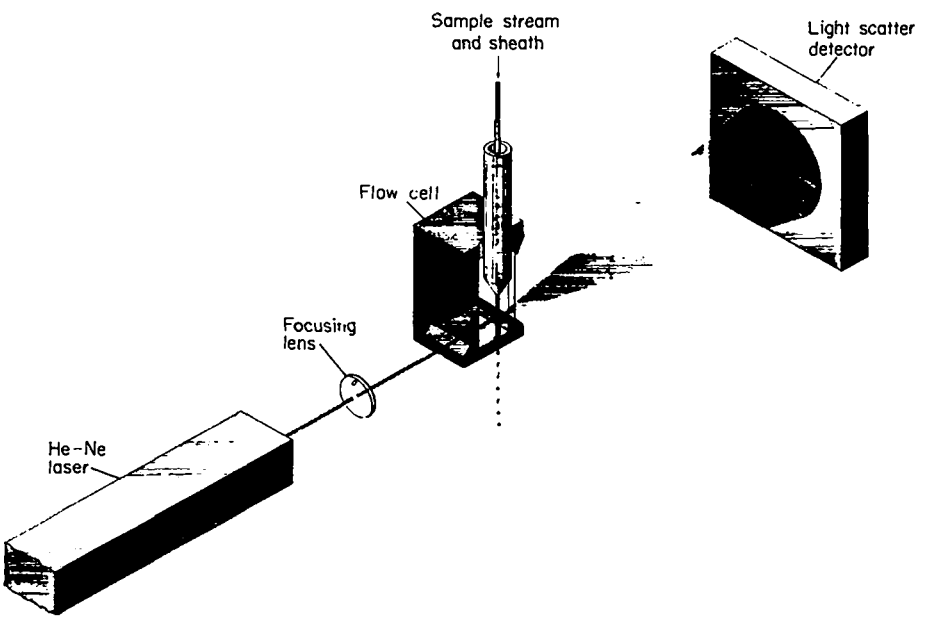
The instrument development program addresses problems in basic and applied biology. Our instrumentation has been used at LASL for studies of radiation and drug effects on tissue culture cells, white blood cell identification, studies on human tumors, detection of pre-neoplastic changes due to energy technology by-products, and detection of changes in the immune response. Methods have been developed for binding fluorescent stains to various cellular components such as DNA, RNA, protein, and cell surface antigens. Individual cells are measured using parameters such as fluorescence, light scattering, and cell volume. Specific cells can be separated using the LASL-designed cell sorter. These instruments are currently capable of differentiating cells based on two-color fluorescence, cell volume, light scattering (at

32 angles), or any combination of these parameters. This flow-system technique was pioneered at LASL. In addition to applications of the instrumentation developed to ERDA problems, we are participating in the development of this method for application to prescreening for gynecological cancer and design of chemotherapy regimes for leukema patients (both of these programs are in cooperation with the NCI). Our USDA work (in conjunction with Group H-6) relates to the use of these techniques for animal disease diagnosis.

H-11—Organic and Biochemical Synthesis

Stable isotopes of carbon (^{12}C, ^{13}C), nitrogen (^{14}N, ^{15}N, and oxygen (^{16}O, ^{17}O, ^{18}O) have a great potential as nonradioactive tracers in chemistry, biology, and medicine. The enriched, separated isotopes are presently produced by the Los Alamos Isotope Separation Facility (Group CNC-4), but the chemical forms used in the separation process are generally not suitable for biomedical research. One objective of the Organic and Biochemical Synthesis Group is to develop efficient methods for synthesizing organic compounds labeled with stable isotopes. Both organic synthesis methods, in which simple isotopic precursors are chemically transformed into more complex molecules, and biochemical synthesis methods, in which organisms are incubated with isotopic substrates to produce labeled materials, are used in preparing isotopically labeled substances. The synthesis of a labeled compound is quite often a research problem requiring development of the appropriate methodology. The second objective of Group H-11 is to engage in research projects that demonstrate the beneficial uses of stable isotopes in scientific and technological disciplines. Most of these projects have involved collaborative experiments with investigators within and outside LASL. They have included clinical diagnostic tests using labeled compounds, atmospheric tracing with nonradioactive tracers, and investigations into chemical reaction mechanism and cell biochemistry. Additional uses of stable isotopes are encouraged by supplying labeled materials to the National Stable Isotopes Resource established at Los Alamos by the National Institutes of Health.

Multiangle Light Scatter System



ISD

INFORMATION SERVICES
MS-180, ph. (505)-667-4355

Primary responsibility is the supervision and adminstration of the operations and services performed by the following groups.

ISD-1—Public Information

The primary responsibility of ISD-1 is to disseminate unclassified information about the Los Alamos Scientific Laboratory to Laboratory employees, their families, members of Congress, government agencies, news media, members of the public, etc. This information is relayed by means of the LASL bulletin, The Atom, and press releases.

The group coordinates and assists in preparing written or filmed news releases on a variety of Laboratory activities. This includes interviews with Laboratory staff members on subject matters selected by the news media.

Brochures used by the Laboratory for recruiting purposes, informing the public, etc., are originated by this group. A large photographic file is kept and maintained in support of all Laboratory activities.

ISD-2—Public Relations

The primary responsibilities of ISD-2 are: (1) Operating the Bradbury Science Hall and Museum, which is open seven days a week. (2) Coordinating logistics for most Laboratory technical and administrative meetings, i.e., arranging travel, lodging, local transportation, coffees, luncheons, and official receptions and maintaining a calendar of LASL and community events to help Laboratory groups avoid scheduling conflicts, etc. (3) Conducting tours of Laboratory sites by students or special groups and arranging LAMPF tours for the general public. (4) Administering the County Civil Defense program. (5) Assisting the Director's Office with special visitors, i.e., arranging travel, lodging, badges, escorts, etc. The group also manages the National Security and Resources Study Center, which began operation in early 1977.

ISD-3—Illustration Services

The primary responsibility of ISD-3 is to provide authorized LASL personnel with the technical and commercial art work required in fulfilling Laboratory assignments. Working from penciled graphs, sketches, engineering drawings, typed copy, photographs, rough layouts or other reference material supplied by the requester, the group prepares finished art work such as graphs, charts, tables, schematics, diagrams, isometrics, cutaways, exploded views, perspective drawings, retouched photos, patent drawings, master forms, posters, signs, covers, booklets, brochures, etc., in black and white, halftone or color, most of which are reproduced as book, journal, or report illustrations, slides or Vu-Graphs, or are used as visual aids.

ISD-4—Library Services

ISD-4 is responsible for the operation of LASL's Main Library of unclassified books, journals and technical reports, and of the Classified Report Library, both located in the National Security and Resources Study Center. The group also acquires material for more than thirty specialized branch

libraries, the whole encompassing collections of 270,000 volumes and 480,000 reports. There are more than 3,750 active journal titles, and collections of motion picture films, video tapes, etc.

The library system offers reference and translating services and computerized bibliographic retrieval, maintains records about all unclassified LASL publications, and publishes several lists of items in its collections.

ISD-5—Mail and Records

ISD-5 is responsible for Laboratory mail, telecommunications, and records management. The group processes incoming and outgoing official correspondence and provides Laboratory mail and messenger service. It operates the Telecommunications Center, which offers teletype, facsimile transmission, secure voice transmission, and cryptographic transmission (both narrative and data) services. The group is responsible for the Records Storage Center and provides assistance in records management matters, including the establishment of records retention schedules and the analysis of file systems and file equipment usage. It is responsible for issuing and updating the LASL Mail Stop Directory, the Card-of-Authority listings, and (in cooperation with E-1) the Laboratory Telephone Directory. ISD-5 maintains a master file of ERDA Directives and is responsible for their distribution and also maintains the Director's Office files and handles special distribution for the Director's Office.

ISD-6—Technical Information

ISD-6 is responsible for assuring that technical information generated within the Laboratory is in compliance with statutory provisions for safeguarding Restricted Data and other classified information. To achieve this objective, the group provides the necessary classification guidelines, handles day-to-day classification problems, provides classification education, and reviews all technical information leaving the Laboratory. In addition, the group edits Laboratory reports, composes camera-ready copy for certain selected reports, and writes some special-purpose technical reports. The group serves as a focal point for many outside inquiries regarding various facets of technical information, including advice and consultation to ERDA and other ERDA contractors on publication problems or difficult classification questions.

ISD-7—Graphics Arts Services

Group ISD-7 is responsible for providing a variety of graphic services for the Laboratory.

The Group's Still Photo Section provides photographers for both studio and on-location photography, film processing, and a wide range of black-and-white and color photographs, transparencies, and slides. The capability of photographic materials research is also available for non-standard applications.

The Lithography Section performs printing services for authorized forms and publications using Ozalid, Xerox (continuous form originals can be used), and offset printing equipment. Related bindery operations include collating of printed materials, and, staple, plastic, spiral, padding, and perfect binding techniques.

The Micrographics Section generates several microfilm formats. These include micro-thin jackets, 24X microfiche, 16mm cartridge or roll (continuous form originals can be used), with Kodamatic, Image Count or Miracode retrieval indexing, 35mm aperture cards, and 105mm microfilm. Duplicating and microfilm-to-paper blowback capabilities are available for all listed formats.

The ISD-7 Copy Center contains a variety of copying machines to provide fast turnaround for jobs of limited run lengths. Capabilities include single-side copying, duplexing, continuous forms printing, and reduced-size copying up to 18-inches wide from originals up to 36-inches wide.

Group ISD-7 is responsible for printing and coordination and procurement of all Laboratory printing requirements. Printing not done in house is procured through the U.S. Government Printing Office's Regional Procurement Office in compliance

with specifications established by the U.S. Joint Committee on Printing for all Federal agencies.

ISD-9—Motion Picture and Video Production

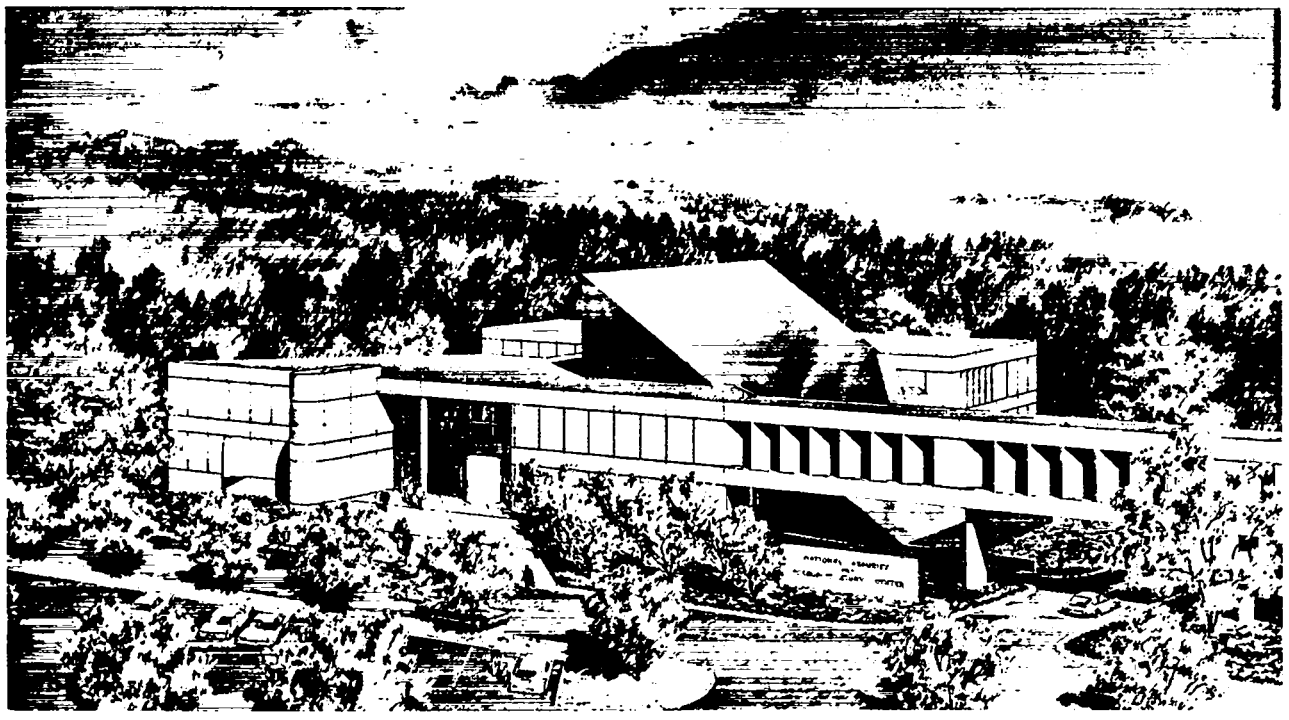
Group ISD-9 is responsible for the production of motion pictures and video tapes for the Laboratory. With still photography support from ISD-7, it is also responsible for the production of synchronized sound slide presentations.

Productions may be simply documentary coverage of an event or they may be complex, full-scale productions involving synchronized sound, titles, music, etc. Color is available on both 16mm film and video tape. ISD-9 provides the assistance of trained professional help through all stages of script preparation, production, and post-production.

Other services provided by ISD-9 include high-speed cinematography, audio consultation, recording services for meetings and special events, duplication of audio and video tapes, and full assistance to the Laboratory on all official audio-visual problems.

ISD-10—Food Services

The Laboratory operates three cafeterias: South Mesa, West of the Administration Building, DP West and S Site. With the exception of DP West, they are open to the public. The group Office is in South Mesa Cafeteria. The principal function of ISD-10 is to provide wholesome, nutritious food for Laboratory and ERDA contractors' employees at noon of each working day at reasonable cost. This, of necessity, includes meal planning, purchasing of food, and supervising the preparation and service of the meal. The group frequently works with the Director's Office for special luncheons and with ISD-2 in catering the Director's receptions and providing coffee service for official meetings. The group maintains a calendar for use of the two side dining rooms. Official meetings have preference over non-official meetings. The group office cooperates with H-2 when special diet instructions are required. It is a source of nutrition information for many people.



J DIVISION

FIELD TESTING
MS-670, ph. (505)-667-4236

Primarily responsible for testing nuclear weapons, J Division comprises scientific, engineering, and logistics groups. The efforts of the scientific groups include the acquisition and investigation of data derived from and pertinent to nuclear tests to determine the performance of nuclear devices and to study the various phenomena related to nuclear explosions. Work in the division involves development of new diagnostic techniques and equipment; research in the field of atomic and molecular physics; and the development and use of computer programs to carry out theoretical and practical research in those fields of interest to the division and the weapons program. The engineering groups are responsible for the design, construction, and maintenance of field-test facilities; mechanical design of the specialized equipment used in field testing; electrical engineering tasks including data acquisition, recording, telemetry, and the timing and firing of tests; and special electronic design.

J-DOT

Group J-DOT, attached to the division office, handles special research and staff activities not logically a part of any group effort. This group initiates new programs and pursues programs that are not yet sufficiently large to merit group structure. Guest members also act as consultants or advisors to the division office and to the various groups of the division.

The areas of current activity include advanced experiment concepts, environmental studies, analysis of past test data, hazard evaluation, and coordination of DoD test activities with the LASL test program.

J-1—Administrative Services

J-1 is a service group which provides administrative support to the scientific and engineering groups of J Division. This support includes maintaining the personnel records for the division; preparation of personnel action documents for all categories of employees within the division; and providing liaison between the groups of the division and Laboratory service departments. The group is responsible for coordinating the preparation of program effort reports for J Division; makes travel arrangements outside the scope of the LASL Travel Office; and prepares, records, and coordinates security clearance information for personnel of J Division as well as members of other Laboratory divisions and departments who travel to the Nevada Test Site or locations other than Nevada. Members of the group are responsible for property management of capital equipment for the division at Los Alamos and at field locations. The group is responsible for safety liaison, including safety inspections of J Division work areas at Los Alamos, preparation of inspection reports, and indoctrination of personnel. J-1 coordinates office and working space requirements; maintains a secretarial substitute pool and provides other miscellaneous support. It also

arranges for communications support and administers radio frequency coordination. When required, J-1 assists in coordinating LASL field operation efforts with various organizations and maintains the capability for the planning, execution, and monitoring of operational support for Laboratory field activities at locations other than the NTS.

J-3—Operations - NTS

J-3 is permanently located in Nevada and is responsible for providing operational, administrative, and personnel support for the Laboratory's weapons testing program at the Nevada Test Site (NTS).

J-3 prepares and executes non-technical test operation plans and checklists. The group is responsible for the preparation of emergency evacuation plans and monitoring their execution.

The group obtains requirements and makes arrangements for vehicular and communications support; for security assistance related to operations; housing facilities; laboratory and office space; and bus service between Las Vegas, Mercury, and the forward areas. It arranges for the loan of clerical and related personnel from the Reynolds Electrical and Engineering Co., Inc. J-3 recruits, interviews, assigns, orients, and administratively supervises such employees.

The group arranges for food service in the forward areas, makes travel and hotel reservations, and provides transportation between Las Vegas the the Test Site for TDY personnel. It arranges for security clearances and badges for permanent and TDY personnel. It assigns and inspects dormitory space allotted to the Laboratory in Mercury and arranges for housing for Laboratory personnel in the forward areas. The group provides briefing aids service and arranges for recreational support. Mail and Records and reproduction services are provided by J-3.

J-3 assists with preparation of NTS budgets, furnishes assistance on matters of Laboratory and ERDA administration and policy; investigates security infractions and reports of unauthorized use of Government property. J-3 conducts orientation tours of the Test Site; processes new and terminating employees; and provides information on Laboratory hospitalization, insurance, and retirement programs.

J-6—Facility Production

Group J-6, with offices at both the LASL and the NTS, is responsible for the design, construction, maintenance, and operation of LASL field test facilities at ERDA test sites. In this capacity the group is concerned with the solution of problems associated with mechanical, electrical, civil, and drilling engineering disciplines. The group acts as the Laboratory representative to the ERDA and its engineering and construction contractors for the design, construction, operation and maintenance of these test facilities including responsibilities for fire protection and safety coordination. The group coordinates the requirements of the Laboratory test groups, prepares construction criteria, submits the criteria to the ERDA and the designated architect-engineer, reviews and approves the plans and specifications, then provides technical inspection of the facilities during construction.

In the underground nuclear testing program the group has the primary responsibility for the design (excluding device and diagnostic racks), fabrication, proof testing and quality control of the emplacement hardware; it directs and has complete responsibility for the emplacement and stemming operations; it is the laboratory group responsible for the planning and drilling of emplacement holes and for the planning and conduct of post-shot drilling operations to obtain rad-chem samples.

The group also acts in a staff capacity in preparing budget estimates, test schedules, justifications for field construction and operations, and in assisting other groups in designing their test facilities.

J-7—Mechanical Support

Group J-7 provides mechanical engineering services in support of J Division activities, principally underground testing of weapons at the Nevada Test Site. For a typical project, the group furnishes the "rack", a structure containing the device to be tested and equipment required for diagnostic measurements. This involves scheduling, design, monitoring of fabrication, testing, and final preparation of the rack at NTS for underground emplacement.

Technical specialties include machine design, structural design, interactive graphics, high vacuums, optics, refrigeration, hydraulics, pressure vessels, and piping.

J-8—Timing and Firing, Phenomenology Support

In support of nuclear explosive testing, the Timing Firing Section of J-8 compiles device information, signal, monitor, and electroexplosive firing requirements and evaluates this information to provide the proper system for the test execution. The responsibility for the testing and compatibility of system components, conduct of dry runs, test device electrical connections, prearming, arming, and firing also rests with this section. Nuclear explosive safety studies or surveys are required by the ERDA prior to each test and J-8 coordinates these activities with the proper Field Office.

Typical equipment used includes world time systems, signal programmers, microwave-multiplex transmitting and receiving stations, fail-safe interface components, relay controllers, and device associated components.

The Data Acquisition and Reduction Section is responsible for the instrumentation for, and recording of, such measurements as temperature, pressure, acceleration, and ground motion both in the field and at LASL. The selection or design of proper transducers and recording equipment, the design of data transmission links, the fielding and operation of the system, and the subsequent data reduction are parts of this responsibility.

Analog, digital, and analog-to-digital data reduction is accomplished in facilities at the NTS and LASL. Data may be obtained from nuclear explosive testing and other such field test activities.

An Interactive Graphics Display System consisting of a minicomputer refreshed cathode ray tube display terminal with various input/output and mass storage peripherals is in operation. It provides the experimenter/operator with the capability to manipulate his data reduction under interactive control of the computer and graphics display and to obtain hard copy plots of the reduced data. Computer codes are developed as required for data reduction and analysis.

The Special Engineering Section provides design, development, and fabrication of specialized field test equipment which is then operated and/or maintained by J-8 personnel, usually in support of other J-Division Groups. Particular emphasis is placed on digital data recording systems, fast-pulse circuitry, microcomputer control systems, servo systems, and electromagnetic pulse (EMP) sensors and recording systems.

J-9—Underground Nuclear Test Phenomenology

Group J-9 is concerned with the containment of underground nuclear tests. Effort is concentrated on rock dynamics, gas flow, stemming designs, shock wave propagation studies, and the analysis of data from prior underground tests. J-9 participates in emplacement-site selection and prepares the containment evaluation documentation for each LASL test.

Group members also study the effects of atmospheric nuclear explosions with large radiation-transport/hydrodynamics computer algorithms and through the analysis of data from previous atmospheric nuclear tests.

New programs involving many of these techniques include the study of ballistic cratering and of fracture rubblization of oil shale.

