SAND78-1134
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Sandia Laboratories Technical Capabilities

AUXILIARY CAPABILITIES

Environmental Health
Information Science

Sandia Laboratories

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SANDIA LABORATORIES TECHNICAL CAPABILITIES

AUXILIARY CAPABILITIES

ENVIRONMENTAL HEALTH
INFORMATION SCIENCE

ABSTRACT

This report characterizes some of the auxiliary capabilities at Sandia Laboratories. These auxiliary capabilities provide essential support to the line organizations.

FOREWORD

Sandia Laboratories, a multiprogram laboratory of the Department of Energy, is located in Albuquerque, New Mexico, and Livermore, California, with a remote testing facility at Tonopah, Nevada. In fulfilling its responsibilities in the fields of national security and energy, and in other programs, Sandia has acquired extensive capabilities in research, development, testing, and evaluation, and has made numerous contributions in scientific and engineering fields. These capabilities–the basic tools used in research and development–are the subjects of this series of reports. Each of these capabilities is described in a separate report, as listed below. In each report supporting information is provided to show applications of the capabilities.

All the capabilities are in current use. It is intended that their descriptions will allow planners to directly associate them with the technical requirements of studies being considered, and that they will also be sources of technical information for other laboratories, federal agencies, universities, and the Sandia staff.

For those interested in the overall capabilities of the Laboratories, all the reports are compiled in a single publication bearing its own number.

J. A. Mogford, Technical Editor
P. L. Mead, Publication Editor

TECHNICAL CAPABILITIES OF SANDIA LABORATORIES

Summary
(SAND77-0651)

Aerosciences	SAND74-0075	**Instrumentation and Data Systems**	SAND74-0083
Applied Mathematics	SAND74-0079	**Materials and Processes**	SAND77-0002
Biosciences	SAND74-0076	**Measurement Standards**	SAND74-0077
Computation Systems	SAND77-0767	**Physical Sciences**	SAND74-0074
Design Definition and Fabrication	SAND76-0413	**Quality Assurance**	SAND77-0652
Earth Sciences	SAND74-0085	**Safety and Reliability Assurance**	SAND74-0090
Electronics	SAND74-0086	**Systems Analysis**	SAND74-0089
Engineering Analysis	SAND74-0087	**Testing**	SAND74-0088
Explosives, Electrochemistry, and Electromechanisms	SAND74-0081	**Auxiliary Capabilities**	SAND78-1134
		Environmental Health	
		Information Sciences	

Compilation of
Sandia Laboratories Technical Capabilities
(SAND74-0092)

ENVIRONMENTAL HEALTH

ABSTRACT

This report characterizes the environmental health capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs.

ENVIRONMENTAL HEALTH*

The primary responsibility of the environmental health function is the evaluation and control of hazardous materials and conditions. The evaluation and control of toxic materials, nonionizing radiation such as laser beams and microwaves, and ionizing radiation such as from radiation machines and radioactive sources, are examples of the activities of environmental health programs. A chemical laboratory is operated for the analysis of toxic and radioactive substances and for the bioassay program to provide an index of internal exposure of personnel to toxic and radioactive materials. Instrumentation support and development is provided for environmental health activities. A dosimetry program is maintained to measure personnel exposure to external ionizing radiation. A radiation counting laboratory is maintained. Reentry safety control and effluent documentation support are provided for underground nuclear tests at the Nevada Test Site. A radiation training program is provided for laboratory personnel which covers all areas of radiation protection, from working with radioactive materials to radiation-producing machines.

Environmental Health Laboratory

Professional Staff	Investment in Equipment (in $1000)
20	$926

*Revised May 1978

Hazard Control

Programs are aimed at evaluating potential hazards to personnel that may exist in current and proposed research and development activities. Emphasis is placed on maintaining the state of the art in personnel-protection techniques.

