DOE F 1325.8
(8-89)
EFG (07-90)

United States Government   Department of Energy

memorandum

DATE: JUN 26 1998

REPLY TO
ATTN OF: Stanford Site Office (SSO)

SUBJECT: SPEAR3 Finding of No Significant Impact Approval

TO: James M. Turner, Ph.D.

Attached is the final Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the Stanford Synchrotron Radiation Laboratory upgrade project, "SPEAR3". The EA has completed the 30 day public review period without any comments. We have finalized the EA and prepared the FONSI for your approval.

We request your approval of the FONSI to complete the NEPA process for the SPEAR3 project. Should you have any questions, please contact me at (650) 926-4963.

Bill Franzwa
SPEAR3 Project Manager
Stanford Site Office

Attachments

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Attachments

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ENVIRONMENTAL ASSESSMENT FOR SPEAR3
DOE/EA-1243

June 23, 1998

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1.0 INTRODUCTION

The proposed action of the Environmental Assessment (EA) is to upgrade the Stanford Positron-Electron Asymmetric Ring (SPEAR) at the Stanford Linear Accelerator Center (SLAC). Although designed as a high-energy physics colliding beam storage ring, SPEAR has been an effective source of synchrotron radiation for much of its 25 year history. The proposed upgrade, called SPEAR3, would result in a substantial improvement in capabilities on all of the SPEAR experimental stations, or beamlines, and would have a significant positive impact on the current and future science and technology program of SLAC's Stanford Synchrotron Radiation Laboratory (SSRL).

SPEAR3 would increase the synchrotron radiation beam brightness by reducing the electron beam size and divergence, called emittance, and increasing the electron beam current stored in the SPEAR3 ring. The bulk of the conversion would take place during a shutdown of approximately six months, with other work being done during earlier short shutdown periods. Concomitant with the machine upgrade, a beamline improvement program is planned to enable all beamlines to take advantage of the new capabilities of SPEAR3.

This EA describes the environmental consequences of implementing the SPEAR upgrade and the no-action alternative. This EA is prepared for compliance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ) implementing regulations (40 Code of Federal Regulations [CFR] 1500-1508), and DOE's Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements, Office of NEPA Oversight, US DOE, May 1993.

2.0 PURPOSE AND NEED FOR SPEAR3

2.1. Purpose

The proposed upgrade to SPEAR would be to improve the quality and brightness of the synchrotron radiation beam utilized by scientists and students performing experiments on SSRL beamlines.

2.2. Need

The SPEAR facility is the only x-ray facility in the western US. The proposed upgrade would enable scientists, students and researchers from local technology companies to conduct state-of-the-art experiments. The improved beam brightness would make possible experiments on SPEAR3 that would not be possible on SPEAR.

3.0 DESCRIPTION OF THE PROPOSED ACTION

3.1 Project Description for SPEAR3

The SPEAR3 project would increase the synchrotron radiation beam brightness by decreasing the emittance and increasing the beam current. An improved beam emittance of about 20 nanometer-radians and a beam current of up to 500 mA at 3.0 GeV or 300 mA at 3.4 GeV would be possible after an upgrade of the magnet lattice, replacement of the vacuum chamber and upgrade of some beamline components. Increasing beam brightness would increase the synchrotron radiation beam power density. Therefore, appropriate synchrotron radiation beamline components would need to be upgraded to handle the increased power loads.

Modification and operation of SPEAR3 is a project of SSRL, a division of SLAC. Figure 1 shows the SLAC site location on the San Francisco Peninsula. The general configuration of the proposed SPEAR3, which is identical to the existing SPEAR, is illustrated on a site plan in Figure 2. The cost of the storage ring upgrade project is

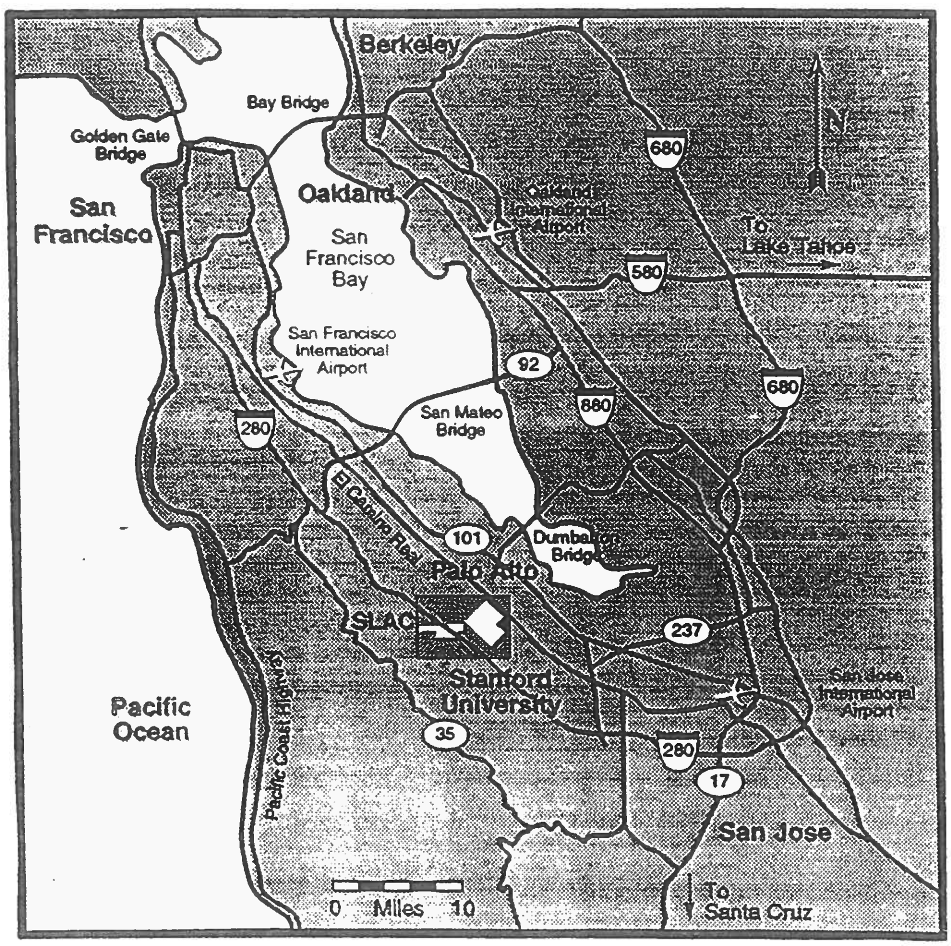

Figure 1: SLAC Site Location on San Francisco Peninsula

estimated to be $45 million. The cost of the modifications to beamlines is estimated to be $12 million. These estimates assume component fabrication would begin in FY2000 with major installation complete in FY2002.

Functionally, the stored electron beam is contained in a vacuum system and is guided by a lattice of magnets. Power, emitted as synchrotron radiation, is restored on each revolution by a radio-frequency (RF) system. Diagnostic and feedback hardware and software measure and control the stability of the beam. The synchrotron radiation is transmitted down the beamlines, often through collimators and monochromators and across focussing mirrors, to the experimental areas. A site plan of the facility and a cross-sectional view of the new SPEAR3 accelerator housing are shown in Figures 2 and 3, respectively.

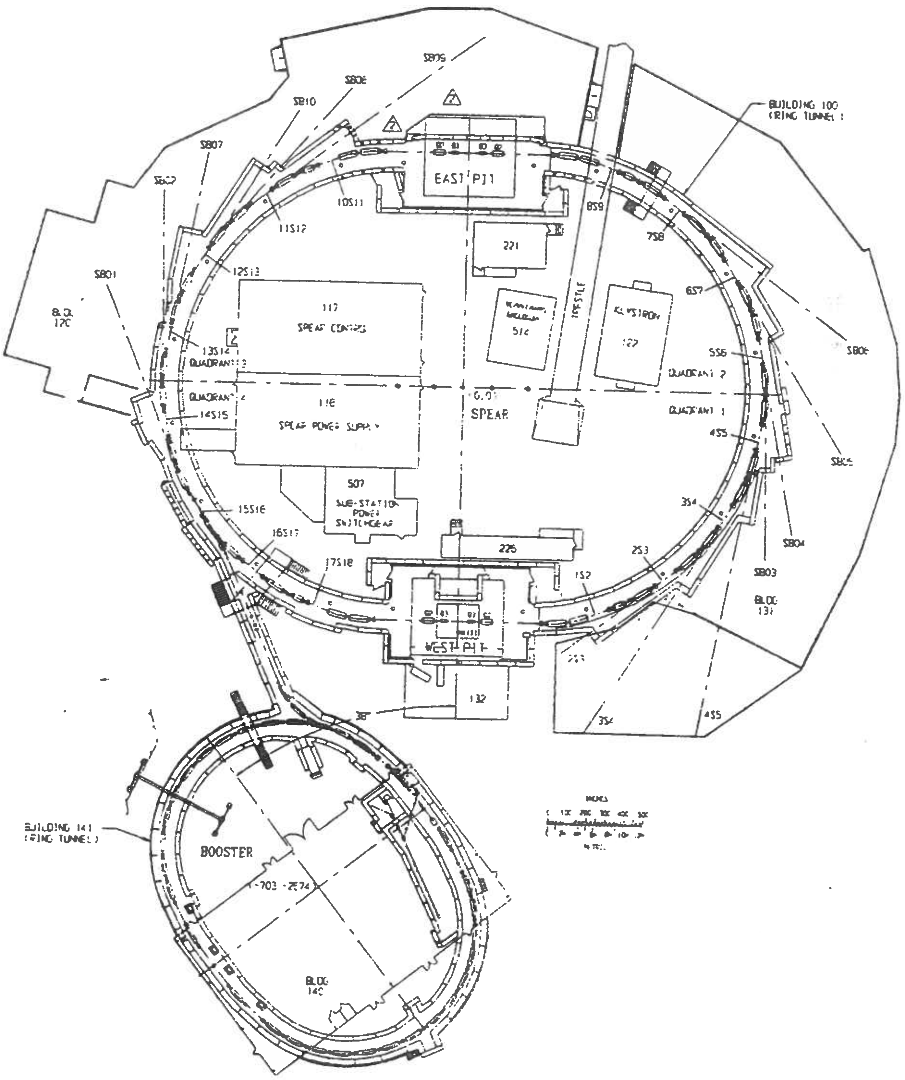

Figure 2: Site Plan of the SPEAR Facility

No conventional construction other than limited augmentation to surface buildings would be required for SPEAR3. The existing conventional facilities for SPEAR and the SSRL beamlines consist of accelerator housings, research areas, support buildings, roads, earthwork, fencing, landscaping, electrical and mechanical utilities, and the sanitary-sewer and storm-drain systems. These existing systems and facilities have adequate capacity and would not require any modifications or expansion. Furthermore, no undisturbed grounds onsite would be affected by the project.