Other activities are aimed at the study of a variety of geophysical and astrophysical problems.

J-10—Atmospheric Sciences; Optical Physics

Investigations of the responses of the earth's atmosphere, from sea level extending well into the magnetosphere, to both man-made and naturally occurring stimuli are conducted by J-10. The group is principally concerned with the atmospheric effects resulting from nuclear detonations; less energetic events which measurably affect the atmosphere, e.g., lightning and various chemical inputs, are also the subject of theoretical and experimental researches. Activities include:

- analysis of data from past atmospheric nuclear tests;
- theoretical modeling of atmospheric physics and chemistry phenomena; and
- conception, execution, and analysis of

laboratory and field experiments related to the fundamental properties of the atmosphere and its responses.

Theoretical models include detailed computation analysis of fluid dynamics, chemical kinetics, radiation transport, and plasma physics effects. Experimental techniques are mainly those of optical physics, i.e., quantitative measurements of radiation from atoms and molecules using optical and electrooptical imaging, photometric, and spectroscopic instrumentation with sensitivities ranging from the ultraviolet to infrared spectral regions.

J-12—Neutron Measurements - Pinex

Group J-12 has as its principal responsibility the acquisition of optical diagnostics on weapon devices. The group effort is expended in the following areas:

- neutron and gamma-ray imaging experiments on nuclear weapon devices to obtain diagnostics useful in assessing weapon behavior and as an experimental data point for weapon designers;
- research in optics, detectors, and electronics directed toward improved resolution in space and time for the imaging experiments and for improved data storage techniques;
- analog and digital data reduction and enhancement;
- experimental and theoretical work on coded apertures (non-redundant pinhole arrays) leading to three-dimensional imaging in both weapons experiments and in fuel pin studies on the LMFBR test reactor; and
- computing effort directed primarily toward preshot estimates of expected neutron and gamma-ray fluences and postshot data analysis. A latent capability exists to do neutron and gamma-ray transport calculations.

J-14—Reaction History

Group J-14 is active in the continuing Underground Weapon's Test Program at the Nevada Test Site. The group's work is mainly concerned with measurements of:

- the detailed reaction history of the nuclear explosion as indicated by the gamma-ray flux resulting from neutrons interacting within the test device;
- special phenomena involving temporal and spectral features of x-ray sources;
- temporal and spatial features of gamma-ray and neutron sources.

The group works closely with the theoretical design groups of the Laboratory to plan each diagnostic experiment in a manner most appropriate to the individual weapons tests, and to interpret the experimental results. It has, in conjunction with an ERDA engineering contractor, developed techniques and systems for high-speed (sub-nanosecond) multichannel recording of signals from these underground tests. It directs the efforts of contractor personnel in instrumenting and recording each test.

In support of these diagnostics, J-14 conducts a program of research and development of advanced instrumentation for the detection and recording of gamma-ray, x-ray and neutron fluxes. The group is actively pursuing fiber optic techniques for high-frequency data transmission. Using the Laboratory's computer facilities, the group has developed advanced analysis techniques for fast transient data.

Major facilities included within the group include 60 keV and 300 keV x-ray sources, 600 keV and 2.3 MeV pulsed electron sources, and an extensive ultra-soft x-ray laboratory.

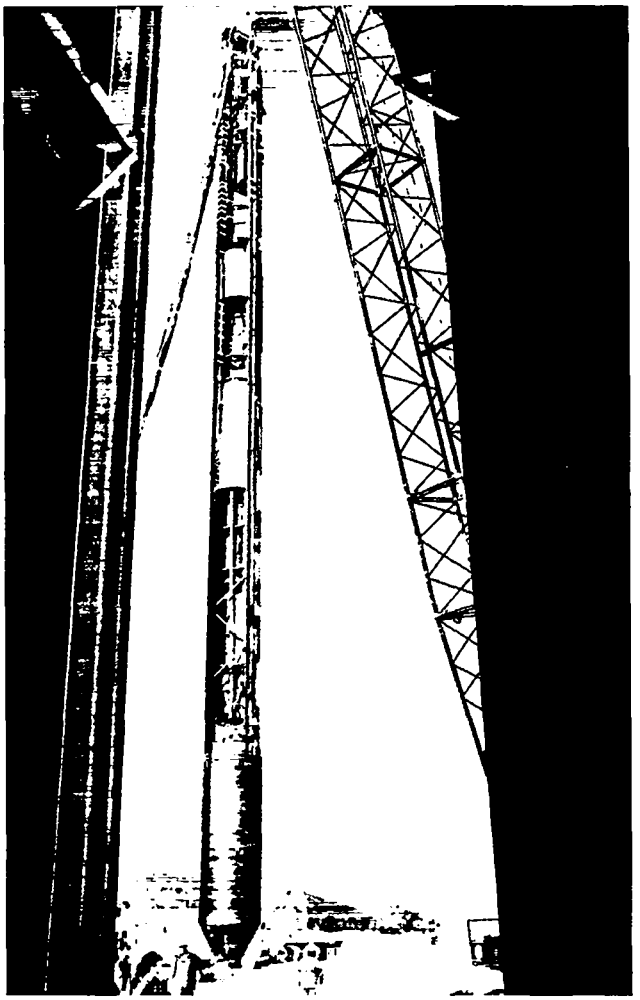
X-ray techniques are used to support the plasma diagnostic effort in L-Division.

J-15—Diagnostics Design - Radiation - Hydrodynamics

Group J-15 studies the flow of energy through matter for situations ranging from nuclear tests to stellar interiors. All of the effort involves calculations of the energy-flow equations using computers.

The main programmatic effort is two-fold.

- Diagnostic experiment design and analysis of data obtained by other groups. Areas of interest are neutron, gamma-ray, x-ray and visible radiation as well as electron-photon and neutron-proton interactions.
- Determination of ground shock and pipe flow interaction for purposes of containment of un-



derground explosions and for protection of certain long-lived diagnostic experiments such as the TV Pinex.

In addition, J-15 determines yields of nuclear explosions by analysis of ground shock data for underground events, and fireball data for atmospheric events as well as verification of Russian yields under the recently negotiated Peaceful Nuclear Explosive Treaty.

Additional analysis of fireball data is done to determine optical signatures, hydrodynamic properties, etc.

Some theoretical calculations of material properties (equation of state, monochromatic absorption and scattering coefficients, opacities) are made in support of the detailed radiation-flow hydrodynamic computations as well as a small experimental effort to check these calculations using L-Division's neodimium glass laser.

Part-time research is done on several astrophysical problems such as stellar evolution, stellar atmospheres, stellar pulsations, gamma-ray astrophysics and the acquisition and analysis of total solar eclipse data.

The computing programs used include Lagrangian 1D and 2D radiation-diffusion-hydrodynamics codes, Lagrangian 1D and 2D radiation-transport-hydrodynamics codes, Eulerian 2D and 3D radiation-diffusion and radiation transport hydrodynamics codes, two Lagrangian 1D gas dynamic pipe flow codes with mass entrainment, and Monte Carlo codes for neutron, photon, coupled neutron/gamma; proton, electron, photon; and neutron, proton interactions.

Basic nuclear physics and instrumentation research is conducted using both laboratory and nuclear detonation sources. The group has measured capture cross sections in the resonance region by using neutrons from nuclear detonations. Attention is focused on cross section whose measurement is difficult or impossible when using other than bomb neutrons.

The group is currently developing a scan converter system for the direct recording of fast transient signals associated with our measurements at NTS.

Some work is being done on an investigation of ionospheric effects.

A section of the group is engaged in scintillator and crystal research with production facilities. Scintillator production includes plastics, organic crystals, inorganic crystals, and screens. Crystal production includes fluor, semiconductors, and laser materials.

J-16—Special Projects - Neutron Measurements

J-16, the special projects group of J Division, is staffed principally with physicists and instrumentation specialists. At present the group's primary function is the measurement of nuclear weapon outputs, in particular, neutrons. Techniques have been developed that provide neutron spectra, device yield and other performance characteristics. Very recently a method of obtaining time-resolved neutron and gamma ray images has been developed and successfully fielded.

L DIVISION

LASER RESEARCH AND TECHNOLOGY

MS-530, ph. (505)-667-5167

L-Division is responsible for the Laboratory's Laser Fusion Program. The laser fusion program is concerned with development of the technology required to demonstrate the feasibility of laser-initiated fusion energy release from small quantities of thermonuclear fuel for both commercial power production and military applications. This effort includes the development of short pulse high-energy lasers, laser-fusion theory, target design and fabrication, laser-target interaction experiments and diagnostics development, and applications systems studies. Thus, the various groups within L-Division are engaged interactively and cooperatively toward common goals.

L-1—Gas Discharge Laser Research and Development

Group L-1 primary activities are directed toward the development of high-energy, short pulse (1 nanosecond or less) CO_2 gas discharge laser systems for laser-induced fusion research and for military applications experiments. L-1 is responsible for the design, fabrication, maintenance, and operation of three CO_2 laser systems:

- the 0.3-TW single-beam,
- the 2.0-TW two-beam, and
- the 10-kJ, 10- to 20-TW eight-beam.

The single-beam system is being used for target interaction studies. The two-beam system, which serves as a prototype for the eight-beam system, is being used for fusion target experiments at powers approaching 1.0 TW. Recent experiments with this latter system resulted in production of thermonuclear neutrons for the first time with a CO_2 laser. The major effort at present is the installation and check-out of components for the eight-beam, 10 kJ, 10 to 20 TW system scheduled for operation in the spring of 1978. Supporting programs include optical component and systems design and evaluation, damage threshold measurements of optical components, and development of methods of small signal gain suppression and retropulse isolation techniques.

L-4—Experiments and Diagnostics

Group L-4 is responsible for conception, design, and analysis of experiments on the interaction of high-intensity light with matter. Primary emphasis is on diagnostics of laser produced plasmas and on measurements of density, temperature, and nuclear reactions in laser-driven implosions. Group activities also include interaction studies on high-Z materials, nonlinear optics such as parametric amplification and frequency translation, and advanced laser technology. The group works closely with the other L-Division groups to design experiments that generally involve unique subnanosecond diagnostic techniques. L-4 also operates a two-beam Nd:glass laser system for shock-wave generation and basic physics experiments carried out by groups from J and P Divisions.

Diagnostic apparatus currently in use include a 3-picosecond streak camera, x-ray spectrometers, charged particle analyzers, neutron counters, optical spectrographs for incident and reflected light, light collector-calorimeter system for target interaction energy balance measurement, and an x-ray pinhole microscope. Experiments have been performed with a 100 joule 1-nanosecond single-beam CO_2 laser system and the two-beam, 1-nanosecond CO_2

laser system with up to 350 joules per beam. Experiments at higher energies will be conducted in conjunction with the laser development groups as the larger lasers are developed.

Experiments have been designed for the high-energy Nd:glass and CO_2 lasers to study the effect of wavelength, pulse duration, and intensity on interaction phenomena. Laser power levels are rapidly increasing, allowing broader investigation of laser-induced nuclear-fusion reactions. Measurements of target performance are continually compared to calculations and scaling laws generated principally by the Laser Fusion Theory Group, L-6.

L-5—Systems and Applications Studies

Group L-5 performs several functions in support of the overall Laser Fusion Program. Studies are made to investigate the technical feasibility of various laser and laser-fusion applications and to evaluate the incentives for the use of lasers in these applications. Feasibility and systems studies are conducted in both the military and commercial sectors, and assistance is provided for experimental programs.

Systems studies of the direct production of electricity in central-station, laser-fusion generating stations are done to identify technological problems requiring long-term development efforts. These analyses include feasibility studies of reactor and other subsystem concepts and systems studies of integrated power plants. Potential commercial applications of laser fusion, other than the direct production of electricity, are also investigated. These studies include the production of fuel for fission reactors, the potential for production of synthetic fuels, and providing high-temperature process heat.

Studies of laser and laser-fusion experiments of military significance include simulation of nuclear weapons effect and weapon physics modeling. There is considerable overlap in technology requirements for military and commercial applications of lasers, and the conception and design of multipurpose experiments is an important objective.

Support is provided to L Division in program planning, compiling and editing progress reports, and responding to external inquiries. Records of scheduling are maintained to ensure achievement of interdependent tasks, and assessments are made of technology requirements necessary for the attainment of short- and long-range goals.

L-6—Laser Fusion Theory

Group L-6 is the focus of the theoretical and computational support of the laser-fusion project. In scope, the group activities cover basic laser physics, non-linear optics, laser-plasma interactions, fusion target designs, post-facto analysis of experiments, and the development of computer codes and theory to support these activities. The prepondance of the group's work is with laser-plasma interaction and target design. Most of this effort is computational and is centered around the laser pellet code LASNEX developed at LLL and the plasma simulation code WAVE developed by L-6. Supporting theoretical efforts scattered throughout the Laboratory are coordinated with the project through the group.

L-7—Target Fabrication

Group L-7 performs several related functions in support of the laser program. Primary emphasis is on the fabrication of targets for laser-fusion experiments. These targets are usually submillimeter-sized hollow shells of glass or metal (referred to as microballoons), filled with high-pressure deuterium-tritium (DT) gas and frequently coated with additional layers or concentric shells of metal and/or plastic to optimize the interaction of the targets with the laser beams. Techniques are being developed to condense the DT onto the inside surface of the microballoon container cryogenically to form a uniform layer of liquid or solid DT fuel. In addition a large number of planar targets are made from metals, ceramics, and/or plastics in thicknesses from 10 nm to 0.1 mm. All of these targets are mounted and aligned in appropriate holders for ready installation into the laser target chambers.

In addition to the laser-fusion targets, targets are fabricated for the several military-applications experiments that are being carried out by groups from

P and J Divisions. These targets have ranged from single- and multiple-layer thin-metal foils for materials properties measurements to hollow plastic shells for blast-wave interaction experiments.

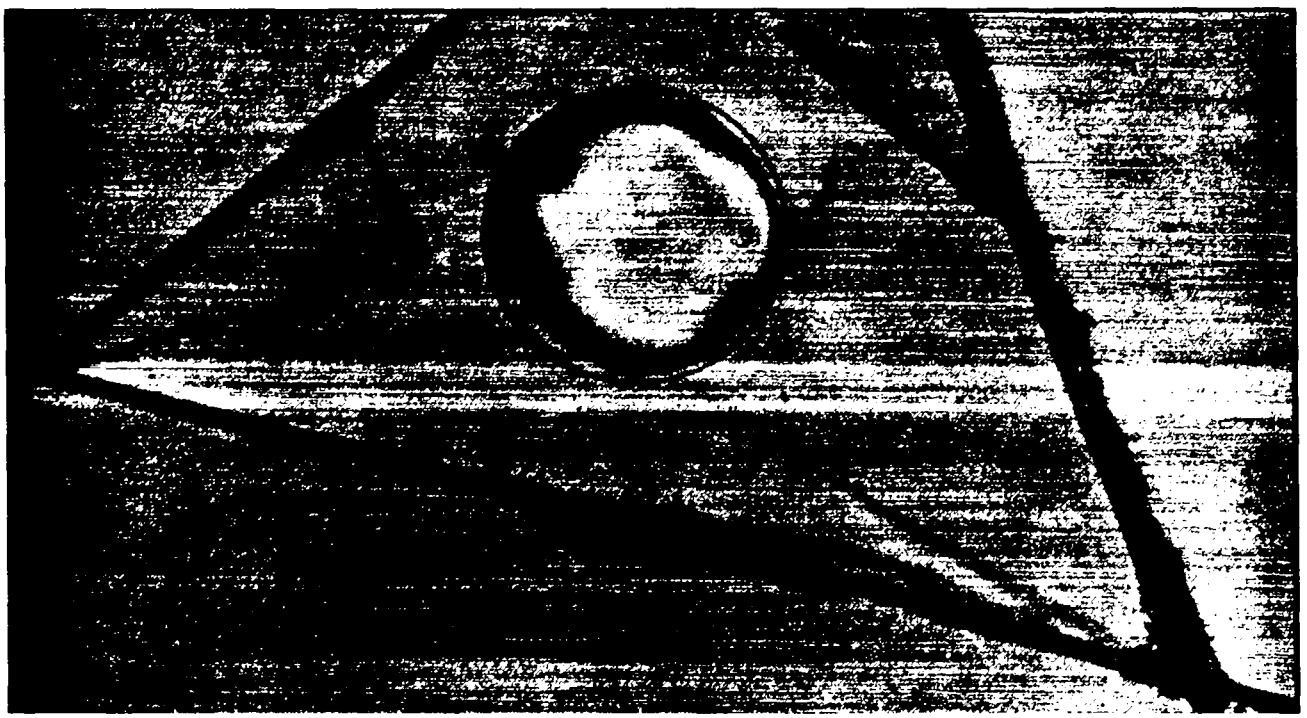
Finally, a wide range of special parts are fabricated that are incorporated in the various diagnostic apparatus developed by Group L-4 for use in the laser experiments. These have included many different single- or multiple-layer metal foils (as thin as 50 nm) for use as selective x-ray filters, small (5-μm-diam) pinholes for x-ray pinhole cameras, very-small-gage thermocouples for use in calorimeters, as well as pellicles, beam splitters, and spatial filter apertures for the laser optical systems.

L-9—Gas Laser Technology

Group L-9 performs basic research and development to support the activities of L Division's CO_2 Laser Fusion program. Working closely with L-1 and L-10, this group's efforts are directed toward advanced subnanosecond oscillator systems, techniques of laser isolation using both solids and gases, basic propagation studies, and development of fast optical and electrical diagnostic methods. L-9 maintains and operates the Gigawatt test facility, a frequency tunable CO_2 laser capable of GW output intensities.

L-10—High-Energy Gas Laser

L-10 is responsible for the design and implementation of the LASL High Energy Gas Laser Facility, a very large carbon dioxide laser system designed for laser-fusion research. The technical objectives of this laser are peak powers to 200 TW, pulse durations variable from 0.2 to 2 ns, and peak irradiance within a factor of 5 of diffraction limited. The facility is expected to be complete in 1982. The programmatic objective for the HEGLF is the experimental demonstration of scientific breakeven (defined as thermonuclear yield equal to or exceeding the incident laser beam energy). The Group is organized into six sections which encompass the necessary technical disciplines: facilities and planning, high voltage and pulse power, mechanical design, optical engineering, instrumentation and control, and supporting research and development.



Fusion Experiment Target - 200-μm-diameter DT-filled glass microballoon with 1-μm-thick wall mounted on 100-mm-thick mylar film.

M DIVISION

DYNAMIC TESTING
MS-682, ph. (505)-667-5653

This division is concerned mostly with the local testing and associated diagnostics on explosive-metal systems. These can be weapons systems or systems for research studies of material properties under dynamic conditions. Flash x-ray, optical, electrical contactor, and other electronic techniques are the main ones employed at the 13 firing sites of the division. The Laboratory's nondestructive testing group, an optical instruments group, and a computerized image analysis group are also included in this division.

M-1—Nondestructive Testing

Group M-1 is staffed and equipped to provide nondestructive testing support to all divisions of the Laboratory. The primary objective of the group is to use nondestructive testing to determine those physical characteristics and conditions of materials, components, and assemblies that determine their ability to perform intended purposes. Nondestructive testing enables these determinations without impairing the parameters being studied. Equipment is available for nearly all of the classical nondestructive testing methods—x- and gamma-radiography in the 1-keV to 25-MeV energy range, ultrasonic inspection eddy current inspection, magnetic particle, both transmission and scattered radiation gauging, potential drop evaluation, passive nuclear radiation measurements, and liquid penetrant inspection. Equipment and expertise are also provided for some of the new or less-widespread methods—acoustic emission, holography and holographic interferometry, infrared and heat transfer, and, in conjunction with Group P-2 Thermal neutron radiography and gauging. Other group objectives are derived from the materials and materials-energy interaction nature of the primary work. Both scanning and transmission electron microscopy are provided. Portable flash x-ray generators of 180, 300, 600, and 900 keV, and one of 2 MeV are applied to recording of dynamic events. Qualitative analysis based on both energy and wavelength dispersive x-ray fluorescence is in use.

An active research and development program continues in support of these activities and in anticipation of future requirements. The result of this program has been the development of certain nondestructive inspection techniques that were unique to LASL, but are now in widespread use at other installations and in industry.

M-2—PHERMEX

Group M-2 is concerned primarily with diagnosis of explosively activated hydrodynamic experiments of direct and peripheral interest to the weapons program. The principal tool for this work is PHERMEX, a blast-proofed electron accelerator capable of producing 100 R of gamma radiation with submicrosecond time resolution. This unique radiographic facility is used in conjunction with more than 50 channels of the most advanced electronic recording capability, and when the occasion demands, with high-speed optical cameras and/or additional pulsed x-ray equipment. The combined capability permits research investigations of both shock-induced pressure-volume-energy states unobservable by other methods and the detailed flow patterns behind detonation fronts in condensed explosives.

A second technology used in M-2 is the total containment of explosions of as much as 20 kg of high explosive, permitting experiments with toxic materials.

M-3—Detonation Physics

Group M-3 contributes to the improvement of design and construction of the high-explosive components of weapons systems by detonating them and measuring their behavior. The group also conducts experimental studies of all aspects of detonation in solid and liquid explosives, and theoretical studies to develop models of observed phenomena or to instigate experiments to test models. The objective is to understand as much as possible about the initiation, development, and propagation of detonation, the transfer of energy from explosives to other materials, and the effect of shock waves, radiation, or other stimuli on explosive behavior. The experimental, theoretical, and computational techniques used are extremely varied, with experimental techniques especially developed in high-speed photography. The facilities operated by the group include four firing sites equipped to study detonating explosive in sizes ranging from a few milligrams to several hundred kilograms, using rotating-mirror and electronic image intensifier cameras, fast oscilloscopes, and pulsed x rays.

