DOE/EA-0257

ENVIRONMENTAL ASSESSMENT

CONTINUOUS ELECTRON BEAM ACCELERATOR FACILITY

NEWPORT NEWS, VIRGINIA

January 1987

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations
Oak Ridge, Tennessee 37830

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ANL	Argonne National Laboratory
AQCR	Air Quality Control Region
CEBAF	Continuous Electron Beam Accelerator Facility
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
COE	U.S. Army Corps of Engineers
DOE	Department of Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
MSL	mean sea level
NASA	National Aeronautics And Space Administration
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NSAC	Nuclear Science Advisory Committee
NSF	National Science Foundation
OHENP	Office of High Energy and Nuclear Physics
ORNL	Oak Ridge National Laboratory
QCD	Quantum Chromodynamics
SCS	Soil Conservation Service
SLAC	Stanford Linear Accelerator Center
SREL	Space Radiation Effects Laboratory
SURA	Southeastern Universities Research Association
VARC	Virginia Associated Research Campus
VPISU	Virginia Polytechnic Institute and State University
VSWCB	Virginia State Water Control Board
ZGS	Zero Gradient Synchrotron

LIST OF FACTORS FOR CONVERSION OF ENGLISH TO INTERNATIONAL SYSTEM OF UNITS (SI)

The following table gives the factors used in this document for the conversion of conventional English units to the equivalent International System of Units (SI) now being adopted worldwide or conventional metric units. The conversion factors have been obtained from the ASTM publication *Standard for Metric Practice*[a] and are used to four-digit accuracy, since most of the values in this document are not known to any more exactness. After conversion, the SI values have been rounded to reflect an accuracy sufficient for the requirements of this document. Most of the values will be presented in SI units with the equivalent English unit following within parentheses.

Conversion of English to SI Units

To Convert From	To	Multiply By
acre	hectare (ha)	0.4047
degree Fahrenheit (°F)	degree Celsius (°C)	
feet (ft)	meters (m)	0.3048
cubic feet (ft^3)	cubic meters (m^3)	0.02832
cubic feet per second (ft^3/s)	cubic meters per second (m^3/s)	0.02832
gallon (gal)	cubic meters (m^3)	0.003785
gallon (gal)	liters (L)	3.79
gal/min	liters per second (L/s)	0.06309
inch (in.)	centimeters (cm)	2.54
inch (in.)	meter (m)	0.0254
mile (statute)	kilometer (km)	1.609
square feet (ft^2)	square meter (m^2)	0.09290
square mile ($mile^2$)	square kilometer (km^2)	2.590
pound (lb)	kilograms (kg)	0.4536

[a] American Society for Testing and Materials, Standard E-380, *Standard for Metric Practice*, February 1980.

SUMMARY

This Environmental Assessment has been prepared by the U.S. Department of Energy (DOE) to fulfill its obligations pursuant to Sect. 102 of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190). The proposed federal action addressed in this document is DOE's funding of a Continuous Electron Beam Accelerator Facility (CEBAF) at Newport News, Virginia. DOE intends to contract with the Southeastern Universities Research Association (SURA) for operation of CEBAF, a continuous wave (CW) linear accelerator system (linac) capable of providing high-duty-factor beams throughout the energy range from 0.5 to 4.0 GeV. CEBAF will be the first of its kind worldwide and will offer a multi-GeV energy, high-intensity, high-duty-factor electron beam for use by the U.S. nuclear physics community in research on the states of nuclear matter and the short-distance behavior of nuclei. The CEBAF project is largely in the conceptual design stage, with some components in the preliminary design stage. Construction is anticipated to begin in 1987 and be completed by 1992.

This assessment, prepared in accordance with the President's Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR, Pt. 1500–1508, November 1978) and DOE guidelines (45 FR 62, 20694–20701, March 28, 1980), considers the impacts of the proposed action and all reasonable alternatives. The alternatives to construction and operation of CEBAF at Newport News, Virginia, include the use of alternate sites (Charlottesville or Blacksburg, Virginia), an alternate technology (pulsed linac with pulse stretcher ring), or no action. An evaluation of alternative sites and their impacts indicates that any one of the three would be a feasible location for CEBAF. The Newport News site was chosen over the others because of the infrastructure of the metropolitan Newport News area (e.g., transportation, labor force, services readily available) and the cost savings to be realized by the use of the existing buildings (VARC and SREL) on-site.

No significant environmental impacts are predicted for any of the alternatives. Following is a brief summary of the minor impacts expected from construction and operation of CEBAF at the proposed Newport News site.

Air quality in the vicinity of the proposed CEBAF site would be slightly decreased by local, short-term emissions of fugitive dust, vehicle and equipment exhaust, and solvent fumes. A non-significant amount of cooling tower drift may deposit downwind of the site.

Groundwater levels at the proposed site could be lowered by dewatering during construction. The potential exists for induced radioactivity in groundwater and soils (and, possibly, surface water, due to contaminated groundwater discharge); however, proper design and careful operation of the accelerator (i.e., shielding, containment of the beam, and storage and monitoring of adjacent contaminated groundwater) will minimize this potential, and no significant impacts are expected. Storm water runoff and discharge from site drainage could potentially introduce contaminants into nearby waterways. Good construction and engineering practices, including a well-planned and well-implemented erosion and sedimentation control program, will minimize impacts.

Some erosion and alteration of topography is likely. About 30 ha (74 acres) of hardwood and hardwood-pine forest will be cleared, resulting in a proportional loss of terrestrial habitat and resident wildlife. However, the species present are not endangered or threatened.

Ambient noise is expected to increase due to operation of construction equipment and, during CEBAF operation, from cooling tower fans. Increases will not affect any sensitive receptors.

No significant atmospheric releases of radionuclides are expected from operation of CEBAF.

1. PURPOSE OF AND NEED FOR THE ACTION

1.1 BACKGROUND

Nearly 15 years ago, nuclear science recognized the need for an electron accelerator with a continuous beam and an energy in the multi-GeV region. The development of a new fundamental theory, Quantum Chromodynamics (QCD), to guide research regarding the short distance behavior of nuclei made the need for such a facility more urgent, especially since many details of QCD are still uncertain, nuclear systems are complex, and answers require an extensive program of electron scattering experiments. Several recent reports (Friedlander 1977; Livingston 1977; NSAC 1979; RPI 1981; NSAC 1982; NSAC 1983; NSAC 1984) document the need for a high-duty-factor electron accelerator in the multi-GeV range.

In January 1983, the Nuclear Science Advisory Committee (NSAC) of the U.S. Department of Energy (DOE) and the National Science Foundation (NSF), appointed a Panel on Electron Accelerator Facilities (hereafter referred to as the panel) to review and evaluate electron accelerator facility proposals to meet this recognized need and to recommend the facility or combination of facilities that would best satisfy the United States' need for basic nuclear research with electromagnetic probes. The panel focused on five proposals which were submitted, respectively, by Argonne National Laboratory (ANL), the University of Illinois, the Massachusetts Institute of Technology (MIT), the National Bureau of Standards, and the Southeastern Universities Research Association (SURA). Each proposal was weighed with regard to many factors. Among the criteria most frequently considered were:

- importance of the accessible physics,
- feasibility of the proposed accelerator system,
- type and seriousness of possible failures to meet specifications,
- ability of the proposing group to perform—track record,
- attractiveness to the scientific community,
- cost effectiveness,
- educational potential,
- potential for facility upgrading,
- quality and commitment of internal staff,
- adequacy of plant and support facilities,
- potential attractiveness to external users,
- provision for, and experience with, external users,
- adequacy of management groups and structures,
- adequacy of proposed experimental facilities,
- adequacy of proposed staffing levels,
- institutional support,

- quality of proposal documentation,
- quality of proposal presentation,
- geographical location, access, and environment,
- impact on the electromagnetic physics community,
- impact on the nuclear physics community, and
- advantages and disadvantages of an entirely new laboratory.

In March 1983, the panel focused major attention on a comparison of the two fully-developed 4-GeV proposals—those from ANL and from SURA. Subsequently, a recommendation was made by the panel that the SURA proposal [the Continuous Electron Beam Accelerator Facility (CEBAF)] for the construction of an accelerator system capable of providing high-duty-factor beams throughout the energy range from 0.5 to 4.0 GeV be accepted. The panel documented its decision-making process in DOE (1983a).

1.2 PURPOSE AND SCOPE OF THE PROJECT

The Continuous Electron Beam Accelerator Facility (CEBAF) is intended to meet the highest priority need for new accelerator construction in the U.S. nuclear physics program. CEBAF's continuous wave linear accelerator complex, with its continuous beam and its capability of providing beams at any energy in the range from 0.5 to 4.0 GeV, offers the opportunity to study the largely unexplored transition between the nucleon-meson and the quark-gluon states of nuclear matter. Recent experiments have established that nucleons and mesons are composed of quarks and gluons, which are believed to interact according to the laws of QCD. The crucial problems facing nuclear physics today are (1) to understand to what extent this clustering of quarks and gluons into nucleons and mesons breaks down in the nuclear medium, giving rise to new states of matter, and (2) to learn how these new states of matter, which are the most visible manifestation of the presence of quarks and gluons and the laws of QCD, can be used to understand the structure of nuclei and the nature of the effective force between nucleons and mesons. CEBAF will possess the unique facilities necessary to address these questions with an unprecedented degree of precision.

Measurements of the electric charge distribution of the neutron, which will be possible at CEBAF, promise to reveal much about the distribution of quarks in simple bound systems. Electroproduction and photoproduction of hypernuclei via the $(e, e'K^+)$ reaction inserts strange quarks into nuclei and thus provides ideal opportunities to selectively study valence quark distributions. Polarized beams at CEBAF will make studies of fundamental symmetries of nature possible and will permit the direct measurement of many amplitudes which are particularly sensitive to details of nucleon structure that cannot be measured otherwise.

Detection of a scattered electron at a given angle and with a particular energy could result from a wide variety of electron-nucleus interactions. To accurately determine the dynamics of the event often requires that one or more reaction products be detected in coincidence with the scattered electron; this dictates that the incident beam have a high duty factor, that is, be a continuous beam rather than the sharply pulsed beams presently available at existing accelerators. The necessity for a continuous beam is essential at all energies and it becomes even more imperative as the numbers and complexity of the possible final states increase, which happens at the higher energies.

CEBAF will be the only facility in the world capable of producing electron beams which meet the necessary criteria of energy, duty factor and beam intensity. Other accelerators can deliver beams of similar or higher energies and others can match the high duty factor, but CEBAF's combination of polarized beams of multi-GeV energy, with high intensity and high duty factor, is unmatched. The unique combination of beam parameters available at CEBAF will make it a facility of unparalleled capability and the research will enable the U.S. to maintain its preeminence in this important area of nuclear science. The broad spectrum of physics accessible at CEBAF ensures that it will become and remain one of the important scientific centers in the world (DOE 1983b).

1.3 FEDERAL ROLE

DOE intends to contract with SURA for operation of CEBAF, which is proposed to be constructed at Newport News, Virginia. (SURA is a consortium of 35 institutions of higher learning, located throughout the southeastern United States, which was formed for the purpose of managing large cooperative projects in physical and biological sciences and in engineering.) The total estimated project cost is anticipated to be $236,000,000.

The CEBAF project is under the direction of DOE's Office of High Energy and Nuclear Physics (OHENP) which has offices located in Germantown, Maryland. In March 1984, field management of the CEBAF project was delegated by OHENP to DOE's Oak Ridge Operations Office (ORO), Oak Ridge, Tennessee.

1.4 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

This document is an Environmental Assessment (EA) prepared pursuant to Sect. 102 of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190), as implemented by regulations promulgated by the President's Council on Environmental Quality (CEQ) (40 CFR, Pt. 1500-1508, November 1978) and DOE Guidelines (45 FR 62, 20694-20701, March 28, 1980).

This EA, prepared by DOE with the assistance of the Oak Ridge National Laboratory, is intended to:

- provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a finding of no significant impact;
- aid DOE's compliance with NEPA when no EIS is necessary; and
- facilitate preparation of an EIS, if necessary.

The proposed action addressed herein is DOE's funding of the CEBAF project. Pursuant to Sect. 1508.9 of the CEQ regulations, this assessment presents information and analyses of all reasonable alternatives, including the proposed action. Section 2 describes the alternatives and compares the potential environmental impacts of each. The environment of the area(s) to be affected or created by the alternatives considered is presented in Sect. 3. The scientific and analytical basis for the comparison of alternatives in Sect. 2 is discussed in Sect. 4, which reports the environmental impacts of the alternatives, including the proposed action; any adverse effects which cannot be avoided should the proposal be implemented; any irreversible or irretrievable impacts; and mitigation measures that may be implemented to minimize adverse impacts.

REFERENCES FOR SECTION 1

DOE (U.S. Department of Energy). 1983a. *Report of the Panel on Electron Accelerator Facilities*, DOE/ER-0164.

DOE (U.S. Department of Energy). 1983b. *DOE 1985 Congressional Budget Request, Construction Project Data Sheets, Project 85-R-203.*

Friedlander, Gerhart. 1977. *Future of Nuclear Science*, submitted to the National Academy of Sciences, report of a panel of the National Research Council chaired by Gerhart Friedlander of Brookhaven National Laboratory.

Livingston, R.S. December 1977. *The Role of Electron Accelerators in the U.S. Medium Energy Nuclear Science*, report of a joint DOE/NSF study group chaired by R. S. Livingston of Oak Ridge National Laboratory.

NSAC (DOE/NSF Nuclear Science Advisory Committee). 1979. *Long Range Plan for Nuclear Science*, prepared for DOE and the National Science Foundation by the DOE/NSF Nuclear Science Advisory Committee.

NSAC (DOE/NSF Nuclear Science Advisory Committee). 1982. *Report of the NSAC Subcommittee on Electromagnetic Interactions*, prepared for DOE and the National Science Foundation.

NSAC (DOE/NSF Nuclear Science Advisory Committee). 1983. *Long Range Plan for Nuclear Science*, prepared for DOE and the National Science Foundation by the DOE/NSF Nuclear Science Advisory Committee.

NSAC (DOE/NSF Nuclear Science Advisory Committee). 1984. *Report of NSAC Ad Hoc Subcommittee on a 4-GeV Electron Accelerator for Nuclear Physics*, prepared for DOE and the National Science Foundation by the DOE/NSF Nuclear Science Advisory Committee.

RPI (Rensselaer Polytechnic Institute). 1981. *Report of the Workshop on Future Directions in Electromagnetic Nuclear Physics*, chaired by Paul Stoker of Rensselaer Polytechnic Institute, published by RPI.

2. THE PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

The National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190) and the CEQ regulations implementing NEPA (40 CFR Pt. 1500-1508) require that the environmental impacts of any proposed federal action be evaluated and considered in comparison to the impacts of various alternative actions. The proposed action evaluated herein is DOE's funding of CEBAF at Newport News, Virginia. Alternatives available to DOE include (1) "no action," (2) construction and operation of CEBAF at other sites, and (3) construction and operation of a facility using a technology different than CEBAF. The following sections present a description of the proposed action and alternatives and a comparison of the impacts of each.

2.2 THE PROPOSED ACTION

DOE intends to contract with SURA for the design and operation of CEBAF, which is proposed to be constructed at Newport News, Virginia (DOE Project 87-R-203). The proposed accelerator facility would include a 4-GeV high-intensity, continuous electron beam linear accelerator complex; experimental areas and equipment to conduct basic nuclear research; and buildings to house the accelerator complex and associated research activities. The project, at the direction of the DOE OHENP, would provide the nation with a high-energy, high-duty-factor electron accelerator capable of delivering electron beams of any energy from 0.5 to 4.0 GeV. This accelerator would enable nuclear science research to focus on fundamental nuclear physics at energies below 1 GeV as well as to study the role of quarks in nuclei at higher energies.

The FY 1987 Congressional Budget Request included $25 million for design and construction of the facility, with a total estimated cost of $236 million.

2.2.1 Project Location

Current plans indicate the use of 68 ha (169 acres) of federal land (DOE) at Newport News, Virginia for construction of the proposed CEBAF project. An additional 16 ha (41 acres) is expected to be made available for possible future use. New construction will be required for the accelerator and support facilities. Offices and laboratories will be located in the existing on-site Virginia Associated Research Campus (VARC) [3250 m^2 (35,000 ft^2 floor area)]. Remodeling of the former Space Radiation Effects Laboratory (SREL) [5,300 m^2 (57,000 ft^2 floor area)] will be necessary if it is to be used as one of the CEBAF project facilities.

The proposed site is previously disturbed land adjacent to the Oyster Point Industrial Park and east of Jefferson Avenue (Route 143) in the suburbs of Newport News, Virginia.

The VARC building lies at the north end of the site; the SREL building occupies the south end. The regional location of the CEBAF project is shown in Fig. 2.1; the specific location of the proposed site in Newport News is shown in Fig. 2.2. A proposed site layout is indicated in Fig. 2.3.

The CEBAF site is located in an area already zoned for research and development. The VARC building is presently occupied by CEBAF's Administration, Accelerator Physics, Engineering, and Project Management Divisions, and is used for research, instruction, and administration. The SREL building, which is presently unoccupied, was operated from 1963 to 1979 by the College of William and Mary for the National Aeronautics and Space Administration (NASA). SREL formerly housed a synchrocyclotron that produced a primary beam of 600-MeV protons. In 1979, the synchrocyclotron was removed by Brookhaven National Laboratory. An Environmental Assessment for Decommissioning SREL was prepared in 1980 (ERC 1980). An assessment of the residual radiological environment in experimental areas of the SREL building was conducted as part of the environmental impact analysis for decommissioning the facility. Results are summarized in ERC 1980 and detailed in Jacobs 1980.

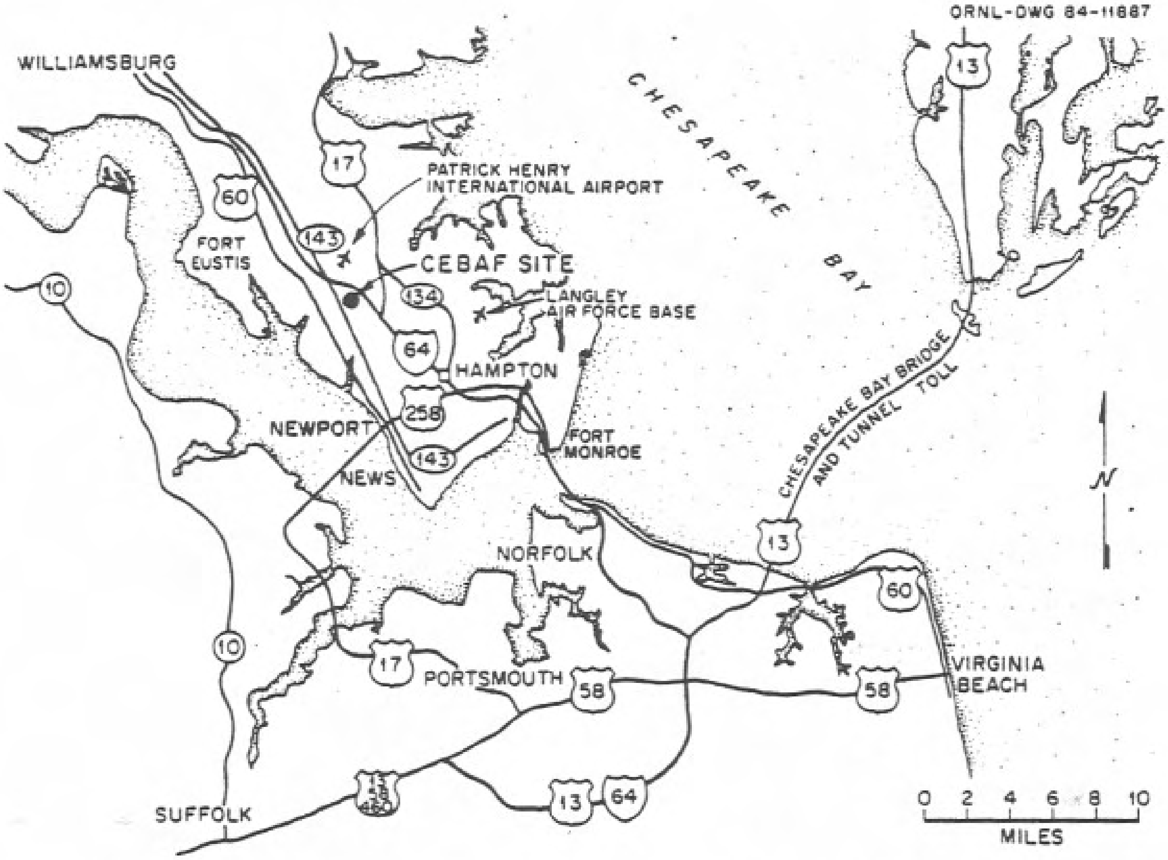


Fig. 2.1. Regional location of the proposed Continuous Electron Beam Accelerator Facility site at Newport News, Virginia.

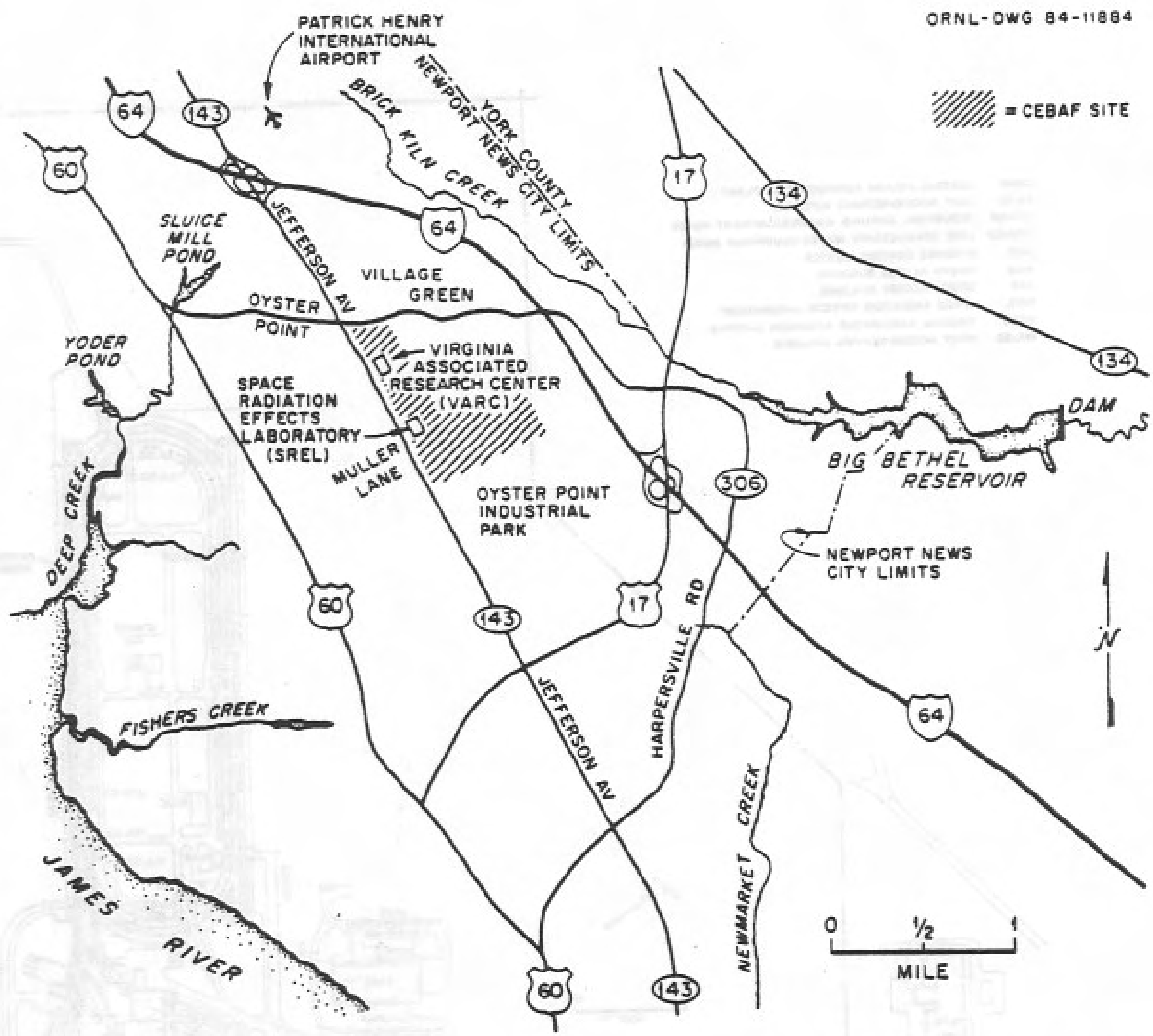


Fig. 2.2. Specific location of the proposed Continuous Electron Beam Accelerator Facility site at Newport News, Virginia.

Because of the relatively short half-life of the residual activation products in contaminated areas of the SREL building, it was concluded that the facility does not pose a long-term hazard to future occupants. Three options for remedial action to limit radiation exposure rates to 0.03 mR/h were recommended : (1) shielding, (2) removal of activated concrete, and (3) nonuse of the facility until natural decay has occurred.

In September 1985, another radiological evaluation of the SREL building was initiated as a contingency for building occupancy. Results of this analysis (Yalcintas 1986) will determine the steps that will be taken by DOE to ensure that radiation exposure rates for future occupants of the building are within acceptable levels.

The proposed site for CEBAF consists of 68 ha (169 acres). The heavily vegetated site occupies sandy, wooded land on a peninsula between the York and James rivers, and is flat to within five-foot variations. No major surface water bodies exist on-site. Immediately adjacent to the CEBAF site are light to medium industry, strip commercial development,

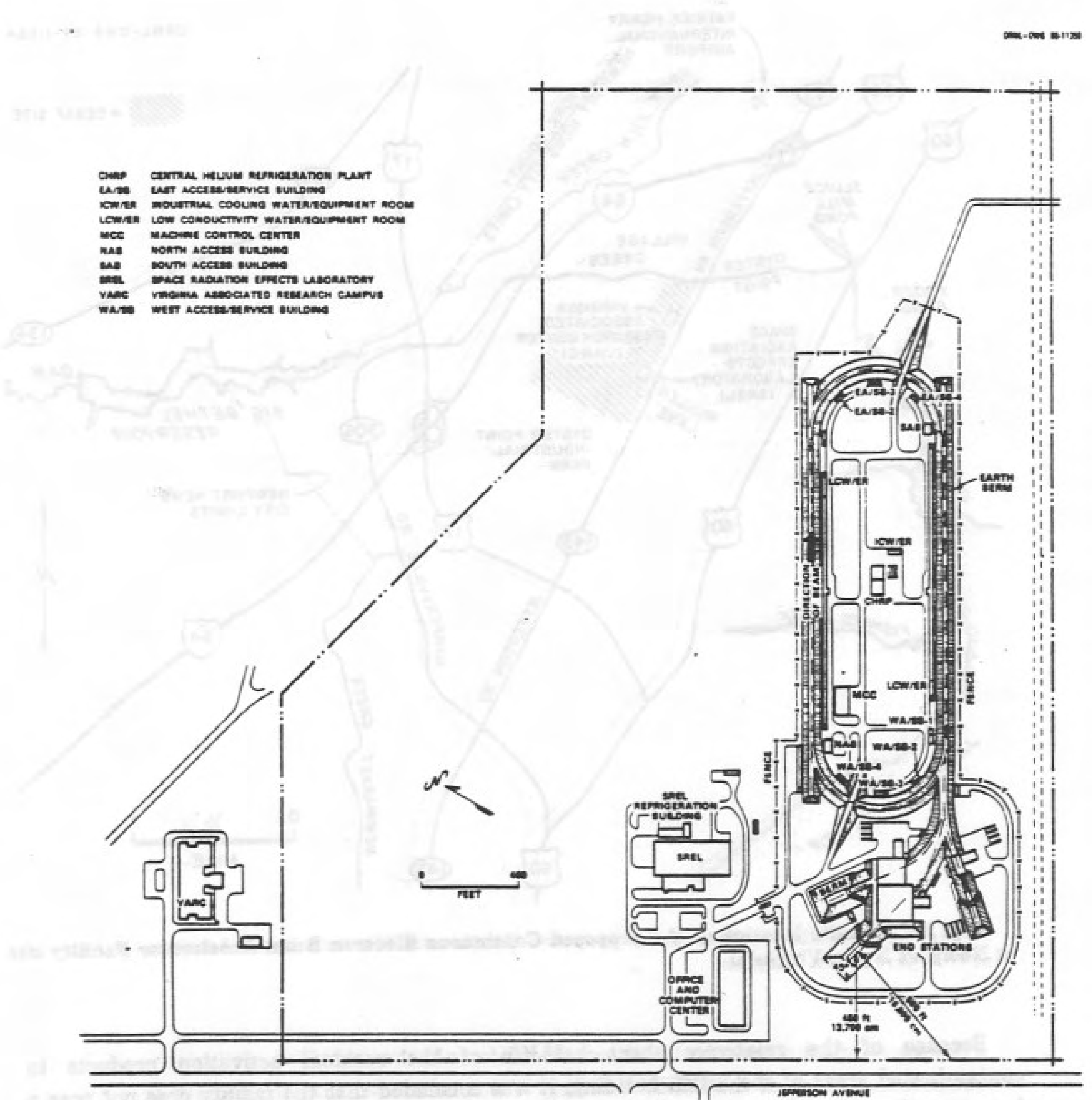


Fig. 2.3. Proposed site layout for the Continuous Electron Beam Accelerator Facility at Newport News, Virginia.

and single-family to multifamily housing. An adjacent tract of land [about 120 ha (300 acres)] owned by the City of Newport News may provide an opportunity for the development of an Applied Research Center (B. Sardella, Assistant Director of Development, City of Newport News, Va., personal communication with W. N. Lingle, Oak Ridge Operations, DOE, December 5, 1984). Existing utilities and services should be adequate to meet the needs of the CEBAF project. A more detailed discussion of the existing environment at the proposed site is presented in Sect. 3.

2.2.2 Project Description

2.2.2.1 Facilities

The proposed CEBAF is to be located in Newport News, Virginia, on the site adjacent to and including SREL. The adjacent land and the SREL building will become DOE property for the purpose of construction and operation of CEBAF. The accelerator facility will include a high-intensity, high-duty-factor, 4-GeV continuous wave linear accelerator, experimental areas and equipment to conduct basic nuclear research, and buildings to house the accelerator complex and its research activities. The proposed site layout is indicated in Fig. 2.3. The laboratory will possess a full complement of experimental equipment and supporting facilities to exploit the capabilities of the accelerator. CEBAF will be unique in that it will supply intense, continuous beams of electrons at energies up to 4 GeV.

The conceptual design for CEBAF and operational details are presented in DOE (1986). A schematic of the CW linac is shown in Fig. 2.4.