The new components and equipment for SPEAR3 and existing beamlines would be fabricated at SLAC or at vendor facilities and tested in existing facilities at SLAC. Final assembly of all components would be performed at SSRL within existing facilities (see figure 3).

Neither the construction nor operation of SPEAR3 would require a significant increase in staffing levels. The potential effects of the construction and operation of the proposed SPEAR3 project are discussed in Section 5.

3.1.1 Facility Requirements

The upgrade of the existing SPEAR storage ring to SPEAR3 and the upgrade of SSRL beamlines would involve: the removal and disassembly of various SPEAR and beamline components (for example, magnets, vacuum chambers, mirror tanks, synchrotron radiation masks, etc.); the fabrication of new components (for example, magnets, vacuum system, mirror chambers, monochromators, synchrotron radiation masks, etc.) at vendor facilities at SLAC, and the assembly of SPEAR3 and beamline components in existing facilities at SSRL. The potential impacts associated with these activities, including hazardous-materials usage and waste production, are discussed in Section 6.1.

Space requirements for SPEAR disassembly of vacuum chamber sections, and beamline components, including storage requirements for magnets and vacuum components, are estimated to be less than 8,000 square feet. SLAC's available shop and assembly space of approximately would provide sufficient space for disassembly, storage, modification, and installation of components.

3.1.2 Component Fabrication

All of the new magnets required for the SPEAR3 upgrade would be manufactured at vendor facilities or at SLAC/SSRL. The magnets that would be newly fabricated for SPEAR3 could require a degreasing procedure and painting. Degreasing operations would be conducted utilizing Bay Area Air Quality Management District (BAAQMD) permitted vapor degreasers at SLAC. Most of the parts for the SPEAR3 vacuum system and many of the beamline components would be fabricated at vendor facilities. Many existing beamline components would be modified at SSRL. The existing SPEAR klystron tubes and RF components for the RF system would be reused and more than 80% of the beamline components would be reused.

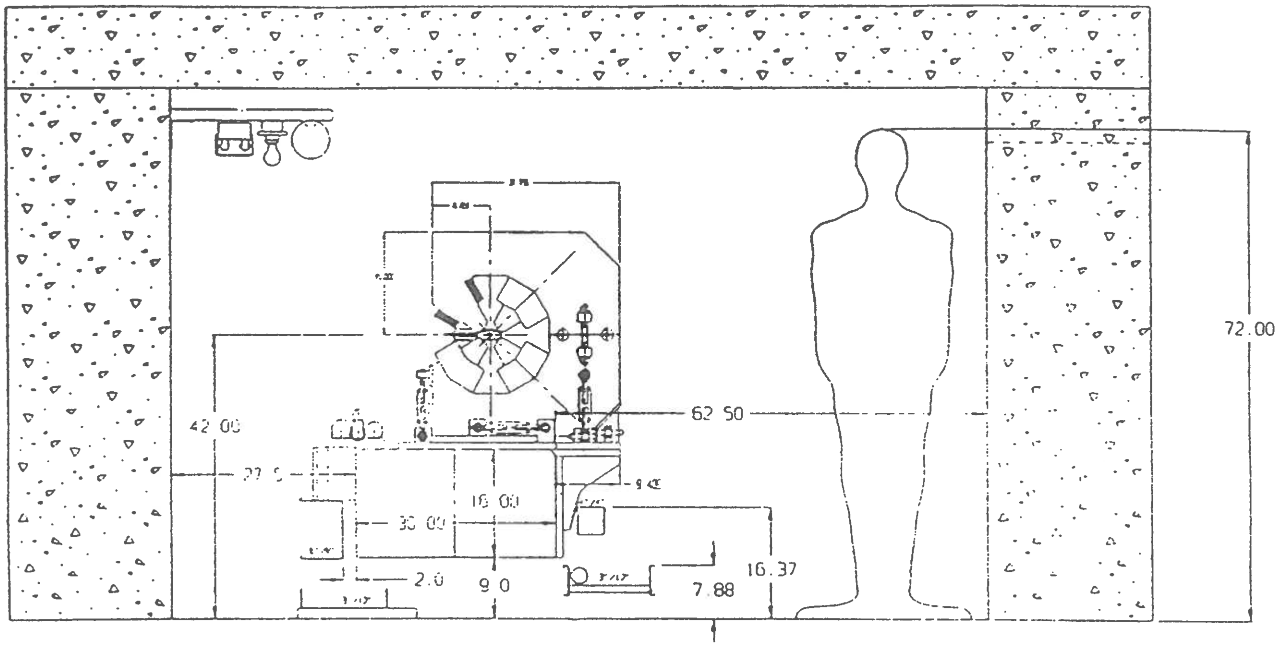

Figure 3: Side View of SPEAR3 Accelerator Housing

3.1.3 Assembly and Installation

Assembly of the components for SPEAR3 and the SSRL beamlines would be performed in existing facilities at SLAC, and would be conducted and monitored in accordance with established Environment, Safety, and Health (ES&H) procedures.

Brazing of vacuum-chamber and beamline subassemblies would be performed at SLAC in hydrogen furnaces with controlled atmospheres. Electron-beam or Tungsten-Inert Gas (TIG) welding would be used for some joints. Assembly of the vacuum chamber and beamline components would occur at SSRL prior to installation in the SPEAR housing and on the beamlines.

SPEAR3 dipole, quadrupole and sextupole magnets, and beamline components may be mounted on existing supports. Components would be positioned during installation. The SPEAR housing and SSRL beamline areas afford sufficient space for assembly operations.

3.2 Operations

Operation of SPEAR3 would be identical to operation of SPEAR. During SPEAR experiments, electrons are accelerated in the SSRL Injector, comprised of the SSRL linac and booster, and injected into the ring where they are stored for 24 hours. After injection, beamlines are opened for continuous use in experiments.

The currently anticipated lifetime of SPEAR3 is ten to fifteen years. During this time, the accelerator would run continuously 24 hours per day, 7 days per week, interrupted by scheduled maintenance averaging two days per month. Occasional down-time would also occur for non-routine maintenance (usually one to two shifts in duration). In addition, a routine down-time of 2 to 3 months for major maintenance is also expected, similar to the historical operation of SPEAR.

Routine maintenance involves activities such as equipment and component testing, calibration, repair and replacement, component cleaning, replacement of cartridges on the deionized water systems, and replacement of air filters. Management of the ground water seepage into the SPEAR interaction areas requires the routine maintenance of sump basins and pumps (See Section 5.3.1). In addition to the routine maintenance, experience with SPEAR and other accelerators indicates that SPEAR3 likely would require minor modifications in order to achieve design-criteria operational parameters. These modifications would add, replace, change or remove equipment and components, but would not change SPEAR3 design parameters or increase the potential effects from operations as described in Section 6.

There may be modifications to, or replacement of, the storage ring and beamlines that would provide capabilities (such as data acquisition and analysis or improved beamline component design) beyond the original design; however, these improvements would not pose any additional impacts on human health or the environment as identified in Section 6. Modifications would include, or be similar in nature to:

- The fabrication and installation of new beamlines, replacement and modification of old beamlines including beamline insertion devices, beam position monitors and associated components, masking devices, focussing mirrors and monochromators

- The fabrication and installation of new beamline instrumentation and associated hardware and systems to enable enhanced experiments in human physiology, microbiology, tomography, protein crystallography, photoemission, absorption and fluorescence spectroscopy (including environmental materials), and microcontamination

- The replacement and upgrade of existing communications equipment; computers; machine; personnel protection and feedback control systems; as well as the installation of measuring and monitoring instrumentation

- The removal, replacement or modification of magnets; segments or components of the vacuum system and collimators; modulators and RF driving and phasing equipment for klystrons

- The fabrication, replacement, modification and addition of power supplies and AC distribution systems from existing substations

The SPEAR facility was originally designed to operate with a 4.0 GeV electron beam. In contrast, SPEAR3 would normally run with a 3.0 GeV beam. Incidental increases in SPEAR3 operating conditions over the course of its projected service life would not exceed 3.5 GeV.

3.3 Waste Minimization and Pollution Prevention

The inherent design of SPEAR3 (that is, the use of the existing SPEAR facility and the reuse of a majority of the existing SPEAR and beamline components) is consistent with DOE's policy on Waste Minimization and Pollution Prevention (WMIN/PP) (DOE, 1992a). By reusing most of the existing SPEAR and beamline components, modification of SPEAR3 and the SSRL beamlines would avoid and reduce the generation of hazardous substances, pollutants, wastes, and contaminants at the source. SPEAR and uncontaminated beamline components not destined for reuse in SPEAR3 would be evaluated for their salvage potential.

3.4 Decontamination and Decommissioning

At the conclusion of SPEAR3's useful life, conservatively estimated to be 15 years, decontamination and decommissioning of the equipment would be performed in accordance with applicable laws and regulations, as reflected in established SLAC policies and procedures. For a project of this type, a comprehensive radiological survey would be performed and if any components or materials were determined to have residual radioactivity, they would be stored onsite pending future reuse or ultimate disposal. Based on radiological surveys conducted for SPEAR, low levels of residual activity would be expected for SPEAR3. Potential impacts associated with decontamination and decommissioning activities are discussed in Section 6.4.

4.0 DESCRIPTION OF ALTERNATIVES

4.1 No Action

Under the No-Action Alternative, SPEAR3 would not be built and existing SSRL facilities would continue to operate under current management practices.

In the event that SPEAR3 would not be built, the research scientists and students from western universities, government laboratories and technology companies would not have the local resources to conduct state-of-the-art experiments.

4.2 Modification and Operation at DOE Facility Other Than SPEAR

The only DOE facility comparable with SPEAR/SSRL is the National Synchrotron Light Source (NSLS) at the Brookhaven National Laboratory (BNL) on Long Island in New York. BNL proposes to upgrade the NSLS at the same time as the SPEAR3 upgrade. It is necessary to upgrade both facilities to provide the national resources to meet the current and future demands of synchrotron radiation users.

5.0 DESCRIPTION OF THE EXISTING ENVIRONMENTS

5.1 Site Description

5.1.1 Location

SSRL is a division of SLAC. SLAC is a national facility operated by Stanford University under contract with the US Department of Energy. SLAC is located on the San Francisco Peninsula between San Francisco and San Jose, California, as shown in Figure 1. The site is located on a belt of low rolling foothills between the San Francisco Bay to the east and the Santa Cruz Mountains to the west. The SLAC site occupies 426 acres of land owned by Stanford University and is located west of the University and the city of Palo Alto. SLAC's facilities are located on a parcel roughly 1,000 feet wide and three miles long, oriented in an east-west direction. The width of the parcel expands to about 3,000 feet at the target (east end) to allow space for buildings and experimental facilities.

