DRAFT

ENVIRONMENTAL ASSESSMENT

FOR

Alternating Gradient Synchrotron Complex, Upgrades for Continued Operation

BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK

BROOKHAVEN SITE OFFICE

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1.0 INTRODUCTION

The United States (U.S.) Department of Energy (DOE) has prepared this Environmental Assessment (EA) to evaluate the potential environmental consequences of upgrading the Brookhaven National Laboratory (BNL) Alternating Gradient Synchrotron Complex (AGS) to ensure long-term operational efficiencies of the complex and to increase the energy level of the Accelerator Test Facility (ATF) Upgrade up to 10 Giga-electron-volt (GeV) while expanding its use as a user facility.

The preferred alternative includes all foreseen and unforeseen maintenance, upgrades, and enhancements within the AGS Complex to ensure long-term operational success supporting the scientific mission of the Department of Energy.

Other alternatives considered, both assessed and not assessed, are also described. This EA will be used to determine whether a "Finding of No Significant Impact (FONSI)" to the environment would result from the continued operation of the AGS Complex with upgrades and enhancements or whether an Environmental Impact Statement (EIS) must be prepared.

This document complies with the National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4321-4347); the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1500-1508); and the DOE NEPA Regulations (10 CFR 1021).

2.0 SUMMARY

BNL is a national laboratory overseen and primarily funded by the DOE Office of Science (SC), and operated and managed by Brookhaven Science Associates (BSA). BSA is a limited liability company, formed between Battelle Memorial Institute and The Research Foundation of State University of New York (SUNY) on behalf of Stony Brook University (SBU). Located 60 miles east of New York City in Upton, NY, BNL conducts research in high energy and nuclear physics, chemistry, nanotechnology, environmental sciences, energy technologies and national security (See Figures 1 and 2). Among its missions, the Laboratory is charged with conceiving, designing, constructing and operating world-class, complex, leading-edge research facilities in response to the mission needs of DOE and to a large community consisting of university, industry, government and international users (BNL 2015).

This EA analyzes the potential environmental impacts associated with:

- ATF upgrade alternative with other proposed changes to the rest of the AGS Complex
- The ATF upgrade alternative, with no changes to the rest of the AGS Complex
- The No Action Alternative in which no modifications are made to the AGS or ATF

In the No Action Alternative, BNL would continue to operate the AGS Complex (See

Figure 3) in its current configuration and continue all activities within the current configuration for the foreseeable future or until conditions warranted discontinued use.

A summary of the potential environmental impacts of the three alternatives is presented in Table 1. Full analysis of these topics is covered in the Environmental Impacts section of this document.

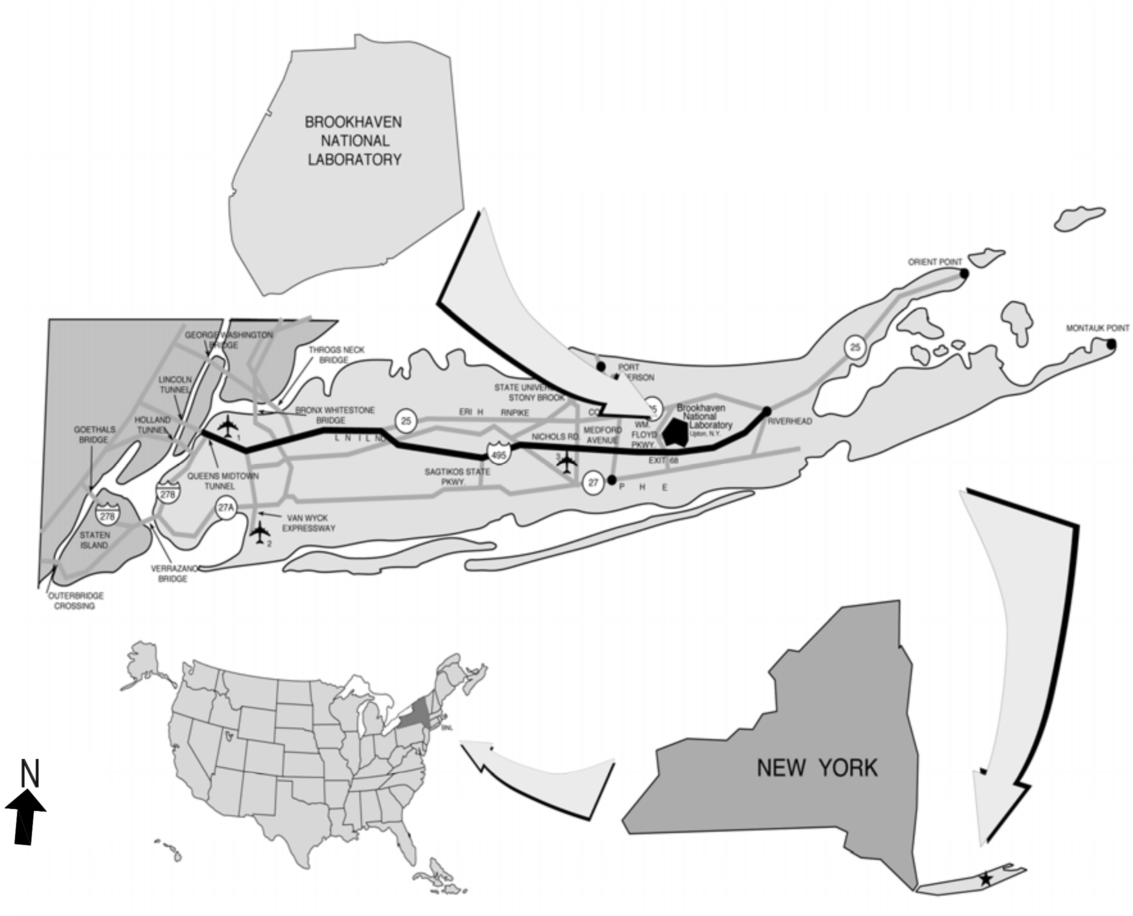


Figure 1. Regional View of Brookhaven National Laboratory Location

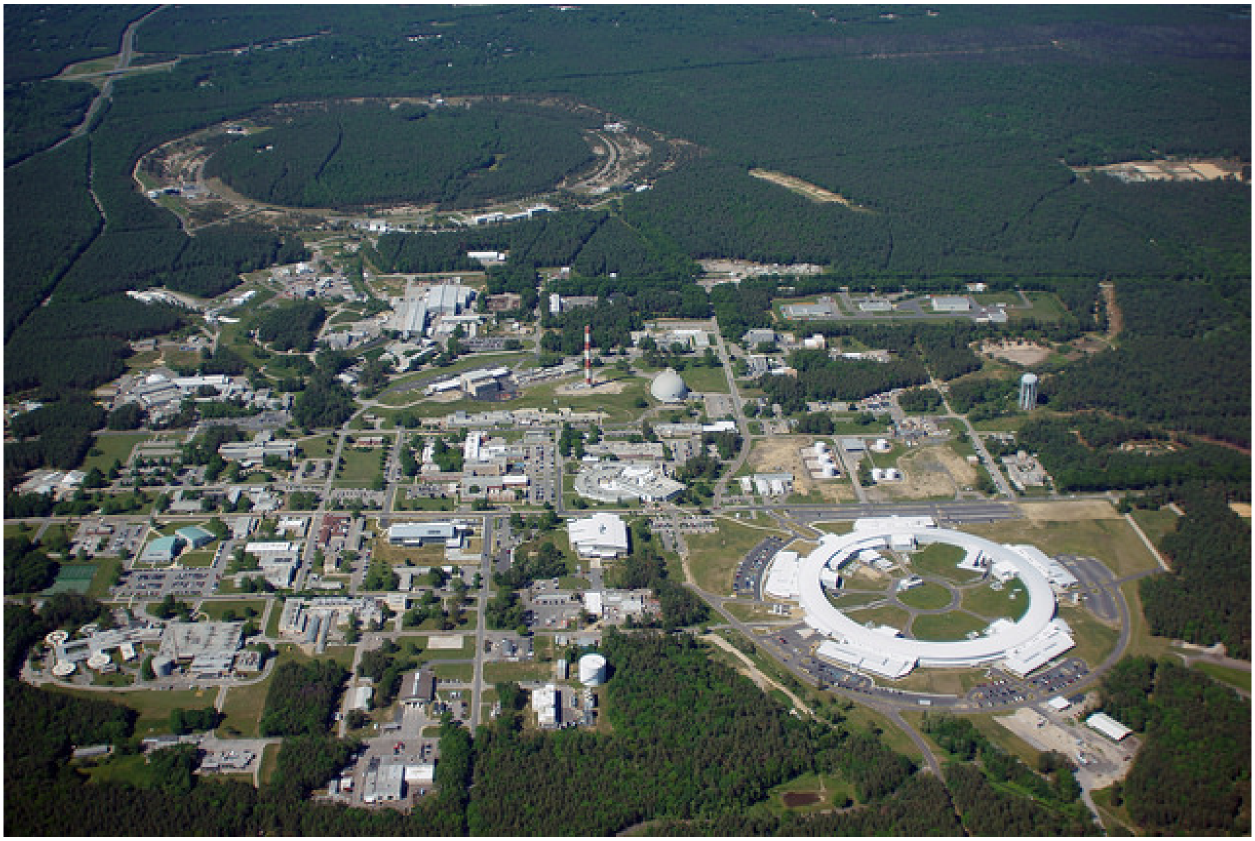


Figure 2. Aerial View of Brookhaven National Laboratory Core Developed Area

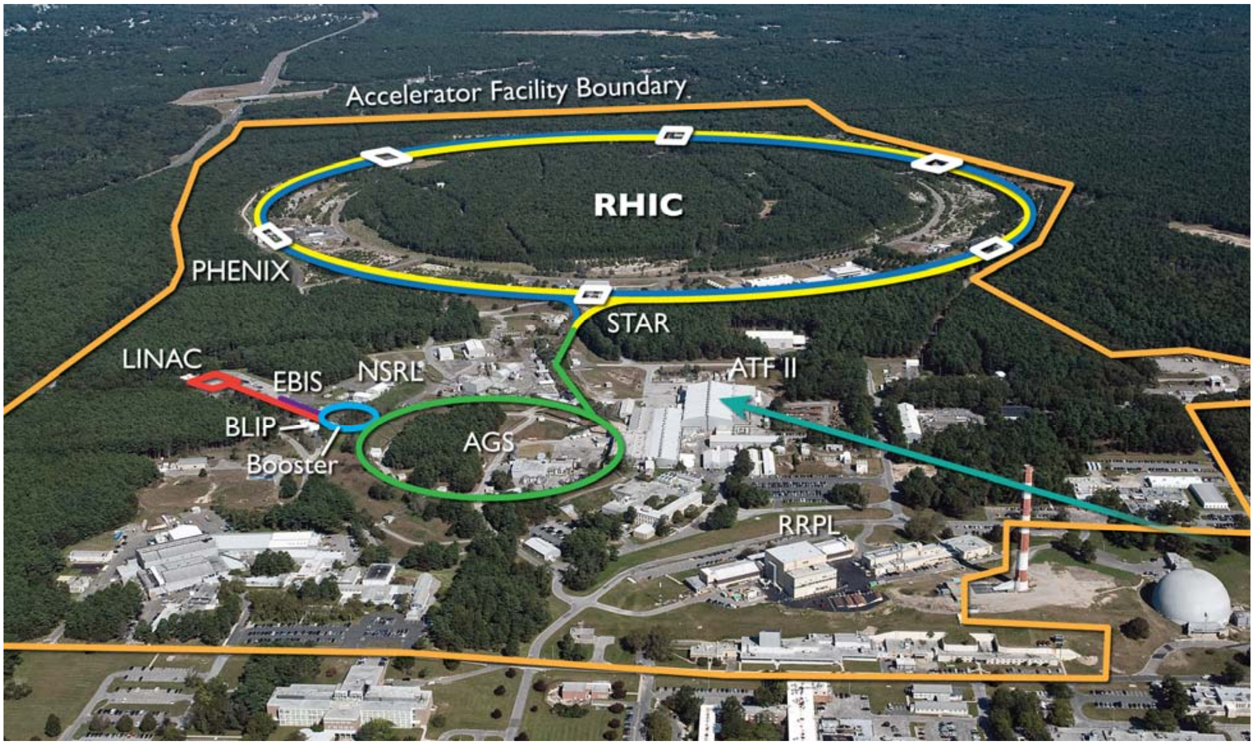


Figure 3. Collider Accelerator Complex Boundaries.

RHIC (Relativistic Heavy Ion Collider including PHENIX and STAR detectors) – complex not included in the scope of this EA; LINAC (linear accelerator); EBIS (Electron Beam Ion Source); BLIP (Brookhaven LINAC Isotope Producer); NSRL (NASA Space Radiation Laboratory); ATF II (Accelerator Test Facility II); and RRPL (Radionuclide Research Processing Laboratory)

Table 1: Summary of Potential Environmental Impacts and Controls for the No Action Alternative, ATF Upgrade Only, and the Preferred Alternative			
Comparison Factors	**The No Action Alternative**	**ATF Upgrade Only**	**Preferred Alternative**
General Information	No change from the existing BNL operations.	No Change	No Change
Ecological Resources	No change from the existing BNL operations.	No Change	No Change
Water Resources	No change from the existing BNL operations.	No Change	No Change
Land Use, Demography, and Environmental Justice	No change from the existing BNL site conditions.	No Change	No Change
Socioeconomic Factors	No change from the existing BNL site conditions and operations.	No Change	No Change
Transportation	No change from the existing BNL site conditions.	No Change	Minor Increase
Cultural Resources	No change from the existing BNL site conditions.	No Change	No Change
Air Quality	No change from the existing BNL site conditions.	No Change	Minor Increase in permitted radiological release
Climate	No change from the existing BNL site conditions.	No Change	No Change
Visual Quality	No change from the existing BNL site conditions.	No Change	No Change

Table 1: Summary of Potential Environmental Impacts and Controls for the No Action Alternative, ATF Upgrade Only, and the Preferred Alternative			
Comparison Factors	**The No Action Alternative**	**ATF Upgrade Only**	**Preferred Alternative**
Noise	No change from the existing BNL site conditions.	No Change	No Change
Industrial Safety and Occupational Health	No change from the existing BNL site conditions.	No Change	No Change
Radiological Characteristics	No change from the existing BNL site conditions.	No Change	Minor increase
Natural Hazards	No change from the existing BNL site conditions.	No Change	No Change
Intentional Destructive Acts	No change from the existing BNL site conditions.	No Change	No Change
Utilities	No change from the existing BNL site conditions.	Minor Increase	Minor Increase
Electric and Magnetic Fields (EMF)	No change from the existing BNL site conditions and operations.	No Change	No Change
Waste Management and Pollution Prevention (P2)	No change from the existing BNL site conditions and operations.	No Change	Minor Increase
Commitment of Resources	No change from the existing BNL site conditions.	No Change	No Change
Decommissioning and Restoration	Building 820, ATF, would be de-activated.	Same as No Action	Same as No Action

3.0 PURPOSE AND NEED

The mission of the Department of Energy's Nuclear Physics (NP) program is to discover, explore, and understand all forms of nuclear matter. NP supports experimental and theoretical research - along with the development and operation of particle accelerators and advanced technologies - to create, detect, and describe the different forms and complexities of nuclear matter that can exist in the universe, including those that are no longer found naturally.

The mission of Brookhaven National Lab's Collider-Accelerator Department is to develop, improve and operate the suite of particle / heavy ion accelerators used to carry out the program of accelerator-based experiments at BNL; to support the experimental program, including design, construction and operation of the beam transports to the experiments plus support of detector and research needs of the experiments; and to design and construct new accelerator facilities in support of the BNL and DOE missions.

The Alternating Gradient Synchrotron Complex (AGS) generates and delivers the beams that collide at the Relativistic Heavy Ion Collider (RHIC), making it the heart of the Collider-Accelerator complex at BNL.

