ENVIRONMENTAL ASSESSMENT

PROPOSED UPGRADE AND IMPROVEMENT OF THE NATIONAL SYNCHROTRON LIGHT SOURCE COMPLEX AT BROOKHAVEN NATIONAL LABORATORY UPTON, NEW YORK

U. S. Department Of Energy
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ACRONYMS, INITIALS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ATF	Accelerator Test Facility
BMRR	Brookhaven Medical Research Reactor
BNL	Brookhaven National Laboratory
BTU	British Thermal Unit
CCWF	Central Chilled Water Facility
CDR	Conceptual Design Report
CFR	Code of Federal Regulations
CSF	Central Steam Facility
CY	Calendar Year
DCCT	Direct Current Current Transformer
DOE	Department of Energy
DUV-FEL	Deep Ultraviolet-Free Electron Laser
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FUA	Facility Use Agreement
FY	Fiscal Year
MEI	Maximally Exposed Individual
MGD	Million Gallons per Day
MLD	Million Liters per Day
MSDS	Material Safety Data Sheet
MW	Megawatt
NEPA	National Environmental Policy Act

NESHAPS	National Emission Standards for Hazardous Air Pollutants
NSLS	National Synchrotron Light Source
NYSDEC	New York State Department of Environmental Conservation
ORPS	Occurrence Reporting and Processing System
PCB	Polychlorinated Biphenyl
ROI	Region of Influence
SBMS	Standards Based Management System
SDL	Source Development Laboratory
SER	Site Environmental Report
SPDES	State Pollutant Discharge Elimination System
SR	Synchrotron Radiation
VOC	Volatile Organic Carbon
VUV	Vacuum Ultraviolet

SUMMARY

This Environmental Assessment (EA) addresses the proposed action by the U.S. Department of Energy (DOE) to upgrade the facilities of the National Synchrotron Light Source Complex, namely the National Synchrotron Light Source (NSLS), the Accelerator Test Facility (ATF) and the Source Development Laboratory (SDL). The environmental effects of the No-Action Alternative as well as the Proposed Action are evaluated in the EA.

The No Action or Continued Maintenance Alternative would not involve any upgrades and would keep the NSLS Complex operating in its existing configuration, repairing and replacing components involving only in-kind (non-upgrade) equipment. The Proposed Action includes upgrades to accelerators and research beamlines that would improve operating characteristics and, consequently, meet the demands of the increasingly large and diverse scientific user community. Constructing additional spaces onto existing structures to accommodate new accelerator components and offices also would be included in the Proposed Action.

This EA describes the current and anticipated operations. The NSLS has operated successfully since the early 1980s and needs a variety of upgrades to maintain its leading scientific capability among U.S. synchrotron light sources. Most upgrades would take place over several years and would occur within existing buildings. Current beam line and accelerator components would be replaced with improved state-of-the-art devices. Typical devices that would be upgraded include monochromators and mirrors that guide synchrotron light beams or radio frequency cavities that provide power to the electron beams. Implementing the upgrades would involve disassembling existing systems and components and installing replacements. Upgrading components would improve facility operating characteristics by enhancing the ability to control, monitor and manipulate the beams, along with increasing the reliability of the systems. Safety aspects and scientific attributes would be improved by having more focused, stable beams. This EA evaluates the overall potential impact of the anticipated upgrades. The EA includes a general description of the Brookhaven National Laboratory (BNL) environment, the environmental impacts due to current operations and the environmental impacts anticipated due to the proposed upgrades.

1.0 INTRODUCTION

BNL is a multidisciplinary scientific research center located close to the geographical center of Suffolk County, New York, about 97 kilometers (60 miles) east of New York City (Figure 1). Figure 2 is an aerial view of BNL.

The NSLS Complex, sited at the center of BNL, consists of three electron accelerator facilities (Figure 3). The first facility is the NSLS which operates a Linear Accelerator, Booster Ring, Vacuum Ultraviolet Ring, X-ray Ring and many beamlines. This facility is dedicated to producing synchrotron light (infrared, visible, ultraviolet, X-ray and gamma ray light) which is used to determine the properties of a wide variety of materials. The second is the ATF, which operates a Linear Accelerator, high-power lasers, and four

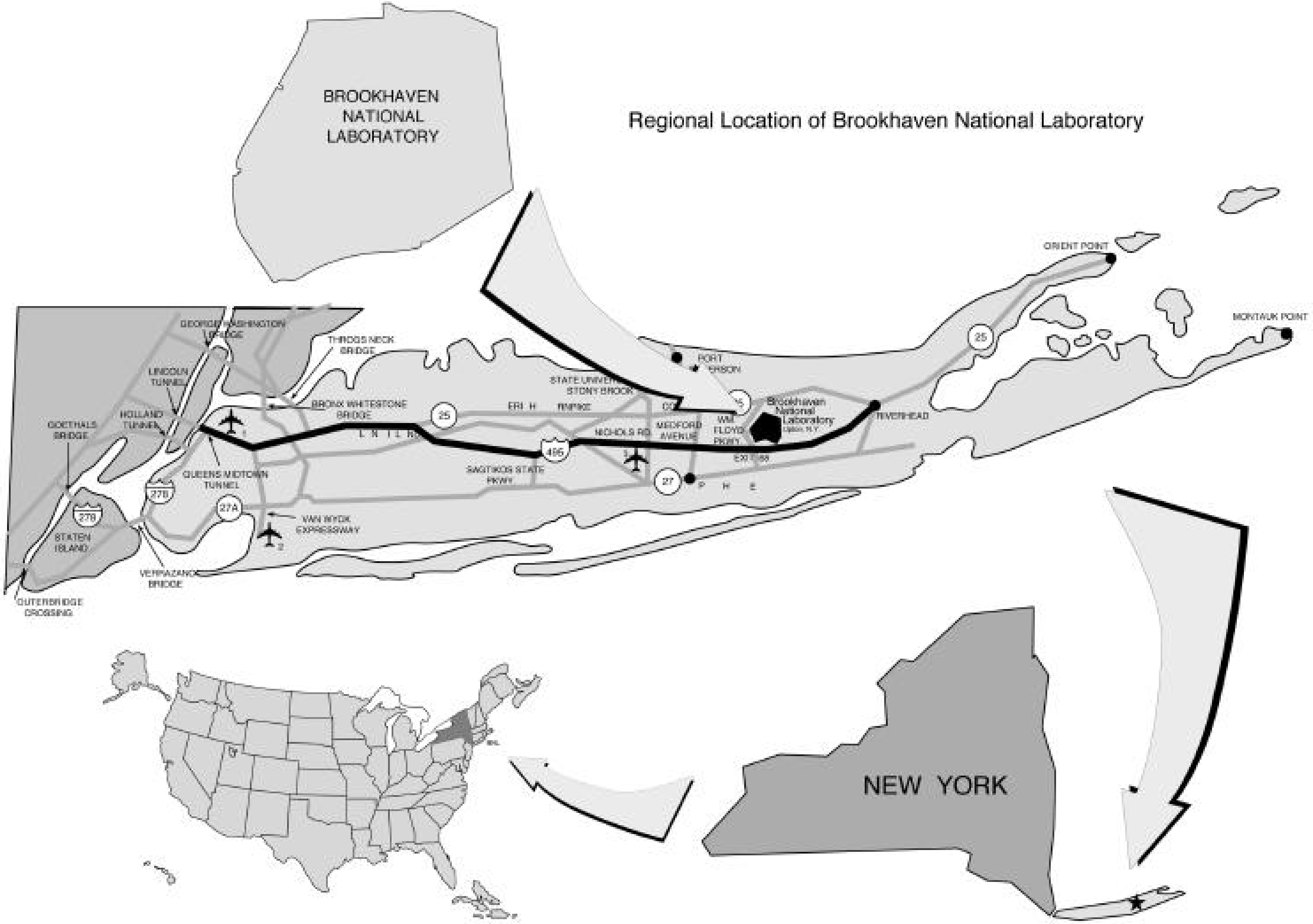

Figure 1. Regional location of Brookhaven National Laboratory.