The oval-shaped 240 meter housing of SPEAR, and its associated support buildings, are located at the eastern end of the site. The Injector lies to the southwest of and adjacent to the SPEAR facility. It has been the source of electrons for SPEAR and would continue to be the source of electrons for SPEAR3.

The SLAC facility is situated in a moderately hilly area covered largely by grassland and oak woodland. The Jasper Ridge Biological Preserve of Stanford University is located south of the SLAC accelerator facilities and southwest of the SPEAR facility. San Francisquito Creek flows through the preserve near its northern boundary, roughly parallel to the SLAC linac (also known as the 2-mile accelerator), and ultimately flows into San Francisco Bay. Because this preserve has long been recognized as a unique ecological resource representing extraordinary biological diversity, SLAC construction activities have been conducted so as to prevent or minimize adverse impacts to this area.

5.1.2 Geology/ Seismic Conditions

The SLAC site is underlain by bedrock comprised of sandstone and claystone. In general, the bedrock on which the western half of the SLAC accelerator facilities rests is of Eocene age (over 50,000,000 years old) and that under the eastern half is of Miocene age (over 10,000,000 years old). On top of this bedrock at various places along the SLAC linac accelerator are found alluvial deposits of sand and gravel generally of Pleistocene age (1,000,000 years old). At the surface is a soil overburden of unconsolidated earth materials averaging from three to five feet in depth. The San Andreas Fault, which extends nearly the entire length of the state, is present about a mile west of the site boundary. The probability of a strong earthquake (monument magnitude of 7.0 or greater) originating in the proximate section of the San Andreas Fault is in the range of 23 per annum (that is, 23% chance in the next thirty years) and may be increasing with time.

5.1.3 Population

SLAC is located in San Mateo County and is mainly surrounded by five communities: Atherton; West Menlo Park; Portola Valley; Woodside; and Stanford. The land use around SLAC is a mix of office, school, university, housing and pasture. Population data from the recent 1990 census for the five communities total about 38,000. There are currently approximately 1,500 staff and contract personnel employed at SLAC.

5.2 Air Quality

5.2.1 Non-Radiological

Non-radiological air emissions from stationary sources at SLAC are regulated by the BAAQMD. Primary sources of non-radiological air emissions include: volatile organic compounds (VOC's) from solvent cleaning and coating operations, nitrogen oxides (NOx) from industrial boilers, and particulates from metal- and wood-working activities in various shops. Currently, SLAC has 24 air-pollution sources listed with the BAAQMD. Of the 24 current sources, 12 are permitted and 12 are exempt from permitting requirements. Nevertheless, these twelve exempt units are listed with the BAAQMD because they are associated with a pollution-abatement device in their operation. The SLAC facility is currently in compliance with Federal, state, and local regulations and all requirements included in its active permits regarding both Criteria Pollutants and Toxic Air Contaminants. Radiological aspects, both background conditions and contributions from SLAC operations, are discussed in Section 5.2.2.

5.2.2 Radiological

Given the range of potential hazards associated with the SPEAR3 upgrade and operation, those associated with radiation are relatively low. However, because they are not standard safety hazards, this section has been included to provide context and define relevant terms.

5.2.2.1 Natural Sources of Radiation and Background

Radiation from natural sources permeates the universe and thus is an inherent aspect of life on earth. All living things are continuously exposed to this natural radiation, both externally from cosmic radiation and natural radioactive material in the earth, and internally from natural radioactive materials taken into the body via air, water, and food. The public also receives, and generally accepts the risks associated with, radiation exposure from medical x-rays, nuclear medicine procedures, and some consumer products (for example, tobacco, building materials, some water supplies).

The standard unit for expressing the amount of radiation received or absorbed is the millirem (mrem). As shown in Table 1, an average member of the public in the United States receives 300 millirem per year (mrem/year) from natural sources of radiation and 60 mrem/year from human-made sources (NCRP, 1987a; NCRP, 1987b), for a total of approximately 360 mrem/year, or 1 mrem/day.

The figures shown in this table are approximations and are subject to some variation. For example, the dose equivalent rate from cosmic radiation at sea level in the US averages 32 mrem/year with a range of 25 to 50 mrem/year, dependent on geographic location. By comparison, the dose equivalent rate from cosmic radiation at an altitude of approximately 1 mile, such as on the Colorado Plateau, averages 63 mrem/year, with a range of 50 to 100 mrem/year, dependent on altitude (NCRP, 1987a; NCRP, 1987b).

Source of Radiation	Annual Average Dose Equivalent Rate (mrem/yr)	Type of Radiation Source
Natural	60	Cosmic, Primordial and Cosmogenic
Natural	40	Internally-deposited (not including radon or radon daughters
Natural	200	Internally deposited radon and radon daughters
Medical Procedures	50	Human-Made
Consumer Products	10	Human-Made

Table 1: Natural and Human-Made Sources of Radiation Exposure to the Public

Exposure to some types of radiation, both human-made and natural, is voluntary or can be controlled. Average dose equivalents to individual members of the public from medical x-ray examinations can range from 1 mrem for an extremity examination to over 400 mrem for a barium enema (NCRP, 1987a). A 5-hour jet flight across the US can result in a dose equivalent of 2.5 mrem, due primarily to cosmic radiation (Lamarsh, 1983).

5.2.2.2 Contributions to Background Radiation Levels from SLAC Operations

High-energy particles are absorbed by design at least ten separate locations at SLAC: the Beam Switch Yard (BSY), the Positron Source (PS), the electron and positron beam dumps in the Final Focus System (FFS), the Final Focus Test Beam (FFTB) dump, the damping rings (DR), the Next Linear Collider Test Accelerator (NLCTA), the Positron-Electron Project II (PEP-II) facility, the SLAC linear accelerator (linac), the present SSRL facility, and Beam Dump East, which is associated with End Station A. Because these areas are high beam loss areas, they are potential sources of detectable gaseous radioactive emissions.

In compliance with the National Emissions Standards for Hazardous Air Pollutants (NESHAPs), a report prepared by SLAC calculated the maximum release levels of airborne radionuclides from these five areas, using the EPA-approved software code CAP88-PC, Version 1.0, in 1996. These calculations yielded an effective dose equivalent of 0.0006 mrem/year, to a maximally exposed individual which represents less than one percent of the NESHAPs standard of 10 mrem/year, as discussed in the SLAC 1996 Site Environmental Report (SLAC, 1997a).

The SLAC boundary is monitored by seven peripheral monitoring stations, which measure and record doses and dose equivalents due to gamma rays and neutrons. Signals from these monitoring stations are fed into a central control station. The monitors measure both background radiation from natural sources and any direct radiation associated with SLAC operations. In addition, SLAC has a site boundary environmental thermoluminescent dosimeter (TLD) monitoring program in place that also provides measurements of gamma ray and neutron dose equivalents. The maximum dose equivalent above background for an individual at the location of the nearest residence 24 hours per day was estimated to be less than 5 mrem (calculations show that the contribution from SPEAR3 would be less than or equal to 0.2 mrem) in a year (SLAC, 1997a). This level of exposure from radioactive gases and direct radiation was substantially less than two percent (2%) of the total background radiation received from natural sources.

5.2.3 Air Pollutants

The air quality in the San Francisco Bay Area Air Basin is generally fair and is improving. However, health-based ambient air quality standards are occasionally violated for ozone (O3) in inland valleys during summer and for carbon monoxide (CO) in urban areas on cold winter nights.

5.3 Water Quality and Hydrology

5.3.1 Non-Radiological.

There are no drinking-water wells at or near SLAC, mainly because the ground water is naturally high in total dissolved solids (TDS) and has very low flow rates. A report prepared for SLAC (King, 1989) to identify and evaluate potential underground water supplies concluded, based on the information available, that the Tertiary bedrock beneath the facility did not constitute a viable water source for SLAC.

The on-site ground water monitoring network comprises 21 wells located in areas of the facility that have either historically or presently store, handle, or use chemicals or radionuclides posing potential threats to ground water quality. Samples collected from the monitoring wells are analyzed for a wide range of constituents. Analytical results indicate that ground water samples collected from several of the wells contained chlorinated solvents (TCE, TCA, methylene chloride, and freon). There is, however, no known contaminated ground water in the vicinity of the SPEAR facility. The presence of chlorinated solvents is most likely due to past practices related to paint shop operations, degreasing and general cleaning and maintenance activities (Earth Sciences Associates, 1993). SLAC has institutionalized training of hazardous materials operators. As a result of increased awareness, training, and improvements in procedures over time, the overall potential for ground water contamination due to disassembly and refurbishment activities has been minimized.

Due to a normally high water table and the low hydraulic conductivity associated with the consolidated sandstones underlying SLAC, ground water continually seeps into the SPEAR interaction regions. This seepage is corrosive and attacks iron, aluminum, and some plastics. It also supports the growth of algae. In addition, the high mineral content of this water produces deposits that can clog drain pipes, drainage channels and gutters (SLAC, 1991a). The volume of ground water seeping into the SPEAR interaction regions varies from 0 to 40 gallons per day. In general, the seepage volume is correlated with seasonal variations in rainfall and ground water recharge, rather than any specific operations at SLAC.

The seepage is channeled into sumps that contain a level-activated pumps that discharge into a 500 gallon tank, one in each interaction region. After testing to ensure that there is no tritium exceeding permitted concentrations, the water is pumped into the sanitary sewer system.

5.3.2 Radiological

The possibility of radioactivity in surface water and ground water, along with potential activation in soils and sediments, has been addressed at SLAC. Tritium is the primary radionuclide of interest in ground water or surface water, while gamma-emitting species are the potential concern in soil.

It should be noted that SLAC has only electron accelerators, which are much less likely, by a factor of about 1,000, to produce activation in ground areas near shields than are proton accelerators. Surface water and ground water are routinely monitored and the data indicate that there have been no offsite releases of radioactive substances.

Periodic ground water sampling for tritium was initiated in July, 1992. These data show that old monitoring well MW-24, now known as EXW-4, has shown levels of tritium ranging from 8,357 picocuries per liter (pCi/l) to 12,237 pCi/l. By comparison, the EPA drinking-water standard for tritium is 20,000 pCi/l. Well EXW-4 was sampled on a periodic basis for tritium beginning in 1968 until 1992 when quarterly sampling was initiated for several years. The well is now sampled yearly. EXW-4 is the closest well to a high-power beam dump used with the high-energy physics Fixed-Target Program. High-powered beam dumps are not used in the operation of storage rings such as SPEAR or SPEAR3.

Unlike water, soils and sediments are not routinely analyzed for radionuclides at SLAC. However, characterization samples of surface soils and gamma spectral analysis done to date have not indicated any onsite or offsite radioactivity associated with SLAC accelerator operations. Only naturally occurring radionuclides have been detected in soil and sediment environmental samples taken around the SPEAR facility.