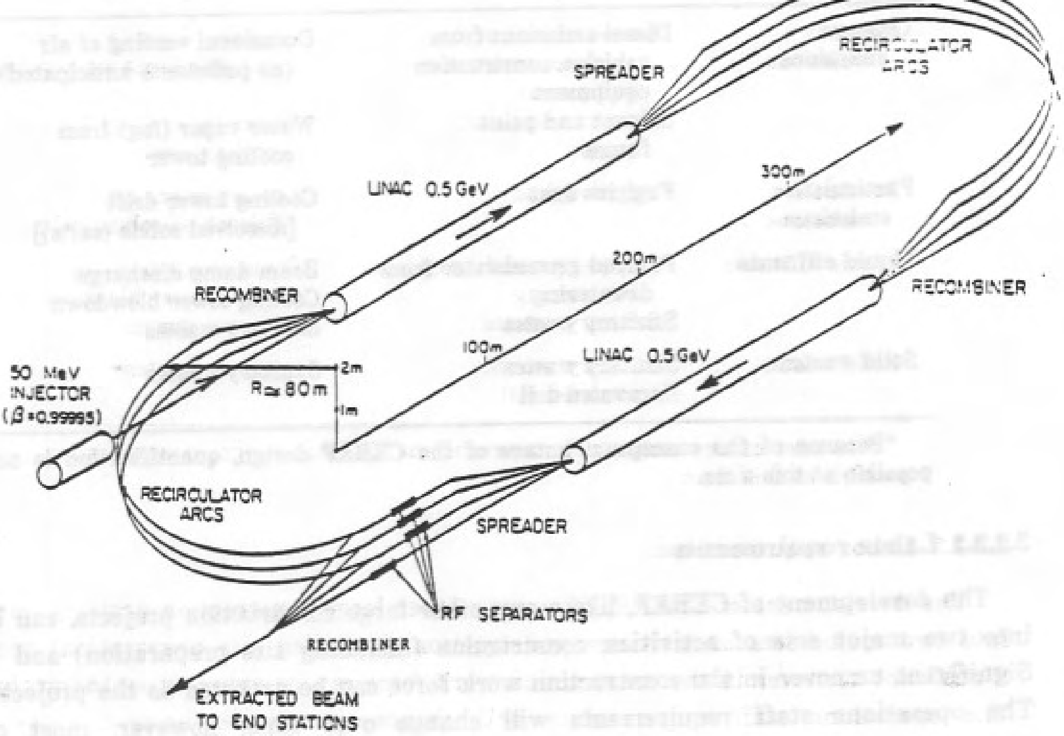


Fig. 2.4. Schematic of the CEBAF recirculated superconducting continuous wave linac.

2.2.2.2 Emissions and effluents

Emissions and effluents that could result from construction and operation of CEBAF are summarized in Table 2.1. Sanitary wastes and cooling tower blowdown will be discharged to the community sewer system. It is likely that groundwater from dewatering and from holding tanks at the beam dumps will be discharged to the site drainage system. Any excavated soil not used on-site will be disposed of at a licensed landfill facility or used as fill elsewhere in the vicinity.

The CEBAF facility is subject to the National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart H—*National Emission Standard for Radionuclide Emissions from Department of Energy (DOE) Facilities*. Subpart H establishes that radionuclides to air from DOE facilities shall not exceed those amounts that cause a dose equivalent of 25 millirem/year to the whole body or 75 millirem/year to the critical organ of any member of the public. It also establishes emission monitoring and compliance procedures and reporting requirements. Radiological emissions from the CEBAF are expected to be insignificant and compliance with the standard is anticipated. All required procedures and reporting requirements will be followed, and applications for approval of construction will be submitted by DOE to the EPA prior to construction.

Table 2.1. A qualitative summary of emissions and effluents that could result from construction and operation of the proposed Continuous Electron Beam Accelerator Facility at Newport News, Virginia[a]

	Construction	Operation
Gaseous emissions	Diesel emissions from vehicles, construction equipment	Occasional venting of air (no pollutants anticipated)
	Solvent and paint fumes	Water vapor (fog) from cooling tower
Particulate emissions	Fugitive dust	Cooling tower drift [dissolved solids (salts)]
Liquid effluents	Pumped groundwater from dewatering Sanitary wastes	Beam dump discharge Cooling tower blowdown Sanitary wastes
Solid wastes	Sanitary wastes Excavated soil	Sanitary wastes

[a]Because of the conceptual nature of the CEBAF design, quantification is not possible at this time.

2.2.2.3 Labor requirements

The development of CEBAF, like many other large construction projects, can be divided into two major sets of activities: construction (including site preparation) and operation. Significant turnover in the construction work force can be expected as the project proceeds. The operations staff requirements will change over time; however, most operations personnel, particularly key staff members, are expected to be sufficiently adaptable to be effective in new operations roles.

Construction of the proposed CEBAF project will require laborers and heavy construction workers as well as electricians, millwrights, and other skilled craftsmen. The construction work force is anticipated to peak at around 300 people in late 1988. During this peak period, there may be up to 200 design and operations specialists onsite in addition to the construction workers. Some of these may be visiting professors serving as short-term consultants.

Operations period staff members can be divided into four groups: administrators, machine builders, machine operators, and machine users. The objectives of the four groups are quite distinct, although some people may work in more than one group. Each group may include professionals, technicians, clerks, typists, and various other workers. The laboratory operating staff may total about 250 employees (Brobeck Corporation 1983). In addition, about 50 visiting scientists could be expected to be onsite at any time (DOE 1986).

2.2.2.4 Schedule

A proposed timetable for major milestones associated with CEBAF is given in Fig. 2.5. Initiation of construction is anticipated in FY 1987, with completion targeted for mid-FY 1992. DOE (1986) contains a detailed construction schedule.

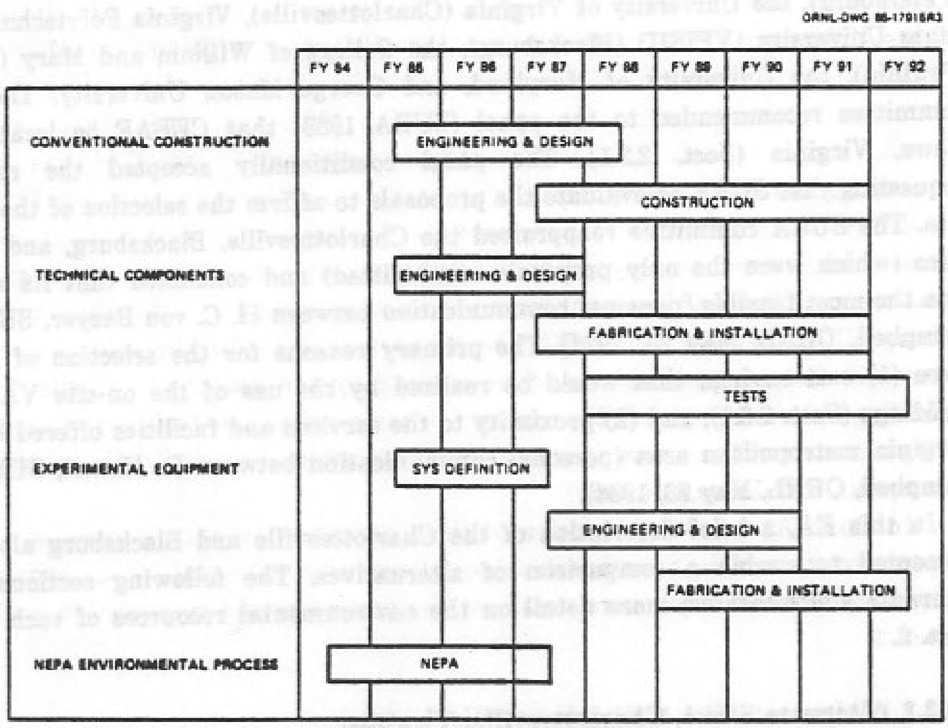


Fig. 2.5. Proposed timetable for activities associated with the Continuous Electron Beam Accelerator Facility project at Newport News, Virginia.

2.3 ALTERNATIVES

2.3.1 No Action

If no action is taken to fund the CEBAF project, the highest-priority need for new accelerator construction in the United States nuclear physics program would not be met. The CEBAF, with its continuous beam and its capability of providing energies from 0.5 to 4.0 GeV, offers American scientists the opportunity to study the largely unexplored transition between the nucleon-meson and the quark-gluon states of nuclear matter (DOE 1983a). To take no action would deny this opportunity.

2.3.2 Other Sites

Following the April 1983 recommendation of the NSAC Panel on Electron Accelerator Facilities that the proposal submitted by SURA be accepted and funded for the construction of a new national electron accelerator laboratory (CEBAF), SURA reevaluated proposals received from among its members for the location of CEBAF. A site selection committee, consisting of SURA representatives and other appointed scientists, had previously reviewed and evaluated the site proposals submitted, respectively, by Virginia State College (Petersburg), the University of Virginia (Charlottesville), Virginia Polytechnic Institute and State University (VPISU) (Blacksburg), the College of William and Mary (Newport News, Virginia), the University of Maryland, and George Mason University. The site selection committee recommended to the panel (SURA 1983) that CEBAF be located at Newport News, Virginia (Sect. 2.2.1). The panel conditionally accepted the recommendation, requesting that SURA re-evaluate the proposals to affirm the selection of the Newport News site. The SURA committee reappraised the Charlottesville, Blacksburg, and Newport News sites (which were the only proposals resubmitted) and concluded that its earlier decision was the most feasible [personal communication between H. C. von Baeyer, SURA, and A. W. Campbell, ORNL, May 24, 1984]. The primary reasons for the selection of Newport News were (1) cost savings that would be realized by the use of the on-site VARC and SREL buildings (Sect. 2.2.1), and (2) proximity to the services and facilities offered by the Norfolk, Virginia metropolitan area (personal communication between D. Hamel, SURA, and A. W. Campbell, ORNL, May 23, 1984).

In this EA, a brief description of the Charlottesville and Blacksburg alternate sites is presented to enable a comparison of alternatives. The following sections describe the alternate site locations; more detail on the environmental resources of each is provided in Sect. 3.

2.3.2.1 Alternate Site 1, Charlottesville, Virginia

The Charlottesville site proposed for CEBAF by the University of Virginia would be located on approximately 80 ha (200 acres) in Albemarle County, 10.4 km (6.5 miles) north of the City of Charlottesville and 14.4 km (9 miles) north of the university (Fig. 2.6). The site is just west of Route 29 and just northeast of the Charlottesville-Albemarle Airport, near the county's newest industrial park. The area location for the site is shown in Fig. 2.7.

ORNL-DWG 84-12045

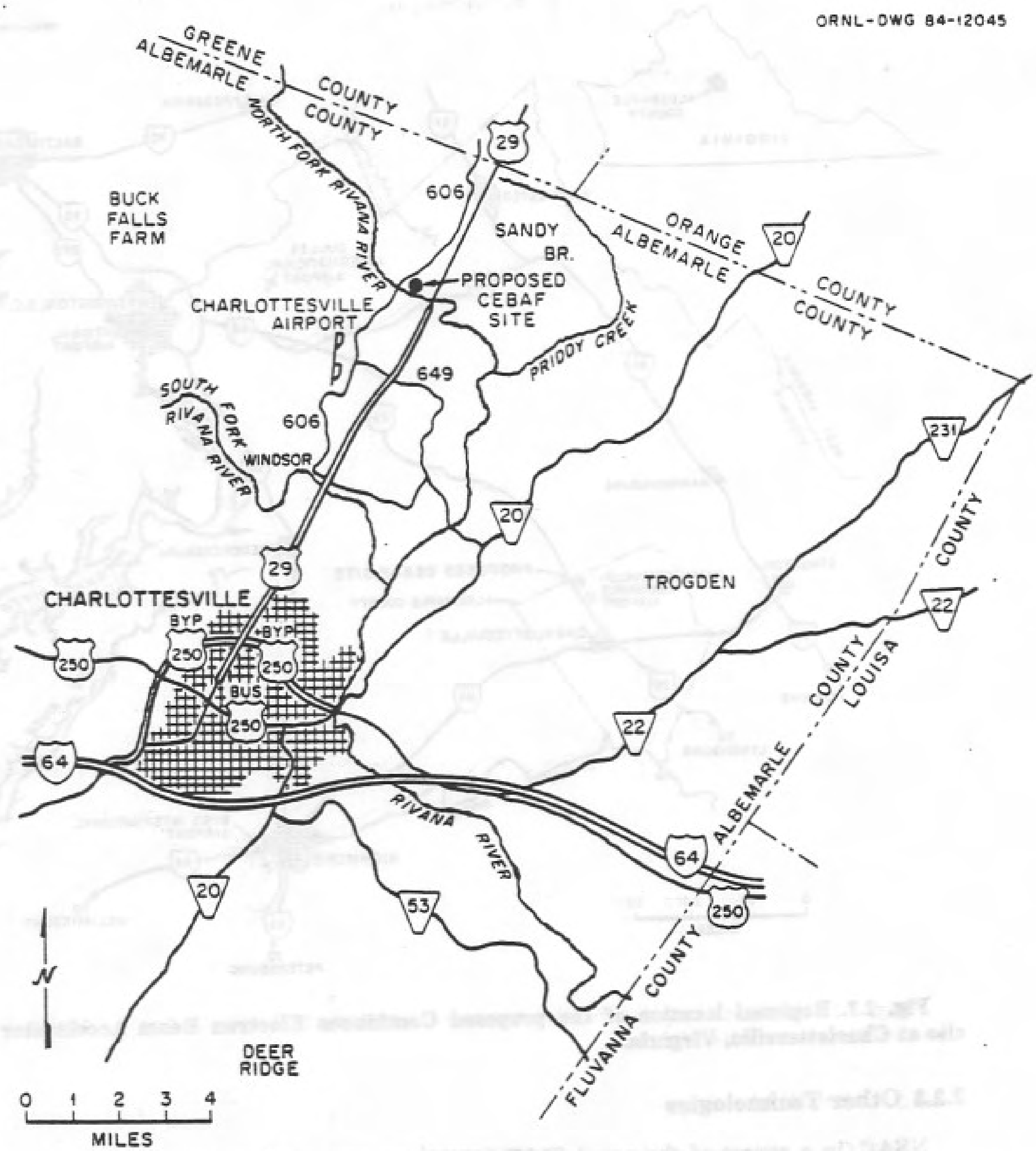


Fig. 2.6. Specific location of the proposed Continuous Electron Beam Accelerator Facility site at Charlottesville, Virginia.

2.3.2.2 Alternate Site 2, Blacksburg, Virginia

The proposed Blacksburg site would be located on approximately 80 ha (200 acres) on the VPISU campus in southwestern Virginia, about 64 km (40 miles) southwest of Roanoke, Virginia. The proposed site location is indicated in Fig. 2.8; the regional location is shown in Fig. 2.9.

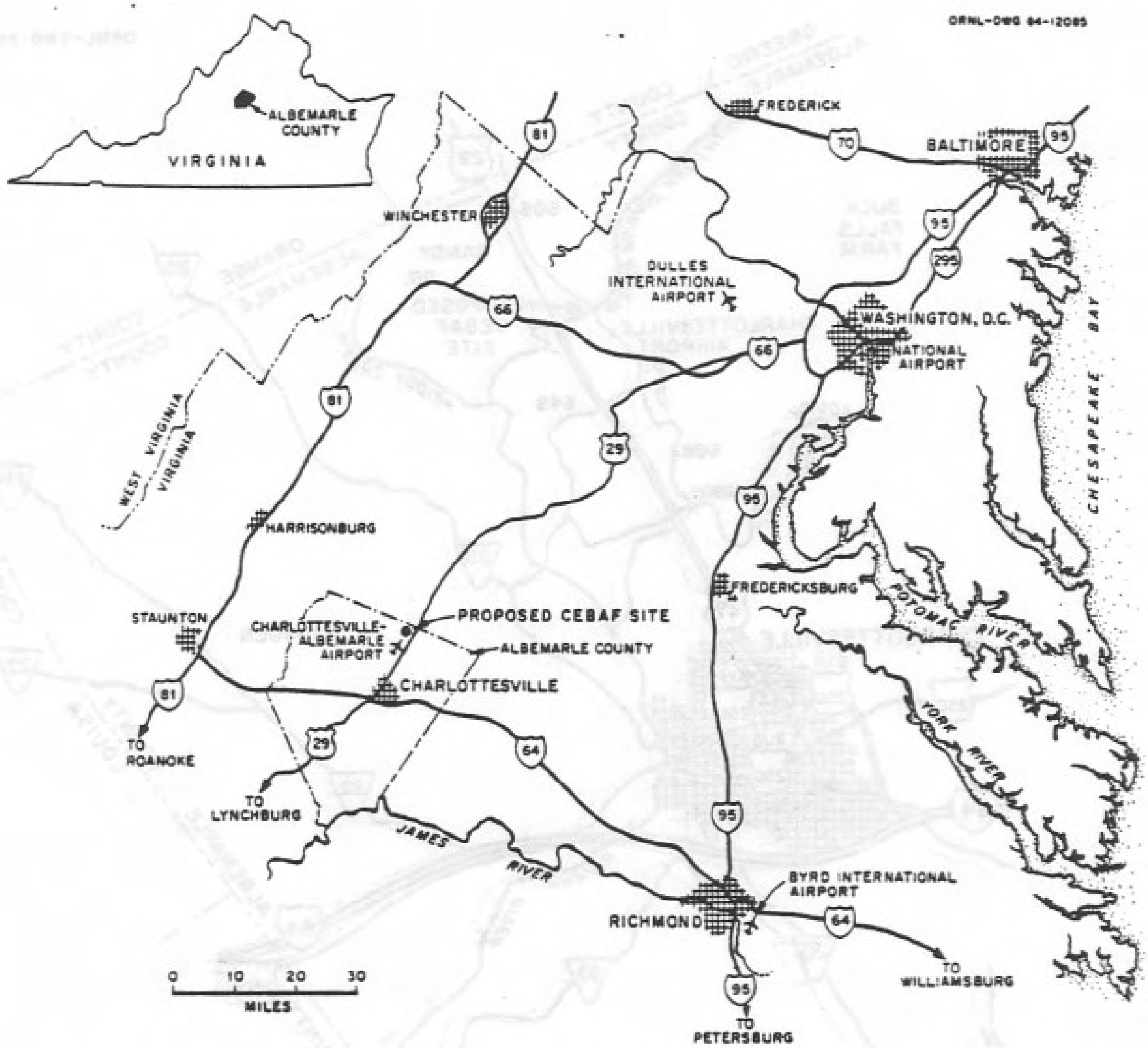


Fig. 2.7. Regional location of the proposed Continuous Electron Beam Accelerator Facility site at Charlottesville, Virginia.

2.3.3 Other Technologies

NSAC, in a report of the panel (DOE 1983b), reviewed and evaluated electron accelerator facility proposals submitted by ANL, the University of Illinois, MIT, the National Bureau of Standards, and SURA. Following preliminary screening, the panel narrowed its considerations to the ANL and the SURA proposals. The principal recommendation of the panel was the SURA proposal for CEBAF (Sect. 1.1). The technology proposed by ANL was a six-sided CW 4-GeV electron microtron (Hexatron or GEM) to be housed in the existing Zero Gradient Synchrotron (ZGS) buildings at ANL, Argonne, Illinois.

The alternative CEBAF technology considered in this EA would include a high-duty-factor, 4-GeV electron linear accelerator/pulse stretcher storage ring complex, experimental areas and equipment to conduct basic nuclear research, and buildings to house the accelerator complex and its research activities. The site layout is indicated in Fig. 2.10. The alternative technology would consist of the following (Fig. 2.11):

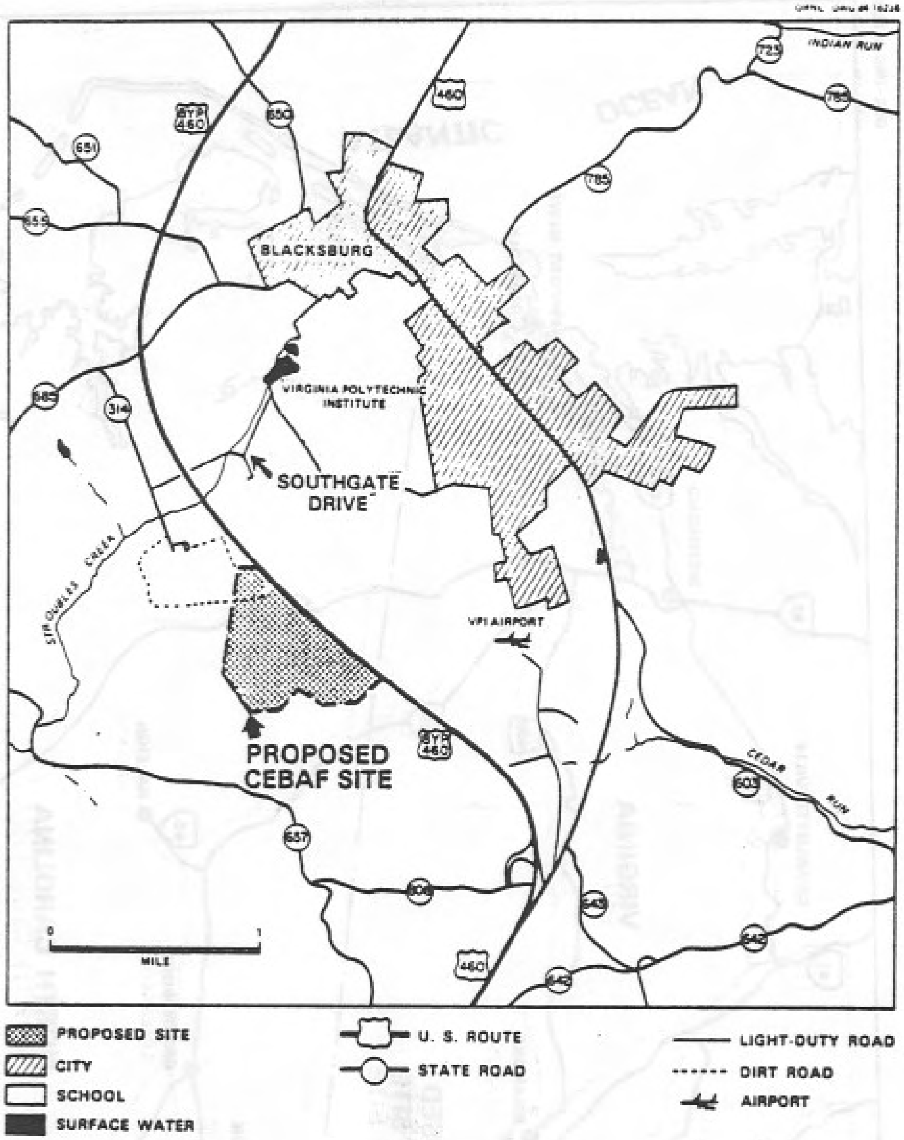


Fig. 2.8. Specific location of the proposed Continuous Electron Beam Accelerator Facility site at Blacksburg, Virginia.

Linear Accelerator. This would be a constant-gradient, s-band, traveling wave linac together with a recirculation beam transport. The intensity and energy of the electron beam would be variable on a pulse-to-pulse basis. The linac operates in the beam-loaded region and the maximum energy attainable is dependent upon the accelerated current. The zero-current limit of the accelerator is 4.8 GeV. The linac and recirculator components would be designed and optimized for the present energy range of the linac, 0.5 to ~4.0 GeV.

Pulse Stretcher Ring. The ring would have a racetrack shape with a circumference of 370 m (1233 ft). Each electron pulse would be injected into the closed, central orbit of the ring during a single turn. The components of the ring would be designed to match the energy range of the linear accelerator.

ORNL-DWG 84-16235

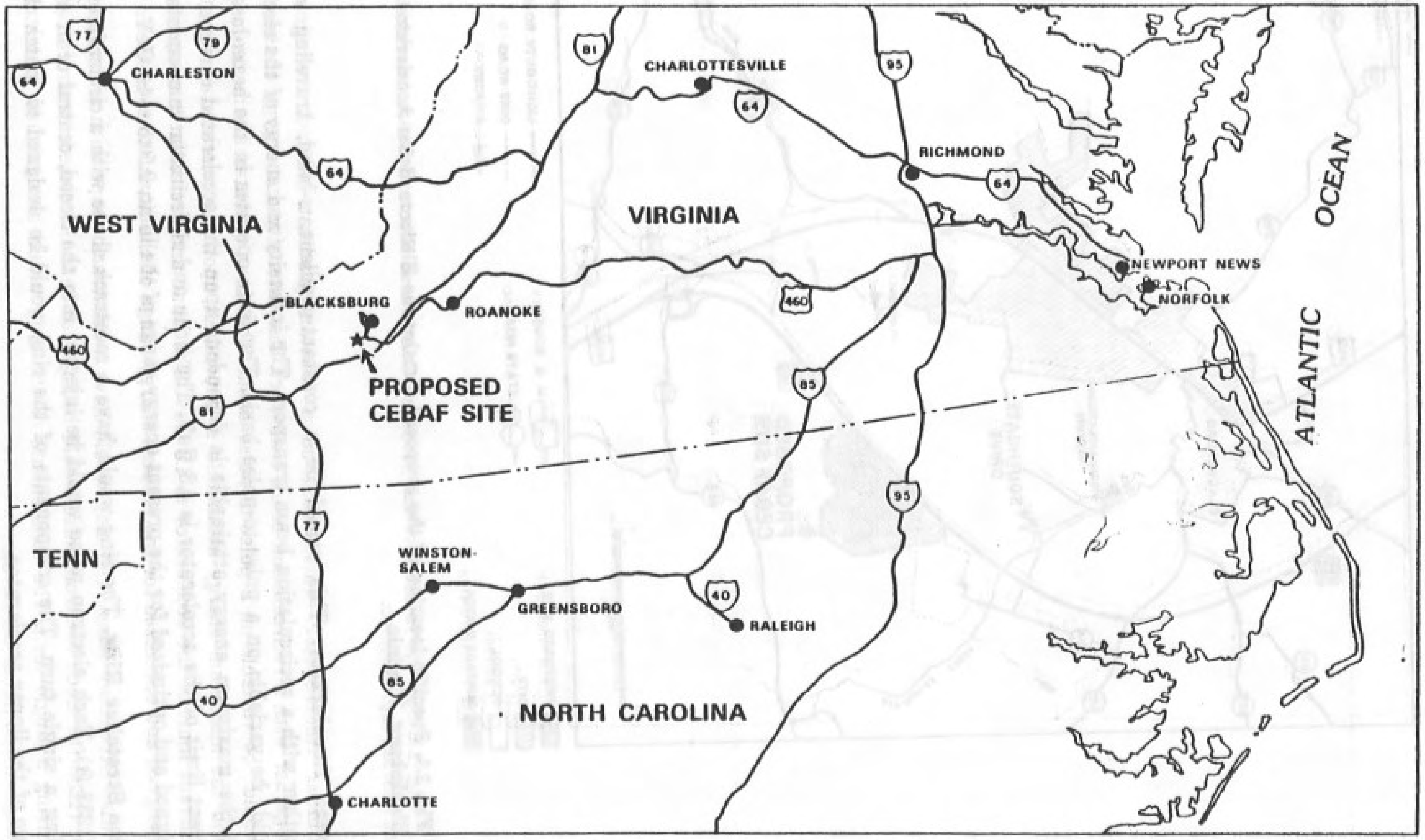
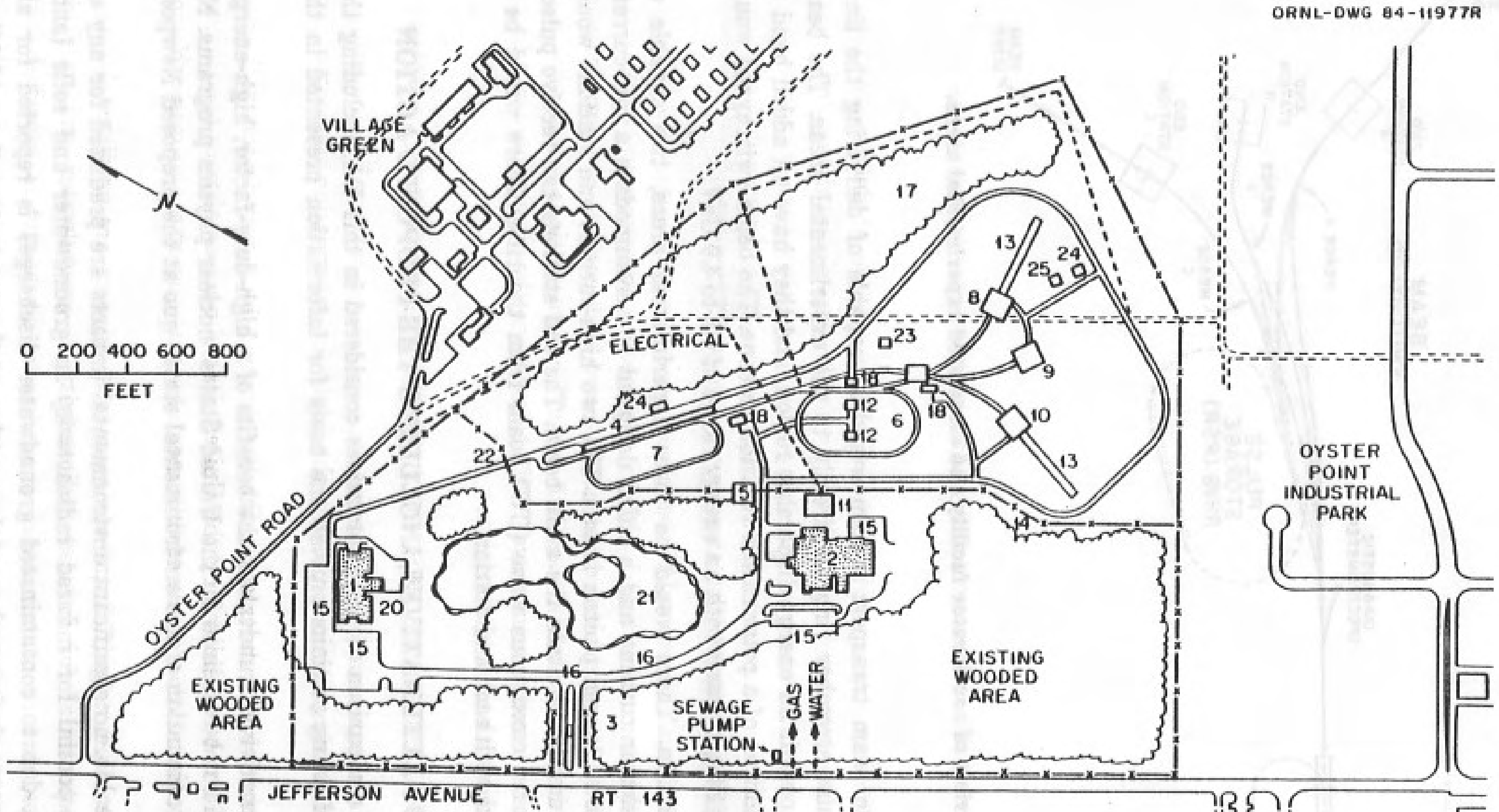


Fig. 2.9. Regional location of the proposed Continuous Electron Beam Accelerator Facility site at Blacksburg, Virginia.



