SLAC–Report–388

Stanford Linear Accelerator Center

CORRECTIVE ACTION PLAN

In response to the October–November 1991 Tiger Team Assessment

October 1992 • Prepared for the Department of Energy under contract number DE–AC03–76SF00515

Preface

On June 27, 1989, Secretary of Energy James D. Watkins announced a 10-point initiative to strengthen safety, environmental protection, and waste management at Department of Energy (DOE) facilities. To support this initiative, the Secretary established independent "Tiger Teams" to assess environmental, safety, and health (ES&H) programs. This *Corrective Action Plan* presents a formal response to the Tiger Team assessment of the Stanford Linear Accelerator Center (SLAC) and the Stanford Synchrotron Radiation Laboratory (SSRL) conducted from October 7, 1991 through November 5, 1991. This *Corrective Action Plan* has been prepared by the staff of SLAC/SSRL and the DOE Field Office, San Francisco (DOE-SF) in preliminary consultation with the staff of DOE Office of Energy Research (DOE-ER).

The purpose of this plan is to set forth the strategies and specific actions that have been or will be taken by SLAC/SSRL, DOE-SF, and DOE-ER in response to the Tiger Team findings and concerns. While the individual Tiger Team findings and concerns have been specifically addressed, the overall corrective action response strategy has been focused on understanding and correcting the underlying root causes which led to the conditions identified by the Tiger Team and the SLAC self-assessment. By addressing these underlying causes, improvements in ES&H activities, operations, and management leadership can and will be achieved.

In this *Corrective Action Plan*, the actions proposed to correct the Tiger Team findings and concerns are addressed in the form of tasks with associated milestones and budgets. Earlier drafts of the plan were submitted in January and July, 1992. Comments on those drafts were received from the DOE Offices of Environment, Safety, and Health and Environmental Restoration and Waste Management. The present revision of the plan reflects modifications made in response to those comments and reflects progress on completed actions.

Executive Summary

This report is the Stanford Linear Accelerator Center's (SLAC) response to the DOE Tiger Team assessment. That assessment was conducted at SLAC, at the Stanford Synchrotron Radiation Laboratory (SSRL), at the DOE Field Office, San Francisco (DOE-SF), and at the DOE Office of Energy Research (DOE-ER) from October 7, 1991 to November 5, 1991. (Note that for the purposes of ES&H activities, SSRL is considered a division of SLAC. Therefore, the term SLAC will be used throughout this report to signify both SLAC and SSRL organizations.) The Tiger Team was composed of approximately 50 specialists from various DOE offices, contractors, and consultants organized into three subteams: environmental, safety and health, and management. The findings and concerns of the Tiger Team are documented in a report, *U.S. Department of Energy Office of Environment, Safety and Health, Tiger Team Assessment, Stanford Linear Accelerator Center*, October-November 1991 (Draft [DOE EH-0214]).

The Tiger Team identified a number of deficiencies in SLAC's ES&H program, and in the oversight of SLAC by DOE-SF and DOE -ER. The environmental subteam identified a total of 52 findings. The safety and health subteam originally identified 131 concerns. There were no Category I concerns and ten Category II concerns of which one was subsequently dropped; the balance were Category III. The remaining nine Category II concerns were addressed as soon as they were identified by the Tiger Team. The management subteam identified 17 findings. Additionally, there were five findings related to the SLAC and DOE-SF self-assessments. One noteworthy practice was highlighted by the Tiger Team. These findings and concerns were distilled into 15 key findings and the following two root causes:

1. To a large extent, the present condition of ES&H activities at SLAC is the carryover from a past era, a period when many of the ES&H requirements did not exist or were not deemed applicable, and any SLAC priorities for ES&H compliance were dwarfed by the programmatic activities.

2. DOE-ER has not held its program line managers fully accountable for their direct line responsibility for implementation of the Secretary's initiatives, and these line managers have not, in turn, held their respective subordinates fully accountable.

While faulting the laboratory for its deficiencies and weaknesses which were related largely to management systems and lack of adequate performance assessment and monitoring mechanisms, the Tiger Team noted that none of the deficiencies warranted cessation of operations nor was there any imminent danger to SLAC personnel, the general public, or the environment. They noted the commitment of SLAC management to implementing and upgrading its ES&H program activities and the motivation of the staff. They also noted the quality and comprehensiveness of the self-assessment performed by SLAC.

In this *Corrective Action Plan*, SLAC and DOE-SF addresses the findings and concerns of the Tiger Team by developing tasks with associated milestones to correct these findings and concerns and to eliminate the underlying root causes. This *Corrective Action Plan* has been developed around a response strategy designed to address and correct the root causes underlying the deficiencies identified by the Tiger Team.

Corrective Action Plan Process

DOE-SF and both SLAC and SSRL management have taken a leadership role in developing this *Plan*. Overall coordination of action plan responses has been assigned to and performed by a team of line managers with the support of SLAC's ES&H Coordinating Council to ensure overall integration of responses and continued high-level attention to implementing actions described in the *Corrective Action Plan*.

As stated in the Tiger Team report and confirmed by the SLAC self-assessment, the present condition of ES&H activities at SLAC is due, in part, to the strong emphasis management placed on programmatic achievement. Programmatic and operating interests were fully represented at the highest levels of the organization, but ES&H was not. (While SLAC took steps to address this issue by strengthening the ES&H organization and establishing a management council, these efforts have not had sufficient time to produce the desired results.) In addition, line managers have not been sufficiently trained regarding their responsibility for implementing the Secretary's 10-point initiative.

The overall response strategy consists of the following seven strategic elements, each of which addresses one or both of the underlying root causes (see Figure 2-8):

Management Direction, Oversight, and Planning

Hazards Assessment

Roles, Responsibilities, and Authorities

Formality of Operations (Procedures, Training, Document Control)

Management Systems

Human Resources Planning

Self-Assessment (Management Oversight, Line Organization, and Independent Appraisals)

In developing these strategies for the *Corrective Action Plan*, SLAC management has focused on the key findings and root causes identified by the Tiger Team. The resultant strategies address and correct the underlying root causes, and permit an integrated response to the specific individual findings and concerns.

The individual tasks, which vary in scope, complexity, direction, and cost, have been developed to implement these strategic elements. These tasks address all of the findings and concerns of the Tiger Team and "roll-up" to the key findings and root causes. Priorities and milestones have been established for each task to allow for orderly scheduling and tracking.

Schedules for implementing corrective actions have been developed to achieve early and substantive correction of the highest priority deficiencies. This was accomplished by performing a risk-based assessment of the Tiger Team findings and concerns, and ranking them according to their safety and environmental significance. Corrective actions were then developed to address the fundamental concerns. In this way, SLAC is able to focus resources on the more significant items.

Sensitivity to costs and programmatic impacts have resulted in an emphasis on cost-effective strategies. The anticipated cost of completion and closure of implementing the *Corrective Action Plan* over the FY92–FY96 period is $18.7 million in FY92 dollars. A well-managed structure and project-planning effort has optimized development of an integrated, coordinated plan involving all elements of SLAC's operations. Overall costs and funding requirements are given in section 2.3.3.

If there are discrepancies between the resource estimates for EM activities identified in this *Corrective Action Plan* and the validated cost estimates identified in the Department's current EM Five-Year Plan, the cost estimates in the validated Five-Year Plan shall supersede the resource estimates in the *Corrective Action Plan*. The planning for the Tiger Team corrective actions is an ongoing exercise, and the cutoff time for planning for corrective actions is different than that for the Five-Year Plan. Beyond fiscal year 1992, budget requests will be based on validated costs identified in the updated Five-Year Plan, or new or revised agreements with the regulatory bodies.

SLAC has a history of scientific excellence and outstanding contributions to the U.S. and international scientific communities. The Tiger Team assessment and the laboratory's preparation for it brought a new awareness of the current ES&H requirements and expectations to the whole laboratory. Responding to the Tiger Team assessment offers opportunities for improving laboratory operations. SLAC management is committed and the staff is prepared to carry out the tasks presented in this *Plan*. SLAC recognizes that both programmatic and ES&H objectives must be accomplished with limited resources. As a result, the strategies developed include awareness that resource allocation should be based on a consideration of risks and mission objectives, and that effective ES&H performance will be achieved through strengthened management leadership and line management accountability. Development of the *Corrective Action Plan* was also pursued from the perspective of achieving significant overall improvement to SLAC operations and management, rather than from a narrow attention to the individual findings and concerns.

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Introduction

1.1 Background

On June 27, 1989, Secretary of Energy James D. Watkins announced a 10-point initiative to strengthen safety, environmental protection, and waste management activities at DOE's production, research, and testing facilities. In support of the 10-point initiative, the Secretary established independent "Tiger Teams" to conduct environmental compliance assessments at DOE facilities. The assessments are on-site, independent reviews of DOE environment, safety, and health programs to ensure compliance with applicable federal, state, and local regulations; permit requirements; agreements, orders, and consent decrees; and DOE Orders. In addition, the Tiger Teams assess DOE operations for conformance with applicable "best" and "accepted" industry practices and the adequacy of DOE and site contractor management programs.

The Tiger Team Assessment was conducted at the Stanford Linear Accelerator Center (SLAC) and the Stanford Synchrotron Radiation Laboratory (SSRL) between October 7, 1991 and November 5, 1991. A report, *U.S. Department of Energy Office of Environment, Safety and Health, Tiger Team Assessment, of the Stanford Linear Accelerator Center*, November 1991 (Draft [DOE EH-0214]), documenting the findings made by the Tiger Team, was provided at the end of the assessment. The final *Assessment Report* (DOE/EH-0243) was provided in June, 1992

1.2 Purpose and Scope of the Corrective Action Plan

The purpose of this *Corrective Action Plan* is to provide a formal response, consisting of strategies and specific actions, to each of the findings and concerns cited in the Tiger Team assessment report. The *Plan* includes descriptions of the tasks to be implemented by the site to satisfy the findings and concerns, with associated milestones and costs. The *Corrective Action Plan* also identifies tasks that are included (or planned for inclusion) in DOE's *Environmental Restoration and Waste Management Five-Year Plan.*

1.3 Organization and Content of the Corrective Action Plan

The *Corrective Action Plan* consists of four sections. This section, the Introduction, provides background information on the Tiger Team assessment process, the purpose and scope of the *Corrective Action Plan* prepared in response to the Tiger Team assessment, and descriptive information on SLAC programs and facilities.

Section 2, Organization and Management Structure to Implement the Corrective Action Plan, identifies the principal personnel and their responsibilities in implementing the *Corrective Action Plan.*

Section 3, Findings, Concerns, and Planned Actions, is divided into five subsections: Root Causes, Environment, Safety and Health, Management, and Self Assessment. Each of these subsections includes planned actions, a schedule for implementing the actions, and associated costs.

Section 4 includes tables summarizing the site's planned actions, schedules, and projected costs for the planned actions.

Section 5 consists of appendices.

1.4 Facility and Research Program Description

The Stanford Linear Accelerator Center (SLAC) is a national facility operated by Stanford University for the U.S. Department of Energy. SLAC is a single-purpose laboratory, devoted to experimental and theoretical research in elementary particle physics, and to the development of new techniques in high-energy accelerators and elementary particle detectors. SLAC is located on 426 acres of Stanford University land which is leased to the government. For over 25 years, SLAC has been in continuous use in a national research program that has made major contributions to the understanding of nature. SLAC is one of a handful of laboratories worldwide that stands at the forefront of research in the study of the basic constituents of matter and of the forces that act between them.