Current Activities

- Toxic materials
  - Atmosphere sampling for gaseous and particulate matter
  - Particle-size analysis
  - Toxicity evaluation
- Nonionizing radiation
  - Microwaves
  - Lasers
  - Thermal effects
  - Ultraviolet and infrared light
- Ionizing radiation
  - Electron-beam fusion
  - Laser fusion
  - Radioisotope thermoelectric generators
  - High-energy pulsed x-ray machines
  - Pulsed research reactors
  - Mixed fission-product hot-cell work
  - Plutonium-in-air dispersal studies
  - Shielding calculations
- Noise
  - Industrial
- Sanitation
  - Food service
  - Potable water quality

Analytical Chemistry

Analytical methods are employed to determine qualitatively and quantitatively trace levels of chemical contaminants in air, solids, and liquids. (Item 1)*

Current Activities

- Analytical programs
  - Urine bioassay
  - Air, water, soil, and vegetation samples
  - Trace-metal analysis
  - Proprietary product identification
  - Method development
- Analytical methods
  - Atomic absorption spectrophotometry
  - Emission spectrography
  - Visible, ultraviolet, and infrared spectrophotometry
  - Gas chromatography
  - Fluorimetry
  - X-ray fluorescence spectrometry
  - Liquid scintillation spectrometry
  - Alpha and gamma-ray spectrometry
  - Classical wet chemistry
- Typical analyses
  - Heavy metals
  - Beryllium
  - Organic solvents and compounds
  - Tritium
  - Actinides
  - Fission products
  - Halogens
  - Air pollutants

Radiation Dosimetry

Thermoluminescent dosimeters are employed to quantize beta, gamma, and neutron personnel exposures from background to several hundred REM. The dosimeters are packaged in a small holder that permits automatic exposure evaluation and data collection. A computer is used for data reduction, record keeping and generation of exposure reports. Dosimeters can be "tailored" for special radiation measurements. High dose rates or short bursts of neutron radiation are measured by the use of activation materials such as gold, indium, rhodium, and copper.

Current Activities

- Thermoluminescent dosimetry
  - X-Ray
  - Gamma
  - Beta
  - Neutron
- Criticality Dosimetry
  - High-level gamma
  - High-level beta
  - High-level neutron
- Applications
  - Personnel
  - Area
  - Device
  - Accident
  - Environment
  - Special problems

*See Highlights below.

Instrumentation Development

Health protection equipment is developed when needed devices are not commercially available. Signal conditioning and interfacing have been designed to allow assembly of larger monitoring systems. Microprocessors have been employed to facilitate automatic data collection and presentation. Maintenance and calibration services are provided for both portable and stationary health monitoring instruments throughout the Laboratories.

Current Activities

- In-situ environmental monitor
- Microprocessor-based area monitor with graphics display
- Monitor for plutonium in wounds
- Multichannel data handling
- High dose-rate nonsaturating detectors
- Pulsed neutron detection
- Computer interfacing of laboratory equipment

Radiation Counting Laboratory

A radiation-counting laboratory is maintained in support of the environmental health department and Sandia's diversified weapon and energy R&D programs. The laboratory provides routine evaluation (qualitatively and quantitatively) of radionuclides present in environmental and experimental samples. Verification is supplied through environmental analyses of soil water and vegetation that Sandia is not contributing any significant radionuclides to the environment. The laboratory has its own minicomputer and custom software for data analysis storage and retrieval. Radiation calibration standards are maintained to provide traceability to the National Bureau of Standards.

Current Activities

- Automated gross alpha/beta analysis
- Automated alpha spectrometry
- Beta spectrometry
- Computer-based gamma spectrometry
- Low-level counting enclosures
- Radiation calibration range (2 mR/hr - 1200 R/hr)
- Environment monitoring

Reentry Safety and Effluent Documentation

Experience has been gained in evaluating the extremely hostile environments associated with the underground testing of nuclear devices. Data from instrumentation are used to evaluate several environmental conditions such as high radiation and tunnel failure, to document "source terms" and released amounts of radioactive isotopes, and to develop procedures for safely reentering and rehabilitating a facility. The capability is available for working in and/or with high radiation-exposure levels, gross contamination, explosive-gas atmospheres, and highly toxic materials. (Refer to Item 1)