The Brookhaven Linear Accelerator (LINAC) started operation in 1971 as a major upgrade to the AGS complex. Its purpose is to provide accelerated protons to the AGS for use in RHIC and to the Brookhaven LINAC Isotope Producer (BLIP). The basic components of the LINAC include ion sources, a radiofrequency quadrupole, and nine accelerator radiofrequency cavities spanning the length of a 150 meter tunnel.

The BLIP is mainly used to produce radioactive materials for refined radiopharmaceutical ingredients. The refinement processing of these materials occurs in Building 801 in the Radionuclide Research and Processing Laboratory (RRPL).

The LINAC is capable of producing a negatively charged hydrogen beam of up to 200 million electron-volts (MeV) energy and 135 microampere average current. With the replacement and upgrade of some LINAC components, using currently available technology, the average proton current capabilities of the accelerator could be increased to as high as 320 microamperes.

This beam intensity upgrade would increase the production capabilities of the BLIP process, to meet present and future demand for active pharmaceutical ingredients such as Strontium-82 and Actinium-225.

Ac-225 is not currently produced at BLIP. However, research has shown that the BLIP process could efficiently produce this product at the scale to support clinical applications. Processing of Ac-225 at the RRPL would be done in a newly constructed laboratory at Building 801.

The Accelerator Test Facility (ATF) at BNL is a proposal driven, Program Advisory Committee reviewed, facility that provides users with high-brightness electron- and laser-beams. High-brightness, 80 MeV, sub-picosecond, 3 kA electron bunches are being delivered to the experimental hall where user experiments are parked in three beam lines. The experiment beam lines are fully equipped with beam manipulation and diagnostic and special insertion devices to support diverse user requirements. The ATF unique capabilities include the possibility to combine the electron beam with synchronized high-power CO2 laser.

The DOE has identified a national need for an upgraded facility that could perform electron accelerator research, and continue nuclear physics research with heavy ions and polarized protons. In addition to upgrading the intensity of the LINAC, continuing the nuclear physics mission and incorporating the Brookhaven LINAC Isotope Producer (BLIP) facility and Building 801 radiochemistry activities, this environmental assessment describes the alternatives considered and associated environmental impacts with the construction of an upgraded, relocated ATF at BNL.

The 10 GeV ATF Upgrade (or AFT-II) facilities are proposed to be built in Building 912 and will consist of three principal components: 1) electron accelerator; 2) synchronized suite of lasers; and 3) experiment halls and beam lines. The facilities will include:

A synchronized CO2 laser, upgraded from the current 1 terawatt (TW) to 100 TW State-of-the-art photocathode Radio Frequency (RF) gun Experimental halls that allow up to 10 GeV electron beams Electron beam power of up to 500 Watts

4.0 ALTERNATIVES

4.1 Alternative 1 – (Preferred Alternative)

4.1.1 Project Location

Figure 3 depicts the general layout of the Collider-Accelerator Department (C-AD) facilities. The AGS Complex is the heart of the Collider-Accelerator Complex. The following roads and site perimeter identify the Department's boundary that is under the purview of the DOE's Order 420.2C, Safety of Accelerator Facilities or its successor document. This encompasses all the buildings, utilities, surrounding land, air, waterways, and roads within the boundary. C-AD excludes within this defined boundary the former nuclear reactor facilities, as specified in their respective DOE-approved Hazard Assessment Documents, and for equipment from both these facilities stored in, and moved on grounds and roads. As Figure 3 shows, the C-AD accelerator facility boundaries are

- East of Upton Road
- North of Cornell Avenue
- West of Renaissance Road to E. Fifth Avenue plus Building 820 and associated grounds (current ATF area)

- North of E. Fifth Avenue, including the C-AD Shield Block Yard
- The North Boundary of BNL

  The current accelerator facilities within the C-AD complex (Fig. 4) include, but are not limited to
- H^- High-Intensity Source
- Optically Pumped Polarized Proton Source (OPPIS)
- Electron Beam Ion Source (EBIS)
- 200-MeV LINAC
- Tandem Van de Graaffs (TVDG)
- Booster
- Alternating Gradient Synchrotron (AGS)
- U-Line and Retired V-Line
- Energy Recover LINAC (ERL)
- Accelerator R&D Facility in Building 912
- Brookhaven LINAC Isotope Producer (BLIP)
- Radionuclide Research Processing Laboratory (RRPL)
- Accelerator Test Facility (ATF)

Additional AGS Facilities, which are not addressed in this EA include:

- Relativistic Heavy Ion Collider (RHIC)(DOE/EA 0508)
- NASA Space Radiation Laboratory (NSRL) (DOE/EA 1232)

The 200-MeV LINAC's purpose is to provide accelerated protons; its basic components include a high-intensity H^- ion source, the optically pumped polarized proton ion source, and a radiofrequency quadrupole pre-injector that are used to inject the LINAC and nine RF cavities, which span the length of LINAC's 150 m straight tunnel.

The Booster (see Figure 3) is an accelerator which began operations with protons and heavy ions in April 1992. Particles injected into the Booster came originally from either the MP7 of the Tandem Van DeGraff (TVDG) or the 200-MeV LINAC. The TVDG accelerators (MP6 and MP7) have been operational since 1970, and supplied heavy ions to the Booster via transport through the Tandem to Booster (TTB) line that was completed in 1991. The electron beam ion source (EBIS) located at the end of the LINAC building now supplies heavy ions to the Booster at a fixed energy of 2 MeV/u, and it began operation in 2010. EBIS replaced the main role of the TVDG in the RHIC and NSRL programs. The 200-MeV LINAC provides polarized and un-polarized proton pulses to the Booster and to BLIP.

The maximum kinetic energy available to beams from the Booster to AGS or to NSRL is 4.4 GeV for protons and 0.35 GeV/u to 1.5 GeV/u for heavy ions. Lighter heavy-ions of mass close to iron range up to 1.5 GeV/u and the maximum energy of the heaviest ions, gold or uranium ions, is about 0.3 GeV/u. The Booster acts as a pre-accelerator to the

AGS which in turn can accelerate protons to 30 GeV/c (momentum) and 11 GeV/u (kinetic energy per nucleon) for gold ions.

The AGS injects RHIC with heavy ions with mass numbers that can range from 2 to 238. In RHIC, heavy ions reach up to 120 GeV/u prior to collision, and polarized protons reach up to 300 GeV prior to collision.

NSRL (see Figure 3) is an experimental facility designed to take advantage of heavy-ion beams from the Booster accelerator. The NSRL's users conduct radiation biology studies that are of great importance to the future of manned space flight. Radiations encountered in space may cause adverse health effects in humans, especially during prolonged space missions beyond the earth's protective magnetic field. Before such missions can be undertaken, NASA needs a much more detailed understanding of these effects to provide a basis to effectively protect astronauts. The TVDG, EBIS, and Booster accelerators used for these studies match well with the ions and energies encountered in space. Heavy-ions originating in the TVDG or the EBIS travel through to Booster for acceleration to high energies. The Booster extracts energetic heavy-ion beams to the shielded NSRL target room where various specimens are exposed.

Of particular uncertainty are the effects of long-duration radiation from the high-energy heavy-ion components of galactic cosmic rays during space flights. Here, many NSRL studies with cells, tissues, and animals provide estimates of such risks to humans in space.

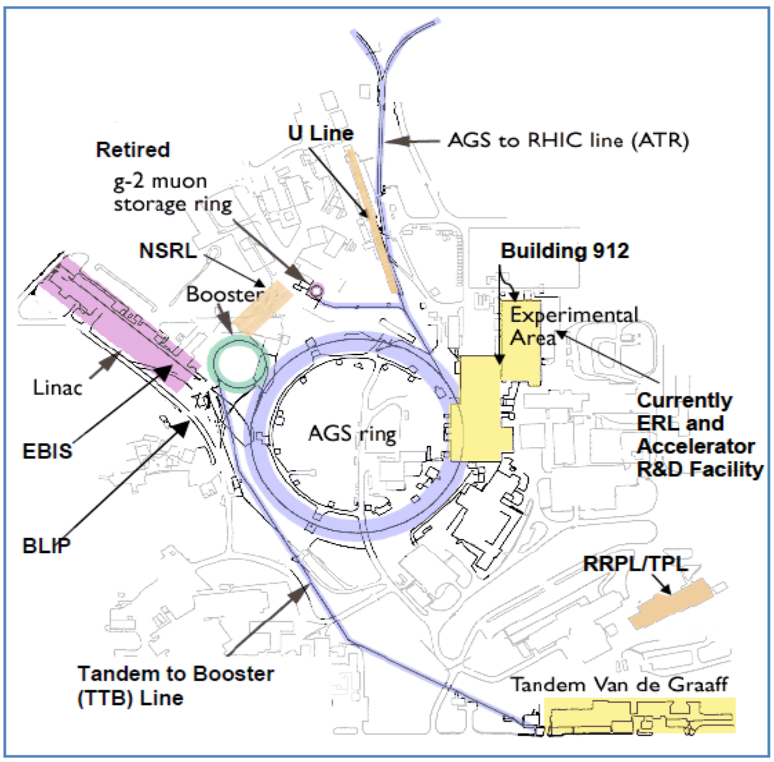


Figure 4 AGS Complex that is Part of the C-AD Accelerator Complex

The BLIP is located past the end of the 200-MeV LINAC (see Figure 4). At the end of the BLIP branch of the LINAC tunnel is a physical boundary between the LINAC and BLIP; that is, a concrete wall separates the LINAC tunnel from the BLIP's secondary containment tank. The targets irradiated at BLIP are placed near the bottom of a stainless-steel shield tank, enclosing several other tubes and shafts. The shield tank is about 2.4 m in diameter and 9.5 m high.

The RRPL in Building 801 (see Figure 4) has various facilities for handling accelerator-produced radioactive products; facilities such as hot cells, hot boxes, analytical chemistry equipment and an accelerator target receiving area. The staff performs most of the radiological work in a few rooms within the RRPL known as the Target Processing Laboratory (TPL). There, the staff chemically process accelerator targets to separate ingredients used in research and in clinical medicine. The RRPL's mission is to receive and work on accelerator targets that were irradiated primarily using a proton beam from C-AD's LINAC. Occasionally, the RRPL handles targets irradiated at the BNL cyclotrons or off-site facilities. The RRPL distributes radiopharmaceutical ingredients for offsite sale, primarily to the nuclear medicine community.

The RRPL personnel also study new accelerator-produced radionuclides for use in design, development, and evaluation of new and more specific radiopharmaceutical ingredients.

Currently BLIP and RRPL produce Strontium-82 (Sr-82) that is used as a medical generator for Rubidium – 82 (Rb-82), (a decay product of Sr-82), that is used for the evaluation of cardiac viability.

BNL has begun planning and development of a process to produce Actinium-225 (Ac-225), using the BLIP/RRPL facilities and processes. This development process starting with clinical trials, currently underway, that include irradiating Thorium foils that are then shipped to Oak Ridge National Laboratory where they are processed to produce Ac-225, for use as a cancer treatment. Advancement and completion of the development work would result in the production of Ac-225 at RRPL.

Targets typically sent to the RRPL from BLIP are subjected to several stages of processing. At the end of the various processes waste components are removed and captured in liquid waste tanks. Desired components go through a series of drying steps to obtain a finished product. Airborne emissions from target processing are captured in acid scrubbers or on particulate HEPA filters.

Building 912, an approximately 5 acre facility, is known as the AGS Experimental Area (see Figure 4). It currently houses smaller R&D facilities such as the Vertical Test Facility, the clean room, the cryomodule assembly area, and a cryogenic helium refrigeration plant. It also houses the Energy Recovery LINAC, which is an R&D accelerator designed to explore electron cooling for current RHIC operations. ERL also serves as an R&D facility to help develop the technology needed for the RHIC Electron

Ion Collider (eRHIC) proposal. The ERL generates and accelerates an intense, 100 mA or greater, electron beam with energy up to about 25 MeV. Energy recovery rests on the fact that an electron-beam-bunch decelerates to a few MeV before being dumped in a block of iron and most of the bunch's kinetic energy is recovered in an RF field that is used to accelerate the next electron-beam-bunch.

The proposed ATF-II, shown as a plan view in Figure 5, will occupy about 2 acres of space that is currently unused in Building 912. The ATF-II site is within the AGS Experimental Area that was used for the former AGS's B and C extraction beam lines and target caves. C-AD would use existing concrete shield blocks to construct enclosures for the accelerator and the two experimental halls. Accelerator components would largely be re-claimed components from ATF, National Synchrotron Light Source (NSLS) and Source Development Lab (SDL), all of which are former accelerators at BNL, and from Bates Accelerator Laboratory, which is a former accelerator in Massachusetts associated with MIT and DOE. In addition to the conventional ATF-II accelerator facilities to reach 300-MeV beam energy using RF radiation, the facility would require installation of laser experimental equipment, and laser radiation would be used to accelerate bunches of electrons to energies up to 10 GeV.

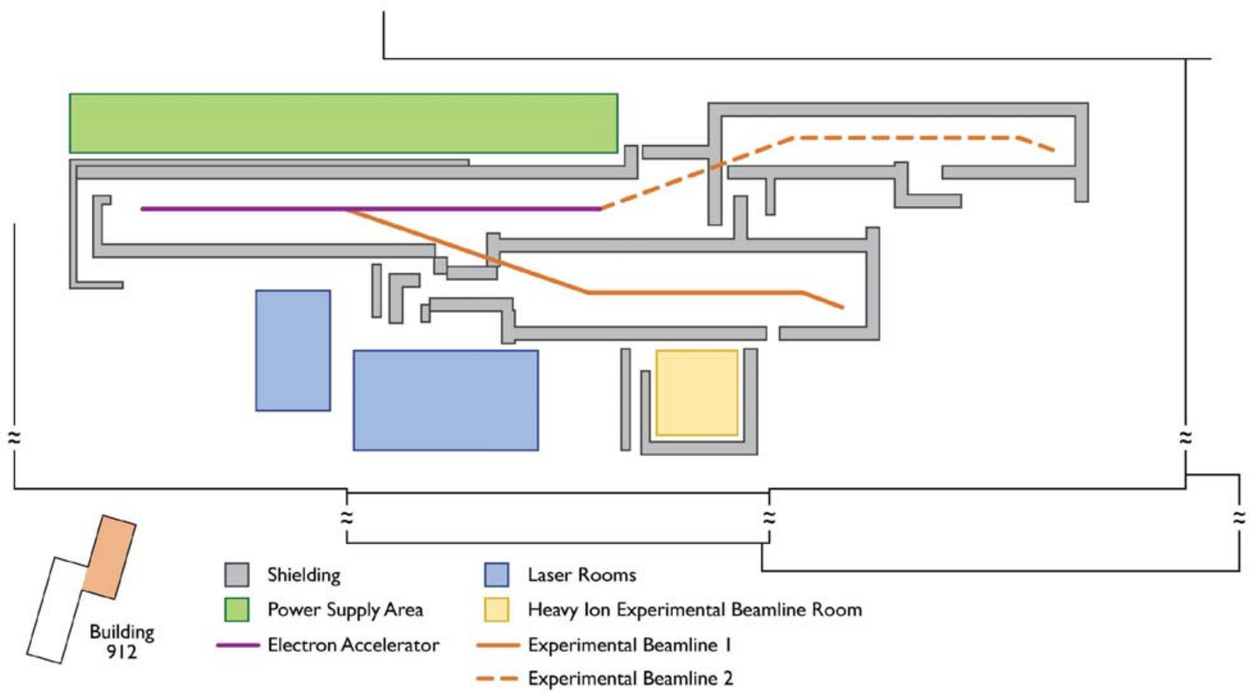


Figure 5 Plan View of ATF Upgrade to 10 GeV in

4.1.2 Scope of Upgrades

The Preferred Alternative would improve accelerator facility efficiency by upgrading existing facilities to meet operational requirements and the requirements for environmental protection, safety and health of workers and the public.