Additional monitoring wells are being planned for installation during FY98 near high-power beam dumps associated with the high-energy physics program at SLAC. While these wells will expand the coverage for ground water monitoring for the SLAC site, based on calculations, there are no expectations of levels of tritium greater than those seen in EXW-4 nor prospectively any significant contribution from SPEAR3. The additional wells will serve to provide additional assurance that the most likely sources on site have close monitoring to ensure no significant environmental releases are occurring well inside the SLAC boundaries that could eventually move off site.

The SLAC Radiation Safety Program is designed to ensure that radiation doses above background received by workers and the public shall be as low as reasonably achievable (ALARA), as well as to prevent any person from receiving more radiation exposure than is permitted under federal government regulations. The main provisions of the ALARA program ensure

- that access to high radiation areas is controlled

- that the accelerator facilities and the associated detectors are provided with adequately shielded enclosures for times when the possibility exists for a radiation field to be present

- that new facility and significant modifications design incorporates dose reduction, contamination reduction, and waste minimization features in the earliest planning stages.

Several technical, operations, and administrative systems exist to implement the program, as described in the SLAC Radiological Control Manual (SLAC, 1992g) and the SLAC Guidelines for Operations (SLAC, 1992e).

5.4 Hazardous Materials Usage and Waste Production

5.4.1 Non-Radiological

Approximately 350 tons of hazardous wastes are generated at SLAC on an annual basis. As defined by the Resource, Conservation, and Recovery Act (RCRA), SLAC is a "generator" of hazardous waste and is allowed to accumulate waste onsite for a maximum of 90 days before it must be transported offsite to a permitted Treatment, Storage and Disposal Facility (TSDF) for recycling, treatment, or disposal. Examples of waste types or waste streams generated at SLAC include heavy-metal-bearing wastes from plating shop operations; solvents from degreasing operations; oils and coolants from equipment, heavy machinery, and automobiles; contaminated soils from remedial activities; PCB wastes from transformers; and transformer carcasses.

SPEAR operations infrequently generated "California Only" (non-RCRA) regulated wastes, such as mineral oils, due to leakage or seepage from oil-filled equipment. The equipment was repaired or replaced, and the hazardous waste was disposed of or recycled according to California's Hazardous Waste Control Laws (HWCLs).

5.4.2 Radiological

No radioactive wastes are routinely generated by the operation of SPEAR. SLAC generates a small amount of low-level radioactive waste from other accelerator operations. Low levels of radioactivity were induced in some accelerator components. Most of the induced material has not been declared waste but, rather, is held on site for potential reuse at SLAC. Non-reusable components are surveyed, according to established policies and procedures, and if found to be activated, are stored onsite. These components are stored in the fenced and bermed Radioactive Material Storage Yard (RAMSY) while awaiting disposal at a DOE-approved radioactive waste disposal site.

5.4.3 Occupational

The potential hazards to workers from hazardous materials are addressed by the SLAC Industrial Hygiene Program, which is detailed in the ES&H Manual (SLAC, 1997c). This program identifies all occupational health hazards, quantifies and documents the extent of employee exposure, and implements engineering, administrative, work practice, and personal protective equipment control methods to eliminate or mitigate health hazards to an acceptable level. There are no current or anticipated activities at SLAC that would expose workers to concentrations of air contaminants at or above the Occupational Safety and Health Administration (OSHA, 1996) permissible exposure limit (US DOL,1996) or the American Conference of Governmental Industrial Hygienists threshold limit values (ACGIH, 1995).

Facility-wide procedures for storing, transporting, handling, inspecting, and disposing of hazardous materials and wastes are contained in the SLAC Hazardous Materials Management Handbook (SLAC, 1992f). The SLAC waste minimization policy is detailed in the SLAC Waste Minimization Program Plan to Comply with California's Hazardous Waste Source Reduction and Management Review Act of 1989 (SLAC, 1992b) and the SLAC Waste Minimization Program Plan to Comply with Department of Energy Order 5400.1 (SLAC, 1992a). In addition, all personnel who handle hazardous materials or hazardous wastes are required to complete Hazards Communication (HAZCOM) training and Hazardous Materials and Waste Management training.

5.5 Archaeological and Historic Sites

The Stanford University Archaeologist's office compiles and maintains maps and detailed descriptions of all archaeological sites known on Stanford property, many of which lie along San Francisquito Creek. Examination of these materials revealed approximately 20 sites south of the SLAC facility on both sides of the creek, but none in the vicinity of the existing SPEAR facility.

There are also no known historic sites in the vicinity of the SPEAR facility. Furthermore, due to the fact that the SPEAR3 upgrade project would be accomplished within existing facilities, the State Historic Preservation Officer (See Appendix A) has notified DOE that he does not object to the determination that this undertaking would not affect historic properties and that no further DOE action is required to comply with Section 106 of the National Historic Preservation Act.

5.6 Sensitive Species

Based on information provided by the California Department of Fish and Game and the U. S. Department of Fish and Wildlife, 14 animal species and 13 plant species occurring in San Mateo County are currently listed as endangered, threatened, proposed, or as species of concern. Of these, 3 of the animal species may occur on or immediately adjacent to the SLAC lease holding: the San Francisco gartersnake (Thamnophis sirtalis, subspecies tetrataenia), the California red-legged frog (Rana aurora draytonii), and the steelhead trout (Oncorhynchus mykiss).

The San Francisco garter snake has occurred historically on and around the SLAC facility (Barry, 1976). However, the subspecies designated as endangered by the Federal Government (T. s. tetrataenia) intergrades with a similar subspecies (T. s. infernalis) in southeastern San Mateo County and northwestern Santa Clara County

(Seib and Papenfuss, 1982). In other words, the SLAC facility lies near the northeastern edge of the endangered subspecies' distribution, rather than near its center. Given its specific habitat requirements, the presence of this subspecies at or near SPEAR is considered highly unlikely, according to biologists currently working at the Jasper Ridge Biological Preserve, located immediately south of SLAC.

Both the red-legged frog and the steelhead are aquatic species associated with San Francisquito Creek, located south of the SLAC linac. The creek flows roughly parallel to the linac and receives runoff from SLAC via three natural drainages. These undeveloped areas are at least 1,200 feet south of SSRL, which is a fully developed area surrounded by asphalt and concrete. As a result, any impacts produced by upgrade and operation of SPEAR3 are unlikely to have any measurable effect on either of these two species.

Other sensitive species potentially occurring in the area around SLAC include the San Francisco forktail damselfly (Ischnura gemina); the Bay checkerspot butterfly (Euphydryas editha bayensis), the California tiger salamander (Ambystoma tigrinum californiense), and serpentine bunchgrass. According to staff biologists and researchers at the Jasper Ridge Preserve, both the butterfly and the bunchgrass are strongly associated with outcrops of serpentine soils, which do not occur on the SLAC lease holding. In addition, the salamander can be found downstream at Lake Lagunita on the Stanford University campus, but prefers marshy areas to running waters. Therefore, three of these four species are unlikely to occur at SLAC (SAIC,1991a).The damselfly is known to occur outside the Jasper Ridge area, although its distribution is not well known and would require field surveys for a conclusive determination. Given the above considerations, however, such surveys do not appear to be warranted, especially in light of the limited extent of the potential wetlands at SLAC.

5.7 Floodplains/Wetlands

Examination of the most current Federal Emergency Management Agency (FEMA) floodplain maps for the area indicates that a 100-year flood will be confined to the San Francisquito Creek channel and would not reach any part of the SLAC site, including the SPEAR facility (SAIC, 1991a).

No wetlands have been identified in the vicinity of the SPEAR facility. Of the scattered marshy areas on SLAC property, the largest is approximately 1,000 feet southeast of the eastern end of the SLAC linac. A focused environmental survey (SLAC, 1991b) could not determine whether this area met the criteria for designation as wetlands due to persistent drought conditions. The portion of this area where the three conditions necessary for wetlands status occur (hydric soils, aquatic vegetation, and soil saturation) is only 750 feet long and averages 1 foot in width, representing less than 0.1 acre where the potential for wetlands remains a question. As a point of comparison, the Army Corps of Engineers (the agency responsible for protecting much of the nation's wetlands) has used ten acres as a functional cutoff for "significant" wetlands.

The 1992-1993 rainy season brought the first year of normal amounts of rainfall since 1986-1987. Although the drought is officially over, some of the environmental conditions brought on by the drought may still exist. Until these environmental conditions are normalized, any further investigations could again result in indefinite conclusions.

Due to the fact that the SPEAR3 upgrade would be accomplished within existing facilities, there would be no disturbances of undeveloped land; no excavation would be necessary.

6.0 POTENTIAL ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

The proposed action involves no major conventional construction or any new ground-disturbing activities, and would therefore have no construction-related impacts on threatened and endangered species and their habitats, wetlands, and floodplains. Most of the existing components in the SPEAR facility would be reused in SPEAR3, and the work would be performed within existing buildings with essentially the current labor force. Accordingly, fabrication and installation-related effects from the proposed action on noise, transportation, visual aesthetics, cultural resources, and land use would be negligible. Activities associated with the modification or operation of SPEAR3 would not expose workers to concentrations of air contaminants at or above the OSHA permissible exposure limit or the American Conference of Governmental Industrial Hygienists threshold limit values (ACGIH, 1995).

From a safety standpoint, SPEAR3 would not present any new hazards. Any potential hazards associated with the proposed project have been encountered before during previous modifications or experimental activities at SLAC. A variety of programs are in place to address these hazards in order to protect the environment along with the health and safety of workers and the general public. Further, upgrade of the synchrotron radiation facility would take advantage of a number of currently-used, proven safety features and systems. Their presence and operational readiness would provide an extra measure of safety during the dismantling of SPEAR and the modification and commissioning of SPEAR3. The modification and operation of SPEAR3 would not require any substantial change in SSRL staffing level. Present staffing levels are adequate for SPEAR3 operations.

6.1 Effects From Modifications

No new buildings would have to be constructed for SPEAR3. Disassembly of the SPEAR ring would be performed within existing structures at SSRL. Existing buildings and structures at SLAC would be utilized for the fabrication of new components for the SPEAR3 and SSRL beamlines. These refurbishment and fabrication activities are routine operations at the respective facilities and therefore pose no additional health or environmental impacts.

6.1.1 Air Quality

VOC emissions generated from solvent cleaning and painting/coating operations would comply with the BAAQMD air-permit conditions specified for each facility. SLAC's paint booth is equipped with pollution-abatement devices to control emissions of particulates and organic compounds.

Upgrade activities associated with SPEAR3 would not cause any impacts on air quality beyond the existing conditions discussed in Section 5.1.

6.1.2 Water Quality

Because there would be no conventional fabrication associated with SPEAR3, surface-water runoff associated with excavated soil would not occur. Components intended for removal from the facility and stored outdoors, pending either refurbishment or disposal, would first be surveyed or sampled to ensure that no contamination of any kind exists that could affect surface runoff.