KEY

1 – EXISTING VARC OFFICE BUILDING OFFICE AND LABORATORIES
2 – EXISTING SREL SUPPORT BUILDING MACHINE SHOP, MAINTENANCE AND CRYOGENICS ACCELERATOR CONTROL AND POWER
3 – GUARDHOUSE
4 – KLYSTRON GALLERY
5 – OPERATIONS BUILDING
6 – PULSE STRETCHER RING
7 – LINAC
8 – END STATION A
9 – END STATION B
10 – END STATION C
11 – MASTER POWER SUBSTATION
12 – RING GALLERY
13 – BEAM DUMP
14 – SECURITY FENCE
15 – PARKING
16 – ROADWAY
17 – FUTURE EXPANSION
18 – TUNNEL ACCESS BUILDING
19 – HAS BEEN DELETED FROM PLANS
20 – COURTYARD–COMMONS AREA
21 – LAKE (BORROW AREA)
22 – CONTROLLED ACCESS GATE
23 – STANDBY POWER GENERATOR
24 – COOLING TOWER
25 – BEAM DUMP HOLDING TANK

EXISTING STRUCTURE
PROPOSED STRUCTURE
FENCE
FIVE-GRADE ELEVATION ~34
BEAM ELEVATION 24

Fig. 2.10. Site layout for the alternative CEBAF technology at Newport News, Virginia.

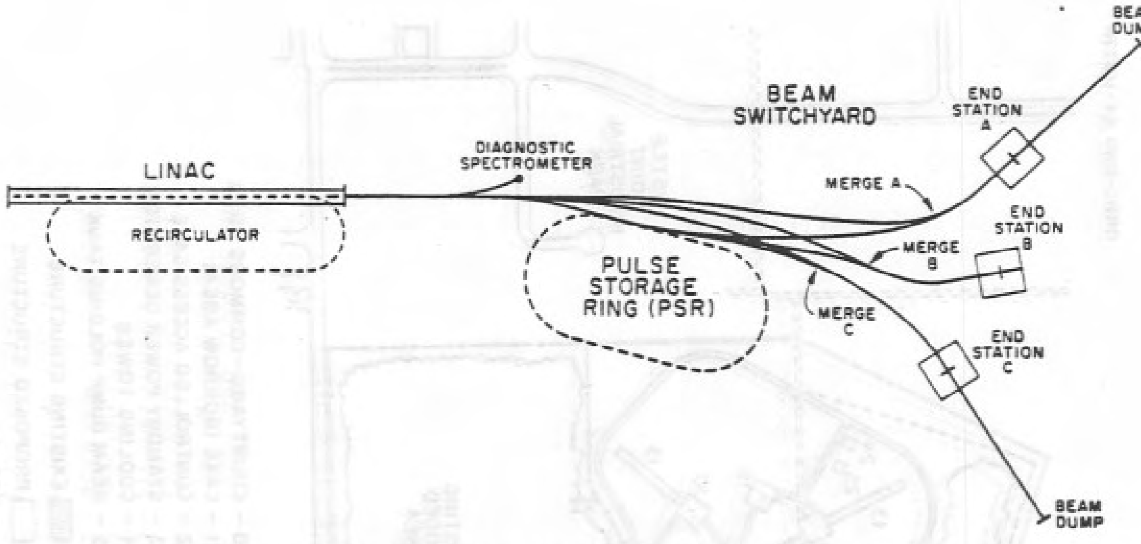


Fig. 2.11. Overview of accelerator facility and associated experimental areas.

Beam Switchyard. The beam transport system would be capable of delivering the linac beams either to the pulse stretcher ring or directly to the experimental areas. The beam lines are configured to permit an energy-dispersing region, and they have an added bend to accommodate a later addition of a polarization rotation chicane. The beam switchyard would be capable of handling 240-μA beams with an energy range of 0.5 to 4.0 GeV.

Experimental End Station. There would be three experimental areas, two capable of receiving the full accelerator current and a third designed to accommodate a low-current beam for the production of tagged photon beams. The two high-current end stations would have associated beam dumps to contain the main beam. The end stations can receive pulsed beams from the linac or a continuous wave (CW) beam from the ring. There would be a countinghouse associated with each end station.

2.4 COMPARISON OF ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Table 2.2 presents a comparison of the alternatives considered in this EA, including the proposed action. The following sections provide the basis for information presented in the table.

If the no action alternative is undertaken, the benefits of a high-duty-factor, high-energy electron accelerator will not be realized by the United States' nuclear physics programs. No action will result in a continuation of the environmental status quo at the proposed Newport News, Virginia site.

As indicated in the table, no significant environmental impacts are predicted for any of the alternatives. The potential for induced radioactivity in groundwater and soils (and, possibly, surface water, due to contaminated groundwater discharge) is reported for all alternatives; however, proper design and careful operation of the accelerator (i.e., shielding, containment of the beam, and storage and monitoring of adjacent contaminated groundwater) will minimize this potential, and no significant impacts are expected.

Table 2.2. A comparison of the alternatives considered in this Environmental Assessment, including the proposed action: construction and operation of the Continuous Electron Beam Accelerator Facility at Newport News, Virginia

Potential impacts (degree of significance)

Alternatives	Air quality, meteorology, and noise	Water resources		Geology and soils	Ecological resources	Community Resources	Radiological impacts[a]
		Surface	Groundwater				
Sites							
Continuous wave linac Newport News, Virginia	Vehicle emissions Fugitive dust Water vapor Cooling tower drift Radioactive gases Cooling tower noise (Low)	Sediment-laden runoff (Low)	Lowered water table Induced radioactivity (Low) ^{3}H-7.7-36 pCi/mL at beam dump 0.072-0.24 pCi/mL at site boundary ^{22}Na-11-60 pCi/mL at beam dump 7.6×10^{-13} to 2.6×10^{-12} pCi/mL at site boundary	Soil activation Low seismic risk Altered topography Erosion (Low)	Loss of 30 ha (73 acres) of forest and associated wildlife (Low)	Positive benefit to the local economy (Low)	Direct radiation dose: 8.5 millirem/year Background dose: 78 millirem/year (Low)
Continuous wave linac Charlottesville, Virginia	Vehicle emissions Fugitive dust Water vapor Cooling tower drift Radioactive gases Cooling tower noise (Low)	Sediment-laden runoff (Low)	Induced radioactivity (Very low)	Soil activation Seismic risk greater than Newport News Altered topography Erosion (Low)	Loss of some terrestrial habitat and wildlife (Low)	Increased demand for housing and services Traffic congestion (Low)	Direct radiation dose: 8.5 millirem/year Background dose: 96 millirem/year (Low)
Continuous wave linac Blacksburg, Virginia	Vehicle emissions Fugitive dust Water vapor Cooling tower drift Radioactive gases Cooling tower noise (Low)	Sediment-laden runoff (Low)	Induced radioactivity (Very low)	Soil activation Seismic risk greater than Newport News Subsidence risk Altered topography Erosion (Low)	Loss of some terrestrial habitat and wildlife (Low)	Increased demand for housing and services Traffic congestion (Low)	Direct radiation dose: 0.06 millirem/year Background dose: 108 millirem/year (Low)
Technology							
Linac/pulse stretcher ring[b]	Vehicle emissions Fugitive dust Water vapor Cooling tower drift Radioactive gases Cooling tower noise (Low)	Sediment-laden runoff (Low)	Induced radioactivity (Low)	Soil activation Low seismic risk Altered topography Erosion (Low)	None	None	Direct radiation dose: 8.5 millirem/year (Low)

[a]At nearest receptors, assuming shielding designed for 10 millirem/year at boundary or 25 millirem/year based on the Clean Air Act amendment limits (Sect. 4.1.6.1).

[b]Location of the alternative technology at any of the alternative sites would result in impacts of the same degree of significance as the proposed technology.

An alternate technology, the linac/pulse stretcher ring, is included in this comparison in addition to the consideration of alternate sites for CEBAF. Impacts of the two technologies are not predicted to be notably different. The selection of the continuous wave linac over the linac/pulse stretcher ring was made by nuclear science experts based on relative costs and technical merits. An assessment of that decision is beyond the scope of this EA.

An evaluation of alternate sites and their impacts indicates that any one of the three would be a feasible location for CEBAF. The Newport News site was chosen over the others because of the infrastructure of the metropolitan Newport News area (e.g., transportation, labor force, services readily available) and the cost savings to be realized by the use of the existing buildings (VARC and SREL) on-site (personal communication between H. C. von Baeyer, SURA, and A. W. Campbell, ORNL, May 24, 1984).

2.4.1 Air Quality

At the three alternate sites evaluated in this EA, the construction of CEBAF would result in insignificant emissions of fugitive dust, vehicle and equipment exhaust, fumes from various solvents and paints, and radioactive gases. Operation of cooling towers at the facility would result in a plume of water vapor emissions, which would probably contain dissolved solids. Upon release to the atmosphere and subsequent evaporation, the solids would remain aloft as "drift," and would later deposit in the environment. Because of the small size of the cooling towers to be used at CEBAF, a significant amount of drift is not anticipated and the potential for impacts is low. Water vapor from the towers could also produce localized fog or enhance naturally occurring fog. At all sites, the towers would be sited far enough from nearby highways and airports to minimize potential traffic hazards due to fog.

Impacts from the operation of a linac/pulse stretcher ring would be similar to those of the continuous wave linac.

In the unlikely event that any of the atmospheric emissions cited above could significantly degrade air quality, available mitigation measures would reduce impacts to acceptable levels (Sect. 4.1.1).

2.4.2 Water Resources

2.4.2.1 Surface water

A small pond exists at the Charlottesville, Virginia site; no surface water bodies exist on the Blacksburg or Newport News sites. The Big Bethel Reservoir, a public drinking water supply, is located 2.7 km (1.7 miles) east of the Newport News site. Uncontrolled storm water runoff and discharge from any site drainage system could potentially introduce contaminants into nearby waterways (Sect. 4.1.2). Good construction and engineering practices, including a well-planned and well-implemented erosion and sedimentation control program, should minimize the potential for adverse impacts at all sites. The potential for surface water contamination by groundwater discharge is discussed below.

2.4.2.2 Groundwater

Dewatering for construction of CEBAF will be necessary (and may be necessary during operation) at the Newport News, Virginia site, where the water table is within 1 m (3 ft) of the surface. Such an activity would lower the water table in the immediate site area. However, because groundwater is not known to be used in the immediate area, this impact would be insignificant. Groundwater levels in the Charlottesville and Blacksburg, Virginia sites are deeper and dewatering is unlikely.

The potential for induced radioactivity in groundwater because of accelerator operation exists at all alternate sites. Induced radioactivity could result from uncontained beam in the accelerator tunnels or the beam dumps. The amount of induced radioactivity would be similar for all alternatives considered (Sect. 4.1.2), but the potential for contamination is greatest at Newport News, where the groundwater is closest to the land surface. Without mitigation, contaminated groundwater could ultimately discharge to nearby surface waters. The greatest concern would be groundwater contaminated by induced radioactivity discharging to Big Bethel Reservoir, which is a drinking water supply near the Newport News site.

Significant impacts due to induced radioactivity in groundwater are not expected, however. Design and shielding of CEBAF will minimize uncontained beam energies. Groundwater adjacent to beam dumps will be monitored for radioactivity content. Beam dump areas, which have the highest potential for induced radioactivity, will be dewatered as necessary. Groundwater from dewatering during operation will be monitored. No groundwater from the dewatering will be released to the environment via the drainage system if it exceeds 1 pCi/mL gross beta. The final design and monitoring and mitigation plans will be submitted by DOE to the U.S. Army Corps of Engineers for approval prior to construction to assure that no contamination of or reduction in flow to Big Bethel Reservoir will occur.

2.4.3 Geology and Soils

Some erosion and alteration of topography is expected for all alternate CEBAF sites.

The degree of seismic risk is greater at the Charlottesville and Blacksburg, Virginia sites than the Newport News site, but the potential for impacts is still low. The geology of the Blacksburg site (Sect. 4.3.3) is such that the potential for subsidence is greater than at the other sites. Mitigation measures are available, however, to minimize adverse impacts.

Induced radioactivity in soils is likely for all sites. Some activity may be further leached to groundwater. Conservative estimates of soil activation (Sect. 4.1.3.2) are low, and impacts are not expected to be significant.

2.4.4 Ecological Resources

About 30 ha (74 acres) of hardwood and hardwood-pine forest will be cleared at the Newport News, Virginia site. Some terrestrial habitats will be destroyed, resulting in a proportional decrease in indigenous wildlife populations (Sect. 4.1.4). Species present are not endangered or threatened, and impacts are not expected to be significant.

Available information regarding the ecological resources at the two alternate CEBAF sites likewise indicates a low potential for impacts.

2.4.5 Community Resources

The proposed and alternate CEBAF sites are all located within the Commonwealth of Virginia. Newport News is on the Virginia Peninsula at Hampton Roads;

Charlottesville/Albemarle County is in central Virginia; and Blacksburg/Montgomery County is in southwest Virginia. In order to gauge the ability of the alternate sites to accommodate project-induced socioeconomic impacts, a worst-case scenario was developed in which 930 new residents in 325 households are projected to move to the principal municipality within the impact area. The population of the greater Newport News region supports the attractiveness of this site as a location for the CEBAF project. With a city population of 153,732 and a total metropolitan population of over 1.2 million residents, the likelihood of negative community resource impacts, even in the unlikely event of the worst-case rate of in-migration, is minimal (Sect. 4.1.5.1). The populations of the Charlottesville/Albemarle County (population 103,344) and Blacksburg/Montgomery County (population 68,113) regions are significantly smaller, indicating that facility-induced in-migration and associated community impacts could be greater than in Newport News (Sect. 4.2.5.1 and Sect. 4.3.5.1).

Vehicular transportation access to the proposed sites is currently adequate only in the case of Newport News. The existing capacity of principal roads in this area is well in excess of local traffic utilization, providing easy movement for project-related vehicles as well as for established residents (Sect. 4.1.5.5). In contrast, certain secondary roadways connecting major direct highways to the Blacksburg or Charlottesville sites would require substantial improvement if the CEBAF project were located at either.

2.4.6 Radiological Impacts

No significant atmospheric releases of radionuclides are expected from CEBAF at any of the sites considered. All doses calculated for direct radiation exposure at the nearest residences are well below boundary dose limits established for high-energy accelerators by DOE (Sect. 4.1.6).

2.4.7 Ambient Noise

At the three alternate sites, the construction of CEBAF would result in short-term increases in ambient noise levels. Because of their brief duration, construction impacts are not expected to be significant. Operation of the cooling tower(s) at Newport News, Virginia is not expected to increase ambient noise levels at the nearest receptor above levels recommended by the Environmental Protection Agency (EPA) for adequate protection of the public. The degree of cooling tower noise impact at the other two sites will depend upon the existing noise levels at each site and on the proximity of sensitive receptors to the sites. Occupational exposure to noise at any of the alternate sites would be limited to levels recommended by the Occupational Safety and Health Administration; therefore, no significant impacts would be likely.

In the unlikely event that any of the estimated noise levels discussed above exceeded EPA-recommended levels, mitigation measures are available to reduce the impacts to acceptable levels (Sect. 4.1.7).

REFERENCES FOR SECTION 2

Brobeck Corporation. 1983. *Cost Estimate for the Continuous Electron Beam Accelerator with Staffing Recommendations (DRAFT).* Report 4500-264-2-R1, Berkeley, Calif., November 1983.

DOE (U.S. Department of Energy). 1983a. *DOE 1985 Congressional Budget Request, Construction Project Data Sheets, Project 85-R-203.*

DOE (U.S. Department of Energy). 1983b. *Report of the Panel on Electron Accelerator Facilities*, DOE/ER-0164.

DOE (U.S. Department of Energy). 1986. *CEBAF Conceptual Design Report*, Project 87-R-203, February 1986.

ERC (Evaluation Research Corporation). 1980. *An Environmental Assessment for the Decommissioning of the Space Radiation Effects Laboratory (SREL)*, Newport News, Va., Sept. 11, 1980.

Jacobs, D. G., L. E. Boring, and J. W. Burden. 1980. *Report On The Radiological Status of the Space Radiation Effects Laboratory, Newport News, Virginia*, Evaluation Research Corporation, Oak Ridge, Tenn., Aug. 14, 1980.

NSAC (Nuclear Science Advisory Committee). 1983. *Report of the Panel on Electron Accelerator Facilities*, Nuclear Science Advisory Committee, prepared for DOE/NSF.

SURA (Southeastern Universities Research Association). June 1983. *Letter Report on CEBAF Site Selection*, prepared for DOE/NSF NSAC.

Yalcintas, M. G. 1986. *Results of the Radiological Survey at the Space Radiation Effects Laboratory*, ORNL/TM-10064, May 1986.

3. THE AFFECTED ENVIRONMENT

3.1 THE PROPOSED SITE, NEWPORT NEWS, VIRGINIA

3.1.1 Air Quality and Meteorology

3.1.1.1 Meteorology

The meteorology of the proposed site is strongly affected by the nearby marine environment. Chesapeake Bay moderates the climate and weather of the site, with land–sea breezes dominating the wind patterns during much of the year. The mean monthly temperature at the Norfolk Regional Airport, the closest and most representative National Weather Station, ranges from about 6°C (41°F) in January to 26°C (79°F) in July. The record low temperature is −13°C (8°F), while the record high temperature is 39°C (103°F). Normal annual precipitation is 112 cm (45 in.), spread evenly throughout the year. Extreme precipitation events, caused by hurricanes or tropical cyclones, have deposited as much as 29 cm (11.5 in.) of rain in 24 h on the area. Average snowfall is 18 cm (7 in.), but up to 35 cm (14 in.) has fallen in a month. Because of the proximity of the bay, fog is a common occurrence in the area. Heavy fog, reducing visibility to less than 0.4 km (0.25 mile), occurs an average of 23 d/year.

Severe weather, in the form of thunderstorms, averages 37 d/year. Tornadoes are rare in coastal Virginia but may be spawned by severe thunderstorms, either during spring, when associated with frontal activity, or during summer and early fall, when associated with hurricane or tropical cyclone activity. Hurricanes average less than one per year in Virginia, but have caused both wind and flooding damage to the area since colonial times (Gale 1978).

3.1.1.2 Air quality

The proposed site is located in the Hampton Roads Intrastate Air Quality Control Region (AQCR) 223 (Fig. 3.1). The AQCR is in attainment with all criteria pollutants (EPA 1983): sulfur dioxide (SO_2), nitrogen dioxide (NO_2), total suspended particulates (TSP), carbon monoxide (CO), ozone (O_3), and lead (Pb).

3.1.2 Water Resources

The proposed site is located on the York–James Peninsula between the York and James rivers. The peninsula is characterized by tributaries, tidal basins, and shorelines associated with the estuarine hydrology of Chesapeake Bay. Groundwater is located at shallow depths, and drainage is required to alleviate seasonal flooding from heavy precipitation. With proper drainage control, the site is not susceptible to flooding from precipitation events.

ORNL-DWG 84-11886

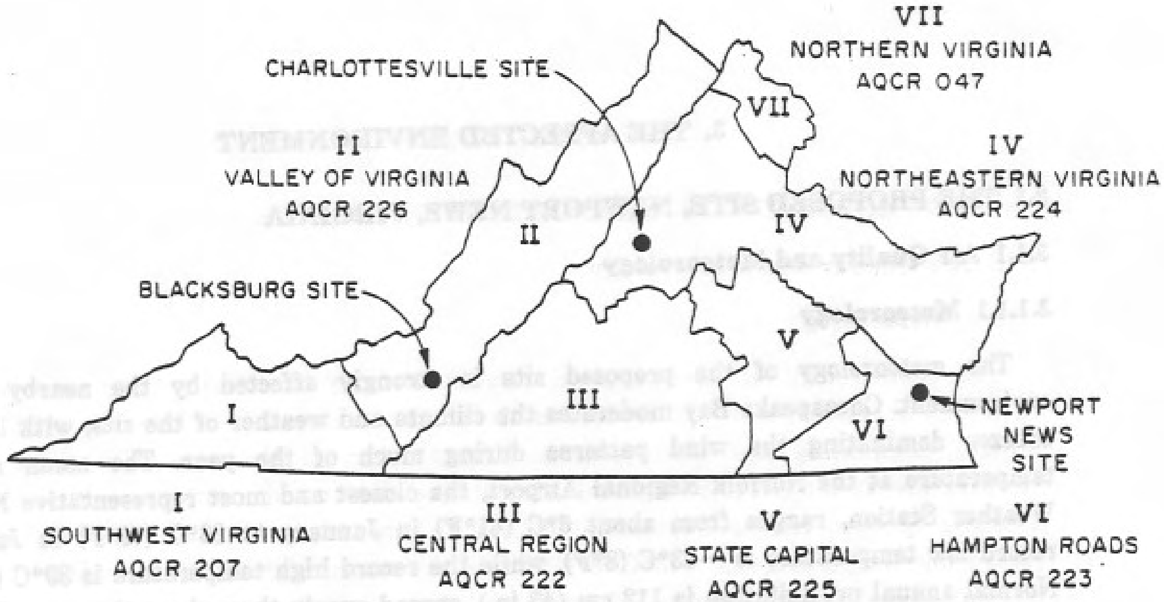


Fig. 3.1. Air Quality Control Regions relevant to the proposed Continuous Electron Beam Accelerator Facility sites.

3.1.2.1 Surface water

The proposed site is located in the watershed of Brick Kiln Creek, which discharges to Big Bethel Reservoir (Fig. 2.2). No perennial streams are present on the site. An ephemeral stream flows from on-site retention basins to Brick Kiln Creek. The retention basins have remained following the use of the area as a borrow site for the construction of revetments by the military during World War II. The site is poorly drained, with drainage patterns heavily influenced by previous construction. Localized ponds that occur during periods of heavy precipitation are drained by surface runoff and groundwater recharge. The site elevation is 7.5 m (25 ft) mean sea level (MSL), which is above the standard project tidal floodplain level of 4 m (13 ft) MSL. The standard project tidal floodplain is a catastrophic flood greater than the 100-year storm event (Johnson 1976).

Oyster Point Development Corporation is expanding the drainage system for the tract of land southeast of the proposed site (Fig. 3.2). The expanded drainage system has been designed to increase surface runoff to Brick Kiln Creek by 2.52 m^3/s (90 ft^3/s) for the 25-year 24-h storm [16.8 cm (6.6 in.) of precipitation]. The system will increase the natural drainage from the proposed CEBAF site because it will lower ambient groundwater levels. Under present undeveloped conditions, runoff from the CEBAF site is estimated to be 8.9 cm (3.49 in.) and is expected to increase to 13.8 cm (5.43 in.) once the site is fully developed (Dischinger 1981).

Big Bethel Reservoir, located 2.7 km (1.7 miles) east of the proposed site, is owned by the U.S. Army, Fort Monroe, and is the water supply for 20,000 personnel at Fort Monroe, Langley Air Force Base, and NASA Langley Research Center. The water treatment plant

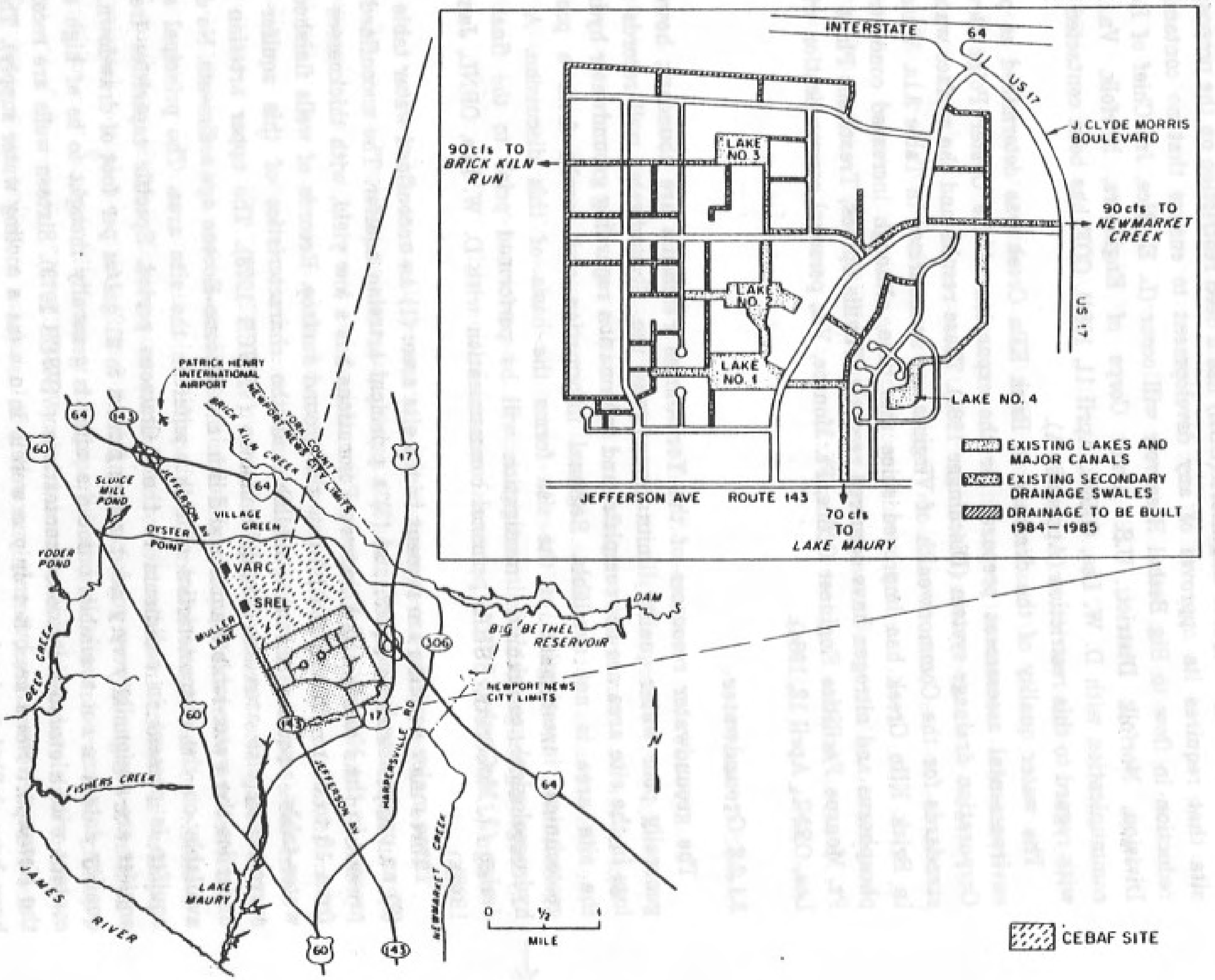


Fig. 3.2. Drainage System at the Oyster Point Industrial Park near the proposed Continuous Electron Beam Accelerator Facility site at Newport News, Virginia.

has a capacity of 0.16 m^3/s (4 Mgd), with current use ranging from 0.12 to 0.15 m^3/s (2.8 to 3.8 Mgd). The water quality of Big Bethel Reservoir is surveyed annually by the Army Environmental Hygiene Agency (Army 1980).

The U.S. Army Corps of Engineers (COE) has a deed restriction on the proposed CEBAF site that requires its approval of any development to ensure that no contamination or reduction in flow to Big Bethel Reservoir will occur (L. E. Rice, Jr., Chief of Real Estate Division, Norfolk District, U.S. Army Corps of Engineers, Norfolk, Va., personal communication with D. W. Lee, ORNL, April 11, 1984). COE has been contacted by SURA with regard to this restriction (Appendix A).

The water quality of the drainage to Brick Kiln Creek was determined as part of an environmental assessment prepared for the expansion of the Oyster Point Development Corporation drainage system (Dischinger 1981). These results and the surface water quality standards for the Commonwealth of Virginia are summarized in Table 3.1a. Water quality in Brick Kiln Creek has improved since this time, although increased concentrations of phosphorus and nitrogen have occurred recently (Phyllis Sprock, Treatment Plant Manager, Ft. Monroe Facilities Engineer Office, Ft. Monroe, Va., personal communication with D. W. Lee, ORNL, April 12, 1984).

3.1.2.2 Groundwater

The groundwater resources of the York–James Peninsula are abundant; however, the generally poor water quality limits groundwater use. Groundwater well records and well logs in the site area are not complete, and information regarding groundwater hydrology in the site area is not available. Regional information and results from a preliminary geotechnical investigation of the site forms the basis of this discussion. A detailed hydrogeological-geotechnical investigation will be performed prior to the final CEBAF design (J. McCarthy, SURA, personal communication with D. W. Lee, ORNL, January 29, 1985).

Three major aquifers are present in the site area: (1) an unconfined water table aquifer, (2) an upper artesian aquifer, and (3) a principal artesian aquifer. The unconfined aquifer present in the Norfolk and Yorktown Formations has a low yield, with thicknesses ranging from 15 to 30 m (50 to 100 ft) below the ground surface. Records of wells finished in the water-table aquifer are not available and the characteristics of this aquifer in the surrounding site area are largely unknown (VSWCB 1973). The upper artesian aquifer underlies the water-table aquifer and lies in the Miocene–Eocene age sediments. No data are available on the characteristics of this aquifer in the site area. The principal artesian aquifer is present in sediments of the Cretaceous period. Specific capacities from this aquifer are regionally very good, ranging from 3 to 21 gal/m per foot of drawdown. Water quality data are not available, but the aquifer is generally thought to be of high mineral content with elevated chloride concentrations (VSWCB 1973). Sixteen wells are recorded in the Newport News area, but only one well is in use (as a cooling water supply). The wells have been drilled to depths ranging from 60 to 330 m (200 to 1100 ft), with the depth to water ranging from 0.6 to 15 m (2 to 50 ft) (VSWCB 1973).