M-4—Implosion Diagnostics and Related Research

A primary concern of M-4 is the accurate determination of metal motions for the explosive-metal components in modern weapon designs. In this capacity the group works in close cooperation with separate theoretical design groups. Experiments are also conducted to develop and/or to investigate short-duration neutron and gamma-ray sources.

In addition to its work on weapons, M-4 conducts research studies in hydrodynamic phenomena and in the related properties of materials. Hydrocode calculations are performed to detail the motion for plane or axisymmetric explosive-metal systems of interest and to provide comparisons with test results. In its materials research, the group uses a variety of methods for generating and measuring strong stress waves. The data from such measurements are then used to deduce the underlying properties of materials at explosively attainable pressures and strain rates.

To accomplish its objectives, M-4 operates several firing sites and a wide range of modern electronic recording equipment.

M-5—Optical Engineering and Repair

Group M-5 is a Laboratory service group for optical instruments. The group's primary functions are the design, modification, repair, and cleaning of lenses and optical instruments, which include cameras (ordinary, special, and high-speed), shutters, projectors, readers, binocular telescopes, microscopes, rotating mirrors, and many others. Secondary functions are the production of glass sheets, mirrors, thin-film coatings, and engraved labels to meet special requirements. Major equipment includes an optical testing laboratory (optical benches, collimators, interferometers, refractometers, spherometers), optical surfacing shop (sawing, grinding, lapping, and polishing machines), vacuum evaporation plant, balancing machine, pantograph engraving machine, and machine shop.

M-6—Shock Wave Physics

Group M-6 is a research-oriented group using shock wave technology to study the behavior of materials and systems under extreme conditions of pressure, temperature, and magnetic field. Shock waves are induced in samples using high explosives or hyper-velocity guns. The results are recorded with high-speed cameras, flash x rays, and various electronic trandsducers. Equations of state and ultra-high strain rate mechanical properties are determined at pressures of several million atmospheres and temperatures of several thousand degrees for a variety of materials. This data is particularly important for the design of nuclear weapons, but is also of great interest to other fields like geophysics and solid state science. To complement the shock data, the group also has a strong

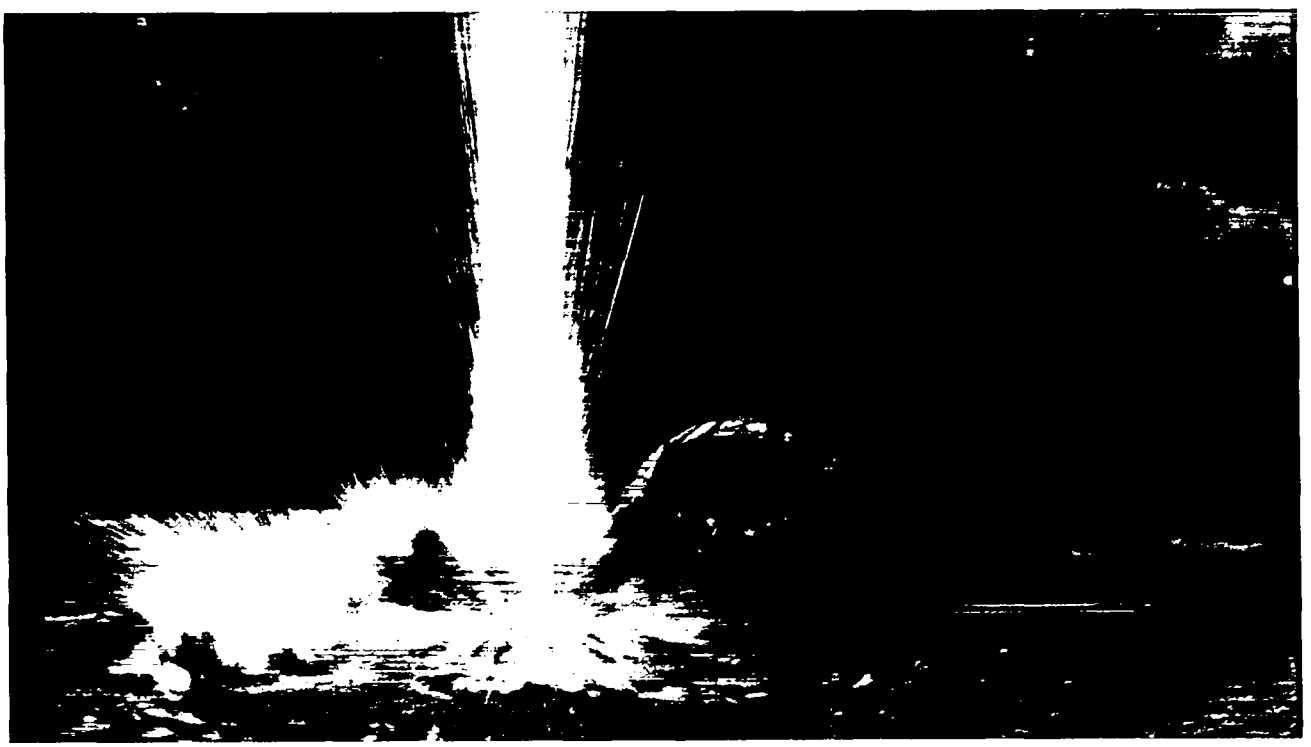
capability in static high-pressure and high-temperature techniques, including ultrasonics and x-ray diffraction. The group has developed explosive techniques for generating extremely high magnetic fields (in excess of one million gauss) and using them in the study of solid state physics. These techniques also lend themselves to the generation of high power electrical pulses by converting the chemical energy of high explosives to electrical energy. The generators are relatively lightweight and have been used to drive rocket-launched plasma guns. They are now being developed to drive a plasma focus tube that can create an intense burst of neutrons suitable for flash radiography.

A portion of the Group is directly concerned with testing and improving the hydrodynamic performance of nuclear devices. High-speed streaking and framing cameras, as well as flash x rays can accurately record the motion and condition of components during the chemical explosive stage of a device's performance. In addition, the group is active in several non-weapons funded projects including the development of shaped explosive charges for use in conventional weapons and the study of advanced explosive mining technology, with particular application to the *in-situ* extraction of oil and natural gas from oil shale deposits.

M-8—Image Analysis

Group M-8 is involved in all types of computerized image analysis. Though originally devoted to restoration of degraded images from various LASL projects, activities have been expanded into computer-aided extraction of data from imagery, image coding and decoding, linear and nonlinear systems analysis, coded apertures, three-dimensional reconstructions, and application of the theory of the photographic process. A portion of the group activities now arises from non-LASL requirements and is funded from external sources. Both research into new methods of analysis and implementation of developed methods on the LASL computers are pursued as group functions. Typically, images of interest may arise from radiography, high-speed photography, remote environmental sensors, and astronomy.

The group operates electronic and mechanical scanners and image viewers. The group is currently building a facility for interactive image processing. The system will be tied to the LASL Central Computing Facility (CCF), which will permit distributed computing between the system minicomputers and the large CCF computers.



MP DIVISION

MEDIUM-ENERGY PHYSICS
MS-850, ph (505)-667-5907

This Division is concerned with the scheduling, operation, and maintenance of the Clinton P. Anderson Meson Physics Facility (LAMPF). Experiments have been conducted for a two full years during which time the steadystate beam intensity achieved in the experimental areas was in excess of 10 μA at full energy. During the next year, the accelerator will be brought to 100 μA, and to the full design intensity by 1980.

LAMPF is a multifaceted, multidisciplinary facility that is designed to bridge the intellectual and technological gap between nuclear and subnuclear physics, and to address practical applications as well. The experimental facilities are used by research staffs of the Laboratory and other laboratories in the U.S. and abroad.

MP-1—Electronic Instrumentation and Computer Systems

Group MP-1 provides MP Division and the LAMPF users with on-line computer systems, software, and instrumentation. The group is responsible for:

- the continued development and support of the computer-based accelerator control system,
- the design and implementation of the experimental area beam-line controls and instrumentation,
- the development of an integrated computer-based data-acquisition system to support the program of experimental physics, and
- the development and maintenance of software for these computer systems.

The group also manages and maintains the LAMPF Electronics and Equipment Pool and provides the Division with a staff of electronics draftsmen.

MP-2—Accelerator Operations

This group is responsible for the operation and first-level maintenance of the LAMPF accelerator. It participates actively in the planning and execution of machine-development experiments for achieving more effective beam tuning procedures and higher beam intensities. The machine is in operation 24 hours per day, seven days per week, throughout most of the year, requiring the operating crews to work rotating shifts. The group is also responsible for maintenance and repair of local control hardware and computer interfacing equipment, closed-circuit television equipment, pulsed signal distribution systems, beam current and loss monitors, and interlock systems for personnel safety and machine protection.

MP-3—Practical Applications

Group MP-3 is responsible for conducting a research program leading to the development of practical applications of LAMPF. A substantial part of the program involves performing physics research to investigate the use of pions for cancer therapy. The group operates and upgrades the pion biomedical channel, develops beams and treatment plans for therapy, performs dosimetry and microdosimetry experiments, and provides general support for the clinical trials.

Other areas of research include muonic x-ray analysis to determine elemental composition and chemical structure, muon spin rotation experiments for materials characterization, proton radiography experiments, and the development of biomedical instrumentation for the diagnosis and treatment of disease. The group is responsible for helping to coordinate the activities of other groups in such fields as radioisotope production, radiation damage studies with protons and neutrons, and electronuclear fuel production.

MP-4—Nuclear and Particle Physics

Group MP-4 is primarily responsible for conducting a basic research program in medium-energy physics. This problem includes studies in elementary particle physics, atomic physics, nuclear reactions, and nuclear structure, using the pion, muon, proton, neutron and neutrino beams available at LAMPF. Currently the research covers such topics as electron-neutrino interactions, parity violations in strong interactions, rare pion-decay modes, pion-nucleon and pion-nucelus scattering and reactions, negative hydrogen photo-detachment, and pion total cross sections on nuclei. Much of this research is done in collaboration with other Laboratory groups and institutions.

Detector systems and experimental systems are under continuous development to make this program viable. General purpose spectrometer systems, for neutral and charged pion detection, are in use or under construction. The group supervises operations of an electronics equipment pool, a scintillator counter shop, and a wire chamber shop.

MP-7—Experimental Areas

Group MP-7 has general responsibility for the experimental areas and the facilities for carrying out pion, muon, and nucleon physics research at LAMPF, except for the two spectrometer projects and the biomedical facility. The group has the following major objectives:

- to install and maintain the primary beams, the secondary beams, and the research facilities.
- to provide beam stop systems, shielding, targeting, and remote-handling capabilities for operation of the primary beam at the 1-mA level;
- to manage the general plant maintenance and improvements of the experimental areas; and
- to provide a trained staff to support routine operation of the main beams, the secondary beams, and the cryogenic target systems.

The research facilities include three pion beams and a muon beam in Experimental Area A, and external proton beam and high energy neutron beams in Area B, and several irradiation stations for nuclear chemistry applications.

MP-8—Engineering Support

Engineers, technicians, and draftspersons form the staff of MP-8 and are responsible for providing engineering services to the varied programs at LAMPF. The major activities involve consultation, design, technical assistance and fabrication skills in support of the accelerator, experimental and related programs. The combined talents of the six sections in the group possess the experience and resources to fully implement projects, from concept through design, fabrication, installation, testing and maintenance.

Experiment Support Section. Engineering, planning, fabrication and technician assistance are provided all major experiments. Experiment engineers are assigned to each experiment to ensure that the setup meets the LAMPF production cycle schedules from the planning stage through field supervision of the installation. Experimental support shops are managed to provide light pipe and multiwire proportional counter fabrication services to users.

Fabrication Section. Mechanical fabrication and repair are performed by this section which staffs a machine shop, soldering and welding shop, furnace brazing facility and ion pump rebuild shop. The various fabrication and shop services are provided to the experiment, accelerator and klystron and ion pump rebuild programs.

The following shops are maintained:

Machine Shop - A staff shop is well equipped with general purpose machine tools and equipment.

Welding Shop - The welding shop includes gas, arc, TIG, and soldering capabilities in addition to a He mass spectrometer vacuum leak detector station.

Furnace Brazing Facility - Three retort type electric furnaces, using inert or hydrogen gas atmosphere, are used on a routine basis for the fabrication and rebuild programs.

Ion Pump Rebuild - Programmatic rebuild and testing of approximately 200 ion pumps in use at the facility are conducted in this shop.

Klystron Section. Repair and rebuild of the accelerator's 805-MHz klystrons (44 in operation) are ongoing activities representing an amalgamation of the equipment and expertise resulting from the design and fabrication of the side-coupled linac and from klystron research and development carried out in parallel with the klystron procurement and testing program. In addition, the section provides a major portion of the off-line maintenance and frequent on-line support of the accelerator rf power systems.

Alignment Section. The staff maintains a high skill level in the field of precision metrology and serves all of the alignment requirements at LAMPF. A metrology lab is maintained which includes a large tooling dock for precision coordinate measurements, surface plates, mechanical measuring tools, laser alignment equipment, optical tooling, and a collimating stand for optical instrument calibration. Alignment crews perform services both in the lab and in the field.

Drafting Section. General drafting services are provided in support of the engineering activities. Mechanical and electrical drawings are originated as well as circuit diagrams, printed circuit artwork and illustrations in addition to the associated files and documentation.

Mechanical Engineering Support Section. A large pool of electromagnets is maintained and provided to experimentalists as required. Mechanical maintenance and rebuild of the accelerator structure and magnet spares are performed by this section.

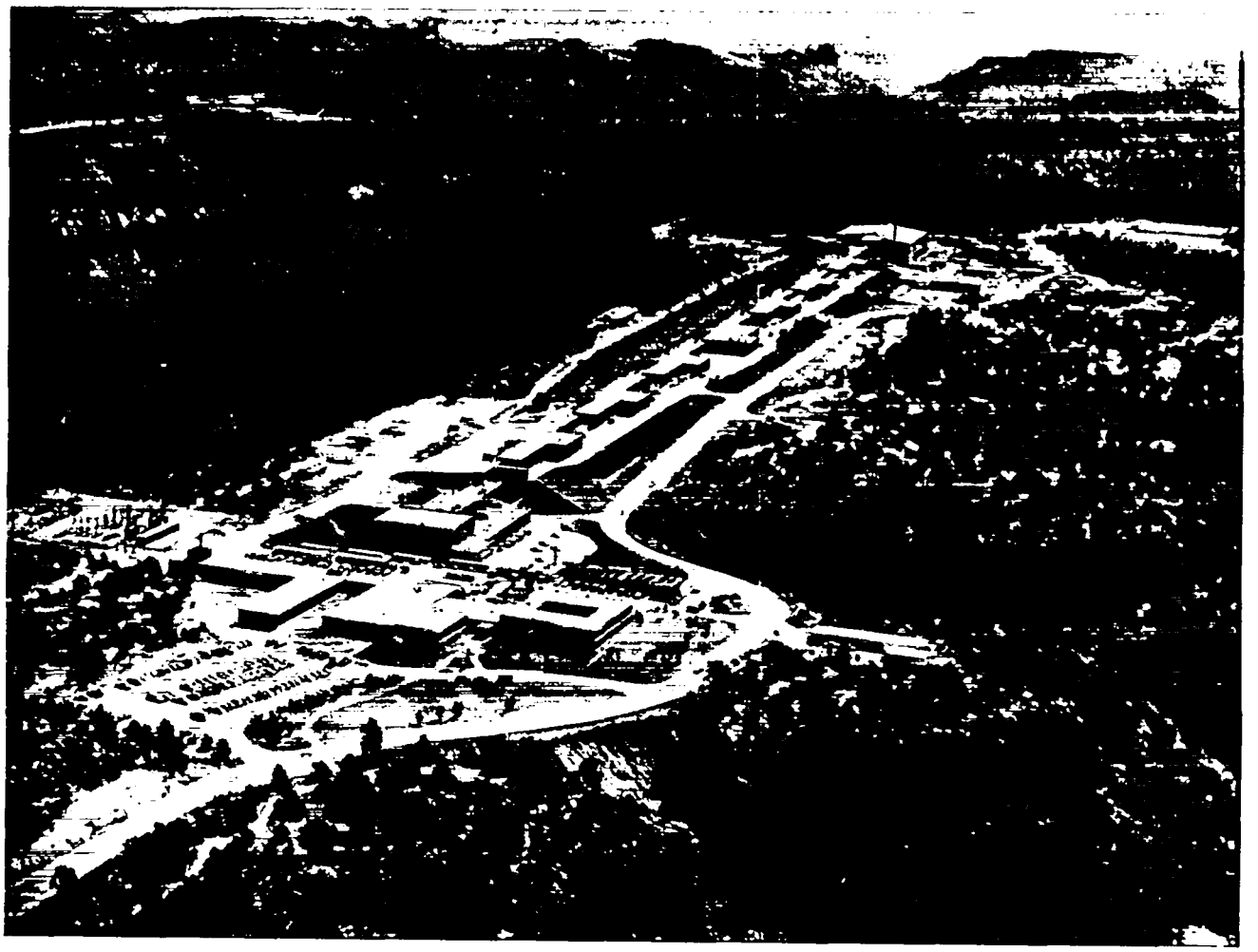
MP-9—Accelerator Systems Development

MP-9 conceives and develops procedures necessary for tuning the accelerator to the design intensity and the specified beam quality. This work requires a high degree of understanding of the fundamental behavior of the machine from the beam dynamics point-of-view, particularly with respect to the requirements for simultaneous beam acceleration and very low beam loss. The central computer control system is used to tie the system together, and the tuning procedures and advanced operational development work are structured around this control system. Instrumentation for experimental measurement of the phenomena involved is developed as needed.

The group is also responsible for the development of facility management tools using database techniques. Database systems for monitoring the performance of accelerator equipment, managing the experimental physics machine schedules, equipment pool inventories, user's office needs and other applications are developed for use throughout the Division.

MP-10

Two large, high-resolution spectrometer facilities are under construction by MP-10. EPICS (Energetic Pion Channel and Spectrometers) is a unique, high-resolution system allowing nuclear physics research to be carried out with pions. HRS (High-Resolution Spectrometers) is a proton system which allows high-resolution studies of nuclear structure using protons up to 800 MeV. MP-10 is responsible for the research programs of these spectrometers as well as construction and operation of the facilities. Most of the work of this group is carried out in collaboration with outside users and approximately half of the staff consists of long-term guests from the LAMPF users community.



MP-11—Accelerator Support

Group MP-11 is primarily responsible for maintenance and upgrading of the permanent facility. In this capacity, the group provides a trained staff and the necessary spare parts and test equipment to perform this function. The group also performs a service to other MP groups in areas of special expertise, such as rf systems research and development and other related systems.

MP-12—Injector Systems

Group MP-12 has the general responsibility for all injector systems at LAMPF. There are three on-line injectors capable of providing a high intensity H^+ beam simultaneous with either a polarized or unpolarized H^- beam. Specifically, the group is responsible for:

- the initial tuneup and maintenance of all three injectors and associated beam transport systems;
- the development of new ion sources and beam pulsing systems which will provide greater beam intensity and more flexible beam modulation capability that will be needed by the experimental program at LAMPF; and
- the design and construction of a very bright injector for use on the PIGMI accelerator.

The injector group works closely with various operations, development, and experimental groups at LAMPF to provide the required ion beams needed both for production runs and accelerator development tests.

MP-13—Beam Line Development

Group MP-13 is responsible for development of primary and secondary beam lines at LAMPF with the exception of Line C, EPICS, and the Biomedical beam line. for primary beam lines, this includes optics design and calculations; development of beam measuring, diagnostic, and monitoring instrumentation; development for beam tuning and monitoring procedures; beam studies; design, fabrication/procurement, measurement and maintenance of radiation-hardened magnets; specification of other beam line components; providing advice and some support to users of primary beam lines; maintenance of the SWYD. Development of beam diagnostic and monitoring instrumentation is shared with other groups. In general, MP-13 would specify instrumentation and software needs, develop the detectors, front-end electronics, (as appropriate) and work closely with whoever develops other electronics data acquisition hardware and data processing.

The development of secondary beam lines is coordinated with other groups who have responsibilities in this area. MP-13 concentrates on beam line physics, instrumentation and magnet engineering developments which include optics design, beam diagnostic and monitoring instrumentation, tuning procedures, beam studies, magnet design and measurements and providing advice and some assistance to users of the secondary beam lines.

MP-14—Linac Technology Group

The basic charter of the Linac Technology Group is concerned with the extension of linear accelerator applications and technology. Currently, the linac related research and development is directed toward an optimized design for a Pion Generator for Medical Irradiation (PIGMI), participating in a study of the feasibility and basic design parameters for an electronuclear breeder accelerator and investigating other charged particle beam applications.

Principal investigative efforts include the Alternating Phase Focusing Linac structure, the development of permanent magnet quadrupole lenses, the experimental study of radio frequency field gradient limitations, the evaluation of various cooperplating processes for linac applications, the development of microprocessors and minicomputer systems for beam diagnostics and accelerator control, parametric studies of high-frequency accelerator structures, rf manifolding and the development of computer programs for beam transport and structure field distribution.

