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Safeguards And Security Technology Development Directory

FY 1993

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U.S. Department of Energy
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LIST OF ILLUSTRATIONS

LIST OF ACRONYMS

A&PCT	Active and Passive Computed Tomography
ACTS	Automated Calorimeter Test System
ADPA	American Defense Preparedness Association
AIS	Automated Information System
ANL-E	Argonne National Laboratory-East
ANL-W	Argonne National Laboratory-West
ANSI	American National Standards Institute
APSWG	Armor and Protective Systems Working Group
ARGUS	Argonne Unified Safeguards
ASSESS	Analytic System and Software for Evaluating Safeguards and Security
AST	Automated Sensor Tester
ASTM	American Society for Testing Materials
B&R	Budget and Reporting
BNL	Brookhaven National Laboratory
CCTV	Closed Circuit Television
CDOCS	Classified Document Control System
CIAC	Computer Incident Advisory Capability
COPS	Committee on Physical Security
COTS	Committee on Technical Security
CRADA	Cooperative Research and Development Agreement
CSOM	Computer Security Operations Manager
CSSO	Computer Systems Security Officer
CTA	Central Training Academy
CTF	Central Training Facility
CWC	Chemical Weapons Convention
DARPA	Defense Advance Research Projects Agency
DIDS	Distributed Intrusion Detection System
DoD	Department of Defense
DOE	Department of Energy
ES&H	Environmental Safety and Health
FAA	Federal Aviation Administration
FMF	Fuel Manufacturing Facility
FOCI	Foreign Ownership, Control or Influence
HE	High Explosives
HEU	Highly Enriched Uranium
HPGe	High-Purity Germanium
IAAS	Intelligent Actinid Analysis System
IACSE	Interagency Advisory Committee on Security Equipment
IAEA	International Atomic Energy Agency
ICP	Inductively Coupled Plasma
ICPP	Idaho Chemical Processing Plant
ID	Inventory Difference
IDART	Inventory Difference Anomaly Resolution Team
IFRS	Intelligent Facial Recognition System
IMSS	Intelligent Mobile Security System
INEL	Idaho National Engineering Laboratory
ITMS	Ion Trap Mass Spectrometry
IV&V	Independent Verification and Validation
LAN	Local Area Network
LANL	Los Alamos National Laboratory
LEAFS	Laser Excited Atomic Fluorescence Spectroscopy
LEPS	Low Energy Detector Performance
LLNL	Lawrence Livermore National Laboratory
MBA	Material Balance Area
MCA	Multichannel Analyzer
MC&A	Materials Control and Accounting
MD	Mound
MGA	Multiple Group Analysis
MMES	Martin Marietta Energy Systems
MOX	Mixed-Oxide
MSSA	Master Safeguards and Security Agreement
MSE	Molten Salt Extraction
NBL	New Brunswick Laboratory
NDA	Nondestructive Assay
NMMSS	Nuclear Materials Management and Safeguards System
NNPA	Nuclear Non-Proliferation Act
NPR	New Product Reactors
NRC	Nuclear Regulatory Commission
NSR	New Special Recovery
NSM	Network Security Monitor
ORNL	Oak Ridge National Laboratory
OSE	Office of Security Evaluations
OSS	Office of Safeguards and Security
PAMTRAK	Personnel and Material Tracking System
PIDAS	Perimeter Intrusion Detection System
PMCA	Portable Multi-channel Analyzer
PSEAG	Physical Security Equipment Action Group
R&D	Research and Development
RAF	Receipts Assay Facility
RAOPS	Resource Allocation/Optimization Model
RPSF	Radioisotope Power Systems Facility
S&S	Safeguards and Security
SAFER	Security and Force Protection Enhancement Resources
SCCS	Safeguards Control and Communications System
SGS	Segmented Gamma Scanner
SNL	Sandia National Laboratory
SNLA	Sandia National Laboratories - Albuquerque
SNM	Special Nuclear Material
SOLIC	Special Operations/Low Intensity Conflict
SRS	Savannah River Site
SSSP	Site Safeguards and Security Plan
SSWG	Security Systems Working Group
TCI	Technology Commercialization Initiative
TDPMIS	Technology Development Program Management Information System
TEWG	Tactical Entry Working Group
T&E	Test and Evaluate
TID	Tamper Indicating Device
TRU	Transuranic
TSD	Technology and Systems Development
TSWG	Technical Support Working Group
VMD	Video Motion Detector
WHC	Westinghouse Hanford Company
WIPP	Waste Isolation Pilot Project
WSRC	Westinghouse Savannah River Company
XRF	X-Ray Fluorescence

CHAPTER 1

INTRODUCTION

1.0 Purpose of the Technology Development Directory

The *Safeguards and Security Technology Development Directory* is published annually by the Office of Safeguards and Security (OSS) of the U.S. Department of Energy (DOE), and is intended to inform recipients of the full scope of the OSS R&D program. It is distributed for use by DOE headquarters personnel, DOE program offices, DOE field offices, DOE operating contractors, national laboratories, other federal agencies, and foreign governments. The present edition of the Directory provides information about the OSS domestic Safeguards and Security (S&S) Technology Development Program for fiscal year 1993. The FY 1993 Directory is the sixth update of a document initially prepared and published in October 1986, titled, *Safeguards and Security Research and Development Directory and Long Range Plan, FY 1987-1992.*

1.1 Organization of the Directory

Chapters 1 through 7 of the Directory provide general information regarding the Technology Development Program, including the mission, program description, organizational roles and responsibilities, technology development lifecycle, requirements analysis, program formulation, the task selection process, technology development infrastructure, technology transfer activities, and current research and development tasks. These chapters are followed by a series of appendices which contain more specific information on aspects of the Program. Appendix A is a summary of major technology development accomplishments made during FY 1992. Appendix B lists S&S technology development reports issued during FY 1992 which reflect work accomplished through the OSS Technology Development Program and other relevant activities outside the Program. Finally, Appendix C summarizes the individual task statements which comprise the FY 1993 Technology Development Program.

The information found in this Directory is sorted and categorized according to Technology and Systems Development (TSD) codes (see Figures 1-A through 1-D) which identify individual areas of research and development (R&D) component and systems testing, or applications of technology within the overall Technology Development Program. The TSD codes correspond to DOE Budget and Reporting (B&R) categories (discussed in Chapter 3) and to Technology and Systems Development subprograms (further discussed in Chapter 7). The TSD codes have been updated since the previous edition of the Directory to reflect revised B&R codes as well as to more accurately depict the type of R&D funded by OSS.

FIGURE 1-A

Nuclear Safeguards and Security Program

GD-05 Operational Activities

- Nuclear Materials Management and Safeguards System (NMMSS)
- Nuclear Materials Measurement Laboratory (New Brunswick Laboratory)
- Information Security
- Personnel Security
- Central Training Academy
- Security Education Briefing and Awareness Program
- Additional Support

FIGURE 1-B

Technology and Systems Development

A. GD-06-01 Science and Technology Base

1. Physical Security
   - a. Detection
   - b. Assessment
   - c. Delay
   - d. Entry/Exit Control
   - e. Response
   - f. General
3. Information Security
   - a. Automated Information Security Systems
   - b. Classified Matter Protection and Control
   - c. Operations Security (OPSEC)
   - d. Technical Surveillance Countermeasures (TSCM)
   - e. General
2. Material Control and Accounting
   - a. Measurement
   - b. Accounting
   - c. Control
   - d. General
4. Personnel Security
   - a. Human Reliability
   - b. Clearance Program
   - c. Access Authorization
   - d. General
5. Integrated Systems
   - a. Vulnerability Assessments
   - b. Systems Integration
   - c. In-Line Safeguards & Security
   - d. Automation/Robotics
   - e. General

FIGURE 1-C

Technology and Systems Development

B. GD-06-02 Concept and Demonstrational Development

1. Physical Security
   - a. Detection
   - b. Assessment
   - c. Delay
   - d. Entry/Exit Control
   - e. Response
   - f. General

2. Material Control and Accounting
   - a. Measurement
   - b. Accounting
   - c. Control
   - d. General

3. Information Security
   - a. Automated Information Security Systems
   - b. Classified Matter Protection and Control
   - c. Operations Security (OPSEC)
   - d. Technical Surveillance Countermeasures (TSCM)
   - e. General

4. Personnel Security
   - a. Human Reliability
   - b. Clearance Program
   - c. Access Authorization
   - d. General

5. Integrated Systems
   - a. Vulnerability Assessments
   - b. Systems Integration
   - c. In-Line Safeguards & Security
   - d. Automation/Robotics
   - e. General

FIGURE 1-D

Technology and Systems Development

C. GD-06-03 Full Scale Development

1. Physical Security
   - a. Detection
   - b. Assessment
   - c. Delay
   - d. Entry/Exit Control
   - e. Response
   - f. Technical Support
   - g. General
2. Material Control and Accounting
   - a. Measurement
   - b. Accounting
   - c. Control
   - d. Technical Support
   - e. General
3. Information Security
   - a. Automated Information Security Systems
   - b. Classified Matter Protection and Control
   - c. Operations Security (OPSEC)
   - d. Technical Surveillance Countermeasures (TSCM)
   - e. Technical Support
   - f. General
4. Personnel Security
   - a. Human Reliability
   - b. Clearance Program
   - c. Access Authorization
   - d. Technical Support
   - e. General
5. Integrated Systems
   - a. Vulnerability Assessments
   - b. Systems Integration
   - c. Technical Support
   - d. In-Line Safeguards & Security
   - e. Automation/Robotics
   - f. General

CHAPTER 2

THE TECHNOLOGY DEVELOPMENT PROGRAM

2.0 The Office of Safeguards and Security

The mission of OSS is to protect the DOE's nuclear weapons, nuclear materials, and facilities against theft, sabotage, espionage, and terrorist activity as well as to prevent the unauthorized disclosure of classified/sensitive information. More specifically, OSS has responsibilities to:

- o formulate policies and plans to assure effective and efficient protection of DOE facilities, classified and sensitive unclassified information and other matter, and special nuclear materials (SNM);
- o develop policy for and coordinate the DOE personnel security program;
- o assist in the development, evaluation and implementation of S&S programs at DOE facilities;
- o oversee the development of S&S plans at DOE facilities, such as Site Safeguards and Security Plans (SSSPs); and
- o direct safeguards and security R&D in a manner which supports policy objectives and addresses field and facility user needs.

Consistent with its basic mission and functions, the objective of OSS in managing the Technology Development Program is to assure the R&D tasks undertaken through the Program are responsive to the requirements of DOE field organizations and are supportive of Departmental policy and program objectives. In order to meet this objective, OSS has established a management process which takes into account both current and projected S&S technology "user needs" (i.e., the needs of the programs and operating facilities that use S&S technologies) and long-range plans of the Department of Energy. To prepare for the future, the program will fund programs which address issues related to the accelerated Weapons Return Initiative, Arms Controls Agreements, Facility Transition, and Complex 21.

2.1 The Technology Development Mission

The mission of the OSS Technology Development Program is to ensure that state-of-the-art safeguards and security technologies, including technical capabilities and procedures, are available and are responsive to our customer's needs.

2.2 Description of the Program

The OSS Technology Development Program presently conducts R&D in five distinct disciplines: physical security, material control and accountability (MC&A), information security (including Automated Information Systems (AIS) Security), personnel security, and integrated systems. The Program in FY 1993 encompasses 98 separate R&D tasks at twelve laboratories and research organizations, with funding of approximately $26 million.

The Program includes a broad range of activities to develop and apply advanced technology in safeguarding DOE facilities, materials, and information through: (1) basic research, applied research, and exploratory development to conceive, scope, and explore technology options and provide a foundation for application to specific S&S problems; (2) the design, fabrication, and documentation of advanced S&S equipment and methodologies; (3) the testing, evaluation, and systems integration of our R&D products or commercial equipment with existing or planned S&S systems; and (4) technology transfer to ensure that developed and

proven technology is successfully implemented throughout the DOE complex and is shared with other governmental agencies. These activities, range from basic research to technology commercialization, and provide the capability to address the current, as well as longer-term, anticipated needs of the DOE complex. Depending on where they occur in the "technology development life cycle" (discussed in Chapter 3), these activities can fall into the following three areas which correspond to the maturity of a technology.

- **Science and Technology Base.** Activities within this stage include basic research, applied research, and technology or exploratory development which is conducted to investigate the applicability of various technologies to user requirements, and maintain a viable technology base that ultimately advances the state-of-the-art in S&S technology.

- **Concept and Demonstrational Development.** At this level, advanced development and engineering development is conducted to systematically apply knowledge toward the identification of solutions to meet specific safeguards requirements.

- **Full Scale Development.** This phase provides final testing, evaluation, documentation, and technical consultation on specific methodologies, systems, or equipment to facilitate transferring of the technology to DOE field sites and development of commercial sources.

Efforts within the scope of the Technology Development Program are intended to ensure that the results of R&D sponsored by OSS are shared with the widest possible audience of potential users, including other federal agencies, state and local governments, commercial power licensees, foreign governments, and private industry.

2.3 Management of the Program

The Planning and Technology Development Branch, located in the OSS Field Operations Division (see Figure 2), administers and manages the program. The Branch serves as the principal interface between OSS and our national laboratories. As such, the Branch is responsible for the overall planning and oversight of the Program.

Each of the branches in the OSS Policy, Standards, and Analysis Division, and the remaining branches within the OSS Field Operations Division, have technical monitors who are responsible for technically overseeing the R&D activities by monitoring the technical direction and accomplishments of the tasks and reporting task status to the Planning and Technology Development Branch. The technical monitors also assist in identifying and selecting the user needs to be addressed by the program and in formulating the R&D program.

2.4 Functions of the Program

The Program ensures that technology development tasks reflect the needs of its customers and are consistent with the direction of future OSS policy formulation. Specific functions of the Technology Development Program in carrying out these responsibilities include:

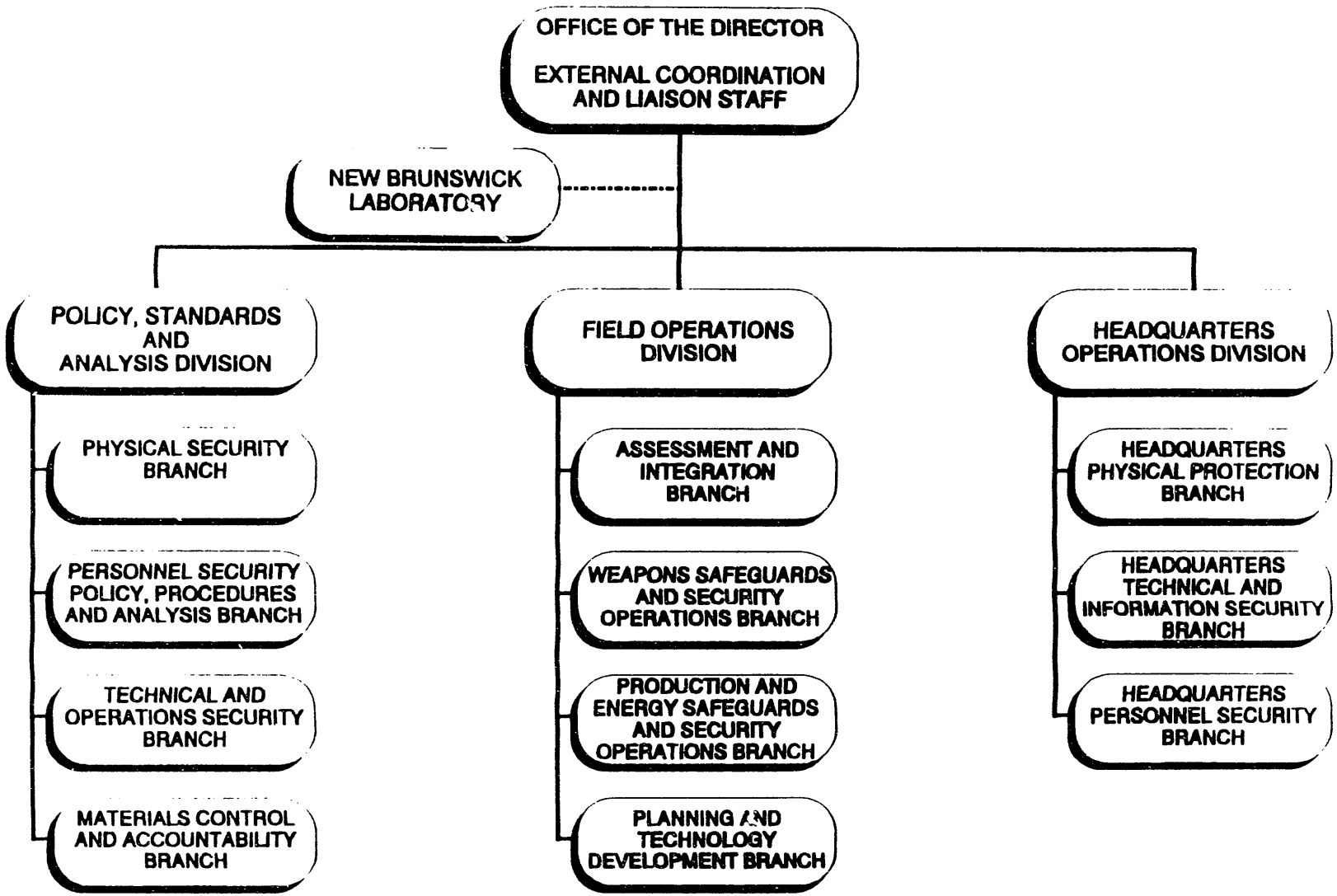
- identification, evaluation, and prioritization of user needs;

- Technology Development Program formulation and execution;

- liaison with other DOE R&D programs, other U.S. government agencies, commercial vendors and contractors, and foreign interests;

- long-range planning for technology development;

Figure 2
OSS ORGANIZATION CHART



- o technology transfer between the laboratories, DOE field organizations, private industry, other Federal agencies, State and local agencies, and foreign interests;

- o technical assistance in the evaluation of S&S systems and the application of S&S technologies for DOE programs and at DOE field sites; and

- o general OSS mission support.

2.5 Program Initiatives

The initiatives that have been undertaken in the last year to improve the Program include:

- o a new B&R structure which allows the maturity of each technology to be monitored;

- o greater interagency liaison to synergize ongoing and future R&D efforts through participation in various interagency groups and by hosting the first Interagency Security Technology Exchange and second Physical Security Technology Update;

- o a more comprehensive and efficient database to manage and maintain configuration control of user needs and task statements, and to document the status of milestones and deliverables;

- o the establishment of technical monitors in the Field Operations Division to assist in technically overseeing the progress of R&D activities and in identifying and prioritizing field user needs; and

- o revised task statement reporting requirements (to be implemented in FY 1994) which identify when a project will transition between each phase of a life cycle and thus when it will be available for application to DOE programs and facilities.

2.6 Technology Development "Situation Analysis"

A wide range of factors may influence the future direction of the OSS Technology Development Program. These include:

2.6.1 **The Evolving Threat:** According to the FBI, DOE is now the number one U.S. target for technological espionage; thus, we must proactively address this threat by providing state-of-the-art technology to protect our assets. We will continue to emphasize the development of technologies to protect against the increased insider threat resulting from facility closings, especially in areas of SNM control and accountability and in information security. However, our acknowledgement of these changing threats will not decrease our emphasis on the continued protection of our assets from previously known and still viable threats, such as terrorists.

2.6.2 **Weapons Return Initiative:** To respond to the rapid rate at which nuclear weapons are being dismantled, we need to assist in the expansion and enhancement of SNM storage capacity in the DOE complex by developing technologies to extend and/or automate SNM inventories to reduce radiation exposure of DOE personnel and by improving measurement capabilities to reflect changes in the composition of materials of interest to the DOE.

2.6.3 **Arms Controls Agreements:** The Chemical Weapons Convention (CWC) allows foreign nationals to conduct onsite inspections, thus providing access to sensitive areas and materials. Improved inspection methods are required to meet agreement obligations while protecting assets against espionage or sabotage. Similar concerns exist for the implementation of other international treaties.

2.6 Technology Development "Situation Analysis" (Continued)

2.6.4 **Facility Transition:** The changing DOE mission will involve increase utilization of facilities, formerly focused on defense-related activities, for peaceful purposes. This will allow uncleared personnel access to previously secure locations, require removal of SNM from previously inaccessible locations, and involve transfers of SNM to recovery and storage facilities. Temporary entry/exit control methods will be required to prevent uncleared individuals from entering classified areas. Improved personnel and material tracking capabilities will also be needed to protect SNM from theft or use for radiological sabotage. Improved methods for measuring holdup will be required to increase the safety of cleanup personnel. Improved methods of measuring SNM during recovery operations will also be required to ensure that radioactively-contaminated materials are treated properly. Lastly, improved methods are required to safely and securely store recovered SNM.

2.6.5 **Complex 21:** Including advanced technologies in newly constructed or renovated facilities will increase S&S system effectiveness and reduce operational costs. Opportunities include: improved mechanisms for measuring SNM to prevent shipper/receiver differences; in-line security systems; automated/robotic handling of potential materials; automated measurement/inventorying systems for SNM; and advanced computer/information security to address evolving threats.

2.6.6 **Shrinking Federal Budgets:** The continual decline in the S&S Technology Development Program budget is threatening the technology base. Collaboration with other agencies and developing Cooperative Research and Development Agreements (CRADAS) with private industry will be necessary to at least partially mitigate the impacts of these budget cuts.

CHAPTER 3

THE TECHNOLOGY DEVELOPMENT LIFE CYCLE

3.0 Technology Development Phases

The development cycle of OSS-sponsored R&D projects is modeled after the statuary categories, and spans a series of "phases" through which a technology advances as it matures. The point at which the technology passes from one phase to another represents a "key decision" for DOE program managers, DOE policy representatives, and the scientists and engineers at the laboratories. The OSS technology development phases, with their respective key decision points, are shown in Figure 3. An explanation of the type of work performed under each phase in the technology development life cycle follows.

3.1 Science and Technology Base

The goal of this effort is to conceive and explore technology options and to provide a foundation for the development of specific projects. This B&R category consists of three phases in which a technology may enter: basic research, applied research, and exploratory development. A technology does not necessarily have to enter each of these phases before progressing to the Concept and Demonstrational Development category, particularly when the complexity of a problem is not significant and the user requirement is strong.

3.1.1 **Basic Research** entails the systematic, fundamental study directed toward scientific knowledge or the understanding of fundamental principles.

3.1.2 **Applied Research** is the systematic study directed toward more comprehensive scientific knowledge of a technology.

3.1.3 **Exploratory Development** is the application of knowledge from applied research to a specific user requirement.

3.2 Concept and Demonstrational Development

A project normally transitions to this category when all experiments and studies single out a specific approach as being a feasible method of addressing a specific requirement of a potential user. The goal of this phase is to develop hardware or software that meets specific safeguards and security requirements.

3.2.1 **Advanced Development** advances work or prototypes developed in previous phases to a working model that can be tested in a technical environment.

3.2.2 **Engineering Development** further engineers a working model to consider performance, producibility, reliability and lifecycle costs with respect to the user requirements, and proves the system in an operational environment. Commercialization is initiated during this phase.

3.3 Full Scale Development

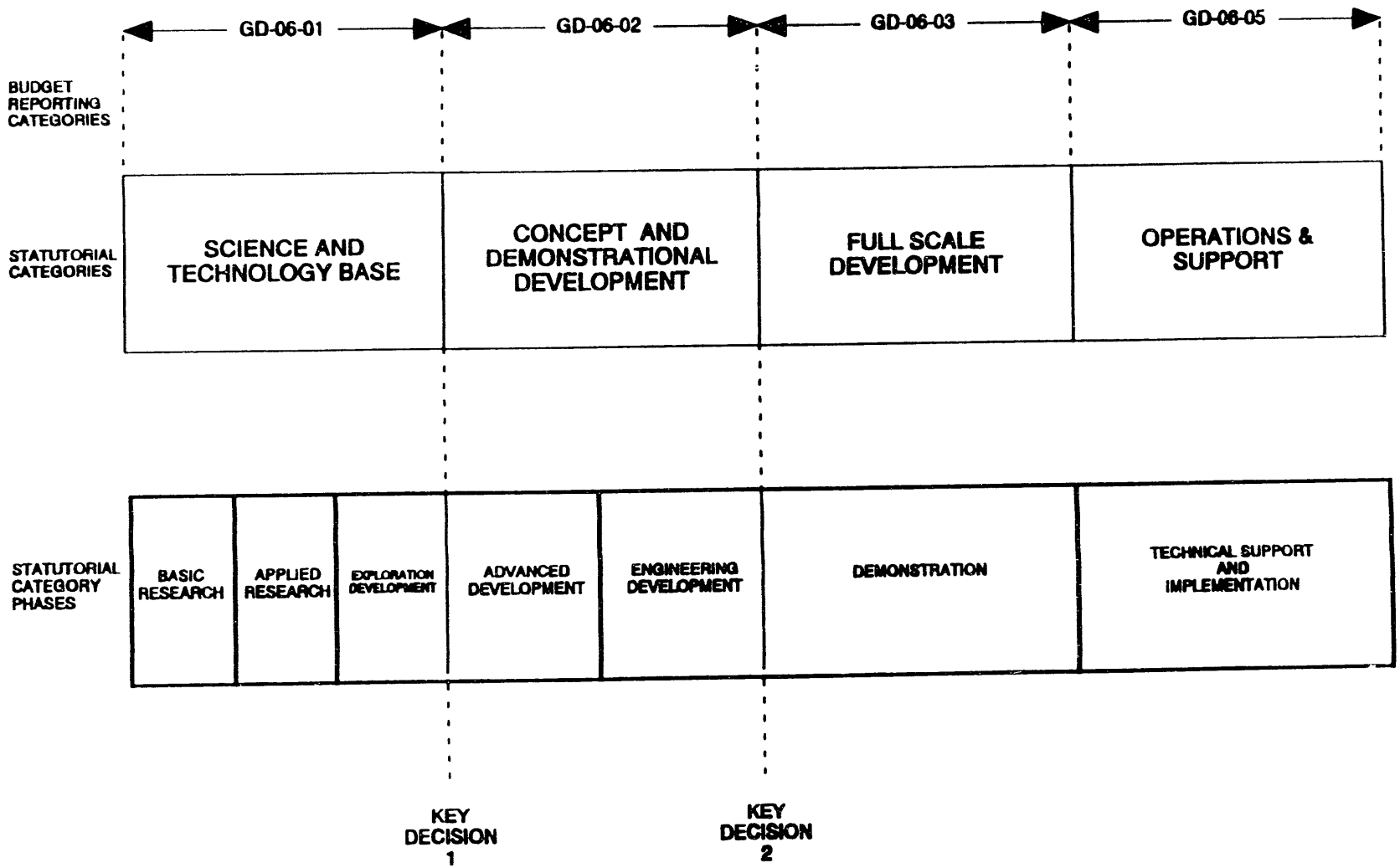
A project transitions to this phase when all developmental and major design issues have been resolved through successful completion of a technical or operational test. It includes demonstration and production or operation of the system or equipment.

3.3.1 **Demonstration** consists of on-site evaluation to refine designs, and documentation for the purpose of procurement, operation, maintenance, testing, and calibration. Validates the acceptability of the documentation against the commercial market. Transfers the technical capability to the DOE field through consultation, training, and reports on commercial sources and product acceptability.

3.3 Full Scale Development (Continued)

3.3.2 **Technical Support and Implementation** ensures that the system/component meets customer's needs, transfers or implements the mature technology, and provides technical support to end users.

Figure 3
OSS RESEARCH AND DEVELOPMENT ACQUISITION PHASES



CHAPTER 4

REQUIREMENTS ANALYSIS AND PROGRAM FORMULATION

4.0 Overview

Each year OSS formulates its program based on its mission and available resources, as well as internal and external factors related to safeguards and security. The internal factors are addressed through a series of criteria that consider the ability of laboratory task proposals to:

- o support the OSS and technology development missions;
- o offer a solution to a known or anticipated S&S problem;
- o apply to requirements at multiple facilities;
- o decrease S&S operational costs;
- o improve performance and efficiency of S&S systems;
- o increase reliability of current safeguards and security system;
- o address future requirements such as those likely to result from returning weapons, facility transitions, and weapons complex renovation and construction activities;
- o contribute to the standardization of S&S technologies;
- o perform true research and development versus an operational activity or line item upgrade that is better handled by a program office; or
- o explore an innovative idea or theory that may enhance S&S.

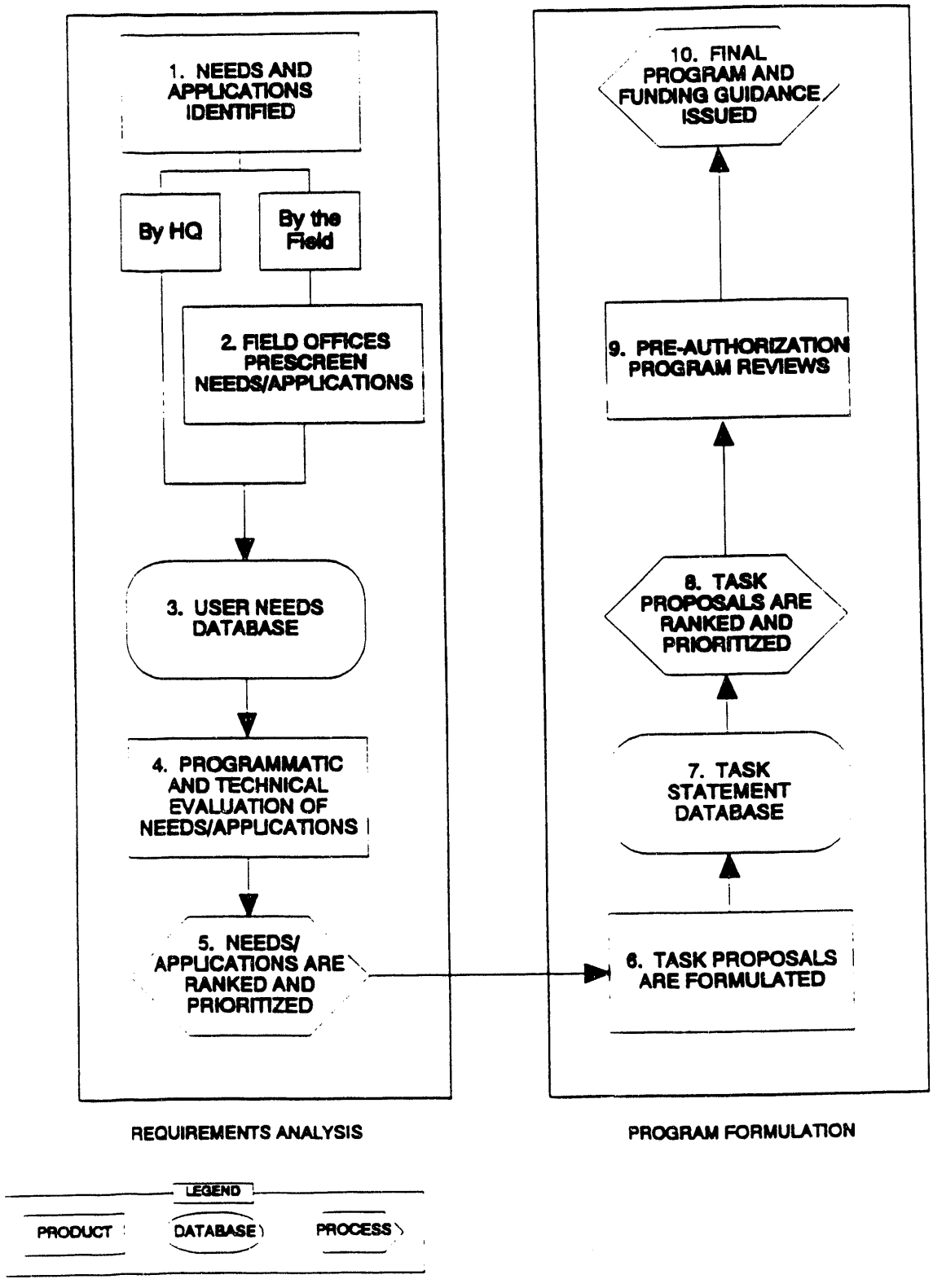
Examples of external factors include laws and regulations, industry trends, threat projections, and anticipated technological advancements.