Groundwater at the proposed CEBAF site is near the surface and interacts with surface water during periods of heavy rainfall. Groundwater in the unconfined aquifer at the site is

Table 3.1a A comparison of the water quality of the Oyster Point drainage system with Virginia surface water quality criteria

Parameter	Oyster Point drainage system range (mg/L)[a]	Virginia water quality criteria (mg/L)
Arsenic	0.001-0.004	0.05
Barium	0.07-0.08	1.0
Cadmium	<0.0001	0.01
Chromium	0.0037-0.0043	0.05
Fluoride	0.14-0.24	1.8
Lead	<0.0001-0.0004	0.05
Mercury	<0.0003	0.002
Nitrate	<0.05-0.08	10.0
Selenium	<0.0001-0.0002	0.01
Silver	<0.0001-0.0001	0.05
Chloride	14.3-22.0	250
Copper	<0.01	1.0
Hydrogen sulfide	<0.01	0.05
Iron	3.78-11.6	0.30
Manganese	0.29-0.87	0.05
pH	7.3	6.5-8.5
Sulfate	2.5-18.9	250
TDS	242-344	500
Zinc	<0.01	5.0
Alkalinity	137-249	
Aluminum	0.18-0.49	
Calcium	52.3-92.1	
Calcium hardness	130.6-230.0	
Total hardness (calculated)	153.1-266.9	
Magnesium	2.61-3.49	
Magnesium hardness	10.7-14.4	
Nitrogen-ammonia	0.1-0.6	
Nitrogen-nitrite	0.008-0.020	
Nitrogen-total Kjeldahl	0.6-1.1	
Phosphate-total	0.61	
Phosphate-ortho	0.15-0.24	
Potassium	1.73-2.91	
Residue (total)	269.0-399.0	
Volatile	47.0-66.0	
Fixed	206.0-341.0	
Residue (filterable)	242.0-344.0	
Volatile	39.0-15.0	
Fixed	200.0-293.0	
Silica	16.0-37.2	
Sodium	14.3-17.7	
Specific conductance (μmhos/cm)	450.2-302.4	
Strontium	0.26-0.43	
Nickel	0.01	
Boron	0.06-0.12	
BOD	1.0-2.0	
COD	17.0-25.0	
Gross alpha activity (pCi/L)	0.2-2.2	15

[a]Number of samples = 3.
Source: Dischinger 1981.

considered to be a source of recharge to the underlying artesian aquifers. Groundwater levels at the site have been noted to decline after the construction of the drainage works at Oyster Point Development Corporation. The water quality of the groundwater in the unconfined aquifer at the proposed CEBAF site was investigated as part of a preliminary geotechnical investigation. The available results are presented in Table 3.1b. These data indicate that the existing water quality is good, although the quantity of available groundwater is not known.

The COE has drilled a test well at Big Bethel Reservoir with the intent of developing a 0.04 m^3/s (1 Mgd) groundwater supply (Jack G. Starr, Chief, Engineering Division, Department of the Army, Norfolk District, Army Corps of Engineers, Norfolk, Va., personal

Table 3.1b. Quality of groundwater at the proposed CEBAF site at Newport News, Virginia[a]

	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6
pH	6.70	6.45	6.70	6.50	6.55	6.50
Arsenic	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Barium	0.11	0.16	0.09	0.14	0.08	0.12
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoride	0.73	0.22	0.97	0.17	1.03	0.28
Mercury	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007
Selenium	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloride	30	24	14	5	10	18
Copper	0.01	0.02	0.03	0.01	0.04	0.02
Corrosivity (by pH)	*b*	*b*	*b*	*b*	*b*	*b*
Iron	0.05	0.70	1.02	1.04	0.06	1.52
Manganese	0.05	0.93	0.03	0.08	0.02	0.08
Sodium	69	60	62	60	9	98
Zinc	0.01	0.01	0.06	0.09	0.01	0.02
Color	10	15	25	25	3	25
Lindane	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000
Endrin	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000
Methoxychlor	<0.0007	<0.0007	<0.0007	<0.0007	<0.0007	<0.000
Toxaphene	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.000
2,4-Dichloro-phenoxy	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000
2,4,5-Trichloro phenoxy propioni-cacid	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000
TDS	310	603	483	383	120	390
TOC	21	14	13	15	25	12
TOX	0.130	0.094	0.300	0.067	0.420	0.089
Radiological gross alpha[c]	<2	<2	<2	<2	<2	<2
Gross beta[c]	4	<3	<3	<3	<3	<3
Radium 226[c]	<1	<1	<1	<1	<1	<1

[a]All results in mg/L, unless otherwise stated.
[b]Noncorrosive.
[c]Picocurie/L.

communication with D. W. Lee, ORNL, April 16, 1984). The test well was drilled to a depth of 360 m (1100 ft). Results of water quality testing of the well samples indicated that the water was too brackish for use as a water supply.

3.1.3 Geology and Soils

The proposed site is located in the Coastal Plain of the lower York-James Peninsula, which is characterized by a succession of plains and intervening scarps. The site is located on the Huntington Flat, which is very flat and poorly drained. Site elevation ranges from 9 to 12 m (30 to 40 ft) above MSL. It is underlain by the clayey-sand and sand facies of the Norfolk Formation that represent an aggradational surface formed by the ancestral James River during the late Pleistocene age (Johnson 1976). The Norfolk Formation is underlain by the Yorktown Formation, which is composed of marine sand, silt, and coquina deposited during the Pliocene age.

The Norfolk Formation is lithologically complex because it was deposited under fluvial-estuarine and nearshore marine conditions (Johnson 1976). Geotechnical investigations of the site area identified three strata of the Norfolk Formation (Schnable 1983):

1. brown, gray to greenish-gray, fine to medium sand, with variable amounts of silt to silty clay, very loose to firm;
2. brown, gray to greenish-gray silty-clay to clay with variable amounts of sand, soft to very stiff; and
3. dark brown, organic silty clay and clay and peat, soft to stiff.

Stratum 1 ranges in thickness from 4.2 to 16.3 m (14 to 54.5 ft) and is interbedded with strata 2 and 3. Stratum 2 ranges in thickness from 0.75 to 13.5 m (2.5 to 45 ft) and is interbedded with strata 1 and 3. Strata 1 and 2 are evident at the ground surface. Stratum 3 is beneath strata 1 and 2, occurring at depth of 7.2 to 10.8 m (24 to 36 ft) below the ground surface. Additionally, surficial fill deposits 0.6 to 2.2 m (2 to 7.3 ft) thick were identified that were composed of silty-clayey sand that was loose to firm.

The Yorktown Formation was encountered at depths of 5.7 to 13.0 m (19 to 43.5 ft) below the ground surface at all but one boring location. The Yorktown Formation was identified as gray to greenish-gray, fine to medium, silty to silty-clayey sand with shell fragments and coquina, loose to very compact. The Yorktown Formation is suitable material for building foundations with a preconsolidation pressure of 22,448 kg/m^2 (2.3 t/ft^2) over the existing overburden pressure.

The preliminary geotechnical investigation of the site provided additional data describing the site conditions. The Norfolk Formation extends to depths of 20 to 40 ft below the ground surface across the site, with depths of 20 to 30 ft in the vicinity of the accelerator location. Layers of peat and organic materials were encountered in the Norfolk Formation at the east end of the accelerator location. In addition, several borings, cores, and dilatometer soundings encountered soft clays.

The site is located in an area of low seismic risk (Jacobs 1980). The Norfolk Formation has silty-sand facies with low to moderate erosion resistance and clay-sand facies with low to moderate bearing capacity. No other geologic hazards have been identified in the site area.

3.1.4 Ecological Resources

3.1.4.1 Land use

The proposed CEBAF site is a temporarily wet, upland area occupied predominantly by hardwood-pine forest (Table 3.2). Areas actively used or occupied by facilities include the VARC and SREL facility areas, access roads, and a solid waste dump. Forests on the site are currently not used for research activities or for the harvest of timber. The City of Newport News has zoned the site and vicinity for research and development. Surrounding areas support a mix of residential, commercial, and light to medium industrial developments.

3.1.4.2 Terrestrial resources

Vegetation

The CEBAF site is entirely forested except in three small areas: the SREL facility, the VARC facility, and a dump where leaf litter and similar materials are deposited by the City of Newport News (Table 3.2). The forests on the site are mainly of two types: oak-loblolly pine and loblolly pine. Most of the site is covered by the oak-loblolly pine forest, which is similar to the loblolly pine-hardwood forest described by Eyre (1980). Loblolly pine makes up less than 20% of the canopy in this forest type on the site. Shortleaf pine may also be present. Hardwood species include southern red oak, swamp chestnut oak, white oak, water oak, red maple, sweetgum, yellow poplar, and others. The understory is sparse and includes, among other species, numerous highbush blueberry; some sourwood; and scattered American holly, greenbrier, and Japanese honeysuckle. According to Eyre (1980), this forest type is widespread but sporadic on the Coastal Plain from Delaware south to Florida, and west to eastern Texas and southern Arkansas. It occurs on Coastal Plain soils that are derived from unconsolidated sedimentary deposits of sand, silt, clay, and peat. This is a transitional forest

Table 3.2 Existing land use on the proposed Continuous Electron Beam Accelerator Facility site

Use	Hectares	Acres
Idle (forests)	60.9	152.2
Active use	6.8	16.8
VARC[a] building	0.8	1.9
SREL[b] building	3.9	9.6
Roads	1.2	2.9
Dump	1.0	2.4
Total	67.7	169.0

[a]Virginia Associated Research Center.
[b]Space Radiation Effects Laboratory (presently unoccupied).

type that is undergoing succession toward the climax, which is pure hardwood forest lacking pine.

The loblolly pine forest, similar to the loblolly forest type described by Eyre (1980), occurs on the wetter portions of the site, primarily southeast of the SREL facility. This type is dominated by loblolly pine with smaller amounts of red maple, sweetgum, blackgum, and yellow poplar. Shortleaf pine may also be present. This forest type occurs extensively from Delaware south to Florida and west to eastern Texas and southern Arkansas. Succession is toward a hardwood forest type.

On aerial photographs, forests on the proposed CEBAF site are finer grained than those in some surrounding areas, suggesting that the on-site forests are less mature than the others. On April 15, 1984, a brief walking survey of forests on the site found exceptionally large trees lacking. Only one tree (an oak) with a trunk approaching 1.2 m (4 ft) in diameter was found. Oaks with trunks roughly 0.6 m (2 ft) in diameter were scattered throughout much of the forest.

Fauna

Terrestrial vertebrate fauna whose geographic ranges encompass the site include 26 amphibian, 26 reptilian, 150 breeding avian, and 55 mammalian species (Conant 1958; Simpson 1964; Cook 1969). Because the site lies within a disturbed residential and commercial area and because of its small size, only a small fraction of these 257 species would be expected to actually exist at the site. Amphibians, reptiles, and mammals are not likely to be abundant because the site has no permanent wetlands, is mostly wooded, and has only sparse vegetation at the ground level. A long-time resident staff member of VARC does not recall any snakes being observed on the site (F. Heidt, VARC, personal communication to R.L. Kroodsma, ORNL, April 5, 1984), although several species of small snakes are probably present. Amphibians on the site should include several species of frogs, toads, and salamanders. Arboreal wildlife species likely are dominant, including squirrels and many species of birds. Bird species observed during the DOE staff site visit on April 15, 1984, included pileated woodpeckers, wood ducks, downy woodpeckers, and common crows, which are permanent (year-round) resident species at the site. Summer resident species, which probably number about 30 to 40, had not yet arrived for the breeding season. No squirrels were seen, although several squirrel nests were observed. White-tailed deer, which at one time were common in the area, are now apparently scarce or absent.

Continuing urban growth in the area will further reduce wildlife habitat and wildlife populations around the site. Because of this disturbance, the fragmentation of forests, and the increasing isolation of the on-site forests from those in surrounding areas, forest wildlife populations on the site should also decline, even if no on-site clearing were conducted (Samson 1980; Whitcomb et al. 1981).

3.1.4.3 Aquatic resources

There are no permanent streams, ponds, or other aquatic habitats on or near the site (Sect. 3.1.2). Drainage ditches and low areas on the site typically have flowing or standing water in the winter, spring, and early summer. The most significant temporary aquatic habitats are the drainage ditches and a shallow borrow pit area southeast of the SREL facility. The borrow area evidently has standing water except in late summer and fall. The nearest significant permanent body of water, to which most of the site drains, is Big Bethel Reservoir, 2.7 km (1.7 miles) northeast of the site.

Aquatic fauna, such as fish, that are typical of permanent waters are absent at the site. Semi-aquatic forms, however, such as frogs and salamanders, are present.

3.1.4.4 Endangered species

Only two endangered species potentially occur at the site, the bald eagle and the peregrine falcon (50 CFR Pt. 17.11 and 17.12). However, there is no habitat at the site that is important to these species, and they would occur only as extremely rare visitors, if at all. Both species nest in the eastern United States in association with aquatic habitats. The U.S. Fish and Wildlife Service concurs that only transient individuals of endangered or threatened species may occur at the site (letter from Glenn Kinser, U.S. Fish and Wildlife Service, to W. Nelson Lingle, DOE, June 14, 1984) (Appendix A).

3.1.4.5 Floodplain and wetlands

Though not located in a floodplain, the site is in an area where forested temporary wetlands (Cowardin et al. 1979) are abundant. During wet seasons, many small, very shallow pools of standing water form in shallow depressions on the forest floor over most of the site. These pools are temporary and therefore support little aquatic vegetation. This wetland type occurs abundantly in the region surrounding the site, but its extent is being reduced by drainage for urban development. A few hundred meters northeast of the SREL facility, a deeper man-made depression in the forest floor has standing water for a longer time but still usually becomes dry by late summer. Because wetlands on the site are ephemeral and shallow, they are of little importance in supporting wetland species of wildlife and in performing other valuable functions typical of more important wetlands (e.g., groundwater recharge, sediment entrapment, and pollutant removal from flowing waters). No wetland in Newport News has been identified as a potential natural landmark (Goodwin and Niering 1975), and none has been recognized officially as a natural landmark (DOI 1983).

Staff of the U.S. Army Corps of Engineers (COE) responsible for permitting drainage of or construction in wetlands have surveyed the site at the request of the Department of Energy. As a result, the COE determined that the site's wetlands do not qualify as wetlands requiring the protection and consideration specified by Executive Order 11990, Protection of Wetlands, i.e., the site's wetlands are not inundated by surface water or groundwater with a frequency sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soils for growthand reproduction. Thus, a permit and the preparation of a wetlands assessment as specified by DOE Floodplain/Wetlands Environmental Review Requirements (44 FR 42136, July 18, 1979) will not be necessary (Jones 1986).

3.1.5 Community Resources

3.1.5.1 Impact region definition

Impacts from CEBAF are anticipated to be highly localized and site specific. For this reason, the City of Newport News, Virginia was designated as the impact region. Located on the Virginia Peninsula at Hampton Roads, the city is bounded on the west by Hampton, Virginia, and York County; on the north by Williamsburg and Jamestown, Virginia, and James City County; on the east by the James River; and on the south by the Hampton Roads Channel (Fig. 2.1). The proposed CEBAF site in Newport News is located just east of Jefferson Avenue, less than 0.8 km (0.5 mile) to the west of Interstate 64. The site is just south of Oyster Point Road and just north of Oyster Point Industrial Park (Fig. 2.2).

3.1.5.2 Demography and settlement patterns

The site, which is just north of Oyster Point Industrial Park, was previously (since 1964) occupied by a 600-MeV synchrocyclotron operated by NASA in SREL. Thus the community is accustomed to the presence of an accelerator in this location.

Although data from the 1980 Census of Population (U.S. Bureau of of the Census 1981) show the proposed CEBAF site to be located in a heavily populated census tract, there are actually very few people living near the site. The CEBAF proposal indicates that the facility will be located in census tract 321.01, which grew from 10,332 residents in 1980 to 13,049 in 1983. It is estimated that the tract's population will reach 14,339 in 1985, becoming Newport News' second most populated census tract (Table 3.3). However, density figures reveal that it is the large (geographic) size of the tract which accounts for the high number of residents. While the 1983 average population density for the city was 2228 persons per square mile, tract 321.01 had a density of only 1293 persons.

The City of Newport News grew from a population of 138,177 in 1970 to 144,903 in 1980. By 1983, population growth had risen to 153,732. A population increase of 14.9% is projected for 1990, for a total of 176,600 residents. The Metropolitan Statistical Area (MSA) which includes Norfolk, Virginia Beach, and Newport News, was created in June 1983. The MSA is predicted to increase from a 1983 total of 1,201,400 residents to 1,281,900 in 1990 (Department of Development 1984).

The median family income in this census tract was $27,620 in 1983, exceeding the city average of $24,550 (Table 3.4). Salaries earned by CEBAF operators are also expected to exceed the local average.

3.1.5.3 Land use

A small number of residents live in the immediate area of the proposed CEBAF. The VARC and SREL facilities on-site offer 3,250 and 5,300 m^2 (35,000 and 57,000 ft^2) of reusable space, respectively. The VARC building lies at the north end of the site; the SREL structure occupies the south end.

The COE holds a deed restriction on the CEBAF site that is intended to maintain the water quality of the Big Bethel Reservoir, which receives surface drainage from the site and is a drinking water supply (Sect. 3.1.2.1). Any development must be such that a significant amount of surface runoff is not diverted from the reservoir, and that the reservoir and the water flowing into it are not contaminated. DOE will submit final design and monitoring plans to the COE for approval prior to construction. Approval must be renewed every five years.

The site is located in an RD-1 Research-Development District, as designated in Article XVII of the city's zoning ordinance. Approximately 85 ha (210 acres) will be used for the

Table 3.3. City of Newport News, population change by census tract 1982–1983

Census tract	Population 1980	Population 1983	Annual change (%)	1985 est.
301	908	914	0.22	918
302	4,453	4,563	0.8	4,633
303	8,030	8,351	1.31	8,570
304	3,380	3,496	1.13	3,575
305	3,069	2,965	−1.12	2,897
306	3,918	4,084	1.39	4,198
307	3,032	2,945	−0.96	2,889
308	2,156	2,301	2.19	2,402
309	4,501	4,627	0.93	4,714
310	818	865	1.87	897
311	2,327	2,395	0.92	2,436
312	1,819	1,626	0.05	1,628[a]
313	5,350	5,528	1.09	5,648
314	6,656	6,894	1.17	6,985
315	6,051	6,246	1.06	6,378
316.01	5,343	5,637	1.81	5,844
316.02	5,645	5,811	0.97	5,924
317	5,160	5,354	1.23	5,485
318	4,182	4,382	1.58	4,523
319	5,453	5,810	2.13	6,059
320	13,660	14,797	2.70	15,606
321.01	10,332	13,049	4.83	14,339[b]
321.02	8,439	9,888	5.42	10,987
322.01	11,591	12,509	2.57	13,160
322.02	9,963	10,844	2.87	11,475
322.03	826	826	0	826
323	7,842	7,025	−3.6	7,025[c]
Total	144,903	153,732	2.0	160,021

[a]Population change in Tract 312 was influenced by removal of 120 mobile homes in 1983; 1985 estimate calculated on a "normal" annual growth rate of 0.05%.

[b]Population change in tract 321.01 influenced by relocation of 65 mobile homes in 1984; 1985 estimate calculated on "normal" rate of 4.83%.

[c]Tract 323 (Fort Eustis) will remain stable, with no anticipated change in military personnel requirements.

Source: Newport News Department of Codes Compliance, *1980 Census of Population.*

facility and all anticipated expansion. The heavily vegetated site occupies sandy, wooded land on a peninsula between the York and James rivers, and is flat to within five-foot variations. No major surface water bodies exist on-site.

Just south of the site is the Oyster Point Industrial Park, which is a community of small businesses dealing in research, technology, and manufacturing. Immediately adjacent land uses include strip commercial development and a space arrangement of single-family to multifamily housing. Much land in this area is vacant. In addition, the city owns about 120 ha (300 acres) of developable land adjacent to the site, which may be used to provide

Table 3.4. Population, density, median family income, City of Newport News, Virginia

1983 Estimate

Census tract	Population	Density (per sq. mile)	Median family income[a]
301	914	2,285	16,600
302	4,563	4,645	6,720
303	8,351	7,961	20,400
304	3,496	9,941	13,550
305	2,965	9,056	12,910
306	4,084	9,371	12,890
307	2,945	5,632	14,920
308	2,301	4,325	16,280
309	4,627	8,129	14,290
310	865	1,817	14,420
311	2,395	3,565	26,430
312	1,626	1,841	19,900
313	5,528	6,800	24,200
314	6,894	4,030	24,160
315	6,246	2,306	28,430
316.01	5,637	4,264	27,120
316.02	5,811	3,552	23,950
317	5,354	3,172	30,400
318	4,382	3,088	45,250
319	5,810	1,928	32,630
320	14,797	3,085	30,340
321.01	13,049	1,293	27,620
321.02	9,888	1,057	27,190
322.01	12,509	3,360	31,190
322.02	10,844	2,743	24,740
322.03	826	352	15,970
323	7,025	583	17,130
City total	153,732	2,228	24,550

[a]Personal income adjustment of 1.32864 applied to 1980 census family income data.

Source: U.S. Joint Economic Committee, Economic Indicators, *1980 Census of Population.*

an Applied Research Center. Also within a 1.6-km (1-mile) radius are two schools, a cemetery, the tracks of the Chesapeake and Ohio Railroad, and Interstate 64. Patrick Henry International Airport is located 3.2 km (2 miles) north of the site.

The June 1983 *General Plan Handbook*, produced by the Newport News Department of City Planning, proposed that the site be used for "Government-Educational-Institutional" needs. The surrounding area is designated largely industrial and commercial, with relatively few single-family and multifamily residential units to the north. Local planners appear to be encouraging the continuation of research and development functions on the site; the CEBAF project is compatible with this land use planning objective.

Within a 80-km (50-mile) radius of the site are the College of William and Mary, Old Dominion University, NASA/Langley Research Center, Hampton Institute, Fort Eustis, and several Navy bases. In 1978 less than 5% of the land in this radius was used for pasture, 10 to 25% produced truck crops, and 25 to 50% was nonfederal forest land (ORNL 1978). The city as a whole is primarily suburban and residential in character. Due to its linear shape [approximately 33.6 km long, 6.4 km wide (21 miles long, 4 miles wide) at its widest point, and 0.5 km (0.3 mile) wide at its narrowest point], Newport News is also characterized by low-density strip commercial development (Department of City Planning 1983).

3.1.5.4 Housing

The City of Newport News has ample housing stock and land designated for future residential development. In 1983 it was estimated that 56,984 total housing units existed in the city (Table 3.5). Of these units, 30,246 were owner-occupied and 26,738 were rentals.

Table 3.5 City of Newport News housing units

1983 Estimate

Census tract	Single-family units	Multifamily units	Mobile homes	Total
301	199	458	0	657
302	1,265	329	0	1,594
303	2,510	797	5	3,312
304	940	242	1	1,183
305	905	301	2	1,208
306	1,476	189	1	1,666
307	874	265	3	1,142
308	645	19	0	664
309	1,637	262	1	1,900
310	352	105	0	457
311	740	354	0	1,094
312	386	78	287	751
313	1,635	529	1	2,165
314	2,094	467	2	2,563
315	2,309	446	42	2,797
316.01	1,500	536	3	2,039
316.02	1,796	680	2	2,478
317	1,635	535	1	2,171
318	1,571	7	0	1,578
319	1,770	357	1	2,128
320	4,215	728	2	4,945
321.01	2,781	1,560	641	4,982
321.02	2,779	993	17	3,789
322.01	3,092	859	246	4,197
322.02	2,453	1,016	434	3,903
322.03	206	88	2	296
323	438	857	30	1,325
Total	42,203	13,057	1,724	56,984

Source: Newport News Department of Codes Compliance, *1980 Census of Population.*

Slightly under 2% of all units were vacant by the fourth quarter of 1983 (VRERC 1984). Since then, the City of Newport News has approved many additional single-family and multifamily development proposals.

There are seven distinct neighborhood settings in Newport News: (1) Downtown/Old North End, (2) Southeast Community, (3) Briarfield, (4) Hilton, (5) Beaconsdale/Morrison/Harpersville, (6) Denbigh, and (7) Lee Hall. Denbigh, located approximately 3.2 km (2 miles) from the site in the northern section of the city, is the newest and fastest growing area of Newport News.

While many available housing units exist in these communities, sufficient housing in all cost ranges is not available (Department of City Planning 1983). Specifically, there is a shortage of low and moderately priced housing. Approximately 69% of the housing in Newport News is available to only 40% of the families. The city presently provides assistance to 5000 families; 34% are in public housing and 66% are in subsidized housing.

3.1.5.5 Public services

The City of Newport News has an adequate quality and quantity of public services. On the proposed CEBAF site, however, it is likely that slight expansion of the utility systems will be required.

Natural gas is supplied to the site by Virginia Natural Gas Company, a subsidiary of the Virginia Electric and Power Company (VEPCO), through a 20.3-cm (8-in.) pipeline in Jefferson Avenue. Electric power into the site is proposed to be 12.47 kV, with a maximum capacity of 25 MVA. The incoming service is planned to be brought into a master substation adjacent to the east side of the existing SREL building; the 12.47-kV power would then be distributed to five area substations. This system would accommodate future expansion without extensive modifications. VEPCO facilities are expected to maintain a reserve capacity of more than 20 to 30% throughout the 1980s.

The water system serving the site is owned and operated by the City of Newport News. Water is presently supplied from the 61-cm (24-in.) water main on the north side of Jefferson Avenue. The system should have adequate capacity and pressure to serve the site, because the supply, derived principally from the Chickahominy River, has historically exceeded demand by at least 40%. The Newport News water system is equipped with modern filtration and purification plants and meets EPA standards for water quality (Department of Development n.d.).

The site is located in an area served by four sewage treatment plants, which are operated by the Hampton Roads Sanitation District. The site is currently served through a lift station by a 30.5-cm (12-in.) force main in Jefferson Avenue; there is a 20.3-cm (8-in.) cast-iron sewer to the VARC building. To adequately serve the CEBAF project, it is anticipated that the lift station on Jefferson Avenue will be enlarged or supplemented; sewage will be piped (by gravity where possible) to centrally located lift stations which will discharge to the Jefferson Avenue Station.

The City of Newport News has developed a comprehensive drainage system at the adjoining Oyster Point Development Corporation (Sect. 3.1.2). Storm-water runoff at the site will be largely overland, and drainage will be discharged either to new or existing ditches or to a large pond that is part of the CEBAF landscaping plan. Enclosed areas will be equipped with drop inlets and underground storm drains. Final design is pending. Water pumped from the CEBAF beam dump area may be collected in a 113-m^3 (30,000-gal) steel tank and held until the level of radioactivity allows discharge into the storm drainage system (Hayes et al. 1983). The beam dump discharge will require an NPDES permit (VSWCB 1985).

Local school facilities are adequate for grades K through 12, and opportunities for post-secondary education in the area are excellent. Declining birth rates, smaller families, slower rates of population growth, and a stable relationship between public and private school enrollment has meant that total school enrollment has been declining since 1970. The number of students in Newport News public schools is projected to decline from 26,696 in 1979 to 21,721 in 1985. An increase in school-age children created by new development can easily be accommodated by existing facilities. In fact, it has been estimated that some elementary, middle, and high school facilities may be closed in 1985 due to lack of enrollment (Department of City Planning 1983).

Land-based fire protection facilities are adequate in Newport News, although government and commercial vessels have minimal marine fire protection services. Between 1977 and 1979 the total number of calls for fire protection services decreased by 4%, with the decline attributed to an increased emphasis on fire prevention by the city. Health care for Newport News residents is provided by several medical facilities, including Riverside Hospital and a Veterans Administration hospital in Hampton. Several nursing homes and extended care facilities are located on the peninsula. Newport News also offers a variety of social service centers located in diverse areas of the city.

3.1.5.6 Transportation

All vehicles traveling to the proposed site are expected to gain access by way of Jefferson Avenue (Route 43). This road is a four-lane highway which was a major artery before Interstate 64 was built. The current capacity of Jefferson Avenue is well in excess of local traffic use.

According to traffic counts made in 1983 and previous years by the City of Newport News, average daily traffic on Jefferson Avenue, from J. Clyde Morris Boulevard [3.6 km (2.25 miles) south of the proposed site] to Oyster Point Road [0.4 km (0.25 mile) north of the site] has continually decreased since 1979. Traffic on Jefferson Avenue from Oyster Point Road north to Interstate 64 is expected to exhibit a gradual, slight increase; a more significant increase is predicted for Oyster Point Road east from Jefferson Avenue to Interstate 64 (Table 3.6).

In late March 1984, the Newport News City Council approved the last of three resolutions that schedule improvements for Jefferson Avenue and Oyster Point Road. These improvements, slated for completion between 1985 and 1989, include widening Jefferson Avenue to six lanes divided from J. Clyde Morris Boulevard to nearly 3.2 km (2 miles) north of the site. Another planned improvement is the widening of Oyster Point Road to four lanes and the construction of a new four-lane interchange at its intersection with Interstate 64.

Table 3.6. Traffic flow at the proposed Continuous Electron Beam Accelerator Facility site, City of Newport News, Virginia

Location	Adjusted traffic count					Projection	
	1979	1980	1981	1982	1983	1984	1988
Jefferson Avenue from J. Clyde Morris Blvd. to Oyster Point Road	23,938	25,453	25,671	25,083	25,731	25,340	25,026
Jefferson Avenue from Oyster Point Road to I-64	24,799	32,353	24,025	28,634	28,634	28,842	30,397
Oyster Point Road from Jefferson Avenue to I-64	7,137	8,000	8,689	9,474	9,738	10,610	13,280

Source: Department of Engineering, City of Newport News. *Traffic Volume Book*, Newport News, Virginia, April 1984.

Access to the site would be provided by two separate entrances on Jefferson Avenue, one allowing restricted access to the accelerator complex, the other allowing access to administrative and visitor areas. An expanded network of roadways will accommodate onsite traffic, with paved sections in areas where heavy truck traffic is anticipated (DOE 1986).

The CEBAF site is 30 min from Norfolk International Airport via Interstate 64, and less than 1 h from Byrd International Airport in Richmond, Virginia. Patrick Henry Airport, designed to accommodate scheduled and chartered jets of all sizes, is 3.2 km (2 miles) from the site, providing convenient commuter service to Washington, D.C., and Baltimore. An interchange of Interstate 64 is 1.6 km (1 mile) away via Jefferson Avenue. Amtrak passenger service operates daily from Newport News and Williamsburg, Virginia to Washington, D.C. and points north. For freight service, there are Chessie System railroad sidings within 1.6 km (1 mile) of the site, as well as the port facilities of Newport News. Pentran is the area's intracity bus line.

3.1.5.7 Economic structure

Well over 150,000 people of various backgrounds participate in the highly diverse Virginia Peninsula labor market. This group, from which Newport News firms draw employees, includes labor resources from the Norfolk-Portsmouth area, the west bank of the James River, Virginia's middle peninsula, and part of North Carolina. It is likely that the majority of CEBAF related workers will come from this general area.