P DIVISION

PHYSICS

MS-434, ph. (505)-667-4117

The activity in P Division is primarily in experimental physics, with special emphasis on low-energy nuclear physics and space physics. The nuclear physics efforts include experimental studies of nuclear reactions, nuclear structure, and the fission process. Electrostatic accelerators and a research reactor are used in these studies; the neutrons from underground nuclear detonations are used to measure difficult nuclear-reaction cross sections and physical parameters of materials. Two new factilies, the Weapons Neutron Research Facility (WNR) and the Intense Neutron Source (INS), will add to the capability for studying problems in nuclear physics and radiation damage. The space physics experiments rely on sophisticated detector systems placed aboard satellites or rockets.

P-DOR—Special Research Projects

Some special research activities are not logically a part of any group effort and are handled by senior staff members who report directly to the Division Office. These activities currently include an experiment at LAMPF for studying the basic nucleon-nucleon interaction, and the development of an electron accelerator which ultimately will become part of a variable-energy x-ray source for applied physics measurements.

P-2—Research Reactor Experiments

Group P-2 operates the Omega West Reactor (OWR). Using this 8-MW nuclear reactor the group conducts a varied program of basic and applied physics research. The reactor facilities and the advistory services of the group are made available to all divisions of the Laboratory. At 8 MW, the OWR provides steady-state fluxes of up to 8 x 10^{13} neutrons/cm^2·sec. A large variety of experimental facilities are built into the reactor, making it a very versatile research tool. It is used for sample irradiations, external neutron-beam experiments, in-core irradiation of instrumented capsules, neutron radiography of weapon components, neutron-capture gamma-ray studies, and neutron-activation assay work, including fissionable materials assay for weapon diagnostics. A major applied research program within P-2 is the assay of field samples for uranium, part of a nationwide uranium exploration effort. The group also performs numerous trace-element analyses, using a neutron-activation technique, in which sensitivities for some elements are below a part per billion.

Basic research activities of P-2 personnel include measurements of the properties of nuclear states excited by radioactive decay or neutron capture; an experiment at LAMPF in which muons are employed for probing nuclear shapes and charge distributions; and neutron diffraction studies of condensed matter.

P-3—Neutron Physics

Our principal responsibility is to maintain a versatile program in experimental neutron physics, both in basic research and in support of the weapons program. We use a wide variety of neutron sources

including accelerators and reactors at LASL and other ERDA laboratories, and underground nuclear explosions. Present and past experiments include differential measurements of scattering and reaction cross sections and integral tests of neutron transport calculations.

Other activities include an experimental program to study high-pressure shock waves. We have used neutrons from nuclear explosions to obtain equation-of-state information in the 10 to 40-Mbar regime, and are currently undertaking a series of experiments to study shock waves generated by high-energy lasers.

We also operate a theta pinch for studying the transmission of low-energy x-rays through high-density and high-temperature plasmas, and are joining CTR division in a program to study the dynamics of a high-density Z pinch.

P-4—High-Altitude and Space Physics

Group P-4 has the primary responsibility for developing the nuclear radiation detection systems carried by satellites to detect foreign nuclear weapons tests in space. For this purpose, twelve operating Vela satellites have been placed in orbit since October 1963; and the last four satellites, launched in 1969 and 1970, are still being operated as part of the U.S. Atomic Energy Detection System (AEDS). The program is being continued on large multi-mission Air Force satellite systems. Recent launches of these systems have augmented the old Vela system with modernized instrumentation. A significant portion of the group effort centers around analyzing and interpreting the scientific information from the background monitoring instrumentation on board the satellites, and developing, fielding, and interpreting results from experiments carried on low-altitude sounding rockets and on various NASA research satellites. The group's basic research is in solar-terrestrial physics and astrophysics with emphasis on solar activity, the interplanetary medium, the Earth's magnetosphere, and x-ray and γ-ray astronomy.

P-6—Radiation Calibration Facility

Group P-6 maintains a standard graphite pile for use in calibration of encapsulated radioactive neutron sources and operates a calibration facility for the Laboratory's radiation safety instruments and other special detectors.

P-9—Van de Graaff Accelerators and Nuclear Physics

Two electrostatic accelerators make up the essential parts of the P-9 facility. The vertical accelerator was designed and built by LASL and has been in productive operation since 1951. The high-potential terminal of the vertical machine can be charged up to 8 million volts. Particle beams of protons, deuterons, tritons, helium, and heavy ions are commonly accelerated. The vertical accelerator has been used primarily for neutron experiments, where the neutrons are made by several nuclear reactions either for steady neutron beams or for pulsed time-of-flight.

The second machine is a tandem accelerator purchased from a commercial source. This accelerator can be operated independently and is located in a concrete building with sufficient radiation shielding so that no interference is caused by both machines operating simultaneously. The same variety of particles can be accelerated with the tandem and proton energies of 16 to 17 MeV can be obtained. The tandem is used primarily for charged-particle experiments where thin targets of various materials are directly bombarded with the accelerated particles and studies are made of scattered particles, secondary reaction particles, and properties of the target and residual nuclei.

The two machines may be used in series for energies up to 23 MeV. The experimental programs in nuclear physics take advantage of the unique features of electrostatic accelerators for producing fully variable particle beam energies of various species wherein the energies are precisely known.

Tritons are now available in each acclerator with three-stage accelerated tritons being in particular demand by various experimenters. Triton beams are uniquely available at LASL and the (t,p) reaction that adds two neutrons simultaneously to a nucleus is a powerful investigative tool in nuclear research.

Both the tandem and the vertical accelerators can deliver a pulsed beam of a few microamperes average current. The repetition rate is approximately 2 MHz and the pulses are less than one nanosecond wide.

Sources of polarized H^-, D^-, and T^- of >100 nanoamperes intensity and >80% polarization have been developed and are in operation with the tandem. The polarized T^- beam is unique in the world and is currently the center of a vigorous research program.

P-11—Weapons Neutron Research

Group P-11 is responsible for implementation and operation of the Weapons Neutron Research facility (WNR). WNR is a broad spectrum neutron time-of-flight laboratory, built in conjunction with LAMPF. A small fraction of the 800-MeV proton beam producted by LAMPF is used at the WNR. This beam, which consists of a series of short pulses, is transported by a system of magnets to a heavy metal target where it produces large quantities of neutrons. The neutrons, produced in pulses whose length and frequency correspond to that of the proton pulses, have energies extending from 100 MeV to thermal. Experimental use will be mainly based on the time-of-flight method, where the neutrons are distinguished according to energy by measurement of the time it takes them to traverse the distance from the generating target to the experimental equipment.

It is expected that LAMPF, when it reaches design performance, will provide 500 μsec macropulses of both 800-MeV protons (17 mA peak current), and 800 MeV H^- ions (1.7 mA peak current), with a repetition rate of 120 Hz. The WNR facility, in its initial phase, will use a short proton pulse (up to 5 μsec long) diverted from the trailing edge of each LAMPF proton macropulse. With a large heavy metal target, one expects about 20 neutrons to be produced for each incident proton. For a nominal pulse width of 100 nsec, which would be useful for a large range of the experiments planned at the WNR, one can expect 2×10^{11} neutrons/pulse, or 2.5×10^{13} neutrons/sec.

It is proposed that, in a second phase, the WNR facility be upgraded by the addition of a high-current proton storage ring. This device will improve the WNR neutron pulse effectiveness by a factor of 100 to 1000, depending on neutron energy and storage ring operating mode. The storage ring basically acts as a pulse compressor, converting long LAMPF pulses into very much shorter (but more intense) pulses, enabling many more neutrons to be generated at the WNR target within pulse lengths suitable for time-of-flight use. The ring will be designed to store very high levels of circulating current, but for relatively short times (milliseconds), and will utilize a newly developed charge-exchange injection technique. which converts an H^- beam into circulating protons.

A range of operating modes is envisaged for the storage ring. In one scheme, 200 turns of H^- ions are injected into the ring, which has a particle circulation period of 300 nsec. The ions are injected in such a way as to form six bunches of 1 nsec width, circulating in the ring. Each bunch finally contains about one μsec worth of a LAMPF macropulse. The bunches will be ejected from the ring at a repetition rate of 720 Hz. In this mode one expects 2×10^{12} neutrons/pulse and 1.2×10^{15} neutrons/sec. At the other extreme of operation, a great many turns of H^- ions (several thousand) are injected into the storage ring. If the ring design criterion of 100 A of circulating current can be attained, 3×10^{15} neutrons/pulse will be produced, in a pulse length of about 150 nsec. The repetition rate for this mode will be at most about 1 Hz. The instantaneous neutron production rate in this mode is 2×10^{22} neutrons/sec.

The WNR beam transport system has been completed to the end of the channel and also to the primary neutron production target. It is now operated routinely for a variety of purposes including tuneup, detector development, and preliminary experiments. The end of the beam channel has been used for experiments employing the proton beam directly, and neutrons have been produced in the primary target area using a temporary carbon target.

NUCLEAR TEST DETECTION FROM SATELLITES

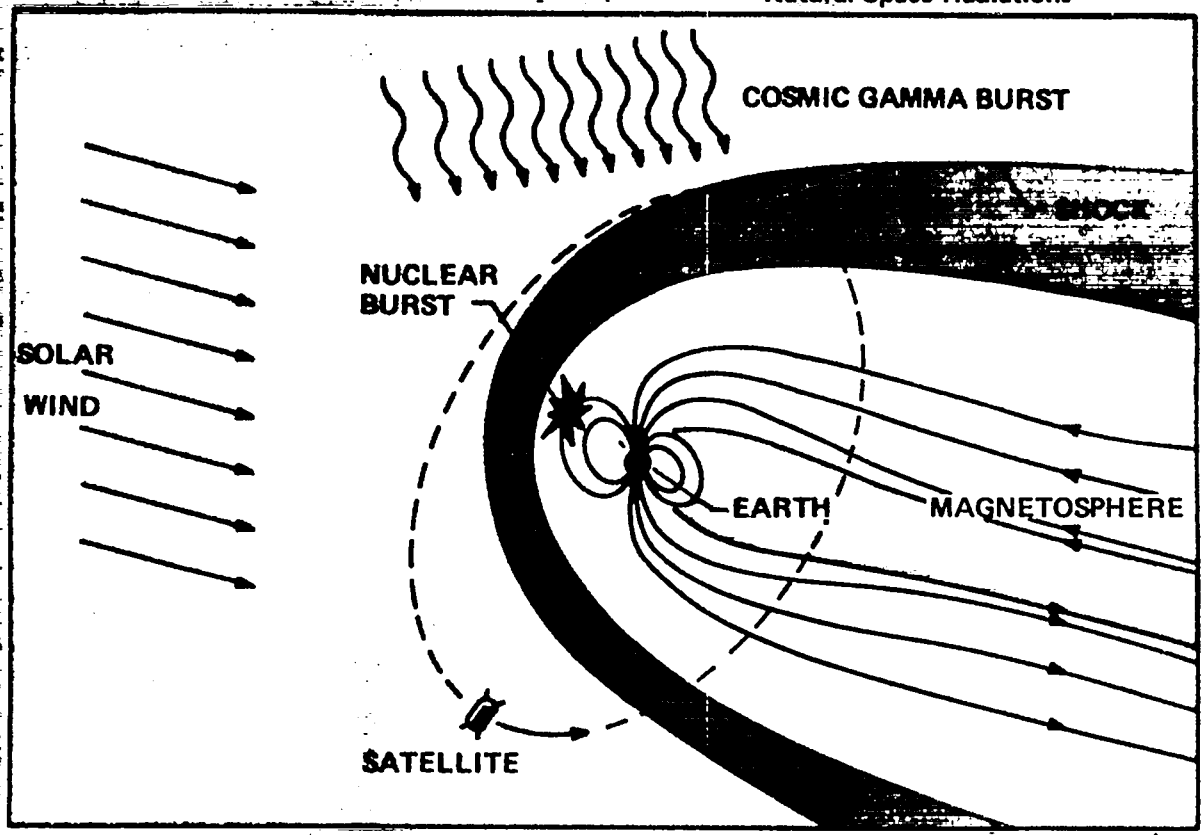
Objectives
- Space Nuclear Event Surveillance
  - Near Earth
  - Distant Space
  - Behind Moon
- Tactical Information
- Debris Tracking at High Altitude
- Magnetosphere and Outer Space Effects
- Technology R & D

Satellite Systems
- Vela Satellites
- Vela Follow-On
- Global Positioning
- Misc. Piggyback

Instrumentation
- X-Ray
- Gamma-Ray
- Neutron

} To Observe Nuclear Explosions

Natural Space Radiations

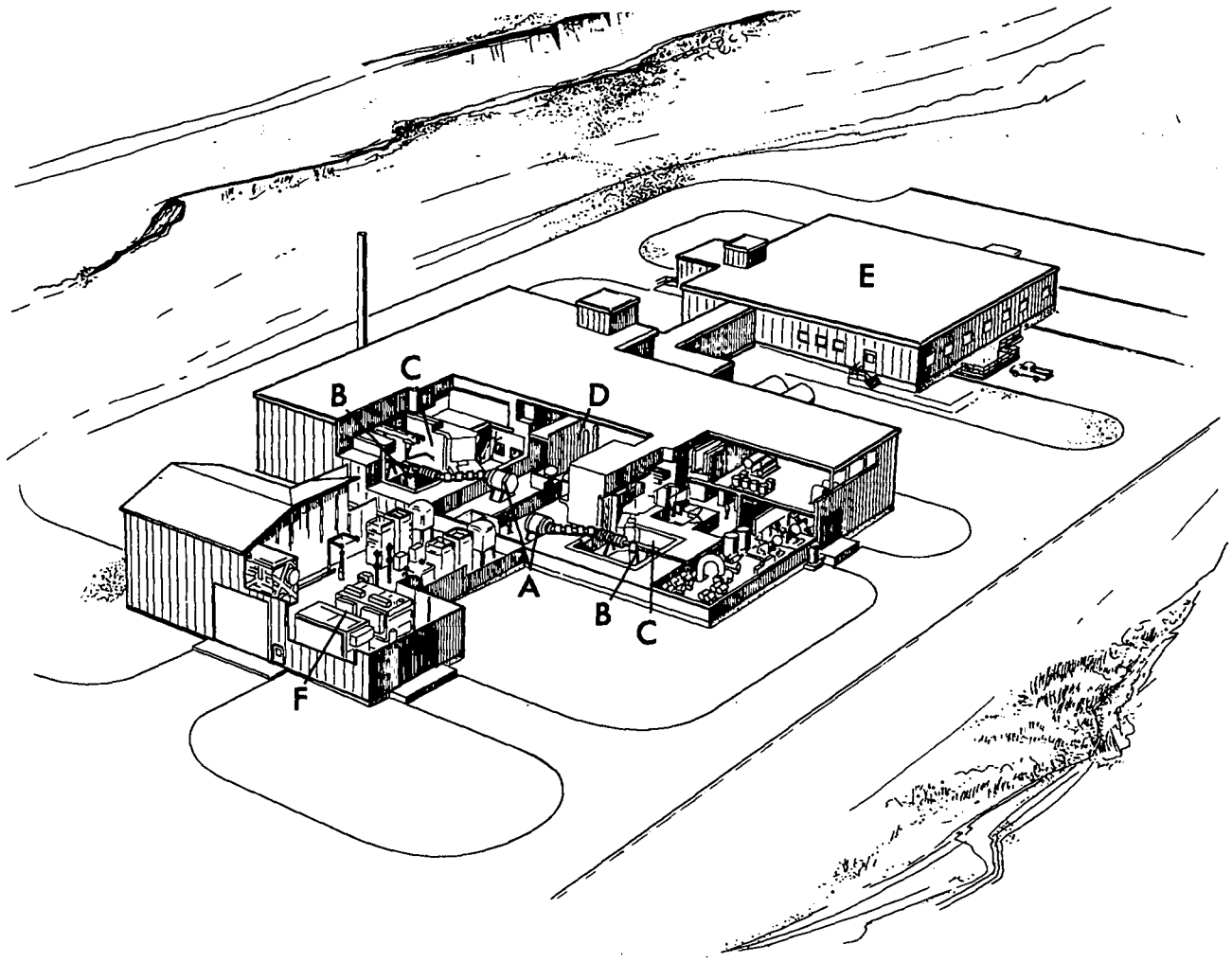


SPACE RESEARCH – RADIATION ENVIRONMENT

Los Alamos Scientific Laboratory of the University of California

Solar-Terrestrial Relations
- Solar Physics
- Interplanetary Medium
- Magnetosphere Phenomena

Astrophysics: Cosmic Gammas, X-Rays, Particles



In the artist's conception of the INS facility, various areas of interest are shown: A. shows the ion source; B. the target area where the tritium ion beam and deuterium jet target converge; C. the two source cells containing the intense neutron sources; D. the three-stage isotope separation system; E. the Laboratory-Office-Control Building that contains the computerized control center and offices; F. the wing of the building containing two high-voltage power supplies and capacitor banks.

Target and moderator handling systems are now being completed, and installation of several neutron flight paths is in progress. Two will be used for the fast neutron experimental program, and two more will be available for materials studies with thermal neutrons. Measurements on the neutron spectrum from the primary target have been initiated, and the experimental program is expected to get under way during the late summer and fall of 1977.

P-14—Intense Neutron Source Development

An Intense Neutron Source facility is being designed and built on Two Mile Mesa to study radiation damage effects that might occur in the similar environment of a fusion reactor. Group P-14 proposes to collide an intense tritium ion beam (3 amp beam current) with a deuterium gas jet target. The resulting D-T reaction will produce 10^{15} 14-MeV

neutrons per second. With this concept, the usual problem of deposition of heat in the target is solved with a supersonic jet that continually carries off the heat from the impinging beam, at the same time allowing sufficient neutron production. The specific yield of neutrons per unit of deposited heat is thereby increased along with the power deposition rate.

The experimental area is small in the Intense Neutron Source concept because the maximum neutron flux will exist at a radius of only a few centimeters from the target. Sophisticated miniaturizing of experiments will be necessary to use this experimental environment. Access to the source will be handled completely by remote control. Walls 3.5-m thick and a roof 3-m thick will shield workers from the radiation.

The Magnetic Fusion Energy program will gain needed information from the INS experimental program. Radiation damage experiments on bulk material, material surfaces, and insulators will serve to reduce the ultimate cost and provide design parameters for fusion power reactors to be built in the future. The Intense Neutron Source will provide needed data on 14-MeV nuclear cross sections and shielding. Routine and safe handling of 29 g of tritium and extraction of tritium gas continuously from the deuterium-jet exhaust system by means of the isotope separation system will demonstrate the feasibility of tritium's use in future reactors. The Intense Neutron Source's production of 14-MeV neutrons may serve later to calibrate and correlate results from experiments on other neutron sources with different flux spectra.

Meanwhile, Group P-14 is testing these experimental principles with a Beam-on-Target (B-O-T) prototype complete with computer control. This system accelerates a hydrogen ion beam to impinge upon a hydrogen jet. By using hydrogen, the B-O-T prototype will test the concept without the problem of neutron production or the handling of tritium. Results from these tests, expected by 1978, will influence the final design of the INS facility. The new facility is expected to be operating by 1980.

PER

PERSONNEL
MS-280, ph. (505)-667-6187

The Personnel Department is composed of Groups PER-1, Employment; PER-2, Recruiting, Visitor Liaison and Housing; PER-3, Personnel Systems Coordination, Reports and Records; PER-5, Training and Orientation; PER-6, Employee Benefits. The Personnel Department Office is responsible for (1) the organization, administration and supervision of the Department; (2) the development and administration of personnel policies and procedures; (3) preparation of any modifications of Appendix "A" to Contract W-7405-36 which covers the Laboratory's reimbursable expense items related to "Employee" costs; (4) administering the postdoctoral program and recommending policy changes; (5) handling appeals under the Laboratory's informal grievance procedure and the implementation of all details for a formal grievance; (6) garnishments and notice of levy; (7) participation on the Salary Policy Committee which reviews all reclassifications and recommends policy changes as regards wage and salary administration for graded series personnel; (8) assisting in preparation of Laboratory responses to, and investigation of formal charges filed with, the Equal Employment Opportunity Commission, N. M. Human Rights Commission, and Office of Federal Contract Compliance; (9) administering Personnel Department Operating and Equipment Budget; (10) Supervisors' Manual revisions; and (11) Employee Handbook revisions.

PER-1—Employment-Personnel Services

Group PER-1 is composed of two operating sections: Employment and Personnel Services.

Employment. The Employment Section is responsible for the employment mechanics involving all employee categories except Consultants and Long- and Short-Term Visiting Staff Members. Personnel Representatives and their secretaries are assigned two or more divisions or departments. They are responsible for providing all of the administrative support necessary to hire the best qualified personnel available to carry out the LASL mission. Some of the major activities of the Section are: requesting pre-employment references, extending interview invitations, making interviewee travel arrangements and interview scheduling, preparing and issuing formal employment offers, *Bulletin* job vacancy listing, coordinating internal employee transfers, counseling employees on personal and work-related problems, administering the Summer Graduate Student Program, administering the PER-1 casual secretarial pool, employment mechanics for the YOC and STEP Programs, answering employment reference requests, requests pertaining to verification of employment for credit information, liaison with the Security office to initiate clearance requests for new employees, and active participation in LASL recruiting effort.

Personnel Services. The Personnel Services Section is responsible for the processing of all new hires and terminations, initiation and reinstatement of security clearances, fingerprinting of potential employees, and the operation of the receptionist desk.