Scientists from all parts of the United States and throughout the world participate in the experimental program. Since its inception in 1962, SLAC has supported the research activities of scientists from more than 100 different institutions. SLAC presently has a staff of about 1300, 150 of whom are Ph.D. physicists engaged in particle physics research. In addition, there are typically 300–400 physicists from other institutions who are involved in carrying out experiments at SLAC at any given time.

Experimental research began at SLAC in 1966 with the completion of the two-mile-long linear electron accelerator, a machine capable of producing an electron beam with energy up to 20 GeV. Initial experiments directed these electrons onto stationary targets to study the structure of matter. Since that time, three other major research facilities have been built at SLAC, each based on the use of electron-positron collisions rather than fixed-target electron beam experiments: the 8 GeV center-of-mass SPEAR storage ring (1972), the 30 GeV center-of-mass PEP storage ring (1980), and the 100 GeV center-of-mass Stanford Linear Collider or SLC (1989).

Another research facility, the Stanford Synchrotron Radiation Laboratory (SSRL), is also located on the SLAC site. SSRL is a National Synchrotron Radiation Users' Facility funded by the U.S. Department of Energy and operated by Stanford University. It utilizes the SPEAR and PEP storage rings as sources of extremely intense electromagnetic radiation over a large spectral range in a broad ranging program of basic and applied research in such fields as materials science, protein crystallography, catalytic chemistry, surface science, and diagnostic radiology. The SSRL staff numbers about 120, including 19 Ph.D. scientists. There are 50–100 visiting scientists at SSRL at any given time, and as many as 600 scientists from more than 100 institutions who use SSRL in a given year.

The Two-Mile Linac

During the period from 1966 to 1972 the physics research program at SLAC was based solely on fixed-target experiments carried out with the two-mile linear electron accelerator, or linac. Early experiments with this machine were the first to show that the constituents of the atomic nucleus, the proton and neutron, are themselves composed of smaller, more fundamental objects called quarks. This work was recognized in 1990 with the award of the Nobel Prize in Physics to Jerome Friedman and Henry Kendall of MIT, and Richard Taylor of SLAC.

Later, in 1978, the SLAC linac was used in an experiment of exceptionally high precision that established a clear relationship between the weak and electromagnetic forces. This work was a critical verification of the theoretical prediction that the weak and electromagnetic forces were in fact different manifestations of a single, more basic force now known as the electroweak force.

The linac continues to be used for fixed-target experiments in particle and nuclear physics using the spectrometers in End Station A and as the key element for producing electron-positron collisions in the SLC. The maximum energy of the linac has been gradually increased over the years to 50 GeV as a part of the extensive remodeling that was required for its use in the SLC. This combination of a high-energy and high-intensity electron beam cannot be found anywhere else in the world.

The SPEAR Storage Ring

Stanford University has a long history of involvement in the development and use of colliding-beam storage rings for particle physics research. The first such machine at Stanford was a 500 MeV electron-electron machine located on the main campus. This project was a collaborative effort between physicists from Princeton and Stanford Universities, and it produced the first physics results ever obtained with the colliding-beam technique. The next in the succession of Stanford colliders was the SPEAR machine at SLAC, completed in 1972. SPEAR consists of a single ring some 80 meters in diameter, in which counter-rotating beams of electrons and positrons circulate at energies up to about 4 GeV each. In terms of the rich harvest of discoveries it has yielded, SPEAR is generally believed to be one of the most cost-effective machines ever built in the field of high-energy physics.

Two of these achievements stand out in particular. The first was the 1974 discovery of a particle called the psi that was a made up of a combination of a quark and an antiquark of an entirely new kind. Before that time, only three types of quarks were known, but the discovery of this new, fourth type of quark (called charm) served as convincing evidence that the basic idea of the quark substructure of matter was in fact valid. This work was recognized with the award of the 1976 Nobel Prize in Physics to Burton Richter of SLAC, an award he shared with Samuel C.C. Ting of MIT for a similar discovery of this new particle at the Brookhaven National Laboratory.

The second revolutionary discovery made at SPEAR was that of a new particle called the tau, which turned out to be the third in the sequence of electrically charged elementary particles called leptons. The first of these was the electron, discovered in 1897; the second was the muon (1937); and the third was the tau (1975). Martin Perl of SLAC was awarded the Wolfe Prize in 1983 for his discovery of the tau lepton.

In 1990, the SPEAR facility became fully dedicated to synchrotron radiation research.

The PEP Storage Ring

After SPEAR and several other machines around the world had demonstrated the great power of electron-positron colliding beams to produce important new physics results, the next logical step was to increase the energy of such colliders by a factor of three or more. Both the American and European particle physics communities undertook such a step with the construction of the PETRA storage ring at the DESY Laboratory in Hamburg, Germany and the PEP storage ring at SLAC. The Positron-Electron Project (PEP) was a collaborative effort of SLAC and the Lawrence Berkeley Laboratory (LBL). PEP was completed in 1980 and has been used since that time to support the research activities of several hundred physicists and graduate students.

PEP is about 800 meters in diameter and can produce electron-positron collisions up to center-of-mass energies of about 30 GeV in six Interaction Regions (IR). The PEP physics program has done important work in measuring the lifetimes of certain elementary particles, in studying how the quarks that are initially produced in the collision then fragment or evolve into the various kinds of particles that are actually observed in the detection apparatus, and in tests of the theory (called Quantum Chromodynamics or QCD) that is presently believed to describe the strong force that binds quarks together.

Two undulator beam lines on PEP have been used for pioneering work in synchrotron radiation research. Experiments carried out in parasitic mode during colliding beam experiments have demonstrated the extreme capability of PEP as a high brightness X-ray source. Measurements made with PEP operated in a low emittance optics show that PEP can exceed the brightness of third generation sources now in construction around the world.

A group of scientists from SLAC, LBL, and the Lawrence Livermore National Laboratory (LLNL) has proposed the construction of a new facility at SLAC called an Asymmetric B Factory. This project, which has not yet been approved and funded by the government, would require an extensive modification and upgrade of the present PEP machine, making use of much of the existing equipment and infrastructure. The prospective research program for such a facility is very rich; a central theme of this program will be the detailed study of one of the most puzzling phenomena (called CP violation) ever observed in the behavior of matter. This program requires the copious production of the particles known as B mesons, and this in turn means that the B Factory must operate at very high luminosity (production rate). In the meantime, the PEP ring and four large existing detectors are shut down.

The Stanford Linear Collider

Construction of the SLC began in 1983 and was completed in 1989. This frontier device is a novel kind of machine that serves both as a test bed for a new accelerator technique and as a facility to reach the energy region where the recently discovered Z^0 particle can be produced in quantity and in a simple environment. The key elements of the SLC are an extensive upgrade to the existing two-mile linear accelerator to produce 50 GeV beams of both electrons and positrons, a new system for creating the positrons and transporting them back for injection into the linac, two small storage rings that are used to damp the beams down to suitable dimensions, two long curving arcs of magnets that are used to transport the separate electron and positron beams around to a single collision point, and an elaborate final focusing system that reduces the sizes of the colliding beams down to dimensions that are smaller than a human hair when they reach the interaction point in the detector.

The European community has chosen to achieve 100 GeV electron-positron collisions through the use of the more conventional storage-ring technique at the CERN Laboratory near Geneva, Switzerland. Their LEP machine is a large storage ring, some 16 miles in circumference; it has the advantage of four interaction regions (rather than one at the SLC) and the possibility of a higher ultimate energy, but the SLC also has several advantages over LEP that can be exploited in future years. Thus SLC and LEP are, in a sense, complementary facilities.

The first detector system used with the SLC was the Mark II, which was upgraded after earlier use at both SPEAR and PEP. For the longer term, a more elaborate and complete detector system was needed at the SLC, so a new detector system called the Stanford Large Detector (SLD), was installed at the SLC in 1991.

Early research results from the SLC at SLAC and from the LEP storage ring at CERN have already begun to prove the value of these machines. The mass and other properties of the vital Z^0 particle have been determined to unprecedented precision. Even more importantly, this early work has determined with high probability that the universe is in fact made up of not more than the three generations of elementary particles of the type already discovered, each with two kinds of quarks and leptons, of which one is a very light neutral lepton or neutrino.

Advanced Accelerator Development

As noted earlier, electron-positron colliding beams have proved to be an exceptionally fruitful method for studying the elementary particles and the forces that act between them. The very large LEP machine is almost certainly the largest conventional storage ring for electrons and positrons that will ever be built, because electrons and positrons emit synchrotron radiation when they are accelerated around a curved path, and the rate of such energy losses increases very rapidly as the beam energies go up. Eventually there must come a point at which it is more economical to accelerate the electrons and positrons in a straight line (a linear collider) than in a circular path. A major reason for building the SLC was to test the concept of a linear collider, and the successful production of competitive physics results has shown it to be a viable idea.

It is of great interest to SLAC to continue with this exploration of the potential of the linear collider, and much of the activity in advanced accelerator R&D at SLAC is devoted to this end. The next logical step would be to build a full-fledged linear collider that can collide electrons and positrons at a combined energy of about 500 GeV, perhaps later expandable to 1 TeV or more. Advanced R&D in accelerator physics now taking place at SLAC is aimed at just such a project. New power sources, accelerator structures, and beam-focusing systems must be developed to make this dream a reality.

The Stanford Synchrotron Radiation Laboratory

SPEAR produces intense beams of synchrotron radiation— X-ray photons emitted by the circulating electron beams. Beginning in 1973 a group from Stanford began using this synchrotron radiation for research. Over the years the program grew to the point where the SPEAR ring is dedicated to full-time synchrotron radiation research in atomic and solid state physics, chemistry, biology, and medicine. More than 100 Ph.D. theses have been completed based on research carried out at SSRL. Until recently, the two-mile linear accelerator was used to fill SPEAR with electrons. A new 3 GeV electron synchrotron has been constructed and is now replacing the linac as a source of electrons for SPEAR.

Specific research performed at SSRL is extremely varied and is performed using vacuum ultraviolet and hard X-rays. Work utilizing the vacuum ultraviolet portion of the spectrum includes: ionization properties of small molecules, structural and electronic properties of microstructures, properties of ultra-thin layers and small clusters, kinetic processes in laser materials, lithography and microscopy, and static properties and dynamic processes of chemisorbed gases.

Research in the chemical and biological sciences, utilizing hard X-rays, includes: the structure and function of homogeneous and heterogeneous catalysts, the structure of metal, metal oxide and semiconductor surfaces and their interactions with small molecules, chemical reactivities in the gas phase, the structure of general chemical compounds through Extended X-ray Absorption-edge Fine Structure (EXAFS), multiple wavelength imaging, protein structures and functions through diffraction studies in the crystalline state, protein structures through EXAFS studies, dynamics and fluctuations in biological systems, the nature of membrane structures and membrane protein interactions, the structure and function of metal sites in metalloproteins and metalloenzymes.

Physics and materials sciences, also utilizing hard X-rays, are represented by research in the following areas: structure of amorphous materials, coordination of impurities and alloying species, structures of and phase transitions in surfaces and thin surface layers, kinetics of structural changes in materials, phase transitions at high pressure, structure of crystalline materials, electronic structure of materials through edge absorption studies, fundamental X-ray scattering and absorption physics, and atomic physics.