There is a significant number of skilled workers in the Virginia Peninsula, due largely to the efforts of institutions such as the Newport News Shipbuilding Apprentice School, Langley Research Center Engineering Technician Apprenticeship School, Virginia's Industrial Training Division, the state's community college system, and the local vocational technical skills center. As of March 1983, far more workers in Newport News were employed in manufacturing jobs than in any other industry. In terms of occupation, most people were employed in technical, sales, and administrative roles; executive and professional specialty occupations were also common. Employment and occupational distributions are presented in Table 3.7.

Table 3.7. Employment and occupations, City of Newport News, Virginia, as of March 1983

	Number	Percent
Employment by industry		
Agriculture, forestry, fishing	130	0.20
Mining	12	0.02
Manufacturing	31,227	47.05
Contract construction	2,737	4.12
Wholesale and retail trade	10,595	15.96
Transportation, communications, electric	1,984	2.98
Gas and sanitary services	[a]	[a]
Finance, insurance, real estate	2,342	3.50
Services	15,317	23.08
Government	2,018	3.04
Total	66,362	100.00
Employment by occupation		
Executive and professional specialty	14,436	21.7
Executive, administrative, managerial	5,539	
Professional specialty	8,897	
Technical, sales and administrative support	18,816	28.4
Technicians and related support	1,995	
Sales	6,688	
Administrative support and clerical	10,133	
Service occupations	9,765	14.8
Private household	725	
Protective service	1,074	
General service (except household and protective)	7,966	
Farming, forestry, fishing	482	0.7
Precision production, craft and repair	11,021	16.6
Operators, fabricators and laborers	11,842	17.8
Machine operators, assemblers, inspectors	4,841	
Transportation and material moving	2,696	
Handlers, equipment cleaners, helpers and laborers	4,305	
Total	66,362	100.00

[a]Unknown.

Source: City of Newport News, Virginia. *Statistical Summary,* February 1983.

The average hourly earnings as of February 1983 for manufacturing positions was $8.56; for production of durable goods, $9.14; and for production of nondurable goods, $7.33. The wage and salary structures in Newport News are less expensive in comparison with many nearby locations (Newport News 1983).

As of March 1984, the civilian labor force totaled 71,207, with an unemployment rate of only 3.8%. This compares favorably with the current Virginia state unemployment rate of 4.8% and the national average of 8.1% (Virginia Employment Commission, Research and Analysis Division, Richmond, Va., personal communication with J. A. Boyette, ORNL, May 4, 1984). The average unemployment rate in Newport News for the entire year 1983 was a low 5.3%. The state average was slightly higher (6.1%), as was the national average (9.5%) (U.S. Department of Labor 1984). This fundamental indicator of economic health shows that employment opportunities in Newport News are more abundant than in some other parts of the state and nation. Aside from employment, additional factors indicate that Newport News has a more stable and resilent economy than do many areas of the United States. Construction and development, retail trade, and port activity have all shown positive trends in recent years.

The major retail centers in the Virginia peninsula are the cities of Newport News and Hampton. Retail sales in these cities, which had lagged behind the United States and Virginia during 1981, improved greatly in 1982 and the first half of 1983. In the third quarter of 1982, Newport News-Hampton posted a 3.2% increase over the 1979 base year level. Figures for the third quarter of 1983 indicated that the increase over the same quarter in the base year rose to 20%. During early 1982, Newport News' share of total sales averaged 45%, then rose slightly, to 47%, by summer 1983.

The continuing impact of the 1981-82 recession and a general decline in United States exports was reflected by diminished activity at most North Atlantic ports. Although port activity declined in 1982, container traffic and coal dumpings at the Newport News terminals maintained their positions above the 1979 levels through 1983. While terminal traffic has declined at nearby Southside Hampton Roads, container movement at Newport News has continued to increase (Department of Development 1983).

3.1.5.8 Historic, aesthetic, and cultural resources

No studies to determine the presence of subsurface historic or archaeological features on this site have been made, and the Virginia Historic Landmarks Commission has determined that a field survey will not be necessary for the project (Appendix A). The only visual evidence of historic structures on the site consists of the ammunition bunkers and other outbuildings remaining from military use of this and the surrounding property some 40 to 50 years ago. In the broader area surrounding the site, cultural and recreational facilities include Colonial Williamsburg, the Norfolk Opera, about 70 museums, various performing arts theaters, a zoo, and a botanical garden.

As previously mentioned, the proposed CEBAF site occupies sandy, wooded land on a peninsula between the York and James rivers. The proposed "front door" to the complex will be extensively landscaped to provide a pleasing environment. Existing vegetation will be preserved as a visual buffer between the administrative complex and the tunnel and support areas. A large group of trees will also be retained to partially screen the complex from the existing street. An additional stand of trees will serve to buffer the proposed site from the small residential area to the north. The landscaping will also include construction of a large pond, which, in addition to serving as an aesthetically pleasing landscape feature, will provide a borrow pit for fill required in construction and a receiving point for storm water (Hayes et al. 1983).

Water is one of Newport News' major scenic and recreational assets. The James River, Hampton Roads Harbor, and the Lee Hall and Big Bethel reservoirs give the city an abundance of shoreline. In addition, the York and Posquoson rivers and the Chesapeake Bay are only minutes away for practically all Newport News residents. Atlantic Ocean beaches are less than an hour's drive.

3.1.6 Radiological Background

The dose to humans from natural background radiation is received from cosmic radiation (primarily solar and galactic cosmic rays) and from internal and external exposure to radioactive elements found in the earth's crust (i.e., terrestrial). Terrestrial sources include primordial radionuclides (^{238}U, ^{235}U, ^{232}Th, and ^{40}K and ^{87}Rb daughters) and cosmogenic radionuclides (^{3}H, ^{7}Be, ^{14}C, and ^{22}Na) (NCRP 1975). Cosmogenic radionuclides are formed through interactions of cosmic rays with target atoms in the atmosphere and in the earth's crust, while primordial nuclides are those that have always existed in the crust. The total estimated average annual whole-body dose received by the residents in the Newport News vicinity from natural background is about 78 millirem/year (Oakley 1972). Of this dose, cosmic and terrestrial radiation accounts for 41 millirem and 19 millirem, respectively. Internal exposure via inhalation and ingestion of naturally-occurring radionuclides gives a dose of about 18 millirem. For comparison, the average contributions from cosmic and terrestrial radiation for the Commonwealth of Virginia are 43 millirem and 35 millirem, respectively (Oakley 1972). These, added to the internal sources, yield a dose of 96 millirem for the average Virginia resident.

3.1.7 Ambient Noise

No monitoring of baseline ambient noise levels at the Newport News site was conducted for this project, and no site-specific noise level data are available. Consequently, estimates of existing noise levels have been based on current land use practices (Sect. 3.1.5.3) in the vicinity of the proposed site. Existing noise levels at the locations of sensitive receptors are of most interest; the sensitive receptors of primary interest are residences. Although intermittent, high noise levels generated at the proposed site could startle arboreal wildlife species, especially birds, in the vicinity.

Existing noise levels at nearby residential areas are probably in the 50 to 55 dB (A) range (EPA 1978). Interstate 64 and the Chesapeake and Ohio Railroad, which are both located within 1.6 km (1 mile) of the proposed site, undoubtedly influence peak noise levels in the site vicinity. Air traffic associated with the Patrick Henry Airport, which is located two miles north of the site, could also affect noise levels at residences near the proposed site.

3.2 ALTERNATE SITE 1, CHARLOTTESVILLE, VIRGINIA

Figure 2.5 illustrates the specific location of the proposed CEBAF site at Charlottesville, and Fig. 2.6 provides a regional overview of the site.

3.2.1 Meteorology and Air Quality

The climate of Charlottesville, in the Central Mountain climatic province of Virginia, is continental, with some occasional marine influences. Data from the Lynchburg Municipal Airport, the most representative source of climatic information, are used to summarize the existing environment at the alternative site. Monthly average temperatures range from 3°C (37°F) in January to nearly 24°C (76°F) in July. Temperatures as low as −20°C (−4°F) and as high as 37°C (99°F) have been recorded. Precipitation averages in excess of 95 cm (38 in.), but up to 27 cm (11 in.) has fallen in a single month, and the 24-h maximum is in excess of 15 cm (6 in.). Snowfall is moderate, averaging 47 cm (19 in.), but more than 77 cm (31 in.) has been measured in a single month. Because of the terrain, high humidity, and light winds, dense fog commonly occurs: during a typical year, 40 d will have fog that restricts visibility to less than 0.4 km (0.25 mile). Although hurricanes and tropical cyclones rarely penetrate inland to the Virginia mountains, an average of 41 thunderstorms are recorded at the Lynchburg Municipal Airport (Gale 1978).

The Charlottesville site lies in AQCR 224, the Northeastern Virginia Intrastate Region (Fig. 3.1). The air quality at the site is presently good, with the area meeting or exceeding regulatory standards for all criteria pollutants (EPA 1983) (Sect. 3.1.1.2).

3.2.2 Water Resources

The Charlottesville alternative site is located in the James River watershed and drains to the north fork of the Rivanna River. The site is generally well drained, and facilities can be located on the site above the 100-year floodplain, even though part of the site lies within the floodplain. Data that quantify surface water hydrology and surface water quality at the site are not available.

Groundwater in the Piedmont Plateau is present in unconfined aquifers overlying bedrock and in fractures within the bedrock. The availability and use of groundwater are quite variable. Site investigation revealed groundwater in two borings; the level in one borehole was equivalent to the level of an on-site pond and the other was 8.4 m (28 ft) below the surface.

Additional data concerning the size and quality of the groundwater resource in the site area are not available.

3.2.3 Geology and Soils

The site is located on the edge of the Piedmont Plateau largely between two prominent parallel ridges with several small valleys between them. The site is underlain by granite gneiss of the Precambrian era. The essential minerals in the gneiss are feldspar and quartz, with the accessory minerals being biotite and epidote. The gneissic structural strike is in a northeasterly direction and dips to the southeast at approximately 70 degrees. Abundant quartz float present at the surface indicates the presence of quartz veins in the gneiss. Rock outcrops are present. A geological and soil investigation of the site was performed, revealing an irregular rock surface with soil depths ranging from 0 to >9 m (0 to >30 ft) (E. O. Googh and Associates, Charlottesville, Virginia, Geological and Soils Studies, Proposed National Electron Laboratory Site, Wood Property," letter to Tom Lincoln of Gloeckner, Lincoln, and Osborne, Charlottesville, Va., May 24, 1983). Of the seven test borings, groundwater was encountered in two boreholes.

Soils at the site overlying the gneiss on the broad-topped ridges were determined to be of four strata:

1. topsoil typically 0.3 m (1 ft) deep,

2. red micaceous silt or clayey silt, medium to stiff, 0.3 to 1.35 m (1 to 4.5 ft) thick,

3. brown-red-yellow micaceous silty sand, medium to stiff, 0.6 to 7.2 m (2 to 24 ft) thick, and

4. weathered granite gneiss with increasing hardness at depth.

These soils were observed to be typical of soils in the Charlottesville area. They are not subject to serious volume changes with changes in moisture content and have allowable bearing capacities from 3,000 to 10,000 psf.

Soils are subject to frost action, with frost penetration of about 76 cm (30 in.). They are stable and have no history of slope instability. Earthquakes are infrequent in the site area; the maximum earthquake of record had an intensity of VI on the Modified Mercalli Intensity Scale. The site is located in seismic risk zone 2, where moderate earthquake damage could be anticipated (Bolt et al. 1977).

3.2.4 Ecological Resources

The Charlottesville site lies in an area that is disturbed ecologically by the presence of an adjacent airport and industrial park. The description of the site contained in a proposal to DOE did not indicate the vegetation types or wildlife species on the site. About 20% of the site lies within the 100-year floodplain of a stream flowing into the north fork of the Rivanna River. Although the site lies at the head of a small watershed and evidently contains no permanent streams, such a stream flows along about a quarter of the site boundary. No other wetlands of significant size are located on-site. Elevations range from about 110 m to 175 m (360 to 570 ft). No endangered plant or animal species is expected to reside or occur regularly at the site, as indicated by the federal list of these species and by literature describing the habitats of endangered species occurring in the Commonwealth of Virginia.

3.2.5 Community Resources

The region that may be affected by construction of CEBAF in Albemarle County includes both the county and the city of Charlottesville, Virginia. This area is located in central Virginia, roughly 48 km (30 miles) southeast of Staunton, Virginia; 112 km (70 miles) northwest of Richmond, Virginia; 192 km (120 miles) southwest of Washington, D.C.; and 216 km (135 miles) northeast of the North Carolina state line (Fig. 2.5). The proposed CEBAF site is 10.4 km (6.5 miles) north of the City of Charlottesville's northern boundary and 14.4 km (9 miles) north of the University of Virginia. The 81-ha (200-acre) site is located at the edge of the county's newest industrial park, roughly 1.6 km (1 mile) west of Route 29 and 0.8 km (0.5 mile) northeast of the Charlottesville-Albemarle Airport (Fig. 2.6). Municipal water and sewer services are available at the site.

The City of Charlottesville grew from a total population of 38,880 in 1970 to 39,916 in 1980. The population is estimated to be 40,459 in 1984, and is expected to reach 41,000 by 1990. Compared to this extremely modest growth rate, the independent jurisdiction of Albemarle County raised its 1970 population of 37,780 to 55,783 in 1980. The county population for 1984 is estimated to be 62,885. By 1990 this total is expected to climb to 73,600. These figures indicate that the 1984 population of the designated impact region is 103,344, with the majority located in Albemarle County. The region is predicted to have

114,600 residents in 1990 (State Statistical Abstract Service, personal communication with J. A. Boyette, ORNL, May 9, 1984).

Vehicular transportation to the proposed site would be accommodated on Route 29, a four-lane divided highway that is the major north-south vehicular artery in Albemarle County (Figs. 2.6 and 2.7). This highway, which passes within 1.6 km (1 mile) of the proposed site, currently provides no direct access to the site. Interstate 64, the state's major east-west vehicular artery, is 9 miles south of the site.

Travelers en route to the site would most likely turn west off Route 29 onto heavily traveled State Road 649, which leads to the Charlottesville-Albemarle Airport. After roughly 0.8 km (0.5 mile) on this road, the traveler would turn north onto State Road 606, which is a secondary road that would require improvement to meet facility-induced demand. After roughly 1.2 km (0.75 mile) on State Road 606, one would reach the short, unpaved agricultural road that leads to the site.

To accommodate travel to CEBAF, the University of Virginia offered to engage a developer to construct a 1.6-km (1-mile) road that would connect Route 29 directly to State Road 606, thereby allowing facility-induced traffic to avoid airport-related travelers on State Road 649. The developer's plan would also include the construction of a new road, roughly 270 m (900 ft) in length, that would connect State Road 606 to the site. At this time there are no roads leading travelers onto the site; automotive access is limited to off-road and four-wheel-drive vehicles. In order to facilitate on-site traffic, the university offered $500,000 for basic site development and construction of internal roadways.

3.2.6 Radiological Background

The sources for exposure to naturally occurring radioactivity are discussed in Sect. 3.1.6. With no published information available specific to the Charlottesville area regarding measured values of cosmic and terrestrial radiation, it is assumed that residents in this area receive an average whole-body dose of about 96 millirem/year. This estimate is the same as that for the average Virginia resident from both external and internal exposure to natural background radiation.

3.2.7 Ambient Noise

No monitoring of baseline ambient noise levels at the proposed Charlottesville site was conducted for this project, and no site-specific noise level data are available. Consequently, existing noise levels are described qualitatively, based on current land use practices in the site vicinity, as interpreted from the information in Sect. 3.2.5.

Existing noise levels at the proposed CEBAF site near Charlottesville are probably influenced by air traffic at the Charlottesville Albemarle Airport, which is located 0.8 km (0.5 mile) to the southwest of the proposed site. Activity at the adjacent industrial park also probably contributes to site noise levels.

3.3 ALTERNATE SITE 2, BLACKSBURG, VIRGINIA

Figure 2.7 illustrates the specific location of the proposed CEBAF alternative site at Blacksburg, and Fig. 2.8 provides a regional overview of the proposed site.

3.3.1 Meteorology and Air Quality

The Blacksburg alternative site lies in the Southwestern Mountain climatic province of Virginia, with a continental climate that is moderated by local terrain. Data from the Woodrum Airport at Roanoke, Virginia are used to represent the climate at the proposed site. The climate in the Virginia mountains is pleasant, with a minimum monthly temperature of 2°C (36°F) in January and a warmest average temperature of 24°C (75°F) in July. The coldest recorded temperature is −20°C (−4°F), and the highest is 38°C (100°F). Precipitation averages 98 cm (39 in.), uniformly distributed throughout the year. The maximum monthly precipitation recorded is more than 22 cm (9 in.), while the most precipitation recorded in a 24-h period is in excess of 15 cm (6 in.). Snowfall averages 65 cm (26 in.) per annum, though more than 102 cm (41 in.) fell in January 1968. Because of the terrain, humidity, and moderate winds, dense fog that restricts visibility to less than 0.4 km (0.25 mile) occurs an average of 25 d/year. Hurricanes and tropical storms never fully penetrate the Virginia mountains, but an average of 38 thunderstorms visit the area each year (Gale 1978).

The alternative site lies in AQCR 226, the Valley of Virginia Intrastate Region. The air quality is presently good and all regulatory standards for the criteria pollutants presently being attained (EPA 1983) (Sect. 3.1.1.2).

3.3.2 Water Resources

The Blacksburg site is located in the New River Basin and is drained by ephemeral channels that discharge to Stroubles Creek. No perennial streams are present on the site. All facilities on the site can be easily located above the 100-year floodplain. Data that quantify the surface water hydrology and surface water quality in the site area are not available.

Groundwater in the Blacksburg area is present in unconfined aquifers overlying bedrock and in fractures within the bedrock. The availability and use of groundwater are quite variable. Limestone- and dolomite-rich formations typically have large quantities of groundwater of good quality. Site investigation revealed no groundwater in the shallow borings made in the Elbrook Formation [4.0 m (13.3 ft) maximum depth of borehole] (Parker 1981). Springs were suggested to be the primary source of water for the ephemeral channels on the site. The elevation of the ephemeral channels was suggested to be representative of the approximate groundwater level (Garst 1983). Additional data of the size and quality of the groundwater resource in the site area are not available.

3.3.3 Geology

The site is located in the Valley and Ridge Province and is underlain by the Rome and Elbrook Formations of the Cambrian period. Also present at the site are Terrace deposits within the Rome Formation and alluvium deposits in the ephemeral stream channels that overlie the Elbrook Formation. The Pulaski Fault lies along the southern boundary of the site.

The Rome Formation consists of interbedded mudstone, sandstone and siltstone, and dolomite. The rock is extensively fractured with calcite-coated and slickenside surfaces. Soil thicknesses for the Rome Formation are typically very thin. The strike of the rock varies from east to northeast with a dip of 36 to 67 degrees. The Elbrook Formation is thick and consists primarily of dolomite with thin beds of sandstone and limestone. The structural composition of the formation is complex and variable with depth. The strike of the rock is variable, with a dip of 20 to 67 degrees. Terrace deposits are unconsolidated, stratified deposits of quartz and feldspattic sandstone in an extensively weathered soil matrix with thicknesses of 0 to 6 m (0 to 20 ft).

Borings were made at three locations in the Elbrook Formation, to a maximum depth of 4 m (13.3 ft) (Parker 1981). Rock was encountered in two borings at depths of 1.2 m and 4 m (4 ft and 13.3 ft). Soil horizons identified were:

1. dark grayish-brown loam, 0.08 to 0.15 m (0.3 to 0.5 ft) thick,
2. gray clayey silt weathered from interbedded limestone and shale, up to 30% chert, 0.5 to 1 m (1.7 to 3.3 ft) thick, and
3. orange, brown very stiff clay from weathered limestone and shale, with shale fragments and lenses of silty sand, 2.2 to 3.4 m (7.3 to 11.3 ft) thick.

A field visit to the site revealed that the 6- to 7.5-m (20- to-25 ft) cut slope along the U.S. 460 Bypass showed no hard rock. The alluvium present in the middle of the site is about 15 m (50 ft) wide, soft, and marshy and is reportedly spring fed (Garst 1983).

The site is located in seismic risk zone 2, where moderate damage from earthquakes can be anticipated (Bolt et al. 1977). Nineteen earthquakes have been identified in the area for a 204-year period of record (1774–1978). The maximum intensity was VII on the Modified Mercalli scale (Bollinger and Wheeler 1980). A potential maximum intensity of VIII is considered possible at the site, based on data collected by Bollinger (G. A. Bollinger, VPISU,"Seismic Characteristics of the Blacksburg Area in Montgomery County, Virginia," letter to T. F. Parkinson, director, Nuclear Reactor Laboratory, VPISU, Nov. 10, 1980). No other geological hazards have been identified for the site area.

3.3.4 Ecological Resources

The Blacksburg site lies adjacent to a four-lane highway and on land owned by VPISU. This land is not subject to local zoning ordinances. Most of the site consists of grassland, while a small portion is forested. The site lies at the head of a watershed and has one or two small intermittent streams flowing through narrow [15-m (50-ft)] strips of soft, wet marshy land that supports cattails and other marsh vegetation but lacks standing water. The nearest permanent stream is Stroubles Creek, about 610 m (2000 ft) from the site, which flows into the New River. No other wetlands of significant size are located on-site. Elevations range from about 610 m to 640 m (2000 ft to 2100 ft). No endangered plant or animal species is expected to reside or occur regularly on the site, as indicated by the federal list of such species and by literature describing the habitats of endangered species occurring in the Commonwealth of Virginia.

3.3.5 Community Resources

Montgomery County, which includes the town of Blacksburg, is designated as the region most likely to be impacted by the construction of the CEBAF project in Blacksburg. The proposed CEBAF site consists of approximately 8.1 ha (20 acres) of rolling hills located on U.S. 460 within the town of Blacksburg and on the VPISU campus (Fig. 2.7). Located in southwest Virginia, this part of Montgomery County is less than 64 km (40 miles) southwest of Roanoke, Virginia, and approximately 56 km (35 miles) southeast of the West Virginia state line via U.S. 460. Municipal water and sewer services are available at the site.

The population in Montgomery County grew from 46,828 in 1970 to a total of 63,244 residents in 1980. According to the 1980 census, the town of Blacksburg accounted for 30,638 of these residents, or almost 50% of the county population. Montgomery County's 1984 population is estimated to be 68,113, and is predicted to reach 77,500 in 1990 (State Statistical Abstract Service 1984).

The proposed site is roughly 16 km (10 miles) north of Interstate 81 and adjacent to U.S. 460 (Fig. 2.8). The capacity of U.S. 460, which is a four-lane divided highway, is well in excess of local traffic use (F. Norris, Virginia State Highway Department, Christianburg, Virginia, personal communication to J. A. Boyette, ORNL, May 16, 1984).

At present the only access to the site is through an unpaved agricultural road that joins U.S. 460 at its intersection with Southgate Drive. Leading southwest from the heart of the VPISU campus to the proposed site, Southgate Drive is a wide, two-lane road that is capable of accommodating an increased traffic demand. However, if this site were chosen for CEBAF construction, the unpaved agricultural road that extends to Southgate Drive southwest of U.S. 460 would require substantial improvement to carry facility-induced traffic. VPISU offered to resolve this problem by taking responsibility for the construction of 0.8-km (0.5-mile) of roadway that would reach from the intersection with U.S. 460 to the major buildings on the CEBAF site.

The proposed site's accessibility would be greatly improved by the Virginia State Highway Department's plan to build a major cloverleaf connector and overpass at the intersection of U.S. 460 and Southgate Drive. These improvements would make exiting U.S. 460, or crossing on Southgate Drive, much easier and safer. Alternate access could be provided over a former railroad right-of-way that approaches the site from the south. On-site roadways would be provided by the developer.

3.3.6 Radiological Background

The sources for exposure to naturally occurring radioactivity are discussed in Sect. 3.1.6. Published background radiation information is not readily available for Blacksburg specifically, but measurements are available for the Roanoke, Virginia area, about 48 to 56 km (30 to 35 miles) away. The whole-body doses from cosmic and terrestrial sources are about 44 millirem and 46 millirem, respectively (Oakley 1972). The total dose from naturally occurring radioactivity in the Blacksburg area is estimated to be 108 millirem/year (including 18 millirem from internal sources). This compares to 96 millirem for the average Virginia resident (Sects. 3.1.6 and 3.2.6).

3.3.7 Ambient Noise

No monitoring of baseline ambient noise levels at the proposed Blacksburg site was conducted for this project, and no site-specific noise level data are available. Consequently, existing noise levels are described qualitatively, based on current land use practices in the site vicinity, as interpreted from the information in Sect. 3.3.5.

The principal land use affecting noise levels at the proposed site is U.S. 460, which is adjacent to the site boundary (Fig. 2.7). Noise levels undoubtedly vary with the traffic level on the highway. Additional nearby land uses, such as the university, could also affect existing noise levels in the site vicinity.

REFERENCES FOR SECTION 3

Army (U.S. Army). 1980. *Final Environmental Impact Statement, Fort Monroe Base Realignment,* Concise Special Planning Group, U.S. Army Planning and Doctrine Command (HQTRADOC).

Bollinger, G. A., and R. L. Wheeler. 1980. "The Giles County, Virginia, Seismic Network Monitoring Results, 1978-1980," paper presented at the 52nd Annual Meeting of the Seismological Society of America, Eastern Section, Pennsylvania State University, Oct. 27–30.

Bolt, B. A., W. L. Horn, G. A. McDonald, and R. F. Scott. 1977. *Geological Hazards,* Springer-Verlag, New York.

Conant, R. 1958. *A Field Guide to Reptiles and Amphibians.* Houghton Mifflin Company., Boston, Mass.

Cook, R. E. 1969. "Variation in Species Density of North American Birds," *Systematic Zool.* 18: 63–84.

Cowardin, L. M., et al. 1979. *Classification of Wetlands and Deepwater Habitats of the United States,* FWS/OBS-79/31, U.S. Fish and Wildlife Service.

Department of City Planning (City of Newport News, Va.). 1983. *General Plan Handbook.*

Department of Development (City of Newport News, Va.). n.d. *Emerging Newport News, Virginia: The New Star in the Southeast.*

Department of Development (City of Newport News, Va.). 1983. *An Update of Recent Economic Trends: City of Newport News.*

Department of Development (City of Newport News, Va.) 1984. *Demographic Data by Census Tract: 1983 Estimates.*

DOE (U.S. Department of Energy). 1986. *CEBAF Conventional Facilities Report,* February 1986.

DOI (U.S. Department of the Interior). 1983. National Registry of Natural Landmarks, Federal Register, 48.

Dischinger, H. C. (Hugh C. Dischinger Engineers and Surveyors). 1981. *Drainage Study Report Brick Kiln Creek Development Newport News, Virginia*, job 81-10-1057, Grafton, Va.

EPA (Environmental Protection Agency). 1978. *Protective Noise Levels*, EPA-550/9-79-100. [As cited in "Noise," reprinted from the *Tenth Annual Report of the Council on Environmental Quality*, U.S. Government Printing Office, Washington, D.C., 1980.]

EPA (Environmental Protection Agency). 1983. *Maps Depicting Nonattainment Areas Pursuant to Section 107 of the Clean Air Act—1983*, EPA-450/2-83-004, Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

Eyre, F. H., ed. 1980. "Forest Cover Types of the United States and Canada," *Soc. Am. Foresters*, Washington, D.C.

Gale Research Company. 1978. "Climates of the States," vol. 2, Detroit.

Garst, H. 1983. *Trip Report: Field Visit, National Electron Acceleration Lab, VPISU, Blacksburg, Va.*, Hayes, Seay, Mattern, and Mattern, Inc., Roanoke, Va.

Goodwin, R. H. and W. A. Niering. 1975. *Inland Wetlands of the United States: Evaluated as Potential Registered Natural Landmarks*, Nat. Park Serv., Washington, D.C.

Hayes, Seay, Mattern and Mattern, Inc. 1983. *Conceptual Design Report (Draft), CEBAF*, Roanoke, Va.

Jacobs, D. G., L. E. Boring, K. R. Earnshaw, and J. S. Epler. 1980. *An Environmental Assessment for the Decommissioning of the Space Radiation Effects Laboratory (SREL), Newport News, Va.*, Evaluation Research Corporation, Oak Ridge, Tenn.

Johnson, G. H. 1976. "Geology of the Mulberry Island, Newport News North, and Hampton Quadrangles, Virginia," *Commonwealth of Virginia, Division of Mineral Resources, Report of Investigations 41*, Charlottesville, Va.

NCRP (National Commission on Radiation Protection and Measurement). 1975. *Natural background radiation in the United States*, NCRP 45.

Oakley, D. T. 1972. *Radiation Exposure in the United States*, ORP/SID-72-1, U.S. Environmental Protection Agency.

ORNL (Oak Ridge National Laboratory). 1978. *Regional Energy-Environment Data Book of the Southern Region (Draft)*, ORNL-5443, Oak Ridge, Tenn.

Parker, J. C. 1981. *Drill Logs for Investigation of Electron Accelerator Site at VPISU, Blacksburg, Va.*, Agronomy Department, VPISU.

Samson, F. B. 1980. "Island Biogeography and the Conservation of Nongame Birds," *Trans. North Am. Wildl. and Nat. Resour. Conf.* 45: 245–251.

Schnable Engineering Associates. 1983. *Preliminary Geotechnical Engineering Study, Proposed Accelerator and Support Facilities, Route 143, Newport News, Va.*, contract V83412, Richmond, Va.

Simpson, G. G., 1964. "Species Density of North American Recent Mammals," *Syst. Zool.* 12: 57–73.

U.S. Bureau of the Census. 1981. *1980 Census of Population and Housing*, PHC 80-V-48.

U.S. Department of Labor, Bureau of Labor Statistics. 1984. *Employment and Earnings*, vol. 31, No. 2.

VRERC (Virginia Real Estate Research Center). 1984. *Real Estate Markets in Virginia*, School of Business, Virginia Commonwealth University, Richmond, Va.

VSWCB (Virginia State Water Control Board). 1973. "Ground Water of the York–James Peninsula Virginia," *Basic Data Bulletin 39*, Richmond, Va.

VSWCB (Virginia State Water Control Board). Jan. 17, 1985. Comments on the Draft Environmental Assessment for the CEBAF, letter to Charles Ellis, Virginia Council on Environment.

Whitcomb, et al. 1981. "Effect of Forest Fragmentation on Avifauna of the Eastern Deciduous Forest," pp. 125–205, *Forest Island Dynamics in Man-Dominated Landscapes*, ed. R. L. Burgess and D. M. Sharpe, Springer-Verlag, N.Y.