4.1 Requirements Analysis

The requirements analysis ensures that OSS-sponsored technology development activities are responsive to user needs, consistent with policy and program objectives, and selected according to documented evaluation criteria. This process places a shared degree of responsibility and accountability on each cognizant field office, DOE operating contractors, OSS Headquarters, and the research laboratories for the review and evaluation of user identified needs and proposed tasks. Figure 4 presents a flow diagram of the Task Evaluation Process. The paragraphs below discuss specific steps in the process which correspond to the numbered boxes shown in Figure 4.

4.1.1 **Needs and Applications Identification:** User need statements are solicited by the Planning and Technology Development Branch through the field offices. The Branch solicits user needs in order to ensure that safeguards and security R&D activities remain relevant and result in effective applications. HQ elements also identify needs based on programmatic requirements in their respective areas of the overall DOE S&S program (e.g., physical security, MC&A, etc.). Technology development needs are requested and evaluated on an annual schedule, but may be

Figure 4
TASK EVALUATION PROCESS



submitted at any time. Users are encouraged to resubmit justifiable needs that were not immediately incorporated into the Technology Development Program, or to modify active user needs. User needs should reflect current or anticipated requirements that cannot be met with available analytical methods or technology.

The format of submissions should follow the outline given in Exhibit 1. Concise but thorough submissions will ensure the effective study and evaluation of the proposal. It is expected that some submissions will outline the need for exploratory research with general goals while others will request expansion of current programs in specific areas. Proposal length is not necessarily an indication of the merit of the need. The proposal should include all details necessary to evaluate the need and plan research projects.

Factors other than user need requests also provide justification for technology development projects. These include vulnerability assessments, program oversight activities such as inspections and surveys, and program and facility priorities. Additionally, Complex-21 reconfiguration plans and S&S performance requirements provide justification for R&D efforts.

4.1.2 **Field Offices Prescreen Needs/Applications:** Facilities forward their needs to their field office for screening and preliminary selection. This review:

- o Ensures that the identified need/application is consistent with S&S policy and the guidance provided in this document;
- o Ensures that the identified need/application is based on a valid S&S program requirement;
- o Ensures that the need/application will reduce risks associated with potential acts of theft, diversion, espionage or sabotage, or offers potential cost reductions in the operation of S&S systems;
- o Ensures that each need/application is truly a technology development effort and not a facility upgrade project (which should be funded out of existing capital equipment, General Plant Project, or operating funds); and
- o Ensures that each need/application is properly classified in one of the TSD subprogram categories listed in Figures 1-A thru 1-D.

Each field office ranks its needs and applications according to the field office priorities (high, medium, or low). Submission of needs or applications requiring extensive implementation costs must include facility or field office plans to fund implementation of developed and proven technologies.

4.1.3 **User Needs Database:** Upon receipt of prescreened user needs and applications from the field offices, OSS enters information contained in the requests into the Technology Development Program Management Information System (TDPMIS). TDPMIS organizes information on past and current user need submissions, task proposals, need/task linkages, and funding levels, and maintains configuration control.

EXHIBIT 1

USER NEED SUBMISSION FORMAT AND GUIDELINES

User Need Title
Provide the title of the user need.

TSD No.: See Figure 1B-1D
(e.g., A1a, A1b, etc.)
PRIORITY: High, medium, or low (relative priority, as assigned by field office)

Facility Point-of-Contact: Name and telephone number of person originating the user need.

Operations Office Point of Contact: Name and telephone number of point-of-contact familiar with all user needs submitted by contractors, laboratories, and program organizations under the cognizance of his/her respective Operations Office.

Problem or Need and Background

Provide a description of the need or problem that clearly indicates why an improvement is needed in this area in order to support the DOE S&S mission. Be specific in stating the background of the issue that has led to this need. State the specific S&S function that would be provided by a technology development task designed to address this need or problem.

Potential Solution or Objective

Describe the approach envisioned to address the identified need. Provide any known information to support the feasibility of the suggested approach. Describe the perceived application of the effort (e.g., where, and under what conditions might this initiative improve S&S). Identify performance objectives that should be met for the initiative to successfully address the need or problem. To the extent known, specify the estimated costs of this effort in terms of manpower and equipment.

Relationship and Integration with Other Systems/Efforts

Describe any pertinent considerations relative to other systems or efforts, including existing or planned S&S initiatives (e.g., line items), that could have an effect on the validity of the need or the feasibility of achieving the project objectives.

Time Frame

Identify the time frame in which the need or problem should be addressed in order to support the DOE S&S mission. Define the time frame in which the effort can reasonably be accomplished. Identify any aspects of other efforts that may have a bearing on the scheduling of this work.

Transition to Implementation

Identify the program planning and budgeting schedule (e.g., schedule 44, General Plant Project, operating) requested by field offices to permit implementation of successful technology development results.

Interim Measures and Impact

Identify the S&S measures already in place that are used to deal with the need or problem. Describe the aspects of this effort that will represent improvements over the current system or methods, and the magnitude of those improvements (quantitatively if possible), especially any cost savings that would be realized as a result of those improvements.

4.1.4 **Programmatic and Technical Evaluation of Needs/Applications:** User needs are evaluated for overall validity, technical feasibility, consistency with S&S policy and program objectives, inability to be met by current and projected R&D, and potential for providing test cases for new technology. In evaluating the user need statements submitted by the field offices, every effort is made to determine tradeoffs and the widest possible application of a given technology. DOE laboratories and other R&D organizations also study the user needs to plan and justify their technology development programs.

The Planning and Technology Development Branch ensures that submissions are grouped in the appropriate technical areas such as physical protection, materials control and accounting, information security, or integrated systems. The Branch, and other OSS elements, evaluates the needs and applications according to programmatic considerations, long-range plans, policies, and goals. Concurrent with the OSS review and screening process, laboratories supporting the Planning and Technology Development Branch conduct a similar review of the same set of user needs and applications. They determine whether a need can be satisfied in whole or in part by past or present technology development programs, or by commercial sources. They also determine whether needs can be met by new programs. OSS provides programmatic guidance to the laboratories throughout the process.

4.1.5 **Needs and Applications Prioritization:** The laboratories forward the results of their technical evaluation to the Planning and Technology Development Branch. The Branch consolidates the evaluation results, and ranks the user needs and applications based on OSS plans, field office priorities, and the Headquarters and laboratory evaluations. To date, no quantitative method exists for evaluating and prioritizing technology development user needs. However, the needs are qualitatively evaluated by Headquarters staff and technical experts at the laboratories based on their knowledge of conditions in the field, the scope of the OSS and related R&D programs, and the state-of-the-art in the relevant technical areas. Based on this evaluation, a need is placed in one of several categories (see Exhibit 2). Needs categorized as "active" or "valid" receive priority in planning and formulating the OSS research and development program.

In addition to user need statements, user needs are identified by survey findings, inspection evaluations, changes in performance requirements, and changes in Departmental policies. Each of these source may point to the need for applications requiring R&D. These applications are documented and used in the planning process.

4.1.6 **Formulation of Task Proposals:** The prioritized user needs and applications are sent to laboratories conducting research in specific technical areas required by the user need or application. The laboratories compare user needs to ongoing technology development activities and current capabilities. They use these comparisons to develop task proposals for continuing or expanding base technology R&D and to suggest innovative solutions to user needs. Proposals may also be submitted for work not directly related to current user needs and applications. Exhibit 3 illustrates the format and offers general guidelines for project proposals. The laboratories forward task proposals to OSS for review and establishment of formal linkages between tasks and user needs.

4.1.7 **Task Statement Database:** Upon receipt, and pending acceptance of task proposals, OSS accumulates the information contained in the task proposals in TDPMIS.

EXHIBIT 2

USER NEED STATUS CODES

A = Active

Assigned to a valid user need request clearly falling within the scope of the Technology Development program.

B = Complete

Assigned to a user need which has been satisfied by proven technology (i.e., no longer "needed" technology), or commercially available solutions.

C = Not OSS Technology Development

Assigned to a user need which clearly falls outside the scope of the Technology Development program. Usually a status code of "C" will indicate that the user need is clearly a facility upgrade or implementation project, or could be better defined as an operational support activity. The responsibility for these projects resides with the programmatic outlay office.

D = Too General

Assigned to a user need in which the scope is so vague that it cannot be fully understood or evaluated.

E = Not Technically Feasible

Assigned to a user need requesting technology development which would prove to be either not cost effective or not technically feasible.

F = Duplicate

Assigned to a user need submitted in duplicate by the same site or facility within the same year or resubmitted the following year. In this case, one user need is labeled active and retained in the database while the other is assigned a status code of "F".

G = Valid

Assigned to a user need that is a valid need, but is not currently being addressed by the Technology Development program.

4.1.8 **Tasks Proposals Prioritization:** Task proposals are ranked by the Branch and OSS personnel. Proposals are ranked on merit, technical feasibility, ability to reduce S&S risks, ability to reduce operational costs, and direct or related alignment to user needs and facility applications. The selected information will be used to evaluate the strength of linkages, whether needs and applications without corresponding tasks warrant research support, and whether tasks without corresponding needs have merit for other reasons. The Branch also evaluates task proposals for duplication of effort and makes recommendations for program initiations and cancellations as needed. The Director of OSS approves research programs tasks and associated funding.

4.1.9 **Pre-Authorization Program Reviews:** After approval of the tasks and their associated funding levels by OSS, the Technology Development budget is reviewed and modified as necessary by DOE internally, the Office of Management and Budget, and Congress. OSS then negotiates the final R&D program scope with each laboratory in response to final budget levels.

4.1.10 **Issuance of Final Program Task and Funding Guidance:** OSS issues the final task statements, as program direction and fiscal guidance, to the laboratories at the beginning of the fiscal year.

Figure 5 illustrates how the entire evaluation process repeats annually during the planning, formulation, and execution phases of each fiscal year's Technology Development Program.

EXHIBIT 3

TECHNOLOGY DEVELOPMENT TASK
PROPOSAL FORMAT AND GUIDELINES

TITLE OF TASK

The laboratory will provide the title of the proposed task, including the B&R category under which it should be reported (e.g., GD-06-01 Science and Technology Base Development, GD-06-02 Concept and Demonstrational Development, etc). The laboratory will also include the subprogram category which best describes the scope of the proposed effort. (See Figures 1B-1D for the listing of subprogram categories.)

LABORATORY /CONTRACTOR

The name of the laboratory and/or contractor requesting the task will be stated, including the laboratory point-of-contact and telephone number.

OVERALL TASK GOAL/OBJECTIVE

The laboratory will briefly describe the overall goals of the proposed task, including the laboratory's involvement in the specific area and its applicability to the DOE/OSS technology development mission and objectives.

The laboratory should also describe the relevance of the proposed task in addressing and providing a viable solution for a specific user identified need.

ANTICIPATED ACCOMPLISHMENTS THROUGH FY XX

If the proposed task was funded during the previous fiscal year, the laboratory shall describe its anticipated accomplishments through the end of that fiscal year. These "anticipated accomplishments" will be revised and changed to "actual accomplishments" as the request is converted into current year program direction.

FY XX ACTIVITIES

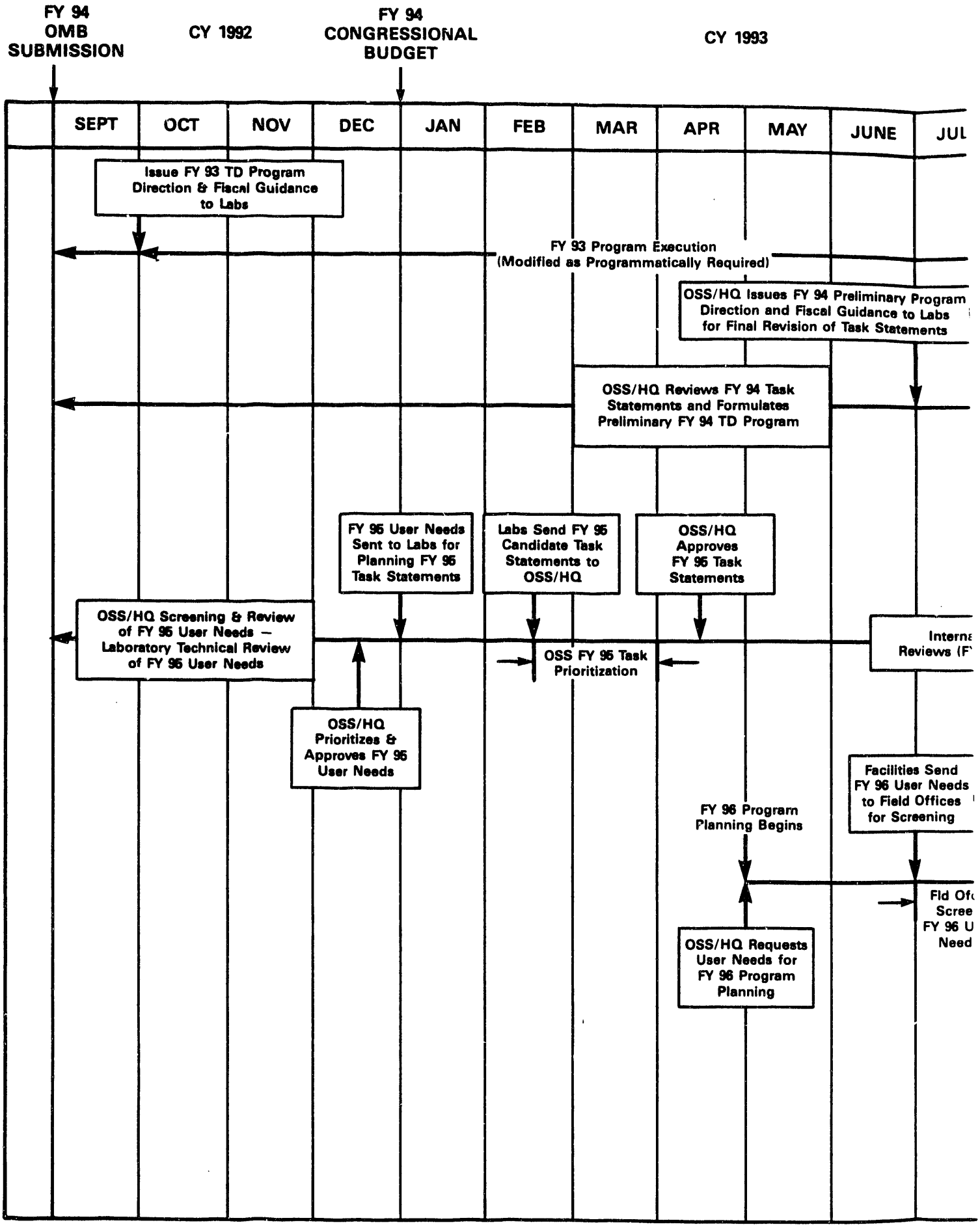
The laboratory will summarize the scope of the requested task, including a brief statement of work and services anticipated during the course of the fiscal year.

FY XX MILESTONES

The laboratory will list the specific objectives which will be met during the fiscal year, complete with anticipated due dates.

FY XX DELIVERABLES

The laboratory will list the specific products and/or services (complete with anticipated due dates) to be delivered either to OSS or to DOE facilities as a result of the work performed during the fiscal year (e.g., or final reports; prototype instrumentation, hardware, or software; system documentation; installation and/or demonstration, etc.).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FY 93 Program Execution (Modified as Programmatically Required)
OSS/HQ Issues FY 94 Preliminary Program Direction and Fiscal Guidance to Labs for Final Revision of Task Statements
OSS/HQ Reviews FY 94 Task Statements and Formulates Preliminary FY 94 TD Program
FY 95 User Needs Sent to Labs for Planning FY 95 Task Statements
Labs Send FY 95 Candidate Task Statements to OSS/HQ
OSS/HQ Approves FY 95 Task Statements
OSS/HQ Screening & Review of FY 95 User Needs — Laboratory Technical Review of FY 95 User Needs
OSS FY 95 Task Prioritization
OSS/HQ Prioritizes & Approves FY 95 User Needs
Facilities Send FY 96 User Needs to Field Offices for Screening
FY 96 Program Planning Begins
OSS/HQ Requests User Needs for FY 96 Program Planning

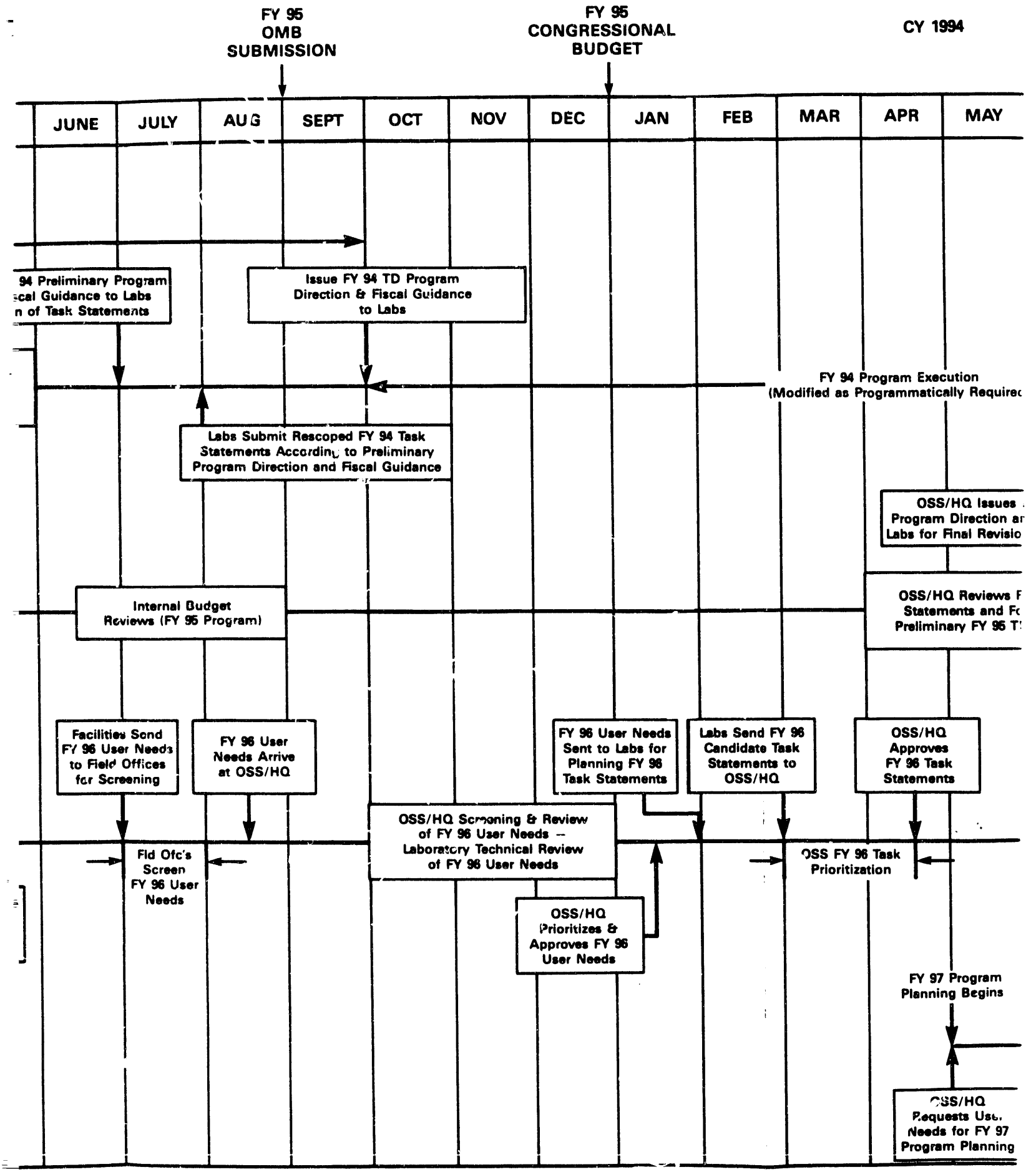
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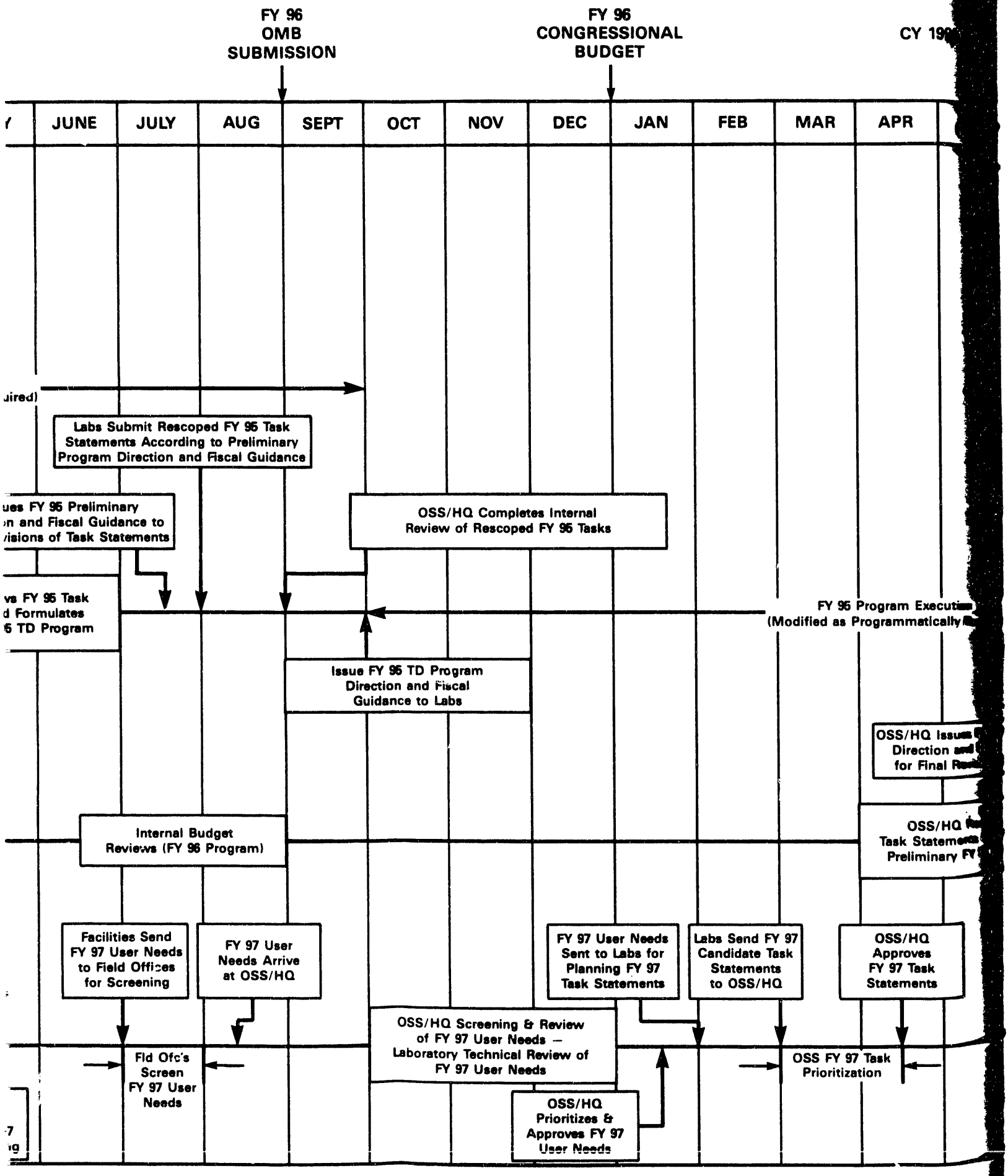
FIGURE 5

OSS TECHNOLOGY DEVELOPMENT (TD) FUNCTIONAL FLOW DIAGRAM



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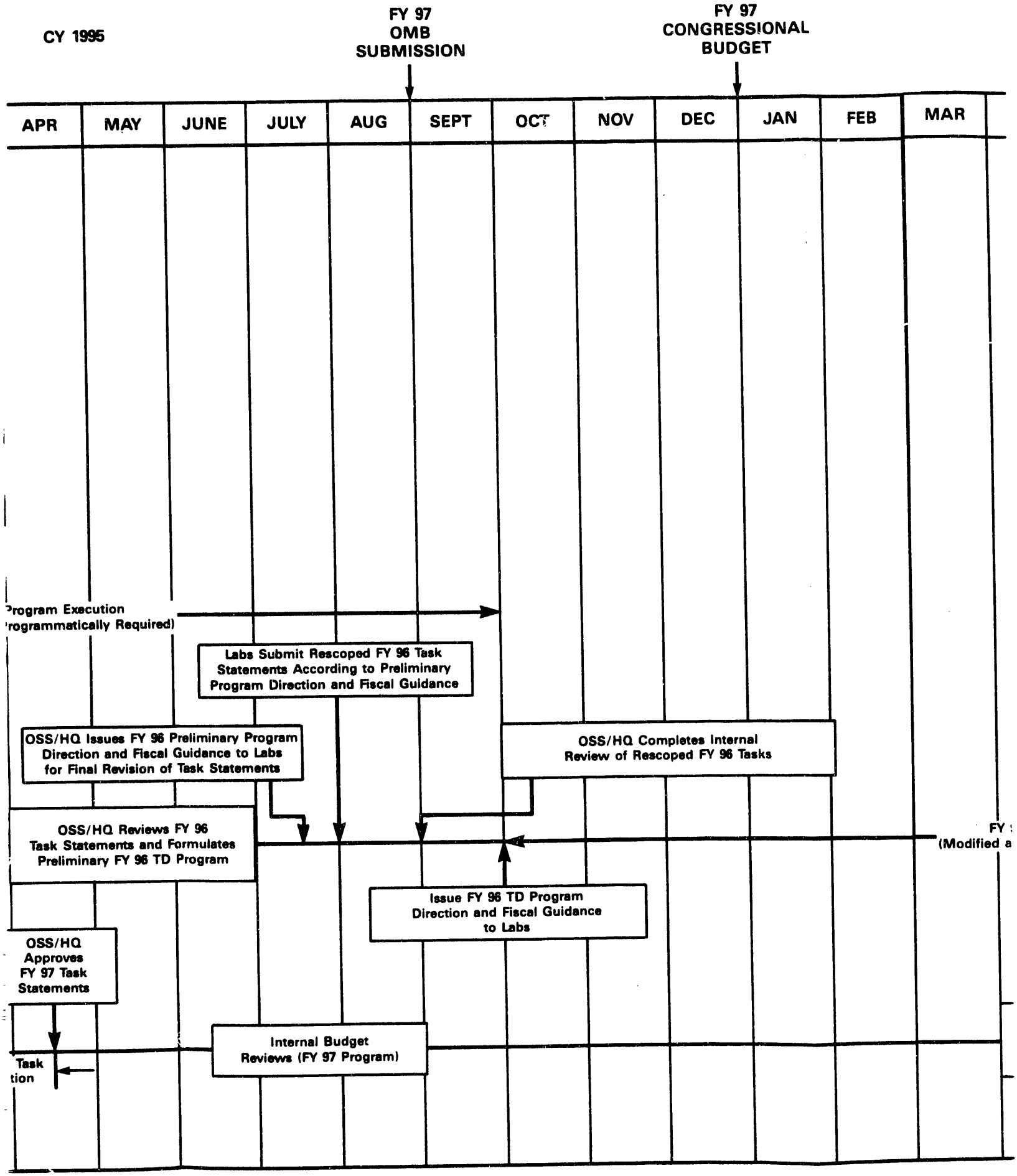
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Review of Rescoped FY 96 Tasks
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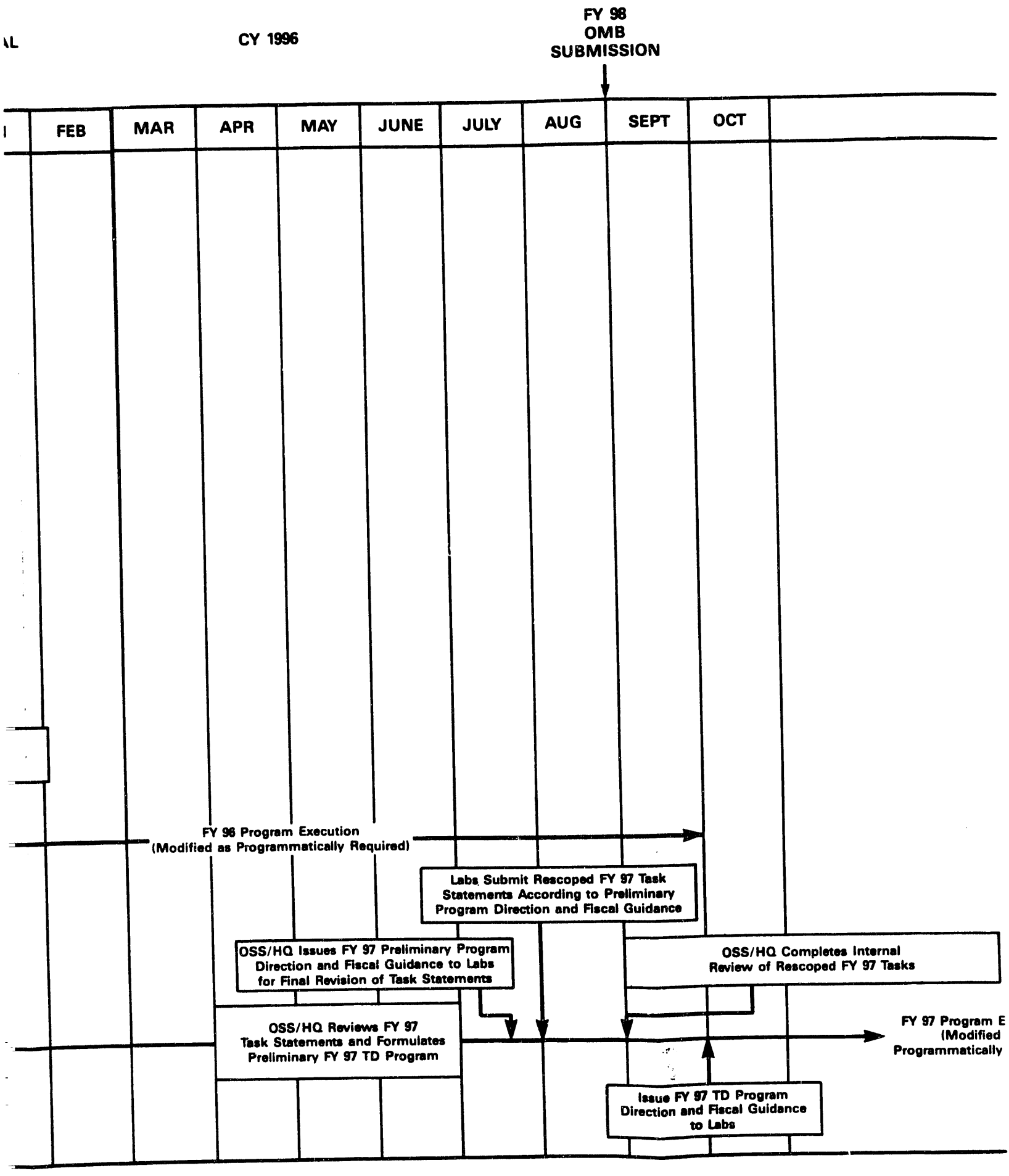
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Program Direction and Fiscal Guidance
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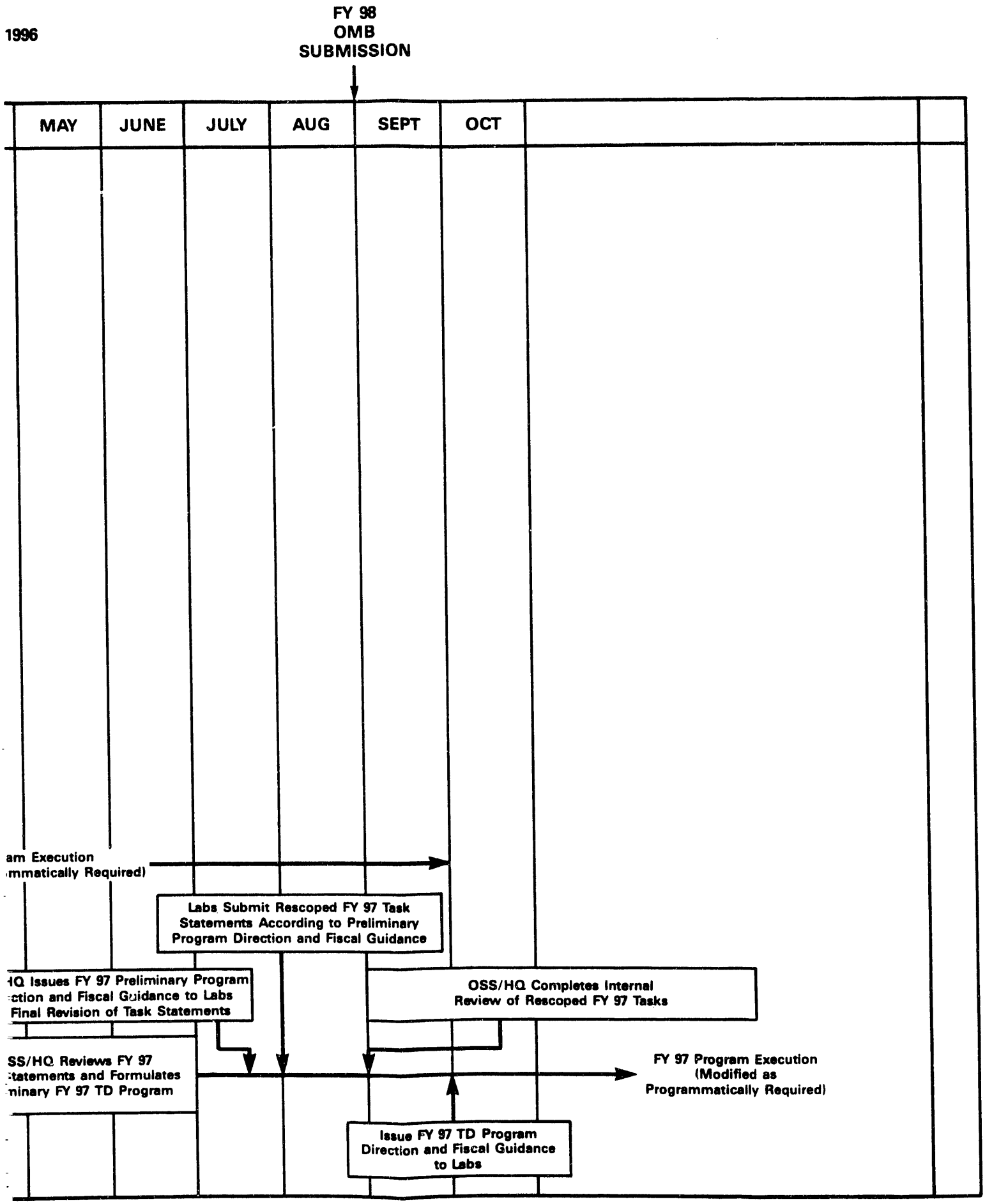
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CHAPTER 5