In addition to scientific research, SSRL has a commitment to the development of advanced insertion devices for the enhancement of synchrotron radiation and the development of state-of-the-art instrumentation for the utilization of synchrotron radiation. A program in accelerator physics concentrates on improvements to and designs for future synchrotron radiation storage rings.

Facilities at SLAC/SSRL

Facilities and structures at SLAC are grouped into three major areas based on functional relationships: the accelerator, campus, and research areas. The accelerator area is composed of the two-mile accelerator itself, which begins at the western end of the site, and the main control center. The campus area includes a landscaped mall surrounded by the Central Laboratory, the Test Laboratory, the Administration and Engineering Building, the Cafeteria, and Auditorium. The research area at the eastern end of the site is where experimental research with high-energy electron and positron beams from the accelerator takes place. The electron-positron colliding beam facilities of SPEAR, PEP, and SLC, the beam switchyard, and a complement of large research instruments for fixed target physics are located here. The first building on the SLAC site was completed in 1963 and the accelerator began operation in 1966. Most of the physical plant and the infrastructures of SLAC are over 25 years old. The current replacement value of the facilities on site is more than a billion dollars.

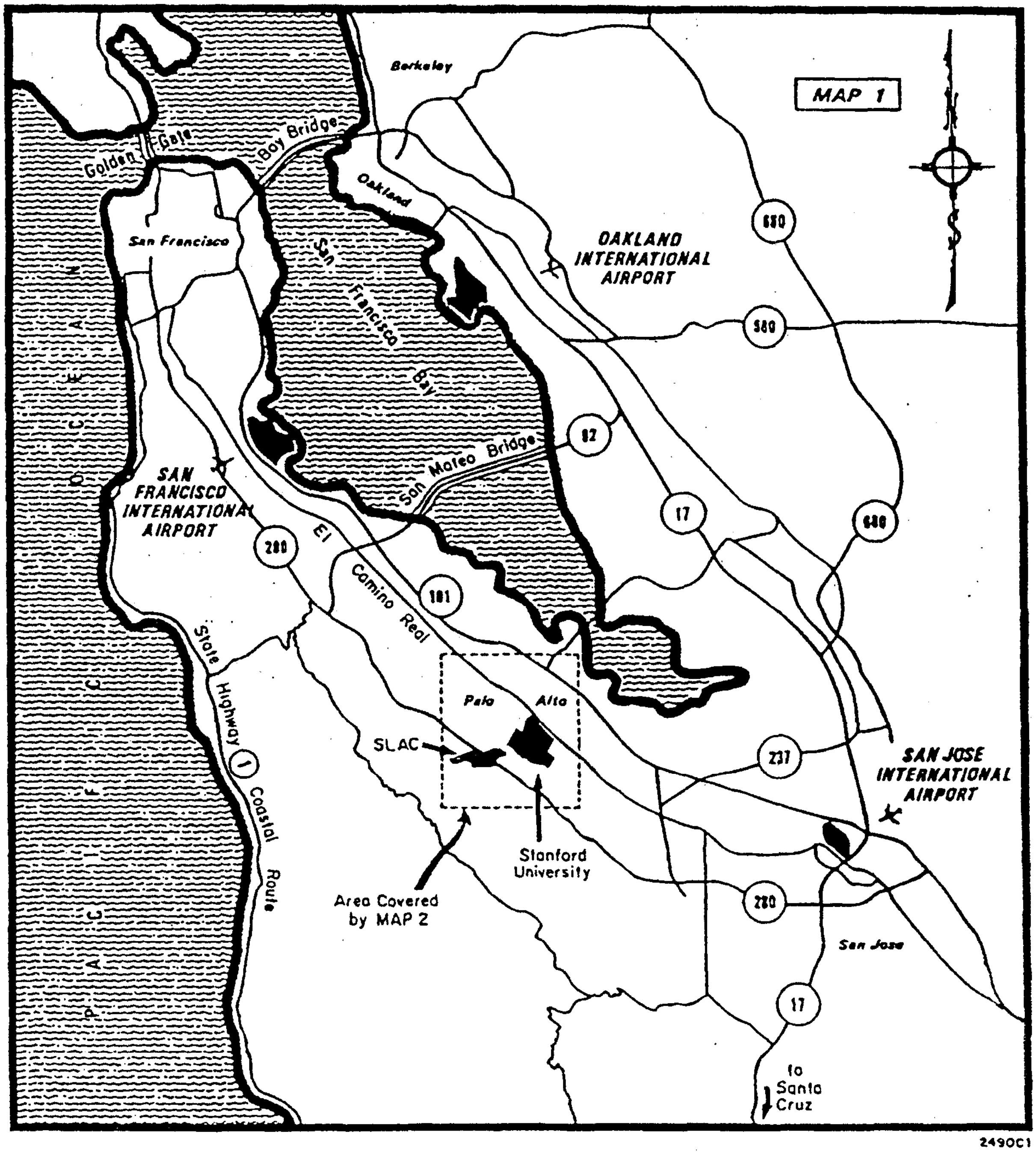

Figure 1-1 Bay Area Map

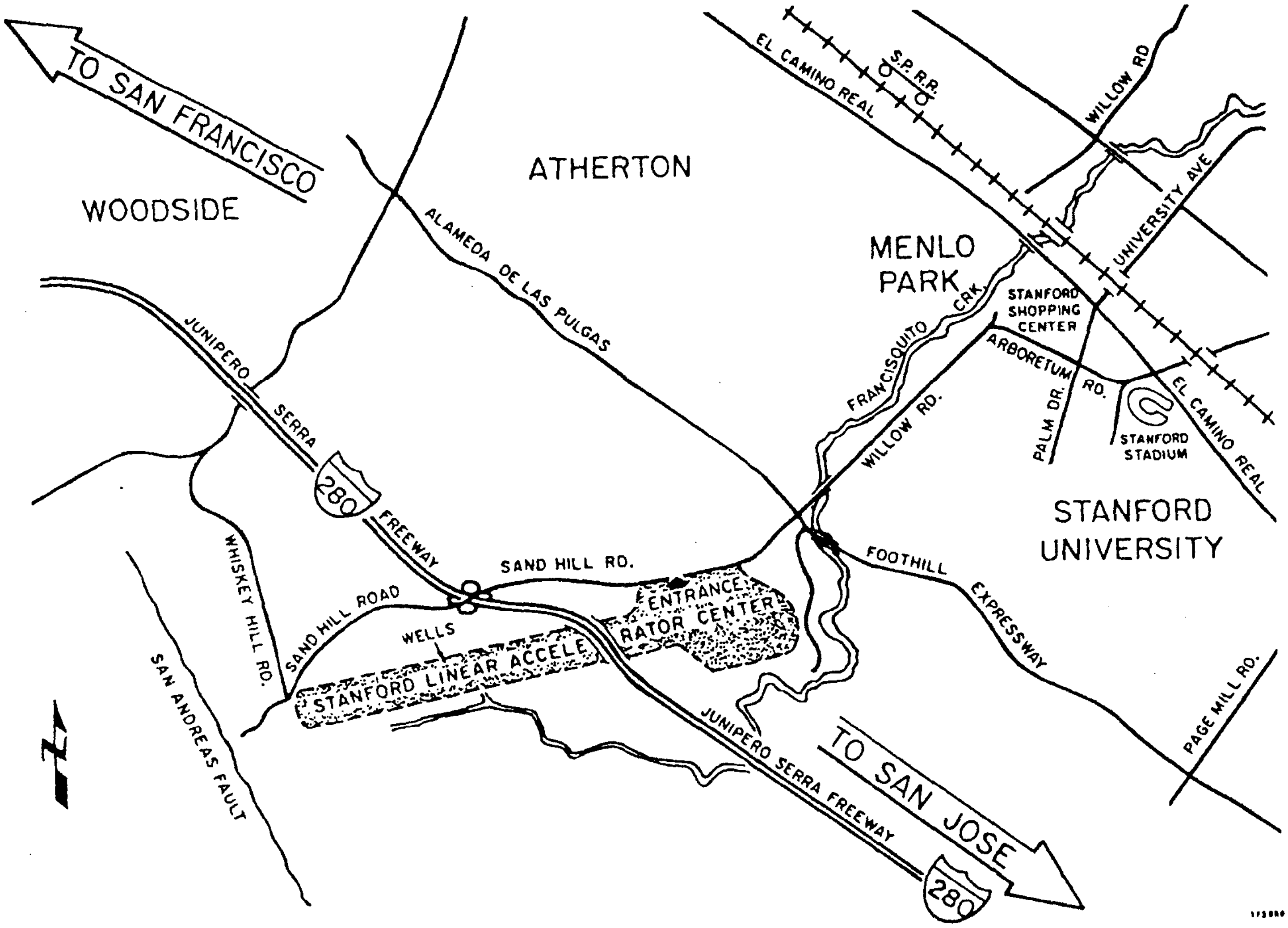

Figure 1-2 Accelerator Area Map

Administration/Engineering Building (A&E)	41
Alpine Gate Guard House	88
Auditorium	43
Auxiliary Control Building	3
Beam Switch Yard	9
Cafeteria	42
Central Laboratory	40/84
Central Utility Building	23
Chemical Storage Building	36
Cleaning Facility Building	30
Collider Experimental Hall (CEH)	750
Computer Building (SCS)	50
Controls Building	34
Cryogenics Laboratory	6
Experimental Facilities Department Shops (EFD)	104
ES & H Building	24
End Station A (ESA)	61
End Station B	62
Fire Station	82
Fort Apache	282
Gate 17 Guard House	86
General Services Building (Shipping & Receiving)	81
Hazardus Chemical Storage	247
Heavy Fabrication Building	26
Klystron Gallery (Visitors Alcove, Sector 27)	2
Lignt Assembly Building	33
Light Fabrication Building	25
Main Control Center (MCC)	5
Main Entrance (Information Booth)	83
Master Substation	16
Metal Stores Shelter	29
Parking	A to G
PEP Beam Facility/SSRL	650/730
PEP Control Room	685
PEP Interaction Region 2 (IR-2)	620
PEP Interaction Region 4 (IR-4)	640

PEP Interaction Region 6 (IR-
PEP Interaction Region 8 (IR-
PEP Interaction Region 12 (IF
Plant Maintenance and Utiliti
Power Conversion
SPEAR Control Building
Sector 30 Guard House
Stanford Synchrotron Radiati
Laboratory Offices, Shops
SLC Offices
SPEAR Experiment Assembly
Test Beam Facility
Test Laboratory
Vacuum Assembly Building
Warehouse/User Offices