4. POTENTIAL ENVIRONMENTAL IMPACTS

4.1 THE PROPOSED SITE, NEWPORT NEWS, VIRGINIA

4.1.1 Air Quality

Construction of the proposed facility will result in increased vehicle exhaust emissions, fugitive dust, and various solvent and paint fumes. These emissions are anticipated to be small, and no noticeable offsite effects are expected. Effective dust-control techniques, such as spraying unpaved roads and soil stockpiles that will exist during on-site construction, may be required during dry periods to minimize dust released from the site.

Operation of the proposed facility will result in water vapor emissions from the cooling system. Although the final design for the cooling system has not been completed, most presently available cooling systems tend to have similar impacts. Water vapor emissions from the cooling tower(s) are not anticipated to be detectable offsite; however, fog from the tower(s) may (1) be present on otherwise clear days, (2) enhance naturally occurring fog, or (3) cause naturally occurring fog to persist longer than it would without the emissions from the tower(s). If the tower(s) is (are) sited more than a few tens of meters from the closest roads, as planned, no traffic hazards are anticipated.

The operation of the facility will have a negligible impact on the meteorology of the site. Dissolved solids contained in the cooling water will be emitted as drift from the facility, but well-designed and well-maintained drift eliminators will reduce these emissions to such a level that offsite concentrations will be undetectable above background levels of naturally occurring salts. Because no other atmospheric emissions are anticipated, no other air quality impacts should occur.

4.1.2 Water Resources

4.1.2.1 Surface water

Surface waters that could be impacted by construction and operation of the proposed facility are Brick Kiln Creek and Big Bethel Reservoir (Fig. 3.1). The surface water discharge from the site to Brick Kiln Creek will increase as a consequence of site development. Dischinger (1981) has estimated an increase in runoff of 5.4×10^4 m^3 (1.9×10^6 ft^3) for a 25-year 24-h precipitation event. This estimate, which represents a 56% increase in runoff, was determined using Soil Conservation Service methods for hydrologic analysis. For this increase in runoff to occur, the site would be drained in a manner similar to that proposed by Oyster Point Development Corporation (Sect. 3.1.2). Dischinger also considered the effects of full development on the upper watershed of Brick Kiln Creek. Full development of the upper watershed would produce an increase in the peak discharge at the box culvert at Interstate 64 west of the site. The peak discharge is estimated to increase from 13.3 to 67.9 m^3/s (470 ft^3/s to 2400 ft^3/s) for the 25-year 24-h precipitation event. A retention basin sized to hold the projected runoff from such storm events has been proposed. The drainage system for the site will be designed and submitted to the COE for approval prior to construction to ensure that no contamination or reduction in flow to Big Bethel Reservoir will result. A properly designed drainage system for the site would result in adequate site drainage without reduction in flow to Big Bethel Reservoir (A. Schlimm, Manager, Oyster Point Development Corp., Newport News, Va., personal communication with D. W. Lee, ORNL, April 11, 1984). An environmental assessment of the expansion of the Oyster Point Development Corporation drainage system has been prepared (Dischinger 1982). The assessment concluded that no significant impacts to the environment would result from expansion of the drainage system.

Water for potable and other consumptive use, such as cooling tower makeup, will be obtained from the municipal water supply system. The City of Newport News Waterworks foresees no potential impacts due to consumptive use at the CEBAF facility (W. E. Meyer, City of Newport News, personal communication to DOE/ORNL, April 5, 1984 site visit). Blowdown from the cooling system will be discharged to the municipal sewer system; therefore, no receiving waters will be affected.

4.1.2.2 Groundwater

Because groundwater at the site is shallow and influenced by site drainage, any impacts to groundwater would be extended to surface water and ultimately to Big Bethel Reservoir. Impacts to groundwater during building construction and operation could occur as a result of dewatering. Facility operation could impact groundwater by induced radioactivity from an uncontained beam in the accelerator complex.

Dewatering

According to the conceptual design, the accelerator tunnels and end stations will be below grade. Their construction will require dewatering because of the prevailing high water table. Pumping rates and volumes associated with dewatering have not yet been quantified. During operation, sump pits within the accelerator complex will be pumped as necessary to lower locally high water table conditions. These waters will be monitored for contamination prior to treatment and discharge. No groundwater from dewatering will be released to the environment via the site drainage system if it exceeds 1 pCi/mL gross beta. The reviewing system for groundwater pumped during facility operation has not yet been identified. A detailed hydrogeologic-geotechnical study to characterize groundwater will be conducted prior to final design.

The removal of water by dewatering will lower the local water table. The extent of the lowering depends on the unconfined aquifer characteristics, which are presently not well known. Following the construction of the accelerator tunnels and end stations, the groundwater levels are expected to rebound; however, due to dewatering in some areas during operation, groundwater levels are not expected to fully return to preconstruction levels. The site drainage system is also expected to result in a lowering of groundwater below preconstruction levels. In any case, because groundwater is not used in the site area, the lowering of the water table by dewatering would not be a significant impact.

Dewatering effluents could contain sediment, oil, grease, and other contaminants, and low levels of radioactivity during operations. These effluents will be monitored and treated, as necessary, before they are released to the environment. Dewatering discharges released to the Brick Kiln Creek drainage system require the approval of COE to ensure that there is no contamination of Big Bethel Reservoir. Any dewatering discharges to the site drainage system during operations will require a National Pollution Discharge Elimination System (NPDES) permit (Appendix A). Discharges to the municipal sewer system may require an NPDES permit (Appendix A) and would have to comply with the applicable standards of the Commonwealth of Virginia (1982). Also, releases to the storm sewer could be considered to be a reduction in flow to Big Bethel Reservoir. If so, consultation and approval by COE would be required.

Induced Radioactivity

Operation of CEBAF would result in radioactive groundwater contamination in the immediate vicinity of the accelerator complex as a result of soil activation. The greatest potential for radioactive contamination of groundwater is in the vicinity of the beam dumps. Detailed design of the beam dumps was not prepared as part of the conceptual design. Consequently, the site-specific assessment of the impacts of the beam dump is inferred from similar facilities and the use of conservative analysis.

It is the policy of DOE to conduct the Department's operations in compliance with the letter and the spirit of applicable environmental statutes, regulations, and standards. Accordingly, the CEBAF will be designed and operated to assure that it meets all applicable, or relevant and appropriate federal or state groundwater standards.

Presently, the State of Virginia has established groundwater standards for radioactivity that specify that gross beta concentrations should not exceed 1 pCi/mL. In addition, the State has an antidegradation policy for groundwater which states: "If the concentration of any constituent in groundwater is less than the limit set forth by the groundwater standards, the natural quality of the constituent shall be maintained." However, the State Water Quality Standards do allow a variance to this policy if it is demonstrated that such a variance is "justifiable to provide necessary economic or social development, that the degree of waste treatment necessary to preserve the existing quality cannot be economically or socially justified, and that the present and anticipated uses of such water will be preserved and protected" (VSWCB Pub. RB-2-86). Therefore, even though the facility will be designed and operated to be within the State's groundwater standards (wherever they are applied), a variance may still be required because of the antidegradation policy. The groundwater contamination and a possible variance to the standards would be handled via a No-Discharge Certificate (R. A. Masiello, VSWCB, Sept. 2, 1986; see Appendix A).

The Department has initiated discussions with the Virginia State Water Control Board (VSWCB) and the Bureau of Radiological Health regarding the application of State groundwater requirements to the project. As final design is developed and a more accurate prediction of the concentration of radioactivity in the soil and groundwater is available, the Department will work with the State of Virginia to establish an appropriate monitoring system and schedule to ensure that no significant impacts occur as a result of this project.

The Department and State are also discussing the permits and processes necessary to assure compliance with the State groundwater quality protection laws and policies. All necessary permits will be obtained prior to construction of the proposed project.

At the proposed site, each beam dump would be designed to minimize the amount of induced radioactivity in the surrounding soil and groundwater. Well points would be installed at appropriate locations near the beam dump to permit monitoring of the soil moisture content and induced radioactivity. Water collected in the sumps associated with the end stations and countinghouses and water collected from dewatering beam dump areas (if dewatering is required) will be monitored. The collected water would not be released to the environment unless it meets DOE and State discharge requirements.

The Stanford Linear Accelerator Center (SLAC) is similar to the proposed facility and has been used as a comparable facility for assessment. SLAC operates in a pulsed mode, rather than continuously, with a maximum duty cycle of 0.06% (Neal 1968). The maximum average beam power for design is 2.4 MW, with a beam energy of 4 GeV. The accelerator tunnels and beam dumps are below grade. Groundwater wells in the vicinity of the beam dumps are routinely sampled for the presence of radioactivity. To date, no evidence of radioactivity in groundwater in excess of natural radioactivity has been detected (SLAC 1983). At SLAC, the groundwater level is beneath the facility, and it is equipped with a drainage system to maintain that condition. At the CEBAF site, the groundwater level is closer to the surface and thus, specific measures will be needed to prevent significant activation of groundwater.

Monitoring results from Fermi National Accelerator Laboratory, which is a proton synchrotron capable of operating at 1000 GeV, have detected radioactivity in soils because of accelerator operation but have not detected accelerator-produced radionuclides in groundwater (Baker 1982).

Studies of groundwater activation were carried out to serve as a basis for determining levels of induced radioactivity at the Newport News site. Calculations were done assuming a 1% beam loss to approximate conditions around the accelerator. Additional calculations were carried out for 100% beam loss to approximate conditions around the beam dumps. The results of those studies are described below.

Groundwater activation due to accelerator operation at the proposed CEBAF site was predicted initially for a 1% beam loss in the accelerator tunnels (Barbier 1980). The analysis assumed a beam energy of 2 GeV and geohydrologic conditions of (1) no circulation of shallow groundwater, (2) no drainage of precipitation, (3) an aquifer of 9 to 21 m (30 to 70 ft) thickness at depths of 3 to 3.6 m (10 to 12 ft), (4) groundwater levels at 0.6 to 0.9 m (2 to 3 ft) below the surface, and (5) 3 m (9 ft) of earthen shielding or equivalent concrete. The proposed CEBAF has since been upgraded to 4-GeV beam energy, and the site drainage system would facilitate the transport of shallow groundwater and precipitation runoff to Big Bethel Reservoir, thus rendering assumptions (1) and (2) inconsistent with the present design. Barbier (1980) considered soil activation of ^{3}H and ^{22}Na leached into groundwater, ^{3}H production by thermal neutron capture of ^{2}D, and ^{3}H production by high-energy neutron spallation of ^{16}O. Recalculating the Barbier (1980) analysis for the elevated beam energy (4 GeV) gives maximum saturation concentrations of ^{3}H and ^{22}Na from soil activation of 214 pCi/mL and 11.4 pCi/mL, respectively. Thermal neutron capture of ^{2}D was calculated to give concentrations of 0.4 pCi/mL. These values are less than the maximum permissible concentrations (DOE Order 5480.1A) of 3000 pCi/mL for ^{3}H and 40 pCi/mL for ^{22}Na for water in uncontrolled areas. All aspects of the analysis for calculating the maximum saturation concentrations are conservative. The assumption of a beam loss of 1% contributing to induced radioactivity outside the accelerator tunnel is probably greater than would be realized in actual operation. Localized beam losses at the beam switchyard and beam dumps may, in fact, be greater than 1%, but would be attenuated by the shielding.

The maximum saturation concentrations in groundwater from accelerator operation would be diluted and transported by uncontaminated groundwater while decay was occurring. These mechanisms significantly influence the concentration of contamination at any distance away from the radiation source.

Another analysis of the activation of groundwater was prepared by Stapleton (1986). This analysis was performed using a step-function model consisting of an activation zone in which tritiated water is generated.

Stapleton's analysis used an approximate groundwater velocity of 2.5 m/year (7.5 ft/year), determined from the preliminary geotechnical investigation. The analysis was performed for 6 GeV with a 1.2-MW (100%) beam loss. These assumptions are specific to the beam dump vicinity. The calculation made the conservative assumption that groundwater would be present immediately adjacent to the beam dump shielding; dilution by uncontaminated groundwater was not considered. Calculations were performed using a shielding factor of 10^3 to represent the least amount of shielding that would be considered in the construction of the accelerator. The maximum saturation concentration for tritium adjacent to the beam dump was calculated to be 2400 pCi/mL. The calculations identified a concentration of 1.5 pCi/mL in groundwater at a distance of 200 m (600 ft) from the source located at the beam dump. A conservative estimate of the residence period of groundwater of one year within an activation zone of one mean free path was included in the analysis.

Further improvements in the analysis of potential activation of groundwater and the associated contamination of surface waters from soil activation were considered by Lee (1986). In this analysis, the effects of recharge and dilution were considered. The need for estimating the size of the activation zone and the length of the residence period was removed. The analysis used the maximum saturation concentrations at the beam dump developed by Stapleton (1986). The dilution capacity of the site groundwater was conservatively estimated because site data are not available. The results are presented in Table 4.1. The results show that at the site boundary the concentration of radioactivity in the groundwater would be well below the Virginia standard of 1 pCi/mL gross beta. The

Table 4.1. Concentrations of radioactive groundwater at the beam dump and the site boundary resulting from CEBAF operation (conservative model)[a]

Isotope	Low dilution		High dilution	
	Beam dump	Site boundary	Beam dump	Site boundary
^{3}H	36	0.24	7.7	0.072
^{22}Na	50	2.6×10^{-12}	11	7.6×10^{-13}

[a]All values as pCi/mL.

calculations do not include the effect of retardation of radionuclides by adsorption, which will further reduce the concentrations of ^{22}Na at the site boundary by approximately a factor of 100. Tritium is not adsorbed in soil; hence, its concentrations would be unaffected.

These results do not consider the effect of any additional shielding to be incorporated into the design, which would further lower the concentrations. Realistic operating conditions, compared to the conservative model utilized above, will result in lower average beam energies (a mixture of energies from 1 to 4 GeV instead of the 6 GeV assumed), beam currents (50 to 100 microamps instead of the 200 microamps assumed), and hours of operation (4500 hours instead of the 8760 hours assumed). This will reduce levels of induced radioactivity from the values shown in Table 4.1 by about a factor of 5 (estimated by the DOE Program Office). Specific design features will further lower this concentration to well within the State standards through the use of shielding, dewatering, or other measures, applied either individually or in combination. For example, a 33% increase of shielding thickness raises the shielding factor to 10^4. 10^3 was assumed in the model above. This would lower the activation by another factor of 10, and bring the largest value in Table 4.1 down to 1 pCi/mL.

The measures necessary to meet Virginia standards are well within technical capability, and can be achieved with project resources. The CEBAF project will meet all State standards on- or off-site in accordance with the State determination as to where those standards apply. When the design of the accelerator has been finalized and geotechnical investigations have been completed, more accurate estimates of potential radioactive contamination should be possible.

Any release of contaminated groundwater to surface waters will be subject to dilution by uncontaminated surface waters. A water balance for the site, prepared by Lee (1986), has shown that a dilution of at least 100 can be expected from site runoff prior to leaving the site. As a result, the levels of contamination in surface waters and groundwater at the site boundary are expected to be extremely small.

The Virginia State Water Control Board (VSWCB) established groundwater quality standards for radioactivity that specify that gross beta concentrations should not exceed 1 pCi/mL. Although ^3H and ^{22}Na are both beta emitters, ^3H is not considered in measurements relative to the standard. The Virginia non-degradation policy will be handled via a No-Discharge Certificate. The method used would probably require the issuance of the Certificate with requirements for groundwater monitoring and conditions necessary for a "groundwater mixing zone" or a variance to the standard (R. A. Masiello, VSWCB, Sept. 2, 1986; see Appendix A).

4.1.2.3 Monitoring and mitigation

Potential impacts to groundwater and surface water will be minimized by incorporating into the facility design a comprehensive monitoring and mitigation program. Potential impacts to surface water arising from construction will be minimized by sediment and runoff control. The use of sediment control basins for retaining construction runoff and the use of good construction practices will minimize the potential of any offsite impacts from construction.

Potential impacts to groundwater arising from groundwater activation will be reduced by the incorporation of shielding, dewatering, or other measures. The quality of any pumped water will be monitored. If the radioactivity level is above standards, the water will be retained, while the level decays. When the induced radioactivity is below the prescribed standard, the water could be released to the site drainage system or the municipal sewer system. The discharge of pumped groundwater will require an NPDES permit (VSWCB 1985). Additional soil and water monitoring will be performed to detect any activation products of accelerator operation. When final, design and monitoring and mitigation plans will be submitted to the COE for approval prior to construction.

4.1.3 Geology and Soils

4.1.3.1 Construction impacts

Potential impacts to geology and soils from construction of the proposed facility are associated with topography, foundation settling, and erosion. Earthmoving is not expected to have any significant adverse effects on topography, based on previous experience in the site area by the military and based on the conceptual design for the facility. If the final grading results in localized depressions, seasonal accumulations of water may occur and consequently limit site utilization. Erosion of the earth shielding over the accelerator tunnels could adversely affect facility performance unless the soils are properly stabilized and vegetated. By establishing a vegetative cover soon after the construction and stabilization of the earthen covers, the potential for this impact is expected to be minimized.

Soils of the Norfolk Formation (Sect. 3.1.3) are not suitable for heavily loaded structures because of their low bearing capacities. Heavily loaded structures such as the end stations, beam dumps, and countinghouses are to be constructed with concrete piles embedded in the Yorktown Formation. Lightly loaded structures such as the accelerator tunnels, refrigeration plant, offices, and shops are to be constructed with shallow spread foundations on soil horizons 1 and 2 (Sect. 3.1.3). Soil type 3 is to be avoided so that large settlements arising from the peat and organic sediments will be minimized. Primary consolidation resulting from the 17-ft and 21-ft berms for shielding the linac and curved tunnels is expected to require 80 and 120 days, respectively, with total settlements on the order of 3 to 4 in. The 31-ft berms for shielding the beam dumps are expected to take 240 days for primary consolidation, with similar total settlements. Further long-term settlements are anticipated for drained creep or secondary compression.

4.1.3.2 Operation impacts

Potential impacts to geology and soils from CEBAF operation are associated with soil activation and seismic activity. The potential for seismic activity is low, and the risks associated with seismic events are small in the site area. Consequently, adverse impacts are not anticipated.

Soil activation from accelerator beam losses are expected to occur during operation. Maximum levels of soil activation are expected to be 630 pCi/g for ^{3}H and 160 pCi/g for ^{22}Na, using the results of the analyses prepared by Stapleton (1986) and Lee (1986). The levels of soil activation do not consider the effect of any additional shielding, which would further decrease the levels. This activity is not expected to result in a significant impact during the life of the facility; however, the decommissioning plan for the facility would need to address the excavation and disposal of the contaminated soil.

The magnitude of soil activation and the quantity of soil contamination produced over the life of the facility cannot be accurately predicted from the conceptual design. Periodic sampling and radiological analysis of the earthen shield over the accelerator tunnels and beam dumps would provide the data needed to determine the extent of contamination. If the activation reaches a level such that a potential impact to facility operation or groundwater resources could occur, the activated soil could be removed and replaced with additional shielding material or unactivated soil. The contaminated soil would require disposal at a DOE low-level waste facility.

4.1.4 Ecological Resources

4.1.4.1 Land use

Land actively used for research on the CEBAF site will increase from 7 ha (17 acres) to 36 ha (90 acres), while forested areas will decrease from 61 ha (152 acres) to 31 ha (79 acres) (Table 4.2).

Table 4.2. Comparison of preconstruction and postconstruction land uses on the Continuous Electron Beam Accelerator Facility site

Land use	Postconstruction Hectares (acres)	Preconstruction Hectares (acres)	Change (%)
Idle (forests)	31.6 (79.0)	60.9 (152.2)	48 loss
Active use	36.4 (90.0)	6.8 (16.8)	435 gain
VARC area	0.8 (1.9)	0.8 (1.9)	
SREL area	3.9 (9.6)	3.9 (9.6)	
Roads	1.2 (2.9)	1.2 (2.9)	
Dump	0.5 (1.2)	1.0 (2.4)	
Cleared (previously forested and 0.5-ha dump)[a]	24.6 (60.8)		
Pond (previously forested)	5.5 (13.6)		
Total	67.7 (164.0)	67.7 (169.0)	

[a]Includes new roads for CEBAF.

The site is located in an area already zoned for research and development, so the project is consistent with local land use planning (Sect. 4.1.5). Areas surrounding the site support a mix of residential (single-family and multifamily housing), commercial, and light to medium industrial uses. It is expected that existing utilities and services will be adequate to meet the needs of the CEBAF project.

The only potentially significant, nonradiological impacts of CEBAF operation on land use are related to cooling tower emissions. These emissions will consist of small water droplets (drift) and gaseous vapors. The drift will contain elevated concentrations of the dissolved salts found in the cooling tower makeup water. Some of the dissolved salts, particularly sodium chloride, are toxic to vegetation and, in large quantities, can affect land use by reducing the yields or growth of agricultural, ornamental, and native plants. The drift can also cause increased ground-level fogging in the local area, which could affect vehicular traffic on local roads. Biocides and corrosion inhibitors used in the cooling system also potentially affect vegetation.

Although such impacts are possible, they are unlikely to occur because the CEBAF cooling towers will be small, and the drift emission rate will be low (Sect. 4.1.1). Cooling tower installations many tens of times larger than those to be used at CEBAF have operated for many years without significant impact (Carson 1976). Also, because the potable water that will be used for cooling tower makeup is low in dissolved solids, the deposition of drift solids on vegetation and soils will be minimized. Operation of the CEBAF cooling towers should therefore have no impacts on land use in the area. In the unlikely event that offsite impacts occur, the most probable location of an impact is to the northeast, in an area which is already in a disturbed condition due to the presence of light industry and abandoned facilities not associated with CEBAF. No impacts on agricultural land use will occur, as no agricultural areas are located near the CEBAF site.

4.1.4.2 Terrestrial resources

Approximately 30 ha (73 acres) of hardwood and pine-hardwood forest, much of it forested temporary wetland, will be cleared for the CEBAF project. Plant communities and species occurring on the 68-ha (169-acre) site (Sect. 3.1.4.2) appear to be common in the region. Thus, there should be no particularly significant effects on rare or unusual floral resources. Areas of the cleared land that are not to be covered by permanent facilities will be seeded with grasses and landscaped. Operation of CEBAF has the potential to affect vegetation through deposition of cooling tower drift on foliage. Actual impacts resulting from operation of the small cooling towers, however, should be minor and inconsequential (Sect. 4.1.1), and reduced growth of vegetation is not expected.

Impacts to wildlife will result primarily from destruction and permanent loss of habitat during the construction of CEBAF. Populations of wildlife species occurring at the site (Sect. 3.1.4) will be permanently reduced, at least in proportion to the amount of their habitat destroyed. The lack of permanent wetlands and important species at the site, and the already disturbed condition of the site vicinity (Sect. 3.4.1) minimize the significance of this impact.

As no endangered or threatened species reside at the site, none will be adversely affected by the project.

4.1.4.3 Aquatic resources

As there are no permanent aquatic habitats on the site, on-site impacts will be insignificant. The nearest important body of water is Big Bethel Reservoir, approximately 2.7 km (1.7 miles) from the site. Construction practices at the site will adhere to the erosion control ordinances of the City of Newport News and the requirements of the VSWCB. Thus, the effects of sediment-laden runoff on Big Bethel Reservoir should be minimal.

During the operation of CEBAF there will be no routine discharges to surface waters. Sanitary wastes and cooling tower blowdown will be discharged into existing sewers connected to sewage treatment facilities, and small quantities of radioactive, liquid hazardous wastes will be collected and disposed of off the site at a federally-approved location (John P. Bradshaw, Jr., of Hayes, Seay, Mattern, and Mattern, Inc., Roanoke, Va., personal communication transmitting narrative material and drawings for CEBAF to Richard York, Dept. of Physics, University of Virginia, Charlottesville, Nov. 8, 1983). Although contamination of the reservoir by radioactive substances transported by groundwater is unlikely, this possible impact will be further investigated in the future and corrective actions will be taken if necessary (Sect. 4.1.2.2).

During the construction of CEBAF, a 5.5-ha (14-acre) pond may be created by the excavation of borrow material (John P. Bradshaw, Jr., of Hayes, Seay, Mattern, and Mattern, Inc., Roanoke, Va., personal communication transmitting narrative material and drawings for CEBAF to Richard York, Dept. of Physics, University of Virginia, Charlottesville, Nov. 8, 1983). This pond will serve as a receiving point for storm water from a portion of the site. Drainage ditches will transport other storm waters to points off the site, primarily to Big Bethel Reservoir.

4.1.4.4 Floodplain and wetlands

The proposed site and adjacent area are not located on a floodplain (Sect. 3.1.4.5); hence, no floodplains will be directly or indirectly affected by the CEBAF project. Approximately 30 ha (73 acres) of forested temporary wetland will be permanently altered by initial clearing for the project, and an additional 12 ha (29 acres) may be permanently altered during future expansion of the facilities. These wetlands are not sufficiently permanent to qualify as wetlands requiring consideration under Executive Order 11990, Protection of Wetlands (Sect. 3.1.4.5).

4.1.4.5 Mitigation and monitoring

No compensatory mitigation of impacts on vegetation and wildlife is planned for the CEBAF project. Appropriate erosion control procedures, applied during construction, and subsequent landscaping will prevent the occurrence of unnecessarily excessive impacts. Monitoring of ecological resources during construction and operation will be unnecessary, as impacts of effluents and emissions will be minimal and no particularly important ecological communities or species will be affected.

4.1.5 Community Resources

4.1.5.1 Demography and settlement patterns

In-migration caused by the proposed CEBAF project will be minimal because of the relatively small construction labor force required, and because of the large number of available construction workers in the area. The CEBAF work force is therefore likely to be drawn almost entirely from the Tidewater region. Many of the unskilled laborers, professionals, and technicians are expected to come from the upper peninsula area around Williamsburg, Virginia.

Even if few workers are drawn from the immediate area, impacts in terms of worker in-migration will be negligible. However, to illustrate the impacts of a "worst case" situation where significant in-migration is necessary, a scenario may be assumed in which 50% of all construction and operation workers move to the area. To maximize the potential effects of this population influx, it may be further assumed that all in-migrants will settle in Newport News. (It should be noted that this scenario is extremely unlikely because a 50% rate of in-migration is normally associated with larger projects in sparsely populated regions, and past experience indicates that any in-migrants would tend to disperse throughout the metropolitan regions, depending on some trade-off between activities, cost of living, and commuting distance.)

During the peak construction period, when 500 workers are expected to be on-site, the worst-case scenario would have 250 workers (150 construction and 100 operations and design workers) move to Newport News. Studies of the Tennessee Valley Authority's (TVA) nuclear plant construction experience reveals that two-thirds of all in-migrating construction workers bring families of an average size of 3.2 (Blair and Stevenson 1980). At CEBAF, this would mean that 100 workers would bring families and 50 workers would migrate alone. Because operations workers are more likely to be accompanied by their families than construction workers, a worst case assumes that 100% of this group will have a family size of 3.2 members. Accordingly, 370 new residents would be generated by the construction work force, and 320 individuals would be generated by the operations and design work force, for a worst-case total of 690 individuals in 250 new households.

In addition to jobs created directly by the demand for construction workers, some jobs may be indirectly created by the project. These jobs would employ individuals to provide goods and services required in the course of building the facility as well as those demanded by the construction work force. According to the U.S. Department of Housing and Urban Development, between 0.3 and 0.9 indirect jobs are created by each new construction job (HUD 1976). In highly developed urban areas, such as Newport News, the number of indirect jobs tends to fall toward the lower end of the scale. However, for a worst-case scenario, it is assumed that 0.6 new positions are created by each construction job. One may further assume that 25% of these new workers move to Newport News. Again, this is substantially higher than what can realistically be expected since indirect jobs generally require a relatively low level of skill and can be filled locally by new entrants to the work force, the currently unemployed, and dependents of in-migrating construction workers.

Based on the above assumptions, about 300 indirect positions would be created during the peak construction period, 75 of which would need to be filled by in-migration. Assuming that these workers have the same size of families as operations workers, there would be a total influx of 240 people. Combining direct and indirect employment, along with the assumed rates of in-migration, a worst-case scenario shows an increase of 930 individuals in 325 new households during the peak construction period.

After construction of the CEBAF project, the construction work force will leave; an ongoing work force of 250 employees and about 50 visiting scientists will be needed to operate the facility. Assuming that 50% of this group also must come from outside the area, and that each of these has an average family size of 3.2, the project will bring 560 people to Newport News. The indirect employment stimulated by this group may be slightly higher than that during construction, since their extended period of residence is likely to generate a more constant need for additional goods and services. Assuming that 0.75 indirect jobs will be created for each operations position, and that 25% of these workers will in-migrate, indirect employment will bring 56 new workers and 180 total residents to the city. Altogether, operations period employment would support 740 individuals in 231 new households. This number is less than the 930 new residents anticipated during the peak construction period in a worst-case scenario. Because impacts will therefore be far less during the ongoing operations period, this assessment focuses on potential impacts created during the peak of construction to gauge the community's ability to respond to the greatest demands that might be made upon it.

4.1.5.2 Land use

It is anticipated that the proposed CEBAF facility would not create significant changes in local land use (Sect. 4.1.4.1). Although the worst-case scenario supposes a small population increase, this growth is relatively insignificant in comparison to the size of the Newport News metropolitan area. The anticipated number of new residents would not exert pressure for expansion in land development or cause any other changes in major land uses or ownership patterns.

4.1.5.3 Housing

A significant amount of in-migration is not likely to be induced by the proposed facility. However, using the worst-case scenario described in Sect. 4.1.5.1, the proposed CEBAF project may generate a need for up to 325 new housing units at peak construction. The current amount of available housing is far in excess of this total, and the Newport News Department of Development reports that a large amount of vacant land has already been designated for future residential development. Because low and moderately priced housing is in short supply in the City of Newport News (Sect. 3.1.5.4), incoming workers seeking such housing may not be readily accommodated.

4.1.5.4 Public services

The large size of the greater Newport News region will enable it to absorb the projected population increase and corresponding demands created by the proposed project will have little effect on the city's provision of public services. Water and other utilities are present in adequate quality and quantity with sufficient reserve capacity to absorb the worst-case growth. The school systems, which are not overcrowded, recently have witnessed declining enrollments, creating adequate room for new students. Recreation and other public facilities, including fire and police protection, are maintained at a level of service capable of supplying the potentially increased demand (Sect. 3.1.5.6). As mentioned in Sect. 3.1.5.5., slight expansion of the existing lift station of the municipal sewer system serving the site will be needed, and incoming electric power requirements will increase.

4.1.5.5 Transportation

Even in the worst case scenario, it is expected that the proposed CEBAF project would not significantly impact the local transportation network. When the national average of 1.9 workers per vehicle trip is applied to the maximum of 500 workers on-site during peak construction, an increase of 263 vehicles (Kulp et al. 1980) is indicated. The current capacity of the principal streets is well in excess of local traffic utilization, providing easy automotive movement for this amount of project-related drivers as well as established residents (Sect. 3.1.5.7). Recent studies also indicate that the transportation system is adequate to supply the needs of emergency vehicles and evacuation efforts in case of an emergency during the construction or operations period (Department of Engineering 1984). In addition, it is anticipated that the increased traffic flow would not disrupt other transportation facilities or modes of transport.