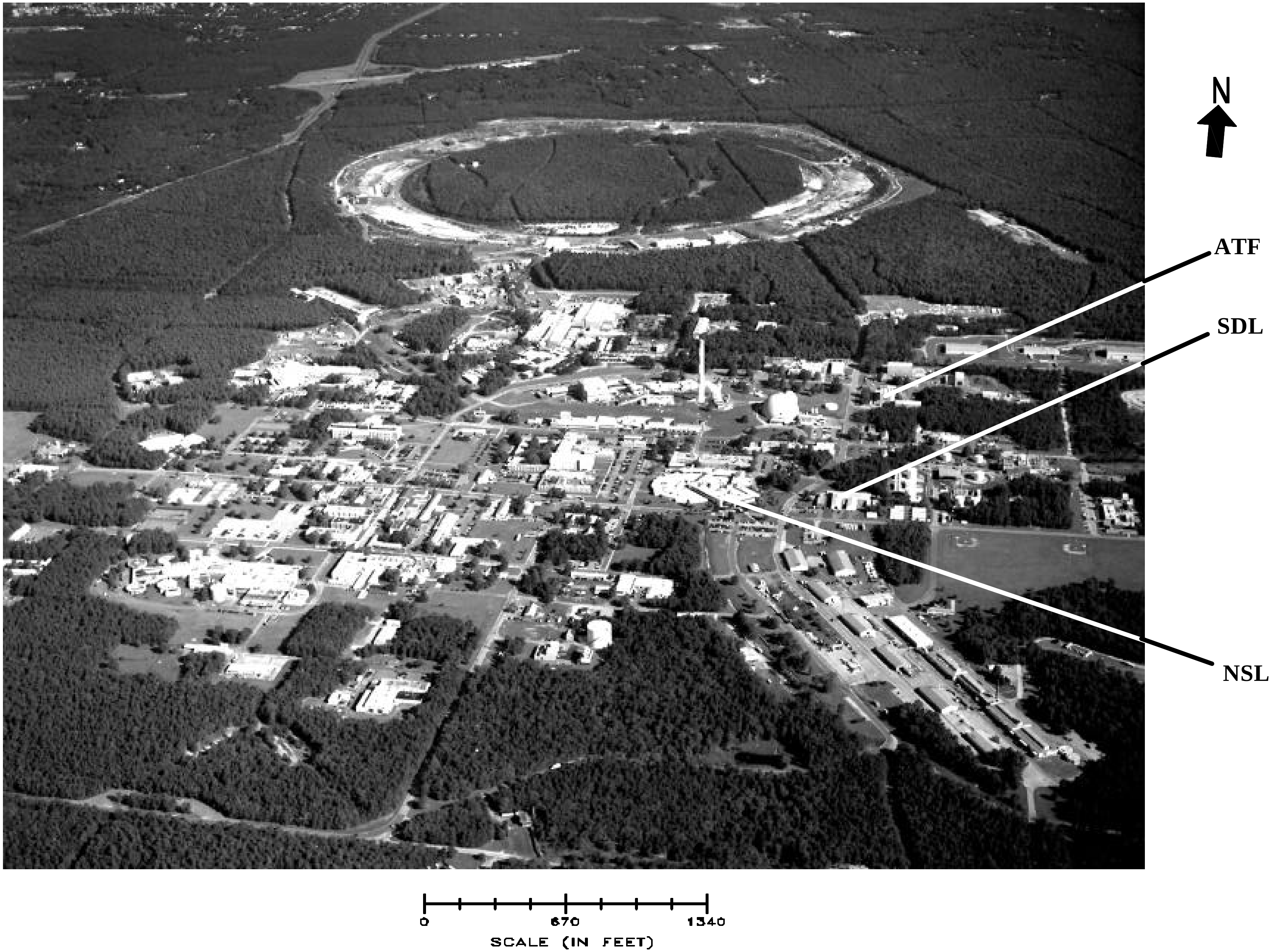

Figure 2. Aerial view of Brookhaven National Laboratory

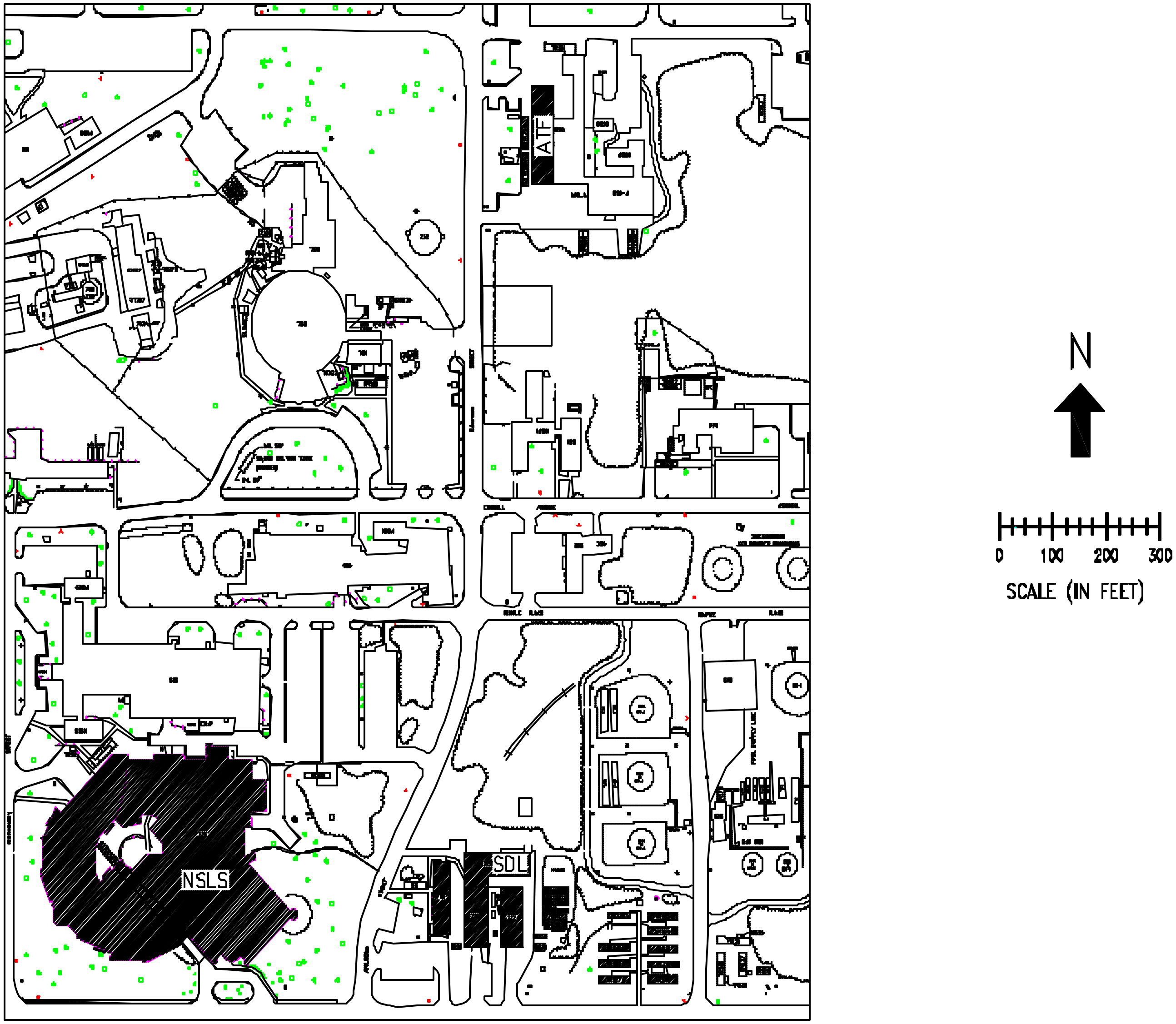

Figure 3. Diagram showing proximity of the Accelerator Test Facility (ATF/Bldg. 820), the National Synchrotron Light Source (NSLS/Bldg. 725), the Source Development Laboratory (SDL/Bldg. 729), and various support buildings (shaded areas).

beamlines. The third facility is the SDL, which operates a Linear Accelerator and high-power lasers. These latter two facilities act as development and test beds for new, advanced accelerator techniques and equipment. In addition, the Complex encompasses support offices, laboratories, machine shops and storage facilities. This EA encompasses all accelerators and support buildings within the NSLS Complex.

1.1 National Synchrotron Light Source (NSLS)

The NSLS, located in Building 725, began operations in 1982 (Figures 4a, b, c). It consists of a Linear Accelerator (Linac), a Booster Ring, and two synchrotron storage rings (the Vacuum Ultraviolet Ring and X-ray Ring) that store and circulate bunches of electrons at speeds close to that of light. As the electrons are accelerated, synchrotron radiation (SR) is produced and directed down the beamlines to the research stations. There are 100 experimental beamlines, 85 of which may be operating at any one time. SR is a very high-intensity, broad-spectrum form of electromagnetic radiation with infrared, visible, ultraviolet, and x-ray energies. It is a powerful research tool and is used by researchers in a wide variety of scientific areas including chemical sciences, materials sciences, life sciences and medicine, geosciences and ecology, applied science and engineering, and optical/nuclear and general physics. Life sciences represent the most rapidly growing component. Most experiments use the techniques of spectroscopy, scattering, diffraction, and imaging. The NSLS operates 24 hours a day, 7 days a week. One thousand and thirteen experiments were conducted in FY99, ranging in duration from a few days to the entire year. In FY99 the VUV Ring delivered ~5900 hours of beam to users, and the X-ray Ring delivered ~5600 hours.

1.2 Accelerator Test Facility (ATF)

The ATF, located in Building 820, began operations in 1990, and is dedicated to research and development in the physics of beams (Figure 5). It consists of a Linear Accelerator that accelerates bunches of electrons to higher energies. The electrons and high peak power laser beams are directed to any one of four research beamlines where more than one experiment may be installed at once. Users carry out research and development in advanced accelerator physics, studying the interactions of high power electromagnetic radiation and electron beams, including laser acceleration of electrons and free-electron lasers. Other topics include the development of high brightness electron beams, high-power laser beams, electron injectors, beam diagnostics, and computer controls. The ATF conducted eight long-term experiments in 1999, and delivered ~1000 hours of beam to users.

1.3 Source Development Laboratory (SDL)

The SDL, located in Building 729, is expected to begin operations in 2001 (Figure 6); it was founded, in part, on the advances made at the ATF. It consists of an electron Linac plus associated accelerator components, and acts as a test bed accelerator and laser facility producing an intense ultraviolet beam delivered in extremely short, trillionth of a second pulse lengths. The beams are applied to a variety of basic and applied research experiments, analogous to those conducted at the NSLS. The SDL was originally

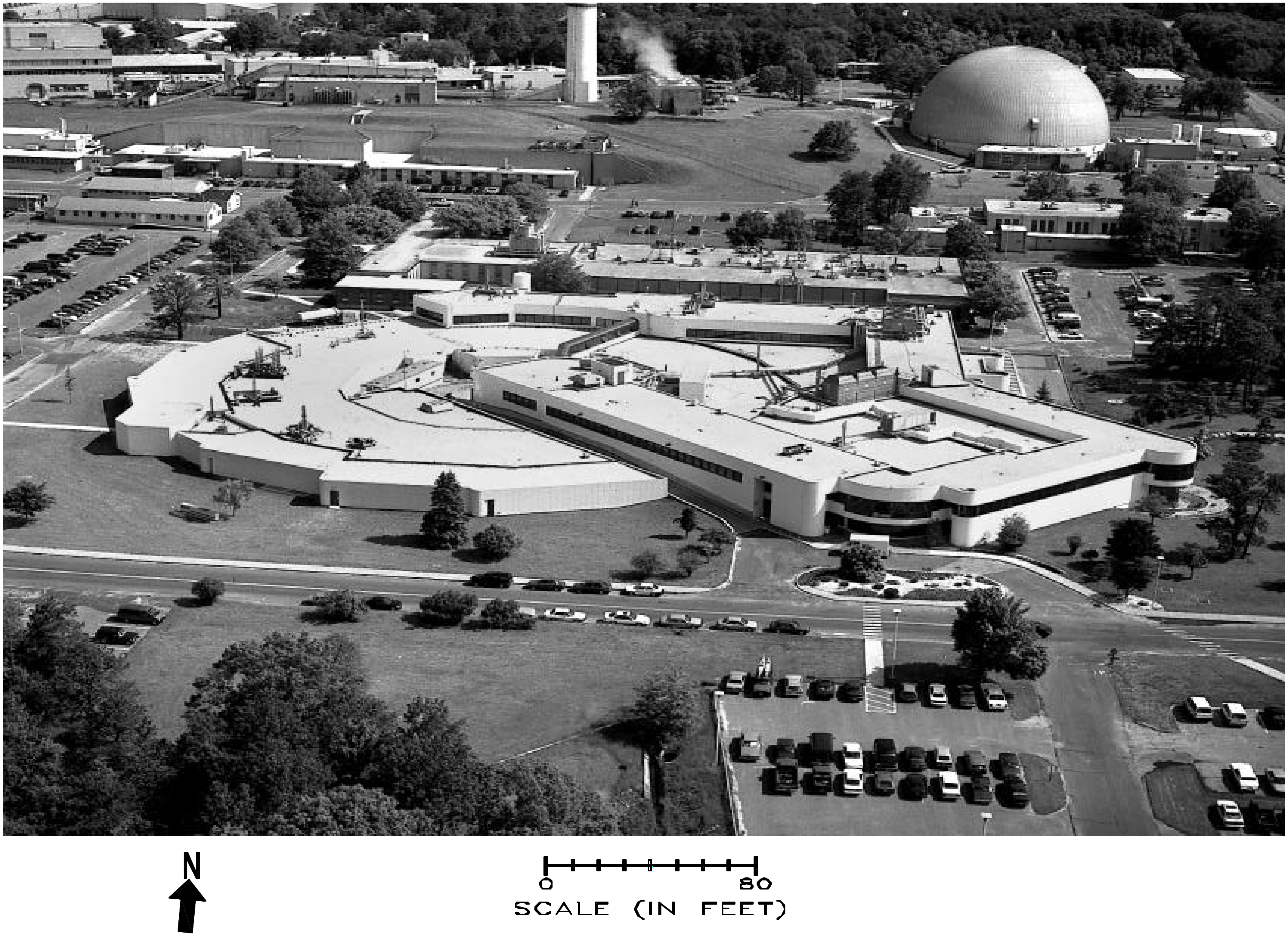

Figure 4a. Aerial view of the National Synchrotron Light Source, Building 725.

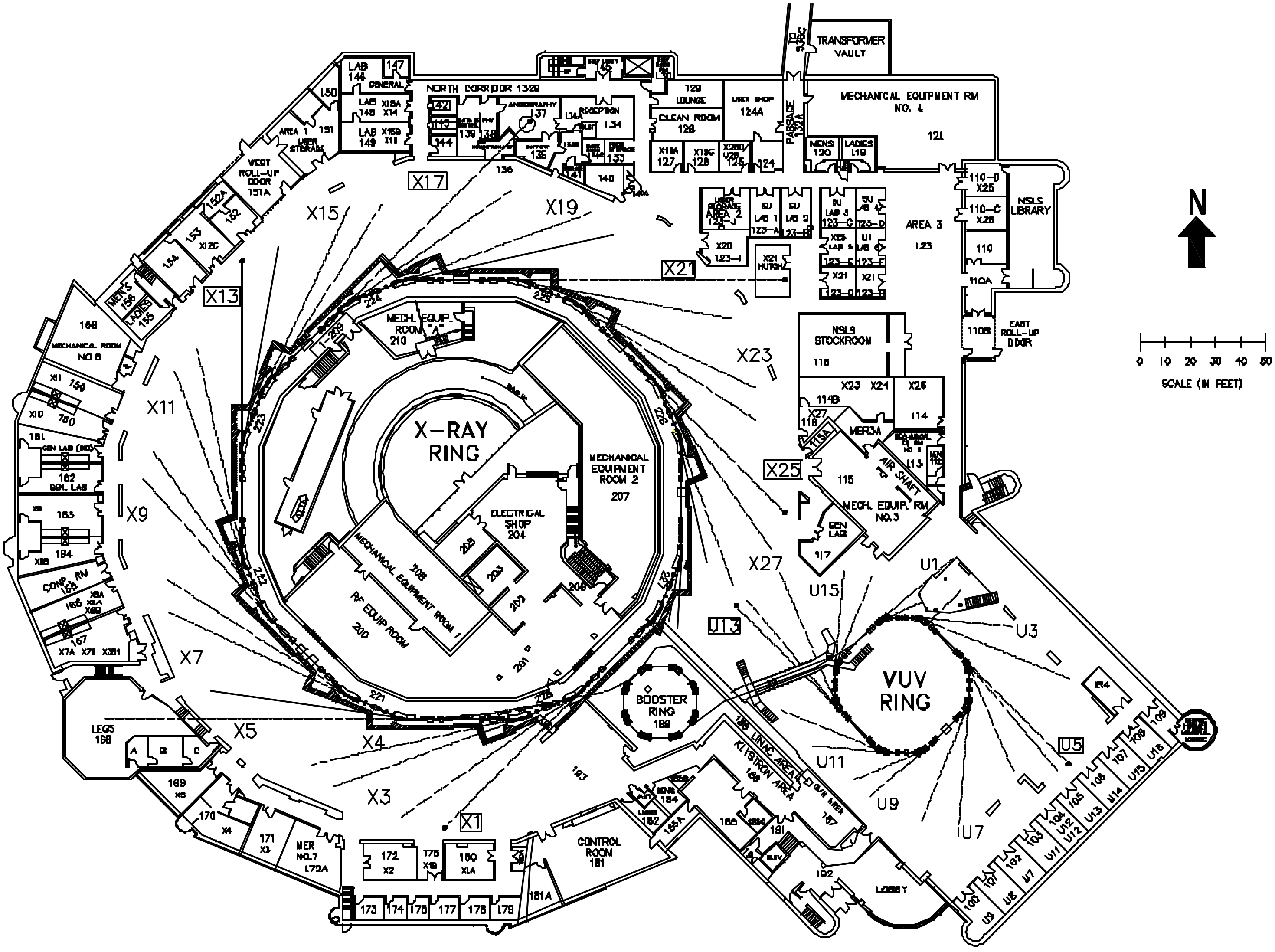

Figure 4b. NSLS experimental floor, Building 725.