THE TECHNOLOGY DEVELOPMENT INFRASTRUCTURE

5.0 General Description

The Technology Development Program sponsors research and development activities at the National Laboratories and other R&D facilities. Within OSS, other operational organizations support or benefit from the products of the OSS Technology Development Program. The R&D facilities, operational support organizations, DOE Headquarters, and other agencies that interact with the Department, comprise the infrastructure of the technology development program. The role of each participant is discussed below.

5.1 Research and Development Facilities

Each R&D facility sponsored by OSS is noted for one or more areas of technical expertise. OSS sponsors R&D in Physical Security, Material Control and Accountability, Information Security (including computer security), Personnel Security, and Integrated Systems. The operational facilities address a wide spectrum of subjects in each of the broader disciplines noted above. They interact with one another, with other federal agencies, and with researchers abroad to synergize the benefits of federally funded research. In addition to performing R&D, the laboratories provide technical advice on new and existing technology; many are also involved in developing the design of the reconfigured complex. Table 1 lists the facilities currently funded by OSS in FY 1993 and gives the areas in which they are primarily receiving funding.

Table 1. Research Facilities Funded by OSS

Facility	Technical Area
Ames Laboratory	Material Control and Accountability
Argonne National Laboratory-East	Material Control and Accountability
Argonne National Laboratory-West	Integrated Systems
Brookhaven National Laboratory	Material Control and Accountability
Idaho National Engineering Laboratory	Physical Security
Los Alamos National Laboratory	Material Control and Accountability Integrated Systems Information/AIS Security
Lawrence Livermore National Laboratory	Information/AIS Security Material Control and Accountability Integrated Systems Physical Security
Mound Laboratory	Material Control and Accountability

Table I. (Continued)

Facility	Technical Area
Oak Ridge-Martin Marietta Energy Systems	Information/AIS Security
Oak Ridge National Laboratory	Physical Security
Pacific Northwest Laboratory	Material Control and Accountability
Sandia National Laboratory	Physical Security Material Control and Accountability Information/AIS Security Integrated Systems

5.2 Operational Support Organizations

Other DOE field organizations and laboratories provide support to OSS to maintain and ensure the effectiveness of various DOE Headquarters-sponsored S&S operations. These groups are not funded by the Technology Development Program, but perform functions related to R&D; they support implementation of new technology in the field, training of S&S personnel, and evaluation of S&S activities. Operational support organizations conducting those activities include:

- The Martin Marietta Computing and Telecommunications Services Division in Oak Ridge, which is chartered to operate and maintain the Nuclear Materials Management and Safeguards System (NMMSS). NMMSS is the national database and management information system for nuclear materials.

- The New Brunswick Laboratory, which is chartered to operate and maintain a national nuclear materials measurement standards laboratory for quality assurance of MC&A measurements. This laboratory also provides and maintains an internationally compatible national reference base for the calibration and standardization of nuclear material measurements.

- The Central Training Academy (CTA), which provides uniform training programs for DOE in all areas of S&S. These courses are taught both at the CTA and at field facilities to reach a broader audience. Currently, there are courses offered in the following areas: Program Planning and Management, Protection Program Operations, Materials Control and Accountability, Information Security, Personnel Security, and Instructor Development.

5.3 Outside Research and Development Participants

The Technology Development Program is heavily involved with other federal agencies through participation in various interagency groups; it also hosts and participates in various technology exchanges. This involvement in the federal community avoids duplication of effort and ensures the most effective use of taxpayer dollars. Technology transfer and interagency liaison on safeguards and security R&D matters are further discussed in Chapter 6.

CHAPTER 6

TECHNOLOGY TRANSFER

6.0 DOE Technology Transfer Program

The National Competitiveness Technology Transfer Act of 1989 established technology transfer and its implementation as a mission of DOE and the laboratories. Currently, under applicable law and consistent with its missions, the Department is required to transfer federally-owned or originated technology to state and local governments, private industry, and universities or other nonprofit organizations to enhance the prospects for commercialization of such technologies.

OSS wants to maximize the returns of its R&D developments and actively promotes the transfer of its technology both within and outside the DOE complex through publications, seminars, training classes, participation in interagency groups, and technology exchanges. In addition, OSS benefits from outside R&D through participation in interagency groups, CRADAs, technology exchanges, and program reviews.

6.1 Safeguards and Security Technology Transfer Within DOE

The R&D facilities supported by OSS are encouraged to transfer information to DOE Headquarters, DOE field offices, facility contractors, and other program offices on an ongoing basis. This includes not only OSS-funded technology, but also technology available from other federal agencies, private industry, and other nations that have an S&S application. OSS R&D facilities use several methods to communicate with the DOE complex:

Quarterly Reports: The laboratories provide R&D status reports on a quarterly basis; this information is available throughout the DOE community.

Technical Reports: The laboratories document and publish their findings in various papers and reports; these publications are available for distribution through the Office of Science and Technical Information (OSTI).

Technology Exchanges: OSS sponsored technology exchanges or updates are often used by the laboratories to transfer information throughout the complex. For example, in August 1992, Sandia National Laboratory hosted the Physical Security Technology Update in conjunction with the Nuclear Regulatory Commission (NRC).

Personal Contacts: The laboratories interact with DOE operating facilities and provide input on the design, fabrication, and testing and evaluation of new methodologies, developments, or systems.

Program Reviews: Other program offices within DOE are encouraged to attend OSS sponsored R&D program reviews.

Training: The laboratories also aid in the development and delivery of training courses in specific areas, both at the CTA and at the laboratories.

Technical Assistance: The laboratories are funded (under full scale development activities) to provide technical assistance to both the field and headquarters on various technical matters.

6.1 Safeguards and Security Technology Transfer Within DOE (Continued)

Working Groups. OSS participates in various working groups such as the Tactical Entry Working Group, the Special Response Team Working Group, and the Security Systems Working Group to ensure the Technology Development Program addresses current needs.

6.2 Safeguards and Security Technology Transfer Outside DOE

Customers of OSS sponsored R&D are not limited to DOE facilities, operations offices, and program offices. Technology is also transferred to other federal agencies, foreign governments, state and local governments, and private industry.

Federal Community: Our program serves as the technology base for other federal agencies such as the Department of Defense, the Federal Aviation Administration, the Nuclear Regulatory Commission, the Federal Bureau of Prisons, the U.S. Mint, and the General Services Administration. OSS actively participates in interagency groups (discussed further in section 6.3), interagency technology exchanges, DOE Work for Others Program, and reciprocative program reviews to prevent duplication of effort and to effectively seek solutions to a problem.

International Community: The technology base serves as the foundation for nonproliferation efforts. OSS transfers technology to the international community through participation in bilateral support with nations participating in the IAEA; and through bilateral exchanges on counterterrorism with allies. Recently, significant transfers of technology have been made to the Russians.

State and Local Governments: These governments also benefits from technology development activities. For example, information pertaining to Protective Forces has been transferred to state and local police departments.

Private Industry: In accord with the National Competiveness Technology Transfer Act of 1989, OSS promotes the transfer of OSS funded technology to U.S. private industry so that businesses may become more competitive in the Global market. This is done largely through Cooperative Research and Development Agreements (CRADAs) where the laboratories and industry jointly fund and conduct R&D on a project and technology exchanges, where interested vendors can receive information on the latest technological accomplishments. Additionally, laboratory personnel actively communicate with vendors so that when a technology matures it can be transferred to private industry to be manufactured.

6.3 Interagency Coordination

Interagency information exchange allows DOE to become aware, on a timely basis, of S&S technology development efforts in progress or planned by other Federal departments and agencies. As previously noted, OSS has focused considerable attention in the past year on establishing contacts with other agencies and implementing procedures to coordinate R&D efforts to maximize technology development. These contacts have been established through individual networking, participation in interagency bodies, and attendance at conferences, technical workshops and symposia. Examples of these activities are discussed below.

6.3 Interagency Coordination (Continued)

Technical Support Working Group. The TSWG sponsors rapid prototype R&D for meeting multi-agency counterterrorism requirements.

Interagency Advisory Committee on Security Equipment (IACSE). OSS is a regular participant in IACSE. IACSE is developing standardized procurement specifications for security hardware.

Committee on Physical Security (COPS). COPS is a committee organized by the State Department to encourage interagency dialogue concerning the latest technologies and techniques for the protection of National assets.

Committee of Technical Security (COTS). COTS is an intelligence community committee that very closely tracks the COPS.

Armor and Protective Systems Working Group (APSWG). This CIA working group includes representatives of all government agencies with security needs. It works only on classified systems and conducts research in the black.

Department of Defense Physical Security Equipment Action Group (PSEAG). This DoD working group sponsors technical symposia to display new technologies.

American Defense Preparedness Association. This civilian organization brings together all the latest technologies related to national defense and security.

Facility Security Technical Working Group. This group is sponsored by the American Defense Preparedness Association, and prepares generic federal specifications for integrated facility security.

Interagency Ammunition Working Group. This is a DOE organized working group that serves all government agencies with a need for specialized ammunition.

Defense Advance Research Projects Agency (DARPA). This DoD agency heads procurement and research of advanced concepts.

Special Operations/Low Intensity Conflict (SO/LIC). This DoD organization is headquartered at McDill AFB, Tampa Bay, FL. It conducts other than full scale combat operations around the world. This includes such operations as the current activities in Somalia.

Program Reviews. OSS regularly invites representatives of other DOE offices, as well as representatives of other federal agencies, to laboratory program reviews.

Conferences and Symposia. Professional societies provide a valuable means of technology transfer. In recognition of this fact, members of the OSS staff are encouraged to participate in organizations such as the Institute of Nuclear Materials Management, the American Defense Preparedness Association, the American Nuclear Society, and the American Society for Industrial Security.

6.4 Major Safeguards and Security Technology Transfer Accomplishments

Technology transfer is accomplished through a variety of methods. Some of the more common methods are the transfer of S&S instruments to individual facilities; publication and presentations of technical reports; preparation of applications guides and manuals; providing direct consultations; creation of S&S information libraries; and instruction of and participation in training courses.

Laboratories also host symposia where the DOE community, other agencies, and interested vendors are invited to view end products or prototypes resulting from the laboratory's R&D program. The goal of such exchanges is to transfer the demonstrated technology to a vendor for final development and manufacturing, or for production of the product for specific DOE facilities and potential application outside the DOE. The laboratories also design and transfer system or instrument specifications to commercial manufacturers to develop instruments for use by facilities or for applications outside DOE.

6.4.1 Technology Transfer Accomplishments During FY 1992 -- OSS sponsors a wide variety of technology transfer activities through the Technology Development Program. Examples of accomplishments for the past fiscal year are summarized below. (The corresponding task identification number for each activity is shown in parentheses.)

Argonne National Laboratory-West (ANL-W)

ANL-W participated in the Technology Update 1992 Workshop at Sandia National Laboratories, Albuquerque. A poster of the ARGUS inventory system was presented during this workshop. (ANLW88001-92)

Brookhaven National Laboratory (BNL)

BNL published: "Guidance Document on the Variance Propagation Requirements in DOE Order 5633.3," Report BNL-52315, Revised October 1991. (BNL86003-92)

Idaho National Engineering Laboratory (INEL)

INEL established a Work for Others agreement with the U.S. Army Toxic and Hazardous Materials Agency for HE, TNT, and VOC fiberoptic chemical sensors. These sensors will be utilized by both DoD and DOE to conduct environmental screening and monitoring of contaminated government facilities. (INEL91001-92)

Los Alamos National Laboratory (LANL)

LANL received a 1992 R&D 100 Award from the Industrial Research Magazine for its development of the neutron multiplicity counter. One hundred of these prestigious awards are presented annually by the Research and Development Magazine for the new products, processes, and materials that the publication determines to be the year's most significant. (LANL86003-92)

LANL presented six training seminars: NDA Techniques for Safeguards Practitioners (March and August 1992); In-Plant Holdup Measurements (May 1992); Materials Accounting for Nuclear Safeguards (March 1992); Measurement Control Practices (June 1992); and Variance Propagation and MC&A Systems Analysis (September 1992). (LANL 86022-92)

LANL completed a purchase order and vendor selection for commercial procurement of two californium shufflers. (LANL 90040-92)

LANL developed a compact shielded NaI detector package (for portable measurements) for commercialization. (LANL 89031-92, LANL 90040-92)

LANL provided multichannel analyzer circuit upgrades to Davidson Company for incorporation in the portable MCA. (LANL 89030-92, LANL 90040-92)

LANL specified and procured a new far-field segmented gamma-ray scanner for Savannah River through the Atlantech Company. This company will receive LANL aid in construction of the instrument, creating a new commercial source for NDA instrumentation. (LANL86015-92).

LANL provided neutron multiplicity electronics package specifications to Canberra Industries for commercialization. (LANL89030-92, LANL90040-92)

LANL wrote a Technology Commercialization Initiative (TCI) for joint Los Alamos/Canberra development of neutron multiplicity counting technology. (LANL86003-92, LANL90040-92)

LANL wrote a TCI for joint Los Alamos/Gammametris development of the ACE algorithm for optimization of waste drum data analysis. (LANL 90039-92,
LANL 90040-92)

LANL wrote a TCI for joint Los Alamos/EV Products development of compact gamma-ray detector technology. (LANL 89031-92)

LANL completed a neutron coincidence counting Applications Note, a draft version of an Applications Guide to californium shufflers, and a draft shipper/receiver Applications Note. (LANL 86019-92, LANL 90041-92)

LANL provided consultation on uncertainty propagation for holdup measurements to Rocky Flats and LANL in support of DOE Complex duct holdup measurement program. (LANL 86016-92, LANL86021-92)

LANL developed circuit boards for a new miniature modular multichannel analyzer for use in the Y-12 holdup measurement program and in other DOE facilities for inventory and waste monitoring activities. (LANL 86016-92, LANL 89030-92)

LANL prepared nine instrument manuals: "Passive/Active Neutron Coincidence Counter Hardware, Installation, and Maintenance Manual," LA-UR-92-2173; "Grand Collect Users' Manual" LA-UR-92-2173; "GRAND MONITOR Users Manual (PNC Version)," LA-UR-92-2172; "GRAND REVIEW Users Manual (CDM Version)", LA-UR-92-2172; "GRANC REVIEW Users Manual (PNC Version)," LA-UR-92-2121; "GRAND MONITORS Users Manual (CDM Version)", LA-UR-92-2825; "Martin Marietta Portsmouth Waste Drum Shufflers User Manual, " LA-UR-92-740; "Martin Marietta Portsmouth Waste Drum Shufflers Hardware Manual," LA-UR-92-938; and "Shipper/Receiver Confirmatory System User Manual," LA-UR-92-2897.

Lawrence Livermore National Laboratory (LLNL)

LLNL and SNL participated in the development and instruction of three Fundamental Vulnerability Assessment Courses and two ASSESS courses at the CTA. (LLNL91019-92)

LLNL and SNL taught an ASSESS course for the DoD in Huntsville, Alabama, June 1-11, 1992. (LLNL91019-92)

LLNL coordinated the Institute of Nuclear Materials Management (INMM) Technical Workshop on Physical Protection and Materials Control and Accountability, March 15-18, 1992 in Pleasanton, CA. The workshop's theme was "Safeguards and Security: Threats, Consequences and Performance." Several other laboratories, as well as other DOE sites, presented papers or participated in working group discussions. LLNL also hosted separate, classified meetings following the workshop. (LLNL91019-92)

Mechanical drawings for the portable x-ray fluorescence analysis system developed at LLNL were provided to Canberra Nuclear/Jomar Systems for commercial development of the hardware. (LLNL90035-92)

Computer Incident Advisory Capability (CIAC) presented Incident Handling Workshops at Argonne National Laboratory, The Office of Scientific and Technical Information, and the Mason and Hanger-Silas Mason Pantex Plant. (LLNL92010-92)

CIAC distributed 30 bulletins to the field describing various vulnerabilities to common DOE safeguards systems and detailed procedures to eliminate them. (LLNL92010-92)

Demonstrated the Distributed Intrusion Detection System (DIDS) at the 15th National Computer Security Conference, October 13-16, 1992 in Baltimore, MD. (LLNL90015-92)

Sandia National Laboratory

SNL hosted over 200 attendees at the Physical Protection Technology Update '92, August 11-13, 1992 sponsored by OSS and the Nuclear Regulatory Commission (NRC). (SNL86025-92)

SNL presented its portion of the Central Training Academy's ASSESS class, August 24-September 4, 1992. Assess support was provided to numerous sites, including ORNL, NTS, NRC, and NPR. (SNL86040-92)

Two physical security CRADAs between SNL and commercial vendors were approved. One of the CRADAs was established with IRT to develop and integrate pattern recognition into the low-dose x-ray personnel scanning system. (SNL86025-92)

The Access Delay and Sensors Libraries have been completed. They contain 1,600 and 2,400 catalogued documents, respectively. (SNL86025-92).

CHAPTER 7

PROGRAM STATUS AND CONTENT FOR FISCAL YEAR 1993

7.0 Scope and Magnitude

The FY 1993 Technology Development Program continues to emphasize a balanced program that includes R&D ranging across the major safeguards and security disciplines. Exhibit 4 highlights the OSS Technology and Systems Development budget for FY 1993. The budget values are based on the OSS Financial Plan as of February 1, 1993, and are subject to change during the course of the fiscal year.

EXHIBIT 4

TECHNOLOGY AND SYSTEMS DEVELOPMENT FUNDING ($ thousands)
FOR FY 1993

B&R Code	Subprogram	Funding
GD-06-01	Science and Technology Base	$12,936
GD-06-02	Concept and Demonstrational Development	$6,171
GD-06-03	Full Scale Development	$6,556
	TOTAL	$25,663

7.1 Technology and Systems Development Subprograms

The B&R categories shown above in Exhibit 4 provide the framework for funding R&D efforts as they progress through the technology development life cycle, from basic research to field installation and implementation. (Chapter 3 describes the correlation between the B&R categories and the phases of the technology development life cycle.)

The FY 1993 S&S Technology Development Program is described below in terms of the B&R categories.

- **GD-06-01: Science and Technology Base** -- This area of the Program is the source of new ideas that underpin technological developments vital for sustaining effective S&S. It includes the exploration of new technologies, equipment development, and the engineering and evaluation of commercial components and equipment for physical security, MC&A, information security, and integrated systems.

- **GD-06-02: Concept and Demonstrational Development** -- This area of the Program includes the development of performance criteria, guides and system evaluation methodologies; the performance of system studies and designs related to the integration of physical protection and MC&A subsystems; the integration of facility and detection information systems; the standardization of S&S systems designs; the development of conceptual designs for new processes and facilities; and the development and evaluation of additional S&S elements, such as human interfaces and transportation.

- **GD-06-03: Full Scale Development** -- This area supports testing, demonstrating, and evaluating S&S systems and approaches in actual DOE operating facilities. It includes facility process modeling and design testing, field consultation, and the demonstration of advanced systems. Emphasis is placed on technology transfer efforts and training courses to ensure that the results of OSS-sponsored onsite test and evaluation activities are shared with the widest possible audience within the DOE complex.

7.2 Summary of FY 1992 Program Content

The following is a summary of major activities within the FY 1993 Technology Development Program. These activities are listed according to the TSD numbers outlined in Figure 1. Following each description of an activity or activities, a unique identification number for the corresponding laboratory task is shown in parentheses. Appendix C lists all the tasks which comprise the FY 1993 Program by task identification number.

A. GD-06-01 Science and Technology Base

1. Physical Security

a. Detection

Based on FY 92 user need statements, Sandia will test and evaluate sensors and continue to assist the field with the design, procurement, installation, testing, and evaluation of exterior intrusion detection systems. The commercial market will be continually monitored for new and useful exterior sensor technologies. Detection sensors will focus on application needs for the changing DOE complex (e.g. facilities moving under EM) of today and the future DOE complex (i.e. Complex 21). (SNL86001-93)

Based on FY92 user need statements, Sandia will continue to assist DOE Sites with interior sensor technology information, design, installation, procurement, testing and evaluation. The commercial market will be continually surveyed for new and useful sensor technologies. Fiber optic sensor technology will be emphasized. New sensors which appear to be promising will be tested and reports written on the results of these evaluations. Improvements to sensor design, combining sensor technologies, and application of piezo film technology will be investigated for possible development.

a. Detection (Continued)

A newsletter will be distributed to sites to increase communication and response to immediate user needs. (SNL86002-93)

Monitoring of existing and emerging technologies will be continued as will activities that were initiated in FY92. The capabilities of remote airborne alarm assessment platform will be extended to include night vision devices and this concept will be presented to potential users to obtain feedback and determine practicality. The firearm control system investigation will proceed with further development testing. Advance the development of the neural network processing for sensors to characterize the performance for various scenarios and assess the feasibility of applying technology to the existing or future DOE complex. Develop complex reconfiguration security system concepts and analyze merits. Develop concepts for monitoring human operations using physiological monitors, image processing, and virtual reality systems. (SNL87004-93)

Receive answered questionnaires from sites. Determine which sites have a need for early warning systems. Perform interviews at DOE sites and field offices to complement and clarify questionnaire responses. Publish a report on DOE-wide early warning systems requirements. Begin a market search for systems which may serve as early warning systems at DOE sites. Complete testing for the Motorola Modular Surveillance Radar (MSR-20) and write a report. Devise conceptual modifications to the MSR for use at DOE facilities (if necessary) and determine the requirements for a companion assessment system. Monitor development of new technologies applicable to early warning. Review new technologies with OSS and identify those that meet the early warning requirements. (SNL89034-93)

1. Formally document the results of the FY 92 effort on Advanced Alarm Multiplexed Communication Systems (AAMCS) so that the work conducted will be available to future efforts. 2. Define and document for use by the DOE community the Enhanced Line Supervision (ELS) activities from FY 92 such that others can capitalize on this work and know how to implement and obtain the needed components. 3. Complete the Personnel and Material Tracking System (PAMTRAK) Independent Vulnerability Analysis (IVAN) and the specification on software analysis tools begun under the canceled software security initiatives task (SNL90041-92). 4. Develop concepts for non-human testing/maintenance of the various devices used in vaults in order to minimize personnel presence in the vaults. 5. Provide contributions to DOE policy implementation and standardization manuals. Issues related to line supervision, testing, and COTS equipment will be addressed. 6. Expand the previous insider tampering study to include 1) a categorization of the insider

a. Detection (Continued)

capability and needs to accomplish a particular tamper attack vs. the feasibility of such tampering attacks and 2) a risk analysis for the more feasible tamper attacks. (SNL89037-93)

1. Execute a joint development contract with subcontractor for hardware development for Eyesafe Field Prototype Laser Subsystems. 2. Establish Quality Review and Work Progress Review procedures between SNL and contractor. Develop accountability matrix and schedule Quality Review and Work Progress meetings. 3. Review and finalize Project Plan. 4. Complete software modifications for Image Processing Subsystem then install and test within host computer. 5. Complete software modifications for Communications Interface then install and test within host computer. 6. Review performance data for key hardware components within laser subsystems for Eyesafe Field Prototype. 7. Conduct preliminary design review for Eyesafe Field Prototype. Evaluate and propose necessary changes to design. 8. Conduct Eyesafe Field Prototype final design review for acceptance and necessary modifications to complete quality assessment and work review. 9. Perform performance modeling for final design of laser subsystems and review with contractor. (SNL90055-93)

Activities in FY93 include refining the conceptual design and building the Automated Sensor Testor (AST). Once built, the prototype will be tested to determine if it meets the requirements of the Statement of Work (SOW). The results of the testing will result in further refinements that are needed in the design. Investigations will begin on interfacing the AST to the exterior microwave sensor. Also, another sensor will be selected for future application. This sensor will require some test target testing by the Exterior Sensor Division. R&D will begin on the technology areas determined to be critical. (SNL92068-93)

b. Assessment

1. Perform market survey and evaluate selected solid state frame recorders. 2. Complete evaluation of interior Video Motion Detectors (VMDs). 3. Complete a feasibility study for the development of an efficient IR area lighting source and also consider the lifecycle cost and performance benefits of an IR area lighting source and intensified Closed Circuit Television (CCTV) camera (VS) currently used visible lighting and CCTV cameras, (VS) emerging low cost uncooled thermal imagers. 4. Develop test procedures and equipment requirements for site video and lighting performance tests. 5. Perform site consultation for video assessment at DOE sites. (SNL86009-93)

b. Assessment (Continued)

1. Develop improved image processing algorithms and implementations for: a) two-person rule monitoring, b) recognition and inventory of SNMs, c) change detection in static and dynamic scene environments, and d) integrity verification and inventory of containers holding SNMs. 2. Develop a flexible software structure that will enable each image processing system to operate independently or as a subsystem of PAMTRAK. 3. Integrate image processing systems with PAMTRAK. (SNL88013-93)

1. Conduct a functional requirements study that addresses integrated alarm annunciation and entry-control minimum and application requirements which are appropriate for adoption within the DOE community. The final products will serve as input to the "standardized operational, maintenance, test and procurement documentation" task and will help fulfill the documentation requirements established by that task. This effort will capitalize to the maximum extent possible on work, experience, and lessons learned under the FY 92 standardized badge and interfacility compatible access control task. 2. Conduct a commercial vendor survey of integrated alarm annunciation and entry control systems functional parameters, resulting in a capabilities analysis/report. 3. Begin evaluation of a carefully selected commercial vendor(s) in order to improve the functional requirements, and validate that a commercial source can meet the requirements. (SNL86014-93)

c. Delay

1) Engineering design and construction of first generation detection system prototype based on detection limit evaluation. 2) Field test the prototype light source/NOx detector system as a method of detecting trace amounts of HE on people and on packages. 3) Complete any necessary modifications to the field prototype portable detector as determined from initial field testing. 4) Completed the packaging of a field portable prototype detector for RDX, PETN, HMX, TNT, Ammonium nitrate, etc. 5) Prepare preliminary documentation necessary to transfer this technology to private sector. (INEL91001-93)

1. Consult with DOE facilities on access delay and physical security systems as required. 2. Investigate hardware and procedural fixes for cold smoke generators. This task may include field refurbishment options, hardware redesign for new generators/rebuild, preventive maintenance procedures, and possible review of the Advanced Smoke Generator design for additional development. 3. Perform a market survey on security containers, combination locks, locking devices, and key management techniques. (SNL86005-93)

c. Delay (Continued)

A variety of methods, including databases and expert systems, will be explored as ways to help analysts determine what delay values to use and to document the assumptions of these estimates in their vulnerability analyses. Existing DOE and DOD databases will be reviewed to see what changes and/or additions will allow DOE field personnel to use them more effectively. An expert system that field users might use for assigning delay times will be developed in the prototype stage. A tutorial will be prepared to help users document their delay estimates. (SNL93103-93)

d. Entry/Exit Control

In order of priority: (1) Establish a contact in private industry and attempt to develop a commercial source for this technology. (2) Prepare preliminary documentation necessary to transfer this technology to private industry. (3) Begin operational testing of the entire system. (4) The targeted daughter ion mode of operation using random noise excitation will be evaluated for application to the ion trap explosives detector. (5) A new ion source of geometry will be constructed and incorporated with the ion trap. (6) Sampling/preconcentration systems will be interfaced to the ion trap-based explosives detector and evaluated in an operational setting. (ORNL86001-93)