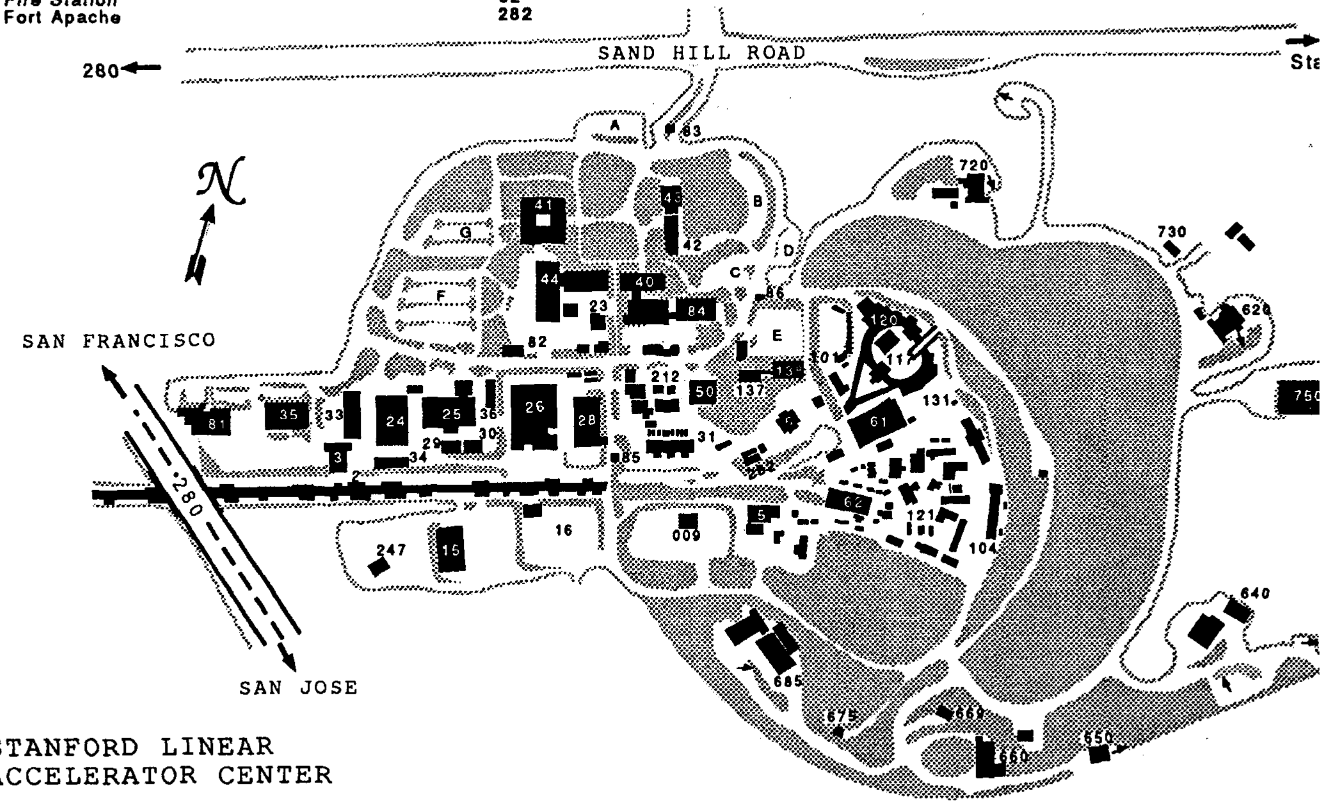

Figure 1-3 Site Map

2
Organization and Management Structure to Implement the Corrective Action Plan

2.1 Introduction

Management and staff from the DOE line organization and SLAC worked jointly to develop the *Corrective Action Plan*. This section identifies the management structures in these organizations, and the processes that will be used to implement the *Plan*.

2.2 Organizational Structures to Implement the Plan

2.2.1 Office of Energy Research

The DOE Office of Energy Research (DOE-ER) has responsibility for the SLAC site. The responsibility is carried out by DOE-ER's Office of High Energy and Nuclear Physics for SLAC and the Office of Basic Energy Sciences for SSRL. DOE-ER provides program direction through the above program offices, depending on the activities being funded. In addition, DOE-ER has established the Office of Assessment and Support, a staff organization with ES&H expertise, to assist the DOE-ER line programs in carrying out their ES&H oversight and assessment responsibilities. Figure 2-1 shows the Department of Energy organization.

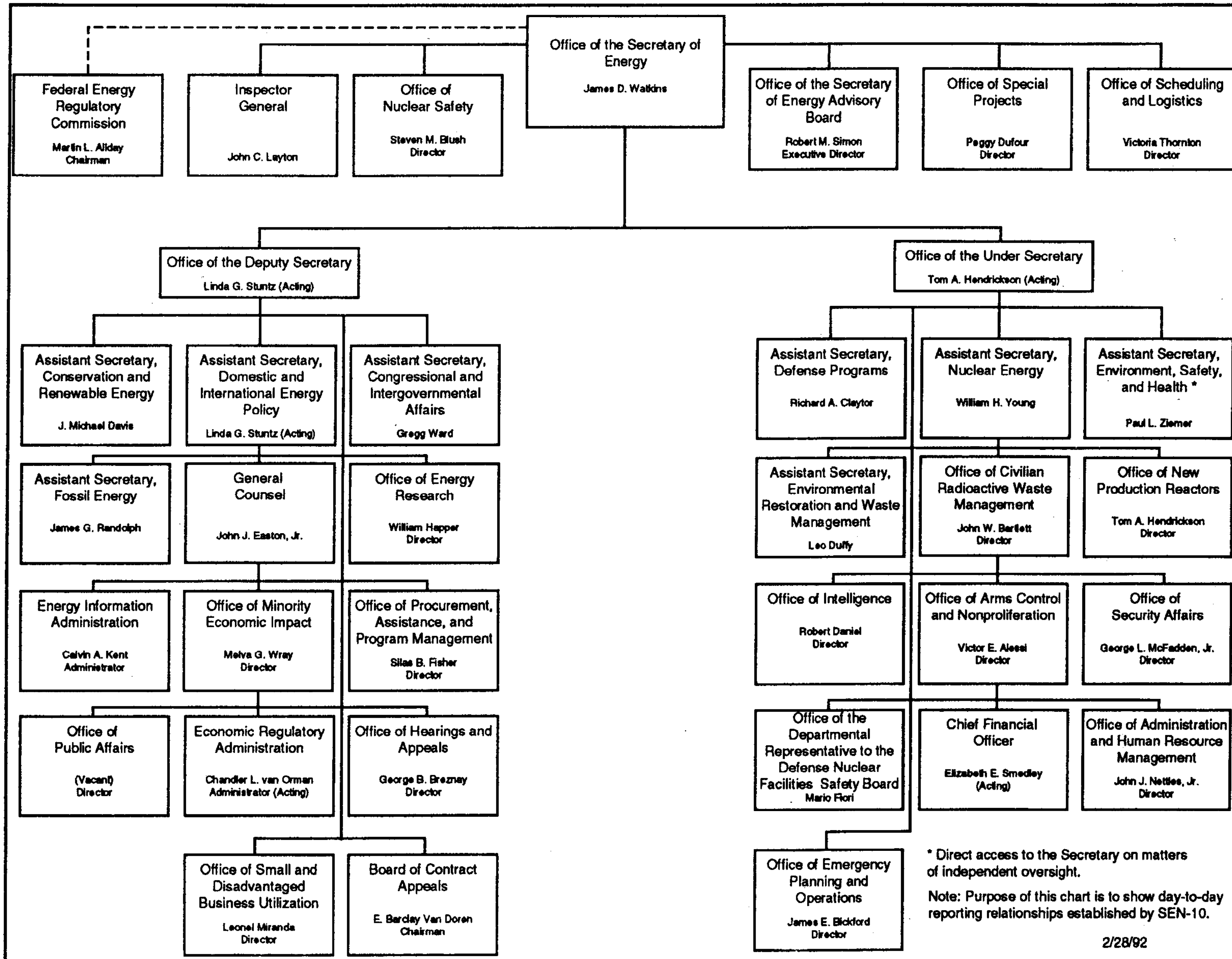

Figure 2-1 Department of Energy Organiization Chart

DOE-ER will be responsible for coordinating all corrective action activities at DOE Headquarters, including:

- Requesting funding from Congress to implement the *Plan*.
- Concurring in the prioritization of activities established by DOE-SF and SLAC.
- Assessing the status and quality of the plan implementation.
- Reviewing contractor performance through the laboratory oversight process.
- Conducting the annual Institutional On-site Review.

2.2.2 DOE Field Office, San Francisco

DOE-SF provides day-to-day management oversight of SLAC operations. DOE-SF communicates policy as well as programmatic, scheduling and budgetary guidelines from DOE-ER. The DOE-SF Field Office is responsible for coordinating the technical, administrative, legal and communications resources required for implementation of DOE programs at SLAC (see Figure 2-2).

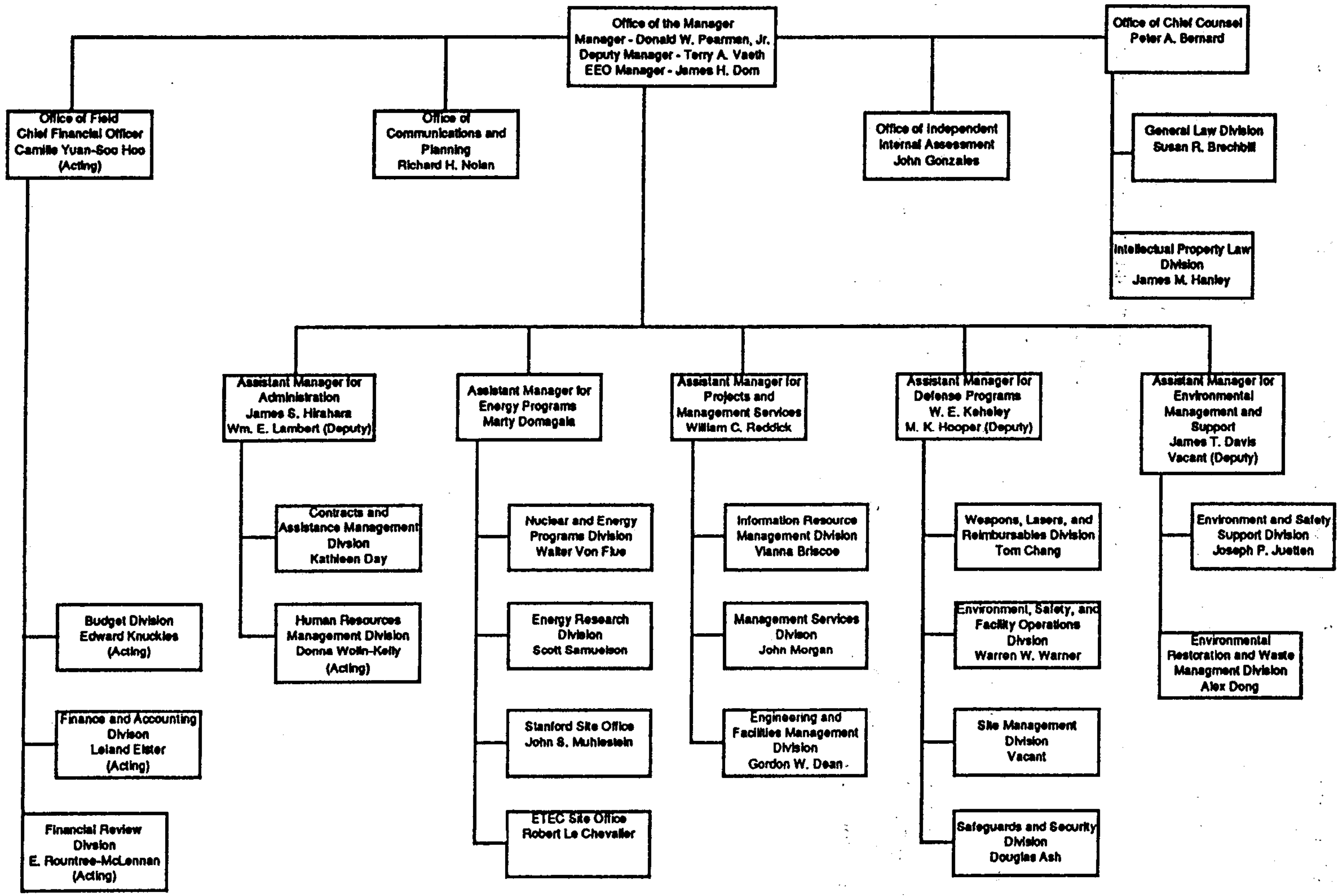

Figure 2-2 DOE-SF Organization Chart

A Memorandum of Agreement (MOA) between DOE-SF and DOE-ER is being developed to further define the relationship between the two offices. Within DOE-SF, lead responsibility for implementing this *Plan* lies with the Stanford Site Office (SSO) Director, who resides at SLAC. The SSO Director is responsible for oversight planning of site-wide contractor operations, including institutional planning and ES&H compliance activities. Current SSO staffing includes the following ES&H personnel:

- **Senior Facility Operations Manager/HENP/BES:** Line management ES&H/QA oversight for assigned program operations and the SLAC facilities in which they are conducted.
- **Facility Operations Engineer:** Line management of assigned ES&H/QA discipline responsibilities and support to Senior Facility Operations Manager.