Current Activities

- High-level radiation contamination
  - Surface reentry
  - Underground reentry
  - Long-term facility rehabilitation
  - Decontamination
  - Long-line (greater than 1 mile) gas sampling and component characterization
- Radiation-source term determination
  - Gases
  - Megacurie activities
- Effluent documentation of released gases
- Instrumentation hardening and multiple remote-readout capabilities

* * * * * * *HIGHLIGHTS* * * * * * *

Item 1. *Remote Gas Sampling*

After an underground test of a nuclear device, the gaseous environment is analyzed for the presence of toxic elements before personnel are allowed to reenter the test area. A system has been devised (Figure 1) in which gas samples are drawn from the most distant parts of each side drift and other critical points, and are transmitted through piping to a portable laboratory where they are analyzed by means of a gas chromatograph. Explosive mixtures of flammable gases also have been measured on several occasions.

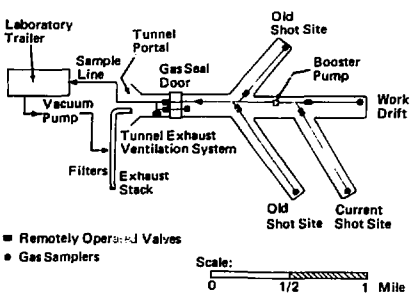

Figure 1. Long-line sampling system

Item 2. *Thermoluminescent Dosimeters (TLD's)*

A continuing radiation dosimetry program has been developed to monitor and document significant personnel exposures to beta, gamma, and/or neutron radiation. The system is based on uniquely identified thermoluminescent dosimeter packages (Figure 2) that can be automatically evaluated and reported in computer-compatible format. The computer reduces the data and performs accounting functions.

Item 3. *Shock/Temperature-Hardened Radiation Sensors*

Enclosures housing radiation-detectors and associated cabling have been designed and used to allow placement and long-term survival (of the order of days) of radiation sensors in the near vicinity of underground nuclear detonations. Sensors without this hardening could not survive stresses in the region where tunnel collapse occurs. About 70% of the sensors are now routinely recovered, usually in sufficiently good condition to be used on later tests.

The enclosures are designed to maintain sensor temperature below 65° for at least 30 minutes in an atmosphere of 300° and 600 psi.

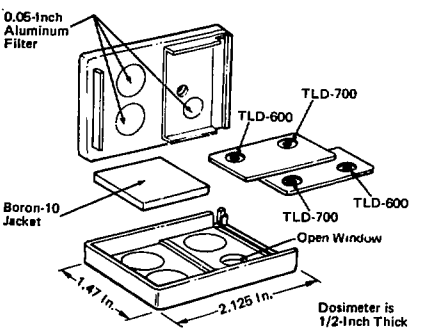

Figure 2. Thermoluminescent dosimeter cards and holder. (TLD-600 dosimeters are neutron- and gamma-sensitive; TLD-700's are gamma-sensitive and neutron-insensitive.)

Item 4. *Pulsed Neutron Detector*

A device was needed that would provide the health physicist a direct measurement in rem (roentgen equivalent, man) of single or multiple short bursts of neutrons. The system developed to answer that need (Figure 3) uses activation of rhodium metal by thermal and epithermal neutrons present at the center of a 10-inch spherical moderator. The resulting beta activity of the rhodium is detected by use of a plastic fluor in intimate contact with the metal.

The detector and its attendant conventional electronics provide a stable pulse-counting system that is portable. The equipment has been calibrated with pulses as short as 7×10^{-6} second and has a sensitivity as low as 5×10^{-5} rem. It is used around pulsed research reactors and in neutron-generator tube applications.