1. Conduct and document performance evaluations of biometric identity devices. 2. Perform and document vulnerability studies of biometrics identity devices. 3. Continue to keep up with the state-of-the-art in automated entry control hardware and concepts, to include biometrics identity verification, entry control booths, and turnstiles. ((SNL86006-93)

1. Develop and execute a plan that will lead to the establishment of a minimum threat quantity. This process should be defendable and provide a minimum quantity and type that should be detected at DOE facilities. The process shall include defining the consequences to be prevented and include working with select DOE facilities. The process shall include defining the consequences to be prevented and include working with select DOE facilities. This effort shall also use the results of the DOE explosive detection survey. 2. Based on the results from item 1 above, prepare a minimum performance specification for bulk and vapor detection systems. 3. Complete the development of a vapor generator that will permit the quantitative evaluation of current and future explosive detection technologies. 4. Conduct technical evaluations of commercial vapor and bulk detector subsystems. Where possible use data generated by other organizations. 5. Work with DOE facilities and analyze their individual explosive detection needs relative to the minimum

d. Entry/Exit Control (Continued)

quantity and type defined in step 1. 6. Continue to develop an explosive detection database that considers costs and benefits/performance by consulting with other government agencies and commercial vendors. 7. Continue to develop and test explosive detection components for a personnel booth that will provide the capability of detecting the more sophisticated explosives, i.e., RDX, PETN, C-4, Detasheet and Semtex. (SNL90073-93)

1. A strong technology base will be maintained through use of the dedicated Contraband Detection Laboratory. Significant results will be transferred to DOE facilities as they become available. 2. Continue to work with industry on metal detector and other contraband detection equipment upgrades to improve performance and reduce vulnerabilities. 3. Develop a method for performing a threat analysis for protracted theft of SNM from MAAs to be used in the establishment of SNM shielding test object standards. 4. Perform a field test of a metal detector using statistical process control methods for monitoring detector performance. 5. Expand the use of statistical process control methods developed for field performance testing of metal detectors to the testing of other types of sensors. (SNL90074-93)

1. Begin documentation for proof-of-principle Intelligent Facial Recognition System (IFRS). 2. Evaluate the performance of the proof-of-principle IFRS in a controlled laboratory environment for an entry control application. 3. Begin evaluation of the IFRS in a "real" environment such as in parallel with a Mardix booth. (SNL91075-93)

e. Response

1. Review DOE Orders dealing with protective forces to identify requirements and evaluate security benefits of implementation. 2. Develop a model of protective force function. 3. Use a DOE site as a prototype against the model. 4. Analyze basic functions and technological alternatives for meeting the associated security requirements. 5. Identify the most profitable activities from the model to improve via technological changes. 6. Identify any obvious procedural enhancements to improve security. 7. Analyze cost-security benefit for those activities and procedures and make site-specific recommendations. 8. Establish requirements for the most cost-effective solutions. (SNL92079-93)

f. General

The airborne monitoring analysis will be conducted, validated, documented, and subsequent report completed and delivered to DOE Headquarters. Airborne monitoring will occur during the DOE day and night qualification courses. Monitoring will be conducted on personnel conducting the firing, range staff, bullet trap areas, and exhaust systems on indoor ranges. Additionally, monitoring will include weapons cleaning activities following all testing phases. Firearms used in the testing will be new firearms that have been test fired with less than 100 rounds of ammunition. (MMES93004-93)

1) Investigate the technical issues associated with the development of Controlled Penetration Ammunition (CPA), Limited-Range Training Ammunition (LRTA), and Non-Toxic Training Ammunition (NTTA). Continue current efforts for identification of mechanisms and materials which may offer solutions to the penetration, range, and toxicity issues. 2) Recommend a programmatic approach for development of specialized ammunition. 3) Represent DOE interests within the ammunition production community. 4) Initiate technology transfer of relevant findings to encourage commercialization. (SNL93118-93)

2. Material Control and Accounting

a. Measurement

Develop work plan in cooperation with the originators of User Need RL001-93 and potential users elsewhere in the DOE complex. Design, develop and evaluate a prototypical simulated source. Prepare a technical report which documents the theoretical principles, experimental results, and characteristics of the prototypical simulated source. (BNL00017-93)

Develop new neutron and gamma-ray Non-Destructive Assay (NDA) instruments and techniques that provide safeguards against insider threats and meet the need for near-real-time accountability by providing better assay accuracy and the ability to measure new material types. NEUTRON ASSAY: Provide safety upgrades to the experimental shuffler hot cell, and continue shuffler development studies with the hot-cell shuffler. Investigate the use of delayed neutron and gamma-ray data and the use of multiple-energy neutron interrogation for matrix corrections, and report on shuffler U-235 assay in varying isotopic mixtures. Begin evaluating the ability to determine (alpha, n) rates for impure Pu using energy-insensitive counters. Begin detailed measurements of impure Pu oxide using passive neutron multiplicity techniques, and document the precision of the active neutron multiplicity for the assay of large U metal

a. Measurement (Continued)

masses. GAMMA-RAY ASSAY: Begin investigating x-ray signatures for solution assay and for flagging particulate forms of uranium to obtain better material accountability. Develop applications of Pu concentration measurements for low-level solutions, and begin investigating the self-fluorescence efficiency of the Pu isotopes. Begin extending the hybrid (K-edge/XRF) technique to solutions of other nuclear materials. Begin a Segmented Gamma Scanner (SGS) drum measurement series to evaluate the performance of matrix corrections, and report the status of existing corrections for variable lump sizes and for end-effects. Develop ES&H procedures for the handling of SGS standards in the safeguards laboratories in accordance with DOE orders. Evaluate the feasibility of hybrid tomographic/segmented gamma-ray scanner. (LANL86003-93)

Evaluate the Segmented Flow Analysis (SFA) automated instrument for spectrophotometric measurement of Pu in chloride, establish measurement precision and accuracy on standards and chloride process samples. Identify possible chemical and physical interferences in chloride samples, and determine and implement procedures for overcoming them. Continue evaluation and development of fiber optics for use with SFA and micro-flow cells. Evaluate discrete systems for automated spectrophotometric measurement of Pu. Maintain technical exchanges and participate in measurement control programs as appropriate. Develop chemical assay methods for nuclear materials as requested by the DOE. Develop techniques for characterizing and packaging reference materials. (LANL86004-93)

Continue evaluation and development of new neutron and gamma-ray detector technologies for fixed, portable, or unattended operations, such as thermal and fast neutron multiplicity counting, energy-spectrum-independent neutron detectors, and portable compact neutron counters and gamma-ray multichannel analyzers. NEUTRON ASSAY: Complete the physics design of a neutron multiplicity counter for bulk scrap containers, and incorporate multiplicity physics algorithms and data processing into the neutron coincidence counting (NCC) software package. Complete the software code and user's manual for an add-a-source neutron coincidence drum counter version of the NCC code. Begin investigating the application of DT and DD neutron generators for safeguards assay. Report the status of the application-specific integrated circuits (ASIC)-based combined multiplicity/shift register electronics. Design a prototype portable neutron coincide counting electronics. GAMMA-RAY ASSAY: Develop a hybrid segmented gamma-ray scanner (SGS)/far-field boxed waste assay system for the assay of multiple isotopes. Complete the physics, mechanical, and electrical design package for a tomographic segmented gamma-ray scanner instrument, and prepare a design package for an in-plant hybrid (K-edge/XRF) solution assay instrument. Complete the

a. Measurement (Continued)

upgrade of the PMCA amp/ADC for high-count-rate Pu isotopics spectra. Report the status of the electrically-cooled Ge detector for total Pu or isotopic determination with the Inventory Verification Sample Counter (INVS). OTHER: Continue to improve software and electronics for NDA instrumentation, including investigation of new integrated circuit technologies. (LANL89030-93)

Develop and evaluate promising new detector and measurement technologies for holdup, confirmation, verification, and waste assay or screening applications. Evaluate integrated coincidence counting hardware for the new compact neutron detector, and begin the design of a neutron monitor for materials control in plutonium metal preparation line. Provide the design and assembly of an automated portable holdup measurement system using a personal computer-based multichannel analyzer, and begin evaluating the application of commercial portable x-ray fluorescence (XRF) systems for the confirmation of waste containing actinides. Begin applying neural networks to pattern recognition for low-resolution gamma-ray-based analysis. Begin integration of neutron multiplicity counting circuitry into the active/passive shuffler, and begin evaluation of the delayed neutron multiplicity signal as a flag for shielded uranium. Report on the diversion sensitivity of Cf-252 shuffler-based active neutron systems, and draft a preliminary report on the use of shuffler neutron activation analysis to provide matrix correction factors and diversion flags for waste drums. Develop a source/shield combination to test the diversion detection capability of active/passive nondestructive assay systems. (LANL89031-93)

Perform computer simulations and develop new data analysis algorithms to improve NDA assay accuracy and extend assay capabilities to other SNM categories. Begin evaluating multiplication and capture corrections for active neutron coincidence counting, and report on the development of algorithms to combine active/passive neutron coincidence counting of high-mass,impure plutonium samples. Complete the evaluation of a neutron coincidence drum counter that uses the add-a-source technique to study diversion sensitivity, and investigate design and data analysis techniques to reduce background for low-level neutron waste screening. Prepare an outline of a manual on the neutronics design of polyethylene-moderated He-3 neutron counters, and begin Monte Carlo calculations for Pu assay using Intrinsic Neutron Resonance Densitometry. Develop decision algorithms for combined neutron coincidence counter/segmented gamma-ray scanner assay systems, and report on them. Begin developing data analysis algorithms for a hybrid tomographic/segmented gamma-ray scanner. (LANL90039-93)

Continue development of NDA techniques for MC&A of heterogeneous and variable matrix plutonium materials.

a. Measurement (Continued)

Demonstrate expanded Multiple Group Analysis (MGA) code to assay solutions for plutonium concentration. Begin demonstration of and continue to develop second generation actinide analysis system. (LLNL88002-93)

Determine optimum spatial resolution and contrast sensitivities measurable. Identify parameters affecting trade-off between measurement time and accuracies achievable. Continued Monte Carlo modelling to optimize experimental parameters. (LLNL91018-93)

Empirically determine those parts of a detector response that cannot be calculated and start to incorporate them with the Monte Carlo transport program. Compare calculated spectra with measured characteristics and start to test data analysis methods and determine systematic biases. Use the calculated spectra with various isotopic analysis codes to test feasibility of calculational "standards". (LLNL88035-93)

The bias between the principal accountability measurements for impure tritium will be quantified. The experimental plan to identify the sources of the biases between the principal accountability measurements used for pure and impure tritium will be developed. The initial field test of the ultrasonic confirmatory technique for tritium in weapons components will be documented. A more quantitative ultrasonic measurement technique will be developed for tritium items. The calorimetry training for tritium would be offered for the first time at Mound. Infrared imaging will be used as a confirmatory technique for tritium containers stored in vaults at Mound. (MD88001-93)

The technique of adjusting the operating temperature of a servo control calorimeter to the measured item will be tested. Tests of the gamma-ray data acquisition and analysis techniques for use with waste drums containing heterogeneous materials will be completed and the results documented. Projects to develop a calorimeter for items the size of drums (30 gallon or more) and a robotic loader for a generic calorimeter will continue. For both projects, fabrication will be completed and performance tests initiated. Continuous improvement of calorimetry and gamma-ray measurement techniques will be a priority. This activity would include integration of modifications in analysis codes identified in ongoing measurement programs and the migration of codes to newer computer platforms, including IBM-compatible personal computers. This includes converting the calorimeter operating system into a C-language program for a personal computer (PC) and installing the FORTRAN version of GRPAUT on a personal computer. Several new projects will be initiated during FY 1993. In response to identified users needs regarding gamma-ray spectroscopy, the computer code

a. Measurement (Continued)

GRPAUT will be modified for the analysis of 237Np in plutonium samples and the analysis of 234U/235U for use in the calorimetry of highly enriched uranium. An investigation of the use of the gamma-ray imaging device as a sample "fingerprinting" will be initiated. Calorimetry projects that will be initiated during FY 1993 include implementing a Proportional Integral Derivative (PID) controller to control the temperature of the calorimeter allowing for faster and more precise measurements. In response to requests from other DOE sites, two additional calorimetric projects initiated in FY 1993 are the material studies required for the development of a calorimeter for high (200-1000W) wattage samples and the development of an air bath calorimeter designed for glovebox use. The viability of a measurements parameter database for possible quantification of confirmatory measurement will be demonstrated. (MD88002-93)

c. Control

Continue developing portal monitor technology, techniques to verify nuclear devices, and package monitoring methods, and continue assisting DOE facilities with effective application of portal monitors. Complete survey of SNM monitoring practices at DOE facilities to determine the status and needs. Begin evaluating the final version of the newly developed TSA Systems, Ltd, MCA465 gamma-ray confirmation instrument. Publish report on experiments with the list-mode multiplicity module, and complete an operations manual for it. Complete testing and demonstration of tomographic gamma-ray scanning units. Evaluate and report on the needs and scope of a proposed applications guide to package monitoring. (LANL86001-93)

Continue to define and develop materials control components and subsystems, with particular emphasis dealing with the insider threat and integration with other safeguards subsystems. Emphasize development of image processing technologies that can reduce personnel resources for vault inventories, daily administrative checks, etc.; reduce personnel radiation exposures; and improve timeliness of anomaly detection and anomaly resolution for unauthorized insider actions. Begin developing a conceptual design for a computer integrated system of materials control elements. Begin integrating multi-media methods into image-surveillance systems. Continue developing new image processing software. (LANL88002-93)

1. Keep current on the status of seals usage and applications at all DOE nuclear facilities. Identify seals with potential for application within the DOE complex. 2. Based on facility needs, select newly

c. Control (Continued)

available seals for evaluation which may be applicable to these needs. 3. Test these selected seals to the standard criteria developed in FY92 and provide a report on the results. 4. Initiate development of concepts for new seals and/or adaptations of seals currently in use. (SNL91076-93)

Create a manual approach for finding industrial radiological and toxicological sabotage targets. Investigate the usefulness of fault tree software, such as SETS, for the identification of radiological sabotage targets. (SNL92083-93)

1. Identify, characterize, and quantify the trade-offs associated with the use of several advanced technologies to provide real-time information on nuclear materials in storage to support decreasing the frequency of inventories conducted by humans. Technologies to be evaluated will include: shelf monitoring systems, robotics, remotely-read signals (radio frequency, infrared, etc.), neuron-based products, and data input devices (movement sensors, barcode readers, radiation and weight measuring devices, video signals, etc.). 2. Assemble and initiate testing on at least one prototype of a system to achieve high confidence in such material control technology. (SNL93114-93)

d. General

Neural Networks: evaluate appropriate data to be used in neural network modeling of MC&A systems. Evaluate a number of different models and architectures for performing the neural network modeling and select one or more that perform best in the general anomaly detection environment. Work with Hanford personnel to periodically review the design and development of Local Area Networks Material Accounting System (LANMAS). Develop documentation for the distributed accounting system, LANMAS. (LANL86006-93)

Continue to enhance the technology for design/evaluation of MC&A systems. Apply concepts from multi-objective optimization and fuzzy analysis to safeguards tradeoffs involving detection probability, timeliness, and system cost. Implement the fuzzy resource allocation program that models non-statistical uncertainties system performance. Begin modifying THIEF to enhance its use in vulnerability assessment. (LANL86007-93)

3. Information Security

a. Automated Information Security Systems

Development and field testing of new software modules will continue during FY 1993. Integration with the Distributed Intrusion Detection System (DIDS) will enhance widespread application of both DIDS and SPI/UNIX. Continued work on the user manual for SPI/UNIX and other software documentation will be done as work progresses. Feedback from field organizations will assist in the process of making further improvements to the existing software and expansions to the capabilities of the SPI/UNIX system. (LLNL90011-93)

Development and field testing of the new software modules will continue during 1993. Integration with the Distributed Intrusion Detection System (DIDS) will enhance widespread application of both DIDS and SPI/VMS. Continued work on the User Manual for SPI/VMS and other software documentation will be done as work progresses. Feedback from field organizations will assist in the process of making further improvements to the existing software and expansions to the capabilities of the SPI/VMS system. (LLNL00012-93)

Investigation into issues surrounding viruses and other malicious code with respect to operating systems for both small and large-scale systems. Continued investigation into real viruses or other malicious code which appear at DOE sites. Expansion of the project to include development of software to perform testing for insecure code (e.g., intentional trap doors, unintentional security-related coding errors, etc.) Continued research into long-range solutions to the problems of the detection of viruses, the prevention of their introduction into DOE systems, the appropriate eradication methods needed to remove them when they do occur, and review of current software made in the commercial sector that supports to accomplish some of these tasks. Outreach programs to instruct DOE sites on how to handle computer virus incidents, primarily through the Computer Incident Advisory Capability. (LLNL90014-93)

Finalization of initial 'thumb print' development and proof of concept testing a means of characterizing traffic in a manner for improved detection but limits privacy concerns. Continued development of the basic Network Security Monitor (NSM). New types of attack signatures will continue to be added to the basic package. Development of a low cost monitor. Currently NSM is based on a Sun platform. FY 93 activities will develop NSM software for a platform in the $1000-$1500 range. Extensions to other types of networks. NSM currently only works on TCP/IP packet switched

a. Automated Information Security Systems (Continued)

networks and will be ported to DECnet. Further integration of NSM and DIDS will be accomplished. (LLNL90015-93)

Planned activities include: Expansion of the audit protocol to fully incorporate all network management functions and define a Management Information Base (MIB) which represents the events to be audited. Examination of intrusion detection systems (e.g., DIDS) such that the distributed auditing system will operate with any intrusion detection system. Continuation of research into auditing issues and inclusion into distributed auditing standards. Continued development of a prototype distributed auditing system. (LLNL90017-93)

An analysis of the DOE computer environments hosting data management systems will be performed. A guideline(s) will be developed for the application of security procedures in DOE and DOE contractor computer environments hosting data management systems. (MMES92007-93)

To develop mechanisms, techniques, and/or procedures to be able to protect a classified AIS running at the Secret level while processing classified information in an unattended mode. This may entail running in a protected environment (DOE Property Protection Area) where Q cleared people may be present. It may be in a protected environment with lower clearances (L cleared) are present. This can include electronic touch alarms, destruction of classified data, proximity alarms, intrusion alarm that enunciates in a central alarm facility, vibration alarms, or infrared alarms. It must provide comparable protection to a volumetric alarm of a vault type room. It must cost less than $500 per workstation to implement. (SNL93116-93)

b. Classified Matter Protection and Control

To continue to enhance the Classified Document and Control System (CDOCS) concept. This enhancement includes: 1. a. Provide a trusted interface to the network. The interface must provide labels on each document transferred across the network. The interface must be tested and certified that users on the network can only retrieve documents from CDOCS, and that users cannot modify the software or change labels on the document while logged onto the CDOCS. Copies of the test plan and test results will be included in this effort. 2. Providing, at the end of this project, the following so that maintenance can be supported by organizations other than SNL: a. Documentation on all locally developed software. b. Documentation on all off the shelf software. c. Documentation on all hardware. (SNL86007-93)

5. Integrated Systems

b. Systems Integration

1. Investigate developing a personnel tag system that has an adjustable detection capability for use in the PAMTRAK systems. 2. Incorporate the improved tamper protection scheme into a prototype personnel tracking tag. 3. Select and evaluate a new movement sensor for WATCH applications. 4. Continue to identify, procure, and evaluate new technologies which can assist in mitigating insider threats and activities. (SNL86018-93)

Begin the design of the integrated and independent system as described above. Demonstrate the capability to have different processes running on the same machine or running independently and communicating intertask between different machines on a network. (SNL93098-93)

B. GD-06-02 Concept and Demonstrational Development

1. Physical Security

a. Detection

Continue to assist in determining the site's documentation needs for intrusion detection systems. Based on the user needs, develop plans to provide solutions to those needs that most benefit the entire DOE complex. This would include selected testing, documents in the form of handbooks, or development of test equipment and procedures. Provide resources for field assistance if requested. Develop maintenance guides and standard test procedures for selected safeguards and security system components. (SNL90062-93)

b. Assessment

1. Complete work on integration, testing, and documenting of Closed Circuit Television (CCTV) Subsystem expert system. 2. Complete feasibility study for enhancements to CCTV subsystem expert. 3. Identify and initiate additional expert system applications. 4. Support product (SENLEX - SENsor Layout EXpert system) currently in the field. 5. Begin coordination with the Central Training Academy (CTA) according to a plan negotiated with SA-134 and CTA. (SNL86019-93)

b. Assessment (Continued)

Continue final engineering of hardware and facility designs that can easily be assimilated by DOE facilities and commercial vendors. Continue to support facilities in utilizing the engineered hardware and designs. Complete engineering development of line security technology for transfer to DOE facilities. Assist sites with implementation of RAMS. Design and demonstrate a prototype communication bus that provides a cost-effective means for communicating all security video and alarm information on a single line. Investigate technical feasibility for achieving cost-effective video compression at a chip device level. (SNL87021-93)

1. Superman will be completed and provided to the SCCS user sites and support will be given to them in the form of installation and training to assure a successful transition. 2. The reengineering tools may be applied to other parts of the existing software to determine the reusability of additional code. 3. Recommendations for the implementation of CG-SS-2 in security systems will be completed. (SNL87022-93)

d. Entry/Exit Control

The activities are in three areas. The first is to enhance Argonne Unified Safeguards (Argus) to a point that is judged to meet all DOE security requirements, the second is to seek public sector companies willing to accept this technology and enter into discussions aimed at transferring the technology, the third is to support SA-10 efforts to evaluate new Smart Card technology. ARGUS ENHANCEMENT: This effort is intended to demonstrate compliance with current DOE orders and enhance the Argus system to bring it in line with the latest DOE security orders. This should make it more appealing and immediately usable by potential commercial transferees. These activities include an Argus compliance evaluation, implementation of two-person rule in the Access control system, and evaluation of the fielding of the DOE selected 3-D hand geometry biometric reader in the Argus access control system. SA-10 will participate in the evaluation of Argus compliance. TECHNOLOGY TRANSFER: These activities include the generation of technical information describing the Argus system to potential transferees, briefing and touring interested parties, and negotiating and executing agreements for the formation of Cooperative Research and Development Agreements (CRADAs) and licenses. There will also be interaction with DOE to identify and address any security concerns arising from the transfer of Argus technology. SMART CARD EVALUATION: LLNL will participate in the evaluation of a Smart Card system to transfer DOE clearance information. This will be done as an option to streamline the classified visit process. Specific activities are: 1) Identify

d. Entry/Exit Control (Continued)

commercial vendors that are capable and willing to accept the transfer of the ARGUS technology and will provide a useful product offering in the government or commercial sector. 2) Develop and present material describing Argus to invited interested companies to develop technology transfer interest and to provide a fair opportunity for interested vendors. 3) Develop an Argus/DOE Order compliance matrix. 4) Provide technical consultation and documentation to allow selected commercial vendors to attain a level of expertise sufficient to make a proposal. 5) Modify ARGUS so that it can be used to enforce the two-person rule, and document the modifications. 6) Evaluate the fielding of the Recognition Systems 3-D hand geometry readers in one building at LLNL. Two Enrollment stations will be fielded to allow enrollment of a test population. Two operational CAIN booths will also be upgraded to accommodate the hand geometry biometrics device. The system will be tested by requiring selected building occupants to pass through one of the biometric booths in order to gain access to the building. A report outlining the results of the test will be generated. 7) LLNL will participate with the SA-10 effort to evaluate the use of a Smart Card for the transmission of clearance information to a site being visited. Using SA-10 selected equipment and SA-10 supplied software and procedures, LLNL will participate in the clearance transmission system between LLNL and other selected sites. (LLNL93003-93)

Classified Visit Procedure Improvement Project: The first project in the streamlining of the classified visit process is to incorporate the use of the CPCI clearance system into the process of accepting visitors on the sites. With access to the CPCI system and modifications to local site visit procedures, it will be possible to handle classified visits without requiring the 5631.20 form for visits of DOE employees at the level of SRD/NWD, or lower in the case of the visitor originating at a non-weapons data site. As part of this work proposal, LLNL will undertake the task of providing support for DOE/HQ in the definition and implementation of this new approach to visit control. Activities will include identification and definition of required policy and procedure changes, and preparation of a LLNL implementation plan for changes. The approved plan and new visit procedure(s) will be implemented at LLNL to handle DOE visitors, and to review, test and validate the new procedures and policies identified by DOE/HQ and validate their practical operation. Once the concept has been tested and validated, it will be implemented at all DOE sites, and we will prepare detailed training materials to facilitate the implementation and assist in implementation. Visitor Biometric Verification Project: This project would consist of investigating a method of using the hand geometry biometrics device to help provide positive identification of visitors to the sites. An initial investigation would be done to determine the feasibility of using the DISS computer system to store and deliver biometric data

d. Entry/Exit Control (Continued)

to site visitor control. This investigation would result in a requirements document and design demonstration system that would be implemented to prove the feasibility of the concept. DISS Communications Security Analysis Project: The purpose of this project is to provide an analysis of the DISS computer system, identify needed improvements, and recommend equipment and procedures that will meet these needs. The product of this project will be a report analyzing the DISS communication security situation and presenting the recommendations for needed improvements. The findings of the analysis will be demonstrated. Clearance Transmittal Network Project: A microcomputer based system identified as "DTMS" has been assembled by PNL as a demonstration of a possible solution to the problem of transmitting clearance information to the sites for visitor verification. We will analyze DTMS and provide a report identifying positive and negative aspects of using such a system in the visit process. The analysis should determine the potential impact that the system would have on DISS, and consider the integration of a smart card into the system. (LLNL93008-93)

1. Perform detailed evaluation of one carefully selected commercial vendor system in order to develop and document the most effective approach to evaluating such systems and comparing this information against experiences gained during CAIN evaluations. NRF, Pantex, Mound, Y-12, and others could benefit from this work. Employ this information to supplement a new separate FY93 program request requiring all sites planning to acquire or modify access control systems to either buy only from a Sandia approved list or employ Sandia as their procurement agent. (SNL89038-93)

Based upon the functional requirements developed by OSS appointed WG's, design and implement a system to electronically transfer personnel clearances and facility visit requests at four program pilot sites initially, and evaluate the system performance. Based on the evaluation, provide assistance in the implementation of the system complex-wide. (SNL93100-93)

2. Material Control and Accounting

a. Measurement

Continue to upgrade NDA standards for the safeguards R&D program and for operational materials accounting. Continue the evaluation of standards for other nuclear materials. Evaluate Pu drum standards for 55 gallon drums, and specify a set of dry, pure MOX standards for the calibration of neutron coincidence counters. Begin

a. Measurement (Continued)

developing methods to estimate NDA measurement errors, and begin investigating neutron multiplicity ring ratios for assay measurement control. In support of DOE orders on radioactive materials control and conduct of operations, generate an inventory and registration record of Safeguards Assay sources and SNM standards. Draft an ASTM Standard Test Method on passive/active neutron (PAN) assay of waste using californium shufflers. Participate in measurement round robins, as appropriate, and in the preparation and review of ANSI and ASTM consensus standards. (LANL86005-93)

At Savannah River: provide active-well coincidence counter (AWCC) standards and calibration support for Receipts Assay Facility startup. Begin Testing and Evaluation (T&E) of the hybrid SGS/far-field boxed waste assay system. Begin investigating the simultaneous determination of total Pu and isotopics using segmented gamma scanner (SGS) data. Provide an SOP for drum conveyor operation of the pass-through shuffler for uranium scrap and waste, and begin facility T&E. At Los Alamos: install the hybrid (K-edge/x-ray fluorescence) solution assay instrument and report the status of the instrument for Pu concentration in solutions enriched in Pu-242. Begin T&E of the multiple-slab detector system for the assay of Pu-bearing low-level waste, on facility evaluation of an in-line neutron coincidence counter (NCC) for the assay and report of molten-salt-extraction pyrochemical residues. Report the status of the T&E of the active/passive neutron coincidence counter for mixed U/Pu materials. At Portsmouth: perform T&E of the active/passive barrel shuffler for HEU diffusion wastes. Provide safety manuals and procedures for robot control of solution assays of U-235 and total uranium. At Livermore and Hanford: provide consultation and support on new nondestructive assay systems for scrap and waste. (LANL86015-93)

Develop and test improved holdup analysis algorithms and incorporate them into software holdup programs to automate holdup measurements and data analysis. Test methods to quantify holdup in decontamination recovery operations of nuclear materials processing equipment. At Oak Ridge: begin evaluation of new handheld miniature multichannel analyzer (MCA) for in-plant holdup measurements and interface to bar-code readers. Begin in-plant evaluation of a compact electrically-cooled Germanium detector with the new hand-held multichannel analyzer. Evaluate low-burnup MOX fuel rods as reference materials for facility calibration of holdup measurements. Provide draft manual for in-plant use of generalized-geometry holdup software, and evaluate the feasibility of the glovebox holdup measurement system for experimental cascade dissolver. Provide Standard Operating Procedure (SOP) for in-plant measurements of experimental cascade dissolvers. Provide SOP for implementation of in-line neutron monitors for automated materials control. (LANL86016-93)

a. Measurement (Continued)

Continue to identify, develop, and demonstrate confirmatory measurement and inventory verification methods in operating facilities. Complete an evaluation of Combined Thermal and Epithermal Neutron (CTEN) or alternative methods for detecting concealed SNM in packages and containers and prepare a report. Begin developing variable background and source position corrections for waste confirmation. Complete adaptation of the FRAM isotopics code to mobile/PC applications for at-line verification of Pu. Extend the shipper/receiver confirmatory system (SRCS) to in-house inventory verification, and report progress on the extension of the system to other U fuels and enrichments. Provide a preliminary report on the performance of the INVS-III inventory sample verification counter on small Pu samples. (LANL86019-93)

b. Accounting

At Savannah River: complete development of generic interface software to adapt Materials Accounting with Sequential Testing (MAWST) to additional process areas, and begin applying generic variance propagation software to other process areas. Begin investigating a redesign of Nuclear Materials Accounting System (NucMASloe) using object-oriented analysis, design, and database concepts to develop the next generation of NucMASloe for advanced MC&A systems. Investigate X-Window System, Interviews Toolkit, and similar products for graphical user interfaces to facilitate user interaction with the next generation variance propagation program. Investigate generalizing the NucMASloe user interface for use with MC&A system other than NucMAS (LANMAS and ARGUS, perhaps). At Rocky Flats: continue training and MC&A system design assistance as negotiated with the facility. At Idaho: develop a variance propagation tool for ICPP, continue peer review of variance propagation work for the Portsmouth cascade as requested by the facility and DOE. (LANL86017-93)

c. Control

Continue to evaluate new SNM monitors as they become available. Report on T&E of portable portal monitor. Begin evaluating linac for improved accuracy assay of large uranium materials. Continue T&E of image-based materials monitoring systems with emphasis on integration of image data with other MC&A databases. If the required funding is available, continue to develop and test acoustic resonance spectroscopy in selected safeguards applications. (LANL86020-93)

d. General

Develop detailed designs and begin coding for an automated safeguards system design tool based on simulation technology. Continue to enhance the Facility Simulation (FacSim) model to incorporate the description of the facility's safeguards system and to simulate the response of the safeguards system to insider adversary scenarios. Begin on-line user's help for FacSim. Begin investigating additional facility analysis developing tools that use the FacSim database. Complete coding of an extended version of FacSim in an object-oriented simulation language. Continue to transfer simulation technology to facilities through advice and assistance on use of FacSim. Study the application of the safeguards simulation technology to other related DOE initiatives including environmental applications, weapons complex reconfiguration, and nonproliferation issues. (LANL88011-93)