Although SPEAR3 modifications and pre-operational activities are not expected to introduce contaminants to the ground water seepage, water accumulated in the SPEAR facility sumps would continue to be sampled to check for contaminants before discharge to the sanitary sewer system. If the sump contents were found to be contaminated, they would be disposed of as appropriate.

6.1.3 Industrial Hazards.

Generic hazards to SLAC workers from construction activities cover a wide range that includes conventional industrial accidents, dust and organic vapor exposure, and noise. Contact with, or inhalation of, organic vapors would be minimized or eliminated by performing solvent degreasing at existing permitted degreaser stations whenever possible, thereby minimizing solvent-related cleaning activities performed within the SPEAR facility. Given the active research efforts nationwide to develop solvent substitutes, degreasing may in fact be performed using newly developed and approved alternative solvents having decreased environmental impacts relative to existing solvents.

Worker noise exposure would be mitigated by implementing a hearing conservation program and providing ear protection if decibel levels from disassembly, refurbishment, or assembly activities exceed OSHA standards.

Health effects to members of the public from SPEAR3 modification could involve slightly increased traffic on access roads due to transportation of newly fabricated components to the site and transport of waste and recyclable materials offsite. However, the total volume of truck traffic to and from SLAC is not expected to be noticeably greater than the current situation.

6.1.4 Hazardous-Materials Usage and Waste Production

Hazardous, non-hazardous, and radioactive wastes could be generated during the upgrade of SPEAR3. As noted above, most of the existing SPEAR components, including the current SSRL beamlines, would be reused in SPEAR3. The various materials removed from the SPEAR facility would be surveyed for residual radioactivity or other contamination and, if none is detected, would be salvaged as scrap or disposed of as non-hazardous waste at off-site landfills. These materials include the lattice magnets and aluminum vacuum chamber pipe.

If any non-reusable SPEAR materials were found to contain hazardous materials, they would be decontaminated and salvaged or disposed of as hazardous waste, in accordance with the procedures of the Hazardous Materials Management Handbook (SLAC, 1992d) and in accordance with RCRA requirements.

The aluminum vacuum-chamber pipe would be replaced with either a new stainless steel or aluminum vacuum-chamber pipe. The original aluminum material and excess material from the new vacuum chamber pipe would be salvaged.

Some components would be treated with a permitted vapor degreaser at SLAC as part of their preparation for use in SPEAR3. Painting of components for SPEAR3 would also be done onsite at permitted SLAC facilities (see Section 6.1, Air Quality).

6.1.5 Radiation

6.1.5.1 Radiation - Occupational

No radionuclide emissions would be generated or released by the disassembly of SPEAR, the refurbishment of its components, or the assembly of SPEAR3.

Based on preliminary surveys and experience from SPEAR, few SPEAR components are expected to have residual radioactivity. The maximum measured surface dose rate from a SPEAR facility component is 20 mrem/hour. The average surface dose rate for components with measurable activity above background is less than 1 mrem/hour. These activated components are in the injection portion of the housing. Components that are located in the other portions of the facility are not expected to have activity detectable above background based upon these measurements and several years of dosimeter history. The estimated average exposure to workers working with SPEAR components with residual activity would be less than 20 mrem/year (the detection limit of the SLAC dosimetry system). Assuming that the maximally exposed worker could receive 100 mrem during the 1 year of SPEAR disassembly, the incremental lifetime cancer risk would be 4×10^{-5}. The disassembly is expected to involve less than 50 person years, resulting in a collective dose of 1 person-rem. This results is an estimate of 0.0004 latent cancer fatalities (LCF).

Any material determined to have residual radioactivity would be handled and transported in accordance with established SLAC policies and procedures. All non-reusable components would be surveyed by SLAC's Department of Operational Health Physics (OHP); any materials with residual radioactivity would be stored onsite in the RAMSY pending future reuse or ultimate disposal in accordance with SLAC's Radioactive Waste Management Plan (SLAC 1996). The detection of residual radioactivity on reusable components would not affect the plans for their reuse.

6.1.5.2 Public Exposure

There would be no radiological exposure to the public resulting from the SPEAR3 and SSRL beamline modification activities or stored materials.

6.2 Effects From Normal Operations

Impacts from the operation of SPEAR3 are discussed below and would be similar to those experienced with SPEAR, and are well understood and documented.

Routine maintenance and the minor modifications that would most likely be needed to achieve the design-criteria operational parameters of SPEAR3 (see Section 3.2) could produce some waste products due to the exchanging of parts and components. The Hazardous-Materials Usage and Waste Production discussion of this section, identifies the effects of routine maintenance operations. Each modification action would be individually reviewed to ensure that it would not result in impacts beyond those identified in this EA for normal operations. Any modifications that would change design parameters or increase impacts to personnel, the public or environment would be subject to a specific NEPA evaluation.

6.2.1 Air Quality

6.2.1.1 Non-radiological

The primary source of non-radiological air emissions during the operation of the proposed SPEAR3 facility would be water vapor from the cooling-tower water (CTW) system, much like the current SLAC operations. CTW emissions may contain trace concentrations of chemicals used to treat the water and maintain the pipes. However, no effects are known to be associated with these releases. Occasional maintenance and component replacement activities could involve machining or cleaning parts, possibly creating dust or VOC emissions. However, air emission levels would not exceed Federal or State standards.

Ozone would be produced by ionization of the air in the accelerator housing in the course of SPEAR3 operations. However, ozone levels in SPEAR3 would continue to be within regulatory thresholds (Vylet,1998). In addition, SLAC has initiated programs to identify ozone-depleting compounds and develop acceptable alternative solvents for cleaning operations.

6.2.1.2 Radiological

Non-ionizing RF and microwave radiation, as well as static electric and magnetic fields, would be generated by the various electrical components associated with SPEAR3 operations. Although these hazards are expected to exist to approximately the same degree as with SPEAR, worker exposures to non-ionizing radiation would be maintained below the threshold limits currently recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). Ionizing radiation would be generated in the facilities during SPEAR3 operations when the electrons radiate energy or interact with materials such as the beam pipe (vacuum chamber) or other components. Nearly all of this radiation would be absorbed by the vacuum chamber and the concrete housing walls. The induced radioactivity in materials may persist after the beam is turned off. The level of this induced radioactivity is very low and non-hazardous. Elevated levels of induced radioactivity could develop in collimators, stoppers, and other devices specifically designed to intercept and absorb or "scrape," rather than transmit, part or most of the beams. Radiation dosage expected to be received by personnel transporting such activated components from SPEAR3 operations would be expected to be well below 100 mrem/year, and most probably non-measurable due to the low level of induced activity expected from SPEAR3 operations.

As discussed in Section 5.3.2, recent environmental sampling indicates no radioactivity associated with the accelerator operations around the SPEAR facility. It is not anticipated that any detectable soil activation would result from SPEAR3 operations.

6.2.1.2.1 Radiological Air Emissions

Radioactivity could be induced in air; the various radionuclides that would be produced (15O, 13N, 11C, and 41Ar) are all short-lived, with half-lives less than two hours. Releases under normal operations could occur only after the beam is shut down and personnel access openings are opened. Gaining access to the SPEAR3 housing takes a minimum of 30 minutes; after that delay time, no measurable doses could be present in the housing or could diffuse out of the housing into occupied areas, due to decay of the radionuclides produced in air. Any possible accumulated dose equivalents to workers from this source would be measured as part of their external radiation exposure.

Radiation from SPEAR3 that could affect the public originates from two sources: direct radiation (gamma rays and neutrons) and short-lived airborne activation products. Radiation exposure to the public from DOE facilities is controlled and minimized in accordance with DOE Order 5400.5 (DOE, 1990). This order stipulates an effective dose equivalent limit to a member of the public of 100 mrem/year from all routine DOE activities, including 10 mrem/year for airborne emissions of radioactive materials. The latter limit is also specified by EPA regulations in Title 40 Code of Federal Regulations (US EPA, 1996).

6.2.1.2.2 Public Exposure

Direct radiation that could reach members of the public could be produced by any of the following operations:

- Normal beam losses during commissioning of SPEAR3
- Start-up operations
- Injection for beam diagnostic purposes
- Complete loss of beam; refilling of an empty ring to 100% after it has, over a period of about 24 hours, lost about 40% of its intensity
- Normal parasitic losses

During normal operations, radiation exposure at the SLAC site boundary would result from radiation penetrating the roof of SPEAR3 and being diffused in the air while coming down to ground level (sky shine). Based on experience from previous SPEAR operations and the projected beam losses in SPEAR3, the expected dose equivalent at the SLAC boundary will not exceed 0.2 mrem per year. The maximum annual dose equivalent to a member of the public would not exceed the Federal (DOE) limit for air of 10 mrem in a year, cumulative from all SLAC sources. This exposure level is calculated for 10 months of operation, 24 hours per day. All forms of radiation would be monitored and corrective actions (for example, rescheduling of beam operations, installation of additional shielding) would be taken as necessary to maintain the general public dose equivalent below 100 mrem in any given year (Vylet, 1997).

The maximum dose equivalent to the public from the release of airborne radioactive materials is documented annually in the SLAC annual environmental monitoring report (such as SLAC, 1997a) and is due to the short-lived activation products discussed earlier in this section. Based on the saturation activity in the various enclosed spaces of SPEAR3, the maximum quantities of radionuclides that could be released (Fasso, 1997a) and the resultant maximum potential dose equivalent to the public were calculated using the EPA-approved software code CAP88-PC, Version 1.0. The dose equivalent associated with airborne radioactive emissions from SPEAR3 operations to a maximally exposed individual was calculated to be no greater than 1.4×10^{-5} mrem in one year (Sit, 1997).

Based on a conversion factor of 5×10^{-4} latent cancer fatalities per person-rem for the whole population (NCRP, 1993) the maximally exposed member of the general public (0.01 rem/year) would have an estimated annual probability of fatal cancer induced by radiation of 5×10^{-6}. The risk of fatal cancer to the maximally exposed individual over the projected exposure period is approximately 7.5×10^{-5}. There are no persons residing within 0.3 km of the SLAC boundary. The population residing between 0.3 km and 0.5 km from the

SLAC boundary is about 1,200 people. The estimated maximum annual dose at 0.3 km from the SPEAR3 operation is 0.2 mrem (Vylet, 1997).

Based on a risk-to-dose conversion factor of 5×10^{-4} latent cancer fatalities per person-rem for the whole population (NCRP, 1993), the estimated latent cancer fatalities for this population over the 15 year operation of SPEAR3 is less than 1.8×10^{-3}.