PER-2—Recruiting, Visitor Liaison Office, and Housing

Recruiting. This section is responsible for recruiting quality candidates for Laboratory staffing requirements. This responsibility entails recruiting at universities, technical institutes, professional meetings and off-site locations; preparation and placement of job advertisements in technical journals, trade publications and newspapers; preparation and dissemination of employment information to universities, colleges, technical institutes, professional societies, and non-fee organizations providing placement assistance to minorities, women, the handicapped, and veterans; development and preparation of fliers describing general and specific employment opportunities; and participation in career and job fairs. Special emphasis is given to the recruitment of affected classes incorporating all of the above as well as developing and perpetuating on-going personal contacts for reaching affected classes. Consultative service and advertising assistance is provided for technology transfer programs. Outplacement assistance is provided to employees required to terminate due to the completion of a fixed term assignment or reduction in force.

Visitor Liaison. This section is responsible for issuing invitations and establishing agreements and contracts required in obtaining the services of Consultants, Short-Term Visiting Staff Members, Borrowed Personnel, Visiting Scientists, Long-Term Visiting Staff Members, Guest Scientists, Industrial Staff Members, ERDA Contract personnel, and employees of government agencies. Visitor Liaison is also responsible for negotiations for services to be rendered and for requesting and issuing payments for such services. Arrangements for LASL employees on loan to other ERDA or federal installations are also made by this Section. Another function is the processing of visas for alien employees and visitors. This Section is also responsible for coordinating the colloquia and Staff Member Meetings.

Housing Office. This section is responsible for the scheduling of occupancy of Government-owned and leased housing and for coordinating the assignments of Consultants, Visiting Staff Members, and other visitors to privately-owned units.

PER-3—Personnel Systems Coordination, Records and Reports

Group PER-3 is responsible for maintaining all active, terminated , and potential employee files. The Group checks all new hire and transfer proposals for compliance with Laboratory nepotism policy, and assigns Z-numbers to all new employees. Requests for employment verification are answered by the Group. As the Personnel Information Center, the Group is responsible for the retrieval of personnel-related information from the Employee Information System and the Potential Employee Data Base. The Vacancy Report listing all job vacancies with the Laboratory is maintained by Group PER-3. The Group's Systems Section is responsible for reviewing the Personnel Department's Systems and Procedures, and for recommending, designing, and implementing new and/or revised administrative procedures. The Systems Section also serves as the liaison between AADP and the Personnel Department for all matters relating to Automatic Data Processing.

PER-5—Training and Orientation

This Group's activities are centered in five areas; In-House Continuing Education, Secretarial Training, University Programs, Management Development, and Employee Orientation. PER-5 sponsors some continuing education courses, and provides general coordination for those in-house courses sponsored by other LASL organizations. In addition, the Group reports on participation in all in-house courses. In the area of Secretarial Training, PER-5 conducts an orientation program for secretarial new-hires, and sponsors skills development courses for all interested LASL secretaries. In the academic area, the Group monitors LASL's Tuition Assistance Program, operates UNM's Los Alamos Graduate Center, and handles the administrative work for the Advanced Study Program,

Professional Research and Teaching Leaves, Graduate Thesis Program, IAEA appointments, and the programs of fellowships for graduate students and faculty members for two consortia of Western Universities. In the Management Development area, PER-5 has a program of seminars for supervisors. The following courses are in the current schedule: Developing Supervisory Leadership Skills, Selected LASL Policies and Procedures, the Effective Executive, Models for Management, and Team Development. In addition, the staff of PER-5 conducts a variety of orientation programs. Some of them, such as the summer orientation programs for graduate students, have a duration time of up to 3 days. The regular orientation programs for new personnel, which include talks on the organization and administration of the Laboratory, security, property management, health and safety, are scheduled on an average of once a month.

PER-6—Employee Benefits

PER-6 is responsible for the administration of employee benefits. This includes working with many different programs such as: University of California Retirement System, Public Employee's Retirement System of California, Group Health Insurance, Group Life Insurance, Accidental Death and Dismemberment Insurance, Short-term and Non-Industrial Disability Insurance, Automobile Insurance, Workmen's Compensation, Unemployment Compensation, and General Liability Insurance. Members of the group provide a variety of services such as counseling employees, advising supervisors of policies and interpretation, reviewing effectiveness of programs, and recommending changes to the appropriate people in LASL, the University of California, and the companies and organizations offering insurance and retirement programs. Newly hired employees are given an explanation of all of the insurance plans and enrolled in those selected. Terminated employees are interviewed so that they may make arrangements to convert insurance coverage and obtain information used in answering unemployment insurance claims. Preretirement counseling is offered so that employees considering retirement may know what kinds of benefits are available and make realistic income projections and plans for the future. This group maintains regular and direct contact with the various insurance companies to expedite the handling of all employee and annuitant claims. The group provides assistance and information for employees who wish to enroll their children in the University of California with the waiver of out-of-state admission requirements. The group is also responsible for administering the Laboratory's severance pay plan and recommending policy and procedural changes for other employee benefits such as vacation, sick leave, and holidays.

Q-DIVISION

ENERGY
MS-561, ph. (505)-667-5590

A reorganization was carried out on February 1, 1977 to facilitate the conduct of certain energy and geoscience-related work at Los Alamos. As a consequence the nongeosciences activities of Cryogenics, Solar Energy, and Systems Studies in Q Division were amalgamated with the Safeguards, Reactor Safety, and Reactor Technology of R Division to form the new Q Division. R Division was formally dissolved and the G Division is described elsewhere. In addition, the Statistics and Systems Studies Group T-13 was included in the Q-Division activities. As part of this reorganization the group structure was modified where necessary and new group numbers were assigned.

The three areas of responsibility are Nuclear Safeguards (Groups Q-1, Q-2, Q-3, Q-4), Reactor Safety (Groups Q-6, Q-7, Q-8), and Technology (Groups Q-10, Q-11, Q-12, Q-13, Q-14).

Q-1—Safeguards Technology, International Safeguards, and Training

The objective of Group Q-1 is the development of rapid, quantitative techniques, principally nuclear nondestructive analysis (NDA), for the measurement of the wide variety of fissionable material types, compositions, and containments that are found in the nuclear industry. The major portion of the Q-1 research program is responsive to nuclear safeguards measurement needs in the areas of inspection, accountability, and control of fissionable materials. NDA measurement capabilities, when integrated with surveillance and physical protection elements of safeguards, provide effective means for assessing the location, type, and amount of material; for rapid detection of losses; and for providing credible assurance that no materials have been diverted. Measurement systems developed for safeguards frequently serve facility operations goals of process control, quality assurance, safety, and efficient management of recycle and waste materials.

Fissionable nuclide characteristics exploited for "passive" assay are the neutron, gamma-ray, and "alpha-heat" emissions accompanying their radioactive decay. Ge(Li) and NaI gamma-ray assay systems are used to measure absolute nuclear material content as well as relative isotopic abundance. High-efficiency neutron counters are developed for the assay of ^{240}Pu and ^{236}U by coincidence neutron detection of spontaneous fission. Supplementing passive NDA techniques, "active" assay methods use external neutron sources, either radioactive sources such as ^{252}Cf and Am-Li or Van de Graaff and 14-MeV neutron generators, to induce fissions in the sample that are then measured by counting fission neutrons or gamma rays. Gamma-ray densitometry, using gamma-ray sources and x-ray generators, also provides a means to determine concentrations of thorium, uranium, and plutonium in typical solids and solutions. Where there are vital gaps in fission data, Group Q-1 either carries out the essential basic measurements or stimulates other research groups to do so.

Translation of laboratory R&D into practical in-plant demonstration of capability is essential to achieve industry acceptance of new safeguards technology. This typically includes the fabrication of prototype assay instruments, together with subsequent testing in ERDA facilities, the development of physical standards and measurement control procedures; and the formulation of a sound set of

minimum performance specifications for generic classes of instruments and measurement problems of interest to both commercial vendors and users. Detailed designs and operating manuals for instruments, as well as documentation on methods, are also supplied to vendors and potential users. Leadership and assitance are provided for a cohesive national program for NDA standards that involves the New Brunswick Laboratory, National Bureau of Standards, ERDA laboratories, and government and commercial nuclear facilities. Group Q-1 also conducts a Safeguards Technology Training Program for the ERDA Division of Safeguards and Security as another means for transferring technology to safeguards inspectors and plant personnel. This program includes the following course offerings:

- fundamentals of nondestructive assay of fissionable material using portable instrumentation;
- in-plant nondestructive assay instrumentation;
- integrated safeguards systems concepts and implementation; and
- gamma-ray spectroscopy for nuclear material accountability.

A highly visible effort is assistance to IAEA safeguards. Development of portable NDA instrumentation to address specific inspection situations, and associated calibration and evaluation of this instrumentation, represents a continuing program that is responsive to the needs for assistance expressed by the IAEA. In 1977 an additional effort has been defined and started, under guidelines of the U.S. Program for Technical Assistance to IAEA Safeguards, a special State Department funded program managed through the International Safeguards Project Office at BNL. This additional effort encompasses a broader program than instrumentation development and addresses, in part, the most urgent needs for technical support (including personnel training) expressed by the IAEA. The project management for LASL contributions to the Technical Assistance Program is currently provided by Group Q-1.

Technical support and research and development on NDA technology is also provided for the ERDA Uranium Resource Assessment Program. The main thrust of this activity is in the following categories:

- application of current gamma-ray and neutron computer codes for the problems encountered in uranium exploration, including calculational support for ERDA's programs;
- investigation of alternative active neutron assay methods (e.g., photoneutron-based system) for *in-situ* NDA applied to boreholes and other uranium measurement applications; and
- improvement of neutron detectors for application to logging and other field measurements.

Q-2—Detection, Surveillance, Verification and Recovery

Group Q-2 is developing instrumentation and techniques for non-destructive verification and identification of special nuclear materials. The techniques are applied to a wide variety of problems in perimeter safeguards for domestic and international nuclear facilities, in nuclear weapon-related safeguards, and in other classified activities. Active techniques which use external sources of neutrons or gamma rays to interrogate a nuclear materials system, or passive techniques which rely on the detection and identification of inherent nuclear radiation, are generally employed in these programs.

A major effort at the present time also involves providing personnel, techniques and procedures, and specialized equipment to participate in ERDA's emergency response to incidents of nuclear extortion and to nuclear weapon accidents. Portable and mobile nuclear detection systems of high sensitivity and incorporating new techniques for real time data processing and analysis have been developed and deployed for field test evaluation and operational use. Additional effort is being focused on research and development related to the diagnostic capability to be used in the field after unknown nuclear devices are located. These efforts require extensive coordination with other ERDA laboratories and with other federal agencies, primarily the FBI and the Department of Defense, having responsibilities in the emergency response system.

Q-3—Safeguards Subsystem Development and Evaluation

Group Q-3 is responsible for developing, implementing, demonstrating, and evaluating the

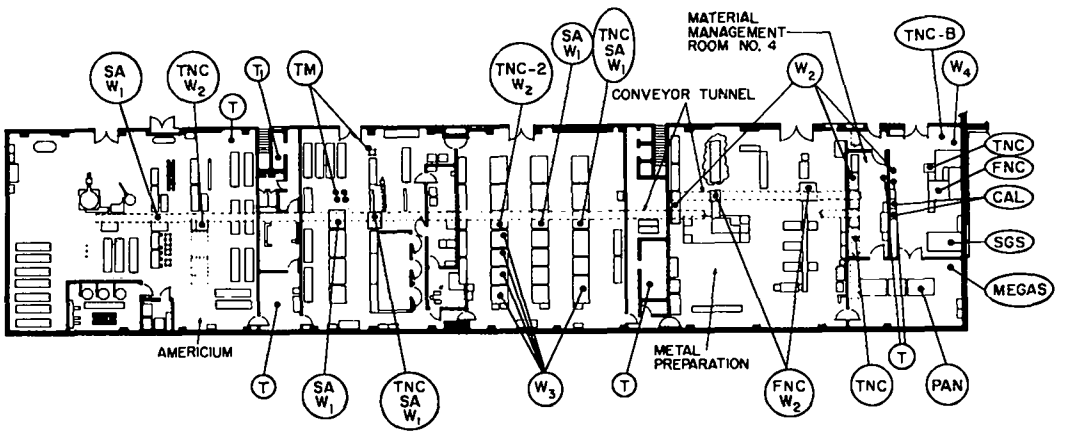
DYnamic MAterials Control (DYMAC) program. DYMAC is a system to control nuclear material within a plant. The system uses a plant-wide network of in-line nondestructive assay (NDA) instruments, coupled with automatic data processing equipment, to continuously pinpoint the quantity, form, and location of nuclear material throughout an operating nuclear plant.

The DYMAC concept was developed because present in-plant material control methods lack timeliness, are relatively insensitive, and levy an economic penalty in frequent plant shutdowns ad cleanouts. DYMAC overcomes the shortcomings of present methods by measuring the material in-line, by using NDA technology, and by transferring the data to an on-line computer system that provides real-time data base management.

The total DYMAC system is organized around four subsystems: NDA instrumentation, data acquisition, data base management, and real-time accountability. The NDA instrumentation subsystem provides rapid, quantitative, on-line measurement for the nuclear material as it moves from one unit process accounting area to another. The data acquisition subsystem provides accurate and reliable material control information to the central computer. The data base management subsystem accepts and organizes incoming data into files for efficent retrieval of specific information. The real-time accountability subsystem draws on the data base for continuous status monitoring of the nuclear material within the facility. On detecting an abnormality, it signals the condition and provides inventory data to aid plant personnel in determining the appropriate response.

A major program effort is to demonstrate the system's feasibility and effectiveness by integrating a working system into the new LASL plutonium facility at TA-55. This system, consisting of 80 measurement stations and 30 interactive terminals, will be fully operational in the fall of 1978. ERDA intends for this demonstration program to show the nuclear industry that a safeguards system can be operationally feasible, reliable, sensitive to missing nuclear material, and cost effective. Other facilities are expected to emulate this model.

As part of a program to disseminate information about DYMAC, Q-3 members regularly participate in technology exchanges in the form of training classes, workshops, and visits to and from other national and international facilities.



FNC	Fast-neutron coincidence counter	TNC	Thermal-neutron coincidence counter
MEGAS	Multienergy gamma scanner	TNC-2	TNC, low range (1-50 g of plutonium)
PAN	Pancake counter	TNC-B	TNC for barrels
SA	Solution assay instrument	W_1	Electronic balance, 0-200-2,000 g
SGS	Segmented gamma scanner	W_2	Electronic balance, 0-10,000 g
T	Interactive terminal, floor model	W_3	Load cells
T_1	Interactive terminal, supervisory model	TM	Tank measurement, gamma or x ray

Proposed DYMAC instrumentation for the recycle wing of the new LASL plutonium facility at TA-55.

Q-4—Integrated Safeguards Systems and Technology Transfer

Q-4 is the Los Alamos Scientific Laboratory's Safeguards Systems Studies Group. It was formed from other elements of the Laboratory and asked in early 1977 to develop conceptual designs for materials control and accountability systems for the entire spectrum of current and future nuclear fuel cycle facilities, both domestic and foreign. These systems integrate projected state-of-the-art measurement, data processing, and analysis techniques with effective physical security measures in a manner consistent with production requirements. The techniques, concepts, designs, and research requirements identified by these studies are subsequently transferred to the nuclear industry; to government and research organizations; and to nuclear plant designers and operators, for their use or for further development.

Important design efforts involve modeling and simulating both current nuclear fuel cycle facilities and future facilities that will have intrinsic resistance to nuclear materials diversion and nuclear weapons proliferation. Generic fuel cycle systems are modeled and their operation simulated by computer, using a variety of measurement and diversion strategies, in order to optimize safeguards designs.

An equally important task is to develop and formalize the methodology and techniques essential for the systematic design and evaluation of safeguards systems and for handling the data they produce. This requirement supports a continuing effort to apply advanced modeling, simulation, and statistical techniques to safeguards systems designs, and to develop and adapt the results of communications theory, control theory, and decision theory to safeguards requirements.

Both of these efforts require detailed knowledge of how nuclear fuel cycle facilities are managed, constructed, and operated; and a familiarity with modern measurement, process control, materials handling, and statistical techniques. Detailed design information for existing facilities is obtained through direct liaison or subcontracts with nuclear facility designers or operators.

Q-4 comprises an interdisciplinary staff with expertise in materials science, process and analytical chemistry, communications, data handling and analysis, process control, nuclear and measurement physics, nuclear engineering, and systems analysis.

In addition to relying on its own resources, the staff is encouraged to call upon other elements of the Laboratory, especially the other safeguards Groups, and the nuclear industry for detailed technical support.

Q-6—Thermal Reactor Safety

Group Q-6 is involved in the development, experimental verification, and application of advanced computer codes to describe the behavior of thermal reactors under postulated accident conditions. This effort is funded by the U.S. Nuclear Regulatory Commission.

A major part of the program concentrates on the development of an advanced, best estimate code, called TRAC, that will analyze all pertinent types of postulated accidents in Light Water Reactors (LWRs). Included are Loss-Of-Coolant Accidents (LOCAs) and Anticipated Transients Without Scram (ATWS). The TRAC code will provide a much more accurate analysis of such accidents than existing codes because it incorporates a detailed multidimensional treatment of the two-phase flow conditions that are important under such conditions. A key aspect of this effort involves the experimental verification of the code's predictive capability by applying it to the analysis of a broad range of available experimental data. Some of these tests are performed in Group Q-8. Ultimately the code will be used to address such pertinent questions as how much safety margin is inherent in current reactor licensing techniques.

Another advanced computer code is being developed to analyze postulated accidents in gas-cooled reactors. The initial version of this code, called CHAP, is directed toward the high-temperature gas-cooled reactor (HTGR) and models the behavior of all major system components.

Another important project in the group concentrates on the analysis and evaluation of reactor containment systems under accident conditions. A computer code, called COMPARE, has been developed to predict the pressurization of LWR containment buildings following a postulated pipe rupture accident. A number of other containment-related problems are also being addressed.

Q-7—Fast Reactor Safety

Group Q-7 is involved in analytical and numerical studies of the behavior of Liquid Metal Fast Breeder Reactors (LMFBR's) during core disruptive accidents.

The group is responsible for creation, modification, and application of the Nuclear Regulatory Commission (NRC) sponsored SIMMER computer code. This program provides new capability for calculating the coupled neutronics and hydrodynamics of an LMFBR following unprotected (no SCRAM) accident initiation. SIMMER computes the long-term extensive motion of the two-phase core material and assesses the neutronic feedbacks due to that motion. New insights into issues related to secondary excursions, accident energy partition and the postaccident heat removal source terms are being gained. A major result of SIMMER this year was the discovery that the damage resulting to the primary containment of an LMFBR from these postulated accidents may be a factor of ten or so less than previously believed.

To support the modeling of physical phenomena related to SIMMER, ERDA supports a separate effort in the phenomena modeling. Analyses and modeling of phenomena generic to core disruption is ongoing. Structural dynamics, transport processes, vapor explosions and other heat transfer processes are studied and modeled.

As a part of this ERDA effort, specific accident analysis studies are performed. These studies currently include SIMMER calculations of sodium boiling, of disruption within an isolated subassembly and of the dynamic pressure loading of the primary containment due to whole core accidents. Work will also be directed toward the characterization of the radiological source term that results from postulated accidents.

To increase our confidence level in SIMMER as a calculational tool, Group Q-7 defines out-of-reactor experiments, performed in Group Q-8. The close relationship between modelers and experimenters provides an ideal research environment and expedites the development of a reliable calculational tool.

In a new activity under an NRC contract, Q-7 is developing an experimentally verified computer code (LAFM) for the analysis of fuel pin behavior during reactor transients. This code will eventually be incorporated as a module for SIMMER.

In another new activity, the Division of Safety, Standards, and Compliance (ERDA) sponsors a technical safety assessment activity in Q-7, that provides safety assessments of selected environmental, safety and health aspects of various programs and projects.

Finally, the NRC sponsors a major effort in LMFBR safety test facility (STF) studies. In this activity, the STF project evaluates and defines national experimental needs (a Q-7 task), investigates associated advanced instrumentation systems, participates in design studies of specialized in-pile facilities, and performs analyses, and participates in planning for major new facilities.

Q-8—Reactor Safety Experiments

Group Q-8 is responsible for the performance of a wide variety of experiments relevant to reactor safety. These experiments are designed to provide information concerning LWR and LMFBR accident phenomena that is of particular interest to LASL Groups Q-6, Q-7, and T-3 who are developing reactor accident calculational methods. Group Q-8 works closely with these groups to allow careful interaction of experiments for code verification with development of analytical techniques.

The group's experimental efforts rely heavily on advanced diagnostic techniques capable of providing information from experiments performed in reactor simulant geometries. For example, gamma beams and laser light are being used in several two-phase flow experiments to acquire data without disturbing flow patterns.

The group is also engaged in a NASA-sponsored program to investigate the direct excitation of lasers by nuclear reaction products. This work is closely related to another NASA-sponsored program intended to examine the feasibility of a uranium plasma reactor for space applications. Group Q-8 also works closely with Group Q-14 in the performance of gaseous uranium critical experiments and performs the optical and radiation diagnostics required in this activity.

Q-10—Cryogenics

The work of Group Q-10 is divided among three areas of activity - basic research in low-temperature physics, cryogenic engineering, and applied superconductivity.