5. Integrated Systems

a. Vulnerability Assessments

Refine and complete the code for evaluating protracted and rollup scenarios. In FY92, we've developed the structure and initial implementation of the database for MC&A components, incorporated rollup into the software, and initiated field testing of the Phase I code. In FY93, our emphasis will be on development and validation of the underlying database assumptions. Continue development of a code for evaluating the violent insider. In FY92, we developed a prototype code for evaluating violent insiders against barriers and delivered a report on manual approaches to evaluating insiders using violence against personnel. In FY93, emphasis will be on user interface for violence against safeguards. Develop a method for identifying radiological sabotage targets and evaluating radiological sabotage scenarios. The task will involve reviewing existing methods, including fault trees, for their adequacy in approaching scenarios of interest and developing a method which is consistent with approaches used to evaluate against theft of SNM. The approach should address both single and multiple access points. Communicate with other national laboratories and contractors regarding technical developments and application in the field. Emphasis will be on available approaches and tools, with emphasis for the insider threat and MC&A system evaluation. Update ASSESS User's Manual and the Insider module technical documentation. Continue validation efforts of the Insider database of strategies, defeat methods and detection probabilities for a variety of insider adversaries. Provide support to ASSESS users, including distribution of software and manuals, and telephone and limited field

a. Vulnerability Assessments (Continued)

support. Provide technical assistance to DOE Headquarters or for Headquarters initiatives in the field, as requested. (LLNL91019-93)

Final changes will be made to the ASSESS manual and software Help feature. The Outsider database delay and detection values will be documented. The final ASSESS code will be documented and tested and code maintenance will be provided. Headquarters support and technology briefings will be provided and validation activities will be continued as required. ASSESS Tech Notes will be distributed in conjunction with Lawrence Livermore National Laboratory. Other vulnerability assessment models, including the Safeguards Automated Facility Evaluation (SAFE) software, will be investigated to see if they can support the Site Safeguards and Security Plan program. Vulnerability assessments require production and management of large amounts of data - performance tests, safeguards and security plans and procedures, facility site plans, ASSESS or other facility descriptions, and analysis results - so we will also investigate approaches for efficiently collecting, managing, review, and reporting such data. (SNL86040-93)

b. Systems Integration

Deliver detection element evaluation approaches for loss detection elements contained in the revised DOE order 5633.3A, including access controls, tamper-indicating devices, portal monitors, inventory confirmation/verification measurements, inventory difference control limits, and material surveillance. (BNL86001-93)

Assistance will be provided to process developers and facilities in implementing MC&A systems to meet both the MC&A performance and MC&A compliance requirements. (BNL86002-93)

LANMAS: develop menus, an extensive help system and error handler. At SRS: complete the software design and begin programming materials control information analysis modules for testing in the FB-Line materials accounting system. Install and begin testing materials control information analysis modules for FB-Line as programming activities are completed. Begin discussions with Sandia National Laboratory on integrated PC-based safeguards systems that coordinate materials control, materials accounting, and physical protection. (LANL86012-93)

1. The Personnel and Material Tracking System (PAMTRAK) will be modified and improved as necessary to meet the needs of the DOE community as identified in the demonstration tests. ANL-W has already suggested the development of a) an integrated ES&H training

b. Systems Integration (Continued)

data base which would enforce up-to-date training, and b) a capability to generate the required Tamper-Indicating Device (TID) reports by using the WATCH data. 2. A new initiative will be undertaken to provide an expanded integrated system based on PC technology. This system will integrate PAMTRAK with at least one of the following in FY93: a LANL PC-based accountancy subsystem, the PC-based access control subsystem being developed in SNL91072, and an SNL or commercial PC-based alarm display system. 3. Determine the feasibility of utilizing the authenticated WATCH units and the new IR tracking schemes, image processing, and canister monitoring system in the PAMTRAK system. 4. Look at security issues regarding an integrated system, and certify PAMTRAK for classified processing. (SNL88017-93)

C. GD-06-03 Full Scale Development

2. Material Control and Accounting

a. Measurement

Based on user recommendations and results of evaluations, a number of additional software functions will be developed and added to the calorimeters to further enhance their functionability and usefulness. (ANLE88002-93)

d. Technical Support

1. MCA-103 Introduction to Performance Testing, Assist in the preparation of lesson plans exercises and course material. Provide review for initial offering of course. 2. MCA-130 MC&A Statistics for Managers, assume a leadership role in the organization of course development team activities, coordinate development team meetings, prepare draft lesson plans for a portion of the course, and present one iteration of the course. 3. MCA-142 Volume Measurement Techniques, Assist with the organization and coordination of course development team activities, adapt software for instrument control and data acquisition equipment and facilities to be used in the course; develop and write lesson plans and other course materials; review course material and participate in pilot run and course presentation. 4. MCA-144 Measurement Control Programs in MC&A, Assist in the organization and coordination of course development team, especially regarding measurement control techniques for mass and volumetric measurements. Prepare lesson

d. Technical Support (Continued)

plans for this portion of the course and provide instructions as required. 5. MCA-233 Estimating Measurement Error/Calibration Data, Assist in the development and presentation of the course, in particular: provide statistical support as required by the course development team, participate in development team meetings, prepare lesson plans and course material for a portion of the course, provide instruction, and review course materials as required. 6. MCA-234 Statistical Methods for Estimating Variances, provide statistical support as determined by course development team, participate in development team meetings, prepare lesson plans and course materials for a portion of the course, provide instruction and review course materials as required. (BNL93024-93)

1. Participate in the development of CTA course MC&A-140, MC&A-120, and MC&A-121. Provide instructors as required. 2. Pending a LANL decision, transfer, MC&A-247, with modifications, to CTA to become MC&A-144. Course materials to be in CTA format. Provide instructors as required. 3. Modify as required and present at LANL the courses MCA-241, MCA-111, MCA-331, MCA-243, MCA-343, and MCA-247. 4. Participate in the work of the MC&A Training Working Group. (LANL93013-93)

Continue to provide technical support to DOE/OSS on ad hoc tasks (radiological sabotage, etc). Continue participation in CTA working groups. Provide onsite assistance to DOE/OSS through March 1993. (LANL86014-93)

Establish a Neutron Users Group to expedite the transfer of neutron-NDA technology to DOE facilities. Report the status of technology transfer of the 256-channel multiplicity shift-register electronics. Provide technology transfer for vendor fabrication and delivery of a second-generation 55-gallon drum segmented gamma-ray scanner (SGS), and support technology transfer for commercially-fabricated Passive/Active Neutron (PAN) barrel shufflers. Continue interactions with vendors regarding fabrication of NDA instruments as appropriate, and provide appropriate NDA design information and consultation to vendors as requested. Prepare Technology Commercialization Initiative documents for multiplicity and shuffler algorithms and holdup detectors. (LANL90040-93)

Implement additional analysis capabilities of LANL TA-55 NDA system and Pu-239 gamma-ray isotopic system installed at LANL's TA-55 facility, portable x-ray fluorescence analysis instrument commercialized. Begin demonstration and evaluation of second generation actinide analysis instrument. (LLNL86004-93)

Mound will administer the Calorimetry Exchange Program. Data submissions will be analyzed and reports will be issued quarterly.

d. Technical Support (Continued)

The annual meeting will be organized and hosted by Mound. Mound will play a lead role in attempting to resolve problems identified through the exchange, including investigating the need for additional samples or exchanges. Mound will present the method for tracking individual instruments to the exchange participants at the annual meeting. A method of intersite comparison will be developed. Mound will coordinate activities heading to the development of additional calorimetric assay standards. (MD86005-93)

Mound will provide a formal training program in calorimetric assay for safeguards of plutonium. Technical assistance will be provided on an as-needed basis to DOE and its contractors to help resolve calorimetric assay problems. The assistance may take the form of hardware/ software developments, measurement control indicators/procedures, development of instrument specifications, or informal training. Mound will participate in the development of consensus standards concerning safeguards. In addition, a 238Pu heat standards laboratory will be maintained. The results of field tests of the self-diagnostic operating system and the preheating/preconditioning system will be documented. As a follow-on to the self-diagnostic operating system, a strategy will be developed for automatically creating control charts from baseline and standards data to verify calorimeter operation. The calorimeter operators training program will be offered to the DOE community. A demonstration of the use of servo control operation to reduce the effects of environmental changes on calorimeter output will be completed. The design requirements for an automated method to match the temperature of the preconditioner to the internal temperature of the calorimeter operating in servo control will be developed. By implementing this automated matching of temperatures a significant improvement in sample throughput can be obtained. In response to an identified user need, Mound will develop a production model based on existing Electrical Calibration Heater (ECH) design. The ECH will be tested at Mound and in the field and the results documented. In addition, calibration and measurement control strategies for the ECH will be developed. The ECH will reduce, but not eliminate, the need for 238Pu heat standards for calibration purposes. (MD87010-93)

1. MCA-103 Introduction to Performance Testing, PNL will design the course, prepare draft lesson plans, and present two iterations of the course in FY 1993. 2. MCA-110 Basic Nuclear Materials Accounting, PNL will participate with CTA and adjunct faculty staff to design the course, prepare draft lesson plans, and present two iterations of the course in FY 1993. 3. MCA-120 Basics of Materials Control, PNL will participate with CTA and adjunct faculty staff to design the course, prepare draft lesson plans, and present two iterations of the course in FY 1993. 4. MCA-121 Tamper Indicating Device Program, PNL will prepare draft lesson plans and

d. Technical Support (Continued)

present two iterations of the course in FY 1993. 5. MCA-130 MC&A Statistics for Managers, PNL will participate with CTA andother adjunct faculty staff to design the course, prepare draft lesson plans, and present one iteration of the course in FY 1993. 6. MCA-132 Sampling Plans for MC&A, PNL will participate with CTA and other adjunct faculty staff in presenting one iteration of the course in FY 1993. 7. MCA-140 Basics of MC&A Measurements, PNL will participate with CTA and other adjunct faculty staff to design the course, prepare draft lesson plans, and present one iteration of the course in FY 1993. 8. MCA-144 Measurement Control Programs in MC&A, PNL will participate with CTA and other adjunct faculty staff to design the course, prepare draft lesson plans, and present one iteration of the course in FY 1993. 9. MCA-150 MC&A Inspection Procedures, PNL will revise draft lesson plans and present three iterations during FY 1993. 10. MCA-351 Planning and Performing Audits/Inspections, PNL will participate with CTA and other adjunct faculty staff to design the course, prepare draft lesson plans, and present one iteration of the course in FY 1993. 11. MCA-234 Statistical Methods for Estimating Variances (SMEV), PNL will participate with CTA and other adjunct faculty staff to design the course, prepare draft lesson plans, and present one iteration of the course in FY 1993. 12. MC&A Workshops, PNL will participate with CTA to develop and present four workshops on MC&A topics in FY 1993. One of the topics will be on resolution of inventory difference anomalies. PNL will provide two people for two workshops and one person for two workshops. (PNL93001-93)

3. Information Security

a. Automated Information Security Systems

Determine the validation methodology necessary to achieve the level of assurance outlined by protection indexes of 2, 3, and 8 required to certify AIS. The Draft DOE Order 5639.6, ITSEC, and the new Information Technology Security Specification will provide bases for this effort. Document the different approaches and recommend the most effective for this Department. Establish a liaison with the IV&V coordinator at LLNL and the training coordinator at Oak Ridge National Laboratory in the form of a review and comment role. (LANL93052-93)

Determine the verification methodology necessary to achieve the level of assurance outlined by protection indexes of 2, 3 and 8 required to certify AIS. The Draft DOE Order 5639.6, ITSEC, and

a. Automated Information Security Systems (Continued)

the new Information Technology Security Specification will provide bases for this effort. Document the different approaches and recommend the most effective for this Department. Establish a liaison with the IV&V coordinator at LLNL and the training coordinator at Oak Ridge National Laboratory in the form of a review and comment role. (LANL93053-93)

Planned activities include: Continued support of "VMS System Security Guideline" document. It will be necessary to modify the "VMS System Security Guideline" document based on newly discovered flaws in VMS and new releases of Digital Equipment Corporation's VMS operating system. Provide on-line help in fixing VMS security problems. The guidance given in the "VMS System Security Guideline" will be automated and integrated into the Security Profile Inspector for VMS (SPI/VMS) tool in the form of on-line help screens for correcting security weaknesses found using SPI/VMS. Provide on-line help in fixing UNIX security problems. UNIX guidance will be developed, automated and integrated into the Security Profile Inspector for UNIX (SPI/UNIX) tool in the form of on-line help screens for correcting security weaknesses found using SPI/UNIX. Other guideline development to serve the DOE classified computer security program. Additional guidance could be provided in security testing to enhance the "Computer System Security Generic Test Methodology Guideline", developed by Oak Ridge, in the areas of: a UNIX test methodology example, sample security function and penetration tests, evaluation of a system's risk, and identification of a system's vulnerabilities. (LLNL90013-93)

e. Technical Support

Continued rapid and effective handling of DOE computer security incidents via Computer Incident Advisory Capability (CIAC) including: virus outbreaks and system intrusions, issuance of CIAC Warning Notices, expansion of the CIAC project team, establishment of improved computer and communications capabilities for CIAC, expansion of the CIAC bulletin board system and related information databases, continued development of software tools for use in incident handling, continued development of cooperative procedures and relationships between CIAC and other DOE sites, Federal agencies, vendors, and computer emergency response teams (CERTs), revision of the incident handling guidelines, analysis of known incidents, analysis of known malicious code (viruses, worms, trojan horses), and presentation of workshops on incident handling as well as other education and awareness efforts. (LLNL90010-93)

Complete the DOE Automated Information Security System (AISS) strategy. Conduct review of the IV&V program for compatibility

e. Technical Support (Continued)

with the auditing/test, certification, and training tools provided to the CSSMs. Develop/review security strategy involving the control of classified information in networks operating in a multi-level security mode and recommend future changes for the on-line AIS audit/testing program. Develop report on changes that have to be made to the audit/testing tools based upon these reviews. Develop a methodology to capture and distribute information from IV&V test results and security vulnerabilities in such a manner that extensive certification retesting of the same AIS components is minimized. (LLNL92025-93)

Provide liaison support between the field organizations and DOE/OSS. Provide technical direction for DOE/OSS-funded computer security projects as required by Headquarters. Provide technical expertise and leadership as requested. (MMES92010-93)

Four courses will be developed during this FY. These include the AISS Introduction designed for 24 hours instruction time, Managers AISS Overview designed for 4 to 8 hours instruction time, AISS II, Wide Area Networks, designed for 40 hours instruction time, and AISS III, Multi-Level Systems and Networks, designed for 40 hours instruction time. These courses will be presented as directed by the DOE INFOSEC Training Working Group. (MMES92011-93)

1. Participate in the work of the MC&A Training Working Group 2. Pending DOE decisions, conduct MCA-112, MCA-212, MCA-214, and MCA-213 3. Participate in the development and presentation of MCA-110, MCA-140, MCA-142, MCA-351, and MCA-132. (MMES93014-93)

4. Personnel Security

e. General

The FY 1993 activities involve the installation of a Classified Document Contol System (CDOCS) to manage terminated review files. The selected hardware and software features will be based on the feasibility study conducted in FY 1992. The installation includes hardware and software required to configure the system, user and system documentation, onsite training on the cost effective use of the system, and ongoing user telephone support. (SNL93117-93)

5. Integrated Systems

b. Systems Integration

Finalize integration of system enhancements initiated in FY 92 and evaluate system performance in operational environment. Evaluate advanced technologies such as image processing as a means to provide continuous surveillance. (ANLW88001-93)

At Savannah River: modify NucMASloe based on testing and evaluation at SRS. Begin installing and using NucMASloe at other SRS separations areas. Design a new module for NucMASloe that generates limit-of error of shipper/receiver differences. At ANL-W: continue enhancement of the PC-based accounting system ARGUS for use in the FMF facility. Complete testing and evaluation of the preauthorization upgrade and the optical disk (WORM) archival and backup software addition to ARGUS. Identify ARGUS portability issues in preparation for installation at other facilities. Begin investigating incorporation of variance propagation (MAWST, probably) into the ARGUS system. Begin investigating the application of the Windows system to ARGUS graphics routines; address Ethernet issues. (LANL86018-93)

d. In-Line Safeguards and Security

Respond to requests for support in the areas of holdup measurements at operating facilities as well as facilities undergoing transitioning, review of facility NDA needs, new NDA for complex modernization, and integrating automated safeguards systems with currently available technologies. Respond to DOE/OSS requests to support MC&A implementation. (LANL86021-93)

Provide guidance and assistance as requested on safeguards and security system integration to DOE for planning new or upgraded safeguards systems to assure that safeguards technology developed through the safeguards R&D program is successfully integrated at the systems level for implementation. Document information on nondestructive assay techniques and safeguards systems provided to Oak Ridge in support of Complex-21 reconfiguration activities at Y-12. Complete the Applications Note on the FRAM Pu isotopics system. Continue to apply information on neutron and gamma-ray NDA performance capabilities to safeguards system studies. Participate as requested on the design of the DOE New Production Reactors and on the Los Alamos Nuclear Materials Storage Facility. Begin writing an Applications Note on neutron multiplicity counting. (LANL90041-93)

d. In-Line Safeguards and Security (Continued)

Complete a draft manual on selecting safeguards system upgrades. The manual will emphasize identification of upgrade needs and possible means of meeting those needs. ((LANL89042-93)

Conduct a study of procedures and technology to minimize radiation dosages received during physical inventories. The study will consider options such as shelf monitors, image surveillance, and radiation monitors to achieve reduced inventory frequency. (LANL93050-93)

1. A PAMTRAK system will replace the older ARGUS system at ANL-W in order to add personnel tracking in the FMF. 2. Assistance will be provided to Hanford in providing additional integration of their safeguards and security systems. (SNL88024-93)

f. General

Continuing support will be provided to Headquarters in the development of MSSAs, R&D user need analysis, development of security courses, and response to special HQ requests. Continuing support will be provided to the field in addressing technology transfer of security technology. Technology Transfer Manuals will be developed as DOE manuals. Additional "Topics in Physical Security Technologies" will be written and published. Development of an additional technical library for entry control, including contraband detection and personnel identification. Workshops will be presented on topics of current interest. Complete plan for new information dissemination method, as agreed upon with DOE. (SNL86025-93)

APPENDIX A

SUMMARY OF MAJOR TECHNOLOGY DEVELOPMENT ACCOMPLISHMENTS FOR FY 1992

The following summary consists of major technology accomplishments during FY 1992. They are categorized into subtopical areas under three general areas corresponding to DOE B&R categories for domestic S&S technology development.

APPENDIX A

SUMMARY OF MAJOR TECHNOLOGY DEVELOPMENT ACCOMPLISHMENTS FOR FISCAL YEAR 1992

A. SCIENCE AND TECHNOLOGY BASE DEVELOPMENT

A.1. Physical Security

A.1.a Detection

- Completed testing of the PPS-15 based prototype detection system. Prepared a questionnaire on early warning systems needs for DOE Headquarters to distribute to its sites. (SNL89034-92)

- Continued to test and evaluate exterior sensors and to assist the field with the design, procurement, installation, testing, and evaluation of exterior intrusion detection systems. (SNL8600I-92)

- Completed Sandia and DOE site evaluation of Enhanced Line Security modules; reported results and made recommendations for future efforts. (SNL89037-92)

- Continued to assist DOE sites with interior sensor technology, information, design, installation, procurement, testing, and evaluation. Investigated glass-break sensor technology and testing procedures. (SNL86002-92)

- Extended capability of the airborne assessment platform to include position location and automatic landing. Identified neutral network processing for sensors. (SNL87004-92)

- Completed an assessment of critical robotics technologies. Finalized a conceptual design for an automated exterior sensor tester. (SNL92068-92)

- Implemented a menu-based user interface for operational control, display, and analysis of radar data for the proof of concept (POC) Prototype Laser Radar Imaging System. (SNL90055-92)

- Completed and distributed a questionnaire on airspace monitoring to help in the definition of requirements. Completed questionnaires were reviewed. (SNL89035-92)

A.1.b Assessment

- Published report on initial evaluation of selected interior video motion detectors. Published report on the effect of frame versus field storage of solid state frame storage devices on video resolution. (SNL86009-92)

- Established an image processing software development environment for the Visual Artificially Intelligent Surveillance System which can be used on other image processing developments. (SNL88013-92)

- Completed basic PC-networked alarm display technology effort. Completed major survey effort of commercial vendors who produce security alarm, communications, and display systems. (SNL86014-92)

A.1.c Delay

- Proof-of-concept demonstration of a UV activation/No_x detection system for sensing HE compounds is ongoing. Initial experiments, performed on HE component residue on glass, indicate low nanogram detection limits are feasible (INEL 91001-92).

- Evaluated the design of commercially available enhanced security personnel door systems. Investigated potential applications of a transportable or portal Special Nuclear Material storage vault. (SNL86005-92)

A.1.d Entry/Exit Control

- A method for universal collisional activation in an ion trap mass spectrometer with utility for explosives detection and other analytical applications has been perfected. A patent application has been submitted and two commercial ion trap vendors are negotiating with MMES Technology Transfer for licenses. A paper was published in the Analytical Chemistry journal describing this development. (ORNL86001-92)

- Advanced the explosives detection technology and consulted with DOE facilities on techniques for meeting the requirement for implementing an explosives detection capability in 1994. Specifically, prototypes of a vapor generator and a preconcentrator for use with an explosives detection portal system were developed. (SNL90073-92)

A.1.d Entry/Exit Control (Continued)

- Designed and documented an automated system for testing remote badge readers. Developed a plan for testing selected biometric identity verifiers. (SNL86006-92)

- Evaluated the performance of the proof-of-principle Intelligent Facial Recognition System (IFRS) in a controlled laboratory environment. (SNL91075-92)

- Completed the magnetic stripe technology market survey and defined a technique for using high-coercivity particles in the magnetic stripe to yield enhanced protection of the encoding. (SNL86004-92)

- Maintained technology base on contraband which will be transferred to DOE facilities. (SNL90074-92)

A.1.e Response

- Developed a preliminary methodology for analyzing the protective force functions. The methodology will be applied first to SNL-specific operations and then to other sites in the DOE complex. (SNL92079-92)

A.2 Materials Control and Accounting

A.2.a Measurement

- Improved ease-of-use and flexibility of the plutonium gamma-ray analysis program, MGA, by adding a measurement configuration file. This feature enables users to adapt the MGA analysis to their hardware system and measurement configuration that can result in more accurate analyses. (LLNL91018-92)

- A dry heat exchanger (air bath) calorimeter was developed at Mound. The design and construction of the instrument were described in a presentation at the 1991 INMM Annual Meeting, "The Dry Heat Exchanger Calorimeter System", (MLM-3680). This report also included performance data obtained at Mound. The instrument was field tested at LANL and the result of the field test, "Field Test Results of the Dry Heat Exchanger Calorimeter at LANL" as presented at the ANS Safeguards and Topical Conference in October of 1991. In response to user requests, the operating software was rewritten in the C computer language and installed on a personal computer. This enhancement was demonstrated at the 1992 INMM

A.2.a Measurement (Continued)

Annual Meeting in a presentation entitled "The Personal Computer Controlled Dry Heat Exchanger Calorimeter System". (MD86002-92)

- In order to increase throughput on the dry heat exchanger calorimeter, as well as in the more traditional water-bath calorimeter, a preconditioning system was developed at Mound. The preconditioned provides heating or cooling in the sample range from 1.5 to 12 watts to more closely match the internal temperature of the measurement calorimeter. The unit occupies a volume of less than 4 cubic feet and does not use water. Tests performed at Mound indicate that preconditioning reduces the measurement time by about 27 to 34 percent. The design and construction of this instrument is described in "The Dry Heat Exchanger Preconditioned" (MLM-3743). The sample preconditioned was field tested at LANL during 1992. (MD86002-92)

- A compilation of the application of automation techniques in calorimetry was completed at Mound. The results were presented at the 1992 INMM Annual Meeting. This information was also detailed in "A Guide to Automation Techniques in Calorimetry" (MLM-3761). (MD86002-92)

- An investigation into the servo-control parameters that affect sample assay time has been completed at Mound. This project is expected to reduce calorimeter assay times for servo controlled systems by enabling dynamic adjustments of the feedback "gain" parameters. The results of initial investigation were presented at the 1992 INMM Annual Meeting in a talk entitled "Calorimetry Servo Control Evaluation". (MD86002-92)

- The use of an ultrasonic technique as a confirmatory measurement for tritium in singly contained, sealed weapons components is being investigated at Mound. Four tritium containers that had been measured on 8/27/91, were remeasured on 2/5/92 and 9/23/92. The containers were remeasured to observe the shift in resonant frequency due to the decay of the tritium gas and the corresponding change in the molecular weight (MW) of the gas. As the MW decreases due to the decay of the gas, the resonant frequency of the gas in the container increases. Increased resonant frequencies were observed for the assigned gas resonance for all four containers. This is a technique that can be used as a confirmatory measurement for tritium. Previously measured containers will evidence a frequency shift that is only consistent with the presence of decaying tritium. (MD88001-92)

- Development continued of Inductively Coupled Plasma-Laser Excited Atomic Fluorescence Spectroscopy (ICP-LEAFS) as a sensitive, interference-resistant technique for the determination of U in complex solutions. Ultrasonic nebulization was substituted for

pneumatic nebulization for sample introduction into the ICP. This lowered the detection limit for U to 370 ppb. (AMES86001-92)

- The development of techniques for the on-site measurement of actinides using inexpensive, portable, high-resolution diode lasers was initiated. Studies of rare earth metals in an atomic beam, using a measurement period of 10 seconds, showed excellent isotopic resolution. It was possible to detect isotopes present at the 0.1% level and to measure isotope ratios with a relative error of 1%. Diode lasers were used for the first time to investigate the optogalvanic spectroscopy of actinides. Doppler-limited optogalvanic spectra (450 MHz FWHM) of U and Th were obtained in commercially available hollow cathode lamps. A portable diode laser system for field use is being designed. (AMES86001-92)

- The development of new atomization sources continued with the modification of a high-temperature heat-pipe oven to eliminate spectral perturbations, making possible high-resolution laser spectroscopic measurements. An Electrothermal Hollow Cathode Discharge (ET-HCD) apparatus is being built for the sensitive and selective detection of actinides with isotopic selectivity. A concentric configuration of two tantalum tubes is being used; the outer tube for electrothermal heating, the inner tube for the glow discharge. Optogalvanic spectroscopy will be possible on both solid and liquid samples in this compact and portable apparatus. (AMES86001-92)

- Development of a next-generation, "intelligent" actinide analysis system was completed. The intelligent actinide analysis system (IASS) is a gamma-ray spectrometry system that utilizes a distributed computer network architecture. Control of most measurement functions can be performed by computer and the system can be monitored remotely by computer. The network architecture permits integration with other safeguards systems at a facility. (LLNL88002-92)

- Monte Carlo calculations are being investigated as a means of simulating gamma-ray spectra of SNM with various counting-sample geometries. The Monte Carlo transport program, MCNP, was installed and experience was gained in simulating gamma-ray spectra for various types of high-purity germanium gamma-ray detectors. Weapons-grade plutonium gamma-ray spectra have been calculated for a known source and detector geometry and compared against measured spectra with the same geometry. (LLNL88002-92)

- Minimum detection limits (MDLs) for ^{235}U, ^{239}Pu, and ^{241}Am in various matrix materials were determined. Evaluated the use of ^{166}Ho as a transmission source for measuring attenuation within various matrix materials as a function of energy for SNM. These

measurements were performed to aid in the design of an emission/transmission computed tomography measurement system. (LLNL88002-92)

- Developed new neutron and gamma-ray NDA instruments and techniques that provide safeguards against insider threats and met the need for near-real time accountability by providing better assay accuracy and the ability to measure new material types. NEUTRON ASSAY: Continued evaluating passive neutron multiplicity measurements of process materials and developed an active neutron multiplicity technique to assay large U metal masses. Began a study of shuffler assay of U-235 in the presence of widely-varying uranium isotopic mixtures. For shuffler assay systems, studied the application of flux monitors for matrix corrections and sensitivity to shielded SNM. Also studied the effects of SNM spatial position and high background on shuffler waste drum assay accuracy. GAMMA-RAY ASSAY: Applied corrections for variable lump sizes to SGS measurements of heterogeneous materials. Documented the design of the hybrid (K-edge/XRF) solution assay instrument. Began a study of self-induced x-ray methods and reported on gamma-ray methods to determine the U fraction in oxides or mixed-oxides for the (infinitely thick) enrichment geometry. Investigated measurements of U-235 and total U by solution assay. Began evaluating SGS end-effect correction methods and the application of tomographic techniques for SGS measurement enhancement and sensitivity to shielded SNM. Prepared standard operating procedures or plutonium solution assay with lasers, x-rays, or gamma-rays. (LANL86003-92)

- Continued the development of detectors and instrumentation to enhance and improve neutron and gamma-ray NDA assay and detection capabilities. NEUTRON ASSAY: Began integrating coincidence counting electronics into the portable compact neutron detector. Fabricated new prototype multiplicity counter electronics packages and reported on bench-top testing and field evaluation at DOE facilities. Developed software for neutron multiplicity counting. Reported on the study of multiplicity counter electronic deadtime for 256-channel scalers. Tested application-specific integrated circuits (ASIC)-based combined multiplicity/SR-4 electronics. GAMMA-RAY ASSAY: Began an upgrade of the PMCA amplifier for high-count-rate capability, and began conversion of the PMCA software into C-language. Began evaluating an electrically-coiled germanium detector for use as a portable neutron coincidence counter endcap. OTHER: Reported on applications of ASICs and gate arrays to compact NDA electronics. (LANL89030-92)

- Performed computer simulations and developed new data analysis algorithms to improve NDA assay accuracy and extend assay capabilities to other SNM categories. NEUTRON ASSAY:

A.2.a Measurement (Continued)

Documented MCNP modeling of the new Inventory Verification Sample Counter (INVS-III). Completed development of deadline correction mathematics for neutron multiplicity counters, and extended the figure-of-merit (FOM) analysis of multiplicity assay precision to active neutron coincidence counting of large uranium samples. Completed the design of a neutron coincidence counter that uses the add-a-source technique to study diversion sensitivity in plutonium waste drums. Reported on the use of thermal neutron counter ring-ratio data to determine emitted neutron energy specter. Upgraded the Deming curve-fitting code to match software release standards. GAMMA-RAY ASSAY: Began developing data analysis algorithms for combined SGS/shuffler boxed waste assay. (LANL90039-92)

- Developed and evaluated promising new detector and measurement technologies for holdup, confirmation, verification, and waste assay or screening applications. Reported on the status of the generalized-geometry holdup software system and on the evaluation of digital gain-drift software compensation for low-resolution gamma-ray holdup detectors. Began testing software for commercial PC-based multi-channel analyzer functions. Reported status of on-line total neutron measurements with compact neutron detectors. Procured a high-resolution gamma-ray detector for (n,gamma) matrix effect studies and began a study of (n,gamma) diversion detection flags for shielded SNM in Cf-252 shuffler-based active neutron assay systems. Began investigating low-level gamma-ray scanning for bulk waste segregation and evaluating neutron detector design for low-level waste screening. (LANL89031-92)

- Completed construction of automated instrument for spectrophotometric measurement of Pu in chloride system based on Segmented Flow Analysis (SFA) system. Completed evaluation and documentation of Advanced Automated Plutonium Titration System for high precision assay of plutonium metal. Completed evaluation of new PAR 273/279 Potentiostat/Coulometer for controlled-potential coulometric measurement of Pu. (LANL86004-92)

A.2.c Control

- Developed testing criteria for seals. Completed tests on seals in use in the DOE. (SNL91076-92)

- Began revising hand-held SNM monitor user's manual to reflect newest instruments. Began collating information on status of package monitoring for use in writing a package monitor applications guide. Investigated the properties of layered plastic scintillators, and evaluated a Jomar JHH-31 gamma-ray confirmation instrument.