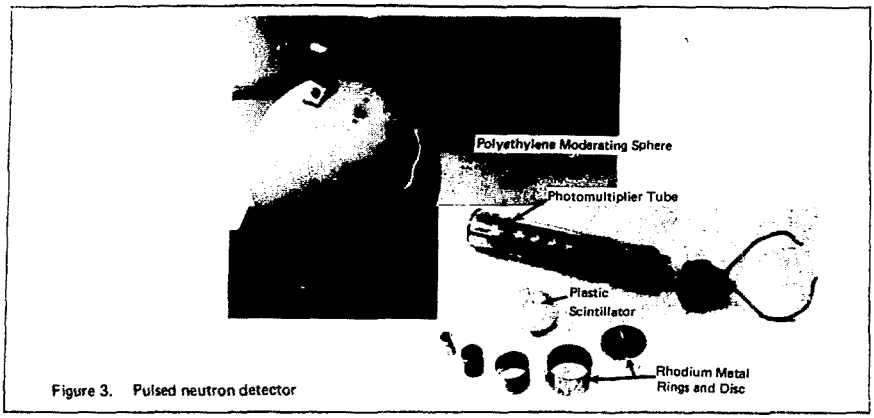

Figure 3. Pulsed neutron detector

Item 5. *Increased Sensitivity for a Forward-Light-Scattering Photometer*

A commercial smoke photometer for testing high-efficiency particulate air filters was improved by Sandia. The photometer was modified to collect forward-scattered light at angles greater than 20 degrees from the center axis, and to reduce stray light at lesser angles. It has been shown that peak intensity is attained at angles greater than 20 degrees (Figure 4).

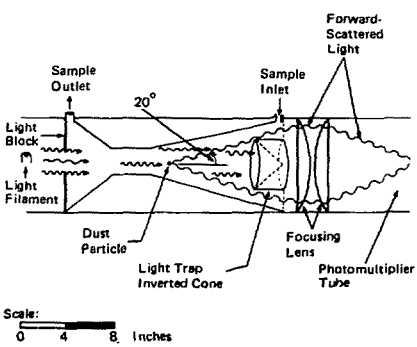

Figure 4. 20-degree angle forward-light-scattering chamber

Item 6. *Automated Alpha Spectrometry System*

Precise alpha spectrometry is normally performed under vacuum, and therefore is not compatible with conventional automated sample changers. A system has been developed that rotates samples into counting position without loss of the vacuum in the counting chamber. Information from the system is processed by multiple single-channel and/or multichannel analyzers with computer data-reduction capabilities.

The system (Figure 5) has a minimum detectability level of 3×10^{-8} μCi.

Figure 5. Automated alpha spectrum system

INFORMATION SCIENCE

ABSTRACT

This report characterizes the information science capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs.

INFORMATION SCIENCE*

The information science activity functions within the framework of Sandia Laboratories' technical libraries. Information science is oriented toward the efficient dissemination of information to technical and administrative personnel. Computerized systems are used to collect, process, and circulate books, reports, and other literature. Current-awareness, reference, translation, and literature-search services are also provided.

Information Science Staff

	Staff	Clerical Support
Computer Management of Materials	5	29
Current Awareness Services	4	2
Reference and Translation Services	6	5

*Compiled April 1978

Computer Management of Materials

The computerized material-management system contains records of all library holdings and generates required processing lists and forms. System programs provide on-line input to and retrieval from the master file, on-line circulation transactions, and batch output of catalogs, inventory lists, overdue notices, purchase orders, claim notices, and special reports. (Items 1,2)*

Current Activities

- Master file maintenance
  - File searching (on-line)
    - Dictionary entry using random access by various keys
    - Boolean search logic
    - Display of complete master file record
  - Input editing (on-line)
    - Format editing of additions and modifications
    - Retrievable output to disk update file
  - File updating (batch)
- Circulation transactions
  - Circulation record searching (on-line)
    - Entry by borrower name or by call number
    - Display of current status
  - Input of current transactions (on-line)

Current Awareness Services

The goal of these services is to bring technical and administrative personnel into contact with elements of current literature that could influence laboratory studies. This is done by means of widely disseminated notifications about the availability of new and pertinent material. The process is called the current awareness service.