6.2.1.2.3 Occupational Exposure

Activities that could expose workers to radiation would include the same processes that produce potential exposure to the public. The DOE in Title 10 CFR Part 835 (DOE, 1997) specifies an annual total effective dose equivalent limit to workers from both internal and external radiation sources of 5 rem (that is, 5,000 mrem). In addition, SLAC maintains an administrative control level of 1.5 rem (that is, 1,500 mrem). During operation of SPEAR3, access control systems (for example, the Personnel Protection System (PPS) and the beamline Hutch Protection System (HPS)) and administrative search procedures ensure that no personnel remain inside the shielded enclosures or accelerator housing during operation. Occupational exposure from injection losses and stored beam operations are most likely to occur in the vicinity of experimental hutches and SPEAR shielding/alcoves. Based on past SPEAR experience and calculations (Vylet and Fasso, 1996, 1997), shielding of these areas will be designed so as to minimize occupational exposure and keep it below administrative limits. Local shielding and appropriate beam containment will be used as necessary.

Occasionally, when a conscious and intentional decision is made to vent the SPEAR ring in less than 30 minutes after beam shutdown, radionuclide emissions to the air could result in a slight increase in radiation exposure. Projected emissions from SPEAR3 indicate that the maximum release level of radionuclides would result in a dose equivalent to a maximally exposed member of the public of less than 1.4×10^{-5} mrem/year. In general, worker exposure, as a result of early entry, would produce a dose equivalent of much less than 100 mrem. An accidental entry immediately after shutdown would expose the worker to initial, and fast decaying, dose equivalent rates of at most 0.63 mrem/h (Fasso, 1997b).

Activation of beamline components and support structures would be confined to the SPEAR3 housing, and no release of activated material would occur from these areas. Occupied areas would be routinely monitored to ensure that the dose equivalent to persons working near SPEAR3 would be maintained as low as reasonably achievable (ALARA), in accordance with established SLAC policy. All areas accessible to workers would be routinely monitored and appropriate signs posted.

Based on relevant experience at SLAC with other projects, it is expected that doses from the proposed SPEAR3 project would be maintained well below 100 mrem/year for non-radiation workers and well below 10 mrem/year for individuals offsite. The number of workers that would be exposed to measurable amounts of radiation from SPEAR3 in the course of normal operations would not exceed 50. The 1996 dosimetry records indicate that the average dose to exposed SLAC workers was 0.066 rem for the year (Flood, 1997). The maximum exposure to a worker predicted for the SPEAR3 operations is not likely to exceed 0.5 rem in one year. Based on a conversion factor of 4×10^{-4} latent cancer fatalities per person-rem for adult workers (NCRP Report No. 116, 1993), the maximally exposed worker would have an estimated annual probability of fatal cancer induced by radiation of 2.5×10^{-4}. The average exposed worker would have an estimated annual risk of approximately 3.3×10^{-5}.

The expected operational life for SPEAR3 is 15 years. The risk of fatal cancer to the average exposed individual over the projected exposure period is approximately 5×10^{-4}. It is assumed that the maximally exposed individual for any single year would not be exposed at the maximum rate for the entire 15 years of operation.

The risk of fatal cancers to the potentially exposed population of 50 individuals over the operating period of 15 years is approximately 0.025.

Under these circumstances, workers engaged in this proposed project would not be expected to incur any harmful health effects from the radiation exposures they receive during normal operations.

6.2.2 Water Quality and Hydrology

6.2.2.1 Non-Radiological.

Ground water seepage into the SPEAR3 interaction regions during operations would be managed in the same manner as was done for SPEAR: the seepage would be channeled into the drainage sumps, and regular maintenance would be performed to keep all drains and gutters clear and pumps operational (SLAC, 1992a). Holding tanks would be sampled to check for contaminants before discharge to the sanitary sewer system. If the sump contents are found to be contaminated, they would be disposed of as appropriate.

6.2.2.2 Radiological

The only long-lived radioactivity that is likely to be produced in water is tritium. Since there would not be any use of high power beam dumps in a storage ring such as SPEAR3, no activation of ground water is expected from SPEAR3 operation. Existing conditions relating to ground water are discussed in Section 5.3. There could be some activation of water in the closed-loop LCW system that is used for cooling beam-line components. However, records on hand indicate no detectable tritium in LCW samples from SPEAR operations, using assays with a 500 pCi/l detection limit. SPEAR3 operations would have similar effects.

6.2.3 Industrial Hazards

Typical industrial hazards associated with operation of SPEAR3 would be similar to those involved with the present operation, and as such are addressed by the SLAC ES&H program (SLAC, 1997c). These include but are not limited to the hazards from high-voltage systems and components, compressed gases, high vacuum, cryogens and general industrial related hazards. Electrical safety procedures are contained in the SLAC Guidelines for Operations (SLAC, 1992e). A Lock and Tag Program for Control of Hazardous Energy (SLAC, 1992f) has been implemented.

6.2.4 Hazardous Materials Usage and Waste Production

Section 5.4 describes the hazardous-materials usage and the types and quantities of waste produced during operation of SPEAR. Operation of SPEAR3 is expected to yield similar results. Limited quantities of hazardous waste would be generated, in virtually the same amounts as was produced by SPEAR. None of the equipment that would require routine maintenance contains hazardous materials. However, some waste oils that are considered hazardous in the State of California could be generated due to leakage from, or mechanical failure of, oil-filled equipment. The equipment would be repaired or replaced, and any hazardous waste would be disposed of or recycled according to California's Hazardous Waste Control Laws (HWCLs). In addition, some organic solvents would be used for routine cleaning of components. The operation of SPEAR3 is not expected to generate hazardous wastewater nor would any PCB- or asbestos-containing materials or articles be used.

As with SPEAR, no radioactive waste would routinely be generated by the operation of SPEAR3. Over the course of its service life, however, low levels of radioactivity may be induced in some SPEAR3 components. Any components repaired or replaced would be surveyed according to established policies and procedures and, if necessary, would be stored onsite or disposed of in an appropriate manner.

Repair of cooling-system equipment could involve the draining of LCW from all, or part, of the system. The LCW would be analyzed for tritium activity and, unless analytical results indicated otherwise, discharged to the sanitary sewer.

Limited amounts of non-hazardous wastes would routinely be generated, primarily small quantities of "office-type" paper wastes and materials. As is the current practice, the office paper would be recycled as part of the SLAC.

6.3 Effects From Accidents

In a facility such as SPEAR3, accidents related to earthquake, high voltage, fire, and/or radiation could occur but the probability is very low. The most "reasonably foreseeable" incident with any consequences would be a cable fire caused by an electrical overload condition. Such an incident is described in the Fire discussion below.

The potential for accidents at SLAC is addressed and minimized by the SLAC ES&H Program as documented in the SLAC ES&H Manual (SLAC, 1997). The responsibility for safety and implementation of the Safety Program is a line function. Worker health and safety are addressed by specific radiation safety, industrial hygiene, electrical safety, fire protection, and industrial programs. Specific response and reporting procedures for incidents, emergencies, and alarms are contained in the SLAC Guidelines for Operations (SLAC, 1992e), which implement the requirements of DOE Order 5000.3B, Occurrence Reporting and Processing of Operations Information (DOE, 1993).

The safety performance of SLAC during the period of 1986 through 1991 was summarized in a draft Safety Performance Profile (EG&G Idaho, 1992). This report indicated that the average total reportable case-injury accident rate was comparable to that of the DOE average for the same period: 3.0 per 200,000 work hours versus 2.5 per 200,000 work hours, respectively. There were no fatal accidents at SLAC during this period. A single fire was reported at SLAC during the same period, causing $15,000 in damage.

6.3.1 Fire

Fire safety is addressed by the SLAC ES&H Program (SLAC, 1997). The Palo Alto Fire Department (PAFD) operates an onsite fire station (Station 7) to provide immediate fire-fighting and emergency response support to SLAC. PAFD personnel conduct fire safety inspections and citation programs and provide training in the use of fire extinguishers to SLAC personnel.

The probability of fire in SPEAR3 would be expected to be similar to that for SPEAR. The SLAC ES&H Program would minimize the hazards from fire to workers and the public from events at SPEAR3, as it does for all areas and activities at SLAC. Like SPEAR, SPEAR3 would be fabricated of essentially nonflammable components, and no large quantities of flammable materials are used in fabrication or operations.

The most "reasonably foreseeable" incident with any substantial consequences would be a fire of the insulating material for electrical cables initiated by an overload condition. The typical insulating material on electrical cables is polyvinylchloride (PVC) because of its resistance to the deteriorating effects of ionizing radiation. PVC cable fires develop and spread slowly. There have been two fires of this type in the last 25 years of operation at SPEAR. Although smoke was generated, no flames developed within the SPEAR housing. Responses from the PAFD were immediate and damage to the facility was minimal; SPEAR resumed normal operations within 1 to 2 days.

A cable fire in SPEAR3 would be expected to develop slowly, providing sufficient time for egress by employees. There is no location in the SPEAR3 enclosure further than 100 feet from an exit and there is no location where two directions of egress are not available. The smoke detectors within SPEAR3 enunciate at the onsite fire station, the SLAC Main Control Center, the SPEAR Control Room, and the City of Palo Alto dispatch center, providing early warning of a developing fire and initiating the onsite response. Typical response time is three minutes and consists of the onsite engine, an additional engine offsite, and one paramedic unit.

Should a fire occur in any part of the SPEAR3 complex, it is expected that there would be no personnel injuries and minimal property damage. No impacts to the public or environment, beyond those resulting from any other large structure fire, are expected. The synchrotron radiation research program is likely to be impacted due to the necessary facility repair.

6.3.2 Earthquake

The emergency situation most likely to occur at SLAC is an earthquake. Facilities constructed on the SLAC site employ appropriate design and construction techniques so that seismic risks are reduced to acceptable levels.

SPEAR3 would make use of the safety design features of SPEAR to ensure that, in the event an earthquake causes the stored beam to dump, the penetrating radiation levels at the site boundary would be negligible. In addition, all mechanical components of SPEAR3 would be secured to protect persons working in the area.

Any damage to SPEAR3 resulting from an earthquake would not release any radionuclides, and the production of penetrating radiation would cease instantly with the loss of the stored beam. Returning the accelerator to operation following an automatic shutdown, such as that which would occur in the event of an earthquake, would not expose the public or the work force to any significant additional radiation than would be expected from normal operations.

The design and installation of experimental equipment for SPEAR3 would be reviewed by the SLAC Earthquake Committee, as mandated by the SLAC Safety Program. Operation of SPEAR3 would be covered by the SLAC earthquake Emergency Preparedness Plan (SLAC, 1991a), which outlines the procedures to be followed in the event of an earthquake severe enough to cause possible structural damage or personal injury.

6.3.3 High Voltage

Potential hazards associated with high-voltage lines and equipment exist throughout SLAC, but established policies and procedures, together with an excellent safety record, show that these hazards can be effectively managed.