A.2.c Control (Continued)

Completed a manual for the list-mode coincidence module, submitted patent application for the module design, and reported on applications of earlier similar multiplicity modules. Developed advanced imaging algorithms for tomographic gamma-ray scanning, began design and construction of a passive tomographic scanner, and reported its status in a conference paper. Completed development of an in-plant test method for vehicle monitors, and introduced it into the ASTM process of standards development. (LANL86001-92)

- Continued to define and develop materials control components and subsystems, with particular emphasis on dealing with the insider threat and integration with other safeguards subsystems. Completed analysis and design for integrable image-surveillance database. Completed enhancements of process monitoring anomaly detection software. (LANL88002-92)

A.2.d General

- Completed a computer security requirements analysis for LANMAS and completed the software design. Developed several prototypes based on different development tools and selected the most appropriate. Completed the software for an authorization and approval system that will be incorporated into LANMAS and completed the LANMAS main menu system. LANMAS (Local Area Network Materials Accounting System) is a powerful, cost-effective prototype distributed automated MC&A system under development in collaboration with Westinghouse-Hanford. It will serve as a model for MC&A systems at other DOE facilities. Documented the theoretical basis for prototype W&S software for anomaly detection covering algorithms, concepts, and the effect of tuning parameters. Tested the prototype with simulated ICPP data and then with real ICPP data. Determined the minimum data requirements for an anomaly detection system based on W&S. [Wisdom and Sense (W&S), is a statistics-based rule generator and analysis program.] Identified the requirements for a neural network application to anomaly detection in MC&A where rules are not readily evident or intuitive. Built a preliminary model for anomaly detection in a simulated MC&A application. (LANL86006-92)

A.3 Information Security

A.3.a Automated Information Systems Security

- An analysis of a comprehensive set of DOE data management systems was performed to determine the current data management security needs and practices. A written report was developed detailing the existing DOE data management security needs and practices, and identifying the areas of vulnerability in need of established security procedures and guidelines. (MMES92007-93)

- A beta version of the Distributed Intrusion Detection System (DIDS) was released to the US Air Force Cryptologic Center in July 1992. DIDS is a joint DOE and USAF research and development program. (LLNL90015-93)

- Demonstrated DIDS at the 15th National Computer Security Conference, October 13-16, 1992 in Baltimore, MD. (LLNL90015-93)

- Developed proof-of-concept prototype of Distributed Audit System using network management protocols and demonstrated in October, 1992. (LLNL90017-93)

- Version 0.7 of the Network Security Monitor (NSM) was released. This version incorporates several new and improved features. These include:
  - The program has been modified to produce results that can easily be searched by the Unix "awk" or "grep" commands.
  - Source and destination ports are now printed when "unknown" services are encountered.
  - The capture tool now utilizes an exceptions file. This allows the user to specify the capture of all but certain unnecessary traffic.
  - Malformed packets are now discarded.
  - Several new manual pages (man pages) have been added.
  - NSM must be registered to a particular machine to run. This feature now helps to prevent the indiscriminate and unauthorized distribution and use of the program. (LLNL90015-93)

- A new User's Manual and a Functional Description have been written for the Network Security Monitor. (LLNL90015-93)

- A new release of the Security Profile Inspector for UNIX-based systems (SPI/UNIX) took place in September. The SPI/UNIX 2.1 release package was supplied to 120 DOE elements, including all DOE Computer Security Site Managers. The package contains the SPI/UNIX 2.1 User's Guide and instructions on obtaining the new release. (LLNL90011-92)

A.3.a Automated Information Systems Security (Continued)

- Added new functionality to SPI for UNIX-based systems, including the Access Control Test (ACT) to identify vulnerabilities related to sequential dependencies in UNIX access controls, and the Binary Inspector Tool (BIT) to identify the security patch levels of system binaries. (LLNL90011-92)

- Enhanced previous functionality of SPI for UNIX-based systems. Modified the Password Security Inspector (PSI) to handle C2 shadow password files in an automatic fashion, and streamlined the product installation procedures. (LLNL90011-92)

- Extended the SPI/UNIX portability to SYSV-based UNIX operating system variants through additional configuration tests. (LLNL90011-92)

- A new release of the Security Profile Inspector for VMS-based systems (SPI/VMS) took place in December (version 1.2) and in May (version 1.3). (LLNL90012-92)

- Added new functionality to SPI for VMS-based systems, including File Protection to assess file access control settings, and a Find Identifier function to locate unowned files. (LLNL90012-92)

- Enhanced previous functionality of SPI for VMS-based systems. Added a mail notification feature, improved online help and output report management, and provided an Audit feature to consolidate the operation of existing SPI/VMS security functions. (LLNL90012-92)

- Developed a prototype Text Analysis Program (TAP) for detecting the unauthorized presence of sensitive text on computer systems and networks. The analysis process is driven by a user-supplied keyword table, which specifies word linkages that potentially represent sensitive phrases. This prototype software is currently being beta-tested at LLNL on known classified information. (LLNL90017-93)

- Began developing a general framework for a distributed systems security model. Acquired appropriate system data and carefully studied it using graphical techniques. Used non-linear modeling techniques of neural networks to build a model interactively from known normal distributed system behavior. Recommended technical guidelines and/or changes to DOE computer security policies to ensure that distributed and parallel computer systems are addressed. Develop design requirements for distributed and parallel systems security analysis tool. Began study of multilevel secure networks, reviewed availability and suitability of commercial encryption, communications, and operating systems technologies. Designed and

A.3.a Automated Information Systems Security (Continued)

implemented a secure wide area network utilizing packet encryptor and began DoD certification/accreditation process for MLS operation. (LANL86010-92)

- Continued development of an integrated graphical network simulation model. Released PC-based graphical network model. Continued developing PC-based graphical network model incorporating enhancements and modifications determined to be necessary. Began integrated implementation of a prototype for network penetration detection and an automated response mechanism. Supported academic/university collaborative efforts in network security research. Studied feasibility of incorporating parallel and distributed computer systems security into the graphical network simulation model. (LANL89033-92)

A.3.b Classified Matter Protection and Control

- Implemented a pilot local area network version of Classified Document Control System. (SNL91076-92)

A.5 Integrated Systems

A.5.b Systems Integration

- Completed evaluation of the IR tag system. Completed a prototype of an improved tamper protection scheme for a tag. (SNL86018-92)

B. Concepts and Demonstrational Development

B.1 Physical Security

B.1.a Detection

- Developed maintenance guidelines and standard test procedures for intrusion detection systems. (SNL90062-92)

- Completed a Manual for Standardization of Installation and Testing for the Bird-Eye Active Infrared Intrusion Sensor and the Racon Bistatic Microwave Intrusion Sensor. (SNL90062-92)

B.1.a Detection (Continued)

- Completed a trial test at Pantex of the Radar Airspace Monitoring System (RAMS). (SNL87022-92)

B.1.b Assessment

- Categorized some of the existing security software and applied reengineering tools to the map editor portions to determine code reusability and design characteristics. (SNL87022-92)
- Completed the Target Cueing and Tracking System (TCATS) technology transfer package. The package includes system drawing, source code, programmable device descriptions or reports describing the system and user, and a user's manual. (SNL87022-92)
- Completed CCTV domain expert and environment expert designs. Completed environment expert implementation. (SNL86019-92)

B.1.c Delay

- Collected and coordinated requirements from several DOE sites for a standardized Intrasite Transport Vehicle. The design was specified and fabrication initiated. (SNL92080-92)

B.1.d Entry/Exit Control

- Developed biometric credential capability for Controlled Access by Individual Numbers enrollment stations, booths, and single door portals. (SNL89038-92)

B.2 Material Control & Accounting

B.2.a Measurement

- Continued to upgrade NDA standards for the safeguards R&D program and operational materials accounting. Developed uranium standards for active neutron coincidence systems and defined a set of Pu standards for neutron multiplicity counting. Began developing modular HEU drum standards for shuffler assay systems and prepared standards to evaluate the diversion sensitivity of shufflers. Provided documentation for Pu drum standards for segmented

gamma-ray scanning, and prepared solution standards for combined U-235 and total uranium solution measurements. Participated in the preparation and review of ANSI and ASTM consensus standards and measurement round robins, as appropriate. (LANL86005-92)

- General: Reported status of T&E of methods for assay of scrap waste containing other nuclear materials. Completed basic neutron coincidence counter software and data analysis package for facility use. At Livermore: Began in-field T&E of in-plant neutron multiplicity counter for impure Pu. At Savannah River: Reported on progress in developing and evaluating pass-through boxed-waste shufflers. Reported on billet shuffler performance, and began a feasibility study of an integrated x-ray scanner/low-density waste assay system. At Los Alamos: Reported on the comparison of shuffler and DDT assay techniques. completed measurements of electrorefining salts with the FRAM Pu isotopic system. Began a facility T&E of the intrinsic densitometry technique for Pu solutions. Began T&E of hybrid active/passive neutron coincidence counter for mixed U/Pu materials, and began facility evaluation of an in-line neutron coincidence counter for pyrochemical residues. Delivered an instrument for the determination of Pu-242 concentration in solution. At Portsmouth: Began in-plant T&E of active/passive barrel shuffler for HEU diffusion wastes. (LANL86015-92)

- Developed and tested improved holdup analysis algorithms and incorporated them into software holdup programs to automate holdup measurements and data analysis. Tested methods to quantify holdup in decontamination and recovery operations of nuclear materials processing equipment. Provided holdup measurement technology and training support for the duct holdup measurement program at Rocky Flats. Reported the status of new compact gamma-ray monitors for in-line measurements, and began the T&E of holdup measurements of the experimental cascade dissolvers. Began the T&E of neutron monitoring of Pu in the recovery process, and began developing a transportable neutron slab holdup detector for Pu recovery facilities. Developed methods for using the neutron hydrofluorinator monitor for automated materials control. (LANL86016-92)

- Continued to identify, develop, and demonstrate confirmatory measurement methods in operating facilities. Performed experiments, using a prototype CTEN or another method, to evaluate alternative means of detecting concealed SNM in packages and containers. Reported status of HEU shipper/receiver system (SRCS) confirmatory data collected at shipper (RFP) and receiver (Oak Ridge Y-12) sites, and extended the HEU confirmatory counter to other uranium fuels and enrichments at Los Alamos. Began adapting FRAM isotopics code to mobil/PC applications for at-line verification, and began testing neutron/gamma-ray instrument for verification

B.2.a Measurement (Continued)

measurements of small Pu samples (Inventory Verification Sample Counter-III). (LANL86019-92)

B.2.b Accounting

- At Savannah River: completed test and evaluation of the variance propagation code MAWST in the FB-line and began developing a generic interface code to extend MAWST to other process areas. At Rocky Flats: assisted safeguards personnel with training and MC&A system design. At Los Alamos: continued to assist with data analysis for holdup measurements. At Idaho: began design of variance propagation tool for ICPP. At Portsmouth: reviewed work on variance propagation for the cascade requested by DOE and the facility. (LANL86017-92)

B.2.c Control

- Completed T&E of portable SNM portal monitor. Reported on imaging and analysis software for prototype photo-fission package monitor. Continued to evaluate new SNM monitors as they became available. Performed proof-of-principle testing on the use of acoustic resonance spectroscopy in selected safeguards applications. Continued demonstration and T&E of digital-image analysis techniques for materials control and testing of new change detection technology. Completed evaluation of prototype process monitoring anomaly detection software system at ICPP. Continued transfer of technology-based products for T&E at appropriate DOE facilities. (LANL86020-92)

B.2.d General

- Completed design of an extended version of FacSim appropriate for an object-oriented language implementation. Began coding FacSim in an object-oriented computer language that will permit easier modifications and upgrades. Designed a graphical user interface for facility description of the facility's safeguards system and to simulate the response of the safeguards system to insider adversary scenarios. These enhancements will facilitate the use of FacSim for analyzing MC&A detection capabilities for insiders. Completed the incorporation of pattern recognition methods for detecting and identifying an abnormal facility status. Completed testing the description of continuous processes in FacSim. Continued to transfer simulation technology to facilities through advice and

B.2.d General (Continued)

assistance on use of FacSim. Documented enhancements through the User's manual. Began investigating an on-line context-sensitive user's help system for FacSim. (LANL88011-92)

B.5 Integrated Systems

B.5.a Vulnerability Assessment

- Outsider was upgraded to display how each element in the Adversary Sequence Diagram was defeated without having to run analyses and to allow users to change path element performance values in Outsider. (SNL86040-92)

- Enhanced ASSESS Insider module, incorporating multiple facility states and improving overall user-friendliness. Upgraded ASSESS for Windows 3.1 compatibility. Updated the User's Manual and Technical Documentation to incorporate new features and software changes. Published, jointly with Sandia National Laboratories, an ASSESS newsletter. (LLNL91019-92)

- Completed development and programming of models and databases for evaluating protracted theft and roll-up theft scenarios to support DOE Order 5633.3. (LLNL91019-92)

- Developed and reported on approach for performing vulnerability assessments for violent insiders, including evaluation of use of force against safeguards and personnel, detection of contraband, and neutralization of insiders. Developed a prototype ASSESS violent insider module for evaluating the use of force against barriers by insiders acting alone. (LLNL91019-92)

B.5.b Systems Integration

- Performed a requirements analysis for development of a methodology for cost-benefit analysis and prioritization of S&S upgrades. (LLNL91019-92)

- Continued development of detection-element evaluation approaches (DEEA). Began integration of performance testing concepts with DEEAs. Continued characterization of a standard test device for evaluation of portal monitoring systems. (BNL86001-92)

B.5.b Systems Integration (Continued)

- Provided assistance to Headquarters and contractor facilities in adaptation, development and evaluation of safeguards approaches. Investigated new concepts for material control and for integration of MC&A and physical security systems for renovated facilities with new or modified missions. Assisted with development of criteria and means for reducing the frequency of nuclear-material physical inventories. (BNL86002-92)

- Completed and tested an integrated personnel and material tracking (PAMTRAK) system. (SNL88017-92)

- At SRS: installed computer hardware system and database software for development of materials control information analysis software prototypes. Selected options to develop for NSR materials control information analysis and began systems design for use in FB-Line. [The project emphasizes use of transfer and inventory measurements for material control. Significant parts involve nuclear material operator-computer interfaces and data visualization.] At Hanford: completed a prototype version of the distributed accounting system LANMAS for demonstration at Westinghouse Hanford. Began software development and coding. Interacted with Hanford personnel on design reviews for LANMAS prototype and LANMAS. (LANL86012-92)

C. Full Scale Development

C.2 Material Control & Accounting

C.2.a Measurement

- Installation of a gamma-ray spectrometer system for the Heat Source Technology Group at Los Alamos to measure plutonium oxide enriched in ^{238}Pu in EP60/61 and fueled-clad (FCC) containers was completed. Performance verification measurements on a Pu-238 oxide sample characterized by mass spectrometry were performed. (LLNL86004-92)

- Installation of a two-detector Pu gamma-ray isotopic system for the Nuclear Materials Measurement and Accountability Group at Los Alamos was completed. The system will be used for accountability measurements and compared with the TRIFID and FRAM systems also installed there. (LLNL86004-92)

- Transferred two-detector version of the MGA code from the DEC VAX computers to IBM-compatible PCs and UNIX-based computers and added the capability for reading most commercially available spectral-data file formats. (LLNL86004-93)

C.2.d Technical Support

- The Calorimetry Exchange Program, coordinated by Mound, promotes accurate measurements of thermal power by calorimetry and relative isotopic composition by gamma-ray spectroscopy. The Calorimetry Exchange Annual Meeting was held at EG&G Mound Applied Technologies on April 22 and 23, 1992. Thirty-five people attended the meeting. The organizations represented included DOE/AL, SRS, Mound, LANL, Rocky Flats, Hanford, LLNL, and Princeton Gamma-Tech. The meeting featured a review of the statistical analysis of the calorimetry and gamma-ray isotopic data submitted to the exchange during 1991. The meeting also enabled the participants to review the progress of five ongoing projects concerning a tritium exchange program, reprogramming of the database, a catalogue of measurement techniques, additional exchange samples, and a revision of the mission statement. In addition, there were fourteen topical presentations given on recent advances in calorimetry and gamma-ray isotopic measurements. A topic of interest to all the participants was the development of additional calorimetric assay (exchange) standards. It was agreed that the additional standards should be of a higher wattage (6-8 watts) and of a different (higher burn-up) isotopic distribution to meet both calorimetry and gamma-ray spectrometry needs. A

standard matching those qualifications was proposed, suitable batches of materials were identified, the scope of the work required was outlined, and a proposal writing task was assigned. Mound will develop the initial proposal with input from all the participants. The dates for the next annual meeting were set for April 28-29, 1993. Quarterly and annual data reports were published and distributed. (MD86005-92)

- The Calorimetric Assay Training School, held annually at Mound, provides a comprehensive background in the theory and application of calorimetric assay (both calorimetry and gamma-ray spectrometry) of plutonium to safeguards. The FY92 Calorimetric Assay Training School was conducted on October 15-18, 1991. Eighteen representatives of twelve DOE and DOE contractor sites participated. This is a CTA approved training course (CTA# MCA-244). For additional information regarding the next offering of the Calorimetric Assay Training School contact MOUND. (MD87010-92)

- A self-diagnostic operating system for calorimeters was developed at Mound. The operating system implements a method to continuously check the integrity of the calorimeter hardware in case of failure. The software was implemented on a MicroVAX II computer. A description of this operating system titled "Self-Diagnostic Operating System", was presented at the 1992 INMM Annual Meeting. The diagnostics were implemented on the Los Alamos four-calorimeter system which will be field tested in August, the projected date of installation for the system. (MD87010-92)

- Mound is continuing to provide instrumentation and expertise to SRS and LLNL to resolve safeguards related measurement problems. Mound provided a large volume calorimeter to LLNL. A transportable calorimeter and a gamma-ray spectroscopy system were loaned to SRS. Mound personnel installed the instrumentation at both sites and provides guidance in its operation. (MD87010-92)

- Mound continued participation in standards writing activities of the ASTM Subcommittee C26.10 on Nondestructive Assay and a number of ANSI safeguards related writing groups. (MD87010-92)

- Mound personnel are actively participating in a coordinated effort by the CTA to develop a training course covering basic Material Control & Accountability Measurements. (MD87010-92)

- The Calorimeter Operator Training School is a performance based training course developed at Mound to provide the participant with a better understanding and knowledge of heat flow calorimeters. The goal of the course is to increase the quality of calorimetry

measurements in the DOE complex. Course development involved performing a job task analysis utilizing the experience of calorimeter operators from several DOE sites. At the request of LANL the first offering of the calorimeter operator training school was held at Los Alamos. This is a CTA approved training course (CTA# MCA-246). This course is held at the site of the requestor. (MD87010-92)

- Assisted the Central Training Academy with development of a course on vulnerability assessment, attended and participated in the course as an evaluator and critically reviewed course materials and content. Participated in workshop on integration of physical protection and MC&A. (BNL86003-92)

- Issued updated and revised guidance document on the variance propagation requirements in the DOE Orders. Participated in Training Advisory Committee Safeguards Working Group activities. Assisted the Central Training Academy with development of a course on statistical sampling. (BNL86003-92)

- Assisted DOE with revision of the Orders on material control and accounting. Provided support to Headquarters on safeguards requirements related to weapons dismantlement operations, complex reconfiguration and restart activities. Assisted facilities with evaluation of inventory difference data. Developed simulation model and evaluated variance contributors for non-destructive assay instruments. (BNL90010-92)

- Provided technical support to DOE/OSS as requested. Provided comments and revisions of MC&A guides. Participated in working groups at the CTA. Participated in Security System Working Group. Reviewed User Need statements and linkages. Reviewed and provided input on B&R structure, the OSS 5-year plan, the Measurement Control Plan, and the training directive. Participated in Complex 21 Safeguards and Security Task Teams. Provided on-site support to DOE/OSS MC&A Branch in the form of one staff member assigned to DOE/OSS Headquarters. (LANL86014-92)

- Documented performance testing of new commercial shift-register electronics package, and began developing specifications for technology transfer of 256-channel neutron multiplicity electronics. Provided technology transfer for vendor fabrications and delivery of a NaI system for holdup monitoring. Provided designs for two commercially-fabricated Passive/Active Neutron (PAN) drum shufflers. Interacted with vendors regarding fabrication of NDA instruments as appropriate. Provided appropriate NDA design

C.2.d Technical Support (Continued)

information and consultation to vendors requested. (LANL90040-92)

- Completed materials for a seminar on Measurements Control Practices and began developing new materials for a seminar on Neutron NDA. Presented four seminars, including a new seminar on Measurement Control Practices. Updated seminar materials as needed. Developed and presented up-to-date materials on radiation and physical safety for students in all laboratory exercises, and developed radiation safety certification procedures for instructors. (LANL86022-92)

- Assisted in planning of MC&A courses at CTA as requested. Continued participation on the DOE/OSS Safeguards and Security Training Advisory Committee. (LANL86045-92)

C.3 Information Security

C.3.a Automated Information Systems Security

- Completed the VMS Security Guideline. This guideline was designed to provide DOE sites with a simple and clear description of the key security management activities for DEC VMS computers. (LLNL90013-93)

- Delivered approximately forty copies of the VMS Security Guideline to DOE, industry, and government personnel. (LLNL90013-93)

- Submitted article to EDPACS Newsletter on VMS Guideline. (LLNL90013-93)

- Demonstrated and evaluated the utility of the PC-based graphical network model and Security Plan Assistant to a significant field problem at a selected DOE site. Conducted a technical computer security workshop focussing on the security issues of distributed computing in network systems. Collected and disseminated to DOE information on computer security by issuing two Computer Security Newsletters. Technology transfer activities included continued distribution and at-site evaluation of computer security products including the PC-based graphical network software, the Security Plan Assistant, and technical reports and guidelines developed under the DOE/OSS program. To foster sharing of developed technologies and to reduce duplication of efforts and costs associated with computer security technology development, technical exchanges were conducted with the Department of Defense, the Department of

C.3.a Automated Information Systems Security (Continued)

Commerce, the Department of Justice, and the Department of Treasury. (LANL86008-92)

- Provided managerial support and program direction for the DOE/OSS-sponsored computer security program at Los Alamos. Provided technical assistance for DOE/OSS projects including developing guidelines and criteria for the cost-effective security evaluation and certification of computer networks. Completed a white paper on detection elements to address the insider threat for computer security. Helped with the security evaluation of software having DOE-wide applications. Provided input to the long-range planning activities for the DOE/OSS computer security research program. Facilitated communication and cooperation between DOE/OSS-funded computer security programs at other installations. (LANL89035-92)

- Completed a study of the Sandia National Laboratories - Albuquerque (SNLA) computer network that examined the technical issues in the design, implementation, and operation of the network. Participated in interim steering committee meetings to report on the status of working group performance testing. Documented interim progress through chart books and meeting minutes. Based on the experiences of the study, developed recommendations concerning DOE-wide network security policy. Completed a report specific to the SNLA computer network describing the technical conclusions of the study. (LANL91048-92)

C.3.f Technical Support

- Computer security incident handling continues to be CIAC's core activity. CIAC responded to a number of intrusions into DOE systems. These intrusions have taken advantage of many subtle vulnerabilities and have exploited anomalies in various operating systems. (LLNL90010-93)

- The CIAC team presented Incident Handling Workshops at Argonne National Laboratory, The Office of Scientific and Technical Information, and the Mason and Hanger-Silas Mason Pantex Plant. The team updated and reorganized the previous workshop course outline and lesson structure. CIAC plans to hold at least six workshops in FY93. The dates and locations are to be determined. (LLNL90010-93)

- CIAC distributed 30 bulletins to the field describing various vulnerabilities and detailed the procedures to eliminate them. Some of these bulletins also warned of on-going network intrusions and offered countermeasures. The CIAC FTP server and Felicia, our

C.3.f Technical Support (Continued)

bulletin board system, saw steadily increased usage throughout the year. These systems can be accessed as follows: The CIAC Bulletin Board, Felicia, can be accessed at 1200 or 2400 baud at (510) 423-4753 / FTS and 9600 baud at (510) 423-3331 / FTS. Previous CIAC notices are available on the Internet through anonymous FTP from irbis.llnl.gov (ip address 128.115.19.60). (LLNL90010-93)

- The Michelangelo event in March 1992 consumed a significant amount of our efforts. We expect that the mass media will continue to take an interest in computer security events that have wide-spread impact. (LLNL90010-93)

- CIAC plans to increase our exposure to the DOE community in FY93 by publishing several documents on how to respond to computer security incidents. These documents are expected to be distributed extensively within the DOE. (LLNL90010-93)

- Provided liaison and technical support staff for DOE/OSS as requested. (MMES92010-93)

- Technical assistance will have been provided for a three-hour AISS module in ISC 201. Initial activities will be undertaken for the AISS Introduction and Managers AISS Overview courses. (MMES92011-93)

C.5 Integrated Systems

C.5.b Systems Integration

- At Savannah River: completed NucMASloe prototype, the interface between the materials accounting system (NucMAS) and the variance propagation code MAWST. Investigated application of generic variance propagation software for all SRS areas using NucMASloe. At ANL-W: continued to enhance the PC-based accounting system ARGUS through addition of an authorization checking module. Completed software and documentation for ARGUS pre-authorization upgrade. Installed optical disk archival and backup software. Began testing these ARGUS upgrades at ANL-W. (LANL86018-92)

- Demonstrated the generic personnel and material tracking (PAMTRAK) system. Completed testing of PAMTRAK at Allied Signal and installed systems at the Savannah River and Hanford sites. Tested the ARGUS system in an operational environment at ANL-W. (SNL88024-92)

C.5.b Systems Integration (Continued)

- Work continues at LANL on the development of software required to evaluate the validity of transactions and identification of anomalous transactions and for the prior authorization of material access. (ANLW88001-92)

C.5.c Technical Support

- For complex reconfiguration, provided recommendations on NDA to Y-12 for uranium processing options, and provided technical task proposals (TTP's) on MC&A and NDA safeguards and planning for plutonium processing modules for Rocky II. As part of a Safeguards and Security technical task team, provided safeguards input for the complex reconfiguration Conceptual Design Report being prepared by the Architectural Engineer, Fluor-Daniels. At Livermore, provided support for the procurement of a passive-active californium shuffler, provided verification of new SGS standards, and began neutron multiplicity measurements of a wide variety of plutonium product, scrap, and waste. For Y-12, supported the integration of the Los Alamos miniature MCA with a bar-code reader system, and hosted a safeguards researcher to develop new interface modules. For Savannah River, consulted on NDA and moisture monitoring for plutonium weapons return materials. At Rocky Flats, began a holdup uncertainty propagation study, and provided proposals on NDA training and neutron instrumentation. At Los Alamos, provided a conceptual design for a tomographic SGS, and supported the duct holdup measurement program. Formed a neutron user's group to disseminate information on neutron NDA to all DOE facilities. (LANL86021-92)

- Provided guidance and assistance as requested on safeguards and security system integration to DOE facilities planning new or upgraded safeguards systems to assure that safeguards technology developed through the DOE safeguards R&D program is successfully integrated at the systems level for implementation. Completed applications guide for Cf shufflers, and completed applications note on HEU drum shipper/receiver confirmatory system (SRCS) and submitted it for peer review. Began drafting applications note on the FRAM Pu isotopics system. Applied information on neutron and gamma-ray NDA performance capabilities to safeguards system studies. Participated in a design review of the Los Alamos Nuclear Materials Storage Facility. (LANL90041-92)

C.5.c Technical Support (Continued)

- Revised and completed manual on safeguards systems design principles. Began outline of manual on selecting safeguards upgrades. (LANL89042-92)

C.5.f General

- Continued to provide technical support and training to OSS as well as field offices and contractors. SNL hosted Physical Security Technology Update 1992. (SNL860025-92)

APPENDIX B

DIRECTORY OF SAFEGUARDS AND SECURITY R&D DOCUMENTS
ISSUED DURING

FY 1992

The following is a compilation of S&S Technology Development papers and documents issued during FY 1992. The appendix includes a collection of reports and papers on the technology development efforts throughout the S&S community sponsored by the Office of Safeguards and Security. Requests for further information on the listed papers and documents as well as the sponsoring agencies may be referred to the OSS Planning and Technology Development Branch. The appendix is organized by subprogram areas within the Technology and Systems Development Program, as shown in Figure 1-B through 1-D.

APPENDIX B

DIRECTORY OF SAFEGUARDS AND SECURITY R&D DOCUMENTS ISSUED DURING FISCAL YEAR 1992

A. Science and Technology Base Development

1. Physical Security

b. Assessment

REPORT NUMBER	SAND91-2579
TITLE	Initial Laboratory Evaluation of Color Video Cameras
AUTHOR	P. L. Terry
PUBLICATION DATE	March 1992

ABSTRACT: Sandia National Laboratories has considerable experience with monochrome video cameras used in alarm assessment video systems. Most of these systems, used for perimeter protection, were designed to classify rather than identify an intruder. Monochrome cameras are adequate for that application and were selected over color cameras because of their greater sensitivity and resolution. The increased emphasis placed on the identification objective of video security stems leads to the need to improve system designs and upgrade existing stems. Color information is useful for identification purposes, and color camera technology is rapidly changing. Thus, Sandia National Laboratories established an ongoing program to evaluate color solid-state cameras. This report describes test parameters and procedures and provides the results of an initial evaluation.

REPORT NUMBER	SAND92-0108/2
TITLE	An Evaluation of Exterior Video Motion Detection Systems - Vol. 2: Nuisance Alarm Results
AUTHOR	Jose T. Vigil
PUBLICATION DATE	September 1992

ABSTRACT: This report discusses the testing and evaluation of two new and two upgraded, commercially available video motion detection (VMD) systems. This is part II of a two-part report. Part II focuses on nuisance alarm data results. (Part I focused on intrusion detection tests). Field tests were conducted in an exterior perimeter zone application. Nuisance alarm data was collected as continuously as possible. Different threshold settings were used throughout the data collection.

d. Entry/Exit Control

REPORT NUMBER	SAND91-2488
TITLE	Evaluation Tests of Secure 1000 Scanning System
AUTHOR	B. T. Kenna, D. W. Murray
PUBLICATION DATE	April 1992

ABSTRACT: The SECURE 1000 system was evaluated as a contraband detector. The evaluation was similar to developmental testing and was not an operational evaluation. The test was composed of a safety evaluation, and three target material tests: (1) explosives, (2) illegal chemical substances, and (3) weapons and special nuclear materials (SNM) container. Written records were made of all tests. The conduct of the tests were recorded on video tape and x-ray images were recorded on computer discs. The safety evaluation demonstrated that the dose from SECURE 1000 is 2 plus minus 1 microrem. Results from the other tests indicate that the SECURE 1000 does have applicability to contraband detection, i.e. detection of explosives, weapons, SNM containers, and illegal chemicals.