With respect to this *Plan,* the SSO Director will:

- Ensure that adequate funding is requested from Headquarters.
- Provide SLAC with formal guidance for implementing Headquarters directives.
- Identify problems and barriers to implementation and assure their resolution.
- Appraise SLAC performance; e.g., functional appraisals in the following areas:
  Safety management
  OSHA compliance
  Environmental monitoring
  Industrial hygiene
  Radiation safety
  Self-assessment
  ES&H organization/operations
- Verify completion of tasks through quarterly reports from the contractor and site inspections.
- Assure that on-site staff are knowledgeable and appropriately trained in ES&H/QA requirements.

2.2.3 Laboratory Organization

Figure 2-3 shows the Stanford University/SLAC environment, safety, and health relationship. The Board of Trustees of Stanford University is responsible for University environment, safety, and health policies, contract approval, and, through the President of the University, assurance that University policies support full implementation of environment, safety, and health policies and contractual requirements. The President has delegated to the SLAC Director all environment, safety, and health responsibility for the site. Further, the President has appointed his Dean of Research as University Officer in charge of the ES&H oversight at the SLAC site. For the purpose of environment, safety, and health, the separately-contracted SSRL operation is treated like a division of SLAC. This is reflected in the SLAC /SSRL Memorandum of Understanding.

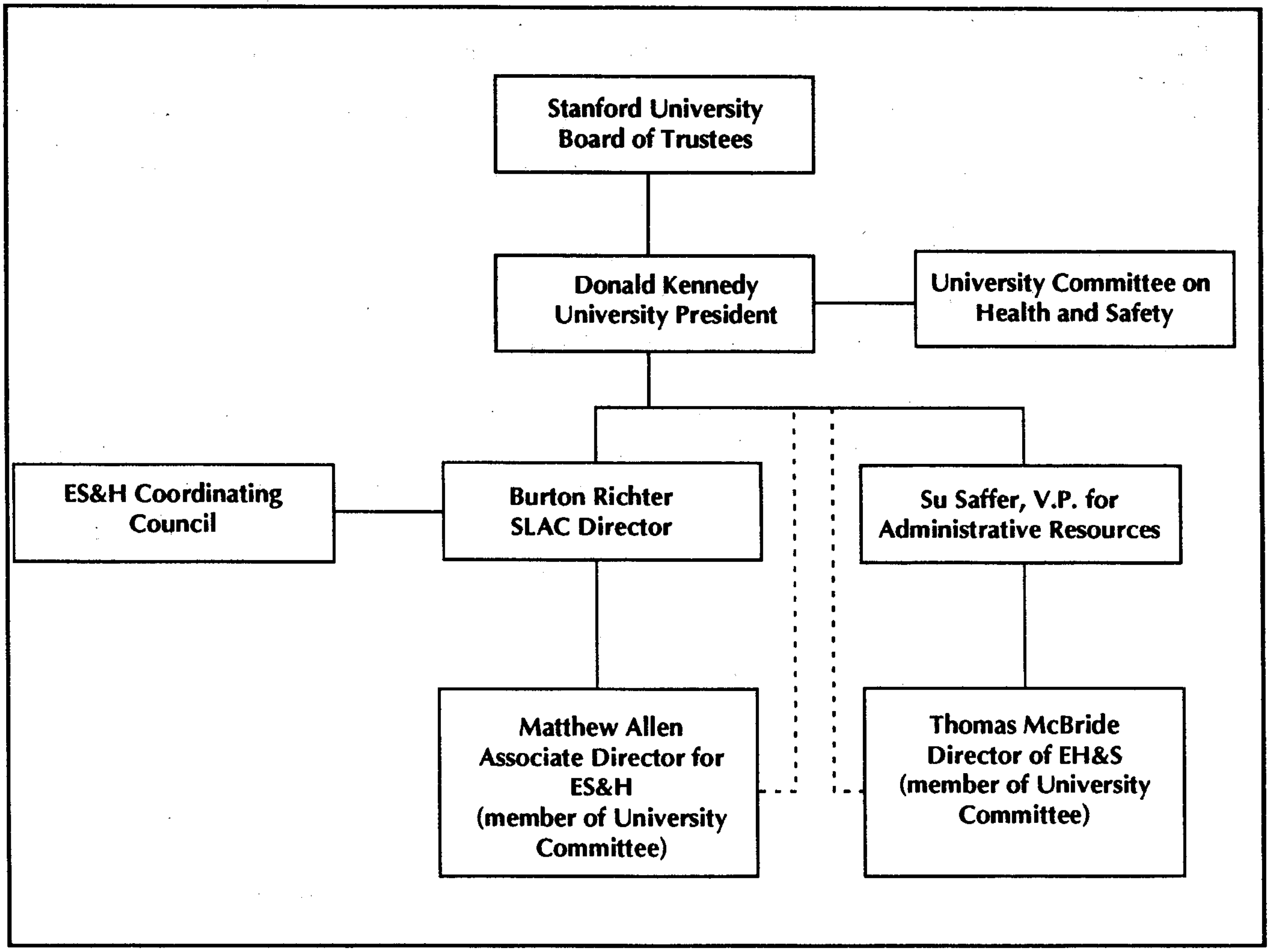

Figure 2-3 Stanford University/SLAC ES&H Relationship

The safety management organization of the laboratory is shown schematically in Figure 2-4. Responsibility for safety flows from the SLAC Director through the Associate Directors to the Department Heads and Group Leaders. Note that since SLAC is responsible for safety at SSRL, the SSRL Director already reports to the SLAC Director in matters of safety.

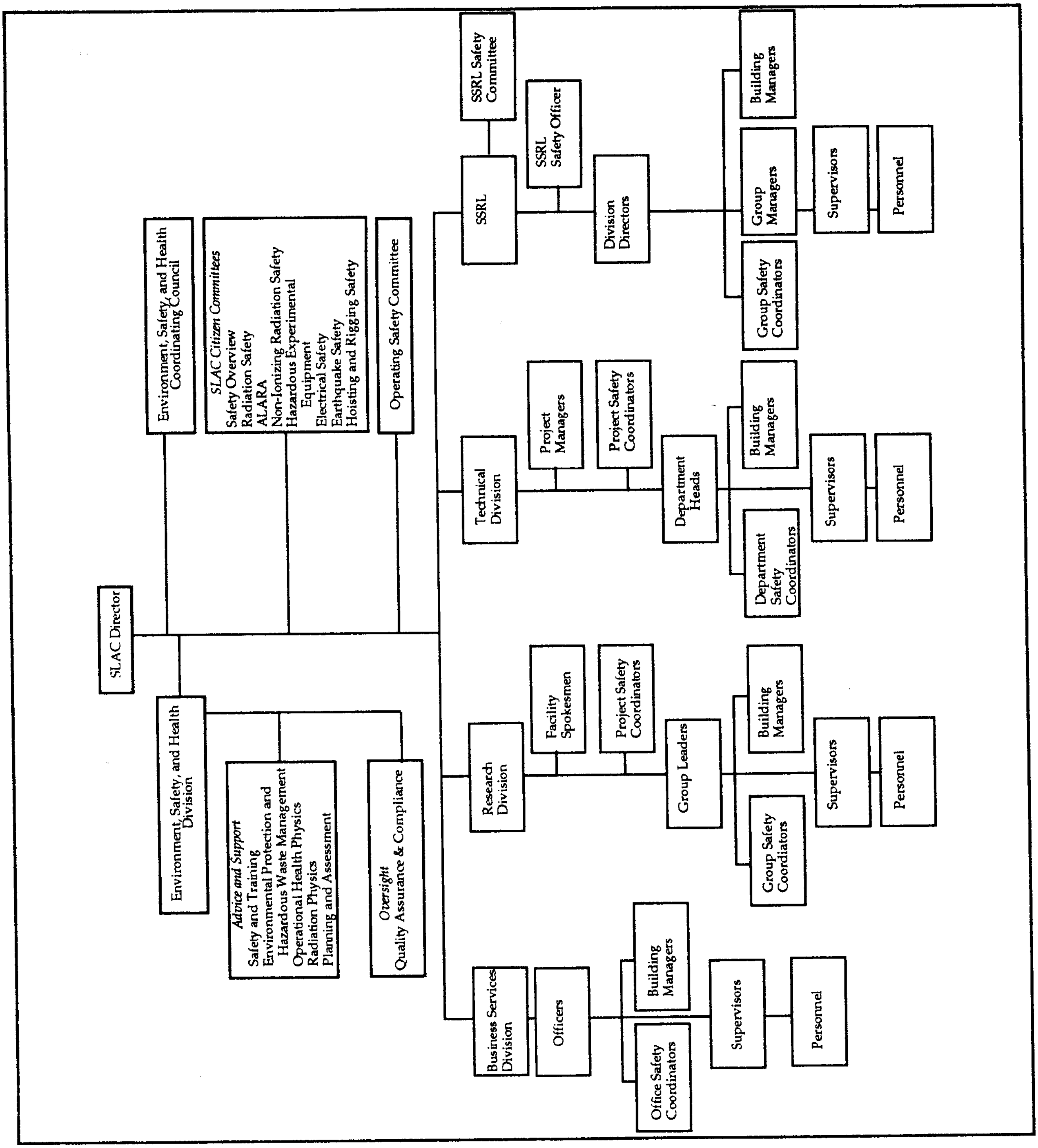

Figure 2-4 Safety Management at SLAC

Figure 2-5 shows the SLAC organization chart. SLAC has four divisions, each headed by an Associate Director. Senior managers are called Department Heads in the Technical and ES&H Divisions, Group Leaders and Officers in the Business Services Division, and Group Leaders in the Research Division. Throughout this report, the terms Group Leader and Department Head are used interchangeably to refer to the head of a group, department, or office.