Sources for current awareness announcements are new book and report acquisitions, recently published journal articles and conference papers, prepublication notices of journal articles and conference papers, and publication announcements of government reports. Services available include a computerized selective dissemination of information process using individualized interest profiles, and printed library publications (most of them computer-generated). Efforts are made not only to inform the using public of new material but to make this material immediately available. (Item 3)

Current Activities

- Selective dissemination of information
  - Interest profiles based on Boolean combinations of keywords
    - Computer matching with any or all data bases
      - Journal articles and conference papers
      - Library book and report acquisitions
      - DOE reports
      - DOD reports
      - NASA reports
    - Search narrowing within fixed subject areas
  - Computer-generated publications
    - Library accessions
    - Current journal articles in physics

Reference and Translation Services

Reference services are aimed at providing prompt replies to technical and administrative questions. Toward this end, subject specialists of the reference staff keep abreast of scientific interests by reading technical and progress reports, attending colloquia, and acquiring information from technical personnel. On the basis of this background they select material for the collection, conduct literature searches, prepare formal bibliographies and state-of-the-art surveys, and organize special collections. Reference personnel also function as consultants to groups wishing to organize their own information resources, provide translations of foreign language material, and arrange for interlibrary loans of special material. (Items 4-6)

Current Activities

- Computerized searches
  - DOE and DOD data bases via telecommunication networks
  - Library book file via teletype console link to Univac-1108
  - Journal indexes through dial-up access to SDC's ORBIT and Lockheed's DIALOG systems
  - NASA data bases through dial-up access
  - New York Times Information Bank through dial-up access
- Special collections and data bases
  - Computer codes data base
  - Energy resource center
  - Terradynamics map file
- Consultation services
  - Referrals to sources of technical expertise
  - Referrals to sources of materials
  - Generation of indexes, manual or computerized
  - Circulation systems, manual or computerized
- Translation services
  - Obtaining foreign-language material
  - Service contracts with translation agencies
  - In-house services
    - Oral reading
    - Foreign correspondence
    - Submissions to foreign-language journals
    - Formal translations

*See Highlights below.

* * * * * * *HIGHLIGHTS* * * * * * *

Item 1. *Operations Overview*

The data in Table I indicate the size and value in dollars of the technical library operation. In an average month the library processes approximately 8800 new items and circulates approximately 9300 items. The computerized material-management system that controls these items is depicted in Figure 1. It integrates all functions previously performed by manual operations.

Item 2. *Input Editing (On-Line)*

To speed processing of new library acquisitions and purchase orders, transactions against the master file are processed daily. The input of new data to the master file takes place in two stages: on-line keying to a disk file followed by batch-mode updating of the master file. Items in the temporary disk file may be retrieved at any time until the batch update takes place. This description deals with the on-line editing portion.

Input procedures are of two types: addition of a new family of records for a new title, or modification (or deletion) of records for a title already in the master file. Input of new records or changes to existing records may be made in any sequence; records that pass the edit stage are sorted for placement in the update file on disk.