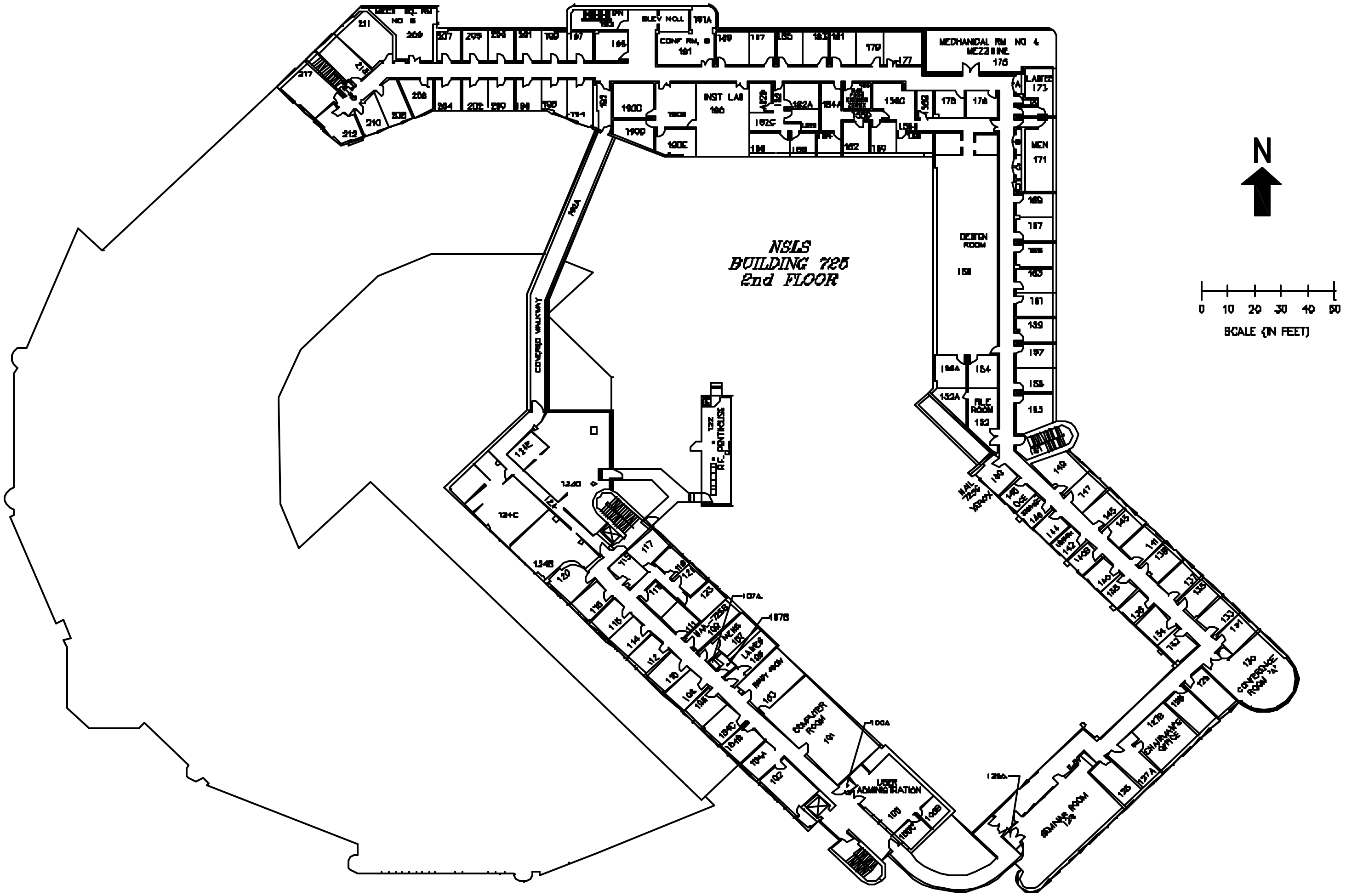

Figure 4c. NSLS second floor offices, Building 725.

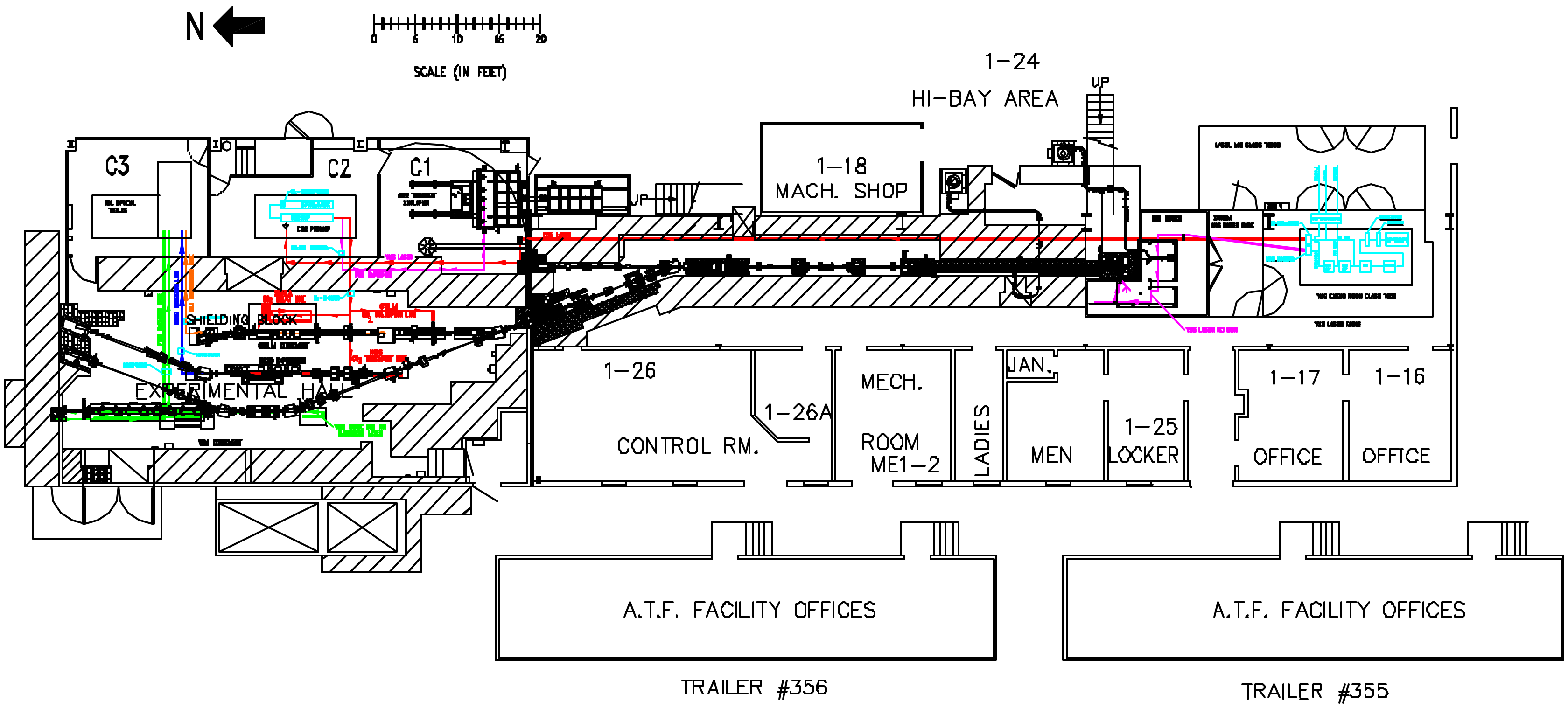

Figure 5. ATF experimental floor, Building 820.

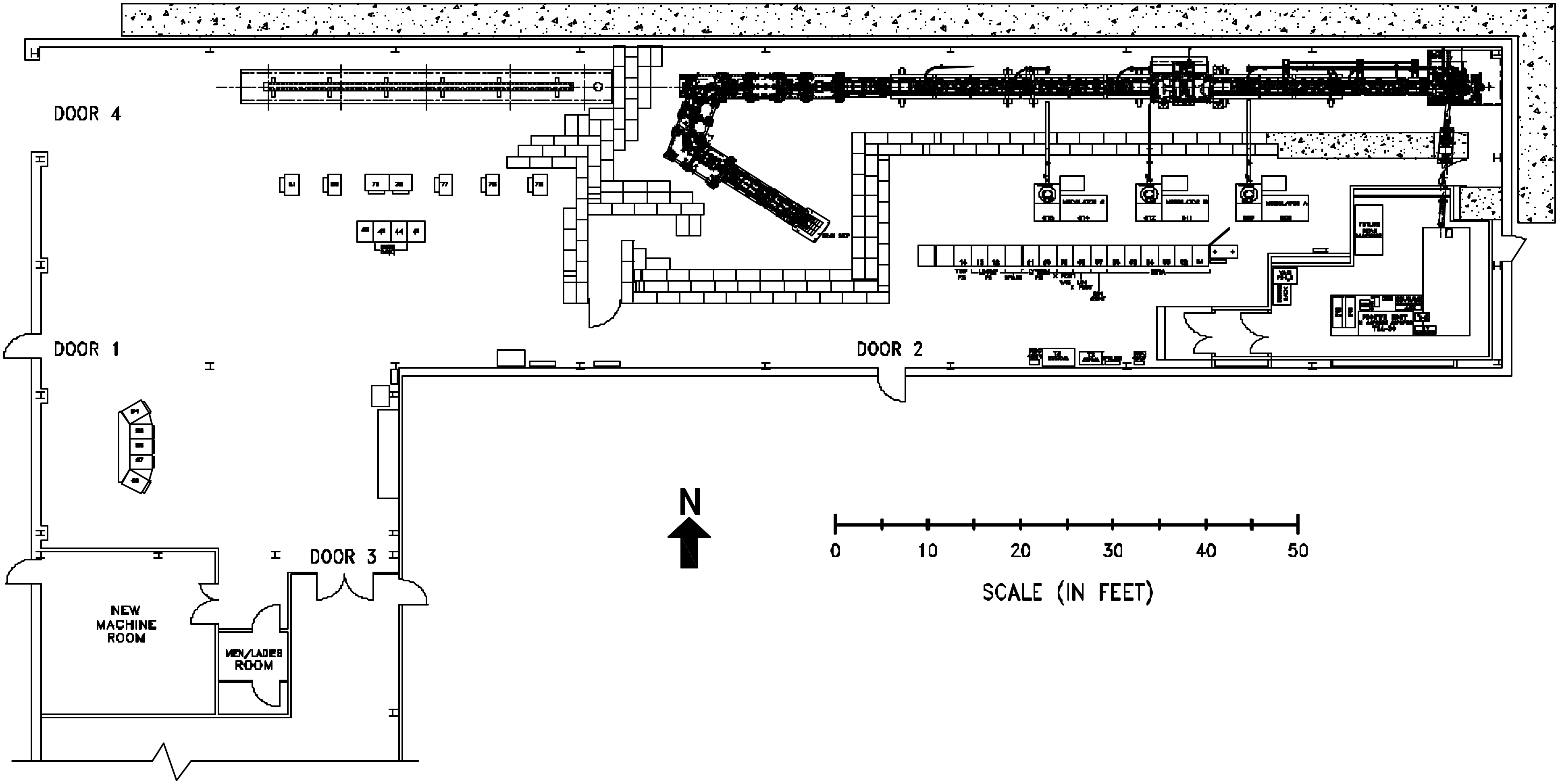

Figure 6. Source Development Laboratory experimental floor, Building 729.

analyzed by the National Environment Policy Act Environmental Assessment #0602 [NEPA EA-0602].

1.4 NSLS Complex Support Buildings

A wide variety of support buildings are needed to properly operate the NSLS Complex accelerators. Offices are located in the second floor of Bldg. 725 (NSLS), in trailers adjacent to Bldg. 820 (ATF), in modular Building 728 west of Bldg. 729 (SDL), and in trailers east of Bldg. 727. Laboratories surround the experimental floor of Bldg. 725. Machine shops in Buildings 725, 726 and 727 are associated with all three accelerators, as are the service groups for surveying, drafting, and maintaining the vacuum, computers, magnets, utilities, and the mechanical, electrical, and electronic components. A large amount of floor space in the accelerator buildings is devoted to assembling and storing accelerator components. Finally, the NSLS Complex uses additional space for offices in Buildings 129, 510E, 535A, and 535C (not shown in the Figures).

2.0 PURPOSE OF AND NEED FOR ACTION

The purpose of and need for DOE to undertake the actions described in this document are to improve the operational and research capabilities of the NSLS Complex (NSLS, ATF, SDL). The advantage gained from these improvements would allow the NSLS Complex to continue the reliability, availability, and performance of the NSLS Complex machines for in excess of 2,300 scientific users annually. Improved reliability and performance of the NSLS Complex would provide beamline capabilities in new and growing research areas, would allow more rapid turnaround time of experiments, and would assure that future scientific uses of the NSLS Complex meet the needs of an increasingly diverse and growing scientific community.

3.0 ALTERNATIVES INCLUDING PROPOSED ACTION

3.1 No Action Alternative (Continued Maintenance)

The No Action Alternative would continue operations at the NSLS Complex at their present levels for the foreseeable future. These operations would include preventive maintenance, repair, and lifetime replacement of operating components. Repairs and replacements would be limited to in-kind, i.e., non-upgrade, capabilities. These continued maintenance activities are also encompassed in the Proposed Action and are listed in Table 1. The continued maintenance activities would involve the same type of actions (disassembly, purchasing/fabricating, waste generation, etc.) as those identified in the following section for Proposed Action.