The areas of basic research include studies of:

- subtle magnetic phenomena in solids using the Mössbauer effect as a delicate probe;
- the dynamics of the destruction of the superconductive state in both Type-I and Type-II materials;
- the equation of state of the light isotopes (H_2, D_2, T_2, He^3, and He^4) using the piston-displacement method for pressures up to 40 kbar and the diamond-anvil-press method for pressures up to 1 Mbar;
- the dissipation mechanisms in the flowing superfluid helium film;
- properties of molecules adsorbed on surfaces using epithermal neutrons generated from the LASL Weapons Neutron Research facility; and
- muon spin resonance to investigate radiation damage and valence shifts in solids.

Cryogenic engineering efforts are directed toward developing advanced systems in support of Q-10 and other LASL programs as well as the determination of engineering properties of materials at low temperature. In the former category are such projects as:

- cryogenic target development for accelerated particle experiments of the Experimental Physics Division and the Meson Physics Division of the Laboratory;
- solid hydrogen target development for the Laser Division;
- cryogenic fractional distillation of DT-T_2 mixtures in support of the Intense Neutron Source and the Tritium Systems Test Assembly;
- providing sophisticated refrigeration systems, gas-handling systems, cryopumping systems, and various diagnostic systems as required for various projects; and
- development of magnetic refrigeration devices using paramagnetic and ferromagnetic working materials to span the temperature range 2 to 300 K in several stages.

Group Q-10 is developing two large-scale applications of superconductivity. The first of these projects is aimed at storing large amounts of energy - up to 10^8 MJ - for use in the electric power industry as system stabilizers and as peak-shaving and load-leveling units. A nominal 100-MJ, 1-MW device is being built at LASL to demonstrate the effectiveness of such a system on the local grid. Future larger devices are planned to be built at utility company sites.

The second applied superconductivity project is developing a dc superconducting power transmission line for underground transport of large power loads - up to 10,000 MW. Separate investigations are being conducted on electrical insulation, superconducting conductors, thermal insulation, and refrigeration schemes. The results of these tests will be used to design a prototype cable approximately 200 m long and with nominal capacity of 5,000 MW; construction is to begin at LASL late in 1978.

Q-11—Solar Energy

Research and development on the use of solar energy for heating and cooling buildings constitutes the funded work at LASL, however, new initiatives in other solar energy areas are being pursued. Projects currently directed by Q-11 include:

- provide technical direction and monitoring of ERDA research and development contracts for solar collectors and passive solar heating systems;
- provide technical assistance to ERDA in planning, complementing and analyzing research in heating and cooling of buildings and in agricultural and process heat;
- conduct research related to solar collector theory, engineering, applications, testing, performance, materials, and cost;
- solar energy demonstration on the new National Security and Resources Study Center at LASL;
- systems and controls analysis of solar heated and cooled buildings;
- solar heating demonstration on the community building being constructed at the Nambe Pueblo, NM (air system);
- solar heating and cooling of factory built housing using mobile/modular homes as a prototype;
- development and testing of a 100-ton solar Rankine-cycle cooling unit;
- evaluation of sun-tempered and other solar heated structures; and

• computer systems analysis leading to the publication of regional solar heating handbooks.

Q-12—Energy Systems and Statistics

The statistics activities of the Group include statistical consulting, statistical research and methodology development, statistical training, and maintaining a library of statistical software.

Consulting services are provided to several divisions and departments at LASL.

Areas of current research and development of statistical methodology include:

• the statistical analysis of chemical data;

• analysis of the effects of radiation on life processes;

• the prediction of secondary structure of transfer ribonucleic acid (RNA);

• curve fitting and modeling;

• development of statistical methods for use in the safeguarding of nuclear materials;

• analysis of uranium sample data from stream and aerial surveys;

• statistical reliability techniques and risk-cost-benefit analyses for reactor safety;

• statistical analysis and display of data on offshore continental shelf oil and gas leases;

• optimization studies of hydrocarbon-reservoir recovery rates; and

• statistical studies of the sensitivity of outputs of large computer codes to variations in input parameters.

Training activities include teaching in-house statistical courses and courses for the University of New Mexico Graduate Center as needed.

Supplying and maintaining a current library of statistical software for the LASL computing facility is another service of the group. The development of computer graphics for statistical analyses is currently being emphasized as a supplement to statistical analysis.

The energy systems activities of the group provides a multi-disciplinary force of physical and social scientists for the evaluation and assessment of the social, environmental, economic and legal aspects of energy related programs. Numerous examples can be provided to demonstrate that the problems of the energy crisis transcend technology and in many instances defy technological solutions alone. For example, coal gasification on a commercial scale could be a reality in the United States today. However, the magnitude of the development is exceptionally large and possible risks to health, safety, and the environment can only be estimated. Sources of capital for single new developments that would double the real property in an entire state have not been found. Financing, construction, and operation of completely new towns of perhaps 20,000 to 30,000 population in arid, remote regions pose difficult problems. The difficulties of extraction, disposal, and reclamation of mines producing significant fractions of the 600 million tons consumed in the entire U.S. in 1974 are clearly very great. The dispersal of effluents has potential global impact. Such problems are addressed by the economists, sociologists, physicists, and engineers in the group.

Current projects in Q-12 include the following:

Regional Studies Program. The Rocky Mountain Region (defined as the States of Montana, Wyoming, Utah, Colorado, Arizona, and New Mexico) is uniquely characterized. It includes 26% of the surface area of the contiguous 48 states and but 4% of the U.S. population, and contains over 50% of the domestic reserves of coal and shale oil and 95% of the uranium . It is the vast watershed that serves as the source for many of the major rivers of the country. In addition, the region is economically underdeveloped, culturally sensitive, and ecologically fragile. The region is also a storehouse of geological phenomena and natural beauty as evidenced by numerous national parks, monuments, and recreation areas, unique resources that must be preserved for use by the entire country. A balance must be achieved whereby the energy and resource demands of the nation can be met without substantial damage to the region. The Regional Studies Program is designed to assist in reaching this objective by:

• providing the basis for the development of a rational energy policy for the use of resources in a manner to minimize detrimental effects;

• providing long-term projections of energy, water, and mineral production and use for the region;

- providing a means for evaluation of the impact of new technology so that these factors can be incorporated into both regional and research planning; and
- evaluating the importance of legal and institutional constraints on regional growth, enegy consumption, and production.

Office of Environmental Policy Analysis. A number of issues that are expected to have significant regional impacts are being considered.

- The decrease in visual range which accompanies energy development may have serious implications if visibility constraints are added to the prevention of significant deterioration amendments to the Clean Air Act.
- The availability of water for energy development is an issue of utmost importance and it may well be the limiting factor in western energy development.
- The Western Indian Tribes control a large quantity of the energy resources which are to be developed. The impact of this development on their traditional way of life can not be neglected.

Cost-Risk-Benefit Study of Electric Power Production in the West. This study compares cost and benefit from environmental, social and economic effects for different electrical power scenarios in the west.

Q-13—Reactor and Advanced Heat-Transfer Technology

Group Q-13 carries out various analytical and experimental tasks in support of reactor development, and reactor safety research. Areas of activity in the group include reactor neutronics and fission product transport, heat transfer, mechanical engineering design, and structural analysis. Computer modeling and the development and application of computer codes are used extensively to evaluate reactor designs, and are also used to support the High Temperature Gas-Cooled Reactor safety research program carried out for the Nuclear Regulatory Commission.

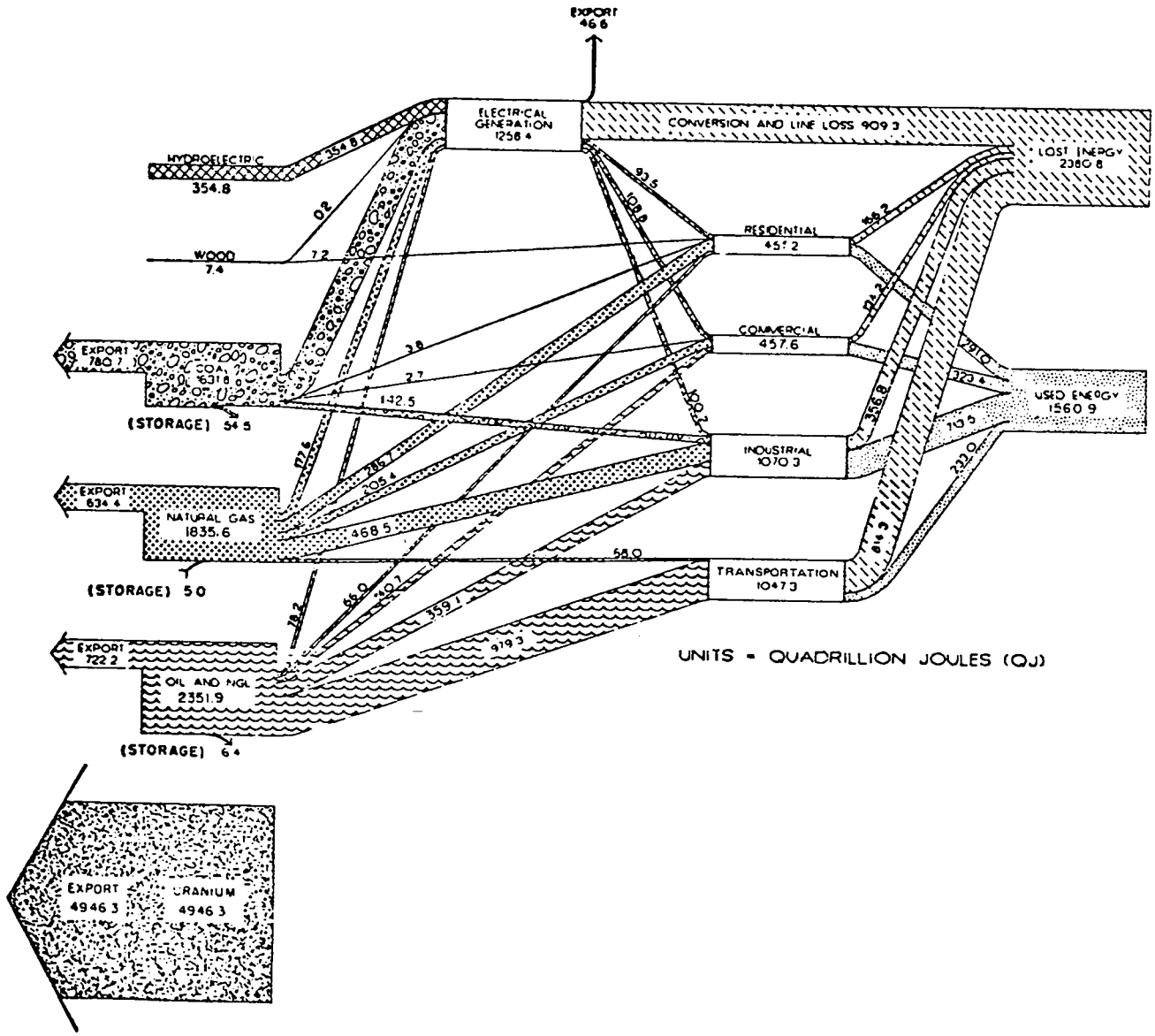
Although members of Group Q-13 carry out analytical modeling of heat pipe performance, the work here is mainly experimental with emphasis on building and testing prototype heat pipes. A well-equipped laboratory allows fabrication and testing of heat pipes and evaluation of their performance for both long- and short-term operation. Currently under development are heat pipes for possible future space reactors, heat pipes for heat removal systems to be used in spent fuel element storage, and heat pipes to be used in recuperators for recovering high-temperature industrial waste heat. The heat pipe developmental program is also supported by an ERDA-funded research program in vapor phase heat transfer. Finally, Group Q-13 members are involved in an experimental program relating to the verification of analytical predictions of the seismic behavior of a High-Temperature Gas-Cooled Reactor Core.

Q-14—Critical Experiments and Diagnostics

Group Q-14 is concerned with a wide range of reactor physics and neutronics areas. These include critical experiments, nuclear safety and radiation effects measurements, as well as analytical studies in several fields.

Q-14's experimental work is based upon the existence of a very wide range of critical assemblies which allow great flexibility in their application to problems. To do such work safely, Q-14 operates the critical assemblies by remote control. The control rooms are approximately 1/4 mile from three critical assembly laboratories. Approximately 10 machines are in use, making this one of the best equipped critical assembly laboratories in the world.

Examples of the variety of work permitted by these facilities are involvement in weapons design, studies in fast reactor safety, studies of gaseous core reactors, and pumping of lasers using fission sources. The capability of assembling and studying such a wide variety of systems is probably unique and a major role is probable in such future projects as reactors for electric power in space.



1975 energy flows,
Rocky Mountain region.

SD

SHOPS DEPARTMENT
MS-472, ph. (505)-667-4849

The Shops Department Office is the administrative office of the department with the attendant responsibilities of personnel actions, machinist apprentice training program, equipment planning and purchases, and the general control operations relating to all SD groups. The Department Office also oversees the operation of the tool cribs, the model shop, the maintenance shop, the tool and cutter grinding shop, and the glass shop.

SD-DO—Technical Staff

The technical staff is responsible for developing coherent solutions to problems applicable to the department and, in some cases, to the Laboratory as well. One responsibility has been to satisfy certain special fabrication research requirements, such as an ultraprecision (diamond turning) machine tool. A prototype machine is now available not only to produce precision parts but also to provide the engineering data for the acquisition of an advanced machine.

Another responsibility involves the acquisition of software and hardware and specifying the operational requirements for a stand-alone computer system. This system with its 3-D AD-2000 Graphics package will be used not only for interactive design and drafting work but also for the preparation of control tapes for use on the numerical control (NC) machine tools. The computer system will also provide the necessary means for data input and retrieval for various metrology and administrative requirements.

Metrication of the machine tools in several branch shops and specialized fabrication areas in the main shop has been a goal of the technical staff. This has been accomplished by installing metric dials and digital readouts on the fabrication equipment. The machinists working in these areas have been provided with metric measuring instruments and cutting tools to achieve complete metric capability.

SD-DO—Vendor Liaison

The vendor liaison office is responsible for placing fabrication orders with outside machine shops located both in the local area and throughout the country. A current comprehensive list of machining capabilities of both vendors and the Shops Department is maintained in this office. Personnel from this office will also work directly with Laboratory groups to place and expedite orders and to follow the orders through final acceptance.

SD-1—Fabrication

Group SD-1 is the nucleus of the Laboratory Technical Shops and operates the main shops located in buildings SM-39 and SM-102. The various shops are completely equipped to do all types of fabrication and employ the types of skilled craftsmen (machinists, heat treaters, metalsmiths, welders) needed to operate a variety of shop equipment. Numerically and computer controlled machines and electrical discharge machines are operated as standard equipment by SD-1 personnel. Specialized equipment and working areas are devoted to fabricating precious metals, and radioactive, toxic, and pyrophoric materials.

Machinists in SD are expected to work from finished drawings or rough sketches and to perform machining operations to exacting tolerances; (at times to millionths of an inch). A machinist must be

familiar with all types of shop equipment such as lathes, milling and boring machines, cylindrical grinders, etc., and make his own setups. On certain jobs he is required to certify the quality of his work through his own inspection setup rather than by a formal SD-4 inspection. The work requirements for each machinist classification are outlined in written job descriptions.

The group also handles fabrication research and development problems. A section of SD-1 operates as a flexible team that can bring fabrication expertise to bear on problems requiring diverse capabilities. All special and unique machines and procedures are evaluated and checked-out before acceptance by this section.

The SD Production Control section, responsible for the estimating and flow of work through the various shops, is part of this group's operation. Estimators are selected from within the Shops and are experienced in all SD current capabilities.

SD-2—Engineering

SD-2 is an engineering group engaged in the design of mechanical apparatus for many of the research groups associated with the Laboratory Technical Divisions. Its personnel makeup includes staff member engineers, senior designers, and drafting personnel. The staff members provide design expertise for experimental equipment associated with accelerators, reactors, and metallurgical and chemical research. The senior designers and drafting personnel assist with the designs and provide drafting help for intricate mechanical devices as well as the design of machines, tools, and dies required for the fabrication of required components. Where it is more advantageous to work closely with a group either due to the nature of the job or the physical location of the Site away from the main SD-2 office, loans of personnel may be arranged.

The group also maintains the Central Drawing Files for the Laboratory. These files contain a current and comprehensive microfilm security deck of all Laboratory engineering drawings issued within the Y-coded identification system. The group has been very active in the development, issuance, and continued follow-up of a Style Guide for Engineering Drawings that is in use throughout the Laboratory.

SD-4—Quality Assurance

Group SD-4 is responsible for verifying the quality of work done by the Shops Department. The SD-4 inspection section is capable of measuring fabricated parts made either by the Shops Department or, on request, by outside vendors. All types of tooling, precision and scientific apparatus, or any other devices that require precision measurements to accuracies of 0.025 micrometers are handled by the inspection section. Included in the array of inspection tooling available are mini-computer controlled gages operating in a controlled environment.

SD-4 maintains the LASL Metrology Laboratory which provides National Bureau of Standards traceability and accuracy. The ability to measure physical characteristics such as length, mass, force, pressure, temperature, flow, humidity, and electrical characteristics such as voltage, resistance, ac parameters, time, frequency and pulse are maintained for the benefit of all LASL programs. Both formal and informal calibration systems are used by LASL programs.

The SD-4 Advanced Measurement section is responsible for developing new measurement techniques for use by the SD-4 Inspection and Metrology sections and other LASL requirements.

SD-4 maintains a dynamic balancing facility where both stationary and portable dynamic balancing machines are used to minimize vibration problems in any type of rotating devices. SD-4 also acts as the Quality Assurance representative in the Shops Department and any Laboratory group requiring such service.

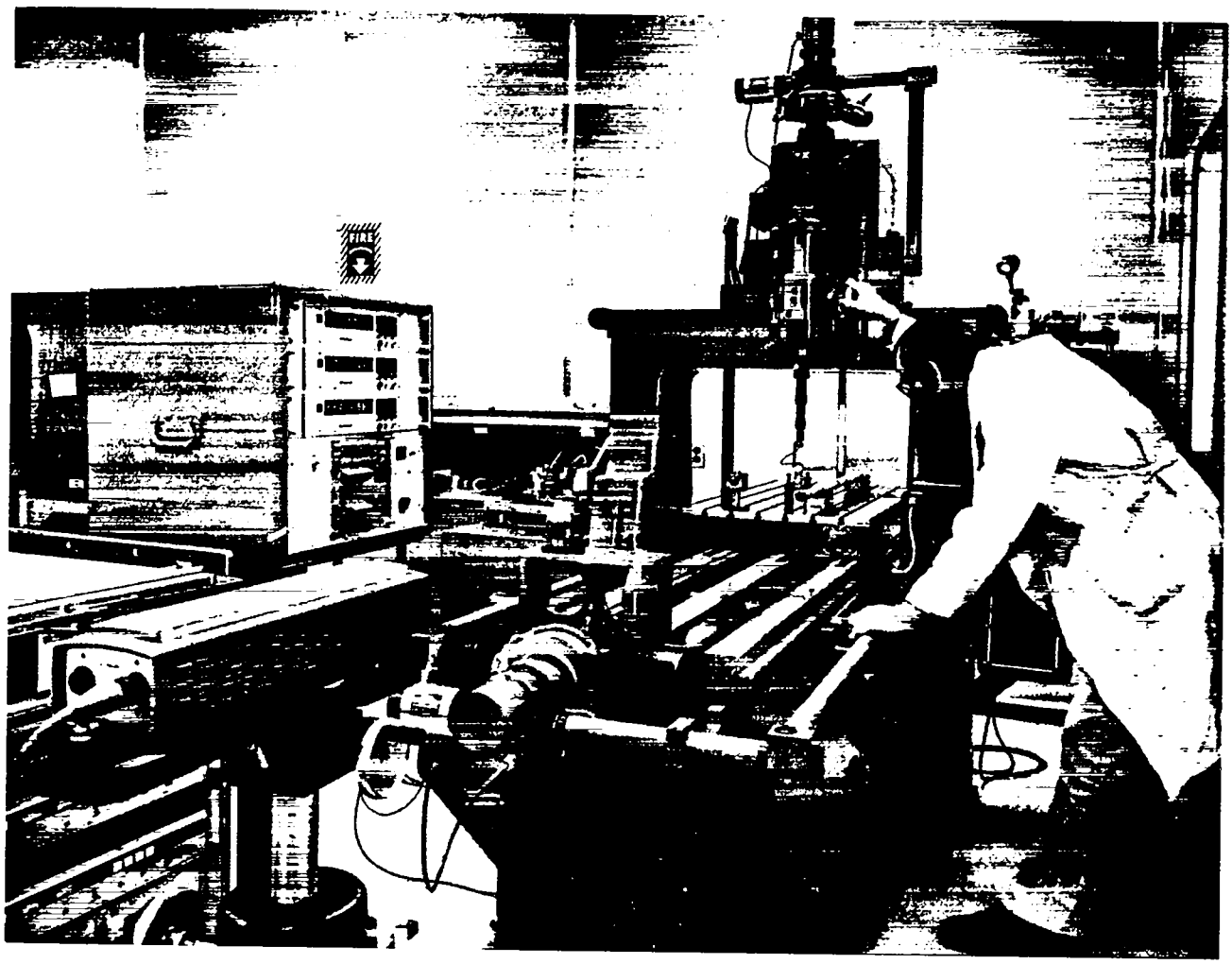
SD-5—Branch Shops

Group SD-5 controls the activities of thirty-two experimental machine shops located throughout the Laboratory, particularly at the outlying sites. These are operated for the convenience and use of the scientific personnel working in the nearby areas. Branch shops range in size from two to ten machinists and are staffed with skilled craftsmen

selected from the Main Shops to meet the particular needs of each area. Selection of a machinist for one of these shops is determined from an evaluation of the individuals ability to work mainly from sketches and in close contact with scientific personnel.