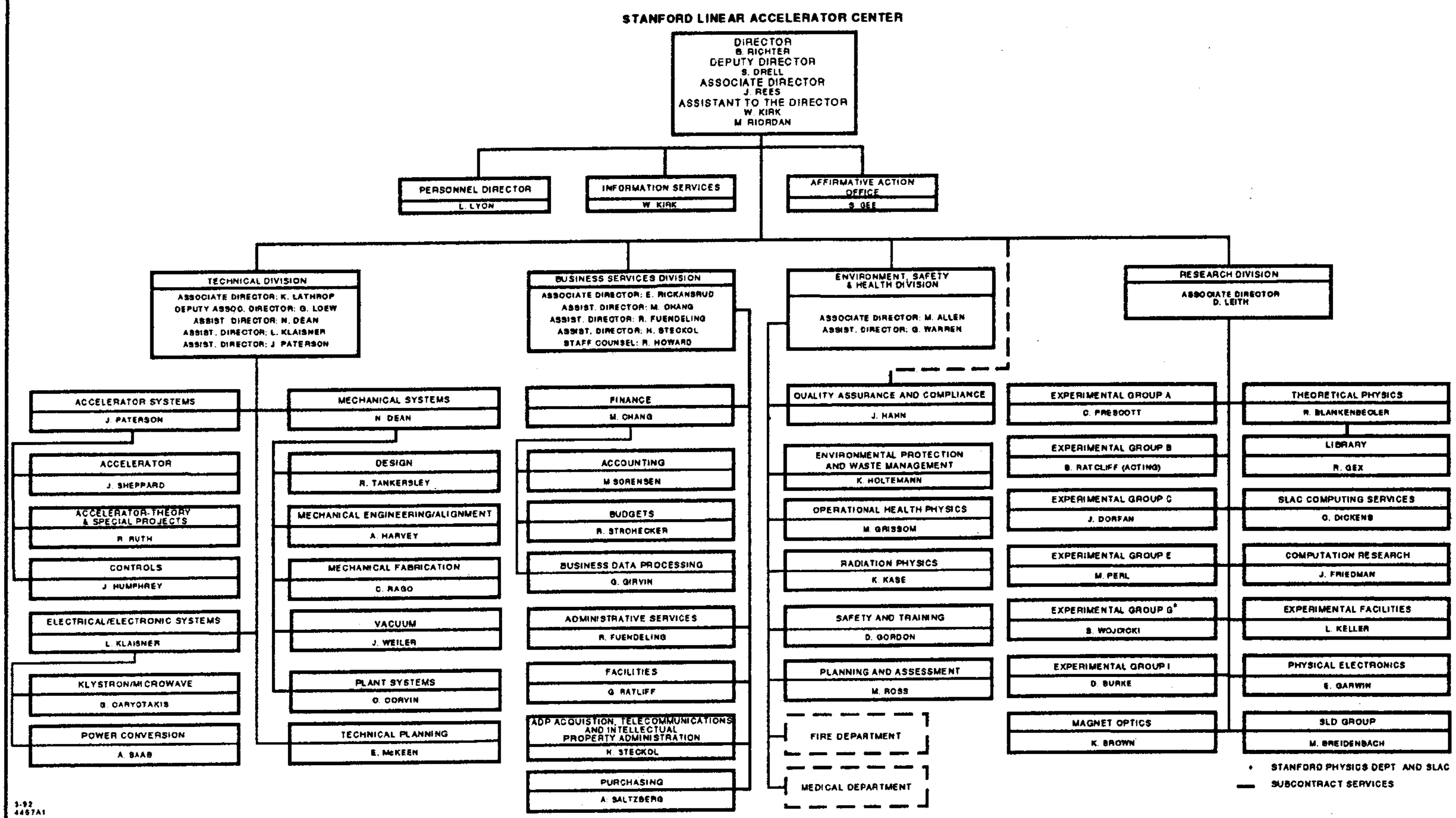

Figure 2-5 SLAC Organization Chart

The Technical Division has eleven groups which:

- Operate, maintain, and upgrade all accelerator systems to maximize their high-energy physics output.
- Develop the conceptual framework and technology needed for the next generation of accelerators and to advance the science of accelerator physics.
- Manage the construction and commissioning of new accelerator systems.
- Support the technology needed for the development of new detectors.
- Provide laboratory support services in areas of scientific, engineering, and technical expertise.

The Business Services Division (BSD) administers and operates various services and functions to support the overall mission of the laboratory. It is responsible for management and oversight functions relative to the prime contract with DOE, and policies of the University. BSD provides services in the areas of finance, budgeting, accounting, purchasing, facilities, communications, technology transfer, and data processing. It conducts liaison activities with staff, other laboratories, universities, industry, and DOE.

In December 1990, the former Environment and Safety Office and the Radiation Physics Group were moved from other divisions and supplemented with the Quality Assurance and Compliance Department and additional staff to form the ES&H Division. This division is responsible for:

- Analyzing and interpreting regulations, and proposing, where applicable, laboratory policies for implementing those regulations.
- Providing technical assistance to the line organizations to enable them to carry out their environment, safety, and health responsibilities.
- Creating, updating, and distributing manuals related to laboratory environment, safety, and health rules and practices, and assisting line managers in creating manuals specific to their own environment, safety, and health activities.
- Promoting an understanding of environment, safety, and health policies and practices by training and educating the laboratory staff, and facilitating the conduct of training by organizations.
- Responding to outside audits and monitoring internal follow-up of audit findings.
- Providing operational services to the laboratory in the areas of waste management, radiation dosimetry, contract management of medical and fire departments, and design of radiation shielding for experiments and new facilities.
- Monitoring for compliance with environment, safety, and health standards and regulations through inspections and internal audits, and following up to ensure that appropriate corrective action is taken.

The Research Division consists of seven experimental physics groups, five technical support groups, a theoretical physics group, and a computation research group. These groups:

- Conduct experimental research in elementary particle physics utilizing the accelerator facilities of the laboratory.
- Promote future experimental programs through developments in detector, accelerator, and computing technologies.
- Conduct theoretical studies in elementary particle physics.
- Provide laboratory support services in the areas of experimental activities, library, and computing.
- Support collaborating institutions which choose to conduct research at the laboratory's facilities.

The Personnel Department, the Information Services Office, and the Affirmative Action Office report to the Director's Office.

Figure 2-6 shows how SSRL is organized. SSRL has three divisions: the Accelerator Research and Operations Division (AROD), the Photon Research and Operations Division (PROD), and the Computing and Administrative Resources Division (CARD).

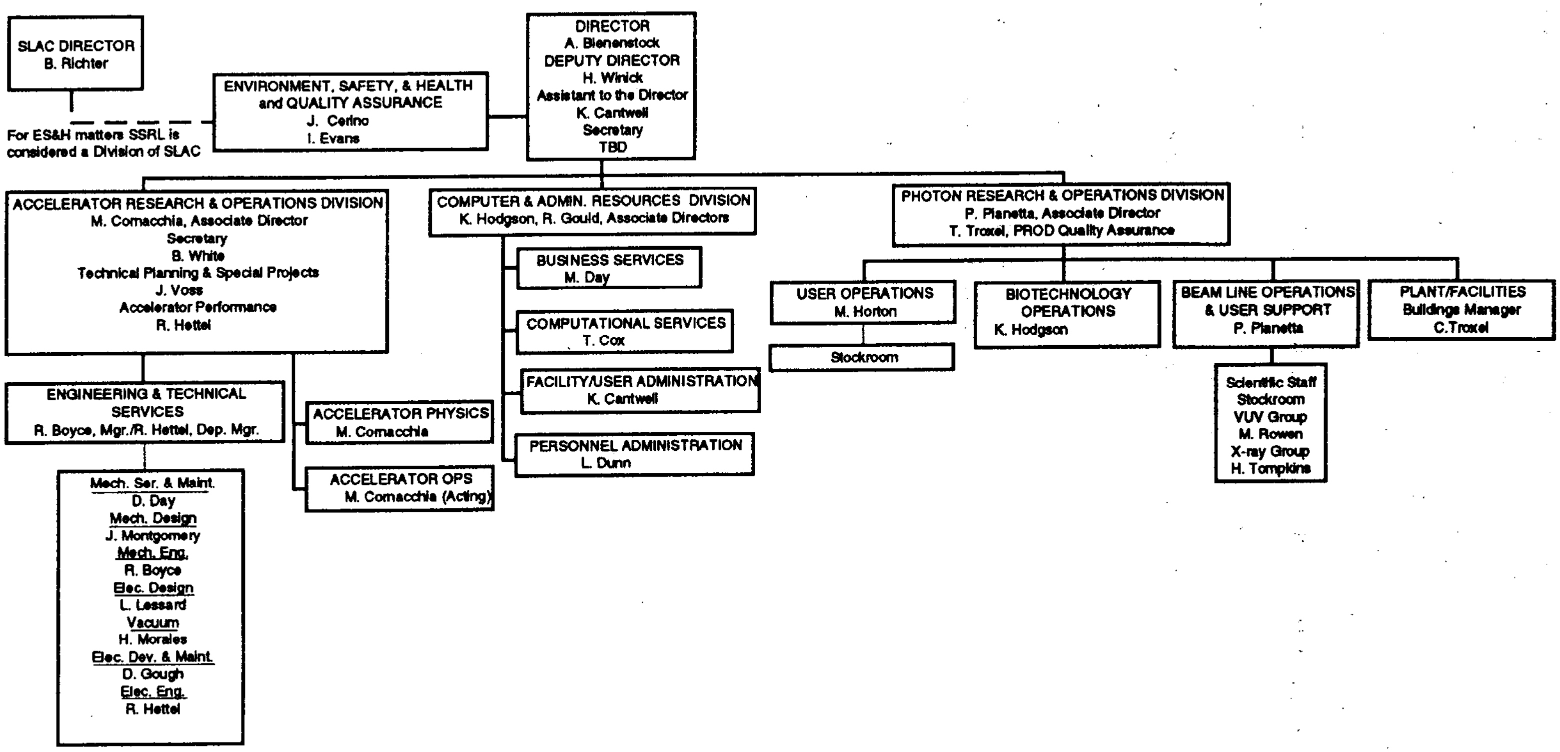

Figure 2-6 SSRL Organization Chart

The AROD has three groups, whose members:

- Operate, maintain, and develop the 3 GeV injector booster and the storage ring, SPEAR.
- Perform accelerator physics research on these and future machines.

PROD has four groups, whose members:

- Manage and develop the experimental beam lines.
- Provide user support.
- Perform in–house research using synchrotron radiation.
- Provide Plant/Facilities management for SSRL.

CARD has four groups, whose members:

- Manage business services and contract administration.
- Manage personnel services.
- Manage and develop computational resources for SSRL.
- Provide facility and user research administration.

2.3 Site-wide Strategies Used to Address Key Findings and Root Causes

2.3.1 The Corrective Action Planning Process

DOE -SF, SLAC , and SSRL management have taken a leadership role in developing this *Corrective Action Plan*. Direction was provided by the laboratory's ES&H Coordinating Council (ES&HCC) to ensure integration and continued high-level attention to completing the *Plan*. Overall coordination of action plan responses has been assigned to and accomplished by a task force appointed by the ES&HCC in August, 1991, two months before the Tiger Team's arrival at SLAC, and comprised of representatives from all SLAC divisions (including SSRL). Individual corrective actions were developed by the cognizant line managers to assure buy-in from those organizations directly responsible for implementation of corrective action tasks.