3.2 Proposed Action

The Proposed Action would upgrade and maintain the operating and research capabilities of the NSLS Complex. The accelerators and their components would be improved, and state-of-the-art upgrades made to the beamlines (e.g., optics, detectors, controls, and analytical equipment). The proposed upgrades to buildings would include increasing the office and research space for the NSLS and SDL facilities. Table 1 lists the anticipated upgrade items and a description of the activities by category is provided in the following sections. The majority would require replacing an existing component or system with an improved one. Other items represent installing new systems (including new construction) within the NSLS Complex. These items constitute all reasonably foreseeable actions that could take place within the NSLS Complex over the next five to ten years; they are major capital and operating budget items. Any such list of upgrades should not be regarded as inclusive as factors beyond current planning, such as new scientific or technical breakthroughs or unforeseen failures of components, could require similar items that are not specified in this list. If any new breakthroughs involve potential environmental impacts not foreseen and addressed in the scope of this EA, separate NEPA reviews would be conducted.

3.2.1 Accelerators and Associated Equipment

Accelerators and their associated equipment function to produce and transport the beams of electrons at the NSLS, ATF and SDL. Upgrades to these systems would replace existing components with the latest generation in order to improve efficiency and reliability. Upgrading modulators, that contain banks of capacitors, would result in reduced failure rates resulting in reduced maintenance costs and improved facility reliability. Upgraded RF systems would replace cavities that have been at the limit of their operating capabilities due to ring upgrades and provide more stable RF operation. With their greater power range, if one cavity would cease to function, the others would be capable of maintaining continued ring operation (this –would not be possible with the older cavities). Upgrades to various feedback systems (e.g. digital, longitudinal, transverse) would result in increasing electron orbit stability within the ring, thereby providing more stable synchrotron beam for the scientific users. Improving these systems would also provide more control over the electron beam. The scope of these upgrades would include disassembling and removing existing systems, design engineering, purchasing of components and power supplies, assembly and installation. Certain systems and components have been previously identified as being potentially activated (Example: electron beam generation and transport components) and are required to be surveyed prior to removal and disposal. Disposal of any activated/contaminated material would follow established approved BNL/DOE protocols. Installation would also involve rewiring the various components and associated power supplies. Equipment upgrades beyond the expertise of BNL staff, such as RF cavities, may be contracted out to vendors or other national laboratories. A short ceramic kicker assembly for the Vacuum Ultraviolet Ring, which requires a ceramic-to-metal weld, would be fabricated by an off-site vendor or national laboratory.

3.2.2 Magnet Insertion Devices and Associated Equipment

Upgrade of the magnet insertion devices (undulators, wigglers) would entail replacing a series of magnets located in the straight sections of the NSLS rings as well as ATF and SDL beamlines. These devices permit manipulation of the electron beam in order to a) shift the synchrotron radiation (SR) to higher energies and/or higher fluxes (wigglers), or b) concentrate the SR output into specific, narrow peaks in energy (undulators). The scope of these replacements would include disassembling and removing existing systems, design engineering, purchasing of components and power supplies, assembly and installation.

3.2.3 Safety Related Systems

Upgrade of safety related systems would include replacing outdated area radiation and neutron radiation monitors with state of the art components for improved reliability and efficiencies. Existing relay-based interlock systems, which alarm and/or shut off the beam when the specified logic is satisfied, would be replaced with programmable logic control (PLC) systems. Modification to these components would result in improved system troubleshooting and diagnostic capability, thereby enhancing reliability and overall safety. Upgrading the NSLS cable trays would improve electrical safety and involve identification and removal of obsolete cables; and identification and separation of signal and power cables into separate trays. Most of the cable tray work would be performed during machine maintenance periods when the cables may be de-energized. Shielding enhancements would involve installation of lead, concrete and/or borated polyethylene in specific areas, thereby improving efforts to ensure the ALARA concept is maintained.

3.2.4 Controls, Computers, Diagnostics

The scope of these upgrades would include design engineering and development by BNL personnel, purchasing of components and off-the-shelf units, disassembling existing electronics and systems for excess or disposal, and assembly, testing and installation of the new components. The upgraded components would result in improved diagnostic capabilities, computational speed and efficiency. This would enhance machine operations as well as experimental data processing.

3.2.5 Beamlines and Associated Equipment

Upgrades to beamlines and associated equipment would, like the other systems, result in improved reliability and efficiencies by employing state-of-the-art technologies. Upgraded mirrors would enable better focusing of the SR beam with less loss in beam intensity. Detector upgrades would result in images with higher resolution and contrast. Improved monochromator crystals would allow researchers to select more precise x-ray energies from the SR beam. Other upgrades would improve positioning and monitoring of the beam to facilitate the desired experimental requirements. For example, the development of a hard X-ray facility at the X29 beam station would entail the planning, construction and operation of a protein crystallography beamline. A small, bright undulator device would employ the technical innovations of enhanced field using novel hybrid-magnet technology. This device requires a straight section of the X-ray Ring and the X29 station has the only straight section available that currently does not have a program or beamline in place.

Certain existing components may be reused/recycled in the modified systems or stored as spares. Whenever possible, components, such as new beampipes would be fabricated at BNL Central Shops facilities. Specialized components would be fabricated by an off-site vendor or national laboratory. Systems and components would be assembled, installed and tested by BNL technicians, engineers and scientific staff.

3.2.6 Construction

Additions to the NSLS Building 725 (~9300 square feet) would match the steel frame and wall construction of the existing building's second floor. While a small amount of excavation would be necessary for installation of footings to support the second story addition, major changes to the actual footprint of this building are not anticipated. The additional space would be used for offices, meeting rooms and mailrooms and would also result in increased equipment set-up and storage space.

The Proposed Action presently does not anticipate any additions to the ATF building. However, ATF programs may expand into existing space within Building 820 in order to improve/increase laboratory space, machine shops, equipment set-up and storage. These activities would primarily involve minor facility improvements and relocating equipment into the newly acquired areas.

The ~3600 square foot extension on the west side of the SDL, Building 729, would be built to accommodate upgrades to the accelerator and beamlines. This extension would continue the existing slab and steel frame/metal wall construction, and would be located over an existing driveway and grassy area. Some additional impervious surfaces (driveway/parking lot) would also be created. While exact dimensions are not available at this time, the size of any new impervious area is anticipated to exceed that of the existing driveway by about 80%.

3.2.7 Miscellaneous Activities

Upgrades to the various lasers would entail component replacement, including replacing existing power supplies with larger units. All modified laser systems would comply with established BNL/DOE protocols for laser safety. Electrical improvements would include purchasing a second emergency power generator, to be installed adjacent to Building 725. A concrete pad (< 100 square feet) would be installed for the new generator, thereby, increasing the size of the existing impervious area. All electrical conduits would be run aboveground. Additional building electrical power feeds would enhance system reliability, involve aboveground cable replacement, and installation of new electrical cables.

3.2.8 Common Aspects

Several aspects would be common to implementing a majority of the proposed scientific actions identified in Table 1. Implementing the upgrades would involve disassembling existing systems and components and installing replacements. Most of the items removed would either be excessed or disposed of as scrap material. Some of the old components would be stored as potential spares, even though they are not the latest technology, due to the high cost of the replacement items. Certain components may be purchased as off-the-shelf items, while others would be designed, engineered and assembled by BNL personnel. Installation would involve mounting and rewiring the various components and associated power supplies. Transport of any heavy equipment would require the use of installed overhead cranes/hoists or hydraulic lift devices by trained personnel. Accelerator work, beamline preparation and equipment installation all occur within Controlled Areas, areas controlled for radiological purposes. Such work could involve some low-level radiation exposures to workers. All appropriate training and worker safety protocols would be in place prior to initiation of the work to minimize exposure using ALARA principles. Some experiments may produce small quantities of biohazardous and radioactive material wastes. These materials would be handled by personnel trained in the proper handling requirements and would be processed according to approved BNL and regulatory protocols. In the NSLS (Building 725) and ATF (Building 820) beamline and accelerator upgrades would be constructed within the existing facility buildings.

Table 1. NSLS Complex: Equipment to be Upgraded (U) or Replaced as Part of Maintenance (M)
A = ATF, N = NSLS, S = SDL, * = all facilities

Accelerators and Associated Equipment

- 50x100 Milliradian Chamber (U/N)
- Beam Enhancement/High Brightness Electron Linac (U/S)
- Development of High Brightness Electron Sources (U/N)
- Digital Feedback (U/N)
- DUV-FEL Amplifier Development (U/S)
- Electron Beam Generation and Transport (UM/*)
- Fast Valves for VUV Ring (UM/N)
- Front End Valve Replacements (M/N)
- Klystrons & Modulators Plus Support Equipment (UM/*)
- Longitudinal Feedback Systems (U/N)
- Radio Frequency (RF) Systems (UM/*)
- Ring Magnets, Power Supplies, Cabling & Supports (M/N)
- Ring Orbit Monitoring & Controls (UM/N)
- Shunt Power Supply for VUV Ring Quadrupoles (U/N)
- Transverse Feedback Systems (U/N)
- Ultrashort Bunch Length Monitor (U/S)
- Vacuum Systems (M/*)
- VUV Dipole Upgrade (U/N)
- VUV Quadrupoles - Change to DCCT (U/N)
- X-ray Ring Loss Monitor (U/N)

Magnet Insertion Devices and Associated Equipment

- Dispersive Section Power Supply and Magnet (U/S)
- Elliptically Polarized Wiggler (U/N)
- High Gain Harmonic Generation (U/A)
- In-vacuum Undulators (U/N)
- Magnet Chambers (U/N)
- Power Supplies (UM/*)
- Ultra Small Gap Undulator (U/N)
- VISA Magnet System (U/S)
- Wigglers (U/N)

Safety Related Systems

- Area Radiation Monitors (U/*)
- Booster Tunnel/Cave Shielding (U/N)
- Electrical Safety - Cable Tray Upgrade (U/N)
- Interlock Safety Systems (UM/*)
- Neutron Radiation Monitor (U/*)
- Shielding Enhancements for ALARA (U/*)
- VUV Catwalk Replacement (U/N)
- VUV Gaps Shielding (U/N)

Controls, Computers, Diagnostics

- Computer Systems for Controls and Diagnostics (UM/*)
- High Speed Image Processor R&D (U/N)
- Network Infrastructure (UM/*)
- Related Electronics (UM/*)
- X-ray Computed Microtomography Computing (U/N)

Beamlines and Associated Equipment

(Note: This grouping is subdivided into major categories and examples)

- Cryogenic Cooled Monochromator (U/N)
- Detector Development
  - 9 Cell CCD Detector (U/N)
  - Solid State Detectors for X-rays
    - 120 Element Detector for EXAFS (U/N)
    - Turnkey Detector System (U/N)
- End Stations
  - Experimental Chambers (Molecular Beam, Std. UHV) (U/S)
  - Magnetic Imaging End Station (U/N)
  - Photo-emission Spectroscopy Chamber (U/N)
  - Plasma Window (U/N)
- Hard X-ray Beamline Development
  - X6A Protein Crystallography Beamline (U/N)
  - X9 Micro Focus Beamline (U/N)
  - XI7 Upgrade (U/N)
  - X21 Upgrade (U/N)
  - X25 Side Station (U/N)
  - X28 A,B,C Instrumentation (U/N)
  - X29 Protein Crystallography Beamline (U/N)
- Photon Beam Diagnostics
  - Coherent IR Monitor & Generation (U/N)
  - U3B Focused Beamline for Diagnostics (U/N)
  - U5/U3 Fast Profile Monitor (U/N)
  - U5U Position Monitor (U/N)
- Photon Beam Transport (UM/N)
- R&D Beamline (U/N)
- Soft X-ray Beamline Development
  - Soft X-Ray Crystal Monochromator Beamline (U/N)
  - U5UA Branch (U/N)
  - X19A Monochromator Replacement (U/N)
  - X1B Spectroscopy Beamline Upgrade (U/N)
  - XI3 Upgrade (U/N)
- User Program Development
  - Infrared Microscopy (U/N)
  - Staffing and Equipping EXAFS Beamlines (U/N)

Construction

- Equipment Set-up and Storage Areas (U/*)
- Experimental Space (U/S)
- Laboratory Space (U/A)
- Machine Shops (U/A)
- Offices, Meeting Rooms, Mail Rooms (U/N)

Miscellaneous

- Additional Emergency Power & Building Power Feeds (U/N)
- Air Conditioning Units (UM/N)
- Experimental Lasers (U/*)
- Power Supplies (UM/*)
- Terawatt C02 Laser Systems (U/A)

Note 1: Equipment for the No Action Alternative (Continued Maintenance) would consist of in-kind components similar in form, fit and function to the components they replace.

Note 2: This list of equipment is not all-inclusive. Factors beyond current planning, such as new scientific or technical breakthroughs or unforeseen failures of components, could require similar items that are not specified.