REPORT NUMBER	SAND90-1326
TITLE	The Collection, Handling, Transportation, and Thermal Description of Explosive Vapor Using Quartz Collection Tubes
AUTHOR	Philip J. Rodacy, David Ingeroll
PUBLICATION DATE	April 1992

ABSTRACT: This work describes the collection, handling, transportation, thermal description, and analysis of explosive vapors using quartz collection tubes. A description of the sampling system is presented, along with the collection efficiency of the quartz tubes and some of the precautions necessary to maintain the sample integrity. The design and performance characteristics of the thermal description system are also discussed. Collection of explosive vapor using empty, 0.25 inch O.D. by 5.25 inch long quartz tubes at a flow rate of 200 mL min01 is quite different. Thermal description of the explosive vapor molecules using a furnace that allows control of the gas phase chemistry in the IMS has been shown to provide a reliable, reproducible means of analysis. Empty quartz tubes provide a sharper description profile than packed collection tubes, resulting in a better signal-to-noise ratio, and perhaps, a lower detection limit than packed quartz tubes. Both the ion drift time of the explosive and its description characteristics can provide a means of identification. Sample handling, packaging, and transportation methods which minimize sample loss and contamination have been developed and evaluated.

REPORT NUMBER	SAND92-0732
TITLE	Automated Test System for Remote Badge Readers
AUTHOR	James P. Holmes, Taivas DeGroff
PUBLICATION DATE	August 1992

ABSTRACT: This document describes an automated, data acquisition system designed to test the performance of remote badge readers. These readers interrogate badges by transmitting and receiving energy. The performance of such readers is statistical and can be affected by geometrical and environmental variables. Characterization of performance, therefore, requires multiple measurements while the known variables are controlled. Automation makes this a practical task.

REPORT NUMBER	SAND92-1651
TITLE	Magnetic Stripe Technology Survey and Particle Rotation Technique Evaluation
AUTHOR	R. Brain Naylor, Terry J. Garino, Don J. Sharp
PUBLICATION DATE	August 1992

ABSTRACT: Part I of this report contains a technology survey of magnetic stripe fabrication techniques and discusses them for possible use on a government, magnetic striped, access control credential. Of the magnetic stripe production techniques studied, stripes produced by particle rotation appear to offer the greatest level of security against data alteration and stripe counterfeiting with the least increase in the fabrication cost of an access control badge. Due to this promise, the merits of particle rotation were investigated further, and a prototype production and encoding process for producing rotated particle magnetic stripes was designed. A set of laboratory sample stripes were also fabricated. This exploratory development work is described in Part II of this report. The technology survey, as well as the technique evaluation, were funded by the Department of Energy, Office of Safeguards and Security as a part of their Science and Technology Base Development, Advanced Security Concepts programs.

REPORT NUMBER	N/A
TITLE	Collisional Activation with Random Noise in Ion Trap Mass Spectrometry
AUTHOR	S.A. McLuckey, D.E. Goeringer, G. L. Glish
PUBLICATION DATE	1992

ABSTRACT: Random noise applied to the end caps of a quadruple ion trap is shown to be an effective means for the collisional activation of trapped ions independent of mass/charge ratio and number of ions. This technique is compared and contrasted with conventional single-frequency collisional activation for the molecular ion of N,N-dimethylaniline, protonated cocaine, the molecular anion of 2,4,8-trinitrotoluene, and doubly protonated neuromedin U-8. Collisional activation with noise tends to produce more extensive fragmentation than the conventional approach due to the fact that product ions are also kinetically excited in the noise experiment. The efficiency of the noise experiment in producing detectable product ions relative to the conventional approach ranges from being equivalent to being a factor of 3 less efficient. Furthermore, discrimination against low

mass/charge product ions is apparent in the data from multiply charged biomolecules. Nevertheless, collisional activation with random noise provides a very simple means for overcoming problems associated with the dependance of single-frequency collisional activation on mass/charge ratio and the number of ions in the ion trap.

2. Material Control and Accounting

a. Measurement

REPORT NUMBER	LANL89030
TITLE	A Compact Neutron Detector for a Geology Application
AUTHOR	R. S. Biddle and P.R. Collinsworth
PUBLICATION DATE	November 1991

ABSTRACT: We recently designed and built a compact neutron detector for a geology experiment. The detector had to fit inside a 1.5-in.-diam borehole in a large block of concrete. We attached a gas-filled, 1-in.-diam ^{3}He tube to a 1-in.-diam electronics preamplifier package of our design. The electronics package consists of a cylindrically shaped, high-voltage section and a single-channel analyzer with a buffered output. The low-voltage components are mounted on a printed-circuit board. The circuit board and the high-voltage section are attached to a semicylindrical base. The outputs consist of a light-emitting diode for visual observations and a fixed-width, TTL-compatible pulse for a counter. This internal assembly is equipped with coaxial connectors and slips into a thin-walled tube that serves as the preamplifier housing. Power for a detector is supplied by an external, high-voltage supply and a 5-Vdc supply.

REPORT NUMBER	LANL86004
TITLE	Segmented Flow Analysis: Alive, Well and Versatile as Ever
AUTHOR	D. A. Burns
PUBLICATION DATE	June 1992

ABSTRACT: Not available at this time.

REPORT NUMBER	LANL86003
TITLE	Measurement of the Assay Precision of the Active Neutron Multiplicity Technique
AUTHOR	N. Ensslin, D. W. Miller, M.C. Miller and M.S. Krick
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: This paper describes a measurement of the precision of the new active-neutron-multiplicity assay technique, which is currently under development for bulk uranium containing kilogram quantities of ^{235}U. The new technique analyzes neutron multiplicity data collected with a

coincidence counter outfitted with AmLi neutron sources. We report on the observed assay precision and the implications for field use of the technique.

REPORT NUMBER	LANL86003
TITLE	Plutonium Isotopic Abundance Measurements on CBNM NRM 271 Analyzed with the FRAM and MGA Codes
AUTHOR	R.J. Friar and T.E. Sampson
PUBLICATION DATE	May 1992

ABSTRACT: We report results of gamma-ray spectrometry measurements of the isotopic distributions of plutonium in the reference-material set CBNM NRM 271 as analyzed by the FRAM and MGA plutonium isotopic codes. We acquired high-quality spectral data under measurement conditions approximating field-use conditions recommended by the code developers. Bias and precision results from these measurements are presented for both codes. Both codes performed very well for these measurements. These standards have proven to be very useful for testing the Los Alamos FRAM code in the high-burnup region where well-characterized materials have been unavailable at Los Alamos.

REPORT NUMBER	LANL86016
TITLE	Characterization and Propagation of Uncertainties Associated with Holdup Measurements at Rocky Flats
AUTHOR	J. B. Glick, F. W. Lamb, D.R. Weier, R. Boan, G.A. Sheppard, N. Ensslin, and A. Goldman
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: EG&G Rocky Flats, Inc. has an ongoing campaign to measure plutonium holdup in the glovebox exhaust ducts. Up to the present time, the total Pu assay of a duct has been assigned a relative uncertainty of 100%. In practice this has been accomplished by multiplying the integral of the point assays along the duct by a factor of two. While it is generally agreed that this approach is conservative, it is also conceded that the 100% uncertainty is arbitrary, and that this approach provides no basis for deducing realistic confidence limits. A more satisfactory and statistically defensible approach is to determine the uncertainties associated with each point assay and then to propagate these uncertainties as the point assays are integrated for a duct total. This total can then be reported with realistic confidence limits. The difficulty is that the sources of uncertainty in a holdup measurement are numerous and difficult to characterize. This study characterized the significant sources of holdup measurement uncertainty at Rocky Flats, and using standard statistical methods, combined them to estimate the uncertainty for each measurement point. A strategy for propagating the point assay uncertainties into an overall uncertainty for the total duct holdup was also developed.

REPORT NUMBER	LANL89030
TITLE	Recent Developments in Multiplicity Counting Hardware at Los Alamos
AUTHOR	J.K. Halbig, S.C. Bourret, P.R. Collinsworth, W.J. Hansen, and M.S. Krick
PUBLICATION DATE	November 5-9, 1992

ABSTRACT: This paper describes a prototype, 256-channel neutron-multiplicity-counting circuit. It is being used with a 4-MHz shift-register-based neutron coincidence circuit. We developed both circuits. They mount in a double-wide nuclear instrument module.

REPORT NUMBER	LANL89030
TITLE	A Miniature Modular Multichannel Analyzer System for Automated, Low-Resolution Gamma-Ray Spectroscopy
AUTHOR	J.K. Halbig, S.F. Klosterbuer, P.A. Russo, J.K. Sprinkle, Jr., and S.E. Smith
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: A new, miniature modular multichannel analyzer (MMMCA) is being designed to meet facility holdup measurement needs. The palm-size, processor-based modular unit includes self-contained battery power, a low-resolution amplifier, high-voltage power, an analog-to-digital converter, and nonvolatile memory to automatically set up hardware and specify conditions for data acquisition. During supervisory setup, checkout, and calibration of the assay system, the MMMCA is connected to a PC by serial port. The PC program provides a display of the spectrum and a user-friendly interface to the typical multichannel analyzer features. The program is used to set the parameters for the desired MMMCA measurement conditions and hardware settings. To achieve the required simplicity and portability in routine operation for holdup measurements, we replaced the PC with a pocket-size, programmable, controller/data-logger unit that automates the acquisition and storage of data and accepts identification and measurement-geometry input from the user by its keypad or by measurement-location bar codes. This particular controller unit is also used to transport the stored user input, reduced data, and location bar codes for hundreds of holdup measurements to a PC database manager that is utilized by a software program to calculate holdup masses.

REPORT NUMBER	LANL89030
TITLE	Miniature MCA Technology Developments
AUTHOR	J.K Halbig, S.F. Klosterbuer, M.M. Stephens, and R.S. Biddle
PUBLICATION DATE	November 5-9, 1992

ABSTRACT: We have recently reduced the size of multichannel analyzers (MCAs) and have implemented more features in hardware to relieve software requirements. We built and tested a spectroscopy grade, 4096-channel MCA. Exclusive of amplifier and power supply, it fits on two boards each approximately 7 by 15 cm. This paper discusses the features and performance of the analyzer and some reasonable applications of these technologies.

REPORT NUMBER	LANL86003
TITLE	Development of Plutonium solution Assay Instrument with Isotopic Capability
AUTHOR	S.T. Hsue and T. Marks
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: A new generation of solution-assay instrument has been developed to satisfy all the assay requirements of an aqueous plutonium-recovery operation. The assay is based on a transmission-corrected passive assay technique. We have demonstrated that the system can cover a concentration range of 0.5-300 g/l with simultaneous isotopic determination. The system can be used to assay input and elutriate streams of the recovery operation. The system can be modified to measure low-concentration effluent solutions from the recovery operation covering 0.01-40 g/l. The same system has also been modified to assay plutonium solutions enriched in ^{242}Pu.

REPORT NUMBER	LANL86003
TITLE	Thermal Neutron Multiplicity Counter Measurements
AUTHOR	M.S. Krick, D.G. Langner, D.W. Miller, J.R. Wachter, and S.S. Hildner
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: An in-plant thermal-neutron multiplicity counter was designed and built to assay plutonium samples for which the relative (a,n) neutron yield and the neutron multiplication are not known. Such samples are difficult to assay with conventional neutron coincidence counting techniques. We have characterized this counter with various ^{252}Cf sources and plutonium samples to study the neutron detection efficiency, electronic deadtime, and neutron die-away properties of the detector and associated electronics. We used a new shift-register electronics module that features 256 channels for multiplicity counting. Preliminary reference parameters have been obtained for performing assays with the multiplicity counting system. We measured a variety of plutonium materials with the in-plant counter in the Los Alamos Plutonium Facility. The materials included samples with high neutron multiplication and samples with high (a,n) neutron yields. Preliminary assay results are presented.

REPORT NUMBER	LANL90039
TITLE	The Use of Ring Ratios to Detect Sample Differences in Passive Neutron Counting
AUTHOR	D.F. Langer, M.S. Krick, and D.W. Miller
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: In passive thermal neutron counting, the detection efficiency of a neutron counter is susceptible to changes in the neutron energy spectrum emitted by a sample. Variable levels of moisture and impurities in samples can cause such changes and thus affect the accuracy of an assay. In this work, we use Monte Carlo simulations of thermal neutron measurements in the four-ring pyrochemical multiplicity counter to study the effect of sample-to-sample changes in the emitted neutron spectrum on the ratios of

total neutron counts from the different rings. We also present ring ratio data obtained in the pyrochemical multiplicity counter for several pure and impure plutonium bearing samples.

REPORT NUMBER	LANL86015, LANL89031
TITLE	Waste-Crate Counter Design
AUTHOR	D.G. Langer, M.C. Miller, and J.R. Wachter
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: We have examined a number of scenarios for configuring slab counters to measure low-level, noncompactible plutonium-bearing waste (LLW) and waste destined for burial at the Waste Isolation Pilot Plant (WIPP) facility. This system must be capable of discriminating waste that is above the 100-nCi/g level from waste that is below this level in reasonable measurement times in an environment susceptible to varying neutron backgrounds; must be able to measure higher level waste destined for the WIPP facility with a reasonable accuracy; and finally, must be somewhat transportable. The system will consist of four slabs each having twenty 152-cm-long ^{3}He tubes. With the four slabs placed optimally for the different types of waste containers, our calculations predict a detection efficiency of about 4.5% in the center between the four slabs. These calculations also predict that the system will be able to discriminate the LLW in 1 to 12 h, depending on the neutron background, and that the system will be able to measure WIPP crates to a 1-s accuracy of about 20% for loadings near the WIPP upper limit. Our calculations have shown that this latter accuracy is determined primarily by the geometric response of the counters rather than the count time.

REPORT NUMBER	LANL89031
TITLE	Accurate Plutonium Waste Measurements Using the Cf-252 Add-A-Source Technique for Matrix Corrections
AUTHOR	H.O. Menlove
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: We have developed a new measurement technique to improve the accuracy and sensitivity of the nondestructive assay (NDA) of plutonium scrap and waste. The 200-l drum assay system uses the classical NDA method of counting passive-neutron coincidences from plutonium but has added the new features of "add-a-source" to improve the accuracy for matrix corrections and statistical techniques to improve the low-level detectability limits. The add-a-source technique introduces a small source of ^{252}Cf (10^{-8} g) near the external surface of the sample drum. The drum perturbs the rate at which coincident neutrons from the ^{252}Cf are counted. The perturbation provides the data to correct for the matrix and plutonium inside the drum. The errors introduced from matrix materials in 200-l drums have been reduced by an order of magnitude using the add-a-source technique. In addition, the add-a-source method can detect unexpected neutron-shielding material inside the drum that might not allow the detection of special nuclear materials. The detectability limit of the new waste-drum assay system for plutonium is better than prior systems for actual waste materials. For the in-plant installation at a mixed-oxide fabrication facility, the detectability limit is 0.73 mg of ^{240}Pu (or 2.3 mg of high-burnup plutonium) for a 15-min.

measurement. For a drum containing 100 kg of waste, this translates to about 7 nCi/g. This excellent sensitivity was achieved using a special low-background detector design, good overhead shielding, and statistical techniques in the software to selectively reduce the cosmic-ray neutron background.

REPORT NUMBER	LANL89031
TITLE	WDAS Operation Manual Including the Add-A-Source Function
AUTHOR	H.O. Menlove, J. Baca, W. Harker, K.E. Kroncker, M.C. Miller, S. Takahashi, H. Kobayashi, S. Seki, K. Matsuyama, and S. Kobayashi
PUBLICATION DATE	April 1992

ABSTRACT: This manual describes the design features, performance, and operating characteristics of a 200-l-drum neutron coincidence counter. The counter has six shielded banks of ^{3}He tubes and a motor-driven door with built-in safety interlocks. The new design has a counting efficiency of 18.6%. The neutron counter measures the spontaneous-fission rate from the plutonium, and when this is combined with the plutonium isotopic ratios, we can determine the plutonium mass. The system can accommodate plutonium loadings up to 10 kg, and the sensitivity limit is less than one milligram of ^{240}Pu-eff. The system includes the new add-a-source (AS) technique that uses a small ^{252}Cf source to determine the drum's matrix perturbation to the plutonium assay. This manual gives the performance and calibration parameters. The matrix corrections by the AS technique are accurate to a few percent for typical applications.

REPORT NUMBER	86003, 86019
TITLE	Capability and Limitation Study of the DDT Passive-Active Neutron Waste Assay Instrument
AUTHOR	N.J. Nicholas, K.L. Coop and R.J. Estep
PUBLICATION DATE	May 1992

ABSTRACT: The differential-dieaway-technique passive-active neutron assay system is widely used by transuranic waste generators to certify their drummed waste for eventual shipment to the Waste Isolation Pilot Plant (WIPP). Stricter criteria being established for waste emplacement at the WIPP site has led to a renewed interest in improvements to and a better understanding of current nondestructive assay (NDA) techniques. Our study includes the effects of source position, extreme matrices, high neutron backgrounds, and source self-shielding to explore the system's capabilities and limitations and to establish a basis for comparison with other NDA systems.

REPORT NUMBER	LANL90039
TITLE	Matrix and Position Correction of Shuffler Assays by Application of the Alternating Conditional Expectation Algorithm to Shuffler Data
AUTHOR	M.M. Pickrell and P.M. Rinard
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: The ^{252}Cf shuffler assays fissile uranium and plutonium using active neutron interrogation and then counting the induced delayed neutrons. Using the shuffler, we conducted over 1700 assays of 55-gal. drums with 28 different matrices and several different fissionable materials. We measured the drums to diagnose the matrix and position effects on ^{252}Cf shuffler assays. The matrices incorporated metals, neutron poisons, and hydrogen in densities ranging from 0.086 g/cm^3, a range of cases more extreme than typically found in routine plant use. We used several neutron flux monitors during irradiation and kept statistics on the count rates of individual detector banks. The intent of these measurements was to gauge the effect of the matrix independently from the uranium assay.

Although shufflers have previously been equipped with neutron monitors, the functional relationship between the flux monitor signals and the matrix-induced perturbation has been unknown. There are several flux monitors so the problem is multivariate, and the response is complicated. Conventional regression techniques cannot address complicated multivariate problems unless the underlying functional form and approximate parameter values are known in advance. Neither was available in this case. To address this problem, we used a new technique called alternating conditional expectations (ACE), which requires neither the functional relationship nor the initial parameters. The ACE algorithm develops the functional form and performs a numerical regression from only the empirical data. We applied the ACE algorithm to the shuffler-assay and flux-monitor data and developed an analytic function for the matrix correction. This function was optimized using conventional multivariate techniques. We were able to reduce the matrix-induced-bias error for homogeneous samples to 12.7%. The bias error for inhomogeneous samples was reduced to 13.5%. These results used only a few adjustable parameters compared to the number of available data points; the data were not "over fit", but rather the results are general and robust.

REPORT NUMBER	LANL86003, LANL86015, LANL90039
TITLE	Nondestructive Assays of 55-Gallon Drums Containing Uranium and Transuranic Waste Using Passive/Active Shufflers
AUTHOR	P.M. Rinard, E.L. Adams, H.O. Menlove, and J.K. Sprinkle, Jr.
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: A passive-active neutron shuffler for 55-gal. drums of waste has been characterized using more than 1500 active and 500 passive assays on drums with 28 different matrices. Flux-monitor corrections have been improved, the assay accuracy with localized fissile materials in a drum has been characterized, and improvements have been suggested. Minimum detectable masses for ^{235}U with active assays and $^{240}Pu_{eff}$ with passive

assays are presented for the various amounts of moderators and absorbers studied.

REPORT NUMBER	LANL86003
TITLE	Precision of Gamma-Ray Measurements of the Effective Specific Power and Effective ^{240}Pu Fraction of Plutonium
AUTHOR	T.E. Sampson
PUBLICATION DATE	May 1992

ABSTRACT: This paper uses gamma-ray spectrometry data from replicate measurements on 40 plutonium-bearing samples to examine the repeatability of the effective ^{240}Pu fraction ($^{240}Pu_{eff}$) and the effective specific power (P_{eff}) calculated from the isotopic distribution analyzed with gamma-ray spectrometry codes. The measurements were used to identify the error component arising from repeatability in the determination of the isotopic composition of plutonium in the sample and the contribution of the error component to the uncertainty in total plutonium mass measurements from neutron coincidence counting ($^{240}Pu_{eff}$) and calorimetry (P_{eff}). The 40 samples had $^{240}Pu_{eff}$ percentages ranging from 2 to 39% and P_{eff} values ranging from 2 to 16 mW/gPu. Four different gamma-ray spectrometry codes (FRAM, MGA, Blue Box, and PUJRC) were used to analyze the data (not all samples were analyzed with each code).

All analyses showed that the percent relative standard deviation of P_{eff} was smaller than that of $^{240}Pu_{eff}$. This result coupled with a cursory examination of uncertainties in coincidence counting of well-characterized samples and water-bath calorimetry errors for the same types of samples leads to the conclusion that smaller uncertainties will be present in the total plutonium mass determined by the combination of calorimetry/ gamma-ray spectrometry than in the mass determined by coincidence counting/gamma-ray spectrometry. An additional examination of the biases arising from the ^{242}Pu correlation used in the gamma-ray spectrometry codes also supported this conclusion.

REPORT NUMBER	LANL90039
TITLE	Computer Simulation of a Germanium Detector Response to Highly Radioactive Waste
AUTHOR	R. Sigg, M.C. Miller, and D.A. Close
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: The Defense Waste Processing Facility (DWPF) at the Savannah River Site will prepare high-level radioactive waste for disposal through the use of a glass solidification process. Westinghouse Savannah River Laboratory personnel are supporting the DWPF in the area of process instrumentation. One type of monitoring system would use a germanium detector positioned at the canyon wall to monitor the waste canister as it is being filled. The ratio of photopeaks from appropriate fission product gamma rays will be determined to provide information on the uniformity of fill of the waste canister and to indicate process performance. Los Alamos National Laboratory personnel are supporting the Westinghouse Savannah River Laboratory by performing computer simulations of the germanium detector response. The Los Alamos Monte Carlo transport code, MCNP, was used to

simulate the spectra obtained from a coaxial germanium detector that was nominally 30% efficient. The computer model included the germanium detector, the concrete wall collimator, and the canister itself. A pulse-height detector tally was used to bin the energy deposited in the germanium crystal. The ability of MCNP to accurately model the geometry and composition of the detector and surrounding materials is an important aspect in the accuracy of spectral simulation because much of the spectrum is due to scattered radiation. Effects of the high radiation level and subsequent distortions in the electronic processing of detector pulses were not included in the simulation. Results of the MCNP calculations and comparisons with experimental data will be presented.

REPORT NUMBER	LANL89030
TITLE	A New, Low-Profile Neutron Detector Junction Box
AUTHOR	B.G. Strait, P.R. Collinsworth, H.R. Dye, and K.E. Kroncke
PUBLICATION DATE	November 5-9, 1991

ABSTRACT: We have designed a new junction box for nondestructive assay instruments that is easier to build, maintain, and repair. Most high-voltage components are sealed from the atmosphere using potting material, therefore eliminating the maintenance requirement of replacing desiccators. The mechanical design cuts the cost of machining and makes it easy to remove and replace the ^{3}He tubes.

REPORT NUMBER	LA-UR-92-242
TITLE	Improvement of Sample Preparation for Input Plutonium Accountability Measurement by Isotope Dilution Gamma-Ray Spectrometry
AUTHOR	K.Nishida, Y.Kuno, S. Sato, J. Masui, T.K., Li and J.L. Parker
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: The sample preparation method for the isotope dilution gamma-ray spectrometry (IDGS) technique has been further improved for simultaneously determining the plutonium concentration and isotopic composition of highly irradiated spent-fuel dissolver solutions. The improvement includes using ion-exchange filter papers (instead of resin beads, as in two previous experiments) for better separation and recovery of plutonium from fission products. The results of IDGS measurements for five dissolver solutions are in good agreement with those by mass spectrometry with ~0.4% for plutonium concentration and ~0.1% for ^{238}Pu isotopic composition. The precision of the plutonium concentration is ~1% with a 1-h count time. The technique could be implemented as an alternative method for input accountability and verification measurements in reprocessing plants.

REPORT NUMBER	IS-5075
TITLE	Optical Assay Technology for Safeguards
AUTHOR	Edelson, M.C., Lipert, R.J., Murray, G.M., Schuler, R.A., Weeks, S.J., Wang, Z-M
PUBLICATION DATE	January 1992

ABSTRACT: Research conducted in the Ames Laboratory Nuclear Safeguards and Security Program during the period April 1, 1991 to June 30, 1991 is reviewed. Current work in applying optical spectroscopy to the determination of actinides and related elements in the gas phase is discussed. Progress in applying optical spectroscopy to the determination of ions in condensed phases is also reviewed. A data acquisition system using LabVIEW 2 for software development is also described.

REPORT NUMBER	IS-5078
TITLE	Optical Assay Technology for Safeguards
AUTHOR	Edelson, M.C., Harold, K.A., Lipert, R.J., Murray, G.M., Schuler, R.A., Wang, Z-M
PUBLICATION DATE	May 1992

ABSTRACT: Research conducted in the Ames Laboratory Nuclear Safeguards and Security Program during the period July 1, 1991 to September 30, 1991 is reviewed. Current work in applying optical spectroscopy to the determination of actinides and related elements in the gas phase is discussed. Progress in applying optical spectroscopy to the determination of ions in condensed phases is also reviewed.

REPORT NUMBER	IS-J 4134
TITLE	A High Temperature Oven for Laser Spectroscopy
AUTHORS	Wang, Z-M., Weeks, S.J., Edelson, M.C.
PUBLICATION DATE	1991

ABSTRACT: A commercial heat-pipe oven (HPO) was modified to extend the useful temperature range from 700°C to ~1700°C. The utility of the modified heat pipe oven as an atom source for spectroscopy is demonstrated with a laser atomic absorption study of the hyperfine splitting of Tm (m.p. 1545°C).

REPORT NUMBER	IS-J 4220
TITLE	Isotopic Abundance Determination By Inductively Coupled Plasma High-Resolution Laser Excited Atomic And Ionic Fluorescence Spectroscopy
AUTHORS	Vera, J.A., Murray, G.M., Weeks, S.J.,Edelson, M.C.
PUBLICATION DATE	1991

ABSTRACT: Inductively coupled plasma-laser excited atomic fluorescence spectroscopy (ICP-LEAFS) has been successfully applied to isotopic analysis for the first time. The criteria for selecting useful excitation/fluorescence line pairs are presented and applied to the determination of uranium isotope

concentration. Calculations of the ICP-LEAFS line profiles for U II 286.57 and 288.96 nm excitation are presented and suggest that the first transition should be useful for isotopic analysis using the ICP source, with a multi-mode dye laser, whereas the second should not. These results were confirmed by experiment. The detection limit for U via ICP-LEAFS using the 286.57/288.96 nm excitation/fluorescence line pair was estimated to be ~2 μg/ml. The non-resonance fluorescence determination of U dissolved in a very complex matrix was shown to be independent of spectral line interferences from the matrix elements.

REPORT NUMBER	IS-J 4250
TITLE	Determination of Uranium Isotopes in a Complex Matrix by Optical Spectroscopy
AUTHORS	Murray, G.M., Weeks, S.J., Edelson, M.C.
PUBLICATION DATE	1992

ABSTRACT: The isotopic determination of ^{235}U and ^{238}U in complex matrices, without prior chemical separation and at μg mL^{-1} detection limits is demonstrated. A narrow line, pulsed dye laser is used to excite fluorescence from uranium ions in an inductively coupled plasma (ICP) discharge. Measurements of uranium fluorescence in dilute acid solutions and in simulated dissolved glass solutions, similar to those proposed for the vitrification of high level nuclear wastes, are presented. The ICP optical emission spectra of uranium in the matrix and of uranium in a dilute acid solution, in the same wavelength range as the fluorescence measurements, are shown for comparison.

REPORT NUMBER	IS-J 4564
TITLE	Application of Diode Lasers to Actinide Atom Monitoring
AUTHORS	Lipert, R.J., Lee, S.C., Edelson, M.C.
PUBLICATION DATE	1992

ABSTRACT: The application of commercial diode lasers to the monitoring of actinide atoms in the gas phase is demonstrated for the first time. The resolution achieved is shown to be sufficient for the isotopic analysis of many actinides, including uranium.

c. Control

REPORT NUMBER	LANL86001
TITLE	Portable Gamma-Radiation Analyzer for Treaty Verification
AUTHOR	K. B. Butterfield, W.S. Murray, D. R. Millegan, and L.E. Ussery
PUBLICATION DATE	November 1991

ABSTRACT: Not available at this time.

REPORT NUMBER	LANL86001
TITLE	Portable Radiation-Detection Instruments for Distinguishing Nuclear from Non-Nuclear Munitions
AUTHOR	Paul E. Fehlau
PUBLICATION DATE	November 5-9, 1991

ABSTRACT: The emission of gamma rays and fast neutrons by nuclear materials provides a simple means for distinguishing between real nuclear munitions and other assemblies that are non-nuclear, such as nuclear-explosive-like test assemblies (NELAs) and conventional munitions. The presence or absence of significant numbers of neutrons and characteristic plutonium gamma rays are distinguishing attributes for plutonium munitions. The presence of energetic gamma rays from 232U daughters, if present in sufficient number, is a distinguishing attribute for highly enriched uranium munitions. Some portable instruments are being developed for verifying that munitions are or are not nuclear, and others are already commercially available. The commercial ones have been evaluated for pre-flight non-nuclear verification of NELAs in Air Force flight tests.

REPORT NUMBER	LANL86001
TITLE	An Update on SNM-Detection Instruments for Distinguishing Nuclear from Non-Nuclear Munitions
AUTHOR	Paul E. Fehlau
PUBLICATION DATE	August 11-13, 1992

ABSTRACT: Since 1972, the Los Alamos Advanced Nuclear Technology Group has been a center for developing and evaluating radiation detection instruments for measuring and monitoring the gamma-ray and neutron emissions from special nuclear materials (SNM). Over the years, we have studied and developed methods and equipment for best detecting SNM passing across facility and access-area perimeters. We have transferred much of the technology to users and manufacturers, and we have evaluated most of the commercially available SNM monitoring equipment. This update describes SNM monitoring and discusses recent developments and evaluations.

d. General

REPORT NUMBER	LANL86007
TITLE	Variance Propagation Using the VP Code
AUTHOR	E.A. Kern
PUBLICATION DATE	September 29 - October 4, 1991

ABSTRACT: The Variance Propagation (VP) Code was developed by the Los Alamos National Laboratory's Safeguard's Systems Group to provide off-line variance propagation and systems analysis for nuclear material processing facilities. The code can also be used as a tool in the design and evaluation of material accounting systems. In this regard, the VP code was enhanced to incorporate a model of the material accountability measurements used in the Idaho Chemical Processing Plant operated by the Westinghouse Idaho

Nuclear Company. Inputs to the code were structured to account for the dissolver/headend process, the waste streams, process sweepdowns, intercycle measurements, and nuclear material products. Tradeoff studies were performed to determine the sensitivity of measurement and sampling errors to the overall material balance error. We determined that the material balance error is very sensitive to changes in the sampling errors.