Figure 2-7 illustrates the development of the *Corrective Action Plan*. The early work of the task force included reviewing Tiger Team assessments and corrective action plans of other laboratories, assembling the required resources for producing the plan, and developing procedures and systems for assigning planning responsibilities and reviewing and finalizing input. Upon completion of the Tiger Team assessment and after reviewing the draft report, the task force,with input from the ES&HCC , developed a strategy aimed at assuring that root causes and key findings and concerns are appropriately addressed, and that corrective actions are planned and carried out in an integrated manner. The task force then developed guidelines and schedules for the line managers assigned with developing individual corrective task descriptions.

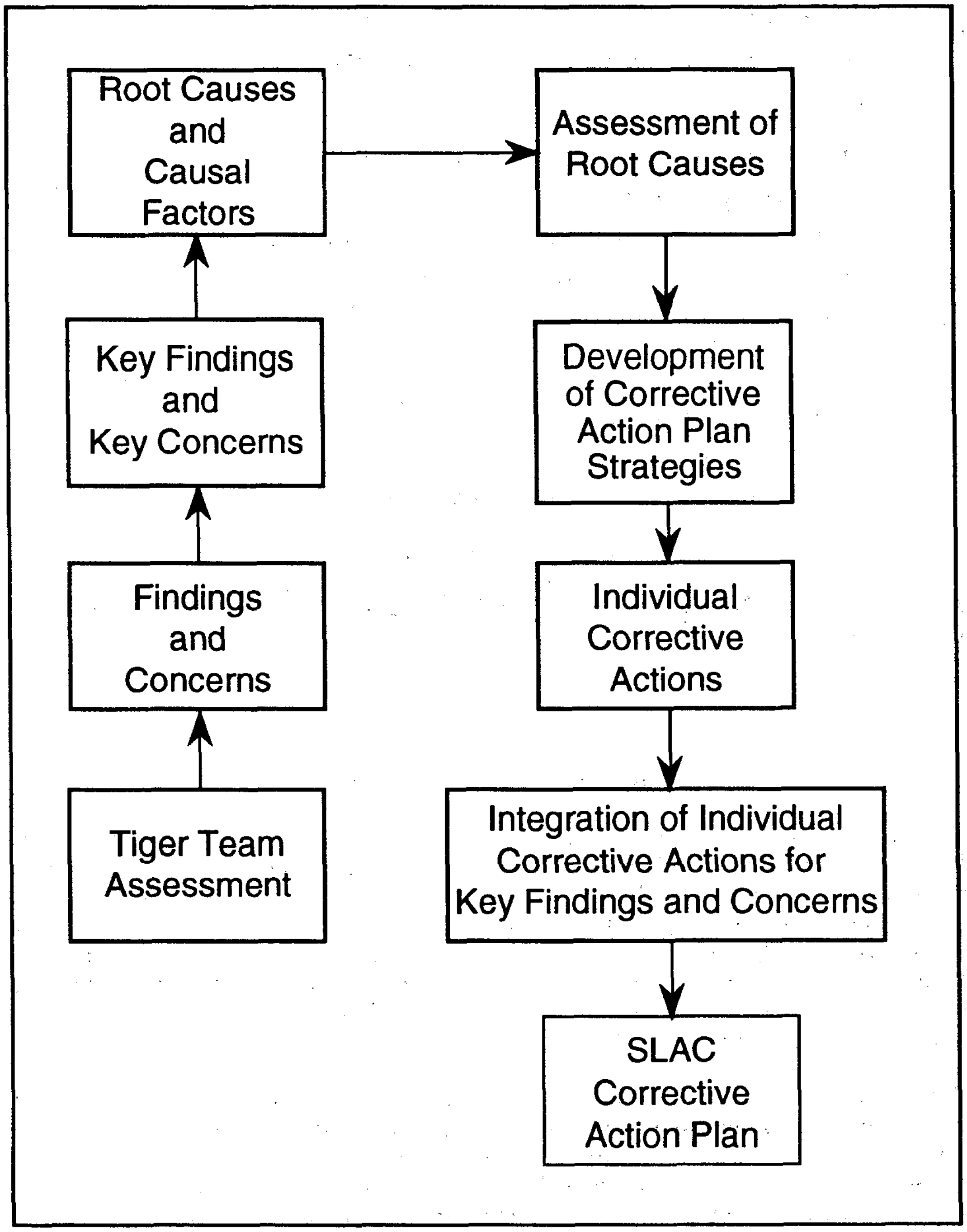

Figure 2-7 Development of SLAC Corrective Action Plan

In this *Corrective Action Plan,* SLAC , DOE-SF, and DOE-ER have addressed the individual findings and concerns of the Tiger Team through development of tasks, with associated milestones, to correct these findings and concerns. In addition, the corrective action tasks were developed and integrated to assure that the underlying root causes were addressed and eliminated. The ten Category II concerns, of which one was subsequently dropped, were addressed as soon as they were identified by the Tiger Team. In some cases, the Category II concerns have been fully corrected; in other cases, interim actions have been taken to address the immediate hazards posed by the Category II findings and longer-range plans have been developed to address the causal factors. In addition to the findings and concerns addressed in this *Plan,* the Tiger Team identified 259 OSHA violations. Although not specifically addressed in this Plan, responsibility for correcting those violations has been assigned and a tracking system has been put in place to assure that those corrections are implemented.

Throughout development of the *Plan,* policy considerations were reviewed by the ES&HCC, which assumed an active role in reviewing the tasks which addressed significant findings and concerns, such as the management findings and the key findings and concerns in the environmental and safety and health areas. The CAMP system, a risk-based prioritization system (refer to Appendix E), was used to assure that resource allocation and schedules were focused in areas of greatest importance.

2.3.2 Major Actions

The Tiger Team identified a number of deficiencies in SLAC's ES&H program and in the oversight of DOE-SF and DOE Headquarters. The environmental subteam identified a total of 53 findings. The safety and health subteam originally identified 132 concerns. There were no Category I concerns and ten Category II concerns of which one was dropped; the balance were Category III. The management subteam identified 17 findings. Additionally, five findings were related to the SLAC and DOE-SF self-assessments. One noteworthy practice was highlighted by the Tiger Team. These findings and concerns were distilled into 15 key findings with the following two root causes:

1. To a large extent, the present condition of ES&H activities at SLAC and SSRL is the carryover from a past era, a period when many of the ES&H requirements did not exist or were not deemed applicable, and any SLAC /SSRL priorities for ES&H compliance were dwarfed by the programmatic activities.
2. DOE-ER has not held its program line managers fully accountable for their direct line responsibility for implementation of the Secretary's initiatives, and these line managers have not, in turn, held their respective subordinates fully accountable.

This *Corrective Action Plan* has been developed around a response strategy designed to address and correct these root causes . As stated in the Tiger Team report and confirmed by the SLAC self-assessment, the present condition of ES&H activities at SLAC and SSRL is due, in part, to the strong emphasis management placed on programmatic achievement relative to formalization of ES&H programs. Research and operating interests were fully represented at the highest levels of the organization, while ES&H considerations were not. In addition, line managers have not been fully informed of and trained in their roles, responsibilities, and authorities for implementing the ES&H program. Although steps were taken during the past year to address this issue by establishing an ES&H Division and a senior-level ES&H Coordinating Council, these efforts have not had sufficient time to produce the desired results.

Planning and implementing corrective actions in response to the Tiger Team assessment are well underway at SLAC. In fact, many actions were initiated prior to the Tiger Team's visit as part of and in response to the SLAC self-assessment. The root cause of SLAC's ES&H deficiencies, as noted by the Tiger Team, is that present conditions are a result of past practices. Reversing the effects of those practices will require time and a focusing of available resources as part of an integrated strategy. The Tiger Team acknowledged the progress that SLAC has made in the past year toward increasing its commitment to ES&H. This commitment has been demonstrated through the increased allocation of resources to ES&H activities, through the performance of a comprehensive self-assessment, and through the communication and training of ES&H expectations to line organizations.

Over the past year, as SLAC personnel have enhanced their understanding of ES&H requirements and prepared for the Tiger Team assessment, a number of organizational changes were made and functions defined to improve the manner in which SLAC approaches those requirements. These included establishing the ES&H Division, forming the ES&H Coordinating Council, and assigning a number of individuals in the line organizations to specific ES&H functions. These actions have helped set the stage for implementation of a comprehensive ES&H program to address regulatory and DOE requirements. The challenge to SLAC now is to further develop these resources and to employ them toward development and implementation of ES&H programs. These programs must be integrated with the operations and research activities of the laboratory in a manner that will ensure the continued achievement of ES&H objectives. SLAC management is committed to providing leadership and oversight to assure the appropriate level of ES&H emphasis in operations and to fulfilling its responsibilities through line management accountability and self-assessment.

The strategy for developing this corrective action plan was to identify strategic elements which address one or both of the underlying root causes. These strategic elements provide the framework within which the individual and key findings are addressed. These strategic elements are:

Management Direction, Oversight, and Planning

Hazards Assessment

Roles, Responsibilities, and Authorities

Formality of Operations

Self Assessment

Management Systems

Human Resources Planning

The individual tasks, which vary in scope, complexity, direction and cost, have been developed to implement these corrective action strategy elements. The tasks address all of the findings and concerns of the Tiger Team and "roll-up" to the key findings and root causes. Priorities and milestones have been established for each task to allow for orderly scheduling and tracking. Figure 2-8 illustrates the relationship between these elements.