4.0 AFFECTED ENVIRONMENT

4.1 Site Description

The BNL site occupies 21.3 sq-kms (5265 acres). Most principal facilities are located near its center. The developed area is approximately 6.7 sq-kms (1,656 acres), of which about 2.02 sq-kms (500 acres) were originally developed by the Army (as part of Camp Upton), and about 0.81 sq-kms (200 acres) are occupied by various large specialized research facilities. Outlying facilities occupy about 2.22 sq-kms (549 acres); these include the Sewage Treatment Plant (STP), agricultural research fields, housing, and fire breaks. The balance of the site (14.6 sq-kms or 3,607 acres) is largely wooded.

4.2 Land Use and Demography

Land use within one mile of the Laboratory consists of preserved open space (public and private land dedicated to public recreation) and low-density residential areas (one dwelling or less per acre) to the East. To the North is a mixture of residential and commercial properties (retail and services), and public utility services. Institutions (schools and churches), open space, and low-to-medium density residential areas are found to the West. To the South are commercial/industrial properties, vacant land, and medium-to-high density residential areas (two or more dwellings per acre). On-site land use consists of open space, industrial/commercial, agricultural, and residential areas.

Approximately 8,000 persons live within one-half kilometer (0.3 mile) of the Laboratory's boundary. Although much of the land area within a 16-kilometer (9.9 mile) radius is either forested or cultivated, there has been an increase in residential housing in recent years, a trend that is expected to continue.

4.3 Geology and Soils

Long Island was formed by two east-west trending glacial moraines, which were deposited during two separate Pleistocene glaciation events. Hence, the general surface geology of the region consists of deposited glacial sands and gravels. These deposits, which range from 20 to 38 meters deep (65 - 125 feet), lie on the Magothy formation, a unit of unconsolidated sands and clays of Late Cretaceous age.

The soils at BNL are predominantly coarse, sandy soils derived largely from glacial outwash materials including the Ronkonkoma moraine. The soils show distinct layering. Coarse gravel often is overlain by finer material. Surface deposits, which vary in texture, range from coarse Duke's sand in the north and east, to finer Sassafras sandy loam in the southwest. The soil types on site, in order of increasing coarseness, are Sassafras loam, Sassafras fine sandy loam, Sassafras sandy loam, Plymouth sand loam, Duke's loamy sand, Plymouth sand, and Duke's sand. Babylon sand and meadows soil are associated with wet sites (ERDA 1977).

The recent Facility Review determined that the NSLS Complex does not have any underground tanks (BNL 1998). The Complex maintains aboveground tanks for helium gas and liquid nitrogen. An emergency electrical generator is situated at the northeast corner of Building 725 (NSLS). A stand-alone, double-walled 280 gallon tank with an overfill protection and a high level alarm supplies the generator.

While some accelerator components become locally activated as a result of operations, this would not extend to the soil.

4.4 Water Resources

Water resources associated with BNL include both surface waters and groundwater. Descriptions of these waters are provided in the following sections, along with the NSLS Complex industrial and potable water systems and their relation to these water resources.

4.4.1 Surface Water

The BNL site terrain is gently rolling, with elevations varying between 13 and 37 meters (44 - 120 feet) above sea level. The land lies within the headwaters region of the Peconic River watershed. Wetland areas in the north and eastern section of the site formerly were principal tributaries of the Peconic River. The Peconic River both recharges to, and receives water from, the groundwater aquifer depending on the hydrological potential. Thus, the river is classified as having intermittent flow on-site. The Peconic River on-site recharges to groundwater, and in most years, leaves no measurable continuous flow at the site boundary. Liquid effluents from the BNL Sewage Treatment Plant (STP) constitute the only continual source of surface water in the tributary's riverbed. These liquid effluents also recharge to groundwater before leaving the site boundary. Combined industrial and sanitary wastewater discharged from the STP receives tertiary treatment and conforms to the criteria in the STP's approved State Pollutant Discharge Elimination System (SPDES) permit issued by the New York State Department of Environmental Conservation (NYSDEC).

4.4.2 Groundwater

The BNL site was identified by the Long Island Regional Planning Board and Suffolk County as being over a deep-flow recharge zone for Long Island [Koppleman, 1978]. This finding indicates that precipitation and surface water that recharge within this zone have the potential to replenish the lower aquifer systems lying below the Upper Glacial Aquifer. Up to two-fifths of the recharge from rainfall is estimated to move into the deeper aquifers. The extent to which groundwater at the BNL site contributes to deep flow recharge was confirmed using an extensive network of shallow and deep wells installed at BNL and surrounding areas [Geraghty and Miller, 1996]. In coastal areas, these lower aquifers discharge to the Atlantic Ocean and to the Long Island Sound.

4.4.3 NSLS Complex and Water Resources

Except for the roof and parking lot drains that empty into groundwater recharge basin HS, located ~4827 feet southeast of the NSLS, virtually all the water used at the NSLS Complex is disposed of through the sanitary waste stream. There are no current requirements to monitor the quantity or chemistry of this outflow. Work planning, experimental review, and Tier I safety inspections are the three methods for ensuring that hazardous effluents do not make their way into the sanitary waste stream.

Water for temperature control systems of the buildings and accelerators flow within closed loop systems and, therefore, do not enter the sanitary waste stream until system maintenance is performed. The closed loop system includes water piped to Building 725 directly from the BNL Central Chilled Water Facility (CCWF), Building 600. An exception to this is the supply of potable water (~10 gallons per minute) to Building 725's cold rooms. This is a single pass system emptying into the sanitary waste stream and operates only when the CCWF is down and not available to those rooms. Some closed loop systems contain deionized water. Rinse water from regenerating resins is segregated into waters that can be pH adjusted and disposed of into the sanitary waste stream, and those that must be disposed of as waste due to their elevated content of heavy metals.

While some accelerator components become locally activated as a result of operations, this would not extend to the groundwater. The NSLS Complex does not generate tritiated water. In 1997, samples taken from the five closed-loop water systems in the NSLS accelerators, which generate the highest energies within the Complex, had no detectable tritium (Gmur 1997).

Experiments using radioisotopes are highly controlled by specific facility procedures and the likelihood of these materials entering the sanitary or groundwater systems is remote due to these strict procedures.

4.5 Climate

The climate at the laboratory can be characterized as breezy and well ventilated, like most of the eastern seaboard. The prevailing ground-level winds are from the southwest during the summer, from the northwest during the winter, and about equal from these two directions during the spring and fall [Nagle, 1975; 1978].

The total precipitation for 1999 was 131 centimeters (51.7 inches), which is about 8.6 centimeters (3.4 inches) above the 50-year annual average. The monthly mean temperature in 1999 was 11.5 ^{o} C (52.7^{o} F), ranging from a monthly mean low temperature of 0.11 ^{o} C (32.2^{o} F) in January, to a monthly mean high temperature of 24.6 ^{o} C (76.3^{o} F) in July.

4.6 Air Quality

The overall regional air quality is a mix of maritime and continental influences from the Atlantic Ocean, Long Island Sound, and the various associated bays; this results in the region, and the BNL site, being very well ventilated by winds from all directions.

The local air quality management in the New Jersey-New York-Connecticut Interstate Air Quality Control Region, which includes Suffolk County and BNL, is in attainment with most National Ambient Air Quality Standards (NAAQS) for criteria pollutants, which include sulfur dioxide, nitrogen oxides, particulate matter, lead, and carbon monoxide.

The BNL Central Steam Facility is the only facility required to continually monitor non-radiological air emissions. In 1999, this facility released 53.5 tons of nitrogen oxides, 16.7 tons of sulfur dioxide, 1.8 tons of volatile organic compounds, and 5.1 tons of total suspended particulates. Since 1997 when conversion of the boilers to natural gas as a fuel source began, there has been a decrease in total suspended particulates, sulfur dioxide, and nitrogen oxides by 8.9 tons, 92.3 tons, and 51.4 tons, respectively, compared to 1996 values. Volatile organic carbon (VOC) emissions have increased by 0.9 tons compared to 1996 values, largely due to the production of higher levels of VOCs by burning natural gas rather than fuel oil [SER].

4.6.1 NSLS Complex and Air Quality

The products emitted to the ambient air from hoods or hutches typically consist of trace emissions of evaporated solvents, acids and other chemicals. These emissions are associated with research and development activities, and, therefore, are exempt from Federal and New York State permitting requirements (two exceptions are noted in Section 5.3.2, below). Experiments and work undertaken at the NSLS are reviewed, with input from the Experimental Review Coordinator (ERC) and the Environmental Compliance Representative (ECR), to identify and manage the types and quantities of chemicals used. The ERC ensures that all safety reviews are performed for each activity and that any issues are appropriately addressed. The ECR is knowledgeable in environmental compliance areas and is responsible for identifying and assisting in the resolution of any environmental issues. There is an active pollution prevention program at the NSLS, which considers alternatives to the chemicals used that possibly would reduce the emissions released (NSLS 2001). Quantities of chemicals brought to the NSLS Complex are kept to the minimum necessary to complete an experiment.

Gases, some in liquid form, are used for experimental purposes. These gases consist of nitrogen, helium and argon, and are typically used to provide inert or non-reactive atmospheres for experiments. Small amounts of hydrogen and other gases such as hydrogen sulfide are used in experiments. Liquid nitrogen and liquid helium are used for keeping experimental samples, such as protein crystals, cool. These liquids are also used to cool beamline equipment, such as detectors, in order to enhance their sensitivity. The liquids are also used to cool accelerator components, such as magnetic insertion devices, in order to make them superconducting (zero resistance to electrical current). Spaces at risk to accumulation of these gases (or gases generated from liquids), thus potentially creating an oxygen deficiency hazard, are supplied with oxygen deficiency sensors that alarm at oxygen levels below 19.5%. These spaces are vented or the gas is directed out of the facility via piping. Any large releases from the outdoor helium and nitrogen storage tanks, while not considered credible scenarios, would not result in adverse environmental impacts since helium is classified as an inert gas and nitrogen is already a primary component of the atmosphere.

For the NSLS, ATF, and SDL facilities, small amounts of air activation products are generated by routine facility operations. These are produced and decay locally, e.g., nitrogen-13 (half-life = 10 minutes) and oxygen-15 (half-life = 2 minutes). The calculated quantities involved are well below the Derived Air Concentration level of 4.0 x 10^{-6} microcuries per milliliter [DOE 10 CFR 835]. Because of their short half-lives, these do not add to the dose of the Maximally Exposed Individual at the site boundary (see Section 4.9.3).

4.7 Ecological Resources

BNL's ecological resources include terrestrial biota, threatened and endangered species, and wetlands. The following sections describe these resources, along with their interaction with the NSLS Complex.

4.7.1 Terrestrial Biota

The Laboratory is located in a section of the historically classified Oak/Chestnut forest region of the Coastal Plain. The BNL property constitutes five percent of the 404.7 sq-km (100,000 acre) Pine Barrens on Long Island. Because there are few fires and other disturbances, the vegetation in the Pine Barrens tends to follow moisture gradients. Much of the vegetation at BNL is in various stages of succession, reflecting the history of disturbances associated with the Laboratory and its predecessor Camp Upton that included land clearing, fires, localized flooding, and drainage projects.

Fifteen mammalian species are endemic to the site, including those common to mixed hardwood forest and open grassland habitats. At least 85 species of birds are common to BNL and 216 species have been identified on-site since 1948. Nine amphibian and ten reptilian species have been identified. Permanently flooded retention basins and other waters support amphibians and aquatic reptiles.

4.7.2 Threatened and Endangered Species

Fourteen breeding sites were confirmed for the New York State endangered eastern tiger salamander (*Ambystoma t. tigrinum*). The banded sunfish (*Enneacanthus obesus*) and the swamp darter (*Etheostoma fusiforme*) are both New York State threatened species and are found within the Peconic River drainage on-site. The stiff goldenrod (*Solidago rigida*) is listed as threatened by New York State and the narrow-leafed bush clover (*Lespedeza augustifolia*) is listed as rare. In addition, twenty-three other plant and animal species are considered species of special concern. No federally listed plants or animals were identified at BNL.

4.7.3 Wetlands

Because of the topography and porous soil, there is little surface run-off and little open water at BNL. Upland soils tend to be very well drained, while seasonally, depressions form small pocket wetlands with standing water. There are six major regulated wetlands providing a mosaic of wet and dry areas correlated to topography and depth to the water table. Nine species of fish inhabit wetland areas, including the banded sunfish (*Enneacanthus obesus*) and the swamp darter (*Etheostoma fusiforme*), both New York State threatened species.

4.7.4 NSLS Complex and Ecological Resources

Storm and cooling tower water from roof drains and water from parking lot drains empty into groundwater recharge basins that are monitored under NYSDEC - SPDES permit #NY 0005835. Recharge basins have been inhabited in the past by the New York State endangered Eastern Tiger Salamander, including basin HS which receives stormwater runoff from the NSLS Complex. None of the permanently flooded retention basins are associated discharges from the NSLS Complex. The remaining water effluents from the NSLS Complex are discharged through the BNL sanitary waste stream which also is monitored by the BNL SPDES permit. Wetlands are not affected by storm water runoff due to the location of the NSLS site and the porosity of soils. The nearest regulated wetland is ~3500 feet from the NSLS.