The Preferred Alternative would result in constructing and operating a high-energy electron accelerator in the former AGS Experimental Hall (Building 912); upgrading LINAC components to allow the accelerator to increase its average current to meet future demand for Sr-82 and other radiopharmaceutical ingredients such as Ac-225; upgrading hot laboratories in Building 801 to meet processing requirements for active pharmaceutical ingredients; and installing an electrostatic ring (with no magnetic fields) inside the AGS tunnel to equip the facility for experiments to measure the proton's electric dipole moment. The electrostatic ring would allow the simultaneous circulation of two counter-rotating proton beams.

The electron accelerator facility would be known as the Accelerator Test Facility II (ATF-II). Construction of the ATF-II would require the following:

- Use of approximately half of the 5-acre Building 912 floor space
- Use of existing shield blocks to construct enclosures for the accelerator and two experimental halls
- Installation of accelerator components re-claimed and/or refurbished from ATF, NSLS and SDL at BNL, and Bates Laboratory in Massachusetts
- Installation of experimental equipment associated with beam acceleration research

The intent of the LINAC upgrade is to double the accelerator's average available proton current up to 320 microamperes. This level is possible with existing technologies by increasing the RF pulse length from 450 micro-seconds to 900 micro-seconds. To increase the beam pulse length, an upgrade/replacement of the low-level RF systems, high power RF systems, quadrupole pulsed modulator systems, beam diagnostic, vacuum systems, and fast beam interrupt system will be required. These upgrades/replacements will be compatible with existing equipment in the accelerator complex and hence will not involve new technologies.

As discussed previously, an upgraded LINAC is synergetic with C-AD's intent to produce Actinium-225 at the RRPL. Capabilities to produce this product would further be improved by the installation of new laboratory space in the RRPL. The new space would allow for segregation of the Ac-225 processing from the existing Sr-82 processing labs.

4.1.3 Continued Operation and Maintenance

In addition to the new facilities and experimental work assessed in this EA, the AGS, Booster and LINAC would continue to be used in current programs/experiments, such as:

1) The nuclear physics mission involving particle injection for collision research at RHIC,
2) The nuclear physics mission to produce active radiopharmaceutical ingredients in fixed targets at BLIP with processing in Building 801, and
3) The NASA mission to study radiobiological effects of space radiation.

BNL would continue to improve the efficiency of the entire accelerator complex associated with these missions. Improved efficiency is defined as increasing each accelerator's capabilities to capture and accelerate particles, and to produce and refine radiopharmaceutical ingredients. Improved capture of particles would reduce beam losses which equates to lost scientific opportunity for study and increased potential for radiation doses to workers and the general public. Improved efficiency actions could include refurbishing or replacing magnets, power supplies, cabling, cable tray, beam line components, shielding, beam stops, hot cells, radiochemistry laboratories, beam dumps, target stations, control rooms, machine shops, high bay areas, ventilation systems, and experimental equipment. It would also include re-use of accelerator components from other accelerator facilities, which reduces overall waste within the DOE accelerator community.

4.1.4 Future upgrades

Future upgrades would support operations for up to 20 years. Experimental upgrades to accelerators would involve improvement of beam acceleration systems, beam control systems, beam monitoring systems, and beam extraction capabilities. These actions would also improve experimental facilities used by the experimental community, provide general environment and safety upgrades, and improve overall operations efficiency. The majority of the actions typically would require the installation of new or modified accelerator equipment or systems within the developed portion of the existing accelerator enclosures. These actions typically would result from component failures or new scientific or technical breakthroughs.

In order for science and technology development efforts to continue excellence in safety and environmental protection, there would be continued renovation and modernization of existing shops, offices and mechanical / electrical infrastructure in order to provide safe and efficient support facilities.

C-AD accelerators and accelerator support facilities are housed in more than 100 geographically dispersed buildings. Many of these buildings were constructed during the 1950's and 1960's. Some buildings are in need of renovation and some have reached the end of their service life. The following are planned C-AD infrastructure improvements and operational goals for the future:

- Renovate those older facilities in good condition as needed to meet modern building, electrical, and fire safety codes, and improve their energy efficiency.
- Reduce the facility footprint by consolidating technician work areas and storage

space in or near the two main buildings, 911 and 912, in order to reduce space cost, save energy and improve the sharing of space and equipment among work groups.

- Renovate existing work areas to provide office space and efficient technical work areas with the infrastructure necessary to support upgrade projects such as super conducting RF cavity development, electron cooling, and eRHIC.

Additionally, BNL continues to improve fire protection systems, upgrade old and overloaded electrical distribution services, and replace old and obsolete building equipment (e.g. HVAC, elevators, and roofs) in order to maintain the level of safety and health protection currently required for workers.

4.1.5 Decommissioning and Restoration

The C-AD plans to develop decommissioning plans for each accelerator and accelerator facility near the end of their operating lifetime. This ensures that such plans are in compliance with existing requirements at the time of the decommissioning. Prior to any decommissioning/demolition activities, C-AD will determine the wastes that will be generated. BNL considers the safety of the workers, protecting the public and the environment, and complying with the applicable regulations of the utmost importance. One key to safe decommissioning is managing the wastes from operations, or other hazardous materials that might remain in the facility after shutdown, as well as those wastes generated during decommissioning itself. Therefore, C-AD will use established operating records that identify the types and quantities of these materials. These records currently include spill reports, inventories of all chemicals, records on beam-loss events, hazardous waste records, radioactive waste records, area radiation surveys, work planning documents, and Radiation Work Permit information.

All C-AD accelerator facilities currently have similar waste streams; however, Building 801 has the greatest amount of dispersible radioactivity during the period that production targets are chemically in-process, which amounts to a few weeks per year.

Only the volumes of the waste materials and the percent activation vary between accelerators and accelerator facilities. The differences in activation levels is the result of different beam intensity, targets, beam energy and types of particles accelerated. All accelerator facilities generate recyclable steel, recyclable copper cabling, clean concrete wastes, and miscellaneous clean wastes. Most radioactive atoms that are not associated with targets are trapped in steel such as accelerator magnets, copper windings or cables, concrete shielding, soil shielding, electronic components, and lead shielding. The radioactivity in accelerator components is about the same composition and after 5 or more years of decay, it consists largely of Co-60, which has a 5.27 year half-life. Some facilities have non-radioactive hazardous materials, such as asbestos, beryllium, and lead. In particular, asbestos is present in many of the older buildings at the C-AD, primarily in pipe- and duct-insulation, ceiling tiles, gaskets, thermal insulation, cement boards and pipes, flooring material, and in roofing products. The effectiveness of the decommissioning methods, that is, their ability to keep personnel exposure to hazardous- and radioactive-materials as low as reasonably achievable, and to eliminate or significantly reduce the potential impact on the environment are important criteria that are applied in choosing the optimum method.

The C-AD will characterize the waste streams that it generates during the decommissioning, and will document the results. The C-AD will evaluate the wastes' characteristics and volumes, and evaluate the options for treatment and disposal. There are multiple waste-streams for both non-radioactive waste and radioactive waste. All wastes will be shipped offsite for recycling or disposal. As is the case with the proposed ATF Upgrade, many accelerator components are anticipated to be re-used at other accelerator facilities in the DOE community.

Current practices include closed-loop cooling to prevent releases of activated water to the environment, and operations procedures to limit beam losses to soil shielding, which in turn limits activation of groundwater. These controls have a large impact on the future cost of decommissioning since they help ensure BNL will not have to handle large volumes of soil and water as low-level-radioactive waste.

The C-AD and its predecessor accelerator-organizations have operated safely since 1953. Records since the mid-1980s, which was the onset of significant increases in beam-intensity operations, indicate that C-AD has annually and safely disposed of approximately 100 m^3 of low-level radioactive waste, 1 m^3 of mixed waste, 5 m^3 of activated water, and 500 m^3 of solid hazardous- and industrial-waste. Based on the advice and assistance of experts in BNL's Environment, Safety and Health Directorate, the C-AD has gained a thorough understanding of the treatment requirements of all waste streams, the off-site disposal sites' acceptance criteria, and the shipping- and packaging-criteria. Although the decommissioning operations will involve larger volumes of wastes, perhaps by several orders on magnitude, it will consist of all the same types of wastes that C-AD now routinely handles.

4.2 Alternative 2 – ATF Upgrade Only

This single action would not allow radiopharmaceutical production to meet customer demand nor would it provide for future experimental activities involving AGS Complex accelerators. This alternative would be limited to moving the existing ATF from building 820 to building 912 and upgrading to ATF-II as described in Section 4.1 Preferred Alternative.

4.3 Alternative 3 – No Action

The No Action Alternative would maintain the current conditions and operations of the AGS complex. The No-Action Alternative would provide for no construction of the ATF Upgrade to 10 GeV project, no increase in LINAC current or RRPL facilities for increased radiopharmaceutical-ingredient production, and no proton electric-dipole moment measurement at AGS. The C-AD would shift research activities to existing capabilities. However, continued use of facilities which do not provide the proper energies, particles or beam currents would seriously affect the viability of C-AD research programs and user facilities.

4.4 Alternatives Considered but not Further Evaluated

The following are considered but not evaluated:

- Upgrade Building 820 for ATF II (The space at Building 820 is limited and a building addition would be needed to meet the mission requirements.)
- Move Sr-82 and Ac-225 production to Los Alamos National Laboratory (This would result in only one Sr-82 producer in the US and result in severe Sr-82 shortages during routine maintenance and accelerator shutdown periods, which last about 6 months per year.)

5.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This section describes the general environment in the area for the proposed alternatives along with specific environmental elements that may be affected. The effects of each alternative on these elements are presented within each subsection. All three of the alternatives have similar impacts; therefore the description of effects will be for all alternatives unless there is a variance between alternatives. Variable effects under any specific target will be parsed out and a description of the effects will be detailed. For additional information on BNL, including detailed environmental monitoring results, please refer to BNL's annual Site Environmental Report (BNL 2015).

5.1 Site Description

BNL encompasses a total of 5,265 acres (2,131 hectares) with most principal facilities located near its central developed area, which occupies approximately 1,656 acres (670 hectares). The remaining 3,609 acres (1,460 hectares) of the site are largely wooded and part of the Long Island Central Pine Barrens region. The central portion of BNL is within the compatible growth area as designated by the Central Pine Barrens Joint Planning and Policy Commission (Commission), while the areas outside the central portions of the Laboratory are designated as Core Preservation Area by the Commission. The onsite portions of the Peconic River have been designated as "Scenic" by the NYSDEC under the New York State Wild, Scenic, and Recreational Rivers Act (NYS WSRRA). Under the Act, the NYSDEC has established a 0.5 mile (0.8 km) buffer on either side of the river which limits certain activities and development that are not compatible with the designation. BNL, as a federal enclave, is not bound by NY State Environmental Conservation Law (ECL) Article 57 establishing the Central Pine Barrens or the NYS-WSRRA. However, DOE works within the spirit of these laws whenever possible by conducting review of standards and/or applying for appropriate permits. The entire AGS complex (excluding RHIC) falls within the Compatible Growth Area of the Central Pine Barrens while the northern portions of this complex fall within the 0.5 mile buffer of the Peconic River.

5.2 Ecology

5.2.1 Existing Environment

The Laboratory has a comprehensive understanding of the various ecological resources present on-site through multiple efforts including an extensive biological investigation conducted in the mid-1990s called the Site Wide Biological Inventory (Lawler, et. al, 1995); the establishment of a Wildlife Management Plan in 1999 (BNL 1999); the Natural Resource Management Plan (NRMP) in 2003 and 2011 update (BNL, 2003/2011); the establishment of the Upton Ecological & Research Reserve (Upton Reserve) in 2000; and the subsequent studies conducted under both the Upton Reserve and Natural Resources Program as well as volunteer work conducted by the Foundation for Ecological Research in the Northeast (FERN), a non-profit organization. Additionally, work associated with the Peconic River Clean-up project provided extensive information concerning contaminants in sediments, fish, and vegetation associated with the river both before and after cleanup.

Vegetation

Vegetation at BNL is for the most part typical of the Pine Barrens in which the site is situated. A 2003 aerial photo analysis of vegetation on-site identified 12 vegetation classes. Vegetation ranges from open lawns and early successional vegetation areas associated with the constructed portions of the Laboratory, to mature forests and pine plantations. Historically, much of the forested area of the BNL site has been disturbed by tree cutting for fuel (cord wood industry 1800s) to extensive site-wide clearing of trees for the establishment of Camp Upton during World War I. The forests are in various stages of succession. BNL has identified more than 350 species of plants on the BNL site with thirty-three of these being identified as NY State designated threatened, endangered, rare, or exploitably vulnerable. None of these thirty-three plants are known to exist within the AGS complex.

Peconic River

What is now known as the Peconic River on the BNL site was considered swamp or wetlands prior to World War I. During World War I, the Civilian Conservation Corps (CCC) era, and World War II, the Department of War trenched or ditched the wetlands to facilitate drainage and water flow to relieve military personnel from the onslaught of mosquitoes and related mosquito borne diseases. The on-site sections of the Peconic River and its tributaries show evidence of these trenching activities with ditches ranging from 6 to 12 feet (1.8- 3.6 meters) wide and up to 4 feet (1.2 meters) deep along with side cast sediment. This ditching extends from an area west of the William Floyd Parkway, through the BNL site, and past the BNL eastern boundary.

Invasive Species

The area of the proposed project contains several invasive species including Japanese Barberry (*Berberis thunbergii*), black locust (*Robinia pseudoacacia*), Asiatic bittersweet (*Celastrus orbiculatus*) and phragmites (*Phragmites australis*). These species were intentionally introduced to the area as ornamentals (i.e. Japanese Barberry), inadvertently transported to Long Island and BNL by visitors, or transferred through movement by animals. The area within the AGS complex has invasive species isolated to berms of the AGS, BLIP, and tunnel areas (black locust); and areas in and near recharge basins (barberry, bittersweet, and Phragmites).

Threatened, Endangered, or Species of Concern

The Northern long-eared bat (*Myotis septentrionalis*) was determined to be threatened under the federal Endangered Species Act in May, 2015. This is the only federally threatened or endangered species known on the BNL property. The NY State designated endangered eastern tiger salamander (*Ambystoma t. tigrinum*) inhabits multiple wetlands on BNL but no confirmed habitats for this species are within the area of the AGS complex. Much of the AGS complex drainage is diverted to recharge basins within the Relativistic Heavy Ion Collider (RHIC) ring and once through cooling water discharge is released to the HO Basin east of the AGS complex. The RHIC Ring recharge basins have historically been documented to support tiger salamanders as is an ancillary basin next to the HO recharge basin. Species listed by NY State as species of special concern that are present in the area of the AGS complex include the eastern hognosed snake (*Heterodon platyrhinos*), and the eastern box turtle (*Terrapene carolina*). Other species of special concern in the proposed project are the Cooper's hawk (*Accipiter cooperi*) and the sharp-shinned hawk (*Accipiter striatus*). A full listing of threatened, endangered, or special concern species may be found in the annual Site Environmental Report (BNL 2015).

Migratory Birds

Under the Laboratory's Natural Resource Management Plan, bird surveys have been conducted through all of the major habitat types on site. Surveys have been conducted April through September annually since 2000, and a total of 132 species of birds have been documented. Additionally, birding has been an avid pastime for many BNL employees. Between 1948 and the present, more than 185 bird species have been documented on-site and approximately 85 species routinely utilize BNL for nesting.

Mammals

A number of mammals utilize the various habitats at BNL, including the AGS complex. The largest mammal found at BNL is the white-tailed deer (*Odocoileus virginianus*), which is present in numbers exceeding 50 per square mile (19.31 per sq. kilometer). Recent implementation of deer management has significantly lowered the number of deer within the constructed portion of the BNL campus. The BNL property also provides habitats for small mammals such as bats, mice, squirrels, rabbits and medium-sized mammals such as raccoons (*Procyon lotor*), red fox (*Vulpes velox*), and grey fox (*Urocyon cinereoargenteus*).