The SPEAR accelerator housings and associated electrical components are potential sources of electrical hazards, as are the other accelerator areas at SLAC. Electrical safety at SLAC is addressed by the SLAC ES&H Program (SLAC, 1997) and the Guidelines for Operations (SLAC, 1992e). These include a Lock and Tag Program for Control of Hazardous Energy (SLAC, 1992f). Some energy sources in the SPEAR facility are deactivated when the PPS is in the "access allowed" mode (that is, permitted access or restricted access).

The probability of a high-voltage accident in SPEAR3 would be the same relative to the original SPEAR operation. In a hypothetical accident scenario, a worker could be injured by electrocution in any number of areas at SLAC, including the SPEAR3 complex. However, no fatalities of any kind have ever occurred during operations at SLAC, as was documented in a comprehensive review of accidents at the facility (EG&G, 1992). No offsite effects on the public or the environment would be possible from such events, except for potential temporary power losses (brownouts or blackouts) stemming from the incident.

6.3.4 Radiation

Possible accidents involving radiation at SPEAR3 that could affect the public or onsite workers include beam-loss events and release of induced radioactivity into the air from normally sealed spaces. The most serious radiation accident that could occur during SPEAR3 operations and affect the public would be the total loss of the injection beam at the maximum possible current and energy. The maximum possible combined-beam power is 45 watts (W). If beam is lost at a point in the ring where the shielding is least extensive, the dose equivalent rate at the nearest site boundary point (a distance of 350 meters) would be about 0.02 mrem/hour (Vylet, Fasso, 1997), and this rate would last for only a fraction of a second, thereby producing a negligible radiation dose. Assuming such an event occurs once in a year, the resultant maximum potential dose equivalent at the site boundary would be completely negligible, with no adverse effect on the population.

Should such a serious accident occur, the maximum dose equivalent rate outside the shielding would be 1.5 rem/hr, therefore not exceeding 25 rem/hour (SLAC, 1992g). The corresponding maximum integrated dose equivalent outside the shielded areas would not exceed 0.04 mrem (0.00004 rem) assuming Beam Shut-Off Ion Chamber (BSOIC) System shutoff and 250 mrem (0.25 rem) if BSOIC shutoff does not occur. By comparison, the DOE (DOE, 1997) specifies an annual effective dose equivalent limit for workers from both internal and external radiation sources of 5 rem. For a population of 50 workers, an exposure of 0.002 rem/year results in a population dose of 0.03 person-rem over 15 years. This leads to an estimate of less than 1.5×10^{-5} latent cancer fatalities.

Regarding induced radioactivity, the maximum possible dose to the public at the site boundary from the release of short-lived radionuclides into the air from normally sealed spaces was calculated by Sit (1997) to be no greater than 1.4×10^{-5} mrem, as described in the Radiation discussion in Section 6.2. This highly conservative estimate assumes that the equilibrium activity in all sealed spaces in the SPEAR3 complex is released instantaneously, 30 minutes after shutdown.

The potential for accidents involving worker and/or public exposure to radiation is minimized by the SLAC Radiation Safety Program and the various Radiation Safety Systems. Shielding exists between beam-housing areas and areas that are occupied during operation, in order to maintain radiation exposures as low as reasonably achievable (ALARA). The PPS controls entry into and exit from accelerator housing areas and the HPS controls entry into and exit from beamline experiment areas called hutches; doors to these areas are interlocked to prevent access whenever the potential exists for radiation generation. A Beam Containment System (BCS) prevents the accelerated beam from diverging from the desired channel or producing excessive radiation in occupied areas. Finally, the BSOIC System utilizes radiation monitors outside the shielding barriers to verify that external radiation levels do not exceed design levels (SLAC, 1992g). In addition, these monitors shut off the beam if radiation levels exceed either 10 or 100 mrem/h outside the shielded areas, depending on the occupancy factors.

In the several decades of cumulative accelerator/ collider operations at the various SLAC facilities (SPEAR, PEP, and SLC), it is noteworthy that no fatality has ever occurred. Nevertheless, in a serious accident the potential exists for a hypothetical worker to receive a lethal dose of radiation by remaining in a housing for an extended period during operation. However, exhaustive precautions have been developed and implemented to minimize the probability of such an event, beginning with a thorough search of the entire area prior to operation. During a systematic search of SPEAR, a search team of three qualified individuals verifies that there is no person left in the housing either by accident or design. A team member physically investigates every possible area large enough for a human being while maintaining a line-of-sight with other team members. After the search, but before the accelerator is turned on, the housing is locked, the lights in the housing are automatically flashed on and off for two minutes and then dimmed, and a recorded message is played stating that the beam is coming on, serving as both visual and audible warnings. There are also emergency shut-down buttons and cables within the housing areas, which can be activated to stop the start-up process. When the accelerator is on, each of the enclosures within the shielding barriers becomes a Very High Radiation Area, as defined in the DOE occupational radiation protection regulations (DOE, 1997).

6.4 Effects From Decontamination and Decommissioning

At the conclusion of the SPEAR3 program, decontamination and decommissioning (D&D) of the facility would be required. In general, the major facilities at SLAC (SPEAR, PEP, SLC/SLD) have remained in use once constructed, and D&D operations are performed mainly on individual components. This pattern of continued use may apply to SPEAR3, as well. D&D activities are expected to comprise two separate stages: mothballing, followed by removal of any radioactive components (should they exist) and dismantling.

Mothballing constitutes placing the facility in a state of protective custody, and comprises the following operations: initial decontamination, drainage of liquid-filled systems, disconnection of some or all operating systems, physical and administrative controls to ensure limited access, characterization surveys to determine whether any residual radioactivity exists, and subsequent surveillance and maintenance, as necessary. This period is estimated to last for one year.

Should any radioactive components exist, their removal and dismantling would involve final decontamination or removal of equipment, materials, and buildings, as appropriate. Any items removed would be stored onsite for future use, or packaged according to DOT specifications and shipped to a DOE-approved radioactive waste disposal site. When the D&D decision is before DOE, the NEPA process would be utilized, as appropriate, to assist decision making.

6.4.1 Non-Radiological Impacts

Non-radiological impacts associated with D&D work would be similar to those involved in facility fabrication, such as noise, dust, exhaust emissions, storm-water management, and related aspects. Associated environmental impacts would be temporary and would have only minor short-term or long-term effects on the SLAC facility or the surrounding area. Hazardous liquid or solid waste generated by D&D activities would be handled appropriately and disposed of offsite. Non-radiological material and wastes would be stored onsite or shipped to an approved disposal facility, as appropriate.

6.4.2 Radiological Impacts

Radiological impacts associated with D&D at SPEAR3 would be minimal. As described for other activities involving potentially radioactive equipment, materials, or components, any of these items containing residual radioactivity would be stored onsite in a dedicated area or shipped to an approved radioactive waste disposal site.

6.5 Socioeconomic Impact and Environmental Justice

The minimal impacts associated with modification and operation of SPEAR3 at SLAC are not expected to pose any substantial effects on local offsite construction projects. There are no current or reasonably foreseeable major construction projects in the immediate vicinity of SLAC. Operation of the proposed project would not result in the addition or reduction of employees at SLAC, and therefore, would have no effect on socioeconomic.

Executive Order 12898 requires that all federal agencies evaluate whether proposed actions would cause disproportionate impacts on minority or low income communities. In this as much, neither upgrade nor operation of the proposed action would affect low income or minority community or place it at a disproportionate risk, nor would it use criteria, methods or practices that would discriminate on the basis of race, color or national origin.

6.6 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts for SPEAR3.

6.7 Irreversible and Irretrievable Commitments of Resources

Manufacturing of new SPEAR3 components would consume various natural resources. However, all of the materials utilized in the manufacture of these components are considered common and none of them represents the depletion of a critical resource. Other resource commitments (for example water, electricity, chemicals, labor hours) are comparable to those incurred for SPEAR.

6.8 Cumulative and Long-term Impacts

No cumulative impacts are expected from the proposed action. Dose equivalents outside the shielding and at the site boundary resulting from normal operations are far below the applicable standards, both for SPEAR3 and for SLAC as a whole.

No measurable long-term environmental impacts are expected from the proposed action. Some portion of the waste products generated by SPEAR3 modification, normal operations and routine maintenance, and D&D activities would require disposal and so would add to waste accumulation and the environmental impacts associated with disposal facilities. However, their contribution would be negligible. SPEAR3 operations are not expected to cause soil or ground water activation (See Section 5.3, the Natural Sources of Radiation and Background Levels discussion in Section 5.2; and the Air Quality and Water Quality and Hydrology discussion in Section 6.2) and would therefore not contribute to the cumulative impacts of SLAC operations on ground water and soil.

As described in the Contributions to Background Radiation Levels from SLAC Operations discussion in Section 5.2.2.2, the maximum dose equivalent above background for an off-site nearest receptor 24 hours per day was estimated to be less than 5 mrem in an entire year (SLAC, 1997a). The dose equivalent attributable to SPEAR3 operations would have only negligible contributions to the cumulative impact of SLAC operations. As stated in the SLAC Radiological Control Manual (SLAC 1992g), non-radiological workers at SLAC are limited to a radiation dose from all SLAC operations of 100 mrem/year, whereas for radiological workers, SLAC has adopted an annual facility Administrative Control Level to limit the radiation exposure from all operations to 1,500 mrem/year.

There are no nuclear facilities or similar emission sources located on the San Francisco peninsula. The medical treatment facilities and other research facilities at Stanford University, located approximately two miles from SLAC, are not expected to have increased measurably cumulative impacts when considered with SLAC's impacts.

7.0 PERSONS AND AGENCIES CONTACTED

Bay Area Air Quality Management District, John F. Semerau, Permit Engineer

Department of Energy, Anthony Aducci, Oakland Operations Office

Department of Energy, Hanley Lee, SLAC Site Office

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Stanford Linear Accelerator Center, Roger Sit, Operational Health Physics

Stanford Linear Accelerator Center, Michael Grissom, Environmental Safety and Health

8.0 GLOSSARY AND ACRONYMS

Accelerator - a device which raises the energy of elementary particles to high energies to allow the exploration of the structure of matter at extremely small distances. There are two main types of accelerators, those which use protons, such as the Tevatron at the Fermi National Accelerator Laboratory (FNAL), and those which use electrons, such as the proposed SPEAR3. Unlike reactors, accelerators consume energy rather than produce energy.

BAAQMD - Bay Area Air Quality Management District.

Background Radiation - All sources of radiation at a given point other than the source in question. Radiation received either naturally from the earth or cosmic rays from outer space, or received artificially as a result of weapons testing. This term also includes radiation from medical x-rays.

Beam Dump - An energy-absorption device for halting a particle beam.

Blowdown - Discharge of mineral-laden cooling-tower water to reduce the concentration of total dissolved solids (TDS) in the cooling system. Cooling towers remove heat by evaporation, which increases the mineral content of the water remaining in the system. Removal of a portion of this water helps maintain system efficiency and reduce maintenance. Blowdown from SLAC's cooling tower system empties into the sanitary sewer.