4.8 Cultural Resources

BNL is developing its program for cultural resources management but has not identified all of the cultural resources on-site. Buildings and features that were identified and determined to be eligible for listing on the National Register of Historic Places include some of the World War I trenches, and buildings associated with the Brookhaven Graphite Research Reactor (BGRR), including buildings 701, 702, 703, 704, 705, 708, 709, 709A, and 801. Since the BGRR is undergoing significant decontamination and decommissioning work, a determination of effects was developed and a Memorandum of Agreement for mitigating them was implemented for Buildings 701, 702, 704, 708, 709, and 709A. In developing its cultural resources management program, BNL is conducting a building-by-building inventory to determine other buildings that potentially may be eligible for inclusion in the National Register of Historic Places. None of the NSLS Complex buildings are currently listed as eligible for inclusion in the National Register.

4.9 Radiological Characteristics

The radiological characteristics presented in the following sections are an overview of both BNL's routine and permitted monitoring efforts. The site baseline radioactivity for water and air are each described, as well as the hypothetical worst-case scenario for a maximally exposed individual. Details on the radiological characteristics of the NSLS Complex are also provided

4.9.1 Site Baseline Radioactivity in Water

Effluents are routinely monitored at the Sewage Treatment Plant's Peconic River Outfall. The average gross alpha and beta activity is 1.4 picocuries per liter and 7.5 picocuries per liter, respectively. Both of these values are considered within background levels. The 1999 average concentration of tritium at the Peconic River Outfall was 142 picocuries per liter. The Safe Drinking Water Act limits are 15 picocuries per liter for gross alpha, 50 picocuries per liter for gross beta and 20,000 picocuries per liter average tritium concentration. BNL utilizes eight recharge basins permitted under the State Pollutant Discharge Elimination System to dispose of once-through cooling water, cooling tower blowdown, and storm water runoff. Both permit and routine monitoring of these basins indicated no elevations of gross radiological activity; no gamma-emitting radionuclides attributable to BNL operations were detected. [SER].

4.9.2 Site Baseline Radioactivity in Air

BNL is subject to requirements of 40 CFR Part 61, Subpart H, National Emission Standards for Hazardous Air Pollutants (NESHAP). The U.S. Environmental Protection Agency (EPA) established a national policy on the airborne emission of radionuclides, and a dose limit to the public of 10 mrem/yr for the airborne pathway. BNL continuously monitors the airborne emission of radionuclides from five facilities. The Brookhaven Medical Research Reactor (BMRR), permanently closed in December 2000, was the major contributor to the airborne emission of radionuclides (Argon-41, half-life = 1.8 hrs), releasing 1640 Curies. The total emission of radionuclides released from all facilities in 1999 was 1672 Curies. Using the computer model CAP88-PC (Clean Air Act Assessment Package-1988), the effective dose equivalent from all sources at BNL for 1999 was calculated to be 0.13 mrem [SER].

4.9.3 Maximally Exposed Individual

The Maximally Exposed Individual (MEI) potentially receiving a dose from BNL activities (airborne Ar-41 0.13 mrem) and known levels of Cs-137 contamination in the fauna (fish 0.25 mrem, deer 4.2 mrem) would receive 4.58 mrem per year [SER]. This value constitutes less than five percent of the 100 mrem/yr limit established by DOE to protect the public. This total exposure is approximately one percent of the average individual dose received annually from natural background sources, including radon, cosmic, terrestrial, man-made, and ingestion paths (total 360 mrem) [NCRP, 1987]. The MEI is a hypothetical worse case scenario, which may never be met, based on an individual (non-employee) located at the northeast boundary of BNL (365 days/yr) who eats 15 pounds of fish and 64 pounds of deer from BNL, and breathes the air [SER].

4.9.4 NSLS Complex - Radiological Characteristics

As described in Section 1, the NSLS Complex utilizes a variety of electron accelerators to carry out its research mission. The interaction of the energetic electrons produced by the accelerators generates secondary particles (e.g. neutrons, photons) that must be shielded to control radiation exposure to personnel near the machines. Electrons are much less effective in producing secondary radiation from nuclear interactions compared to proton and heavy ion accelerators of similar energy and intensity. Consequently, the potential radiological impact of the NSLS Complex accelerators is readily addressed by shielding along with administrative and operational controls. The extent of activation is low in the accelerator components and the cooling water is unaffected. The Complex's operation for the past 18 years has had no known environmental or human health impact.

The external radiation dose to the personnel working in the NSLS Complex is monitored with thermoluminescent dosimeters (TLD). These TLDs are exchanged monthly and analyzed to determine the external whole body dose to the personnel from ionizing radiation. In CY99, 7082 TLDs were issued to individuals in the NSLS Complex. The average whole body dose (gamma plus neutron) was 0.02 mrem/yr and the maximum whole body dose recorded for one individual was 20 mrem/yr [NSLS 2000 Self-Assessment]. In addition, area TLDs and real-time radiation monitors are located throughout the facility to record long-term and immediate doses, respectively. The dose to personnel is kept as low as reasonably achievable (ALARA) through a combination of shielding, operational and administrative controls, and procedures. Control TLDs posted in the facility did not have any recordable dose in CY99 indicating that the operational and administrative controls were very effective. The average ambient external radiation dose measured and reported on the BNL site (i.e., average on-site dose) was 56.4 mrem/yr. The off-site ambient TLD dose reported was 70.8 mrem/yr [SER]. Therefore, because the measured off-site background dose was higher than the on-site dose, it can be concluded that the external dose contribution from the NSLS Complex to the environment and the public is minimal to none.

4.10 Industrial Hazards and Accidents

Hazards, including radiation, magnetic fields, noise, lasers, confined spaces, oxygen deficiency, gases and chemicals, toxic metals such as lead and beryllium, and cryogens, are identified and managed through standard BNL and NSLS specific procedures and training.

An event or a condition that adversely affects, or may adversely affect, personnel, the public, property, the environment, or the NSLS mission may be classified as a) an Occurrence reviewed through the DOE Occurrence Reporting and Processing System (ORPS), or as b) a Non-Conformance followed internally by the NSLS. These processes examine the incidents and analyze their root causes. Corrective actions are taken to improve work practices and to reduce the chances of recurrence. A Lessons Learned program is in place at the NSLS to disseminate useful information to staff and users learned from Occurrences, Non-Conformances or other such events. In a typical year, the NSLS experiences two or three Occurrences. The Non-Conformance system is new and annual statistics are not yet available.

In CY 99, NSLS staff experienced four OSHA recordable cases of injury, down from six cases in each of two previous years.

4.11 Natural Hazards

Natural phenomena, which could lead to operational emergencies at BNL, include hurricanes, tornadoes, thunderstorms, snowstorms, and ice storms [BNL Site Emergency Plan]. Hurricanes occasionally hit Long Island and the high wind speeds associated with them are most likely to damage structures. Record high winds for BNL were recorded during Hurricane Carol in September 1954 [Hoey, 1994]. Tornadoes and hailstorms are extremely rare on Long Island. Thunderstorms, snowstorms, and ice storms do occasionally occur, and have the potential to cause significant damage resulting in an operational emergency. However, operational emergencies do not involve a significant release of or loss of operational control of a hazardous or radiological material. In such an emergency, the BNL management would decide whether to evacuate workers from the site. Individual departments would determine to what status they bring their equipment.

Typical severe weather-related phenomena affect the stability of the electrical power supplied to the NSLS Complex. This impacts the stability of the accelerator magnet power supplies and may result in the loss of the stored electron beam in the accelerators. Shielding protects personnel from such losses. An energy storage device serving the Vacuum Ultraviolet Ring (VUV) can maintain stable electrical power supply for up to 3 seconds during power dips. This has reduced the number of VUV beam losses. If BNL declares a weather-related operational emergency recommending that staff evacuate the site, ring operators would turn off all accelerators. To date the NSLS Complex has suffered minimal impacts from extreme weather. These include the incursion of rainwater (roof leaks and flooding under doors) and loss of some exterior wall panels. Earthquakes on Long Island are extremely rare.

The probable occurrence of an earthquake sufficiently intense (>5.6 on the Richter scale) to damage buildings, accelerators, and reactor structures in the BNL area was thoroughly investigated during planning constructing the Brookhaven Graphite Research Reactor (BGRR), High Flux Beam Reactor (HFBR), and Relativistic Heavy Ion Collider (RHIC) [Pepper, 1992]. Seismologists expect no significant earthquakes in the foreseeable future. No active earthquake-producing faults are known in the Long Island area [Hoey, 1994].

4.12 Sociological and Transportation Conditions

The resident NSLS staff of some 176, plus additional beamline staff of ~100, supported 2416 users in FY99. This is the largest group of research users at BNL. They represented 380 institutions from 80 countries worldwide, with the majority (84%) affiliated with institutions based in the United States.

The NSLS Complex operates a few gasoline-powered trucks and vans, as well as a battery-powered forklift. Vehicles picking up and delivering materials and service personnel visit the Complex. In addition, the staff and users working at the NSLS Complex commute in their own, private vehicles.

4.13 Waste Management

During a typical year of operations, the NSLS generates about 5,000 to 10,000 pounds of hazardous or industrial wastes. Most of this waste results from used machine or cutting oils, but other types of chemical wastes (e.g., solvents, acids, caustics, and wastewaters with high concentrations of metals) also are produced. In a typical year, the NSLS generates less than 10 ft^3 of radioactive waste, and little mixed or medical wastes.

Considering both the number of scientific users in the NSLS Complex (2416 in FY99) and the number of experiments (1013 in FY99), the amount of waste generated is low. Experimental Safety reviews and the quarterly safety inspections are a major factor in minimizing the volumes of chemicals brought to the NSLS Complex, as well as the wastes generated. Many experiments do not generate any waste. The types of waste are as follows for FY99, and the statistics are summarized in Table 2:

- Hazardous Waste = 126 items including chemicals (solvents, acids, bases, some PCBs) and photographic processing waste;
- Industrial Waste = 53 items including mainly oils and oily rags, cutting fluids, resin recharge rinse waters, and photographic wastes (oils and rinse water are the major components);
- Radioactive Waste = 20 items from one experiment;
- Mixed Waste = None.

As a rule, the amount of waste in each category varies from year to year, depending on the type and volume of the materials being disposed of. A good example is the amount of Industrial Waste in 1999 that was almost three times higher than the amount in 1998. This was due to a larger than normal quantity of mineral and transformer oils, as well as deionizer resin recharge rinse water in 1999. Another example is the quantity of hazardous waste in 1999 which was a tenth of the 1997 quantity due to the 1997 disposal of a number of klystrons, chemicals from the closure of the Acid Cleaning Facility, and resin recharge rinse waters. The BNL Waste Management Division has set goals for reducing waste that the NSLS Complex follows.

Table 2 compares waste production from the NSLS in FY99 with that from all of BNL.

Table 2. Waste Comparisons: NSLS Complex to BNL Site (FY99)

Wastes (lbs.)	**NSLS Generated**	**BNL Generated**	**NSLS % of BNL**
Hazardous	962	55,612	1.73
Industrial	3,298	905,651	0.36
Radioactive	739	252,442	0.29
Mixed	0	6,239	0.00
Total Generated	4,999	1,219,944	0.41

Note: the Waste Management Division supplied the numbers. Wastes from environmental restoration are not included.

4.13.1 Pollution Prevention

Many NSLS materials are recycled, such as paper products, cardboard, metals, wood, glass, cans, and laser printer cartridges. For example, in 1999 the NSLS recycled the following materials:

- 48 cubic yards of metals;
- 600 cubic yards of cardboard; and
- 70 cubic yards of lumber.

4.14 Commitment of Resources

The accelerators dominate electrical power-usage for the NSLS Complex. In FY99, the NSLS Complex used ~35,600 megawatt-hours; this is ~12.4% of the BNL usage for the same period (Table 3).

The BNL Central Steam Facility (CSF) provided ~18.4 million pounds of high-pressure steam to the NSLS Complex to heat the facility in FY99 (4.98% of the BNL total; Table 3). This translates into 28,663 decatherms of natural gas and 30,368 gallons of No. 6 oil. Natural gas became the primary fuel used at the CSF after upgrades in 1997 and 1998; fuel-oil usage then dropped 92%. Section 4.6 discusses the criteria pollutants. These values are considered routine and within accepted resource utilizations for the type of facilities described.

The Central Chilled Water Facility (CCWF) supplies supplementary cooling water only to Building 725 in the NSLS Complex for the accelerator components, the structural biology cold rooms, and the building air-conditioning. In FY99, Building 725 used 34.99 x 10^9 BTUs (~33% of the BNL total; Table 3). The CCWF and building-dedicated chiller air-conditioning units share the cooling load for Building 725. These are all closed-loop systems. One exception is a 10-gallon per minute once-through flow of potable water for the structural biology cold rooms that is used should all other cooling water supplies be cut off.

Table 3. FY99 Utility Usage: Comparisons of the NSLS Complex to the BNL Site

Utilities	**NSLS Usage**	**BNL Usage**	**NSLS % of BNL**
Electricity (MW hrs)	35,600	287,097	12.4
Steam (lbs)	18.4×10^6	368.4×10^6	4.98
Chilled Water (BTUs)	34.99×10^9	106.14×10^9	32.96

Note: The BNL Plant Engineering Energy Management Group supplied the above numbers.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 Effects of No Action

Since the Continued Maintenance (No Action) Alternative does not involve any construction or upgrades, there would be no new or added environmental impacts. All consequences would remain as discussed in Section 4.