Since 2011 BNL has been documenting presence of bats on the BNL site. Bat species identified include the federally threatened northern long-eared bat (*Myotis septentrionalis*), little brown bat (*M. lucifugus*), eastern small-footed bat (*M. leibii*), big brown bat (*Eptisicus fuscus*), red bat (*Lasiurus borealis*), and hoary bat (*L.cinereus*). All but the small-footed bat have been confirmed through capture or sight. The small-footed bat has been documented using acoustic surveys. All of these species may utilize trees during summer and the myotids may utilize buildings during other seasons.

Reptiles and Amphibians

BNL is home to 28 species of reptiles and amphibians. The various species are distributed throughout BNL, but may be localized depending on their habitat requirements. Reptiles like the eastern box turtle (*Terrapene carolinensis*) may be found in virtually all habitats on-site, whereas many species of snakes and other turtles are localized near wetland resources. Frogs and toads are isolated around wetlands during breeding periods but may be found moving away from wetlands to forage for food during the late spring through summer months. Several salamander species can be found in and adjacent to wetland areas on-site. These salamanders include the NY State designated endangered eastern tiger salamander (*Ambystoma t. tigrinum*), marbled salamander (*A. opacum*), red-spotted newt (*Notophthalmus viridescens*), and red-backed salamander (*Plethodon cinereus*). Additionally, four-toed salamanders (*Hemidactylium* scutatum) are known to inhabit specific habitats along the Peconic River containing tussock sedge (*Carex stricta*) and/or sphagnum mosses (*Sphagnum sp*.).

Fish

There are seven species of fish known from the Peconic River on BNL including the NY State designated threatened banded sunfish (*Enneacanthus obesus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), chain pickerel (*Esox niger*), largemouth bass (*Micropterus salmoides*), creek chubsucker (*Erimyzon oblongus*), and brown bullhead catfish (*Ameiurus nebulosus*). The swamp darter (*Etheostoma fusiforme*), a NY State designated threatened species is also known to use the Peconic River, but has not been confirmed within the onsite stretch of the river. These species of fish utilize a variety of habitats within the river from slow moving backwater areas to deep open water pools. During very rare high flow period's fish have been documented as far upstream as the ponds within the Relativistic Heavy Ion Collider (RHIC). In these instances fish had to overcome multiple barriers to fish passage. In general fish can only move up and downstream during high water periods, which usually exist in the spring.

Pine Barrens

BNL is within the Central Pine Barrens of Long Island. This area has been designated a protected area under NY State ECL Article 57. Although BNL, as a federal enclave, is not bound by this law, DOE works within the spirit of the law whenever possible by conducting review of standards and/or applying for appropriate permits when planning and implementing projects. The Central Pine Barrens is an area of approximately 105,000 acres (42,492 hectares) and is divided into a Core Preservation Area (CPA) of approximately 55,000 acres (22,258 hectares) where development is proscribed and limited, and the Compatible Growth Area (CGA) of approximately 50,000 acres (20,234 hectares), where development is allowed but must meet a series of standards and guidelines established in the Land Use Plan for the Central Pine Barrens. The STP is within the CPA.

5.2.2 Effects of Alternatives on Ecological Resources

Existing power and water utilities at C-AD will be used for all alternatives as increases/decreases are similar for all alternatives. Increases/decreases in radiological emissions and waste generation will be identified as specifically as possible.

Effects on Threatened, Endangered, or Species of Concern

None of the alternatives would threaten endangered species or their habitat. The recharge basins that serve C-AD are potential tiger salamander habitat. However, BNL has not documented tiger salamander use of basins HT-w and HT-e. The Building 912 basin and other recharge swales do not hold water for sufficient lengths of time to support amphibians. Discharge from the AGS complex to Basin HO does not support the tiger salamanders as the water moves too swiftly and recharges too rapidly for suitable habitat to develop. Discharges of storm water from the AGS complex are routed to recharge basins in the RHIC Ring where the northern most basin provides marginal habitat for tiger salamanders. These storm water discharges are monitored for pH, oil and grease, and other parameters. The storm water discharges result in suitable habitat only in the wettest years.

The northern long-eared bat (federally threatened) primarily utilizes trees for roosting during summer months. Winter hibernacula are suspected to occur somewhere on Long Island but none have been documented. This bat has been documented on the BNL site as early as March suggesting that there may be a small population of this bat overwintering either on or in the vicinity of BNL. Bats in the genus Myotis are known to enter and utilize buildings for roosts and on rare occasions bats have been seen or captured in buildings of the AGS complex. For buildings that may undergo demolition, BNL conducts multiple surveys using both acoustic monitoring and visual searches to ensure that no bats are impacted. In existing buildings, when bats are found or reported as nuisance animals, they are captured when possible, and released without harm.

Effects on Migratory Birds

None of the alternatives would have an effect on migratory birds or their habitat. The buildings where all actions will occur presently exist and construction of new buildings is not expected. Radiation exposures from operations will be as low as reasonable achievable (ALARA) to all life and much less than DOE, EPA or other limits. There will be no changes to liquid effluents with regard to all of the alternatives. C-AD will only return secondary non-activated process cooling-water to the local groundwater through discharges to recharge basins. The limited ponding of this water provides a source of water for both migratory and resident birds. Cooling tower blow-down will be sent to the same outfalls currently used by C-AD. The current water treatment chemical program for C-AD cooling towers does not change as a result of any of the alternatives; that is, there are no new chemicals or increased dosages. Discharge of cooling tower blow-down has not had any detrimental impact on migratory birds.

Effects on Mammals

None of the alternatives would have an effect on mammals or their habitat. The buildings where all actions will occur presently exist. No new construction is expected and therefore no clearing of habitat suitable to most mammals is expected. Radiation exposures will be as low as reasonable achievable (ALARA) to all life and much less than DOE, EPA or other limits. Larger animals, like deer, may enter bermed areas covering accelerator facilities, but do not receive significant radiological dose due to ALARA practices. BNL manages nuisance animals through the Natural Resource Management Plan in cooperation with the Site Resources Division. Nuisance animals such as rodents, raccoons, skunks, and opossums are occasionally reported as getting into buildings. When this happens larger animals are trapped using live traps and appropriately released. Extensive efforts are made to identify where animals are getting into buildings and the openings sealed to prevent entry by other animals in the future.

Effects on Reptiles and Amphibians

None of the alternatives would have an effect on reptiles and amphibians or their habitat. The buildings where all actions will occur presently exist. Radiation exposures will be as low as reasonable achievable (ALARA) to all life and much less than DOE, EPA or other limits. There will be no significant changes to liquid effluents with any of the alternatives. C-AD will only return secondary non-activated process cooling-water to the local groundwater. Cooling tower blow-down will be to the same outfalls currently used by C-AD. The current water treatment chemical program for C-AD cooling towers does not change as a result of any of the alternatives therefore no changes to the existing environment are expected. Recharge basins receiving discharges, either storm water or cooling water, will continue to provide limited habitat for both reptiles and amphibians as is currently occurring.

Effects on the Pine Barrens

None of the alternatives would have an effect on the Pine Barrens or its habitat. The AGS Complex is wholly within the compatible growth area of the Central Pine Barrens. The buildings where all actions will occur presently exist, and no new construction requiring removal of habitat is expected. Radiation exposures will be as low as reasonable achievable (ALARA) to all life and much less than DOE, EPA or other limits. There will be no changes to liquid effluents with any of the alternatives.

5.3 Water

5.3.1 Existing Environment

Water resources associated with BNL include both surface waters and groundwater.

Surface Water

BNL lies within the headwaters region of the Peconic River watershed. The Peconic River is a groundwater fed stream. During periods of high precipitation and high groundwater the river is a discharging stream from groundwater sources resulting in offsite flow. During periods of low precipitation and low groundwater, the river is a recharging river with virtually all water entering the river from precipitation or discharges moves into groundwater limiting flows off the BNL site. In 2014 all discharges to the Peconic River from the sewage treatment plant were permanently diverted to groundwater recharge basins. Since the discontinuance of discharges, the Peconic River has reverted to functioning based solely on groundwater levels and precipitation.

Pocket seasonal wetlands are also found throughout the site and provide habitat for a number of wildlife species including tiger salamanders. The Peconic River and its associated wetlands are the key wetland features on BNL. Several recharge basins are also found within the developed portion of the BNL site with some providing habitat to various wetland dependent species as discussed under impact to ecological resources in Section 5.2.2 above.

Scenic River Corridor

The onsite portions of the Peconic River have been designated as “Scenic” by the NYSDEC under the New York State Wild, Scenic, and Recreational Rivers Act. Under the act, the NYSDEC has established a 0.5 mile (0.8 km) buffer on either side of the river which limits certain activities and development that are not compatible with the designation. The northern portions of the AGS Complex are within the boundaries of the Scenic River Corridor. Any actions causing disturbance within the river channel or within 100 ft. (30 m) of a designated wetland would require a wetlands permit and/or a Wild, Scenic, and Recreational Rivers Act permit from the NYSDEC.

Groundwater

BNL is situated over a U.S. Environmental Protection Agency (EPA)-designated sole-source aquifer that is the primary source of drinking water for both on- and off-site private and public supply wells, and water used for industrial purposes such as cooling and steam generation. The underlying groundwater is further classified by New York State as Class GA groundwater, which is defined as a source of potable water. Federal drinking water standards, NYS drinking water standards as well as NYS ambient water quality standards (AWQS) for class GA groundwater are used as goals for groundwater protection and remediation.

Groundwater flow directions across the BNL site are influenced by natural drainage systems: eastward along the Peconic River, southeast toward the Forge River, and south toward the Carmans River. Pumping from on-site supply wells affects the direction and speed of groundwater flow, especially in the central, developed areas of the site. The main groundwater divide on Long Island is aligned generally east– west and lies approximately one-half mile north of the Laboratory. Groundwater north of the divide flows northward and ultimately discharges to the Long Island Sound. Groundwater south of the divide flows east and south, discharging to the Peconic River, Peconic Bay, south shore streams, Great South Bay, and Atlantic Ocean.

BNL has an extensive groundwater monitoring and protection program with more than 750 permanent monitoring wells. All major facilities with potential for impacts to groundwater have monitoring wells throughout the facility, which includes an extensive monitoring well system for the C-AD complex. The AGS complex contains monitoring systems for BLIP, Building 912, Booster Beam Stop, NSRL, AGS E-20 Catcher, Building 914, Former G-2 beam stop, AGS J-10 beam stop, and the former AGS U-Line Target and Stop Area.

The AGS complex has several locations where impervious caps have been installed over areas where soil activation may occur from beam loss, experimental processes, or beam stops. These caps serve to prevent infiltration of precipitation that could transport soil activation products such as Sodium-22 or tritium into groundwater. Permanent caps are located over the former G-2 beam stop, BLIP, former U-Line beam stop, former AGS E-20 Catcher, former and current AGS Booster beam stops, and NSRL beamline and beam stop. The concrete floor and outer paved areas serve as a cap for Bldg. 912 and the building and floor serve as a cap for Bldg. 914. The caps are monitored and maintained in accordance with the BNL Accelerator Safety Subject Area.

5.3.2 Effects of Alternatives on Water Resources

Effects on Surface Waters

None of the alternatives would have an effect on surface waters. All actions assessed will occur in existing buildings, most likely using existing water discharge points. Radiation exposures will be as low as reasonable achievable (ALARA) to all life and much less than DOE, EPA or other limits. There will be no changes to liquid effluents with the all of the alternatives. C-AD will continue to return secondary non-activated process cooling-water to the local groundwater through the current recharge basins. Cooling tower blow-down will be to the same outfalls currently used by C-AD. The current water treatment chemical program for C-AD cooling towers will not change with any of the alternatives.

Effects on Peconic River Scenic Corridor

None of the alternatives will have an impact on the Peconic River Scenic Corridor. Only the northern most area of the AGS complex falls within the Scenic Corridor. Since none of the alternatives contain construction of new facilities, permits under the New York Wild, Scenic, and Recreational Rivers Act will not be necessary.

Effects on Groundwater

None of the alternatives would have an effect on the groundwater. All actions assessed will occur in existing buildings. Impermeable caps have been placed over soil activation areas to prevent infiltration by precipitation. Any new or modified accelerator installations are reviewed for potential soil activation, and new caps would be installed where modeling indicates it is necessary. Although BNL is situated above a Sole Source Aquifer, operation of this accelerator facility should not affect groundwater quality. The BNL Standards Based Management System Subject Areas "Liquid Effluents" and "Accelerator Safety" provide rules related to discharges and protection of groundwater. C-AD follows these rules to ensure effluents do not make their way into the groundwater. Activated soil shielding under the existing C-AD buildings or caps are maintained and will be managed through any future decommissioning (i.e., allowed to decay in place or physically removed for disposal). The extensive groundwater monitoring well network and program provide significant data to track potential contamination. If groundwater contamination is detected, immediate actions occur to prevent degradation of groundwater resources. Results of groundwater monitoring are reported annually in the Site Environmental Report (BNL 2015).

All fresh water available to BNL and surrounding communities comes from an EPA designated sole source aquifer system. Protection of the aquifer requires scrutiny of all operational programs on water consumption and potential contamination. For the Preferred and ATF II only alternatives, water consumption would be minimized through the use of a closed-cycle cooling system. Water for domestic usage would remain the same for Building 912 where ATF II would be located. Of the water withdrawn, virtually all of it would be returned via STP effluents or direct released to groundwater recharge basins. This water would be drawn from up to 5 supply wells at BNL, depending on operational constraints. The wells can supply water at a rate of 3,785 liters per minute (1,000 gallons per minute) for use as drinking water, process cooling water, or fire protection. In 2014 approximately 1,590 million liters (420 million gallons) of water were pumped for onsite use. As mentioned above, the majority of the water is returned to the aquifer by way of recharge basins.

Water pumpage from the aquifer for the operation of ATF II would represent a total increase in BNL pumpage of 1% and an actual increase in annual water usage of <1% and is well within permitted pumpage volumes for BNL supply wells.

5.4 Land Use, Demography, and Environmental Justice

5.4.1 Existing Environment

Land Use

The current BNL site was established in 1947 specifically to develop and construct large-scale scientific facilities. Figure 6 "Land Use Within 1-mile of BNL Border" presents a 2013 aerial photograph of the Laboratory site and surrounding areas. Land use to the east, within one mile (1.6 kilometers) of the Laboratory, consists of preserved open space, public and private land dedicated to public recreation, and low-density residential areas of one dwelling or less per acre. To the north is a mixture of residential properties, commercial retail and service properties, and public utility services. Schools and churches, open space, and low-to-medium density residential areas are found to the west. To the south are commercial and industrial properties, vacant land, and medium-to-high density residential areas of two or more dwellings per acre. On-site land use consists of open space, scientific, industrial and commercial, and residential areas. The onsite brownfield areas are designated for industrial use within established controls.

Demography

Based on the 2010 U.S. Census and subsequent population estimates for 2014, approximately 6,799 persons live within 1.0 mile (1.6 kilometers) of the Laboratory's boundary. Figure 7 shows BNL boundary and 1-mile extent superimposed over a map of the U.S. Census blocks, along with the 2010 population estimate within the 1.0 mile boundary.

The Laboratory's on-site population includes approximately 2,800 employees and more than 2,400 guest researchers who visit each year[1]. On a daily basis an average of 184 people live in temporary on-site housing and during the summer months an average of 120 additional guest scientists and students who visit the Laboratory stay in the dormitories.

Environmental Justice

[1] NOTE: The Laboratory's on-site population is not shown on Figure 7.

Environmental Justice is 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 a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the adverse environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local and tribal programs and policies. Federal agencies must identify and address disproportionately high and adverse effects of federal projects on the health or environment on minority and low-income populations (Executive Order 12898). An environmental justice population is defined as a population being at least half minority status or at least half low-income status, or this status is meaningfully greater than the general population. A minority is defined as Black or African-American, Hispanic or Latino, Asian, American Indian and Alaskan Native, Native Hawaiian and other Pacific Islander.