BSOIC - Beam Shut-off Ion Chamber.

Electron - The lightest subatomic particle with a non-zero rest mass occurring in nature. It has a negative electrical charge of 1 unit. More technically, the electron is a fermion which undergoes only weak, electromagnetic, and gravitational interactions.

Electron-Volt (eV) - The kinetic energy picked up by an electron while passing through a potential difference of one volt. Equal to 1.6×10^{-16} erg.

Emittance -The measure of beam size and beam angular collimation in an accelerator. For synchrotron radiation machines it is most commonly stated in nanometer-radians.

EPA - Environmental Protection Agency

GeV - Giga-electron-volt; represents one billion electron volts.

Isotope - For a given element, two or more nuclides which have the same number of protons but different numbers of neutrons in their nuclei are called isotopes. Radioactive isotopes are now called radionuclides.

Lattice - A periodic array of magnets designed to work in concert to steer and focus a charged particle beam.

LCW - Low-Conductivity Water, which is used for cooling accelerator and experimental apparatus. LCW is domestic water which has been distilled to remove or reduce its mineral content in order to increase the water's resistance to the flow of electricity.

Linac - Linear Accelerator.

mrem - millirem; equal to one-thousandth of a rem (0.001 rem, or 10^{-3} rem). See rem.

NEPA - The National Environmental Policy Act, which requires that all environmental impacts and alternatives to a proposed action are considered before resources are committed for that action and before decisions are made.

Neutron - An electrically neutral particle with a mass equal to 1,838 electron masses. Neutrons are stable when bound in nuclei, but a free neutron decays into a proton, an electron, and a neutrino having a half-life of twelve minutes.

OSHA - Occupational Safety and Health Administration.

Positron - The positively charged antiparticle of an electron. Electron-positron pairs may be produced from gamma rays, and may subsequently combine to produce gamma rays by annihilation.

Radioactive - Giving off radiant energy in the form of particles or rays produced by the disintegration of atomic nuclei. Radioactivity can be produced spontaneously in fissionable materials, or it can be induced in material that is not inherently radioactive, creating activation products. In sufficient doses, this radiant energy can be harmful to plant and animal life.

Radionuclide - a radioactive isotope of a particular element.

rem - a special unit used for expressing an ionizing radiation dose that incorporates both physical and biological factors. This unit allows the direct comparison of biological dose from all forms of ionizing radiation such as x-rays, gamma rays, beta particles, protons, and neutrons. The natural background dose of ionizing radiation for individuals in the mid-Peninsula region is approximately one hundred millirem (100 mrem), or one-tenth of a rem (0.1 rem).

RF - Radiofrequency, which describes the high-frequency microwave power used to impart energy to electrons in accelerators or storage rings. Low-frequency electric power from the local utility company at a steady flow is transformed into short, rapid bursts of extremely high power and high frequency.

RWQCB - Regional Water Quality Control Board.

SLAC - Stanford Linear Accelerator Center. The center is dedicated to research in high-energy physics and in those fields that make use of its synchrotron radiation facilities. It is operated as a national facility for DOE by Stanford University. Primary facilities onsite include the two-mile linear accelerator, the SPEAR and PEP storage rings and the SLAC Linear Collider. SLAC is located approximately one mile west of the Stanford campus in the foothills on the San Francisco Peninsula in California.

SPEAR - Stanford Positron-Electron Asymmetric Ring, originally a small colliding-beam storage-ring facility and now a dedicated synchrotron radiation facility at SLAC.

SPEAR3 - The proposed upgrade to the SPEAR synchrotron radiation facility at SSRL/SLAC.

SSRL- Stanford Synchrotron Radiation Laboratory.

Storage Ring - a type of accelerator in which large numbers of elementary particles are accelerated and stored in a beam. Most modern accelerators are built as storage rings, as this configuration uses the energy of the beams most efficiently in probing short distances.

Synchrotron Radiation - Radiation produced in accelerators when the path of a charged, relativistic particle is changed, usually in a magnetic field produced by a bending magnet. The spectrum of radiation is continuous from the low, visible region of light up to into the tens of kilovolts range of energy.

Vacuum Chamber - An air tight metal vessel designed to maintain a vacuum from 10^{-6} to 10^{-10} Torr.

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U.S. Department of Energy (DOE)
Finding of No Significant Impact
Upgrade of the Stanford Positron Electron Asymmetric Ring (SPEAR) at the Stanford Linear Accelerator Center (SLAC), California.

AGENCY: U.S. Department of Energy (DOE)

ACTION: Finding of No Significant Impact (FONSI)

SUMMARY: The U.S. Department of Energy (DOE) has prepared an Environmental Assessment (EA), DOE/EA-1243, evaluating the proposed action to upgrade the Stanford Positron Electron Asymmetric Ring (SPEAR) at the Stanford Linear Accelerator Center (SLAC).

Based upon the information and analyses in the EA, the DOE has determined that the proposed federal action does not significantly affect the quality of the human environment within the meaning of the National Environmental Policy Act of 1969.

Description of the Proposed Work :

The proposed action is to upgrade the Stanford Positron Electron Asymmetric Ring (SPEAR) at the Stanford Linear Accelerator Center (SLAC), enabling the synchrotron radiation beam brightness and beam current to increase, while decreasing the beam emittance. The upgrade called SPEAR 3, would result in a substantial improvement in capabilities to all of the SPEAR experimental stations, or beamlines, and would have a significant positive impact on the current and future science and technology program at SLAC's Stanford Synchrotron Radiation Laboratory (SSRL).

Upgrade of the existing SPEAR 3 storage ring, reduces the need for conventional construction other than limited augmentation to surface buildings. The existing conventional facilities for SPEAR and SSRL, consist of accelerator housings, research areas, support buildings, roads, earthwork, fencing, landscaping, electrical and mechanical utilities, and the sanitary-sewer and storm-drain systems. These existing systems have adequate capacity and would not require expansion. Furthermore, no undisturbed grounds onsite would be affected by the project.

The upgrade of the existing SPEAR would involve:

(1) The removal and disassembly of various accelerator and beamline components, such as vacuum chambers, magnets, mirror tanks etc.

(2) The refurbishment of reusable accelerator and beamline components.

(3) The fabrication of new components at vendor facilities or SLAC.

(4) Assembly of accelerator and beamline components into the existing housings and support buildings.

(5) The upgrade, modification or replacement of hardware such as power supplies, control systems, AC distribution systems from existing substations, RF driving and phasing equipment for klystrons, modulators, personal protection system, beamline data acquisition instrumentation ėtc. that is needed to achieve SPEAR 3 operating criteria.

(6) Disposing of some components that can not be reused and possibly disposing some components as low-level radioactive waste.

Operation of SPEAR 3 is expected to begin in 2002, with an estimated operational life time of 15 years. During operations electrons are accelerated in a Linear Accelerator and injected first in to a Booster Synchrotron and then into the SPEAR storage ring. Synchrotron radiation is an intense, continuous spectrum beam of light generated by electrons circulating in a storage ring.

Alternatives :

Only one alternative to the proposed action was considered: (1) No action. Under the no action alternative, SPEAR 3 would not be built and existing SSRL facilities would continue to operate until the termination of their useful lifetime.

Environmental Impacts :

Upgrade: The EA analyzed the impacts of SPEAR 3 at SLAC for effects from upgrading, normal operation, accidents, decontamination and decommissioning, and cumulative and long term impacts. The EA considered impacts to air and water quality, land use, biological resources, noise, traffic, and hazardous material usage. As described in the EA, there would be no significant impacts from upgrading of the existing facilities.

Operations: The impacts of ionizing radiation produced during normal operation are anticipated to be negligible. Nearly all of the radiation would be absorbed by the stainless steel vacuum chamber and surrounding concrete accelerator housing walls. Induced radioactivity could occur in a small number of components or devices. The number of workers that would be exposed to measurable amounts of radiation from SPEAR 3 in the course of normal operations would not exceed 50. Based on a dose to risk conversion factor of $4x10^{-4}$ latent cancer fatalities per person rem for adult workers, the risk of fatal cancer to the potentially exposed population of 50 workers over the 15 year operating period is less that 0.025. There are no persons residing within 0.3 km of the SLAC boundary. The population residing between 0.3 km and 0.5 km from the SLAC boundary is about 1200 people. Based on a dose to risk conversion factor of $5x10^{-4}$ latent cancer fatalities per person rem for the whole population, the estimated latent cancer fatalities for this population over the 15 year operation of SPEAR 3 is less than 0.0018. (A conversion factor of $5x10^{-4}$ is used for the general population to reflect the presence of children, who appear to be at a greater risk of dying from cancer as a result of exposure to radiation than adults.)

Impacts from radiological accidents would not significantly affect worker or public health and safety at SSRL. The hypothetical worst case accident involving worker and/or public exposure to radiation would be the total loss of injected beam at the maximum possible current and energy. The maximum potential dose equivalent at the nearest SLAC boundary from this worst case scenario would be less than 0.005 mrem in a year., far below the operating limit of 10 mrem/year. For a population of 1200 an exposure of 0.005 mrem/year results in a population dose of less that 0.09 rem person rem over 15 years; less that $5x10^{-5}$ latent cancer fatalities.

Decontamination and Decommissioning (D&D): D&D Activities at SPEAR 3 are anticipated to have negligible impacts to worker and public health and safety. Radiological impacts are anticipated to be minimal through controlled storage of material with residual radioactivity and shipment to an approved low level waste disposal site. Non radiological effects would be similar to those involved in facility construction: potential short term effects to air and water quality, noise, dust, vehicle emissions, storm water management, and waste handling and disposal.

Cumulative Impacts: No cumulative or measurable long term environmental impacts are expected from the proposed SPEAR 3 facility. The radiological dose equivalent attributable to SPEAR 3 operations would have negligible contributions to the cumulative impact of SLAC operations. The contributions of waste products from upgrade, operation, maintenance, and D & D activities would add to the waste accumulation and the environmental impacts associated with the disposal facilities. Their contribution to such impacts would be negligible. SPEAR 3 operations are not expected to cause soil or ground water activation.

Environmental Justice: Executive Order 12898 requires that all federal agencies evaluate whether proposed actions would cause disproportionate impacts on minority or low income communities. Neither the upgrade or operation of the proposed action would affect low income or minority community or place it at a disproportionate risk, nor would it use criteria, methods or practices that would discriminate on the basis of race, color or national origin.

Determination:

Based on the information and analysis in the EA, the DOE has determined that the proposal to upgrade the Stanford Positron Electron Asymmetric Ring (SPEAR) at the Stanford Linear Accelerator Center (SLAC), does not constitute a federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969. Therefore, a FONSI is made and an Environmental Impact Statement is not required.

Public Availability :

Copies of this EA are available from:

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Issued in Oakland, California this 29th day of June, 1998.

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