5.1.1 Commitment of Resources

The No-Action Alternative would not substantially change the utility usage, identified in section 4.14, because no upgrades or construction would be involved and only in-kind replacements would take place.

5.1.2 Soils

The No-Action Alternative would not impact soils differently from current operations, as no construction would occur.

5.1.3 Water Resources

Water usage and effluents in the facility would remain the same under the No-Action Alternative, and, therefore, would not differ from the conditions described in section 4.4.3.

5.1.4 Air Resources

No increase in any potential releases to the air is foreseen with the No-Action Alternative because there would be no upgrades.

5.1.5 Ecological Resources

No change in the effect on ecological resources is anticipated in the No-Action Alternative due to the lack of upgrades and construction.

5.1.6 Cultural Resources

The buildings associated with the NSLS, ATF, and SDL were built in 1981, 1957, and 1982, respectively, and are currently not eligible for inclusion in the National Register.

5.1.7 Sociological and Transportation Impacts

Under the No-Action Alternative the sociological impact of the NSLS would not be expected to change. The number of employees/guests and the number of vehicles and their emissions would not be expected to change under the No-Action Alternative.

5.1.8 Human Health Effects

There would be no anticipated change in the current minimal potential human health effects of these hazards as a result of the No-Action Alternative.

5.1.9 Accidents and Natural Hazards

The potential for accidents or natural hazards would remain the same under the No-Action Alternative.

5.1.10 Waste Management

The quantity of waste generated by the NSLS Complex is not expected to increase under the No-Action Alternative. With pollution prevention opportunities being sought and used, it is possible that the quantity would decrease.

5.2 Effects of the Proposed Action

The majority of the upgrades to the beamlines and accelerators described under this alternative (Section 3.2 and Table 1) would occur within the existing buildings of the NSLS Complex facilities. The exception to this is the proposed 3600-square-foot extension to Building 729 that would contain new accelerator and beamline components (Figure 7) and would be constructed over an existing driveway and adjacent lawn. Also, excavation and backfill would be required to install the footings and foundation to some of the new second-floor offices for Building 725 (Figure 8). The workload for NSLS complex components fabricated at BNL Central Shops is expected to remain at current levels, within routine annual fluctuations. The NSLS complex upgrades would not be expected to increase the environmental impact of the Central Shops facility. The environmental impact of the Central Shops facility would possibly be expected to decrease, when compared to previous years, as a result of the continuous efforts of BNL to reduce waste and improve efficiencies. Upgrades to the Complex accelerators and associated equipment would improve the ability to control, monitor and manipulate the beams, along with enhancing the reliability. These upgrades would not result in exceeding the limits of the established facility authorization documents (Safety Assessment Document, Accelerator Safety Envelope).

5.2.1 Commitment of Resources

The Commitment of Resources for the Proposed Action builds on those conditions described in Sections 4.14 and 5.1.1. Table 1 lists the anticipated upgrades for the NSLS Complex. Table 4, below, summarizes anticipated utility usage for the NSLS Complex, expressing the values as percentages of BNL's projected usage:

- 205 MW hour increase in electrical usage is anticipated for new office spaces (e.g., lighting and computers) and 6,485.3 MW hour increase for upgrades to the beamlines and accelerators;
- ~6% increase in high-pressure steam usage is anticipated due to the construction and heating needs of new office and research spaces (total ≅ 19.5 million pounds/year);
- ~17.7% increase in chilled water usage is anticipated (total ≅ 41,189 x 10^6 BTUs).

Table 4. Anticipated Utility Usage: Comparisons Over ~5 Years of the NSLS Complex to the BNL Site

Utilities	Estimated NSLS Increase	Estimated Total NSLS Usage	Estimated Total BNL Usage	Estimated NSLS % of BNL Usage
Electricity (MW hrs)	6,689	42,289	384,445	11
Steam (lbs)	$1.1\text{x}10^6$	$19.5\text{x}10^6$	$3.92\text{x}10^8$	4.98
Chilled Water (BTUs)	$6.2\text{x}10^9$	$41.19\text{x}10^9$	$1.76\text{x}10^{11}$	23.4

Note: NSLS staff supplied the NSLS estimates. The BNL Plant Engineering Energy Management Group gave the BNL estimates.

The commitment of resources for the Proposed Action upgrades and construction include the resources listed above. As well, there would be additional research and support staff, construction personnel, equipment, materials and utilities, such as electrical, petroleum, and water. Metals, concrete, masonry, wood, plastics, thermal and moisture protection materials, doors and windows, finishes, mechanical and electrical systems would be used to construct the building's proposed additions. Construction may generate dust and

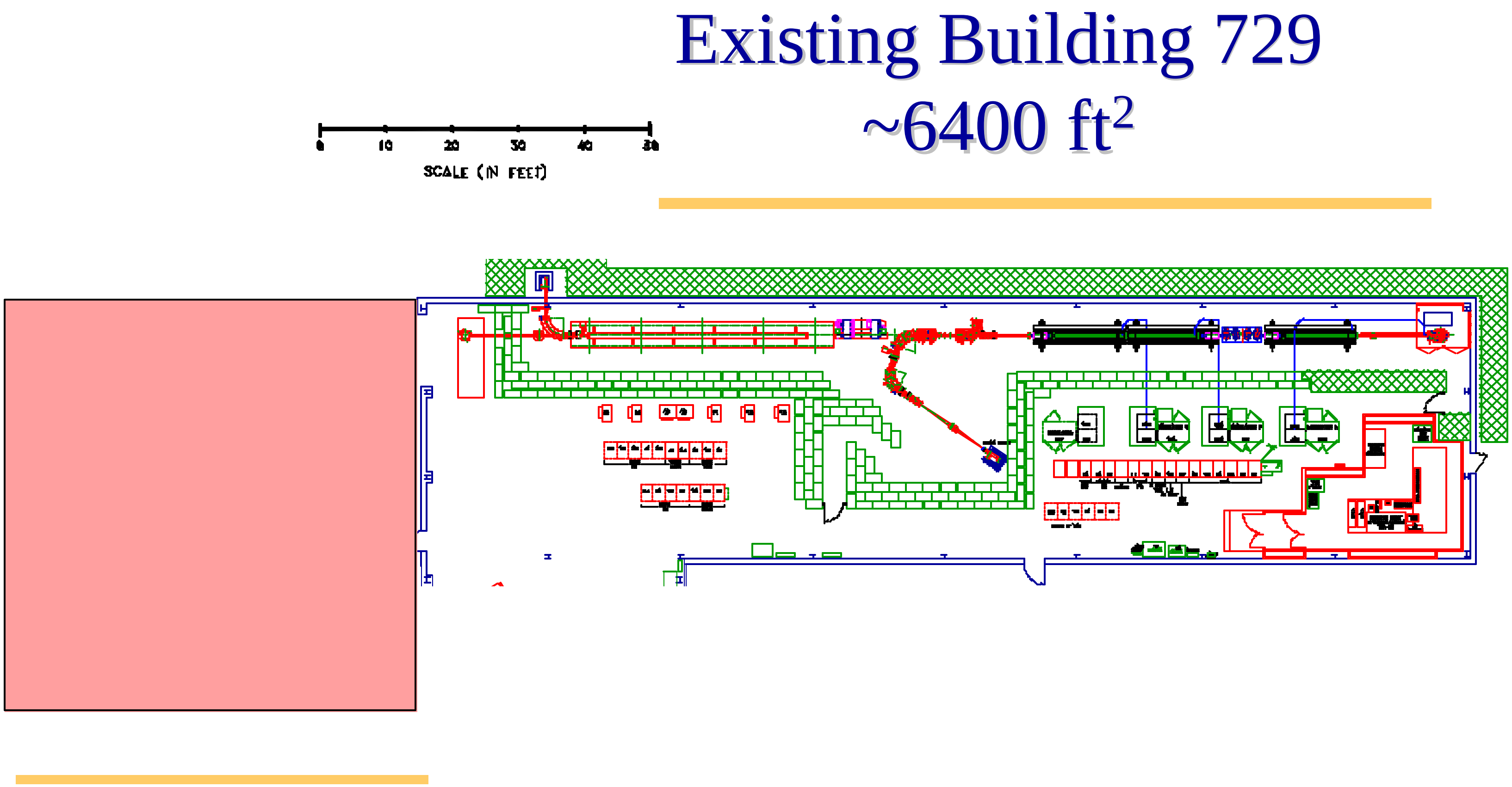

Figure 7. Proposed 3600 square foot extension (cross-hatched) to the SDL, Building 729.

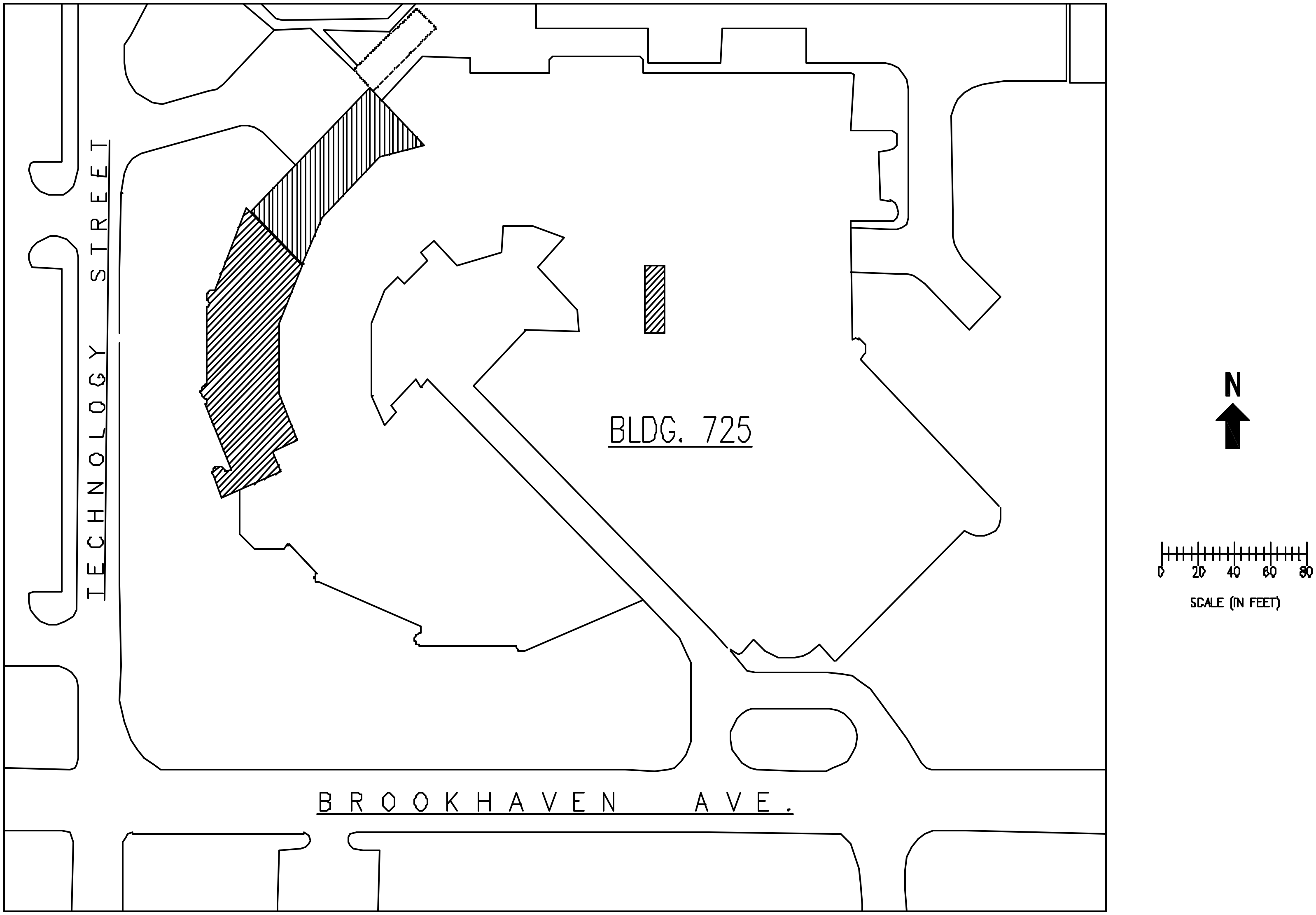

Figure 8. Proposed 9300 square foot additions (cross-hatch) to the NSLS, Building 725.

noise, but their impact would be limited in time and kept to a minimum. Spraying water would control the dust. Noise from excavation equipment would be locally disturbing to office workers near the construction-site, but not away from the immediate area. Fossil fuels and water would be used to operate construction machinery. Construction contractors are trained and instructed to notify the BNL spill-response team if a spill occurs, and are required to possess Material Safety Data Sheets (MSDS) for any chemicals they use. Resources required for much of the construction and upgrades are readily available in local markets. Some specialized components might be manufactured outside the BNL area but this should not impact the availability of raw materials. The energy demands of construction equipment would have a negligible effect on available supplies. The new facilities would be tied into existing climate controls with electronically controlled systems for heating, ventilation, and air-conditioning linked to BNL's site-wide Energy Management Control System [CDR]. In summary, there would be no irreversible or irretrievable commitment of resources.