BNL is situated within the Town of Brookhaven which has a population of 486,040 persons, based on the 2014 adjusted U.S. Census data. According to the 2014, 14 percent of Brookhaven Town's population consisted of minorities. Using the same 2010 U.S. Census data within one mile of the Laboratory's boundary the percentage of minority population is estimated to be approximately 15.9 percent or roughly 1,081 individuals. While the percentage of minorities is slightly higher than that of the Brookhaven Town, the 1.9 percent difference would not constitute a percentage that is meaningfully greater than the general population. Therefore, the population living within one mile of the Laboratory border would not be defined as an environmental justice population based on minority status.

In regard to low-income status, no data was available to evaluate the income level of the discrete population living within one mile of the Laboratory's boundary, or corresponding to the same geographic blocks used for the population data. Income data for the year 2014 was available for the Town of Brookhaven from the U.S. Census Bureau. It must be noted that the Town of Brookhaven is the largest of the 10 towns in Suffolk County, NY, and is composed of many communities with variable average incomes. The median income for households in Brookhaven was $86,828. Approximately 7.6% of individuals in the Town of Brookhaven are below the poverty level. In the four communities bordering the BNL site 3.9% of individuals in Manorville, 7.1% of individuals in Ridge, 9.8% of individuals in Yaphank, and 8.3% of individuals in Shirley are below the poverty level.

The percentage of low-income families is slightly lower for the combined populations of the four communities bordering BNL than that of Brookhaven Town; the 0.3 percent difference may not constitute a percentage that is meaningfully different than the general population. Therefore, the population living within one mile of the Laboratory border would not be defined as an environmental justice population based on low-income status.

5.4.2 Effects of All Alternatives on Land Use and Demography

Under all of the alternatives there would be no change from the existing conditions related to land use, demographics, or environmental justice.

Figure 6: Land Use within 1 mile of the BNL border.

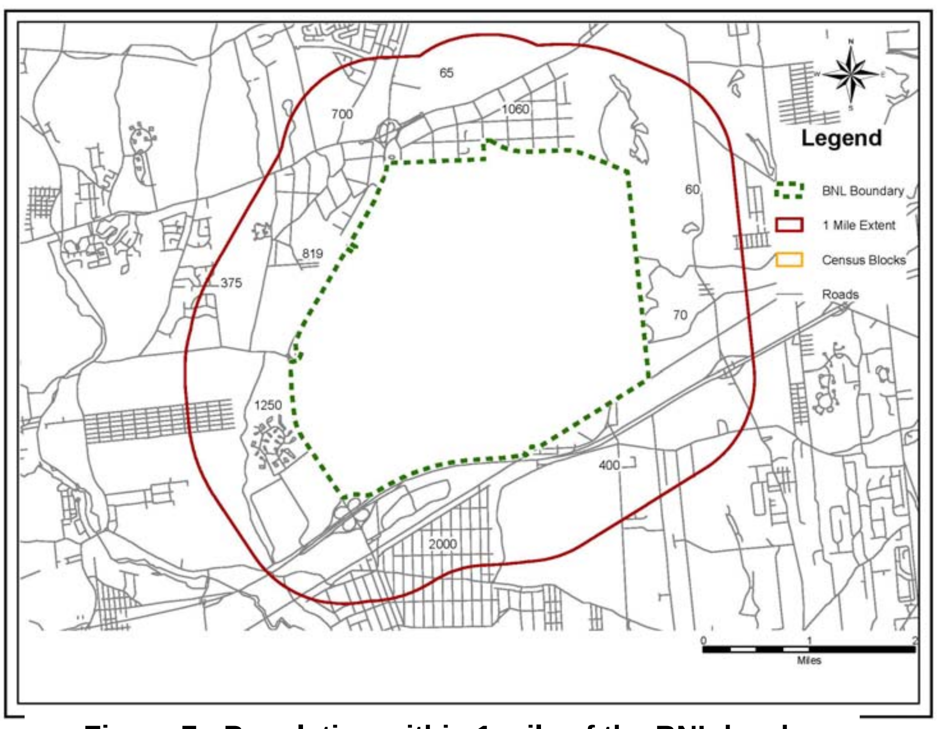


Figure 7: Population within 1 mile of the BNL border.

Table 2: Low Income Status in Communities Adjacent to BNL Site

Town or Community	Population (2014)	Poverty Status in 2014 – Individuals*	Population in Poverty Status
Brookhaven Town	486,040	7.6 %	35,891
Ridge	12,916	7.1 %	919
Shirley	25,477	8.3%	2,124
Manorville	14,164	3.9 %	559
Yaphank	5,051	9.8 %	495
Combined total (Communities Only)	57,608	7.3 %	4,097

*The U.S. Census Bureau defined the average poverty threshold as a maximum annual income of $23,850 or less for a family of four for the year 2014 (U.S. Census, 2014).

5.5 Socioeconomic Factors

Socioeconomic factors describe the local economy and employment that may be influenced by the Proposed Action.

5.5.1 Existing Environment

The Laboratory employs approximately 2,800 full and part-time personnel and has over 4,300 visiting scientific researchers annually. An additional 40,000 members of the public visit the Laboratory site each year as part of educational and group tours, conferences and events. Salaries, wages, and fringe benefits accounted for $404 million, or 62 percent of the total Fiscal Year 2014 budget of $650 million. BNL spent more than $60 million in 2014 on goods and services with approximately $30 million of that with Long Island companies. (BNL, 2015).

5.5.2 Effects of All Alternatives on Socioeconomic Factors

Under all alternatives the Laboratory will continue to employ approximately 2,800 full and part-time personnel and visiting scientific researchers annually will increase due to user facilities like NSLS-II and ATF II, increased radiopharmaceutical ingredient production, and increased use of the AGS complex. Public visits to the Laboratory site each year will continue as part of educational and group tours, conferences and events. Direct spending by BNL varies depending on each annual budget as will total output of goods and services to the region during periods when facilities are upgraded. A few more secondary jobs may be created throughout the economy.

5.6 Transportation Conditions

5.6.1 Existing Environment

On average 2,237 employees pass through the Laboratory entrance gates during the morning commute period from 7 – 9 am. Of this total, 1,496 (66.9 %) drive alone in passenger cars, 483 (21.6 %) drive alone in light duty trucks (i.e. vans, pickups & sport utility vehicles), 204 (9.1 %) rideshare in their morning commute. In addition, 5 employees on average bike to work while 6 employees on average use BNL's shuttle bus service on the second part of their commute from the Long Island railroad station in Ronkonkoma.

The Laboratory's vehicle fleet as of December 2015 contained 255 vehicles, 241 of which are leased. Five of the fleet vehicles are classified as passenger cars while the balance is light duty trucks. On average, Laboratory vehicles travel 2,800 miles per year per vehicle. Currently, 73 % of fleet vehicles use alternative fuels (i.e. compressed natural gas or E-85). In addition the Laboratory currently operates 25 on-road medium duty vehicles, 25 heavy duty vehicles, and 62 utility Kubota vehicles.

5.6.2 Effects of All Alternatives on Transportation Conditions

Under the preferred alternative, transportation conditions would result in periodic increases in the number of shipments received and number of contractor vehicle trips taking place from the existing conditions. These increases would occur during periods of new construction. The number of on-site road transfers of radioactive materials between the BLIP Building, Building 801 and Radioactive Waste Management may double temporarily; however, as one radiopharmaceutical ingredient program declines, due to its transition to a commercial maker, another program tends to develop. That is, Sr-82 is expected to be available from commercial suppliers by the time the Ac-225 program goes into production at BNL. It is unlikely the Ac-225 program will be commercialized for some time since a high-energy proton accelerator (200 MeV) is required to make it efficiently.

Under the No Action and ATF II Alternatives, transportation conditions would not be altered from the existing conditions

5.7 Cultural Resources

5.7.1 Existing Environment

The *Cultural Resource Management Plan for BNL* (CRMP) (BNL 2013) identifies the Laboratory's historic and cultural resources, and describes the strategies developed to manage them in accordance with applicable laws and regulations.

5.7.2 Effects of Alternatives on Cultural Resources

BNL performs cultural resources analyses pursuant to Section 106 of the National Historic Preservation Act. Integrated into the BNL CRMP are recommendations by the Institute for Long Island Archaeology (ILIA) that address the potential for land disturbance/development within the footprint of the former World War I-era Camp Upton (Bernstein, et. al 2001). Since there are no planned ground disturbance activities within the AGS complex, there would be no impact on archaeological resources.

Under the CRMP the Lab has established a Cultural Resource tagging program. As items are identified as being of cultural and/or historic significance, a tag is placed on the item creating a method to track and record its importance and lessen the potential for the item to be disposed of.

All BNL buildings have been assessed for their architectural and historic importance. Before significant changes to buildings are made, a review of the building is made and a Section 106 process under the National Historic Preservation Act to determine if negative impacts may occur. Negative impacts would be addressed under agreements with the NY State Historic Preservation Office. All alternatives are not expected to have impacts on existing facilities.

5.8 Air Quality

5.8.1 Existing Environment

The overall regional air quality is affected by a mix of maritime and continental influences. This results in the region, and BNL, being very well ventilated by winds from all directions.

The local air quality management in the New Jersey-NY-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, and particulate matter less than 10 microns in diameter (PM_{10}), lead, and carbon monoxide (CO). The region is considered a non-attainment area for ozone. While ozone is a regulated pollutant, it is not emitted directly from sources but is formed by a combination of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) reacting with sunlight in the atmosphere. A New York subset of the region, which includes Bronx, Kings, Queens, New York, Orange, Richmond, Rockland Westchester, Nassau, and Suffolk counties, is considered a nonattainment area for the 24-hour PM-2.5 (particulate matter less than 2.5 microns in diameter) standard.

5.8.2 Effects of Alternatives on Air Quality

Under the Preferred Alternative, air quality conditions would not be altered significantly from the existing conditions. Operation of ATF II will not produce measurable air emissions. Air emissions from cooling the fully enclosed targets used for radiopharmaceutical ingredients during irradiation by LINAC beam will remain the same in terms of type (2 minute half-life O-15 and 20 minute half-life C-11). However, there will be an increase in the total amount of these short-lived gases due to increased LINAC beam intensity in the cooling water that travels between targets. The total air emissions would result in exposures that will remain well below the EPA limit of 10 mrem in one year. If needed, BNL will apply for necessary permits or approvals as required by the EPA.

Under the other two alternatives air quality will not be altered from current air quality conditions.

5.9 Climate

5.9.1 Existing Environment

Climate can influence several environmental parameters including regional and local air quality, storm water drainage, surface waters, and natural hazards.

The climate at the Laboratory can be characterized as breezy and well-ventilated, like most of the eastern seaboard. The Long Island Sound, the Atlantic Ocean, and associated bays influence wind directions and humidity and provide a moderating influence on extreme summer and winter temperatures. 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).

BNL has been recording local weather data since August 1948. The average yearly precipitation is 48.84 inches (124 centimeters) and the average yearly snowfall is 32.3 inches (82 centimeters). The average monthly temperature is 50.4˚ Fahrenheit (10.2˚ Celsius). Additional historical meteorological data are available from the BNL Meteorology Services webpage: https://www.bnl.gov/weather/

Climate Change

In recent years, climate change has evolved into a matter of global concern because it is expected to have widespread, adverse effects on natural resources and systems. A growing body of evidence points to anthropogenic (manmade) sources of greenhouse gases (GHG), such as carbon dioxide (CO_2), as major contributors to climate change. Additional greenhouse gases include methane (CH_4), nitrous oxide (N_2O), halocarbons, and fluorinated compounds. Climate is usually defined as the average weather, over a period ranging from months to many years. Climate change refers to a change in the state of the climate, which is identifiable through changes in the mean and/or the variability of its properties (e.g., temperature or precipitation) over an extended period, typically decades or longer (DOE 2009b). Ongoing climate change research was summarized in reports by the United Nations Intergovernmental Panel on Climate Change (IPCC). These reports concluded that the climate is changing; that the change would accelerate; and that man-made GHG emissions, primarily CO_2, are the main source of accelerated climate change (IPCC 2014).

Various GHGs differ in their potential contribution to global warming. The global warming potential (GWP) compares the relative ability of each GHG to trap heat in the atmosphere over a certain period. According to guidelines, CO_2 is the reference gas with a GWP of 1. Based on a period of 100-years, the GWP of methane is 21, implying that a ton of methane is 21 times more effective in trapping heat than a ton of CO_2. The GWP for N_2O is 310. Carbon dioxide equivalent is a measure that expresses, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same GWP (Hailey 2008).

Brookhaven National Lab has prepared and maintains a Site Sustainability Plan in accordance with Federal Executive Orders and Department of Energy requirements. The plan is implemented and is reviewed on an annual basis. DOE labs are committed to advancing environmental sustainability through actions aimed to improve energy efficiency, reduce water use, reduce Greenhouse Gas emissions and reduce the use of hazardous materials.

5.9.2 Effects of Alternatives on Climate

There would be no additional GHGs added to the environment directly as a result of the Preferred Alternative. The Preferred Alternative would result in constructing and operating a high-energy electron accelerator in the former AGS Experimental Hall, Building 912, upgrading the LINAC average current to meet future demand for Sr-82 and other radiopharmaceutical ingredients such as Ac-225, and upgrading radioactive material laboratories in Building 801 to meet processing requirements for active pharmaceutical ingredients.

Relative to an indirect increase in GHGs, electrical power use under the Preferred Alternative would increase by a fraction since the baseline load due to existing LINAC, AGS and ATF operations is a large proportion of the total load relative to ATF II, AGS proton EDM measurement and the LINAC current upgrade. Additionally, counterbalancing effects to indirect GHGs would be deactivating the ATF operations in Building 820 and use of newer more efficient equipment and energy efficiency upgrades overtime throughout the AGS complex.

There would be no additional GHGs added to the environment directly as a result of the No Action Alternative. However, the No Action Alternative would result in the continued use of operating equipment that is less efficient than available upgrade equipment.

There would be no additional GHGs added to the environment directly as a result of the ATF Alternative. Indirectly relative to GHGs, electrical power use would incrementally increase by a fraction. On the other hand, the counterbalance to a small increase in indirect GHGs from power use would be a decrease due to deactivating ATF operations in Building 820 and use of newer more efficient equipment.

5.10 Visual Quality

5.10.1 Existing Environment

Large scientific facilities and structures have been constructed and operated at BNL since the late 1940s. Such structures have included research reactors with a 310-foot (94.5 meter) exhaust stack located on the highest point of the BNL site and a 100-foot (30.5 meter) tall meteorological tower. Current visual features of the proposed project area consist primarily of a Pine Barrens habitat that surrounds these facilities.

5.10.2 Effects of Alternatives on Visual Quality

There would be no effects on visual quality as a result of any of the Alternatives. Buildings and structures would not be added nor would existing buildings and structures be increased in size.

5.11 Noise

5.11.1 Existing Environment

Noise is defined as unwanted sound that interferes with normal activities, or in some way reduces the quality of the environment. Response to noise varies according to its type, perceived importance, appropriateness in the setting and time of day, and the sensitivity of the individual receptor. The EPA developed an index (threshold) to assess noise impacts from a variety of sources using residential receptors. If daytime noise values exceed 65 decibels (dBA), residential development is not recommended (EPA 1974). Noise sensitive receptors are defined as the occupants of a facility or a location where a state of quietness is a basis for use or where excessive noise interferes with the normal use of the facility or location. Typical noise sensitive receptors include schools, hospitals, churches, libraries, homes, parks, and wilderness areas.

Table 3: Common Noise Exposures

Sound Source	Pressure Decibels dBA
Large rocket engine (nearby)	180
Jet takeoff (nearby)	150
Pneumatic riveter	130
Jet takeoff (200 feet)	120
Construction noise (10 feet)	110
Subway train (100 feet)	100
Heavy truck (50 feet)	90
Average factory	80

Sound Source	Pressure Decibels dBA
Normal conversation (3 feet)	60
Quiet office	50
Library	40
Soft whisper (16 feet)	30
Rustling leaves	20
Normal breathing	10
Hearing threshold	0

New York Department of Environmental Conservation (DEC) Guidance "Assessing and Mitigating Noise Impacts" (DEP-00-1, Issuance Date: October 6, 2000 Revised: February 2, 2001) (http://www.dec.ny.gov/permits/6224.html) states that:

"Increases ranging from 0-3 dBA should have no appreciable effect on receptors. Increases from 3-6 dBA may have potential for adverse noise impact only in cases where the most sensitive of receptors are present. Sound pressure increases of more than 6 dBA may require a closer analysis of impact potential depending on existing Sound Pressure Level (SPLs) and the character of surrounding land use and receptors."