In addition to conventional machines, some branch shops are devoted to specialized activities. One such shop is a graphite shop. A ceramics shop with tools and machines necessary to machine hard and abrasive materials is available. One branch shop has some semiautomatic and automatic production-type tooling, including a precision Swiss automatic screw machine, so that design verification and the production setup may be evaluated as well as producing required components. SD-5 also provides trained personnel to operate a numerically controlled tape machine for specialized fabrication activities.

The personnel from SD-5 are also available for short term or temporary assignments to work directly with scientific personnel on specialized projects or programs.



A versatile precision measuring machine that is used to check length, width, height, and roundness. In the foreground is a laser interferometer that may be used in conjunction with the measuring machine to make very exact measurements.

SP

SUPPLY AND PROPERTY

MS-274, ph. (505)-667-4517

The Alternate/Department Head is responsible for the overall supervision and administration of the Department. The SP-DO sections shown below all report directly to the Alternate/Department Head. The Alternate/Department Head acts as liaison between and among the Director's Office, the University, and the Energy Research and Development Administration in formulating and implementing policies and procedures relating to the Supply and Property function. The Department publishes and keeps up to date manuals on Supply and Property Procurement Procedures and Materials Management to familiarize Laboratory personnel with the many forms, rules, regulations, etc., required to obtain necessary materials and services expeditiously.

SP-DO—Procurement Audit Section

One function of this section is to audit all purchase orders in excess of $2,500 to ensure compliance with ERDA and University of California regulations. The procurement auditor serves as Chairman of the SP Contract Review Board which reviews all fixed-price orders in excess of $25,000 and all cost-type orders in excess of $5,000. This section has the responsibility to expedite procurements for various special and high urgency LASL projects.

SP-DO—Priorities, Controlled Materials Allocations, and Airlift Section.

This section is responsible for maintaining control of all Government priorities and allocations of controlled materials. This includes various reports to the ERDA regarding LASL's usage and projected future requirements. Another function is the scheduling of shipments of hazardous and classified materials, including High Explosives and Special Nuclear Materials via Contractor airline and/or ERDA couriers.

SP-DO—Small and Minority Business and SP Personnel Section

LASL Small and Minority Business affirmative action programs are responsive to the University and Federal Government regulations. The SP/LASL Small Business Administrator and Minority Business Enterprises Coordinator is responsible for these programs and contacts Small and Minority Businessmen, visiting their plants and offering information and aid to assist them in placing orders with the LASL.

All SP personnel actions are initiated by this office.

SP-DO—Systems Analyst

Acts for the Alternate/Department Head and reviews all current departmental systems and procedures and is charged with the design and implementation of more efficient systems for the entire department. Word Processors are now being used and terminals being installed in various SP groups

so up-to-date procurement information will be available as soon as it is required.

SP-DO—Contracts Administration

Research and development contracts for LASL are negotiated, written, and administrated by this section. This requires a thorough knowledge of ERDA and Federal Procurement Regulations, and University of California and SP purchasing policies. Close liaison must be maintained with the requesting group, ADLL, and LAAO. All Automated Data Processing Equipment (ADPE) is purchased by this section. This highly specialized type of procurement requires a knowledge of Chapter 1801 of the ERDA (AEC) Manual and coordination with the Coordinator for Automated Data Processing (CADP), the requesting group, and ERDA approval authorities.

SP-DO—Traffic Management Section

The primary function of this section is assurance of compliance with all packing, marking, labeling, and descriptive regulations; and the efficient economical and expeditious routing of all incoming and outgoing LASL shipments. Involved in the performance of this function is reviewing freight rate costs, negotiating tariffs and special freight rates, auditing freight bills, filing loss and damage claims, tracing lost and overdue shipments, and maintaining current liaison with carriers and Federal and State regulatory agencies. The section has the responsibility of preparing import/export documents and the clearance of such shipments through U.S. Customs.

SP-DO—Associate Department Head for Procurement

Acts for the Alternate/Department Head in procurement matters and directly oversees the SP-10 and SP-11 Procurement Groups and the SP-12 Service Group which are detailed below.

SP-DO—Assistant Department Head for Property Management and Field Test Support

Acts for the Alternate/Department Head in matters involving the NTS and is responsible for the LASL/NTS warehouse supply and logistical activities. Works closely with J-Division and assigns a representative to set up property records and field support activities involved in all LASL field tests both within and beyond the Continental limits. Also is Group Leader of SP-2, detailed below.

SP-2—Property Management

This group's primary function is ensuring that all LASL property is identified, classified, and used in conformance with the Unversity's Prime Contract with the ERDA. This involves property not only at LASL, but at NTS and all LASL projects, worldwide. Other functions include the operation of a central motor pool for the entire Laboratory and responsibility for the assignment and record keeping of all vehicles assigned to LASL. All shipping requests are processed through SP-2 and the disposition of Excess ADPE and precious metals are handled through this group. SP-2 also acts for the Laboratory in processing and accepting incoming purchase orders from outside LASL for LASL services and/or supplies. SP-2 processed LASL Job Orders involving intra-Laboratory transfer of charges for work done by one Laboratory group for another Laboratory group. Performs contaminated burials involving classified material, radioactive material, and explosives. Conducts property audits on all LASL groups. Maintains files on all property loaned to and/or by LASL.

SP-3—Stores Inventory

The primary function of this group is administrative and physical control of materials, supplies and equipment. Other functions include establishing and maintaining inventories at an optimum level considering the necessity for not being out of stock and the cost of maintaining inventory.

SP-3 has the Main Warehouse (SM-30), the Chemical Warehouse (SM-31), Metal Stock (SM-39), Liquid and Compressed Gas Facility (SM-170), as well as the Contaminated Laundry Section, the Salvage and Excess Section, and sub-stockrooms throughout the LASL. This involves over 150,000 square feet of space with some 33,000 different stock items valued at over $3 million and "turned over" three times a year. Stores items are received, stored, and disbursed by this group. SP-3 is responsible for the salvage and excessing of both expense and equipment items which are no longer needed by LASL. Depending on the circumstances, this involves circularization within the Laboratory, transfer to Zia, or burial of contaminated items. SP-3 places low dollar value orders directly with vendors for certain of their requirements and expedites these deliveries. They also utilize an ADP system in the various inventory control functions.

SP-4—Shipping, Receiving, and Warehousing

This group's function is the shipping, receiving, picking up, and distribution of all materials and supplies for the Laboratory. This entails the operation of a truck fleet to pick up and deliver items not only at LASL but also in Albuquerque and Santa Fe. Other functions are the packing and crating of outgoing shipments and working with the Traffic Management Section on all damage claims for incoming shipments. SP-4 is responsible for the maintenance and repair of LASL owned forklifts using an outside contractor.

SP-10 and SP-11—Procurement

The primary function of these groups is the procurement of and the contracting for, all supplies, equipment, and services required by the LASL. SP-10 is primarily responsible for purchasing electronic and electrical commodities; SP-11 is primarily responsible for purchasing mechanical and chemical commodities. Typically in any fiscal year, the annual monetary total for purchase orders/contracts issued will approach $80 million and involve the processing of an average of 38,000 purchase requests.

This function must be accomplished in compliance with a myriad of regulations applicable to both Government and University purchasing and in an efficient and expeditious manner.

Additionally, the procurement function entails the administering of purchase orders for lost and damaged materials, return of equipment for repair or replacement, arranging for loans of equipment for engineering evaluation, issuance of modifications to contracts or cancellations as may be necessary and expediting contractual performance as required by regulation.

To facilitate this function, the groups maintain source listings for a large and varied range of commodities, maintain card files on suppliers, solicit proposals, type certain orders, review specification, interview prospective suppliers, and maintain close liaison with LASL requesting groups.

SP-12—Procurement Services

The primary function of this group is the administrative support of the two procurement groups. Included in this function are the receipt, logging, and distribution to SP-10 or SP-11 of all incoming purchase requests. SP-12 has a central typing pool which types and proofreads purchase orders. They also utilize Word Processors to type purchase orders and/or contracts and, at the same time, information is automatically fed directly into the Management Data Base so all Laboratory groups are supplied with up-to-date information relative to the detailed status of their purchase orders and are given a running balance on purchasing dollars committed both group and program. Some low dollar value procurements are typed by SP-10 and SP-11, but SP-12 reviews, approves, and signs all orders for LASL. The message room handles essentially all incoming and outgoing mail for SP. The SP Catalog Library section which is used, not only by the procurement groups, but also by all LASL groups, files and maintains current literature from over 17,000 vendors and an extensive telephone directory file covering over 200 cities in the USA. The Excess Coordinator in SP-12 screens excess lists from within as well as outside LASL and matches these

items with LASL requirements. A central expediting section (AID) handles expediting on approximately 3,500 open orders. Vendor liaison is the responsibility of this group and includes coordination of meetings among buyers, vendors, and the LASL staffs. For this purpose, rooms are maintained in an uncleared area of SM-123. SP-12 maintains purchase order files and vendor files for vendor evaluation.

All management reports for SP, Laboratory management, and ERDA are the responsibility of this group.

T DIVISION

THEORETICAL
MS-210, ph. (505)-667-4401

The Theoretical Division is an interdisciplinary community of theorists performing pure and applied research in a broad spectrum of disciplines ranging from numerical hydrodynamics to theoretical biology.

Most important among the goals of T Division is the guidance and support of major Laboratory programs including weapon design, fission reactor design and safety, fusion energy research, and laser isotope separation. While direct assistance often takes the form of new computer codes and better input data, the theoretical basis for such practical support necessarily involves research on fundamental processes in plasma physics, transport theory, hydrodynamics, and atomic, molecular and nuclear physics. The Division is also taking a more active role in guiding the direction of major programs and in the critical evaluation of new programs. Such efforts have led to the formation of several interdivisional working groups to attack difficult problems arising in programs of major importance.

Since the vitality of applied programs at LASL requires close contact with developments at the frontiers of science, T Division has continued to strengthen its program of basic research until now such research constitutes a major fraction of the theoretical program. Areas of study include low- and medium-energy nuclear theory, elementary particles, statistical physics, mathematical modeling and analysis, astrophysics, and theoretical biology. Moreover, vital contacts are maintained with the academic community through an active visitors and consultants program involving some of the most esteemed scientists in the country.

In the last few years, the Division has established many new programs in response to the changing needs of the Laboratory. In particular, the materials theory group and the theoretical molecular physics group were formed to support new Laboratory programs on materials properties and other energy-related problems. More recently a group devoted to research on the detonation process and related material properties and another devoted to intense particle beam research were formed.

T-DOT

Group T-DOT (Division Office - Technical) is the administrative assignment for efforts to small to justify the formation of a group, or for personnel working directly with the Division Office staff.

Members of T-DOT are presently working on problems in astrophysics, weapons physics, stress field engineering, Taylor instabilities and recursion relations, and non-linear systems. One group member is a consultant to TD-7 on nuclear verification and non proliferation issues.

Astrophysical research is presently focused on the theory of pulsating stars, both strictly periodic objects and the rarer multiple-period Cepheids, and the physics of solar flares. In other work, opacities

are prepared for outside investigators in stellar evolution.

In work on non-linear systems, an important discovery has been made that universal functions describe the bifurcation of solutions to non-linear, one dimensional recursion relations. Important implications of this discovery for such diverse fields as population dynamics and economics modeling are being pursued, as well as attempts to generalize the result to higher dimensions.

T-1—Transport and Reactor Theory

Group T-1 continues work begun at Los Alamos in 1943 under Feynmann and Serber to develop methods for predicting the spatial and angular distributions of neutral particles in both fission and fusion devices. Using the linearized Boltzmann transport equation, still a sufficiently accurate model for most weapons and reactor applications, T-1 develops increasingly more accurate and more efficient numerical methods for its solution. In particular, the growing need for two- and three-dimensional solutions for complicated geometrical configurations requires improvement in the difference schemes, convergence acceleration methods, and data management techniques. This work is guided by analytical studies of the basic equations for neutral and charged particle transport. Over the past thirty years, T-1 has produced virtually every numerical technique used to model the Boltzmann equation. B. G. Carlson, internationally recognized in the areas of transport numerical modeling, remains an active contributor to T-1 research efforts.

The group also develops prototypical neutral and charged particle transport codes for application to weapons design, weapons effect studies, and reactor analysis. Guidance is given in the use of these computer programs and they are maintained for general application throughout the Laboratory within the CCF computer systems.

T-1 produces fission reactor analysis codes for the ERDA Division of Reactor Development and Demonstration. At the same time, the group participates in the development and implementation of standards for the writing of such codes to facilitate the transfer from one type of computing facility to others in the reactor community. Locally, the reactor physics programs are used by the group to analyze a variety of fission reactor core design and shielding problems.

Personnel involved with fission reactor methods and analysis also provide verification testing of complex (neutronic/hydrodynamic/equation-of-state) reactor safety codes for the Nuclear Regulatory Commission.

Most of the fusion reactor neutronics work for the Laboratory is done in T-1. Methods development work is in sensitivity analysis, simulation of particle streaming, and modeling of neutron and neutral atom transport in toroidal configurations. The group also performs design analysis studies of importance to various fusion reactor concepts and shielding analyses for physics experiments related to fusion reactors. Because the principal radiation shielding expertise for the Laboratory resides in T-1, other shielding analyses for space reactors, nuclear wastes, etc., are undertaken also.

T-2—Applied Nuclear Data

Group T-2 provides the link between basic research in nuclear physics and applied research in nuclear weapons, fission and fusion reactors, and other nuclear systems. The work begins with the analysis of available experimental data and the application of theoretical nuclear models to fit, interpolate, and extrapolate from the measurements. Basic differential cross-section data for nuclear reactions over a continum of incident and exit energies and angles are obtained from this evaluation procedure. The data are then processed into a form for direct use in nuclear design codes (neutron transport, diffusion, or burn-up). Because these codes require a manageable set of average cross sections, processing involves collapsing the basic data base - usually by averaging or grouping into relatively large energy bins (multigroup form). The weighting function used to obtain the average cross sections takes into account the effects of geometry and composition involved in the specific application. The resulting processed data sets are then tested by using them to calculate well-measured integral experiments. If they perform well, the data sets are validated for use in nuclear design. The

group is exploring the application of similar techniques to other types of data such as energy resource and utilization data.

T-2 actively participates in development of the national evaluated nuclear data system, ENDF/B. In addition to developing nuclear model codes and deriving evaluated data for use in ENDF, the group is involved in formulating and expanding the system to satisfy new requirements of nuclear technologies. For example, design studies of controlled thermonuclear reactor systems are creating new nuclear data requirements, as are questions of fission reactor safety and fuel/waste management.

The group works in close collaboration with other groups and divisions of the Laboratory concerned with problems in nuclear system design and effects, nuclear data measurement, integral experiments, and nuclear theory. It undertakes studies on behalf of ERDA agencies and divisions, the Nuclear Regulatory Commission, the Electrical Power Research Institute, and the National Aeronautics and Space Administration, and maintains active contact with various national and international groups concerned with nuclear data problems.

T-3—Fluid Dynamics

Group T-3 is responsible for the development and proof-testing of new methods for solving fluid dynamics problems. Numerical solution techniques for time-dependent compressible and incompressible flows in several space dimensions and with large material distortions (PIC, MAC, ALE, and ICE methods) is the group's primary area of expertise. When necessary, new or alternative mathematical formulations of relevant physical processes are derived, and simplified models for complex flow phenomena are often developed from the results of detailed numerical calculations.

Recent accomplishments of T-3 include new approaches to two-phase flow analysis, a technique for combining Eulerian and Lagrangian coordinate systems, computing methods for fully three-dimensional investigations, and the inclusion of such features as chemical kinetics, particle transport, phase transitions, and electromagnetic effects. The group has applied these new techniques to a wide variety of problems including the analysis of multiphase fluid flow in reactor safety problems, the treatment of chemically reacting flows occurring in chemical lasers, and the handling of specialized two- and three-dimensional problems related to the dynamics of floating bodies, the prediction of blast loads on structures, the theory of centrifuge operation, and the dynamics of colliding nuclei. Moreover T-3 has pioneered the application of numerical fluid dynamics problems in astrophysics, biophysics, industrial processes, and the ocean sciences and is engaged in educational activities to introduce new numerical techniques to other investigators.

Approximately three-quarters of the group's activities are supported by contracts or grants from federal agencies other than ERDA.

Laboratory programs receiving theoretical support from T-3 include the intense neutron source facility, the laser isotope separation program, vapor deposition methodology research, and gas centrifuge theory. T-3 also collaborates in the numerical analysis of nuclear weapons and routinely provides consulting services to other groups and divisions throughout the Laboratory. In all these projects, analytical techniques are combined with heavy use of high-speed electronic computers.

T-4—Equation of State and Opacity

The principal responsibility of this group is to provide the theoretical bases for all problems in atomic and molecular physics which may affect the determination of accurate values for material properties such as the equation of state, monochromatic absorption and scattering coefficients, and opacities for all materials of interest in the Laboratory's various programs. The group develops and maintains up-to-date files of such data covering wide ranges of temperature and density and improves these on the basis of new theoretical work or experimental evidence as it may become available. Though most of the results of the group's work are required for practical applications to programmatic needs of the Laboratory, a considerable portion is of very general use and interest and applied in broad fields such as astrophysics and atomic theory. In addition, work in solid-state theory and radiation emission from high-temperature plasmas is carried out in this group.

T-5—Medium Energy Physics Theory

Group T-5 was formed as a theoretical center for medium energy physics in connection with the opening of LAMPF, where high-intensity pion beams are being made available as a new tool for probing the structure of nuclear matter. The group works closely with the experimental effort at LAMPF, suggesting and designing experiments, interpreting data, and extracting final results. T-5 also provides theoretical guidance for a large number of experimental groups in Europe.

At present, the main research interests of the group include pion-nucleon interactions, pion-nucleus interactions, weak interactions, and radiative processes as well as more traditional topics in nuclear physics. Attention is also being directed to the fundamental laws describing the behavior of the elementary particles.

This very active theoretical program is enhanced by frequent visits by eminent scientists from outside insitutions.

T-7—Mathematical Modeling and Analysis

The work of this group is aimed at the more effective use of mathematics in the physical, engineering, life, and social sciences, particularly as they relate to the programmatic efforts at LASL. This can be achieved only through an interactive program of research in which mathematicians in T-7 become thoroughly familiar with the practical problems to be faced and applied scientists recognize the need to apply up-to-date mathematical techniques in the solution of their problems.

At present T-7 provides support for a number of LASL programs, including weapons-related hydrodynamics, two-phase flow in reactor safety systems, optics of laser fusion systems, energy resources modeling, and biological applications. This research includes the formulation and analysis of mathematical models of physical systems involved and the design of efficient numerical methods appropriate for their solution. Extensive numerical computation required for specific applications are left to the scientists working on these problems.

In addition to ongoing programmatic commitments, members of T-7 pursue a program of basic research in mathematical and numerical analysis and serve as consultants on mathematical questions to other groups and diversions throughout the laboratory.

Areas of expertise and active research within the group include the construction of stable, efficient algorithms for the solution of systems of partial differential equations, error sensitivity analysis, problems of significance arithmetic, non-linear wave propagation and global stability questions, the theory of infrared spectra of polyatomic molecules, the general theory of irreducible tensor operators, mathematics of plasma physics, bifurcation theory, statistical mechanics, combinatorics, and econometrics.

T-8—Particle Physics and Field Theory

This group conducts frontier research into the microstructure of matter and the basic laws of nature. Within the group, interests range from basic field theory to the phenomenology of current high-energy experiments. Traditional topics, such as the runaway problem in electrodynamics, are pursued as well as topics of recent interest, such as quark confinement in quantum chromodynamics and the nature of the ψ particles. In the absence of an experimental effort in high-energy physics at LASL, the group keeps abreast of the latest experimental developments through close contacts at the Fermi National Accelerator Laboratory and the Stanford Linear Accelerator Center. The vitality of our efforts is also enhanced by continual participation of long- and short-term visiting theorists, which have recently included M. Gell-Mann and F. Zachariasen from Cal Tech, R. Dashen from Princeton, and F. Low from MIT.

Members of T-8 share in a fruitful interplay with the large medium-energy physics program at LASL and with the low-energy physics effort, offering advice and criticism concerning experiments, performing calculations, and giving informal lectures on such subjects as the quark-parton model and gauge field theories. T-8 thus forms an important element in the overall nuclear physics effort at the Laboratory.

Members of the group are presently active in the following research areas:

- abnormal states of nuclear matter and the vacuum;
- descriptions of multiparticle production at high energy;
- internal and space-time symmetries; their relation to the particle spectrum and relativistic wave equations;
- constructive field theory and the representation of current algebras;
- deep-inelastic lepton scattering and the structure of hadrons;
- quantum electrodynamics;
- non-abelian gauge field theories of the strong, weak, and electromagnetic interactions (quantum chromodynamics); and
- bound-state perturbation theory.

T-9—Nuclear Theory

Group T-9 performs basic research in nuclear theory as part of the nuclear physics effort at LASL. The research program includes phenomenological work on the reactions and scattering of light nuclei and the theory of fission and heavy ion collisons as well as the development of a fundamental quantum field theory of nuclear matter. The phenomenological work is directly applicable to the weapons and reactor programs at LASL.