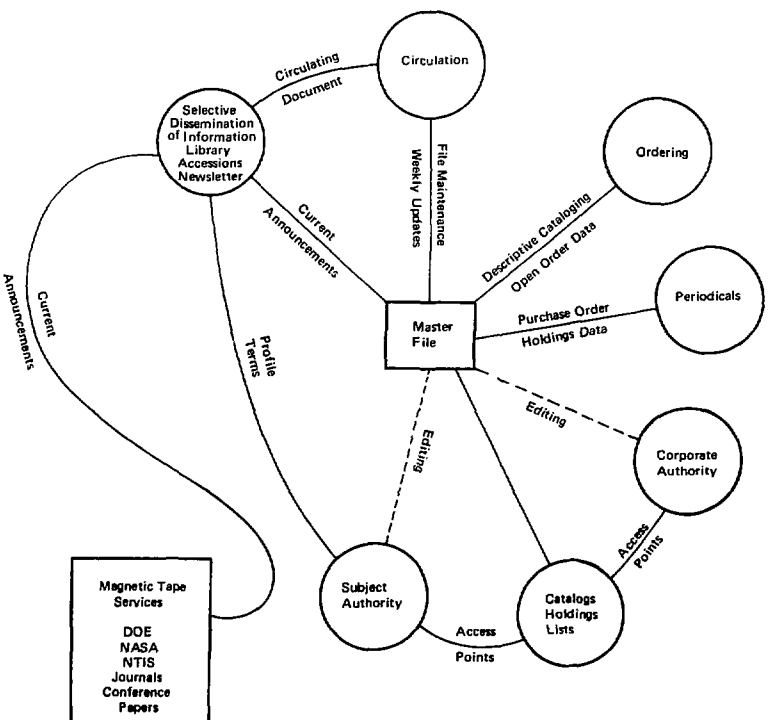

Figure 1. Integrated Livermore/Albuquerque library system

TABLE I

Collection Size and Value, Equipment Investment, and Service Contracts

Collection	Size	Approximate Value	Equipment (excluding facilities, furniture, and shelving)		Service Contracts	
Books:	47,000	$587,500	Microform readers:	$ 37,000	Computer tape services (annual):	$19,000
Paper reports:	98,900	$365,900	Microform storage:	$ 18,000	Computerized search services (annual):	$12,000
Microfiche reports:	480,000	$1,080,000	Computer terminals:	$ 25,000		
Periodical volumes:	25,400	$635,000	Computer time (annual):	$157,000		
Periodical subscriptions:	1,500					
Periodical microfilm		$232,000				
Titles:	600					
Reels:	14,320					

Data in each line or field should contain specific types of information, depending on the line number or field position. This information is machine edited before the record is released to sorting. For example, in the call-number field, each position of the number is checked to see whether it is alphabetic, numeric, or a dash, depending on the position. Any character that does not conform in type to that expected for the position is referenced with an asterisk. The incorrect entry with underscoring is displayed on the on-line terminal as shown in Figure 2, and will be released to the disk file only after appropriate corrections have been made.

Item 3. *Selective Dissemination of Information Algorithm*

Individualized current awareness announcements are generated weekly by computer to inform recipients about new books, reports, conference papers, and journal articles that match their interest profiles. These profiles consist of Boolean combinations of subject categories, authors, and keywords. The term-matching algorithm developed for this Selective Dissemination of Information (SDI) system depends on enumeration of the profile terms into 8-character numeric strings. The Boolean "or" operation is defined by terms enumerated into the same 8-character string. Boolean "and" (or "not") combinations of the profile terms are represented by 8-character composites. An example is given in Figure 3.

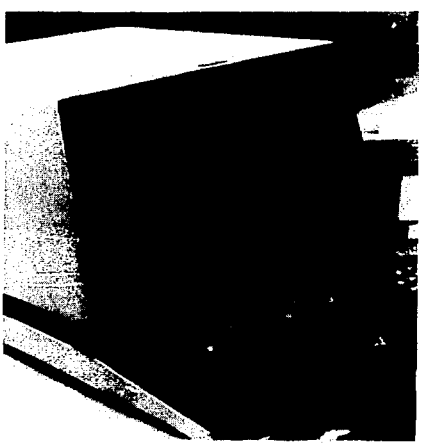

Figure 2. On-line modification of data files

Terms	Enumerated Terms	Boolean Combinations
Fracture	20000000	21200000
Steel	01000000	
Embrittlement	20000000	
Hydrogen	00200000	
Jones JP	30000000	31200000
Alloys	01200000	
Metallurgy	01200000	
Corrosion	90000000	90000000

Combination 21200000 = (Fracture or Embrittlement) and (Steel and Hydrogen) or (Fracture or Embrittlement) and (Alloys or Metallurgy)

Combination 31200000 = Jones JP and (Alloys or Metallurgy) or Jones JP and (Steel and Hydrogen)

Figure 3. Example of machine representation of Boolean combinations of Selective Dissemination of Information profile terms

At the time this computer program is run the SDI profiles containing alphanumeric terms, the enumerated value of these terms, and the enumerated Boolean combinations are processed against one of the SDI data bases. As each record or group of records representing a particular book, report, or journal citation is read in, the alphanumeric profile terms are matched against corresponding terms in the appropriate field (title word, author, etc.). If matches are found, the enumerated strings representing those terms are flagged. Then each character in the first Boolean pattern is matched against "ored" flagged strings. If every character in the pattern can be found in its designated location in the first flagged string, the citation is output as a "hit." If not, the next Boolean pattern is tried until all are exhausted. This algorithm allows both complex and simple Boolean combinations to be represented in just a few 8-character patterns. Highly specific or broadly general interest profiles can be written with facility.