BNL facilities fall under average factory noise pressure (80 dBA, see Table 3) inside the buildings. There are no residential buildings within 300 m of BNL facilities, and noise falls off quickly with distance. It is normal to get a sound level drop of 6 dB per doubling of distance.

5.11.2 Effects of Alternatives on Noise

Under all alternatives the level of noise would remain similar to current levels as no new construction or significantly modified processes would result in a greater level of noise above existing conditions.

5.12 Industrial Safety and Occupational Health

5.12.1 Existing Environment

The graphed results that follow occurred during a period when many new facilities and modifications came into being at the Collider-Accelerator Department's (C-AD) AGS Complex. Off-site dose, on-site dose, inventory of radioactive cooling water, injuries and DOE reportable occurrences that impact ESH trended downward. The downward trends result from improvements in ESH programs that go hand in hand with excellence in science. These improvements were implementation of ISO 14001 and OHSAS 18001, increased training, improvements in beam control and experimental equipment, improvements in configuration management of safety systems, employee involvement in safety, and improvements in worker safety and health assurance systems.

Figures 8 through 10 provide trend data for injury/illness (Fig. 8), annual reportable occurrences (Fig. 9), and collective dose as person-rem (Fig. 10) It should be note that there is a significant downward trend for all metrics over time.

5.12.2 Effects of Alternatives on Industrial Safety and Occupational Health

Under the Preferred Alternative, the research programs would continue and improve; and ATF II, increases in LINAC current and proton EDM measurement could go forward. The record shows that improvements like these will result in declining cumulative impacts on worker safety and health.

The No-Action Alternative would provide for no construction of ATF II, no increase in LINAC current for future API production and no proton EDM measurement. The C-AD would shift research activities to existing capabilities. While continued use of facilities which do not provide the proper energies, particles or beam currents would seriously affect the viability of C-AD research program, there would be no effect on Industrial Safety and Occupational Health programs.

5.12.4 Effects of the ATF Alternative on Industrial Safety and Occupational Health

Under the ATF Alternative, some research programs would continue and improve. The record shows that program improvements will result in declining cumulative impacts on worker safety and health.

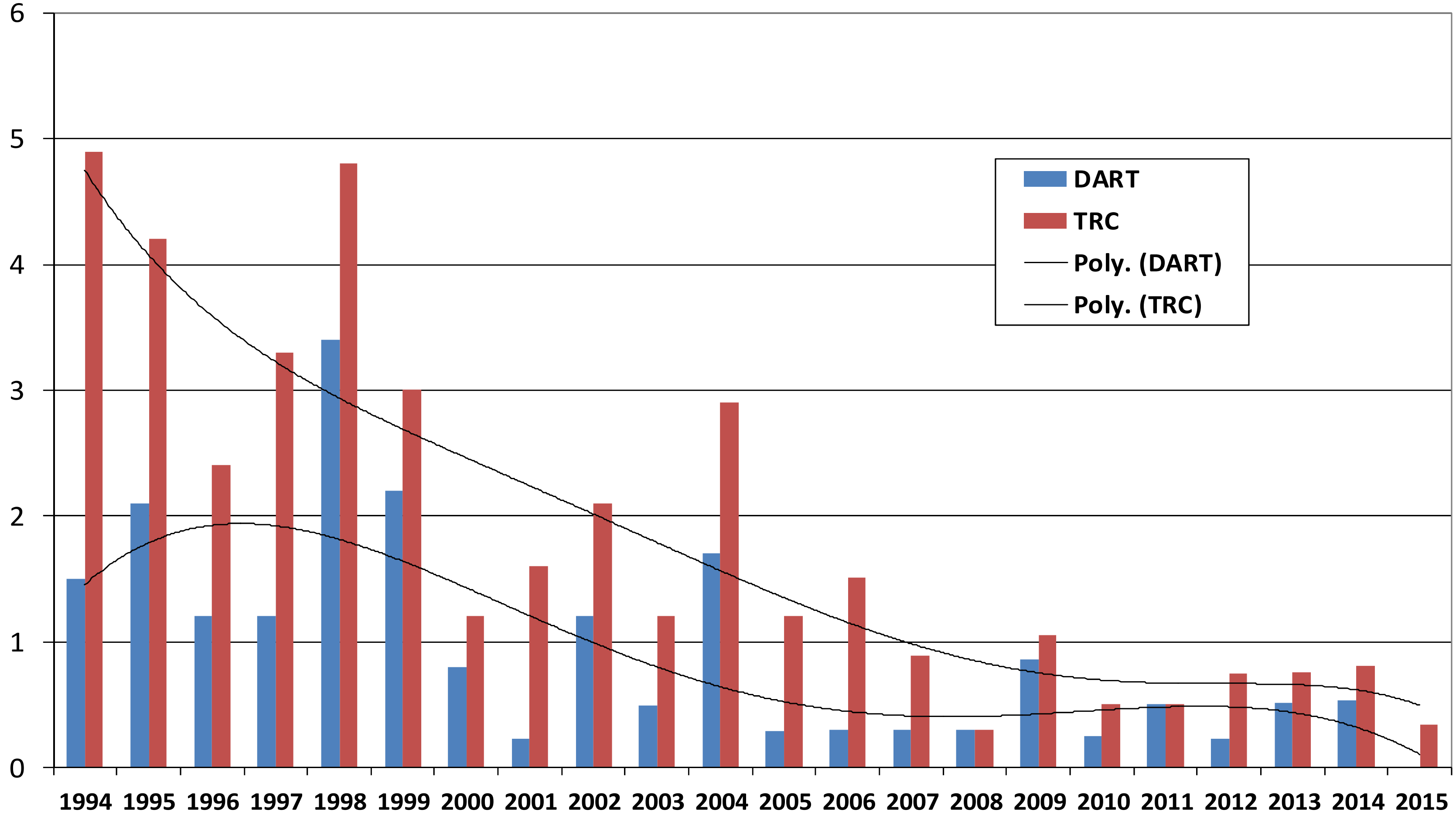
5.13 Radiological Characteristics

5.13.1 Existing Environment

The radiological characteristics of Laboratory operations are determined through routine DOE Oversight. Water discharged from the STP is routinely monitored at the plant's Outfall. In 2014, all effluents were found to be less than the Safe Drinking Water Act limits of 4 millirem annual dose limit for gross beta, 15 picocuries per liter (pCi/L) for average gross alpha activity, and 20,000 pCi/L average tritium concentration.

BNL uses 10 recharge basins permitted under SPDES to discharge once-through cooling water, cooling tower blow-down, and storm water runoff. Routine monitoring of these basins indicated that the average concentrations of gross alpha and beta activity were within typical background ranges, and that there were no Laboratory related gamma-emitting radionuclides detected. In 2014, there were no gamma-emitting nuclides attributable to BNL operations detected in any discharges and tritium was not detected above method detection limits (BNL 2015).

BNL is subject to the requirements of 40 CFR Part 61, Subpart H National Emission Standards for Hazardous Air Pollutants (NESHAP). The regulation requires that emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr. The effective dose equivalent from all air emission sources at BNL for 2014 was calculated to be 0.285 millirem, less than 3% of the allowable limit (BNL 2015).



DART = Days Away or Restricted Work due to injury at C-AD; TRC = Total OSHA recordable injury rate at C-AD

Figure 8. Annual C-AD Injury/Illness Rates (# per 100 FTE) and Trend Lines

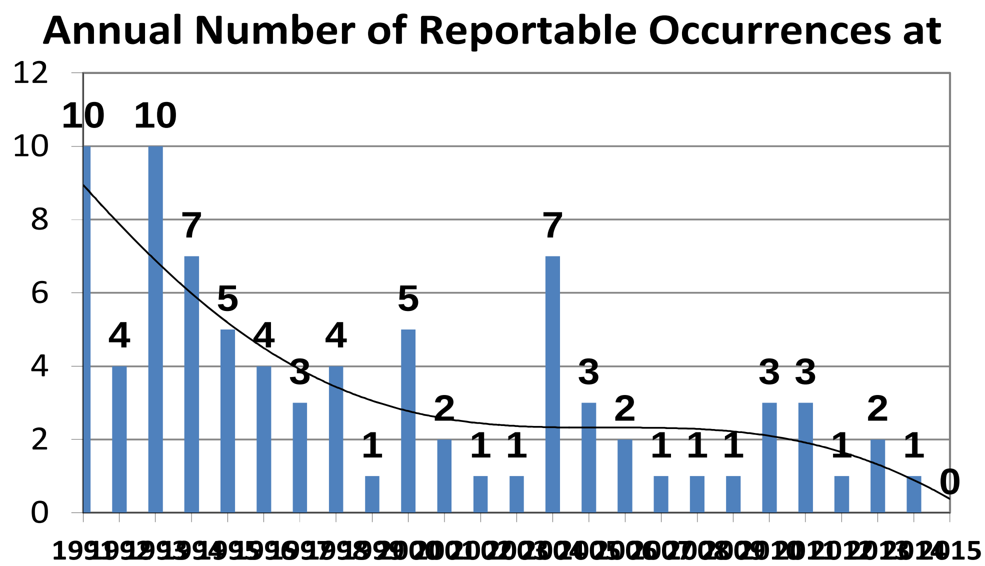


Figure 9. Long Term Occurrence Decline at C-AD, Number per Year

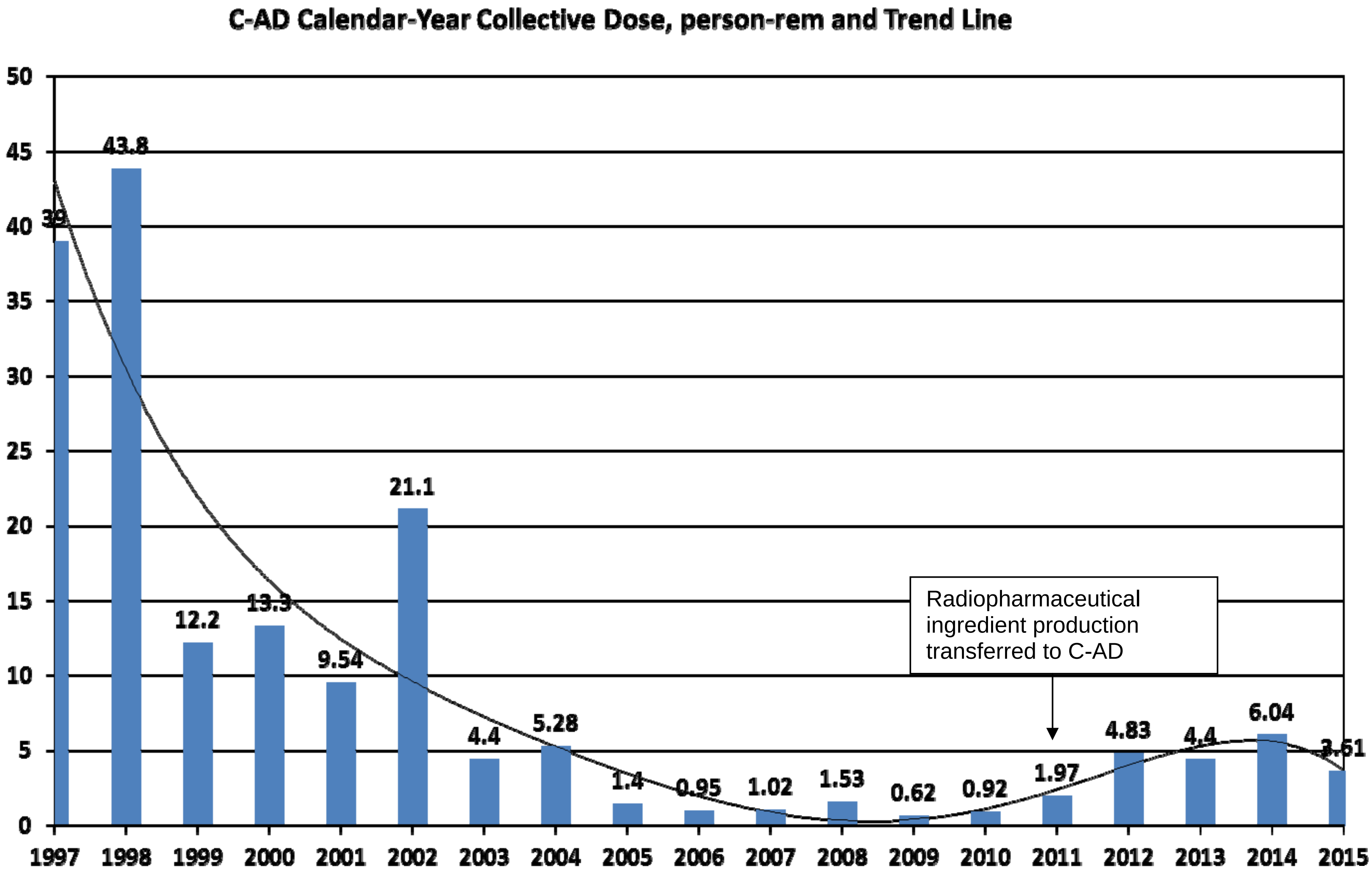


Figure 10. Long Term Decline in Annual Collective Dose at C-AD, person-rem per year

5.13.2 Effects of Preferred Alternative on Radiological Characteristics

The ATF II and the EDM experiment would not have facilities with fume hoods or stacks or other single radioactive airborne emission points. Air in the ATF II facility would be exchanged with normal Building 912 air changes. Air in the AGS would be exchanged with normal AGS Building 913 air changes. There are no single air-emission points in either building. Air is not expected to be activated in the AGS. Due to low beam current, ATF II would not measurably activate water or air.

For the Ac-225 program at the BLIP building 931, the air emissions limit with continuous monitoring is 10 mrem in one year at the site boundary. Typical emission at the BLIP stack is several Ci each hour of operation with LINAC beam. The emissions are primarily short-lived radioactive gases, and also include very small amounts of tritium. The emissions result in about 0.3 mrem per year to the maximally exposed off-site individual. This activity release rate (several Ci per hour) is typical of the existing Sr-82 program and should not change with the Ac-225 program since this emission is due to irradiation of target cooling water and not the targets themselves; that is, the thorium and rubidium targets used to make Ac-225 and Sr-82 are fully encapsulated. The BLIP stack is monitored for routine beta-gamma emissions. Routine alpha-emitter stack monitoring for the Ac-225 program will not be implemented, as it would not be a routine emission.

Radioactive radon isotopes released in the event of a thorium target failure will disperse in the air but have relatively short half-lives, 3 minutes or less, and are in equilibrium with their radium parents. Radon is somewhat soluble in water so detection of gamma rays associated with alpha emitters in the BLIP cooling water is a likely option for routine stack monitoring.

Measurements from a test using thorium foils show the target alone, within its aluminum encapsulation, was about 500 mrem/h at contact with the top of the shipping cask, and 100 mrem/hr at contact on the side of cask, which has a 200 mrem/h limit. The forklift transportation limit is 200 mrem/h at contact on the side represents no issues for the first 3 years of the program. As the program ramps up to larger targets, radiation levels at the back of the BLIP Hot Cell show it may require extra permanent shielding or a moveable shield wall. Transportation beyond the first three years will likely require a type B cask for transport from BLIP to the target processing laboratory in Building 801. Radiation levels from onsite shipping casks would go a short distance in air, about 100 m, and would only affect worker safety and health. Appropriate work planning to maintain dose to workers using ALARA principles would be used.