4.1.5.6 Economic structure

The local economy, rather than suffering any negative impact, could experience some benefit from population growth, due largely to the potentially high level of retail expenditures and tax assessments. However, because the contribution to total employment is quite small, the proposed CEBAF project would have little influence on the nature of the local economic base or the rate of unemployment. Average income in the area may increase slightly because the wages paid to CEBAF workers will be higher than the city average (Sect. 3.1.5.2).

4.1.5.7 Historic, aesthetic, and cultural resources

Because the site has been previously disturbed, it is unlikely that significant historic or cultural resources are present. The Virginia Historic Landmarks Commission has reported that no known standing structure of historic or architectural interest would be affected by the proposed project (Vernon Marsh, Officer, Virginia Historic Landmarks Commission, Commonwealth of Virginia, Richmond, Va., personal communication with W. N. Lingle, ORNL, May 29, 1984). However, the Commission has required that a Phase I archaeological field survey be performed prior to groundbreaking to locate archaeological resources that may be impacted (Appendix A). If significant archaeological resources are suspected, a Phase II survey involving subsurface exploration will be conducted. Coordination among DOE, SURA, and the State will determine if further investigation is needed prior to construction.

Landscaping of the proposed development will reduce project-related impacts on the aesthetic nature of the immediate area. Use of new and existing vegetation is anticipated to effectively buffer CEBAF from nearby streets and the small residential area to the north. In consideration of the proposed landscaping plans and the fact that the site is adjacent to a designated industrial park, the project's aesthetic impacts should not be significant.

Major cultural and recreational facilities in the Newport News area are abundant. Even a worst-case population increase created by the proposed CEBAF project should have no significant impact on these resources.

4.1.6 Health and Safety

4.1.6.1 Radiological Impacts

No significant atmospheric releases of radionuclides are expected from CEBAF. The primary exposure pathway to be considered is exposure from direct radiation. Some consideration is also given to tritium production in helium during cryogenic operations.

An accidental release of radionuclides cannot take place from inside an accelerator facility in the same sense as it might from a nuclear reactor. An accelerator produces radioactive materials from direct impact of the beam in a localized region, or from the impact of radiation caused by the beam (such as x-rays, gamma rays). The beam itself can be switched off instantly. Those radioactive materials which are induced by impact of the beam are part of the structure of the facility (beam transport pipes and shielding materials). If radioactivity levels become significant in these materials, they can be removed, disposed of in the appropriate fashion, and replaced. Thus, there is a very small potential for release of radioactivity to the environment.

The U.S. DOE recently revised the dose limits to the general public to be 500 millirem/year for occasional exposure and 100 millirem/year for prolonged exposure, with an action level of 25 millirem/year. For atmospheric releases of radionuclides, the EPA has mandated (in the Clean Air Act) a dose limit of 25 millirem/year. The "as low as reasonably achievable" (ALARA) policy mandates operating doses lower than those allowed whenever these lower doses are reasonably and practically achievable. A boundary dose of 10 millirem/year (0.1 milliSv/year) was used in establishing the shielding design for CEBAF, based on established DOE limits and the ALARA principle used at existing laboratories.

Direct radiation exposure

Because CEBAF is a proposed facility, no offsite radiation measurements are available. In the proposal for CEBAF, the shielding is designed for a boundary dose of 10 millirem/year (0.10 milliSv/year) from both direct radiation and skyshine neutrons. The nearest potential resident is 91 m (273 ft) away from the facility (across Jefferson Avenue). Assuming that a dose of 10 millirem (0.10 milliSv) at the boundary (137 m from the beam dumps) is from direct radiation, and using the inverse square law, the direct radiation dose at 91 m (273 ft) is estimated to be about 3.5 millirem/year (0.035 milliSv/year) to the maximum exposed individual. This dose is well below the DOE action level of 25 millirem and is in addition to the 78 millirem/year (0.78 milliSv/year) received from background radiation in the Newport News area.

To compare this dose (3.5 millirem) to doses experienced at existing accelerators, reference is made to monitoring reports for SLAC, a 20-GeV linear accelerator very similar in geometry to CEBAF. At SLAC, the average individual dose at the site boundary due to penetrating radiation is less than 10 millirem/year (0.10 milliSv/year) (SLAC 1978, 1983).

The SLAC facility was designed to operate at high energies (20 GeV). At these energies, skyshine neutrons have not been a significant problem (i.e., not distinguishable from cosmic neutron doses). At lower energies, however, the quantity of skyshine neutrons increases. The shielding of the SLAC was not designed to accommodate this increase at lower energies. As a result, greater skyshine neutron doses at the boundary have been encountered when operating at lower energies (Dick McCall, Radiation Physics Group, SLAC, personal communication with S. J. Cotter, ORNL, February 25, 1985). This problem, however, has been considered and accounted for in shielding design criteria for the CEBAF (Jim McCarthy, SURA, personal communication with S. J. Cotter, ORNL, February 26, 1985). The final shielding design will be such that the boundary dose is below the limits mentioned above. Estimating the dose at 200 m and 1000 m from skyshine neutrons is difficult but is likely not to yield a significant dose when compared to direct penetrating radiation doses at these distances.

Tritium production in helium

There is a potential production of tritium (^3H or T) in the cryogenic helium surrounding the RF cavities. It has been conservatively estimated that a total of 270 mCi of tritium may be produced at saturation in the entire machine, and that a possible leak rate of 5.6% would lower the growth of this amount.

If it is conservatively assumed that all 270 mCi is released at a continuous rate for a year, the air concentration can be estimated by the following equation:

$$C = (fQB)/u \ ,$$

where C is the average air concentration of tritium at the receptor (Ci/m^3), f is the fraction of time the wind blows toward the receptor, Q is the effluent release rate (Ci/s), B is the Gaussian plume model diffusion factor modified for building wake effects, and u is the mean wind speed (m/s).

For building wake effects, the center of the facility was considered as a potential release location. The area of the building located at this point is estimated to be about 535 m^2. Default values for f and u were used. The calculated air concentration of tritium is 1.4×10^{-7} pCi/cm^3. Using an effective dose conversion factor of 1.24×10^{-4} rem/μCi for inhalation, the inhalation dose to the nearest potential resident (91 m from the boundary) is estimated to be 1.4×10^{-4} millirem/year (1.4×10^{-6} milliSv/year).

If tritium is released as HTO, it can be assumed that it follows water almost precisely through the environment. If tritium in food is assumed to be in equilibrium with atmospheric tritium, and the nearest resident consumes 1638 g of water daily in his food, the dose conversion factor for food is 6.18 rem-cm^3/pCi-year. Based on the air concentration calculated above, and assuming that the resident eats all of his food grown in his backyard, the dose from eating food containing tritium would be 9×10^{-4} millirem/year. Any fraction of food eaten less than 100% would reduce this dose by the same amount.

The dose conversion factor for drinking water is 5.7 rem-cm^3/pCi-year if the water is assumed to be in equilibrium with atmospheric tritium. If the nearest resident consumes all 1512 g of his daily water intake at his environmental location as tritiated water, his dose would be about 8×10^{-4} millirem/year. Any dilution of water would lower the dose by the same amount (i.e., the dilution factor).

As a result, it can be conservatively estimated that the total dose from a continuous release of tritium at a rate of 270 mCi/year would be less than 0.002 millirem/year (2.0×10^{-5} milliSv/year). This is well below DOE and EPA dose limits (Table 4.3).

Table 4.3 Doses from routine operation of the Continuous Electron Beam Accelerator Facility

Exposure pathway	Dose[a] (millirem/year)	Dose limit[b] (millirem/year)
Newport News[c]		
Direct radiation	3.5	100
Air immersion[d]	<0.2	25
Atmospheric ^3H	<0.002	25
Charlottesville[e]		
Direct radiation	3.5	100
Air immersion	<0.2	25
Atmospheric ^3H	<0.002	25
Blacksburg[f]		
Direct radiation	0.06	100
Air immersion	<0.2	25
Atmospheric ^3H	<0.002	25

[a]Direct radiation dose based on 10 millirem/year.

[b]The operating limit at the boundary is 500 millirem/year. For prolonged exposure, the dose limit is 100 millirem/year (W. A. Vaughan to distribution, "Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities," August 5, 1985; Danny R. Sheppard to distribution, "Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities," September 12, 1985). The EPA dose limit for atmospheric releases of radionuclides is 25 millirem/year.

[c]Nearest residence receiving direct radiation is 91 m (100 yd) from the boundary.

[d]Based on gaseous effluents at the Stanford Linear Accelerator Center.

[e]The nearest residence receiving direct radiation is 91 m (100 yd) from the boundary.

[f]The nearest residence for direct radiation is anywhere from the boundary to 1.6 km (1 mile) away.

Radioactive gases

Venting procedures for CEBAF will be similar to those used at SLAC. That is, air will not be exhausted until the accelerator is shut down for a period to allow radionuclides to decay. To reduce the potential hazard to workers entering the housing after accelerator operation, radioactive gas monitors will be located at alternate exhausts from the accelerator, and at every exhaust from the beam switchyard. Monitors will be also available to measure radioactivity levels in the tunnel or switchyard prior to venting (Babcock et al. 1968). Gases in the accelerator housing are ventilated to provide one air change every 10 min by means of a ducted, forced air system. The switchyard will be vented by five fans that provide one air change every six min.

In the 1976-1982 annual monitoring reports for SLAC, the quantities of gaseous effluents range from 0.4 to 1.7 Ci of short-lived gases, with the highest releases being in 1977 and 1979. In 1982, the release was 0.7 Ci. It has been reported that the offsite concentration for the maximum gaseous release (1.7 Ci) was 2.5×10^{-11} Ci/m^3. Neal (1968) states that the gases are primarily ^{15}O (radioactive half-life 2.04 min) and ^{11}C (half-life 20.48 min), evolving from the water used to dissipate beam energy in the switchyard. Oxygen-15 and ^{11}C have the same air immersion dose-rate factors. As a result, it was assumed that an air concentration of 2.5×10^{-11} Ci/m^3 consists of ^{11}C, since it has a relatively long half-life (compared to ^{15}O). The photon body surface dose-rate factor for ^{11}C for air immersion is 9.98×10^2 rem-cm^3/microCi-h (Kocher 1981). The resulting dose offsite at SLAC is about 0.2 millirem/year. Assuming an air concentration of ^{11}C of 2.5×10^{-11} Ci/m^3, a breathing rate of 8030 m^3/year, and a dose conversion factor of 1.96×10^{-4} rem/μCi to the pulmonary region, the 70-year dose commitment from inhalation would be less than 0.04 millirem. The air pathway limits established by 40 CFR 61, Subpart H, are 25 millirem/year for a whole body dose and 75 millirem/year for any organ. Although SLAC and CEBAF operate at similar beam power scales, CEBAF will probably produce less beam loss and therefore less activity. An EPA approval of the construction of the CEBAF facility will be required.

4.1.6.2 Occupational hazards

Procedures and equipment design for protecting personnel from radiation levels in the proposed CEBAF are not yet available. It is assumed that personnel protection will be similar to that provided at SLAC, as described in Babcock et al. (1968), which is briefly summarized here.

Personnel are protected from radiation generated by SLAC by use of protective equipment, procedures for operating the equipment, an educational program that familiarizes employees with equipment and procedures, and a system for disciplinary action to ensure that procedures are followed properly.

Protection equipment at SLAC consists of automatic controls on accelerator operations, access controls, radiation monitoring devices, and warning signals. Interlocks involving accelerator power are the primary means of protecting personnel from direct accelerator-produced activity. The machine shutoff circuit ensures that the accelerator cannot be turned on until radiation areas are clear of personnel and are secured, and that the accelerator is turned off if the security of any such area is broken. Access controls prevent entry into radiation areas while the accelerator is in operation, and entrances to radiation areas are identified with lights and signs and are fenced. Access to a fenced area is restricted to employees who have film badges. Monitoring devices, which provide continuous, instantaneous (batch sampling) measures of radioactivity levels through both fixed and movable detectors, are interlocked with the beam via the machine protection system and the emergency stop circuit. Monitors are also connected to alarms, lights, and other warning devices which indicate potential radiation hazard areas.

Procedures for implementing the personnel protection system at SLAC are described in detail in Babcock et al. (1968). Briefly, the procedures address (1) delegating responsibility for controlling access to SLAC, (2) ensuring that appropriate health physics staff members are on call for advice during nonstandard operating conditions, (3) establishing protocol for identifying and logging all personnel who enter a radiation area, and (4) establishing requirements which must be met by the equipment in the protective system.

In general, occupational concerns are being addressed in the Preliminary Safety Analysis Report (PSAR). This report considers in detail all occupational concerns, including ionizing radiation, non-ionizing radiation, chemicals, cryogens, electrical, missiles, fire, explosive substances, and general industrial concerns.

4.1.7 Ambient Noise

Construction of CEBAF will result in temporary increased noise levels in the site vicinity. Because of the expected short duration of these activities and ambient noise from an adjacent busy four-lane highway, no significant adverse noise impacts are anticipated.

The principal noise-generating components during operation of the facility would be the cooling towers. Minor noise sources, which will not be addressed in this assessment, include the electrical substation (low frequency, low-decibel continuous noise) and the emergency electrical generator (short-duration noise). The contribution to ambient noise from the operation of cryogenic compressors is not expected to be significant because the cryogenic plant will be housed in an acoustically shielded building.

Cooling towers are steady, continuous noise sources. Noise generated by induced draft towers is produced predominantly by two sources: fan operation, which dominates the low-frequency (31- to 500-Hz) spectrum, and waterfall noise, which contributes to the high-frequency (1000- to 8000-Hz) spectrum (EEI 1978). Although the detailed specifications of the CEBAF cooling towers have not yet been developed, they are expected to be induced-draft, counter-flow units, each with a water throughput of about 0.76 m^3/sec (12,000 gal/min) (D. B. Hunsaker, Jr, ORNL, personal communication with Robert Canova et al., Hayes, Seay, Mattern, and Mattern, Inc., June 20, 1984). Because of the lack of published data concerning towers in this size range and the fact that the final design specifications for the CEBAF towers are not yet available, it was decided to use available noise data for a larger tower for a worst-case scenario.

Sound levels measured in the vicinity of a 55,000-gpm, induced-draft counter-flow tower ranged from 73 dB (A) at 31 m (100 ft) from the rim of the tower to 56 dB (A) at 305 m (1000 ft) from the rim of the tower (Capano and Bradley 1976). The water throughput for such a tower is about twice that of the combined flow rates of the proposed CEBAF towers. Assuming that noise levels at distances beyond 305 m (1000 ft) will decay

6 dB (A) for each doubling of the distance (EEI 1978), and that the nearest residence is located about 1000 m (3300 ft) from the proposed site (ERC 1980), cooling tower operation should produce ambient noise levels, at the closest residence, in the 44 to 50 dB (A) range. At the most, this increment would raise estimated existing noise levels by 3 dB (A), so that the total (baseline and cooling tower) estimated level would be about 53 dB (A). Since noise levels decay with distance, impacts to more distant receptors would be expected to be lower.

EPA recommends an outdoor noise level of 55 dB (A) or less to protect the public (EPA 1978). Thus, no significant impacts from cooling tower noise at the proposed Newport News site are anticipated. In the unlikely event that cooling tower operation would produce ambient noise levels in excess of the values recommended by the EPA, a variety of mitigative techniques exist for reducing noise levels from induced draft towers, including low-speed fan operation, hospital quiet motors, and baffling (EEI 1978).

4.2 ALTERNATE SITE 1, CHARLOTTESVILLE, VIRGINIA

4.2.1 Meteorology and Air Quality

The impacts of the construction and design of the proposed facility at the Charlottesville, Virginia site would be similar to the impacts at the proposed Newport News site, as discussed in Sect. 4.1.1.

4.2.2 Water Resources

Projected impacts to water resources from construction and operation of the CEBAF at the Charlottesville site are based on limited site data and on the conceptual design. Impacts could be greater or less than those presented in this discussion.

Surface waters potentially impacted by construction and operation of the proposed facility are the small tributaries of the north fork of the Rivanna River. The north fork of the Rivanna River is classified as a scenic river under the Scenic Rivers Act (Sect. 10-167 et seq, Code of Virginia). (Scenic river status, however, imposes no additional water quality requirements or standards.) Because the site is well drained, significant drainage improvements or large increases in runoff would not be anticipated. Contamination of surface waters from construction and any needed construction dewatering would be controlled using conventional construction practices. Impacts to surface waters from construction would not be significant and could be mitigated to acceptable levels. Water supplied to the CEBAF cooling system would be obtained either from the municipal system or newly-drilled wells (James McCarthy, University of Virginia, Charlottesville, personal communication with Andrea Campbell, ORNL, March 27, 1985). Blowdown would be discharged to the municipal sewer. Therefore, impacts because of consumptive use of water resources and effluent discharge during operation would not be significant.

Groundwater resources could be impacted as a consequence of activation of groundwater by accelerator operation. The potential contamination can be considered to be qualitatively similar to that at the Newport News site (Sect. 4.2.1.1). Since the description of the groundwater resources at the site is limited, estimates of the quantity of contaminated water generated by the facility cannot be made. However, because of the aquifer depth and greater attenuation, groundwater activation would likely be less than at Newport News. The limited understanding of the geohydrologic characteristics precludes precise estimation of the level of contamination within the underlying aquifer.

4.2.3 Geology and Soils

Potential impacts to geology and soils from construction of the proposed CEBAF facility at the Charlottesville site are associated with topography, foundation settling, and erosion. The topography of the site would be altered to accommodate the proposed facility. Impacts to topography cannot be mitigated. The erosion potential of soils at the site to be used for shielding have not been determined; however, the potential impacts from erosion and the means for mitigating these impacts would be similar to those at the proposed Newport News site (Sect. 4.1.3). The soils at the Charlottesville site are stronger and shallower than those at the Newport News site. Consequently, the foundations for buildings would be of a similar design to those for the proposed site and, depending on the site characteristics, piles may not be required to achieve the allowable limits on settlement for the facility.

Potential impacts to geology and soils from operation are associated with soil activation and seismic activity. Impacts associated with soil activation can be expected to be similar to those at the proposed site (Sect. 4.1.3), although the potential for groundwater leaching of activated soil would be less because of the comparatively lower groundwater levels. Seismic risk at the Charlottesville site is greater than at the proposed site. The potential damage to the facility from a seismic event of record would result in minor damage. Larger seismic events could result in structural damage or major disruption of facility operations.

Monitoring and mitigation measures for the site would be similar to the proposed site (Sect. 4.1.3). Earthquake-resistant features could be incorporated into the facility design to reduce the risk of damage from seismic events, although such measures do not appear to be warranted.

4.2.4 Ecological Resources

Construction would result in the loss of vegetation and wildlife habitat and in the permanent reduction of wildlife populations. The severity of the impacts would depend on the types of habitat present at the site, although nearby disturbances (Sect. 3.2.4) may have already resulted in some wildlife population reductions on the site. Impacts of silt-laden runoff on nearby streams and their aquatic biota could probably be kept within acceptable limits by the use of appropriate erosion control practices. Facilities would not be constructed within the 100-year floodplain, so no bottomland forest or other wetland habitats should be destroyed. No terrestrial or aquatic endangered species would be affected as none occur near the site (Sect. 3.2.4). Use of the site for CEBAF appears to be consistent with other nearby land uses.

4.2.5 Community Resources

4.2.5.1 Population

In Sect. 4.1.5.1, a worst-case scenario was presented to determine the potential impacts created by facility-induced in-migration at Newport News. This scenario assumed 50% in-migration of construction and operations employees and 25% in-migration of workers filling "indirect" jobs created by the project. While such high in-migration rates are extremely unlikely, it was felt that using these assumptions would promote an understanding of the worst possible impacts that could be caused by a significant rate of project-induced growth in the host area.

Applying the same worst-case assumptions to the Charlottesville/Albemarle County area, it is found once more that 930 individuals would move into 325 new households during peak construction. As in the case for Newport News, it is further assumed that all in-migrants would reside within the city limits of the principal municipality, in this case the City of Charlottesville. With an estimated 1984 population of 40,459, the 930 in-migrants represent a 2.3% increase in the number of Charlottesville's residents.

Although these are probably unrealistic assumptions, it is anticipated that an area of Charlottesville's size would, in fact, require more in-migration for facility construction than is typically the case for larger metropolitan areas, such as Newport News. Furthermore, the impacts to housing and public services in Charlottesville resulting from project-induced in-migration are likely to be harder to accommodate than in a larger metropolitan area with a more highly developed infrastructure.

4.2.5.2 Transportation

Vehicular access to the Charlottesville site is hampered by the lack of access from Route 29. The network of smaller roads travelers must currently use to reach the site are not designed to carry the increased amount of traffic that would be generated by the construction of the CEBAF project (Sect. 3.2.5.3). When the national average of 1.9 workers per vehicle trip is applied to the maximum of 500 total workers on-site during peak construction, an increase of 263 vehicles (Kulp et al. 1980) is indicated.

State Road 649, which the majority of site-bound travelers would be expected to use, is already heavily traveled by vehicles en route to the Charlottesville-Albemarle Airport (Sect. 3.2.5.3). Facility-induced traffic on this road may create congestion and hazardous conditions, making road improvements necessary. Although the University of Virginia has plans to construct a 1.6-km (1-mile) long road which would connect Route 29 directly to State Road 606, thereby avoiding the traffic on State Road 649, major improvements to State Road 606 would be necessary to make the plan workable. These costly improvements would also require the construction of a new road, roughly 300 yards in length, that would connect State Road 606 to the site. At present, no date has been set for any of the above-mentioned improvements.

4.2.6 Health and Safety

4.2.6.1 Radiological impacts

The impacts from CEBAF have been estimated for the Newport News site. The assumptions and dose limits for comparison are discussed in Sect. 4.1.6. These assumptions apply to the Charlottesville site with a few exceptions. Since the aquifer is apparently about 9 m (30 ft) below the surface, doses from drinking tritiated water would be negligible.

Direct radiation exposure

The technology for the accelerator is the same as for the Newport News site, but the facility configuration may change. It was assumed that the shielding requirements in the accelerator design will still reflect the dose at the boundary to be 10 millirem/year (0.10 milliSv/year). At the proposed Charlottesville site, the area is more rural than the alternative site at Blacksburg. A resident could live anywhere from 100 yds (91 m) to 1 mile (1.6 km) from the boundary. With a boundary dose of 10 millirem (0.10 milliSv) from direct radiation, the dose at 91 m would be 3.5 millirem/year (0.035 milliSv/year), using the inverse square law. The dose at 1.6 km drops to 0.06 millirem/year (6.0×10^{-4} milliSv/year). At 1.6 km, the dose would be 0.2 millirem/year (0.002 milliSv/year). Either dose would be in addition to the dose expected from background radiation, which for the Charlottesville area is about 96 millirem/year (0.96 milliSv/year). The doses at 91 m and 1.6 km are well below the DOE permissible dose limit of 100 millirem/year.

Tritium production in helium

The nearest potential resident at the Charlottesville site is anywhere from 91 m to 1.6 km away. As shown previously in the assessment for the Newport News site, tritium releases to the atmosphere would result in a dose of less than 0.002 millirem/year at a distance of 91 m. At 1.6 km, the dose would be even less significant.

4.2.6.2 Occupational hazards

Potential occupational hazards associated with CEBAF at the Charlottesville site will not differ significantly from those at the Newport News site, which were discussed in Sect. 4.1.6.2.

4.2.7 Ambient Noise

Construction of CEBAF at the Charlottesville site would have similar noise impacts to those estimated for the Newport News site (Sect. 4.1.7). Estimated ambient noise levels from operation, which are expected to result primarily from the cooling towers, would also be expected to be similar to those predicted for the Newport News site [i.e., 50 dB (A) at 610 m (2000 ft) from the site]. The impact of this noise level on the Charlottesville site noise environment will depend on the existing noise level (which could be higher than that of Newport News because of the proximity of an airport and an industrial park), and on the distance between the nearest sensitive receptor and the cooling towers.

In the unlikely event that cooling tower operation would cause environmental noise levels to rise above EPA-recommended levels, a variety of mitigative techniques are available to reduce cooling tower noise, including low-speed fan operation, hospital quiet motors, and baffling (EEI 1978).

4.3 ALTERNATE SITE 2, BLACKSBURG, VIRGINIA

4.3.1 Meteorology and Air Quality

The impacts of the construction and operation of the proposed facility at the Blacksburg, Virginia site would be similar to the impacts at the proposed site, as discussed in Sect. 4.1.1.

4.3.2 Water Resources

Estimated impacts to water resources from construction and operation of the CEBAF facility at Blacksburg are based on limited site data and on the conceptual design. Impacts could be greater or less than those presented in this discussion.

Surface waters potentially impacted by construction and operation of the CEBAF are Stroubles Creek and its tributaries. Stroubles Creek discharges to the New River and is subject to a maximum temperature standard of 29°C (84°F), in addition to state water quality standards. The temperature standard would not be violated as a result of facility construction and operation. Because the site is well drained, significant drainage improvements or large increases in runoff would not be anticipated. The site would require some grading; however, control measures and good construction practices would minimize erosion and sedimentation impacts. While construction dewatering would not be expected, any dewatering discharges could be controlled using good construction practices. Consequently, impacts to surface waters from construction would not be significant and could be mitigated to acceptable levels.

Water supplied to the CEBAF cooling system would likely be obtained from the municipal system. Blowdown would be discharged to the municipal sewer (VPISU 1983). Therefore, impacts because of consumptive water use and effluent discharge during operation would not be significant.

Groundwater resources could be impacted as a consequence of activation of groundwater by accelerator operation. The potential contamination can be considered to be qualitatively similar to that at the Newport News site (Sect. 4.2.1.1). The presence of a spring-fed tributary at the site could provide a rapid pathway for the transport of contaminated groundwater; therefore, monitoring the water quality in the tributary would be appropriate. Since the description of the groundwater resources at the site is limited, estimates of the quantity of contaminated water generated by the facility cannot be determined. However, because of the depth of the aquifer, some attenuation is likely and activation would probably be less than at Newport News. Similarly, the limited understanding of the geohydrologic characteristics precludes estimation of the level of contamination within the underlying aquifer.

4.3.3 Geology and Soils

Potential impacts to geology and soils from construction of the proposed facility at the Blacksburg site are associated with topography, foundation settling, and erosion. The topography of the site would be altered to accommodate the proposed facility. The impacts to topography cannot be mitigated. The erosion potential of soils used for earthen shielding is not known; however, the potential impacts from erosion and the means for mitigating these impacts would be similar to those for the Newport News site (Sect. 4.1.3). The soils at the site are stronger and shallower than those at Newport News. Consequently, the foundations for buildings would be of a similar design to those at the proposed site. The presence of solution cavities in the dolomite limestone would introduce the potential for adverse impacts, requiring the use of more elaborate engineering features for building foundations. Also, the presence of the alluvium at the center of the site would require engineered features to prevent excessive building settlement. A proposed foundation plan has not been prepared for the facility at the Blacksburg site.

Potential impacts to geology and soils from CEBAF operation are associated with soil activation and seismic activity. Impacts associated with soil activation would be expected to be similar to those for the proposed site (Sect. 4.1.3), although the potential for groundwater leaching of activated soil would be less because of the comparatively lower groundwater levels. Seismic risk at the Blacksburg site is greater than that at the proposed site. The potential damage to the facility from a seismic event of record would result in minor damage. Larger seismic events could result in structural damage or major disruption of the facility.

Monitoring and mitigation measures for the site would be similar to those for the proposed site (Sect. 4.1.3). Earthquake-resistant features could be incorporated into the facility design to reduce the risk of damage from seismic events, although such measures do not appear to be warranted.

4.3.4 Ecological Resources

Impacts would be similar in nature and severity to those at the Charlottesville site, except for the following. Most construction could be limited to grasslands, where the impacts on vegetation and wildlife would be less than the impacts on a forested site. No floodplain habitats would be potentially affected as none occur on the site, but a small amount of wet, marshy land would be destroyed. Since this land does not support standing water, impacts on wetland wildlife would be minimal.

4.3.5 Community Resources

4.3.5.1 Population

Montgomery County, with an estimated 1984 population of 68,113, is the least populated of the impact regions associated with the CEBAF (Sects. 3.1.5.2, 3.2.5.2, and 3.3.5.2). While past experience indicates that facility-related in-migration tends to be higher in more sparsely populated areas, this tendency could be at least partially countered here by the proximity of Roanoke, Virginia, and its sizable labor pool.

To illustrate the impacts of a worst-case situation where significant in-migration is necessary, a scenario was assumed in which 50% of all construction and operations workers move to the area. To maximize these potential impacts, it was also assumed that all in-migrants would move to the principal municipality within the impact area, the town of Blacksburg. Although the assumed level of in-migration, as well as the settlement pattern, is extremely unlikely, these same assumptions have been applied to the analyses of Newport News and Charlottesville to determine the worst possible impacts that could occur.

In this unlikely scenario, total in-migration during the peak construction period would be 930 individuals, creating a need for 325 new households. This population growth represents a 3% increase to Blacksburg's 1980 census population of 30,638. Since Blacksburg is a relatively small town, the existing social infrastructure could be strained by this amount of rapid growth and the accompanying demand for services.

4.3.5.2 Transportation

Without improvements to the existing roadway, the potential would exist for traffic congestion and hazardous conditions for travelers en route to the Blacksburg CEBAF site. In particular, there are two transportation movements most likely to create difficulties. First, travelers on U.S. 460 would likely have to significantly reduce their speed to turn off this major highway onto the unpaved road that leads to the site. Secondly, transportation impacts may arise in the form of traffic congestion at the intersection of Southgate Drive and U.S. 460 as travelers on Southgate Drive attempt to cross U.S. 460 to reach the site.

The Virginia State Highway Department, through its plan to build a major cloverleaf connector and overpass at the intersection of U.S. 460 with Southgate Drive, has presented a means of improving access to the site. Likewise, Virginia Tech, by agreeing to construct a 0.8 km (0.5 mile) roadway from U.S. 460 to major buildings on the Blacksburg site, has proposed transportation improvements designed to reduce impacts. The date of these improvements, however, has not yet been scheduled. These changes to the road system are likely to be quite costly, which would probably add additional delays.

At present, significant transportation impacts would likely arise from the increased CEBAF traffic flow on the existing roadways. When the national average of 1.9 workers per vehicle trip is applied to the maximum of 500 total workers on-site during peak construction, an increase of 263 vehicles is indicated (Kulp et al. 1980). Although U.S. 460 can accommodate this increase without difficulty, the intersection of U.S. 460 and Southgate Drive has a significant traffic accident history, and increasing the amount of traffic would, in turn, be likely to augment this problem (F. Norris, Resident Engineer, Virginia State Highway Department, Christianburg, Va., personal communication with J. A. Boyette, ORNL, May 16, 1984).