For light nuclei, a formalism has been developed to reduce nuclear data to a minimum number of parameters through application of R-matrix theory. This R-matrix formalism is now being used by T-2 (Applied Nuclear Data), with guidance from T-9, to evaluate fusion cross sections and other light nuclear interactions of interest in nuclear design work. T-2 and T-9 also work closely with P Division in their experimental nuclear physics program.

A unified study of large-scale nuclear collections motion, such as occurs in nuclear fission and very-heavy-ion reactions is another major project in T-9. The primary emphasis is on fundamental aspects of nuclei that can be learned from these reactions, including the nuclear potential energy of deformation, the nuclear inertia, nuclear dissipation, and the nuclear equation of state.

Finally, an effort is being made to build a quantum field theory of nuclei from the fundamental interactions between nucleons and the meson field. Heuristic Hamiltonians have been developed and are being used to investigate properties of systems of such strongly coupled fields.

T-10—Theoretical Biology and Biophysics

This group is concerned with the mathematical modeling of real problems in cellular and molecular biology and biophysics. Emphasis in our current research program is placed on he understanding of problems in immunology, photosynthesis, radiation damage, and cancer.

In the last few years, T-10 has become recognized as *the* center for mathematical immunology based on our development of successful models for several immunological assays, for the interactions of antigens with cells, and for the regulation of clonal selection and immune responses. Our work in this field involves collaboration with immunologists at leading universities and biomedical research centers.

In the field of photosynthesis, we are interpreting spectroscopic data obtained in L Division by picosecond laser excitation. Intensities are such that exciton-exciton interactions must be considered as well as the nature of the photosynthetic medium. We are also modeling radiation damage both at the molecular level, where damage to DNA and RNA have been analyzed, and at the cellular level, where alterations of cell kinetics are under investigation in H Division. We have recently devised models for communication between cells which involve either diffusable factors or specific adhesion between cells. Such models have gen insights into the control of growth in normal and malignant tissues.

T-11—Statistical Physics and Materials Theory

This recently formed group conducts research on a broad spectrum of physical problems ranging from the most abstract areas of quantum statistical mechanics to problems of materials science of immediate practical concern to experimental projects at LASL.

Members of this group have a strong research background and continuing interest in the mathematical methods of many-particle physics in both the quantum- and classical-mechanical regimes. This provides a fundamental base for the understanding of the properties of condensed matter and plasmas. Topics of interest to T-11 include: phase transitions of many kinds; collective modes in solids and plasmas; nuclear matter; linear and nonlinear transport in solids, gases, and plasmas; disordered materials; linear and nonlinear optics of condensed matter and plasmas; low-temperature physics; lattice dynamics; and electronic structure of solids. In addition, extensive computer simulations of many-particle systems are carried out.

This fundamental base underlies our efforts to solve practical problems in the science of materials. Theoretical research involving both analysis and computer simulation of radiation damage to solids is underway. This work is of interest to experimental projects in CTR, CMB, R, and L Divisions. In particular, damage to optical and other components by intense laser radiation is of importance to L-Division projects. The scattering of ultrasonic waves by flaws in solids is being investigated as a promising new method of nondestructive testing which, for example, may be useful for detecting flaws in nuclear reactor components. The development of close collaboration with materials science programs throughout the Laboratory is an important goal of this group.

Theoretical work supporting L-Division interests is carried out on an individual basis. This work is concerned with condensation phenomena related to laser isotope separation, nonlinear optics of solids, gases and plasmas, and nonlinear plasma phenomena induced by laser-plasma interactions.

T-12—Theoretical Molecular Physics

T-12 is the only group at LASL devoted solely to the research area of general molecular physics and theoretical chemistry. Currently, we provide the theoretical support for the experimental programs in laser isotope separation and in laser development for laser fusion. In addition we conduct contract research in other areas in which molecular processes play a major role. The interests and expertise of the members of T-12 span much of molecular physics and theoretical chemistry; the scattering of electrons by molecules and atoms; inelastic processes in atom-molecule and molecule-molecule collisions; the electronic states and structure of molecules, including large polyatomic molecules; vibration-rotation spectroscopy of polyatomic molecules; the quantum-mechanical dynamics of polyatomic molecules interacting with a laser field; stimulated Raman scattering and four-wave mixing, particularly in molecular vapors; and the modeling of the complex physical and chemical systems which occur in the practical processes for laster isotope separation being pursued elsewhere in the laboratory.

T-14—Detonation Theory and Application

The group supports the programmatic needs of the Laboratory in weapons and energy-related programs with advanced numerical modeling of the detonation process and of material properties such as elastic-plastic behavior, viscosity, fracture, and melting in the pressure ranges usually studied by explosively driven experiments. The development and application of reactive, one-, two-, and three-dimensional Lagrangian and Eulerian hydrodynamic codes (SIN, 2DL, 2DE, 3DE) are group objectives. The group does modeling of problems being studied by the interdivisional working groups for high-explosives and material properties. The group participates in the Laboratory programs for explosively produced fracture of oil shale and for studying the safety of high-energy propellants. In addition, some work is done using molecular dynamic codes to simulate non-equilibrium statistical mechanics. Work modeling Taylor instabilities is performed in the group.

T-15—Intense Particle Beam Theory

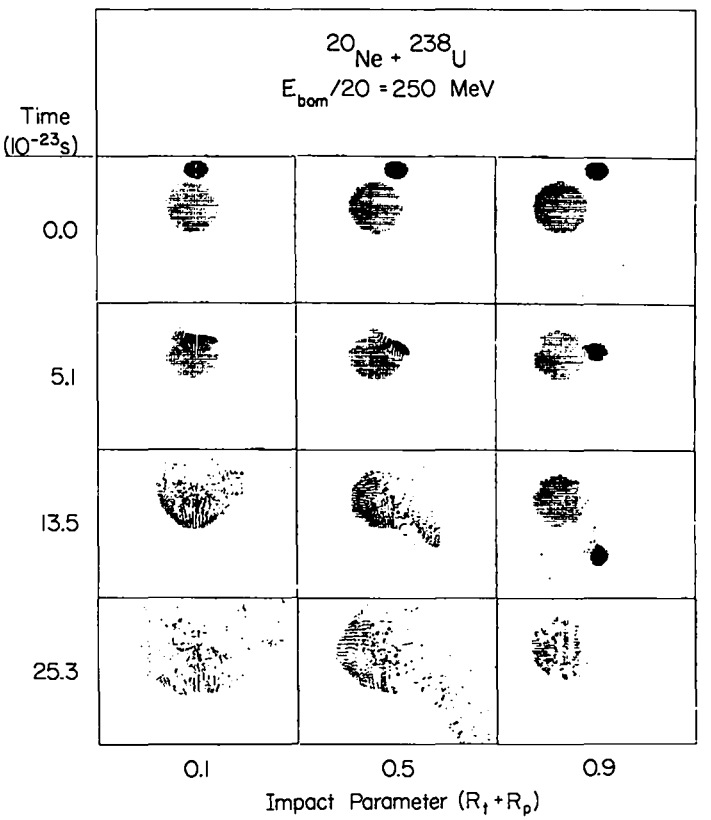
Group T-15 has recently been formed to study computationally and analytically the physics of intense, often relativistic, charged particle beams. Special topics of interest are collective acceleration of ions and plasma heating to thermonuclear temperatures by relativistic electron beams. Computer

codes developed for these studies define the state of the art and are applicable to a broad range of plasma physics problems.

Collective ion acceleration is the concept of trapping and rapidly accelerating ion clumps in the deep electrostatic wells of non-neutral intense electron beams. If successful, this technique will lead to the economical generation of high current, energetic ion beams for such applications as heavy ion initiated fusion, electro-nuclear breeding of fissile material, medical diagnostics and therapy, and basic physics research. Recent research centers on characterizing the propagation of intense electron beams in vacuum, the excitation of nonlinear waves within the beams, and the ion holding power of these waves.

Heating of dense plasmas by relativistic electron beams is a promising approach to obtaining intense x-ray and neutron sources and, perhaps, controlled thermonuclear fusion. T-15 personnel have developed a comprehensive theoretical model for anomalous energy deposition of beams in plasmas and have successfully employed this model to interpret several beam-plasma interaction experiments. The model has been further verified by two-dimensional computer simulations. Present efforts to optimize the deposition process are progressing well.

T-15 maintains close working relations with major experimental and theoretical efforts throughout the country.



Time evolution of the matter distribution in the collision of ^{20}Ne with ^{238}U for three different impact parameters as calculated in a one-fluid hydrodynamical model by members of T-3 (Fluid Dynamics) and T-9 (Nuclear Theory). The laboratory bombarding energy per nucleon is 250 MeV. These and other studies of high-energy heavy ion collisions, where nuclear matter may be compressed to greater than normal densities, promise to yield information about the nuclear equation of state and the possible existence of "abnormal" or soliton-like states of nuclear matter. Members of T-5 and T-8 are also involved in these studies.

TD DIVISION

THEORETICAL DESIGN
MS-218, ph. (505)-667-5496

The Theoretical Design Division is primarily concerned with the physics design of nuclear weapons and nuclear explosive devices. Much of this work is in response to specific defense needs and is carried out in close coordination with other Laboratory Divisions and Weapons Program Offices. TD also maintains a basic program of exploratory development and research in weapons physics designed to continually improve our understanding of just how weapons really operate and to lay the base for future, more-effective weapons designs. Development of computational techniques forms a major part of this program.

The Division also pursues a spectrum of non-weapon activities in areas where its particular skills prove useful to other parts of the Laboratory or other Government Agencies.

TD-2—Thermonuclear Weapons Design

Group TD-2 has as its major responsibility the physics design of thermonuclear weapons. Specific responsibilities range from application of in-hand technology to meet new defense objectives to research on, and development of, new design ideas.

Design concepts are formulated using elaborate computer codes which simulate nuclear weapon behavior. This work requires solution of problems in fluid mechanics, particle transport, and radiative energy transport. Group members also interact continually with experimental groups in M- and J-Divisions in the planning and interpretation of tests required in their work, and with device engineers and designers in WX-Division.

The group is also responsible for developing and maintaining thermonuclear-burn simulation codes which are used routinely in the conceptual design of weapons and in studies of the physics of nuclear explosions. This involves evaluating the effect of various physical phenomena on the performance of nuclear devices, developing improved physical models and computational techniques for calculating nuclear burn, and deciding tradeoffs between calculational precision and speed of execution.

Beyond the direct weapons area, the group has a growing effort in theoretical analysis of the physics of pure fusion, and in exploratory design and development of pure fusion concepts. This work is going on in close collaboration with other theoretical and experimental groups in M-, P-, and L-Divisions.

TD-4—Weapons Design

Group TD-4 performs the conceptual design and the theoretical analysis for several classes of nuclear devices. The analysis generally involves the use of sophisticated computer codes which simulate the operation of these devices. Relevant areas of physics and engineering include hydrodynamics, thermodynamics of materials, neutron transport, plasma physics, and nuclear reactions. Development, improvement, and maintenance of the codes which integrate these disciplines demands about one-third of the group's total effort. The principal task of the group lies in doing weapons physics design studies, using these simulation tools. These studies consist of both broad and detailed investigations of potential nuclear explosives subject to various boundary conditions such as safety, size, weight, and environments. Much of this work is in

response to immediate defense needs, but the group also maintains a sizeable effort in exploring new design concepts for future weapons.

There is constant collaboration between TD-4 and much of the Laboratory. Results of calculations are compared with nuclear (J-Division) and non-nuclear (M- and P-Divisions) experiments relevant to a particular design project. The basic physics data (T- and P-Divisions) used by the codes must be continuously examined and updated. New computers and systems (C-Division) demand code revisions. Choice of materials and specific design features is usually a compromise between theoretical and engineering (WX-Division) requirements.

Because of the breadth of the physical phenomena being considered, the group consists of people having formal training in a variety of specialities in physics, engineering, applied mathematics, and computer science.

TD-6—Monte Carlo, Vulnerability, and Weapons Data

Group TD-6 is concerned primarily with the solutions of problems in particle transport. This work includes the transport of neutrons, photons, and charged particles. An important part of this effort involves the development of new codes, using the techniques of Monte Carlo as well as discrete ordinates methods, to be used by the design groups in the Division and others throughout the Laboratory. A variety of transport calculations is performed for the weapons program on such problems as the vulnerability of weapons to neutron and gamma radiation, lethal effects of nuclear devices, inherent radiation of nuclear devices, and calculations in support of experiments performed by the Laboratory. The group does integral testing of cross section data and maintains libraries of cross sections for use in the discrete ordinates and Monte Carlo codes of TD Division.

TD-6 is also involved in several non-weapon programs and performs detailed transport calculations in areas such as nuclear safeguards, reactor safety, gas-core reactor design, fusion reactor design, and laser shielding.

TD-7—Intelligence Office

Group TD-7 operates the Laboratory's Intelligence Office and serves as the center for intelligence-related activities at LASL. The group also performs intelligence analyses and net assessments for U.S. Government Agencies.

TD-9—Physics and Computation

Group TD-9 is responsible for advanced code development in support of the weapons design groups. The principal interests of the group are the development of improved computational capabilities in the areas of two-dimensional burn simulation, hydrodynamics, and transport calculations. This involves maintenance of a basic physics data base, implementation of new physics options and new numerical solution techniques, and the testing of these features against diagonstics in collaboration with the design groups. TD-9 also takes prime responsiblity for expanding the Division's computational capability as new, more-powerful computers are added to the CCF. The group is playing a leading role in the application of interactive computer graphics to smooth the man-computer interface.

The group is also responsible for providing detailed calculations of weapons outputs as required for DoD effects tests, for analysis of atmospheric tests, and for determining the effectiveness of some weapons systems. Other capabilities or areas of current research include the design of optical systems for high-power lasers, solution techniques and applications of integral equations, and theoretical analysis in support of experiments using lasers to acquire weapons physics data.

WSD

WAGE AND SALARY
MS-710, ph. (505)-667-4536

The Wage and Salary Department is a staff department responsible for advising LASL management in all matters pertaining to salaries and classifications. It is also responsible for implementing LASL policies in these matters. The primary aim is to assure a fair and equitable laboratory-wide system of wages and salaries in compliance with the contract with the Energy Research and Development Administration, with the rules of the University of California, and with applicable State and Federal laws. Specific activities of the Wage and Salary Department are:

1. Conduct, participate in, analyze, and interpret wage and salary surveys to provide a sound labor market basis for LASL salary structures.
2. Establish and maintain LASL salary structures on the basis of information about labor market conditions and the needs of the Laboratory.
3. Provide guidance and allocations for annual merit reviews.
4. Describe and evaluate all jobs, except those of Staff Members, to establish the appropriate salary range for each.
5. Provide staff assistance to all levels of LASL management in various related matters such as individual salary determinations, reorganizations, and job establishment.
6. Negotiate with the ERDA in wage and salary matters requiring their approval.
7. Assure that all personnel actions have been approved by the appropriate authority.

WX DIVISION

DESIGN ENGINEERING

MS-686, ph. (595)-667-4136

The responsibilities of WX Division include those of weapon component design and specification, selected weapon materials development, and assuring the producibility of LASL designed weapons that are destined for production. In addition to its weapon activities, the division provides design and analytical support for new LASL construction projects and facilities such as LAMPF, CTR, WNR, and INS. It is also involved in license reviews and physical security analyses for NRC. Persons trained in all of the engineering disciplines as well as chemistry, physics, and computer science are found in the division.

WX-DOT

This group, attached to the Division Office, provides technical support to the Division Office and oversees all of the reimbursable activity in the division.

WX-1

The primary responsibilities of WX-1 are to provide the engineering design of weapon nuclear components and to assess the vulnerability of U.S. weapons to enemy countermeasures and assure their survival to specified levels. It executes the engineering design of the nuclear components of test devices conceived by theoreticians and oversees the actual hardware fabrication. For weapons destined for production, the group is responsible for vulnerability assessment, engineering design, specification and product surveillance activities. Detailed designs are achieved through the use of static and dynamic structural analyses, thermal analysis, and x-ray, neutron, and charged particle deposition and transport calculations. These analyses are verified by and depend heavily on testing of various kinds; environmental tests such as vibration, static load, shock, thermal, and flight; and weapon effects tests at the Nevada Test site, pulsed reactors, and accelerators. Laboratory and group computer codes and data acquisition systems are used extensively in these analyses and experiments.

The group conducts a variety of physical tests on new materials and components for itself and others. Consultation services are provided to the rest of the Laboratory to coordinate vulnerability studies and activities for U.S. and postulated enemy warheads.

WX-2

The activities of WX-2 include fundamental and applied research on the materials used in weapons or considered candidates for such use. The principal emphasis is on the chemistry of those materials and their chemical interactions. The materials to which the principal effort is devoted are high explosives. The organic, analytical, and physical chemistry of these materials are studied, and their physical and performance properties evaluated by standardized tests. The group can synthesize new explosive compounds that, by theory, could offer improved capabilities to weapon systems, and can produce pilot plant quantities of such materials.

WX-3

WX-3 is responsible for the design, fabrication, and local manufacture of explosives systems and ancillary nonexplosive components. The group is concerned with the development of new explosives with properties more responsive to new weapon requirements or to the needs of new weapon systems. The group fabricates high explosives, conducts or monitors tests of their performance, and studies their reaction to a wide variety of environmental conditions. The components of test devices from the several WX sources are assembled by WX-3. In a relationship to the weapons production system similar to that of WX-1, WX-3 has engineering design, specification, and surveillance responsibilities for the high-explosive components, and warhead assembly, of nuclear weapons in production.

WX-4

The function of Group WX-4 is to provide analysis, engineering, design, and drafting support for groups and projects throughout the Laboratory. The group provides LASL with basic thermal and fluid dynamics analyses, mechanical and chemical engineering design, and drafting applicable to the design, fabrication, and installation of specialized experimental equipment. WX-4 attempts to maintain sufficient flexibility in staff to be able to provide assistance on short notice, for a limited period of time, to solve engineering problems, help on proposals, or provide project assistance on request.

The analysis section of WX-4 is devoted to heat transfer calculations, fluid dynamics, and thermodynamics. The section has conducted studies of chemical vapor deposition furnaces, proton beam collimator thermal stresses, proton target heat removal, nuclear reactor core temperature transients, plutonium plant ventilation systems, complex thermodynamic equilibrium, and others. The section is also responsible for the development of analysis techniques for commercial (and LASL) building energy utilization and conservation.

The mechanical and chemical engineering sections are staffed with hardware-oriented engineers who have a broad range of experience in structural and mechanical design, mechanisms, remote handling, chemical process design, flow sheet development, and contaminated liquid and solid waste handling systems. Projects vary in length from a few days consulting or design effort to long-term project engineering of complete systems. This can include conceptual design studies, preparation of design criteria and specifications, planning, inspection, and checkout as required.

The drafting section supports the WX-4 engineers directly and is available for Laboratory-wide design assistance. Specialties include remote handling, glovebox design, tool and die design, and other complex mechanical systems.

WX-5

WX-5 is a materials engineering group, with principal emphasis on the physical properties of materials used in weapons or considered candidates for such use. The group investigates the properties of materials, their compatibilities, interactions, and response to various environmental conditions. For the materials within its area of responsibility, WX-5 also has a responsibility with respect to the production system for design, specification, and surveillance activities. Programs in both fundamental and applied research on the various factors that influence the properties of materials are initiated and coordinated to make available new capabilities for fulfilling new weapon requirements.

WX-7

WX-7 is a design engineering group responsible for the design, development, and local manufacture of all detonators and cables for the initiation of high-explosives systems. WX-7 has the design, proof of design, specification, and surveillance responsibility for the components made in the production system. The group conducts experimental investigations into the many aspects of detonator design that influence detonator performance as well as fundamental studies of initiation phenomena as they influence detonator design. WX-7 also studies the properties of explosives applicable to use in

detonators and examines new explosives that have possible application in detonator systems. WX-7 provides cables and detonators to many other Laboratory groups for engineering development activities and weapon development testing. The group maintains a high degree of competence in metal-joining techniques, printed circuit technology, plastics fabrication, and explosives loading and other technologies relevant to detonator and cable manufacture

WX-8

Group WX-8 provides design studies, calculations, and analyses complementary to the WX-4 design effort, as well as consulting engineering services for sponsoring organizations within and outside of the Laboratory.

The engineering activities of WX-8 often place particular emphasis on special ERDA/NRC requirements. Group personnel have participated in the design and construction of fusion research devices, and a mobile nondestructive assay laboratory. Nuclear calculations have included shielding studies, thermal analyses, and predictions of particle-target interactions.

Members of the group are experienced in analyzing the response of structures to dynamic loads resulting from blasts, tornadoes, earthquakes, nuclear transients, and impacts. In this work the group utilizes large digital computer programs such as NASTRAN, SAP, and STRESS, making possible the true dynamic analyses of multidegree-of-freedom systems. Use of computer-generated motion pictures for surveying the results of such codes is common.

The above capabilities are presently being extensively used in a consulting capacity to NRC for the review of the safety and environmental aspects of plutonium and nuclear fuel reprocessing plants and of the physical security of power reactors.

The engineers within the group have backgrounds and experience including applied mathematics, civil engineering, computer science, fluid mechanics and heat transfer, mechanical and electrical design, nuclear engineering, physical and nondestructive testing, sanitary engineering, stress analysis, and structural dynamics.

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