Measurements from the test foil show 2.5 mrem/h at the operator location next to the Hot Cell in Building 801. Measurements also show 0.6 mrem/h at the operator location, which is a Hot Box. Scaling up to a full target processing program initially shows operator exposures and dose rates comparable to today’s Sr-82 processing levels. It is planned to implement ALARA practices where practicable to reduce operator exposures by using additional shielding, remote cameras and other improvements as the program develops. Again, these radiations are local and would affect worker safety and health, not the environment.

In most respects the R&D process for Ac-225 is similar to all previous BLIP developments with two exceptions. Radioactivity levels are expected to be similar or lower than current Sr-82 production, at least for the next several years as new processes are developed. However, for the first time in about 50 years, alpha emitters will be handled by the radiopharmaceutical group. This creates some new radiological control issues that will be managed and monitored and will require new or modified standard operating procedures.

The radiological effects calculated for the Preferred Alternatives are presented in the following sections. Information is provided for heavy ion operation or polarized proton operations in the Booster and AGS because there are no high intensity proton operations planned beyond the LINAC.

Direct Radiation Effect of the Preferred Alternative

Although the laboratory site is considered to be a limited access facility, service personnel from offsite and BNL non-radiation workers may work or visit near the AGS Complex. Laboratory policy for such personnel is to restrict the annual dose to less than 25 mrem in one year. This goal would be accomplished through shielding design.

To measure direct radiation from all Laboratory operations, 58 environmental thermo-luminescent dosimeters (TLDs) were deployed by BNL, of which 9 were placed in known radiation areas and 15 off-site areas in 2014. An additional 30 TLDs were placed in a lead-shielded container for use as reference and control TLDs for comparison purposes. The average dose of all TLDs showed there was no additional contribution above the natural background radiation to on-and off-site locations from BNL operations. The annual on-site external dose from all potential sources, including cosmic and terrestrial radiation, was estimated as 69 ± 8 mrem and the annual off-site external dose was estimated as 69 ± 9 mrem. Because of local shielding, the Preferred Alternative will not change annual on-site or off-site external dose, and is much less than 25 mrem in one year when one considers 61.7 mrem as natural background (BNL 2015).

The 10 GeV ATF-II facilities proposed to be built in Building 912 will be operating at low intensity compared to past operations in Building 912. Electron beams will not create significant sky shine or muon beams if properly shielded. Again, the proposed ATF II will be shielded with the intent to maintain direct radiation levels for on-site and off-site as close to natural background as possible.

The measurement of the Electric Dipole Moment (EDM) of the proton with 233 MeV polarized protons inside the AGS tunnel will not create significant activation of equipment, sky shine or muon beams.

Soil Activation and Ground Water Effects of the Preferred Alternative

Radionuclides are typically created in soil particles within the first meter or two of soil beneath a target or beam stop shield. Shield design for the Preferred Alternative would be of appropriate thickness to minimize the potential for creation and accumulation of large amounts of tritium beneath the facility. Some tritium creation will occur despite the shielding in place, but the shielding would also act as a barrier to any water infiltration at the surface that could drive this tritium through the existing six or so meters of soil to permit its movement into the aquifer.

Localized areas of the soil beneath a beam target or dump areas or other known beam loss location can become activated by interactions with secondary particles. The primary radionuclides of concern produced in the activated soil are tritium and sodium-22. Tritium is easily leached from activated soil and is highly mobile, whereas sodium-22 is less leachable and migrates at a slower rate. These activated soils are controlled to prevent human exposure and the leaching of radionuclides into the groundwater. The design practices for engineering controls that minimize beam loss and mitigate the potential for rainwater infiltration into activated soil shielding are described in the BNL SBMS Accelerator Safety Subject Area.

The standard control to prevent leaching of the tritium from the soils is an impermeable cap or other engineered structure such as a building floor that extends over the activated soil. Building 912 was constructed on an extensive concrete pad, which prevents rainwater infiltration around the building's foundation, and the building's roof and roof drain system are maintained. The thickness of the concrete floors in buildings associated with the Preferred Alternative varies because the structures were built in sections and in different decades. For example, the floor over the extraction area of the AGS Ring is 2.5 ft. thick concrete. Under that portion of the AGS Ring that enters Building 912, the floor is 3.6 ft. concrete. The remaining parts of the Building 912, which is 5 acres in size, have floors that range in thickness from 1 to 2.5 feet concrete.

The C-AD has designed facilities to prevent routine beam loss to soil such that levels are as low as reasonably achievable with operational, economic and community factors taken into account. Responsibility for determining beam loss limits have been assigned to the C-AD Radiation Safety Committee. A formal authorization mechanism to change loss limits is required. Responsibilities have been assigned to liaison physicists for determining appropriate instrumentation for measurement of the losses, and for ensuring measurements are reviewed at appropriate intervals in order to validate loss assumptions.

Operations procedures contain loss limits, and response by operators to alarms is written in procedures. Loss problems are corrected within minutes; otherwise operators must reduce the beam intensity to the affected area. By procedure, accelerator operations staff must determine whether there will be a negative impact on the environment, safety or health of workers, a negative impact on the physics program, or a negative impact on accelerator equipment if prolonged high-loss operation is permitted. Authorization for prolonged high-loss operation, with an alarm present, must come from the C-AD Chair and be documented. Responsibility for maintaining loss-monitor systems is assigned, and beam current transformers and loss monitors used to monitor losses undergo periodic calibration. Residual radiation surveys on new accelerator components and structures are made after the first operational running period in order to confirm loss assumptions. Finally, soil coupons (i.e., small containers filled with sand) are placed at known loss areas and are periodically analyzed to confirm beam loss and soil activation assumptions.

Within the AGS Complex, activated-soil caps, which include roofs, concrete floors, and engineered caps, are inspected on a regular basis. At a minimum, all caps are inspected annually for surface cracks or penetrations.

Storm water runoff for the Preferred Alternative and adjacent paved areas is either conveyed to BNL's storm water system or allowed to infiltrate the ground in an area sufficiently away from the activation area. Construction details of these systems have been reviewed and physical inspections have been performed. There is a low probability of storm water infiltration into an activated soil area.

BNL has a comprehensive groundwater surveillance program that provides a means of verifying that the operational and engineered controls at beam loss areas are effective in protecting groundwater quality. Approximately 50 monitoring wells are used, both up-gradient and down-gradient of AGS Complex, to monitor the effectiveness of the engineered controls.

Emission of Airborne Radioactivity for the Preferred Alternative

Accelerator facilities are designed with an objective to minimize beam interactions in air. Beams are transported in a vacuum pipe with typically one linear meter of open space between the vacuum line and a target. Air activation products that could be produced in small quantities through interaction of the beam with air are tritium, beryllium-7, carbon- 11, nitrogen-13, oxygen-14, oxygen-15, and argon-41. Under normal operating conditions there is no direct exhaust of air from the LINAC accelerator enclosure. All radionuclides that would be generated are short lived and would be expected to decay to stable, non-radioactive atoms within the accelerator enclosure.

There is about 5000-7500 Ci of short-lived radioactive gas, originating from activation of target cooling water, released to air from the BLIP exhaust stack annually. Because of half-life of 2 minutes for O-15, and 20 minutes for C-11, the off-site dose has been on average approximately 0.3 mrem per year. Because of the LINAC beam raster and the administrative guideline on cooling-water channel thickness, it is not likely that increase in the LINAC intensity will result in a doubling of emissions, but conservatively may increase to between 4 and 15 percent (.4 to 1.5 mrem/yr) of the EPA limit of 10 mrem per year.

Dose from airborne radioactivity to nearby workers is expected to remain at low levels for uncontrolled areas since the water path thickness in the BLIP target cooling channels will not increase in the future. Routine airborne activity measurements in and around BLIP during operations for all types of weather conditions indicate maximum exposure rates rise to 2 to 5 times natural background levels for 1 inch of water path. These levels (10 to 35 microR/h) may occur for several hours at a time when the ambient weather causes the plume from the BLIP stack to travel close to the ground. This type of weather occurs a few days each year and it traps the plume close to the ground within about 300 meters of the BLIP building due to the local land and tree contours and low effective stack height.

It is noted that the increased protons on target due to use of the LINAC beam raster are expected to be absorbed by target materials and not interact with cooling water since target atoms will no longer move out of the path of a fixed beam spot that causes high-peak temperatures. Thus, daily BLIP emissions are expected to remain close to or slightly higher than current emissions.

Based on airborne activity measurements in and around BLIP during operations for all types of weather conditions, the following controls are in place to limit the level of routine gaseous radioactivity emissions from BLIP cooling water:

- The C-AD Radiation Safety Committee (RSC) follows a guideline to limit the cooling water beam path to a total of 1 inch or less for BLIP target arrays. The total water gap, among other target parameters, is authorized by the RSC for each BLIP target array prior to bombardment.
- BLIP users must provide C-AD RSC information on water gaps in their target arrays. A listing of the water thickness between targets in the array must be included in the documentation submitted to the RSC. This documentation is under configuration management.
- The Production Manager requires vacuum boxes in the array to eliminate unneeded excess water path.
- Each approved BLIP target array is under configuration management.

Airborne emissions at BLIP result from cooling water irradiation with beam and would continue, but operation will involve more efficient use of beam on targets and lower target temperatures following the implementation of a beam raster in 2016. The annual maximum offsite dose to an individual is expected to be from 0.4 to 1.5 mrem/yr. Measurement data for gaseous emissions, in Curies, from 2010 through 2015 for the Sr-82 program are summarized in Table 4 below:

Table 4. BLIP Radioactive Gas Emissions in Curies, 2010 to 2014

	2010	2011	2012	2013	2014	2015
C-11, half-life 20 minutes	1741	1911	1595	1620	2473	1517
O-15, half-life 2 min.	4320	2881	3305	3300	5055	3034

These emissions resulted in an approximate 0.3 mrem/yr for the maximally exposed off-site individual. For 2015, an estimated total of 4551 Ci of radioactive gases were emitted from the BLIP stack. The analyses for specific C-11 and O-15 components are continuing and actual results may vary from those found in Table 4; however, from past experience, the ratio of O-15 to C-11 activity is about 2 to 1.

5.13.3 Effects of the No Action Alternative on Radiological Characteristics

Under the no action alternatives the existing radiological characteristics would remain the same and BNL would continue to monitor radiological emissions and waste streams.

5.13.4 Effects of the ATF Alternative on Radiological Characteristics

Under the no action alternatives the existing radiological characteristics would remain the same and BNL would continue to monitor radiological emissions and waste streams.

5.14 Natural Hazards

5.14.1 Existing Environment

Natural phenomena, which could lead to operational emergencies at BNL, include hurricanes, tornadoes, wildfires, thunderstorms, snowstorms, and ice storms. Hurricanes occasionally hit Long Island, and the high wind speeds associated with them may potentially damage structures. Record high winds for BNL were recorded during Hurricane Carol in September 1954 (Hoey 1994). Tornadoes and hailstorms are rare on Long Island. Thunderstorms, snowstorms, and ice storms do occasionally occur and have the potential to cause damage to facilities.

Earthquakes on Long Island are extremely rare, and no active earthquake-producing faults are known in the Long Island area (Hoey 1994). Long Island lies in a zone 2, or moderate damage seismic probability area, and it is assumed that an earthquake of Modified Mercalli VII could occur (DOE 1999). A recent history of earthquakes in the central Long Island area is presented in Table 5 below (USGS 2016):

Table 5: Recent History of Earthquakes in the Central Long Island Area

Year	Date	Intensity - Modified Mercalli
1925	Feb 25	I-III
1929	Nov 18	I-III
1935	Nov 1	I-III
1937	Jul 18	I-III
1944	Sep 5	I-III
1950	Mar 29	I-III
1951	Jan 25	I-III
1985	Oct 19	IV-V (4-5 on Richter scale)
2001	Jan 17	IV
2001	Oct 27	IV
2010	Nov 30	I-III
2011	Aug 8	I-III
2014	Jul 5	I-III

The likelihood of a serious earthquake in the BNL area is slight and seismologists expect no significant earthquakes in the foreseeable future (Hoey 1994).

The Central Pine Barrens and community types within BNL are fire dependent systems that experience periodic wildfire events. Wildfires, direct flame and smoke could affect BNL operations. A wildland fire burned approximately 300 acres in the northeast portion of the BNL site in 2012, and an additional 700-800 acres offsite. The BNL Wildland Fire Management Plan (WFMP) includes recommendations for periodic mechanical fuels management and prescribed fire (controlled burns) to reduce potential fuel loading and the effects of unanticipated wildfire ignitions (BNL 2009). Prescribed burns, totaling about 16 acres (6.5 hectares), have been performed since 2004. The WFMP also recommends that a cleared area of at least 30 feet (9 meters) be maintained between buildings and the nearest treed area. The BNL on-site fire department is manned 24-hours a day to respond to all fire emergencies, and maintains mutual aid agreements with local fire departments.

5.14.2 Effects of Natural Hazards on Alternatives

None of the alternatives would likely be affected by natural hazards.

The AGS Complex has been constructed over a period of years. During this construction, techniques were used to assure compliance to the building codes, providing for consideration of seismic hazards and wind damage.

DOE Order 1022-94 and DOE Standard 1023-93 provide for seismic hazard categorization of structures, systems and components of the built environment. Commensurate with a graded approach to the facility, a Performance Category of PC-1 would be sufficient to describe the design criteria for the structures, systems and components built at BNL.

Adherence to the building codes at BNL (equivalent of Uniform Building Codes for the region) during construction, being constructed of good-quality materials, and having structural parts securely tied together and anchored to the foundation, provides appropriate seismic hazard mitigation to comply with the criteria of PC-1.

For above ground facilities, the Long Island area basic wind speed (3-second gust) is 120 MPH based on Factory Mutual Data Sheet 1-28 and BCNYS figure 1609.4. The ground roughness exposure category for the area is ‘Exposure B.” Based on the calculations, above ground buildings would have roof assemblies classified as “Class 90” rated assemblies. This does not apply to the LINAC, AGS or BLIP target structures because they are underground facilities.

5.15 Intentional Destructive Acts

5.15.1 Existing Environment

BNL has not historically been subject to significant intentional destructive acts. The Laboratory maintains a 24 hour a day protective security force and fire/rescue group to protect both personnel and property. The Security force routinely patrols the BNL campus. The fire/rescue group’s response time to alarms is typically less than 3 minutes to most locations on BNL.

The Laboratory does experience trespass situations along the north and east boundaries of the site from individuals riding all-terrain vehicles, horses, bicycles, or just walking. These have resulted in little if any vandalism on the site.

5.15.2 Intentional Destructive Acts Effects on Alternatives

It is not expected that any of the alternatives would be affected by intentional destructive acts or vice versa.

C-AD operates 365/24/7 with a Collider Accelerator Watch. That is, there are a minimum of 2 trained staff members monitoring the C-AD buildings each shift. Locked doors are required and they are routinely checked by the Watch in additional to the Site Security Force checks. Additionally, security cameras and card or code access are required to access the C-AD buildings or structures.

5.16 Utilities

5.16.1 Existing Environment

Current peak electrical demand by BNL is about 60 MW. Peak electric use at BNL for FY 2015 from BNL’s Energy Management Group ranges from a low of 31 MW in December 2014 to a peak of 68 MW in May 2015. These figures address the switchover from NSLS-I to NSLS-II. Operating the AGS Complex itself was metered to be about 25 MW.

Cooling electromagnets in the AGS ring is the major water use for the AGS Complex. Water use at the AGS ring has been reduced over time through improvements to system technology. Overall water use has been reduced 3 to 4 fold from 1990's levels to about 15,000,000 gallons per month.

5.16.2 Effects of Preferred Alternative on Utilities

The ATF II is projected to require about 0.8 MW of electrical power. The extra load due to the ATF II would be essentially constant, with low variation at times of shutdown and start up. Power is now supplied to BNL by the New York Power Authority (NYPA). No additional construction would be required offsite to meet the additional energy demands created by the ATF II.