5.2.2 Soils

Standard erosion-control practices (e.g., hay bales) would be employed to mitigate the impacts of construction on soils, when necessary. Upon completion, all areas would be restored to the pre-construction state by regrading and seeding. With the construction of the 3600 square foot addition to building 729 and a concrete pad for a new emergency generator adjacent to building 725, some additional impervious surfaces would be created. These surfaces would result in minimal additional runoff. While exact dimensions are not available at this time, the size of any new impervious area adjacent to building 729 is not anticipated to exceed that of the existing driveway by about 80%. The new concrete pad by building 725 would encompass an area less than 100 square feet. The remaining impacts to soil would be comparable to the No-Action Alternative (see Sections 4.3 and 5.1.2) and expected to be minimal.

5.2.3 Water Resources

The estimated 5% increase in staff (total $\cong$ 185), users (total $\cong$ 2537) and the number of experiments (total $\cong$ 1064) may similarly increase the effluent discharge to the sanitary waste stream. The increased discharge to the sanitary system would slightly increase the total Laboratory discharge rate of 700,000 gallons/day. However, it would be well within the 3 million gallons/day capacity of the plant and would not have a significant impact. The controls described in Section 4.4.3 would continue to ensure hazardous wastes are segregated from the sanitary system.

Increases in impervious surfaces described in 5.2.2 above would slightly increase surface water discharge to recharge basin HS. The estimated increase in impervious surfaces would increase the discharge by approximately 6000 gallons for a typical 2-inch rainfall. This volume would be considered a minimal increase to the total discharge to basin HS.

5.2.4 Air Resources

There would be some temporary increase in emissions due to construction (e.g. vehicles and other equipment). Some increased emissions also would be due to increases in the use of steam, chilled water and electricity (see Section 5.2.1 above) by proposed upgrades and construction. All other impacts to air resources are identical to those described in the No-Action Alternative (see Sections 4.6.1 and 5.1.4) and expected to be minimal.

5.2.5 Ecological Resources

Ecological impacts due to the Proposed Action are not expected to change compared to the No-Action Alternative (see Sections 4.7.4 and 5.1.5) and are expected to be minimal. Impervious surfaces would be increased due to the construction of the Building 729 3600-square foot addition resulting in a minimal increase in surface water runoff. This increase would not significantly change the retained water in the recharge basin (see Section 5.2.3 above). Wetlands would not be affected due to their distance from the NSLS Complex (the nearest regulated wetland is ~3500 feet from the NSLS).

5.2.6 Cultural Resources

The buildings associated with the NSLS, ATF, and SDL were built in 1981, 1957, and 1982, respectively, and, are currently not eligible for inclusion in the National Register. None of the proposed actions are located in proximity to any of the eligible properties identified by BNL. There would be no impact to cultural resources.

5.2.7 Transportation Impacts

Proposed construction would temporarily increase deliveries of materials to the NSLS Complex. The proposed upgrades (including staff and users) would result in an expected increase of approximately 5% in deliveries and the use of private vehicles. The consequences of these are expected to be minimal.

5.2.8 Human Health Effects

The human health effects of the Proposed Action are not expected to change from those discussed in the No-Action Alternative (see Sections 4.9.4 and 5.1.8) due to the strict maintenance of administrative, operational, shielding, and machine safeguards. The improvements and efficiencies gained from component upgrades could possibly result in reduced corrective and preventive maintenance. Shielding upgrades and installation of new radiation monitors would subsequently reduce personnel dose. There would be no anticipated increase in off-site dose to the public from the NSLS Complex operations. Impacts, therefore, are expected to be minimal and even slightly less than the No Action Alternative.

5.2.9 Accidents and Natural Hazards

Occurrences, non-conformances and injuries are not expected to increase under the Proposed Action. The goal of the NSLS Complex would be to maintain existing levels, or lower them, by continuing to implement Work Planning Controls, Experimental Reviews, Tier I Safety Inspections and Training. Upgrades to the NSLS Complex are expected to reduce the potential for the occurrence of accidents, as well as the potential for their consequences.

The potential for natural hazards would remain the same under the Proposed Action Alternative.

5.2.10 Waste Management

The Proposed Action would result in a one-time generation of waste from building construction (e.g., excavated soils, cement, metals and wood). The engineers in charge of the various projects would manage this waste, and materials would be properly disposed of. The Proposed Action also includes equipment upgrades that would slightly raise (~5%) the volume of waste generated. These increases would be within the year-to-year variation that is now experienced. Another possible source would be in the chemical (hazardous) wastes generated by a ~5% increase in the number of experiments [CDR, 1999]. Also, there would probably be more discarded metals during the years of the upgrades as old equipment is replaced by newer equipment. For larger objects, such as beam pipes and chambers, an effort always is made to reuse the equipment and save costs. Much of the remainder would be evaluated for recycling before disposal. Any accelerator components determined to be radiologically activated would be transported to BNL's Waste Management Facility for disposition at an off-site DOE-managed or approved facility. The slight increase in waste expected to be generated under the proposed action would not create an impact.

5.2.10.1 Pollution Prevention

As a result of recent EPA Phase II Process Evaluations and ongoing Pollution Prevention efforts, BNL and the NSLS Complex continue to examine their waste streams to reduce them. A recent NSLS example of pollution prevention was the installation of pre-deionizers on the make-up water lines to three cooling systems. These vendor-supplied cartridges deionize any water before it is added to process water-cooling systems. This action would greatly reduce the frequency with which the main deionizer columns must be regenerated, thus reducing the quantity of wastewater produced as industrial waste. The improvements and efficiencies gained from component upgrades could possibly result in reduced corrective and preventive maintenance that would subsequently reduce waste generation.

5.3 Other Areas of Impact

Environmental Justice, which examines the potential for disproportionate adverse impacts to either low-income or minority populations, and a description of NSLS Regulatory Permits comprise the two sections presented under this heading.

5.3.1 Environmental Justice [HFBR EIS]

EPA's Office of Environmental Justice offers the following definition of Environmental Justice:

> *"The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goal of this 'fair treatment' is not to shift risks among populations, but to identify potential disproportionately high and adverse effects and identify alternatives that may mitigate these impacts."*

The human health effects Region of Influence (ROI) is defined as an area of 80 kilometer [50 mile] radius around the BNL site and the socioeconomic impacts ROI is defined as the Suffolk/Nassau County region. The ROI contains a relatively small racial minority population. In 1990, the ROI population was 88.4 percent white compared to 74 percent for the State of New York and 80.3 percent for the Nation. African-Americans comprised 7.4 percent of the population compared to 15.9 percent for the State and 12.1 percent for the Nation. Other minority groups comprise less than 5 percent of the total population. Persons of Hispanic ethnicity accounted for 6.3 percent of the ROI residents. In addition, the ROI is relatively affluent with only 4.2 percent of the population living below the poverty level (defined in 1990 as income less than $13,359 for a family of four) compared to 13 percent for all residents of New York. There are no identified Tribal areas or concentrated low-income or minority populations in the census tracts immediately surrounding the NSLS Complex.

None of the alternatives would have environmental justice impacts because there would be no anticipated economic or health effects on any potentially affected population (refer to Sections 5.1.8 and 5.2.8). Therefore, there would be no disproportionate adverse impacts to either low-income or minority populations.

5.3.2 Regulatory Permits at NSLS

Presently, the following environmental permits are active (this list is kept current in the NSLS Complex Facility Use Agreement [FUA, 1999] which defines the Complex's operating envelope):

a) NSLS storm water runoff from parking area drains in the warehouse area (Station HS - discharging to groundwater); NYSDEC - SPDES permit #NY 0005835 - Expiration Date 3/1/05.

b) Accelerator Test Facility (ATF) Approval to Construct/Modify Sources of Airborne Radionuclide Emissions; EPA NESHAPS Permit No. BNL-589-01 - dated October 6, 1989. NOTE: The ATF was issued a construction permit based on the understanding that the electron beam would traverse air in some experiments. Actual operation has always been within a vacuum pipe. The permit to construct does not carry any continuing regulatory burden for the ATF.

c) NYSDEC Air Permits:
Bldg. 725D - 1 small degreaser pot and an ultrasonic cleaning tank in Room 2-190A (both exhausted to stack 72501); Bldg. 535C - 1 spray cleaning and 1 rinse tank in the NSLS vacuum laboratory (emission point 53505).

d) Suffolk County Article 12:
All existing NSLS Complex tanks are in conformance with Article 12 requirements. Future installations will also conform.

There is no foreseen increase in regulatory permits from the Proposed Action or the No Action Alternative.

5.4 Cumulative Impacts of the Proposed Action

The cumulative impacts of health effects, resource utilization, and waste generation discussed below are based on BNL’s current operations, and incorporate impacts due to RHIC and Booster Applications Facility (BAF) current and future operations, and impacts due to the NSLS Complex Proposed Action. Table 5 lists the facilities currently sited at BNL. An Environmental Assessment and FONSI were approved for the BAF [BAF, 1998], currently under construction, and for the RHIC Facility [RHIC, 1991] that recently came on line. EAs for both these facilities discuss their cumulative impacts to BNL. Impacts due to the NSLS Complex No-Action Alternative have been discussed above and would remain the same.

Table 5. Major Facilities and Departments, Brookhaven National Laboratory

Particle Accelerators:

- Alternating Gradient Synchrotron Booster
- Alternating Gradient Synchrotron (AGS)
- Heavy Ion Transfer Line (HITL)
- Linear Accelerator (Linac) and Brookhaven Linac Isotope Producer (BLIP)
- Linear Electron Accelerator Facility (LEAF)
- National Synchrotron Light Source (NSLS)
- Radiation Therapy Facility (RTF)
- Relativistic Heavy Ion Collider (RHIC)
- Tandem Van De Graff and Cyclotron

Reactors:

- Brookhaven Graphite Research Reactor (BGRR) - not operating
- Brookhaven Medical Research Reactor (BMRR) - shutdown Dec. 2000
- High Flux Beam Reactor (HFBR) - not operating

Other Scientific Departments:

- Biology (includes Scanning Transmission Electron Microscope - STEM)
- Chemistry
- Energy, Environment and National Security (EENS)
- Medical
- Physics

Support Facilities:

- Central Chilled Water Facility (CCWF)
  - Provides chilled water for facility and process cooling via an underground network of pipes.
- Central Steam Facility (CSF)
  - Provides high-pressure steam for facility and process heating.
- Major Petroleum Facility (MPF)
  - Provides the petroleum reserve needed for operating the CSF and has a storage capacity of 8.7 million liters (2.3 million gallons). Storage is predominantly No. 6 fuel oil. Recent connection to natural gas has reduced BNL's reliance on oil as a fuel.
- Sewage Treatment Plant (STP)
  - Design capacity of 11.3 million liters per day (MLD) [3.0 million gallons per day (MGD)] and receives sanitary water and certain process wastewaters from BNL’s facilities for treatment before discharge into the Peconic River.
- Waste Management Facility (WMF)
  - A state-of-the-art complex of four buildings for managing the wastes generated from BNL's research and operations.
- Water Treatment Plant (WTP)
  - A potable water treatment facility with a capacity of 19 MLD (5 MGD).

The Health Effects sections (5.1.8 and 5.2.8) discuss the radiological impacts of the NSLS Complex No-Action and Proposed Action on personnel working at the Complex, and on-site as well as off-site dose assessments based on TLDs. The results indicate that the NSLS would not add to the cumulative impact on-site or off-site.

The NSLS Complex No-Action and Proposed Action projections for electrical usage are 35,600 MW hours and 42,289 MW hours, respectively. In FY99 BAF used 0 MW hours and RHIC used 117,000 MW hours of electrical power. The following are the five year projections: BAF = 1,500 MW hrs. and RHIC = 170,000 MW hrs. or four times the projected total for the NSLS Complex. The NSLS increases should be within the projected BNL capabilities and would not pose a significant impact to the environment. BAF does not intend to use steam. In FY99, RHIC used 20 x 10^6 lbs. and in five years projects the same usage. The FY99 and five year projections for the NSLS Complex are 18.4x10^6 and 19.5x10^6 lbs., respectively; both are 5% of total BNL usage and within BNL's capabilities. This increase would not create a cumulative impact to the environment.

BAF does not intend to use chilled water. RHIC uses the same amount of chilled water (1,600x10^6 BTUs) for FY 99 and in their 5-year projection. The NSLS Complex used 34.99x10^9 BTUs in FY99 and projects 41.19x10^9 in five years or 23.40% of the BNL projected total. The supply should be sufficient for the projected BNL needs and would not create a cumulative impact to the environment.

The waste from the NSLS Complex in FY99 was 0.41% of the total annual amount generated at BNL. The FY99 Accelerator Division waste (which includes the waste from RHIC) amounts to 6.1% of the BNL total. The workload and subsequent waste generation for NSLS Complex components fabricated at BNL Central Shops is expected to remain at current levels, within routine annual fluctuations. Waste generation at NSLS facilities may increase by up to 5% due to increases in staff, users and the number of experiments run. However, the improvements and efficiencies gained from component upgrades could possibly result in reduced corrective and preventive maintenance that would subsequently reduce waste generation. The NSLS Complex and BNL at-large consistently endeavor to identify opportunities for pollution prevention that would likely result in a net reduction in waste. Such a projection indicates a minimal additional cumulative environmental impact.

A discussion of decommissioning would be reserved for a separate NEPA document to be prepared near decommissioning when detailed data would be available.

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