Item 4. *Computerized Searches (On-Line)*

On-line searching of computerized data banks allows technical personnel and the library staff to compile bibliographies or locate single citations in a fraction of the time needed with manual methods. The library has many on-line retrospective search systems including its own ASTORS* system. ASTORS is a user interactive program written in COBOL, and it makes use of the Index-Sequential/Random-Access capability. It uses two disk data files: an alphanumeric dictionary file that contains 402,000 records, each consisting of a search key and a master file entry number, and the master book file, which contains 425,000 records representing 39,000 book titles. The search keys available are author name, subject term, title word, Library of Congress classification number, accession number, and purchase order number.

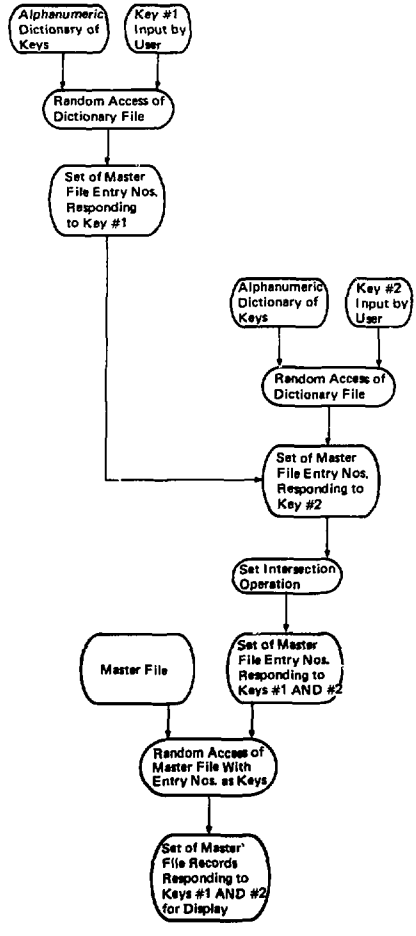

Figure 4. Illustration of ASTORS search with Boolean "and" condition

*Author-subject-title on-line retrieval system.

The chief advantage of the system is the rapid retrieval of book titles that fit user criteria. This is accomplished through Boolean search statements that combine search keys to eliminate all but the desired titles. For example, there may be 500 titles indexed by the term METALS and 200 by the term FRACTURE, but only 20 titles indexed by both these terms. Response to search requests is immediate (<1 second). The flow diagram in Figure 4 depicts the program logic for a search using a Boolean AND statement.

Item 5. *Terradynamics Map File*

The library's reference group organized a data file for the study of Terradynamics; i.e., phenomena attendant upon earth penetration by high-velocity projectiles. Detailed maps (in 8,000 sheets) of the geology, soils, and topography of 27 Eurasian countries were selected, acquired, classified, and catalogued in the library's master file. Coding permits the extraction of a specialized, computer-generated index of countries, subject words, title words, publishers, and authors. The map files are managed and maintained by the Terradynamics organization, while the Reference group follows the state of knowledge and provides continuing selection of new materials.

Item 6. *Energy Resource Center*

The reference staff has organized a special collection of energy-related materials designed to provide background and current information to technical personnel. The collection contains basic bibliographies, current newsletters, an archive of journal articles, and a display of new library acquisitions.

A weekly Library News Bulletin announces new receivals and journal articles in the energy field. A computer-generated keyword index to items announced in the bulletin provides a bibliographic tool for retrieving items in the rapidly growing energy collection.

Sandia Laboratories

NEWS BULLETIN INDEX 05/06/75

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LAND-USE      > 7501208 SEISMIC HAZARDS AND LAND-USE PLANNING
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              > 7503126 NUCL : ERDA AWARDS A $350,000 LASER FUSION CONTRACT TO KMS
              > 7501066 LASER FUSION : ONE MILEPOST PASSED - MILLIONS MORE TO GO
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Figure 6. News Bulletin weekly index for energy logics