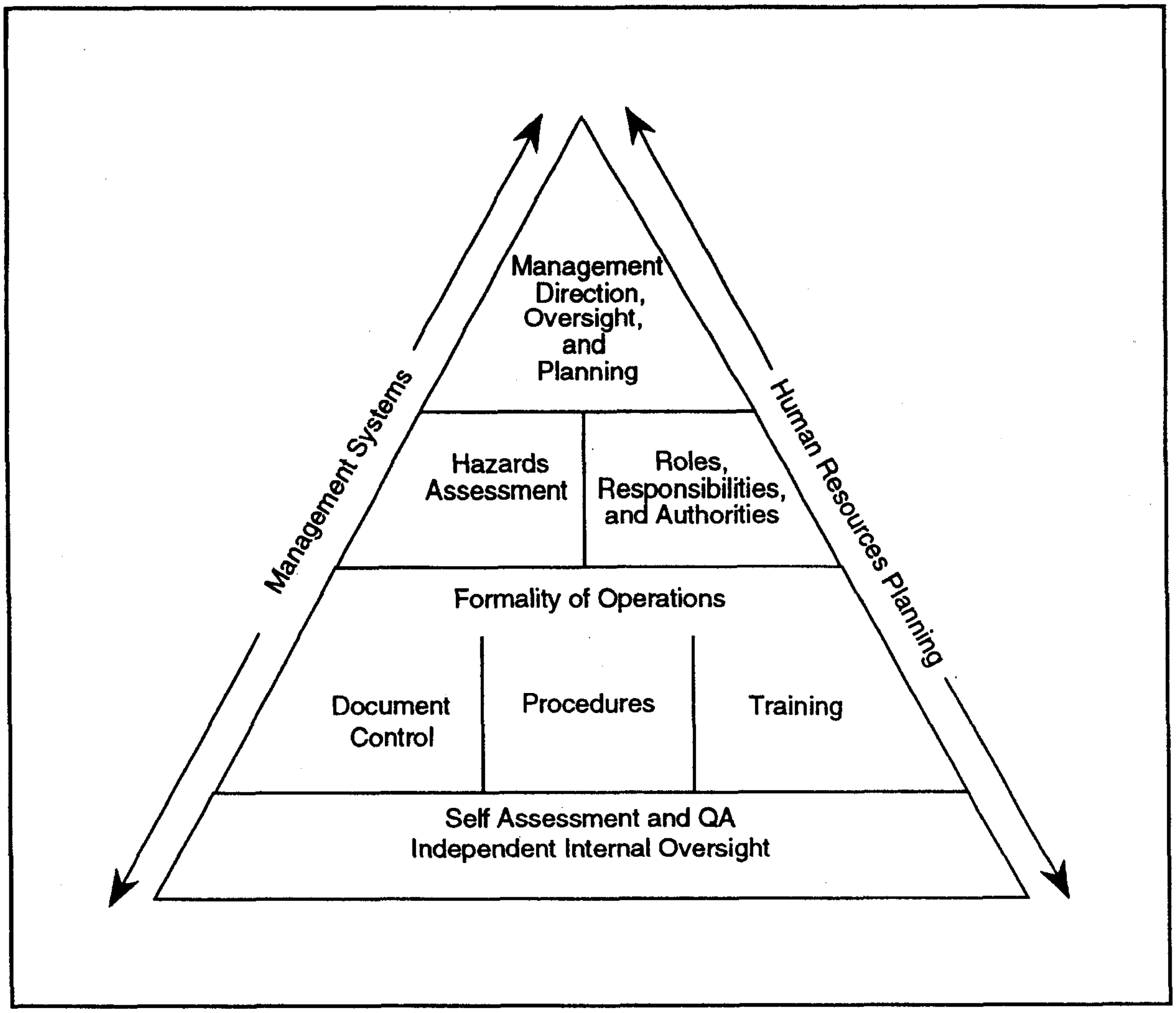

Figure 2-8 Strategic Planning Structure

Management Direction, Oversight, and Planning

Management goals and objectives for addressing SLAC's ES&H needs must be well-defined and the commitment to those goals and objectives must be continually reinforced. SLAC management will articulate its vision of integrating programmatic goals and high ES&H expectations into planning and operations, define management responsibilities, provide a well-understood system for prioritizing needs, use these priorities in allocating resources in the framework of a long-range plan, and provide the monitoring systems needed to ensure that ES&H goals are being met. Major tasks which implement this strategic element are:

- T1196: Establish & communicate ES&H expectations through issuance of an ES&H vision statement.
- T1197: The ES&H Division will develop guidance for integrating ES&H activities into budgeting and planning.
- T1198: Address ES&H leadership and oversight responsibilities in management RRAs.
- T1358: Establish measurable safety objectives and implement appropriate surveillance methods to measure performance toward achieving those objectives.

Hazards Assessment

As recognized by the Tiger Team, operations at SLAC and SSRL do not present high-level hazards. The corrective action strategy for SLAC, therefore, involves the detailed identification and classification of hazards so that an appropriate graded approach to compliance, formality of operations, and allocation of resources may be implemented. Major tasks which implement this strategic area are :

- T1376: A site-wide hazards assessment will be performed to provide the basis for determining the appropriate scope of activities required to meet SLAC's ES&H objectives.
- T1233, T1235: Complete the life safety survey and implement a program of annual fire loss surveys to identify potential exposures of health or property to fire hazard.
- T1335, T1345: A more formal approach will be taken toward identification and control of workplace hazards through a comprehensive industrial hygiene surveillance and personnel protection program.
- T1227: A plan will be developed for characterization of the SLAC site to determine the nature and extent of existing and potential groundwater contamination. This will provide the basis for future remediation activities and for identifying operations that may pose groundwater hazards.
- T1192: A schedule identifying and prioritizing the assessment of significant inactive waste sites will be developed.

Roles, Responsibilities, and Authorities

A fundamental requirement for the achievement of ES&H improvements at SLAC is to assure that all employees know what is expected of them. Organizational and individual roles, responsibilities, and authorities (RRAs) will be formally established and communicated to clarify expectations, and to assure that ES&H responsibility is assigned, understood, and implemented for all important functions. Major tasks which implement this strategic area are:

- T1222, T1224, T1018, T1294: Organizational and individual roles, responsibilities and authorities for implementation of SLAC's ES&H program will be established, documented and communicated.
- T1223: Inter-relationships of organizational RRAs will be clarified.
- T1316, T1411: The roles and responsibilities of experimenters and subcontractors will be clarified and appropriate training provided to ensure that even individuals working on site for only a brief period of time perform their activities consistent with the laboratory's ES&H objectives.

Formality of Operations

Operations at SLAC should be performed with the formality necessary to ensure that ES&H requirements and best management practices are implemented. This includes providing policy guidance and procedures for effective implementation, structured training and communication programs for personnel at all levels, and document control. Major tasks which implement this strategic area are:

- T1303: A graded approach will be taken in identifying the level and scope of formality required to ensure safe and environmentally sound operations at SLAC. Policies and guidance will be developed to direct the development of programs and systems to formalize operations as appropriate.
- T1203: The need for centralized document control will be evaluated and an appropriately formalized system will be put in place to meet SLAC's needs for document control.
- T1327: A graded approach to formal, integrated maintenance management will be implemented.
- T1409: An ES&H training plan will be developed to guide the development and implementation of training programs.

Self-Assessment

A rigorous, multi-level self-assessment program will serve as an important resource to address the root causes identified by the Tiger Team. SLAC has already begun a major effort to establish an integrated self-assessment program which includes strong line management self- assessment, independent self-assessment and appraisal, and management oversight. This activity is extremely beneficial to line management's awareness, understanding, and implementation of ES&H expectations. Implementation of the corrective actions which relate to self-assessment will result in integrating self-assessment into the fabric of line organization responsibilities. Major tasks which implement this strategic area are:

- T1366: SLAC will establish and institutionalize a site-wide self-assessment program.
- T1300: An assessment will be made of the scope of activities requiring independent oversight, and appropriate oversight mechanisms will be put in place to assure that safety and health is not compromised due to a lack of independent oversight.
- T1336, T1337: The ES&H Coordinating Council will enhance its oversight role by undertaking regular operating reviews of the facility and assessments of the safety review system.
- T1293: A comprehensive audit plan will be developed and implemented in phases based on the potential hazards, regulatory and DOE requirements, and time since last audit.
- T1044: The *SLAC Institutional Quality Assurance Plan* will be updated and a schedule developed for its implementation.

Management Systems

The augmentation of management systems to provide more effective and timely information is a strategic element necessary for controlling and monitoring ES&H activities. Effective management systems are essential to providing information in a quality and timely manner to ensure the effectiveness of programs, to measure progress toward achieving ES&H objectives, and to permit timely management attention to potential developing problems. Major tasks which implement this strategic area are:

- T1361: A corrective action management system will be developed and implemented, to provide for tracking, trending and analysis of ES&H deficiencies.
- T1133: The procedures for analyzing, tracking, and closing out reports of unusual occurrences will be reviewed and enhanced.
- T1311: An integrated chemical and hazardous materials management system will be developed to meet regulatory requirements and to provide the information necessary for internal management of those materials.

Human Resources Planning

Human resources planning will be improved to ensure that management and line organizations are effective and available to implement corrective actions. The objective of this strategic element is to assure that sufficient numbers of qualified individuals are available to accomplish the ES&H strategies, objectives, and tasks anticipated as part of the overall corrective action plan. Major tasks which implement this strategic area are:

- T1290: A human resources management plan will be developed to ensure the continued availability of trained personnel to meet the laboratory's ES&H objectives.
- T1291: Existing systems will be enhanced and new procedures developed to ensure the fitness for duty of the workforce.

SLAC has a history of scientific excellence and outstanding contributions to the US and international scientific communities. The Tiger Team assessment and the laboratory's preparation for it brought a new awareness of the current ES&H requirements and expectations to the whole laboratory . Responding to the Tiger Team offers opportunities for improving operations of the laboratory. The laboratory management is committed to and the staff is prepared to carry out the tasks presented in this plan. It is recognized that both programmatic and ES&H objectives must be accomplished with limited resources. As a result, the strategies developed include awareness that resource allocation should be based on a consideration and prioritization of risks and mission objectives, and that effective ES&H performance will be achieved through strengthened management leadership and line management accountability.

This *Corrective Action Plan* is SLAC's response to the Tiger Team assessment. The strategy pursued in preparing the *Plan* focused on understanding and correcting the fundamental root causes which led to the deficiencies identified. These fundamental causes have been addressed while also responding to the specific findings and concerns.

2.3.3 Overall Costs and Funding Requirements

Schedules for corrective actions have been developed to achieve early and substantive improvements on the highest priority deficiencies by performing a risk-based assessment of the Tiger Team findings and concerns, and developing a prioritized ranking of each, based on their environmental or safety significance. Corrective actions were then developed to address the fundamental safety concerns associated with the issues. In this way, resources will be focused on the most significant items.

Development of the *Corrective Action Plan* was pursued from the perspective of achieving significant improvements to overall SLAC operations and management, rather than from a narrow attention to the individual findings.

Sensitivity to costs and programmatic impacts has resulted in emphasis on cost-effective strategies. The anticipated cost of completion and closure of implementing this *Corrective Action Plan* is $18.7 million in FY92 dollars. An overall project planning effort has optimized development of an integrated, coordinated plan involving all elements of SLAC's operations. The financial details are shown in Table 2-1, as a function of time from FY92 through FY96. As can be seen, there are two types of costs: *implementation* (i.e., the one-time cost of taking care of an action) and *ongoing* (i.e., the annual cost of an action which must be repeated on a regular basis). Furthermore, the implementation costs are divided among existing (presently supported) and new activities. A small part of the new activities are expected to be supported by GPP and ERWM funds. All other new activities and ongoing costs are presently unsupported. Resources to implement these activities will have to be identified or, conversely, the present *Corrective Action Plan* will have to be implemented over a period longer than five years.

Assuming that resources can be made available on a timely basis, Table 2-2 gives a projection of overall progress, indicating the rate at which tasks can be completed to close out findings and concerns.

Table 2-1. Implementation and Ongoing Costs by Fiscal Year ($M, in FY92 Dollars)

	FY92	FY93	FY94	FY95	FY96	Total
Implementation Costs						
Existing ES&H Activities	2.37	1.81	0.67	0.05		4.90
New ES&H Activities	1.00	1.65	1.54	0.35	0.03	4.57
GPP	0.14	0.25				0.39
ERWM	0.01	0.06	0.05			0.12
Subtotal: Implementation Costs	3.52	3.77	2.26	0.40	0.03	9.98
Ongoing Costs		1.05	2.10	2.82	2.82	8.79
Grand Total	3.52	4.82	4.36	3.22	2.85	18.77
Informational Subtotal						
New ES&H Activities plus Ongoing Costs	1.00	2.70	3.64	3.17	2.85	13.36

Table 2-2. *Corrective Action Plan* Scheduled Progress

	FY92	FY93	FY94	FY95	FY96	Total
Number of Findings/Concerns Closed	24	89	50	21	3	187
Percent of Actions Completed	13%	47%	27%	11%	2%	100%
Cumulative Percent of Actions Completed	13%	60%	87%	98%	100%	

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