REPORT NUMBER	LANL86006
TITLE	Requirements for an Anomaly Detection System Integrated into an Automated MC&A System
AUTHOR	R. Whiteson and J.A. Howell
PUBLICATION DATE	June 1992

ABSTRACT: An automated safeguards system must be able to detect an anomalous event, identify the nature of the event, and recommend a corrective action. Neural networks represent a new way of thinking about basic computational mechanisms for intelligent information processing. In this paper, we discuss the issues involved in applying a neural network model to the first step of this process: anomaly detection in materials accounting systems. We extend our previous model to a 3-tank problem and compare different neural network architectures and algorithms. We evaluate the computational difficulties in training neural networks and explore how certain design principles affect the problems. The issues involved in building a neural network architecture include how the information flows, how the network is trained, how the neurons in a network are connected, how the neurons process information, and how the connections between neurons are modified. Our approach is based on the demonstrated ability of neural networks to model complex, nonlinear, real-time processes. By modeling the normal behavior of the processes, we can predict how a system should be behaving and, therefore, detect when an abnormality occurs.

REPORT NUMBER	LANL86007
TITLE	Fuzzy Resource Optimization for Safeguards
AUTHOR	A. Zardecki and J.T. Markin
PUBLICATION DATE	September 29 - October 4, 1991

ABSTRACT: Analyzing the risk of a safeguards system, in particular the security of a computer network based on the notion of fuzzy sets and linguistic variables, addresses concerns such as complexity and inherent imprecision in estimating the possibility of loss or compromise. Automated risk analysis allows the risk to be determined for an entire system based on estimates for lowest level components and the component weight. In addition, for each component (asset) we select the most effective combination of protection mechanisms against a given set of threats.

REPORT NUMBER	LANL86007
TITLE	Resource-Allocation Optimization Program for Safeguards - Version 2.0
AUTHOR	A. Zardecki, J.T. Markin, and P. Henriksen
PUBLICATION DATE	March 1992

ABSTRACT: This manual is a guide to the resource-allocation optimization program for safeguards (RAOPS). It provides an overview of the software, explains its operation, and presents an example to illustrate its use. The software uses dynamic programming to help you make the best use of physical and economic resources in safeguarding special nuclear material. The divergent configuration of activities is designed for application to nuclear safeguards. The convergent and loop-forward configurations are included, but they are still experimental.

3. Information Security

a. Automated Information Security Systems

REPORT NUMBER	N/A
TITLE	Finding Security Flaws in Concurrent and Sequential Designs Using Planning Techniques
AUTHOR	Deborah A. Frincke, Myla Archer, Karl Levitt
PUBLICATION DATE	October 1992

ABSTRACT: This paper presents an automated system (SPLAN) that can assist in the validation of secure systems. SPLAN, based on classical planning ideas, takes as input a system description (specifications and/or code, including concurrent programs) and a more abstract specification (e.g., a specification of disallowed states based on a security policy) and attempts to generate a sequence of operations or code statements that will cause the system to reach a state disallowed by the policy. Thus SPLAN attempts to generate sequences of operations that violate the security policy. SPLAN has built-in heuristics to reduce the space of operation sequences it searches, such as loop detection, templates of operations that are flagged as suspicious by a security flow analyzer. We believe that SPLAN would be most useful in the valuation process when applied after the use of conventional testing and of a flow analyzer but before verification is attempted. This paper presents various examples showing how SPLAN can detect covert pictorial channels in a specification for a secure user interface management system and in an erroneous - and previously published - mutual exclusion program.

REPORT NUMBER	N/A
TITLE	Internetwork Security Monitor: An Intrusion-Detection System for Large-Scale Networks
AUTHOR	L.T. Herberlein, B. Mukherjee, K.N. Levitt
PUBLICATION DATE	October 1992

ABSTRACT: The model for an Internetwork Security Monitoring (ISM) is presented. The objective of the model is to significantly improve our

capability to detect and react to intrusions into an arbitrary wide-area network (WAN) (e.g., the Internet) through a distributed intrusion-detection and analysis system. The system will monitor the various component networks of the internetwork and bring potentially intrusive behavior to the attention of the local-network security managers. The model primarily extends the DIDS and NSM intrusion-detection systems and takes advantage of, but does not require, cooperative host monitoring. This design will provide the first intrusion-detection system that aggregates information from different monitors over wide-area networks and will be deployable at different sites with widely different operating environments and security requirements.

REPORT NUMBER	N/A
TITLE	PM: A Unified Automated Deduction Tool for Verification
AUTHOR	George Fink, Lie Yang, Myla Archer
PUBLICATION DATE	October 1992

ABSTRACT: We are developing a tool called PM (Proof Manager) that provides flexible support for the use of automated deduction in verification by providing a common interface to a variety of existing theorem provers. PM works to blend the strengths of these different provers into a proof system more powerful than its competent parts individually. The assertion language of our PM prototype is that of the HOL theorem proving system [Gordon87], chosen because it provides a verifier with a very expressive higher-order assertion language that is especially suited to expressing specifications of complex systems (such as secure distributed systems) and high level reasoning, but -- being essentially a proof checker -- is tedious to use for lower level assertions that are simple for automatic first-order provers. PM is intended to supplement HOL in a sound manner with access to various existing, polished automatic provers. Simultaneously, PM provides a verifier with a convenient means of managing and summarizing proofs.

REPORT NUMBER	N/A
TITLE	Can We Track Code to its Authors?
AUTHOR	Eugene H. Spafford, Stephen A. Weeber
PUBLICATION DATE	October 1992

ABSTRACT: Viruses, worms, trojan horses, and crackers all exist and threaten the security of our computer systems. Often, we are aware of an intrusion only after it has occurred. On some occasions, we may have a fragment of code left behind -- used by an adversary to gain access or damage the system. A natural question to ask is "Can we use this remnant of code to identify the culprit?" In this paper, we detail some of the features of code remnants that mights be analyzed and then used to identify their authors. We further outline some of the difficulties involved in tracing an intruder by analyzing code. We conclude by discussing some future work that needs to be done before this approach can be properly evaluated. We refer to our process as software forensics, similar to medical forensics: we are examining the remains to obtain evidence about the factors involved.

REPORT NUMBER	N/A
TITLE	DIDS Motivation, Architecture, and an Early Prototype
AUTHOR	Steven Snapp, Todd Herberlein, Tim Grance, and Doug Mansur
PUBLICATION DATE	November 1991

ABSTRACT: Intrusion detection is the problem of identifying unauthorized use, misuse, and abuse of computer systems by both system insiders and external penetrators. The proliferation of heterogeneous computer networks provides additional implications for the intrusion detection problem. Namely, the increased connectivity of computer systems gives greater access to outsiders, and makes it easier for intruders to avoid detection. IDS' are based on the belief that an intruder's behavior will be noticeably different from that of a legitimate user. We are designing and implementing a prototype Distributed Intrusion Detection System (DIDS) that combines distributed monitoring and data reduction (through individual host and LAN monitors) with centralized data analysis (through the DIDS director) to monitor a heterogeneous network of computers. This approach is unique among current IDS'. A main problem considered in this paper is the Network-User Identification problem, which is concerned with tracking a user moving across the network, possibly with a new user-id on each computer. Initial system prototypes have provided quite favorable results on this problem and the detection of attacks on a network. This paper provides an overview of the motivation behind DIDS, the system architecture and capabilities, and a discussion of the early prototype.

REPORT NUMBER	LANL86010
TITLE	The Los Alamos National Laboratory Integrated Computer Network
AUTHOR	J. S. Dreicer
PUBLICATION DATE	June 1992

ABSTRACT: A study of the Los Alamos National Laboratory Integrated Computer Network (ICN) was conducted utilizing the Graphical Network Representation (GRPHREP) model. The GRPHREP system was developed for a Texas Instrument Explorer workstation, and the Graphical Network Security System (GNETS) was developed for a PC system. The GRPHREP and the GNETS models are functionally equivalent software tools. The GRPHREP model is a software system application based on graph theory and object-oriented programming methodologies. It codifies the Department of Energy (DOE) Order 5637.1, which is concerned with classified computer security policy, restrictions, and requirements. The Los Alamos ICN is required to control access to and support large-scale scientific and administrative computing. Furthermore, the ICN is composed of multiple partitions that reflect the sensitivity and classification of the computation (data) and designate the required clearance level for the user. The determination of the sufficiency of these classification and clearance restrictions in conjunction with the ICN partitions supplied an excellent opportunity to exercise the implementation (codification) of Order 5637.1. Because the Los Alamos ICN is a large, complex, and dynamic network, the graphical and functional capabilities of the GRPHREP model were tested.

REPORT NUMBER	LANL89033
TITLE	GNETS (Graphical Network Security System) User Guide
AUTHOR	L.A. Stoltz
PUBLICATION DATE	April 1992

ABSTRACT: The GNETS system provides a means of evaluating the security of a computer network operating under DOE guidelines. It is a PC-based system developed to be used by system security personnel to check the security of existing networks, to evaluate the security of proposed networks, and to increase the capability to conduct additional research on networked systems. GNETS allows the user to "build" a computer network graphically. As machines are added to the network, the intelligent graphical interface prompts the user for relevant machine characteristics and security information. As the computer network is created and depicted, a dynamic analysis process inspects the security of the network and warns the user of any security risks. The user can save the network that has been constructed and return to it later to review or modify it. The system is implemented in Zortech C++ for 286 PCs (and compatible microcomputers) with 550K RAM and a graphics display monitor.

B. Concept and Demonstrational Development

1. Physical Security

b. Assessment

REPORT NUMBER	SAND92-0396
TITLE	Overview of the Target Cueing and Tracking System (TCATS)
AUTHOR	R. Horton, B. Naylor, G. Blair, P. Dudley, S. Humphreys, G. Koepp, T. Koepp, S. Unger
PUBLICATION DATE	April 1992

ABSTRACT: The Target Cueing and Tracking System (TCATS) is an advanced video image processing system that uses digital computing techniques for automatic target detection and tracking. This document provides an overview of the TCATS design. The purpose of this document is to present a broad picture of TCATS system's design. It includes description of the TCATS algorithm, software, and custom hardware. This document is intended to assist commercial couplers in developing a commercial version of the existing TCATS or in developing an enhanced commercial version of TCATS. The hardware and software described can be applied to a wide range of applications where video detection, surveillance, or assessment are required. However, the system may require additional development depending on the application. Complete design information on TCATS can be obtained under a non-exclusive license. Contact the Sandia National Laboratories Technology Transfer and Industrial Relations Department for more information.

2. Material Control and Accounting

a. Measurement

REPORT NUMBER	BNL-46554
TITLE	A Generalized Model for Neutron Coincidence Counting
AUTHOR	Ming-Shih Lu and Theodor Teichmann
PUBLICATION DATE	October 1991

ABSTRACT: A generalized model for neutron coincidence counting is developed, based on the use of a dual probability generating function, introduced here. The model, which takes explicit account of neutron absorption and leakage, and gives a clear picture of the underlying processes involved, is an extension of the formalism of Boehnel and Hage and Cifarelli. Applications include active and passive neutron coincidence counting in standard configurations and in forked counters. Extensions to more complex situations are also suggested.

REPORT NUMBER	BNL-46284
TITLE	Propagation of Errors in Combined HRGS and HLNC Measurement
AUTHOR	Ming-Shih Lu and Theodor Teichmann
PUBLICATION DATE	November 1991

ABSTRACT: High level neutron coincidence (HLNC) counting is widely used for the non-destructive analysis of plutonium in various forms, including nitrates, metal buttons, plutonium oxide and mixed oxide powder, fuel pellets and pins. This technique can also be applied to estimating the plutonium content of scrap and waste.

The HLNC measurement is usually carried out in conjunction with high resolution gamma spectroscopy (HRGS), to verify the operators' declaration of the plutonium isotopic distribution in the sample, which underlies the HLNC determination of the fissile plutonium content. The uncertainties in the isotopics (isotopic fractions) must be propagated through the HLNC counting calculations.

Previous treatments of many aspects of the statistical modelling and analyses involved have been given, most extensively by Sampson and Gunnick, Gunnick, O'Hara and DeRidder, and by Laszlo, Goldman and DeRidder. In this investigation, statistical modelling and analysis was carried out to include, as far as possible, all the factors which may play important roles in affecting the overall uncertainty in the final estimates. In particular the quantitative effect on the overall uncertainty of certain aspects of the modelling which have previously been disregarded was included.

More explicitly, expressions were derived relating the errors (uncertainties) in the isotopic fractions measured via HRGS, including those associated with the ^{242}Pu fraction, to the error finally calculated Pu mass, i.e. a comprehensive expression of the error in the Pu mass as a function of these errors. This allowed both an estimate of the overall accuracy of the final

result, and determination of its most important contributors. In addition estimates of the effects of impurities and uncertainties in the various defining physical constants were made possible by this formalism.

REPORT NUMBER	BNL-47071
TITLE	Independent Verification of Tank Volume Measurements by Pressure-Volume Authentication
AUTHOR	Sylvester C. Suda and Bernard Keisch
PUBLICATION DATE	July 1992

ABSTRACT: Brookhaven National Laboratory has developed a portable pressure-volume authenticator as a standard and means of checking the functionality and quality of bubbler-probe volumetric devices. The pressure-volume authenticator (PVA) consists of an automated electromanometer system that is controlled by a laptop computer, and a transportable volumetric artifact. A portable pressure gage is connected, via a scanievalve, to the operator's bubbler-probe system and independently measures all bubbler probes. The transportable volumetric artifact is a one-meter high vessel equipped with bubble-probes, computer controlled air-purge rotameter, and platinum resistance (RTD) thermometer. High quality measurements are obtained by use of a fast sampling technique and sophisticated software developed under this program. The computer software performs the following functions: (a) instrument control, (b) data acquisition, (c) on-line graphical and numerical display of measurement data, and (d) detailed data analysis. The device also may provide hands-on training for inspectors and plant operators in high quality volumetric data collection and analysis. A field demonstration of the automated electromanometer system was conducted on the PETRA input accountancy tank, JRC-Ispra in November 1991.

REPORT NUMBER	BNL-47328
TITLE	Error Propagation for Gamma Spectroscopy and Neutron Coincidence Counting for Plutonium-Bearing Materials
AUTHOR	Ming-Shih Lu and Theodor Teichmann
PUBLICATION DATE	March 1992

ABSTRACT: This paper reports a study of the error characteristics of both high resolution gamma ray spectroscopy (HRGS) and high level neutron coincidence measurements, treated independently, or coupled, as applied to non-destructive analysis of plutonium-bearing materials.

In the case of HRGS, the covariance matrix for the isotopic errors has been derived, both in terms of the relative isotopic abundance errors, and then in terms of the channel count errors. The error in the plutonium-242 fraction, calculated via the Gunnick or Lewis correlation, or by any other means, has been explicitly included.

For the HLNC part of the measurement, the resultant errors, both in the Pu^{240} effective and in the total plutonium mass, have been expressed as functions of the errors in all pertinent physical variables, including the isotopic, instrument, calibration and physical constants, and measurement

uncertainties. Errors due to the presence of moisture and fluorine in the sample are also included. The expressions derived can be used to estimate the overall variance in the error propagation formalism, as well as specific contributions from various sources.

Experimental data, available in the published literature, have been used to illustrate the underlying error characteristics of the HLNC, and the effects of several different isotopic error correlations, associated with materials having different burn-ups, are also discussed.

REPORT NUMBER	LANL88011
TITLE	Simulating Materials Accounting Activities in Reprocessing Plants
AUTHOR	C.A. Coulter, R. Whiteson, and A. Zardecki
PUBLICATION DATE	September 1991

ABSTRACT: Our simulation program, FacSim, has been used to estimate balance closure variances for a number of real and proposed nuclear material processing facilities that rely primarily on item measurements. We are enhancing the program so that it can be applied to facilities such as reprocessing plants that handle bulk materials and primarily perform bulk and flow measurements. The extended simulation program can apply any of several types of sequential statistical tests to near-real-time accounting information to evaluate the capability of the facility accounting system to detect material and operational anomalies in a timely fashion. The program allows facility designers and operators to evaluate measurement and anomaly-detection strategies before system implementation and to demonstrate the facility's capability for maintaining accurate inventory information during plant operation. These features are illustrated by application to a generic reprocessing plant.

REPORT NUMBER	LANL86003
TITLE	Measurement of the Assay Precision of the Active Neutron Multiplicity Technique
AUTHOR	N. Ensslin, D. W. Miller, M.C. Miller and M.S. Krick
PUBLICATION DATE	July 1992

ABSTRACT: This paper describes a measurement of the precision of the new active-neutron-multiplicity assay technique, which is currently under development for bulk uranium containing kilogram quantities of ^{235}U. The new technique analyzes neutron multiplicity data collected with a coincidence counter outfitted with AmLi neutron sources. We report on the observed assay precision and the implications for field use of the technique.

REPORT NUMBER	LANL86015
TITLE	Automated Box/Drum Waste Assay (Cf-252 Shuffler) Through the Material Access and Accountability Boundary
AUTHOR	E.C. Horley, C.W. Bjork, S.C. Bourret, P.J. Polk, C.J. Schneider, and R.V. Studley
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: For the first time, a shuffler waste-assay system has been made a part of the material access and accountability boundary (MAAB). A ^{252}Cf Pass-Thru shuffler integrated with a conveyor handling system will process box or drum waste across the MAAB. This automated system will significantly reduce personnel operating costs because security forces will not be required at the MAAB during waste transfer. Further, the system eliminates the chance of a mix-up between measured and nonmeasured waste. This Pass-Thru shuffler is to be installed in the Westinghouse Savannah River Company 321M facility to screen waste boxes and drums for ^{235}U. An automated conveyor will load waste containers into the shuffler, and upon verification, will transfer the containers across the MAAB. Verification will consist of a weight measurement followed by active neutron interrogation. Containers that pass low-level waste criteria will be conveyed to an accumulator section outside the MAAB. If a container fails to meet the waste criteria, it will be rejected and sent back to the load station for manual inspection and repackaging.

REPORT NUMBER	LANL86015
TITLE	Automated Assay of Uranium Solution Concentration and Enrichment Using Commercial Robots
AUTHOR	E.C. Horley, K. Gainer, W.J. Hansen, T.A., Kelly, J.L. Parker, T.E. Sampson, G. Walton, and S. Jones
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: For the first time, the concentration and enrichment of uranium solutions can be measured in one step. We have developed a new instrument to automatically measure the concentration and enrichment of uranium solutions through the adaptation of a commercial robot. Two identical solution enrichment systems are being installed in the Portsmouth Gaseous Diffusion Plant. These automated systems will reduce radiation exposure to personnel and increase the reliability and repeatability of the measurements. Each robotic system can process up to 40 batch and 8 priority samples in an unattended mode. Both passive gamma-ray and x-ray fluorescence (XRF) analyses are performed to determine total uranium concentration and ^{235}U enrichment. Coded samples are read by a bar-code reader to determine measurement requirements, then assayed by either or both of the gamma-ray and XRF instruments. The robot moves the sample containers and operates all shield doors and shutters, reducing hardware complexity. If the robot is out of service, an operator can manually perform all operations.

REPORT NUMBER	LANL86015
TITLE	Capabilities and Limitations of the Passive-Active DDT Neutron Waste Assay Device
AUTHOR	N.J. Nicholas, K.L. Coop, and R. J. Estep
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: The differential-dieaway-technique (DDT) passive-active neutron assay system is widely used by transuranic waste generators to certify their drummed waste for eventual shipment to the Waste Isolation Pilot Plant (WIPP). We have tested and incorporated software improvements on a mobile DDT system. The motivation for our study was the stricter criteria being established for waste emplacement at the WIPP site that have led to a renewed interest in improvements to and a better understanding of current nondestructive assay (NDA) techniques. Our study includes the effects of source position, extreme matrices, high neutron backgrounds, and source self-shielding to explore the system's capabilities and limitations and to establish a basis for comparison with other NDA systems, specifically, the Cf Shuffler developed at Los Alamos National Laboratory.

REPORT NUMBER	LANL86005
TITLE	Measurement Control: Principles and Practice as Applied to Nondestructive Assay
AUTHOR	T.E. Sampson
PUBLICATION DATE	December 1992

ABSTRACT: This paper discusses the principles and practice of measurement control for nondestructive assay (NDA) instruments. The NDA is not always blessed with the highly controlled samples that are assumed in the analytical laboratory. This adversely affects the use and applicability of the historical error information from instrument stability checks to estimate measurement uncertainties for the broad range of sample characteristics presented to most NDA instruments. This paper emphasizes the methods used to perform instrument stability checks and discusses the resulting uncertainty information that can be derived from these measurements.

REPORT NUMBER	LANL86020
TITLE	A Survey of Infrared Technology for Special Nuclear Materials Control and Accounting
AUTHOR	W.D. Stanbro, R.S. Leonard, C.A. Steverson, and M.I. Angerman
PUBLICATION DATE	March 1992

ABSTRACT: This report reviews some aspects of current infrared measurement technology and suggests two applications in which it may be used in nuclear safeguards. These applications include both materials control and materials accounting. In each case, the measurements rely on passive detection of infrared radiation generated from the heat produced by the radioactive decay of plutonium. Both imaging and non-imaging techniques are discussed.

C. Full Scale Development

2. Material Control and Accounting

a. Measurement

REPORT NUMBER	BNL-52315
TITLE	Guidance Document on the Variance Propagation Requirements in DOE Order 5633.3
AUTHOR	Jonathan B. Sanborn
PUBLICATION DATE	December 1991

ABSTRACT: DOE facilities handling special nuclear material are required to comply with DOE Order 5633.3, which addresses various aspects of nuclear material accounting. In particular, it requires that control limits be calculated for nuclear material inventory differences. These requirements and methods of meeting them are described. The four steps in this process are the creation of a variance propagation model of the nuclear material accounting system, the validation of the model, the application of the model, and the documentation of the model; the first two of these steps are discussed at length. Topics addressed include: the mathematics of variance propagation, the structure of nuclear material accounting systems, sources of uncertainty in real accounting systems, statistical models of these sources of uncertainty, methods of estimating error standard deviations, calculation of control limits from inventory difference standard deviations, and comparison of models with historical inventory difference data. A chapter is also devoted to calculational methods. The approach emphasizes constructing models that can be implemented relatively easily and improved as data is accumulated and understanding of the system is gained, rather than attempting all-inclusive, highly detailed models at the outset.

REPORT NUMBER	UCRL-109620
TITLE	Recent Improvements in Plutonium Gamma-Ray Analysis Using MGA
AUTHOR	W.D. Ruhter and R. Gunnink
PUBLICATION DATE	July 19-22, 1992

ABSTRACT: MGA is a gamma-ray spectrum analysis program for determining relative plutonium isotopic abundances. It can determine plutonium isotopic abundances better than 1% using a high-resolution, low-energy, planar germanium detector and measurement times ten minutes or less. We have modified MGA to allow determination of absolute plutonium isotopic abundances in solutions. With calibration of a detector using a known solution concentration in a well-defined sample geometry, plutonium solution concentrations can be determined. MGA can include analysis of a second spectrum of the high-energy (300-600 keV) plutonium gamma rays that significantly improves the determination of the Pu-241 to Pu-239 ration in high-burnup plutonium. We have expanded the analysis of the high-energy spectrum to include determination of fission product abundances relative to total plutonium. For the high-energy gamma-ray measurements we have

devised a new hardware configuration, so that both the low-and high-energy gamma-ray detectors are mounted in a single cryostat thereby reducing weight and volume of the detector systems. We describe the detector configuration, and the performance of the MGA program for determining plutonium concentrations in solutions and fission product abundances.

REPORT NUMBER	N/A
TITLE	Gamma-Ray Imaging Device: A Method to Determine the Spatial Variation in Isotopic Composition of Special Nuclear Material
AUTHOR	L.J. Satkowiak and E.F. Novak
PUBLICATION DATE	N/A

ABSTRACT: During Mound's annual verification audit visits to other DOE sites, an accurate measurement of a plutonium sample's isotopic composition is required for the use of calorimetric assay for safeguards purposes. The items measured range from isotopically homogeneous to extremely heterogeneous. Currently, isotopic measurements made on heterogeneous materials are conducted using a helical scanning technique which scans the entire sample several times thus "spatially-averaging" the isotopic composition. Although the helical scanning technique provides an average value for the effective specific power, it doesn't provide information regarding the spatial distribution of the heat emitting material in the sample. An instrument was developed to passively scan and determine the spatial distribution of the special nuclear material in an item.

REPORT NUMBER	N/A
TITLE	Heat Distribution Error in Radiometric Calorimeters
AUTHOR	W. W. Strohm; EG&G Mound, R.B. Perry; Argonne National Laboratory
PUBLICATION DATE	N/A

ABSTRACT: Calorimetric assay of plutonium and tritium is an important and well characterized measurement. The discussion of heat distribution error for radiometric calorimeters in relevant consensus standards is adequate for existing water bath calorimeters since they have a relatively flat response profile throughout the sample chamber. The development of transportable dry calorimeters has resulted in instruments with response profiles showing larger variations. This work describes the approach used to determine the heat distribution error term in the error models for two transportable dry calorimeters and recommends that this approach be used for all radiometric calorimeters and included in appropriate consensus standards.

REPORT NUMBER	N/A
TITLE	Proceedings of the International Workshop on Calorimetry
AUTHOR	S.G. Guardini; JRC, W.W. Strohm; EG&G Mound
PUBLICATION DATE	N/A

ABSTRACT: The joint Research Centre of the Commission of the European

Communities and the EG&G MOUND Applied Technologies, have organized an International Workshop on Calorimetry as an Accountancy and Verification Tool for Plutonium and Tritium.

Developers and users of calorimetric assay instruments and measurements, together with interested persons from international and domestic inspectorates and nuclear facilities, have conducted a one week workshop on the calorimetric assay of plutonium and tritium.

The purpose of the workshop was to review the current status of calorimetric assay and make recommendations for further development efforts.

The workshop included presentations, planned demonstrations, measurements by participants, and discussion. Basic technology topics included the specific powers of radionuclides, the different types of calorimeters available for power measurements and the chemical and non-destructive gamma-ray measurements of plutonium isotopic composition. Methods to reduce measurement times have been discussed and demonstrated.

Instrumentation assembled for the workshop included a water bath calorimeter, dry transportable calorimeters built in the USA and dry transportable calorimeters built in England, along with gamma-ray systems for measuring plutonium isotopic composition and calculating plutonium effective specific power. Certified 238-Pu heat standards and well characterized bulk PuO_2 samples are available at the PERLA Laboratory of the Joint Research Centre.

These proceedings consist of the extended summaries presented by the laboratories having participated in the workshop, the results of the measurements carried on and the conclusions drawn.

REPORT NUMBER	N/A
TITLE	Calorimeter Calibration and Performance
AUTHOR	W.W. Strohm, W.W. Rodenburg
PUBLICATION DATE	N/A

ABSTRACT: The Calorimetric Assay of Plutonium and Tritium is used by every Department of Energy Facility in the United States having significant amounts of these materials in their inventories. Some of the reasons for their prevalent use are: calorimeters are simple, rugged, and reliable, calorimetric assay is an accurate and precise measurement relatively free from matrix effects, calorimetric assay is traceable to the National Measurement System, and representative standards are not required for calibration. Over 200 calorimeters have been put into use in the US for measurements in and outside of glove box lines. Calorimetric assay is used for: primary accountability measurements, shipper-receiver measurements, inspectors verification measurements, and product measurements.

REPORT NUMBER	N/A
TITLE	Mound Calorimeter Instrumentation
AUTHOR	J.R. Wetzel, M.F. Duff
PUBLICATION DATE	N/A

ABSTRACT: Mound's radiometric calorimetry technology started in 1942. Mound built the first twin resistance bridge calorimeter in 1948. Since then, Mound has continued to develop instruments for nondestructive calorimetric assay. Mound has investigated and developed other types of calorimeters, ranging from small, but precise, thermocouple calorimeter to a water-flow calorimeter for samples with very high wattage.

REPORT NUMBER	N/A
TITLE	Calorimetry of Tritium at Mound
AUTHOR	T.M. McClelland, J.A. McDaniel
PUBLICATION DATE	N/A

ABSTRACT: Calorimetric measurement of tritium at EG&G Mound Applied Technologies is used for several purposes, including accountability, production, recovery operations, research activities, and component evaluation. Calorimetry is used for the measurement of tritium for several reasons: (1) traceable to the National Institute of Standards and Technology, (2) accurate and precise measurements, and (3) relatively free from matrix effects. Another important characteristic of calorimetry of tritium is its independence from other measurement methods. This independence is important when using calorimetry as a measurement control cross-check for other measurement methods.

REPORT NUMBER	N/A
TITLE	The Dry Heat Exchanger Preconditioner
AUTHOR	S.J. James, J.R. Wetzel, M.M. Duff
PUBLICATION DATE	N/A

ABSTRACT: EG&G Mound Applied Technologies has designed a Dry Heat Exchanger Preconditioner which utilizes air instead of water as the environmental exchange medium. This design helps reduce the risk of a critical event. The sample chamber allows for a calorimeter can 9" high by 4-3/4" diameter to be preconditioned. The preconditioner is a separate unit for the calorimeter. Precise preconditioning setup to the calorimeter is the key factor to reducing calorimetry thermal equilibrium time. Testing of the Dry Heat Exchanger Preconditioner proved both accuracy and time savings for calorimeter measurements. The new preconditioner design is suited for a variety of applications such as glovebox, stand-alone, transportable configuration, or in conjunction with water bath calorimeters.

REPORT NUMBER	N/A
TITLE	Retrofittable Electrical Heater Standard for the Calibration of Heat Flow Calorimeters
AUTHOR	P.W. Kasperski, J.R. Wetzel, M.F. Duff, R.L. Fulz, K.L. Breakall, D.P. Renz
PUBLICATION DATE	N/A

ABSTRACT: The possibility of using a nonnuclear source for calorimeter calibration has been discussed for several years. The use of electrical heaters to replace the currently used plutonium 238 sources had been taken into consideration, but until the currently used calorimeter electronics were developed, this consideration was not a practical one. An electrical resistance heater has been developed at Mound to replace the currently used plutonium 238 standards. The use of this heater should alleviate problems caused by the use of fissile materials in the laboratory in regard to environmental, safety and health concerns. Its replacement of the Pu 238 standards will also alleviate the problems and expense incurred with the transportation of SNMs between the labs which is currently required for their calibration. The electrical standard that was developed at Mound is a very practical device that can be inexpensively produced for wide use in NDA laboratories throughout the complex. It has a wide range of operation, and can be designed for use in practically any calorimeter. The data reproduced in this paper illustrates that the output from a device such as this is extremely close to the power output produced from the traditional plutonium standards. A mathematical correction factor can be applied to the curve produced by the heater output data so that this curve replicates the Pu 238 data curve. This will allow the replacement of the plutonium heat standards by the electrical heater for use in calorimeter calibration.

REPORT NUMBER	N/A
TITLE	Field Test Results of the Dry Heat Exchanger Calorimeter at LANL
AUTHOR	J.R. Wetzel, D.P. Renz, S.J. James, M.F. Duff; Mound, T. Cremers, K. Camp; LANL
PUBLICATION DATE	N/A

ABSTRACT: The Dry Heat Exchanger Calorimeter System was developed by Mound as a calorimeter system that requires no water. The Los Alamos National Laboratory (LANL) conducted a field test of the calorimeter system from November 1990 through February 1991. The results of this field test and a discussion of these results are presented in this paper. The calorimeter system was tested with a variety of reference standards and actual samples, and the results were compared to the assay results of an existing water bath calorimeter at LANL. The standards were assayed with an average error of 0.20% and a standard deviation of 0.8%. These results are in agreement with the results obtained during the Mound testing.

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