Although not directly metered, the LINAC power is less than 2 MW. An upgrade in LINAC beam current to 320 micro amp would not scale linearly with power use. LINAC power that is relevant to beam current is used to heat filaments in vacuum tubes, and most of this power is required even at zero current.

The EDM experiment would require an electrostatic ring (no magnetic fields) for 233 MeV polarized protons inside the AGS tunnel. Power consumption is expected to be low and will be further evaluated during the design phase of the project. NEPA review documents will be prepared early in the design phase to determine if the EDM experiment will fall within the envelope of this EA or require further review.

It is not expected that the Preferred Alternatives would have a significant effect on water or power use at the AGS Complex.

5.16.3 Effects of No Action Alternative on Utilities

The No Action Alternative would not have an effect on water use or power use at the AGS Complex.

5.16.4 Effects of the ATF Alternative on Utilities

The ATF II is projected to require about 0.8 MW of electrical power. Current peak electrical demand by BNL is about 60 MW. The extra load due to the ATF II would be essentially constant, with low variation at times of shutdown and start up. Power is now supplied to BNL by the New York Power Authority (NYPA). No additional construction would be required offsite to meet the additional energy demands created by the ATF II.

5.17 Electric and Magnetic Fields (EMF)

There are no Federal standards limiting residential or occupational exposure to the common-utility magnetic or electric fields found in the United States. The applicable electric field strength standards established by the New York State Public Service Commission (PSC) are set forth in the Opinion No. 78-13, issued June 19, 1978. The magnetic field standards are set forth in the PSC's Interim Policy Statement on Magnetic Fields, issued September 11, 1990.

Opinion 78-13 established an electric field strength interim standard of 0.5 kilovolts per foot (1.6 kilovolts per meter (kV/m)) for electric transmission lines, at the edge of the right-of-way, 3.3 feet (1 meter) above ground level, with the line at the rated voltage. The Interim Policy established a magnetic field strength interim standard of 200 milligauss (mG), measured at 3.3 feet (1 meter) above ground grade, at the edge of the right-of-way, at the point of lowest conductor sag (Caithness 2005).

5.17.1 Existing Environment

The local transmission lines into the BNL site operate at 13,800 V. National Electrical Safety Code requires vertical clearance to be 18.5 feet from the ground for transmission lines with this voltage. The oscillating magnetic field at ground level from AC current transmission has been reported to be about 0.5 to 10 mG at 60Hz.[2]

5.17.2 Effects of Alternatives on EMF

None of the alternatives would require significant additional power to the BNL site. Therefore, there would be no expected change in EMF.

5.18 Waste Management and Pollution Prevention

5.18.1 Existing Environment

The Laboratory has implemented extensive and active pollution prevention (P2) and recycling programs that reflect the national and DOE P2 goals and policies. The Laboratory's Environmental Protection Division (EPD) is staffed with subject matter experts responsible for evaluating and implementing regulatory requirements and P2 programs. The EPD operates the Waste Management Facility (Buildings 855 and 860) where waste generated at BNL is processed and prepared for off-site shipment and disposal. Additional details of the P2 and recycling programs are described in Chapter 2 of the Site Environmental Report (BNL 2015).

Building 912 formerly housed high-energy physics experiments from 1960 to 2002. The program terminated in 2002 and C-AD continues to perform significant waste management activities to manage waste that resulted from these experiments. From 2002 to 2014, C-AD shipped about 400 m^3 of an estimated 1000 m^3 of legacy solid low-level radioactive waste.

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[2] Biological Effects of Power Frequency Electric and Magnetic Fields, Congress of the United States, Office of Technology Assessment, NTIS # PB89-209985, 1989.

About 15 to 20 m^3 of standard industrial/universal waste are generated at the AGS Complex annually from routine operations.

In the 1990s, BNL's enhanced groundwater monitoring program detected several localized, pencil-shaped plumes of tritium at levels above the drinking water standard, which were associated with past Building 912 operations. C-AD has taken corrective measures to prevent further releases of tritium and is addressing the contaminated groundwater monitoring with plume monitoring, and by maintaining the protective caps over activated soils. The protective caps prevent rainfall from transferring tritium in soil to groundwater. Continued sampling has shown the plume concentrations of tritium to attenuate below the detection limit as expected, which is far below the Drinking Water Standard. Plume monitoring and future cap maintenance will extend into the future per CERCLA agreement (Number NY7890008975) between DOE and New York State.

Institutional controls are in place to prevent possible exposure to the contaminated soils and groundwater. The activated soils are located below ground, and workers cannot come into direct contact with the soil either from inside or outside of the beam line tunnel. C-AD will address final disposition of the activated soil when the facility is fully decommissioned.

5.18.2 Effects of Preferred Alternative on Waste Management and Pollution Prevention

C-AD plans to continue shipping large non-reusable radioactive components as waste as funding allows, and to continue disassembling and re-using program equipment where practicable. The Preferred Alternative has a positive effect on the re-use program as low-level radioactive concrete block shielding in Building 912 is being re-used for ATF II.

Increases in solid low-level radioactive waste from the Preferred Alternative are expected to be small in volume compared to legacy waste or compared to waste from current AGS Complex operations. Additionally, the ATF II will reuse or recycle many accelerator components from the decommissioning or deactivation of other DOE accelerators such as NSLS, SDL and Bates. Increased radioactivity from the small volume of solid radioactive waste from the radioisotope medical program will be stored and allowed to decay, prior to disposal, which will allow worker exposures to be kept low.

5.18.3 Effects of the No Action Alternative on Waste Management and Pollution Prevention

There would be no effect on standard industrial/universal waste or low-level radioactive waste from the AGS Complex. C-AD plans to continue shipping large non-reusable radioactive components as waste as funding allows, continue disassembling and re-using legacy program equipment where practicable, and continue with the medical radioisotope program.

5.18.4 Effects of the ATF Alternative on Waste Management and Pollution Prevention

The ATF Alternative has a positive effect on the re-use program as concrete block shielding in Building 912 is being re-used for ATF II. Increases in waste from the ATF Alternative are expected to be small compared to legacy waste or from current AGS Complex operations. Additionally, the ATF II will reuse or recycle many accelerator components from the decommissioning or deactivation of other DOE accelerators such as NSLS, SDL and Bates.

5.19 Commitment of Resources

5.19.1 Commitment of Resources under the Preferred Alternative

Construction of the future ATF II would install new beam lines, power supplies, computer equipment, experimental facilities, experiment preparation facilities, but not require new structures to house operations in Building 912. Raw materials including various metals would be used to assemble accelerator enclosures, magnets, vacuum pipes, beam lines, and beam stops. The ATF II would require approximately 15,000 cubic meters of concrete shielding, but this shielding would be re-used from the prior programs at C-AD. Many magnets and other beam line components from other DOE accelerators would also be re-used. All of the resources required for construction and upgrade of ATF II are readily available in local markets. Some specialized components for ATF II might be manufactured outside the existing area but this should not result in an impact on the availability of raw materials. Energy demands of construction equipment would cause a negligible effect on available supplies.

Modification of the medical radioisotope processing lab for the future Ac-225 program may require additional shielding for hot cells, additional or upgraded analytical equipment, upgrade of the ventilation system, upgrade of the BLIP target drive system, and new shipping containers. Waste volumes are not an issue. Modifications would involve construction within the existing lab and will likely result in a small increase in the disposal of solid radioactive waste.

In most respects the R&D process for Ac-225 is similar to all previous BLIP developments with two exceptions. Overall radioactivity levels will be lower than current isotope production, at least for the next 2-3 years; and for the first time in about 50 years alpha emitters will be handled. New radiological control measures will be put into place. For example, alpha radiation monitors may be used. These devices are readily available commercially.

Modification of the AGS for measurement of the Electric Dipole Moment (EDM) of the proton may require some modification of the injection area near the Booster/AGS interface. Modification would be in a previously disturbed area that was altered in 1993 to add shielding for the Booster to AGS line. The electrostatic ring to be installed in AGS would not require changes in AGS shielding. Raw materials including various metals would be used to assemble the ring: vacuum pipes, conductive metal surfaces and beam stops.

5.19.2 Commitment of Resources under the No Action Alternative

The No Action Alternative would not have an effect on commitment of resources.

5.19.3 Commitment of Resources under the ATF Alternative

Construction of the future ATF II would install new beam lines, power supplies, computer equipment, experimental facilities, experiment preparation facilities, but not require new structures to house operations in Building 912. Raw materials including various metals would be used to assemble accelerator enclosures, magnets, vacuum pipes, beam lines, and beam stops. The ATF II would require approximately 15,000 cubic meters of concrete shielding, but this shielding would be re-cycled from the prior programs at C-AD. Many magnets and other beam line components would also be re-cycled from other DOE accelerators both on and off-site. Fossil fuels and water would be used to produce power to operate construction machinery. All of the resources required for construction and upgrade of ATF II are readily available in local markets. Some specialized components for ATF II might be manufactured outside the existing area but this should not result in an impact on the availability of raw materials. Energy demands of construction equipment would cause a negligible effect on available supplies.

5.20 Sustainability

5.20.1 Existing Environment

Brookhaven National Laboratory has established a Site Sustainability Plan that is used to implement and track sustainability measures. The plan, actions and tracking measures can be found at: https://www.bnl.gov/about/sustainability/.

5.20.2 Effects of alternatives on Sustainability

All alternatives would include actions that improve sustainability including taking advantage of energy savings, water savings, pollution prevention, reuse, and recycling. The Collider Accelerator Division consistently works to reuse accelerator components from other accelerators both at BNL and elsewhere within the DOE complex. As building and facilities are upgraded, Federal requirements dictate the use of Energy Star equipment and/or equipment designated under the Federal Energy Management Program. Construction materials for refurbished areas are required to meet Federal requirements for Environmentally Preferable Purchasing. In addition, it is notable that the major projects assessed are all planned in existing facilities. The re-use of spaces formerly used for other programs does not increase the developed footprint of the lab and is consistent with DOE sustainability goals of optimizing the use of developed space.

5.21 Decommissioning and Restoration

The C-AD plans to develop decommissioning plans for each accelerator and accelerator facility near the end of their operating lifetime. At that time, C-AD will determine the hazards and risks associated with decommissioning, and the activities required for completing it. Environmental reviews, including NEPA, would be completed as part of the decommissioning plans. Of the utmost importance in formulating these plans is ensuring the safety of the workers, protecting the public and the environment, and complying with the applicable state-, local-, and federal-regulations.

5.22 Cumulative Impacts

Besides the activities outlined under this document, recent and planned projects include:

- Sewage treatment plant upgrades with discharge to groundwater (completed 2014)
- Construction and operation of the 200 acre Long Island Solar Farm (completed 2011)
- National Synchrotron Light Source II (completed 2014)
- Discovery Park – 60 acre development near Lab entrance (planning stage 2016)
- e-RHIC – electron – ion collider

Although none of the projects assessed in this EA are expected to require new buildings or structures, recent, current and planned future projects will cumulatively impact approximately 260 acres of the BNL site, with approximately 160 acres of natural areas being cleared. Each project has been or will be reviewed under the requirements of NEPA to assess impacts. Cumulative impacts are not expected to result in significant negative impact to the environment.

6.0 ACRONYMS, INITIALS, AND ABBREVIATIONS

AC-225	Actinium - 225
AGS	Alternating Gradient Synchrotron
ALARA	As Low AS Reasonably Achievable
API	Active Pharmaceutical Ingredients
ATF	Accelerator Test Facility
AWQS	Ambient Water Quality Standards
BER	Brookhaven Executive Roundtable
BHSO	Brookhaven Site Office (DOE)
BLIP	Brookhaven LINAC Isotope Producer
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates, LLC
CAC	Community Advisory Council
C-11	Carbon – 11
C-AD	Collider Accelerator Department
CCC	Civilian Conservation Corps

CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGA	Compatible Growth Area
Ci	Curie
CO	Carbon monoxide
Co-60	Cobalt - 60
CPA	Core Preservation Area
CPB	Long Island Central Pine Barrens Region
CRMP	Cultural Resource Management Plan
DART	Days Away or Restricted
dBA	Decibel
DEC	Department of Environmental Conservation
DOE	United States Department of Energy
EA	Environmental Assessment
ECL	Environmental Conservation Law
EBIS	Electron Beam Ion Source
EDM	Electric Dipole Moment
EIS	Environmental Impact Statement
EMF	Electric and Magnetic Fields
EPA	Environmental Protection Agency
EPD	Environmental Protection Division
ESH	Environmental, Safety, and Health
eRHIC	Electron Heavy Ion Collider
ERL	Energy Recovery LINAC
FERN	Foundation for Ecological Research in the Northeast
FONSI	Finding of No Significant Impact
FTE	Full-time Equivalent
GeV	Giga-electron-volt
GHG	Greenhouse Gas
GWP	Global Warming Potential
HVAC	Heating, Ventilation, and Air Conditioning
ILIA	Institute of Long Island Archaeology
IPCC	United Nations Intergovernmental Panel on Climate Change
LINAC	Linear Accelerator
MEOSI	Maximally Exposed Off-site Individual
MeV	Million-electron-volt
mG	milligauss
MGD	Million gallons per day
MIT	Massachusetts Institute of Technology
MLD	Million liters per day
MPH	Miles Per Hour
MW	Megawatt
Na-22	Sodium – 22
NAAQS	National Ambient Air Quality Standards
NASA	National Space Administration
NEPA	National Environmental Policy Act

NESHAP National Emission Standards for Hazardous Air Pollutants
NOx Nitrogen Oxides
NHPA National Historic Preservation Act
NP Nuclear Physics
NRMP Natural Resource Management Plan
NSRL NASA Space Radiation Laboratory
NSLS National Synchrotron Light Source
NY New York
NYS New York State
NYSDEC New York State Department of Environmental Conservation
NYPA New York Power Authority
OPPIS Optically Pumped Polarized Proton Source
OSHA Occupational Safety and Health Administration
O-15 Oxygen - 15
P2 Pollution Prevention
PM Particulate Matter
PSC Public Service Commission
pCi/l Pico-[trillionths] Curies per liter [Curie = basic unit used to describe the intensity of radioactivity in a sample of material]
R&D Research and Development
RF Radio Frequency
RHIC Relativistic Heavy Ion Collider
RRPL Radionuclide Research Processing Laboratory
RSC Radiation Safety Committee
RWP Radiation Work Permit
SBU Stony Brook University
SBMS Standards Based Management System
SDL Source Development Laboratory
SER Site Environmental Report
SHPO State Historic Preservation Officer
SPL Sound Pressure Level
Sr-82 Strontium - 82
STP Sewage Treatment Plant
SUNY State University of New York
TLD Thermo-luminescent Dosimeter
TVDG Tandem Van de Graaffs
TPL Target Processing Laboratory
TRC Total Recordable
TTB Tandem to Booster
TW Terrawatt
U.S. United States
VOC Volatile Organic Compound
WFMP Wildland Fire Management Plan
WWI World War I
WWII World War II
WSRRA Wild, Scenic, and Recreational Rivers Act

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8.0 LIST OF AGENCIES CONTACTED AND PRESENTATIONS TO STAKEHOLDERS

8.1 Agencies Contacted

DOE NEPA regulations, found in 10 CFR 1021.301, require that the host state be provided the opportunity to review and comment on the EA document prior to DOE's approval of the EA.

Copies of the draft EA were distributed to the following:

New York State Governor's Office – Albany, NY

New York State Department of Environmental Conservation – Stony Brook, NY

USEPA, Region 2 – New York, NY

8.2 Stakeholder Presentations

Presentations related to the continued operation and upgrades to the Alternating Gradient Synchrotron were provided to the following groups:

BNL Community Advisory Council (CAC)

The CAC consists of approximately 27-member organizations representing business, civic, education, employee, environment and health organizations. Members meet monthly, set their own agenda, and work to reach consensus recommendations on issues of concern to them. Meetings are open to the public; each meeting has a comment period during which community members may voice their opinions and concerns [http://www.bnl.gov/community/CAC.asp]. Presentations about the AGS Complex and proposed upgrades were provided to the CAC on January 14, 2016.

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