4.3.6 Health and Safety

4.3.6.1 Radiological impacts

The impacts from CEBAF at Newport News have been estimated and compared to DOE dose limits in Sect. 4.1.6. These same assumptions apply to the Blacksburg site, with some exceptions. As for Charlottesville, tritium in the water supply is likely not to be a significant pathway of exposure to offsite individuals, since the aquifer is located well below the surface.

Direct radiation exposure

The technology for the proposed accelerator is the same for Blacksburg as it would be at Newport News. The facility configuration, however, may vary. It is assumed that the shielding requirements in the design of the accelerator will still yield a boundary dose of 10 millirem/year (0.1 milliSv/year). The area proposed is near a college campus, so the nearest resident could be located anywhere from the boundary to 1.6 km (1 mile) away (James McCarthy, University of Virginia, Charlottesville, personal communication with S. J. Cotter, ORNL, April 26, 1984). At 800 m the dose, using the inverse square law, would be about 0.2 millirem (0.002 milliSv), while at 1.6 km the dose would drop to 0.06 millirem/year (6.0×10^{-4} milliSv/year). At 800 m the dose drops to 0.5 millirem/year (0.005 milliSv/year) and at 1.6 km it would be 0.2 millirem/year (0.002 milliSv/year). These doses are below the DOE permissible dose limit of 100 millirem/year. The dose at either location would be in addition to the dose received from natural background radiation (108 millirem/year for the Blacksburg area resident).

Tritium production in helium

As in the Newport News site assessment, the dose from tritium releases to the atmosphere would be less than 0.002 millirem/year at 91 m. At the boundary, the dose would be only slightly higher, and at 1.6 km it would be much less than 0.002. In any case, the dose from tritium releases would contribute an insignificant amount to the total dose received by the nearest offsite individual.

4.3.6.2 Occupational hazards

Potential occupational hazards associated with CEBAF at the Blacksburg site will not differ significantly from those at the Newport News site, which were discussed in Sect. 4.1.6.2.

4.3.7 Ambient Noise

Construction of CEBAF at the Blacksburg site would have similar noise impacts to those estimated for the Newport News site (Sect. 4.1.7). Estimated noise levels from operation, which are expected to result primarily from the cooling towers, would also be expected to be similar to those predicted for the Newport News site [i.e., 50 dB (A) at 610 m (2000 ft) from the site]. The impact of this predicted noise level on the Blacksburg noise environment will depend on the ambient noise level and on the distance between the nearest sensitive receptor and the cooling towers.

In the unlikely event that cooling tower operation would cause environmental noise levels to rise above EPA-recommended levels, a variety of mitigative techniques are available to reduce cooling tower noise, including low-speed fan operation, hospital quiet motors, and baffling (EEI 1978).

4.4 IMPACTS OF THE ALTERNATE TECHNOLOGY (LINAC WITH PULSE STRETCHER RING)

Air quality impacts of the alternate technology would be similar to the proposed CEBAF design, as described in Sect. 4.1.1. The potential impacts to water resources from the construction and operation of the alternate design would be similar to the proposed CEBAF. The potential impacts to geology and soils from the construction and operation of the linac/pulse stretcher ring complex would be similar to those from the proposed design. Ecological impacts would be slightly greater for the alternate technology than for the proposed design, due to the larger disturbed area. Land actively used for research with the linac/pulse stretcher ring will increase from 7 ha (17 acres) to 43 ha (106 acres), while forested areas will decrease from 62 ha (153 acres) to 26 ha (64 acres). It is anticipated that facility-induced impacts with the alternate technology would be similar to those generated by the proposed SURA technology. The same assumptions related to boundary dose limits have been made for the alternate technology. Consequently, the radiation dose to the nearest neighbors will be identical to that described in Sect. 4.1.6. Noise levels produced during construction and operation of the alternate design would be comparable to those for the new design.

REFERENCES FOR SECTION 4

Babcock, G., and K. E. Breymayer, D. D. Busick, K. Crook, et al. 1968. "Protection Systems," chap. 21 in *The Stanford Two-Mile Accelerator*, R. B. Neal, W. A. Benjamin, Inc., New York.

Baker, S. I. 1982. *Annual Environmental Monitoring Report for Calendar Year 1981*, 82/22, 1104.100 UC-41, DE82 014429, Fermi National Accelerator Laboratory, Batavia, Ill.

Barbier, Marcel M. 1980. *Ground Water Activation at an Electron Accelerator Site*, Technical Report MMB-10, Marcel M. Barbier, Inc., Herndon, Va.

Blair, L., and W. Stevenson. 1980. *The Construction Labor Force Model*, Oak Ridge Associated Universities.

Capano, G. A., and W. E. Bradley. 1976. "Noise Prediction Techniques for Siting Large Natural-Draft and Mechanical-Draft Cooling Towers," *Proceedings of the American Power Conference*, vol. 38, Chicago, Ill.,pp. 756–763.

Carson, J. E. 1976. *Atmospheric Impacts of Evaporative Cooling Systems*, ANL-ES-53, Argonne National Laboratory, Argonne, Ill.

Commonwealth of Virginia. 1982. *Water Quality Standards*, RB-1-80, State Water Control Board, Richmond, Va.

Department of Engineering (City of Newport News, Va.). 1984. *Traffic Volume Book.*

Dischinger, H. C. (Hugh C. Dischinger Engineers and Surveyors). 1982. *Environmental Assessment, Outfall Drainage from Oyster Point Development, City of Newport News, Virginia*, Grafton, Va.

EEI (Edison Electric Institute). 1978. *Electric Power Plant Noise Guide*, vol. I, EEI, New York.

EPA (Environmental Protection Agency). 1978. *Protective Noise Levels*, EPA-550/9-79-100. [As cited in "Noise," reprinted from the *Tenth Annual Report of the Council on Environmental Quality*, U.S. Government Printing Office, Washington, D.C., 1980.

ERC (Evaluation Research Corp.). 1980. *An Environmental Assessment for the Decommissioning of the Space Radiation Effects Laboratory (SREL) Newport News, Va.*, ERC, Oak Ridge, Tenn.

HUD (U.S. Department of Housing and Urban Development). 1976. *Rapid Growth from Energy Projects: Ideas for State and Local Action*, Office of Community Planning and Development.

Jacobs, D. G., L. E. Boring, K. R. Earnshaw, and J. S. Epler. 1980. *An Environmental Assessment for the Decommissioning of the Space Radiation Effects Laboratory (SREL), Newport News, Va.*, Evaluation Research Corporation, Oak Ridge, Tenn.

Jenkins, T. M., et al. 1981. *A Shielding Manual for NEAL*, Radiation Physics Group, Stanford Linear Accelerator Center, Stanford, Calif.

Kocher, D. C. 1981. *Dose-Rate Conversion Factors for External Exposure to Photons and Electrons*, ORNL/NUREG-79, NUREG/CR-1981, Oak Ridge National Laboratory.

Kulp, G., et al. 1980. *Transportation Energy Conservation Data Book*, ed. 4, ORNL-5654, Oak Ridge National Laboratory.

Lee, D. W. 1986. *Analysis of Groundwater Contamination from CEBAF Operation*, Oak Ridge National Laboratory, to be published.

Moore, R. E., et al. 1979. *AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Doses to Man from Airborne Releases of Radionuclides*, ORNL-5532, Oak Ridge National Laboratory.

Neal, R. B. 1968. *The Stanford Two-Mile Accelerator*, W. A. Benjamin, Inc., New York.

SLAC (Stanford Linear Accelerator Center). 1982. *Annual Environmental Monitoring Report, January-December 1982*, SLAC-260 DEC83 011412, Plant Engineering Dept., Stanford Linear Accelerator Center, Stanford University, Stanford, Calif.

Stapleton, G. 1986. "A Simple Production and Transport Model for Tritium in Groundwater," CEBAF Technical Memo TN 0030, Newport News, Va.

VPISU (Virginia Polytechnic Institute and State University). June 8, 1983. *Summary Information*, CEBAF site proposal.

VSWCB (Virginia State Water Control Board). Jan. 17, 1985. Comments on the Draft Environmental Assessment for the CEBAF, letter to Charles Ellis, Virginia Council on Environment.

APPENDIX A

CONSULTATION AND CORRESPONDENCE WITH AGENCIES

CONSULTATION WITH AGENCIES

A meeting was held on April 5, 1984, at the proposed site to advise state and local officials of the project and to solicit their input and concerns. The following representatives were in attendance:

Hans von Baeyer	Virginia Associated Research Center
Frank Heidt	Virginia Associated Research Center
Mahesh Gupta	Planning Department, Newport News, Virginia
Hugh Dischinger, P.E.	Consultant, Newport News, Virginia
Cindy Taylor	Planning Department, Newport News, Virginia
Eddie Wrightson	Engineering Department, Newport News, Virginia
Jack Livingstone	Development Department, Newport News, Virginia
James Taft	Virginia State Water Control Board
William Meyer, P.E.	Waterworks, Newport News, Virginia
Eugene Siudyla	Virginia State Water Control Board
Andrea Reed (Campbell)	Oak Ridge National Laboratory, Tennessee
Donald Lee	Oak Ridge National Laboratory, Tennessee
Roger Kroodsma	Oak Ridge National Laboratory, Tennessee
Nelson Lingle	U.S. Department of Energy, Oak Ridge Operations, Tennessee

No new issues or concerns about the CEBAF project were raised at the meeting.

CORRESPONDENCE WITH AGENCIES

The following pages present pertinent correspondence with the U.S. Department of the Interior Fish and Wildlife Service, the Virginia Research Center for Archaeology, the Virginia Historic Landmarks Commission, the U.S. Department of Agriculture's Soil Conservation Service, the (Virginia) State Air Pollution Control Board, the Virginia Council on the Environment, the (Virginia) State Water Control Board, and Southeastern Universities Research Association, Inc.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES
1825B VIRGINIA STREET
ANNAPOLIS, MARYLAND 21401

June 14, 1984

Mr. W. Nelson Lingle
Energy programs
U.S. Department of Energy
Oak Ridge Operations
P.O. Box E
Oak Ridge, TN 37831

Dear Mr. Lingle:

This responds to your May 22, 1984 request for information on the presence of Federally listed endangered or threatened species within the area to be affected by contruction of a 4 GeV high intensity, continuous electron beam Accelerator Facility in Newport News, Virginia.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 Consultation is required with the Fish and Wildlife Service (FWS). Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to endangered species under our jurisdiction. It does not address other FWS concerns under the Fish and Wildlife Coordination Act or other legislation.

Thank you for your interest in endangered species. If you have any questions or need further assistance, please contact Andy Moser of our Endangered Species staff at (301) 269-6324.

Sincerely yours,

Robert Z. Zeller

for Glenn Kinser
Supervisor
Annapolis Field Office

COMMONWEALTH of VIRGINIA

Virginia Historic Landmarks Commission

221 GOVERNOR STREET
RICHMOND, VIRGINIA 23219
TELEPHONE: (804) 786-3143

H. BRYAN MITCHELL
EXECUTIVE DIRECTOR

May 29, 1984

Mr. W. Nelson Lingle
Program Manager, Energy Programs
and Support Division
Department of Energy
Oak Ridge Operations
P.O. Box E
Oak Ridge, Tennessee 37831

RE: Site of Continuous Electron Beam Accelerator Facility, Newport News

Dear Mr. Nelson Lingle:

Thank you for your inquiry of May 22, 1984

XXXXX We know of no standing structure of historic or architectural interest that would be affected by the proposed project. It seems unlikely that such a structure would be identified by another survey of the project area.

We know of no standing structure of historic or architectural interest that would be affected by the proposed project. However, a survey should be made by your agency to determine if any such structure is in the area of the project. Please contact me to discuss how the survey should be made.

The proposed project would or could affect this structure of which we have a record:

The information that you have supplied us about the proposed project is inadequate for us to determine if the project would affect any structure of historic or architectural interest. Please supply me with:

XXXXXX If this project will result in any ground disturbance, archaeological sites could be affected. To determine this, please contact our archaeological department in Yorktown, if you have not done so already: Virginia Research Center for Archaeology, P.O. Box 368, Yorktown, Virginia 23690, ATTN: Mr. Bruce Larson, Phone (804) 253-4836 (SCATS 427-4836). Your response from the VRCA should be considered as part two of a two-part response from the Landmarks Commission; my letter to you today being part one.

Yours,

G. Vernon March, III
Environmental Officer

PLANNING DISTRICT 21

COMMONWEALTH of VIRGINIA

Virginia Historic Landmarks Commission

H. BRYAN MITCHELL
EXECUTIVE DIRECTOR

RESEARCH CENTER FOR ARCHAEOLOGY

ROUTE 238, BOX 368
YORKTOWN, VIRGINIA 23690
TELEPHONE (804) 253-4836

ALAIN C. OUTLAW, Commissioner of Archaeology

17 June 1984

MEMORANDUM

TO: W. Nelson Lingle

FROM: Bruce J. Larson, Review & Compliance Coordinator

PROJECT: DOE Contract For Operation of Continuous Electron Beam Accelerator Facility

LOCATION: Newport News

[ ] An archaeological field survey will not be necessary for this project. If, however, archaeological resources are unexpectedly encountered during construction, the VRCA should be notified immediately.

[X] Due to the archaeological potential of this location, as well as the project impacts, a Phase I archaeolcgical field survey is necessary. This survey should locate all archaeological resources which may be impacted by the project as it is presently planned. Please find enclosed a list of persons who have expressed an interest in doing contract archaeological work in Virginia. A copy of the resulting report should be forwarded to the VRCA for comment. All necessary archaeological work must be completed, reviewed and approved by this office prior to the commencement of any construction related activities.

[ ] The VRCA has completed its review of the Phase I archaeological survey report on the above project. No further work will be necessary.

COMMENTS: Areas not previously disturbed by construction are recommended for survey.

T 3151

United States Department of Agriculture

Soil Conservation Service

400 N. 8th St., Federal Bldg.
Richmond, Virginia 23240

June 15, 1984

Mr. W. Nelson Lingle
Energy Programs
U. S. Dept. of Energy
Oak Ridge Operations
P. O. Box E
Oak Ridge, Tennessee 37831

Dear Mr. Lingle:

In response to your letter of May 22, 1984, concerning your Continuous Electron Beam Accelerator Facility at Newport News, Virginia, we have the following comments:

We only have partial soil mapping of the subject area.

Soil mapping in and around the general vicinity indicates that the major portion of the area <u>is not</u> Prime or Unique Farmland.

Following are the soils likely to be found in the area:

45, 46	Tomotley fine sandy loam
81	Chickahominy silt loam
70, 95	Man Made and Urban Land (disturbed land)

The soils in their natural setting have a high water table, generally between 0 and 1 foot from the surface and are in Land Capability IV.

Further borings are recommended to determine foundation drain and foundation reinforcement needs.

Further, we recommend that sound sediment and erosion practices be used throughout the construction and land disturbance process.

Let us know if we can be of any further assistance in this project.

Sincerely,

Manly S. Wilder
State Conservationist

Enclosures

cc: J. R. Michael; G. P. Bowie; W. O. Boothe, Franklin; L.L. Seglin, Wmbg.; G. H. Moser

T 3169

COMMONWEALTH of VIRGINIA
State Air Pollution Control Board
Hampton Roads Regional Office
PEMBROKE OFFICE PARK
PEMBROKE IV - SUITE 409
VIRGINIA BEACH, VIRGINIA 23462-5480
TELEPHONE (804) 499-6845

R. P. MINX
REGIONAL DIRECTOR

June 1, 1984

Serial No: 0257-84

Mr. W. Nelson Lingle
Energy Programs
U.S. Department of Energy
Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37831

Dear Mr. Lingle:

I received your letter of May 22, 1984 concerning the proposed Continuous Electron Beam Accelerator Facility (CEBAF) and your request for comments. However, your letter gave no details of possible emissions to the atmosphere other than those associated with construction. As a result this office can make no significant comments on the subject CEBAF at this time.

With regard to construction, please be advised that the contractor should take all reasonable precautions to preclude fugitive dust emissions and, if land clearing is involved, an "open burn permit" will be required.

Thank you for your interest in air pollution and we will look forward to learning more about the proposed facility. We can probably be of help in the permitting process if fuel burning equipment is involved in the new buildings.

Sincerely,

Ramon P. Minx
Ramon P. Minx
Director, Region VI

RPM/LWH/cf

cc: Executive Director

COMMONWEALTH *of* VIRGINIA

Council on the Environment

SHEILA M. PRINCIVILLE
ADMINISTRATOR

903 NINTH STREET OFFICE BUILDING
RICHMOND 23219
804-786-4500

April 23, 1984

Ms. Andrea Reed
Oak Ridge National Laboratory
4500 N, D-33
Oak Ridge, Tennessee 37830

Dear Ms. Reed:

I enjoyed talking with you on April 16 about the proposed Continuous Electron Beam Accelerator (CEBAF) project at Newport News, Virginia. As I understand it, this project is funded by the U.S. Department of Energy, to which Oak Ridge National Laboratory is a contractor. In addition, I understand that Oak Ridge is preparing an environmental assessment (EA) for the Department of Energy.

We have determined that, for purposes of environmental review, this project is not a "major State project" within the meaning of the Virginia Code. Thus it is not subject to the Virginia environmental impact statement (EIS) requirement (Virginia Code sections 10-17.107 and 10-17.108). This determination does not affect any regulatory requirements that may apply to this undertaking.

As the agency responsible for coordinating Virginia's review of federal environmental documents, we will be interested in reviewing the EA being prepared for this project. You indicated that there would be a draft EA prepared for the Department of Energy. We would like to review the draft as well as the final document. Depending upon the extent of the project's likely impacts, we will need to have between eight and 13 copies to allow effective state agency review.

As you requested, I am enclosing two copies of Virginia's EIS Procedure Manual for your use in developing the environmental assessment. The Code section cited above appears on page 40; additional explanation is in the fourth paragraph on page 20.

Ms. Andrea Reed
Page 2

If you have any questions, please feel free to contact me.

Sincerely,

Charles H. Ellis III
Environmental Impact Coordinator

Enclosures

cc: Dr. Dana B. Hamel, Medical College of Virginia

COMMONWEALTH of VIRGINIA

STATE WATER CONTROL BOARD
Tidewater Regional Office
287 Pembroke Office Park
Pembroke No. 2, Suite 310
Virginia Beach, Virginia 23462
(804) 499-8742

Richard N. Burton
Executive Director

Post Office Box 11143
Richmond, Virginia 23230
(804) 257-0056

April 19, 1984

Dr. Donald Lee
Research Associate
Environmental Impact Section
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, TN 37830

RE: Environmental Assessment of Continuous Electron Beam Accelerator to be Located in Newport News, Virginia

Dear Dr. Lee:

Staff members of our Tidewater Regional Office attended a meeting on April 5, 1984 at the site of the proposed facility. At that meeting, your assessment team requested input from various groups with respect to the project.

Based upon the preliminary information presented at the meeting, it appears that some requirements of this Agency might be applicable to the project. We understand that groundwater would be collected as a result of the dewatering operation within the slurry walls surrounding the "Beam Dump" area. The water would then be discharged to a storm drain, after it was determined that the water was not radioactively contaminated. A National Pollutant Discharge Elimination System (NPDES) Permit may be required for this discharge.

We also feel that a requirement for groundwater monitoring wells, placed at key locations around the site, might be appropriate. Our findings at this point are very preliminary and are subject to adjustment as further information on the project is developed. This agency's requirements will also need to be coordinated with those of other appropriate agencies.

We appreciate the opportunity to provide comments at this early stage in the project. Please keep our office informed as you develop more relevant details on this proposal.

Sincerely,

L. S. McBride

L. S. McBride, Director
Tidewater Regional Office

/dak

cc: SWCB - BAT; TRO File
Dr. Hans C. von Baeyer
Mr. D. B. Hamel

SURA SOUTHEASTERN UNIVERSITIES RESEARCH ASSOCIATION, INC

July 24, 1984

Mr. L. E. Rice, Jr.
Chief, Real Estate Division
Department of the Army
Corps of Engineers
803 Front Street
Norfolk, Virginia 23510

Dear Mr. Rice:

We have reviewed the covenant included in the Quit Claim Deed, which addresses the water flow and contamination issue on the Newport News CEBAF site. Dr. James McCarthy, the Acting Director of the Continuous Electron Beam Accelerator Facility and Mr. John Bradshaw of Hayes, Seay, Mattern and Mattern, our current A&E firm have indicated that the accelerator facility to be built in Newport News will not interfere with the natural flow of surface water from the water shed and that the water will continue to flow into the appropriate tributaries which feed into the Big Bethel Reservoir without contamination or pollution.

When the plans and documentation have been developed, they will be submitted to you for your review.

I trust this procedure is acceptable to you.

Very sincerely yours,

Dana B. Hamel

DBH/pm Enclosure: Copy of deed

cc: With enclosure
Dr. Harry D. Holmgren
Dr. James S. McCarthy
Mr. John Bradshaw
Ms. Andrea Reed, DOE/Oak Ridge

Harry D. Holmgren, *President*
Dept. of Physics & Astronomy
University of Maryland
College Park, MD 20742
(301) 454-4153

Dana B. Hamel, *Vice-President*
Box 548, MCV Station
Richmond, VA 23298
(804) 786-6682

Hans C. von Baeyer, *Secretary*
College of William and Mary
Virginia Associated Research Campus
12070 Jefferson Avenue
Newport News, VA 23606
(804) 877-9231

Thomas B. Clegg, *Treasurer*
Dept. of Physics & Astronomy
University of North Carolina
Chapel Hill, NC 27514
(919) 962-3016

James S. McCarthy
Acting Director of CEBAF
Dept. of Physics
University of Virginia
Charlottesville, VA 22903
(804) 924-6783

COMMONWEALTH *of* VIRGINIA

Council on the Environment

KEITH J. BUTTLEMAN
ADMINISTRATOR

903 NINTH STREET OFFICE BUILDING
RICHMOND 23219
804-786-4500

February 15, 1985

Mr. W. Nelson Lingle
Program Manager
Department of Energy
Oak Ridge Operations
ER-112
P.O. Box E
Oak Ridge, Tennessee 37831

Dear Mr. Lingle:

The Commonwealth of Virginia has completed its review of the Draft Environmental Assessment for the Continuous Electron Beam Accelerator Facility (CEBAF). The Council on the Environment is responsible for coordinating Virginia's review of federal environmental documents and responding to appropriate federal officials on behalf of the Commonwealth. The following agencies participated in this review:

Commission of Conservation and Historic Resources
Department of Health
Department of Highways and Transportation
State Air Pollution Control Board
State Water Control Board
Office of Education.

We have no objection to this undertaking on environmental grounds, provided that appropriate environmental precautions are taken. These should include monitoring for radioactivity in groundwater, as proposed in the Draft EA; survey for and mitigation of damage to archaeological resources, as recommended in earlier correspondence (see page A-6 of the Draft EA); adherence to suggestions by the State Air Pollution Control Board in regard to mitigation of construction impacts on air quality (see attached comments); and compliance with applicable regulatory requirements including a National Pollutant Discharge Elimination System (NPDES) permit which will be required for water discharges.

We assume that a hydrogeologic-geotechnical study will be done before the facility design. This study would provide data on groundwater uses, shallow groundwater occurrence, and water table depths and gradients, and is considered essential to adequate groundwater monitoring, as the State Water Control Board has indicated (see enclosure).

Road construction associated with the project should incorporate appropriate Best Management Practices (BMPs) to inhibit soil erosion. BMP Handbooks (the Urban BMP Handbook is recommended) are available from the State Water Control Board.

As you know, eleven Virginia institutions of higher learning belong to the Southeastern University Research Association, with which the Department of Energy will contract for the development of the CEBAF. These institutions are committed to further the work of the CEBAF through in-kind services, professorships, and other resources. They recognize, as does the Governor, that the project will have positive economic, research, and educational influences on the Commonwealth.

Thank you for the opportunity to review this document. We appreciate the extra time you provided for this review.

Sincerely,

Keith J. Buttleman

Enclosures

cc: The Honorable Betty J. Diener
The Honorable John T. Casteen, III
Ms. LaVern Corkran, SWCB
Mr. Bruce Larson, VRCA
Mr. K. Mercer Melvin, SAPCB
Mr. Leon App, DCHR
Dr. Robert Stroube, DOH

COMMONWEALTH of VIRGINIA

Department of Health
Richmond, Va. 23219

JAMES B. KENLEY M.D.
COMMISSIONER

February 1, 1985

Mr. Charles H. Ellis
Council on the Environment
903 Ninth Street Office Building
Richmond, Virginia 23219

RE: Continuous Electron Beam Accelerator Facility

Dear Mr. Ellis:

Our recent telephone conversation regarding this proposed project centered around what relationship might exist between the tritium concentrations which could result from this project and the proposed performance standards relating to uranium development; specifically standards for radon and radium in offsite areas.

First of all, we agree that the release of radioactive gases from the proposed CEBAF facility is expected to cause insignificant offsite exposures, contrary to the potential for exposure from radon emissions from a uranium development facility. Calculated exposures for air immersions in gases from the CEBAF facility are less than 0.2 mrem/year, whereas radon emissions from uranium development are expected to be predominant offsite exposure pathways with lung exposure, especially to the bronchial epithelium, possibly reaching as high as 95 mrem/year to a hypothetical maximally exposed individual. (Using ICRP #26 weighing factors to convert this to equivalent whole body exposure, this gives a maximum whole body exposure of 11-12 mrem per year). Moreover, radium and radon in drinking water pose special problems. For radium, we are concerned about the long half-life (over 1650 years), the high LET emissions, and the fact that radium is metabolized into the bone structure in a manner similar to calcium. For radon in drinking water, we are primarily concerned that through aeration in the home in the normal process of using the water, inhalation of the radon and exposure of the lung results.

Contrary to the situation with radium and radon, tritium in water acts chemically just like hydrogen in that it spends little time in the body, resulting in low exposures.

I hope this discussion has succeeded in pointing out why we are much more concerned about the levels of radium and radon from uranium development than we are about tritium.

If you have any further questions, please do not hesitate to contact me.

Sincerely,

Charles R. Price, Director
Bureau of Radiological Health

CRP:dl

COMMONWEALTH of VIRGINIA

Office of the Governor
Richmond 23219

February 5, 1985

Mr. Keith J. Buttleman
Administrator
Council on the Environment
903 Ninth Street Office Building
Richmond, Virginia 23219

Dear Mr. Buttleman:

Thank you for sending the environmental assessment for the U. S. Department of Energy. I understand that this study was done in anticipation of federal funding for the Southeastern University Research Association for the development and building of a Continuous Electron Beam Accelerator Facility at Newport News, Virginia.

I am pleased to see that the review by our state agencies, so far, indicates that there are no significant environmental problems. Dana Hamel, who is our Chief Liaison Officer with SURA/CEBAF, tells me that he will be contracting, very soon, with Dr. Norman Barker of William and Mary to do a Phase I archaeological field survey required by the Virginia Historic Landmarks Commission.

The location of CEBAF at Newport News, Virginia, will have a positive economic, research, and educational influence on the Commonwealth, and toward this end, the Governor has supported the project. We have provided funds to support research and development, plus $2 million for Distinguished Professorships, outstanding scientists and post-doctoral training in physics. Library expansion at William and Mary to accommodate service to the accelerator's established library and a proposed institute at the University of Virginia are related to CEBAF.

Mr. Keith J. Buttleman
February 5, 1985
Page Two

Further commitments have been made, through William and Mary, to lease approximately 68 acres of land and the facilities of the former Virginia Associated Research Campus (VARC) to SURA for the use of CEBAF. 17.5 positions, formerly at VARC, have also been provided, with funding for these positions, by the Commonwealth.

Eleven Virginia institutions of higher education belong to SURA, two of which represent the private sector. They have made a commitment to further the work of CEBAF through in-kind services, professorships, and other resources.

The location of CEBAF in the Commonwealth will enhance our high tech efforts and provide a rare opportunity for Virginia to take the lead in basic research in physics. This facility, coupled with the CIT, can place us in the forefront of scientific development. The combination of CEBAF and CIT will further our industrial development efforts and be a major attraction for the high tech industry.

I trust the project can move forward on time, on schedule. I appreciate your efforts, and that of your agencies, in helping us get this important facility underway for the Commonwealth.

Sincerely,

John T. Casteen, III

JTC/dtb

COMMONWEALTH of VIRGINIA

STATE WATER CONTROL BOARD
2111 Hamilton Street

Richard N. Burton
Executive Director

Post Office Box 11143
Richmond, Virginia 23230-1143
(804) 257-0056

January 17, 1985

Mr. Charles H. Ellis, III
Senior Environmental Policy Analyst
Council on the Environment
903 Ninth Street Office Building
Richmond, Virginia 23219

Subject: CEBAF-EA

Dear Mr. Ellis:

This project was reviewed by staff from our Tidewater Regional Office. Comments inbuing from that review were sent directly to the Oak Ridge people as is evidenced by the attached copy of that correspondence.

Additional comments, for your coordination, are:

1. No NPDES permit will be required at this time for dewatering. BMPs (such as hay bales) will be appropriate for run-off control; however, the discharger is responsible for compliance with all State and Federal statutes, standards and promulgated guidelines which govern this type facility and its discharge.

2. A NPDES permit will be required for CEBAF operations ground water disposal discharges.

Sincerely,

LaVern H. Corkran

LaVern H. Corkran
Permits Program Manager
Office of Water Resources Management

ns

Attachment: Letter, TRO-Oak Ridge

cc: C. E. Easlick, EIS Coordinator

COMMONWEALTH of VIRGINIA

STATE WATER CONTROL BOARD
Tidewater Regional Office
287 Pembroke Office Park
Pembroke No. 2, Suite 310
Virginia Beach, Virginia 23462
(804) 499-8742

December 26, 1984

Mr. W. Nelson Lingle
Department of Energy
Oak Ridge Operations, ER-112
Oak Ridge, TN 37831

Dear Mr. Lingle:

The environmental assessment for the Continuous Electron Beam Accelerator Facility in Newport News was reviewed and was found to be well done. We concur with the proposed environmental monitoring for radioactivity. It is assumed that a hydrogeologic-geotechnical study will be done prior to the facility design although no mention was made of such a study in the assessment. This study is considered essential in order to assure proper facility design and adequate ground water monitoring. This study would provide data on the ground water users near the site, shallow ground water occurrence, water table depths and gradients, and therefore enable proper design of tunnels, slurry walls, dewatering operations and permanent ground water monitoring wells.

The opportunity to review the environmental assessment was appreciated. If you have any questions or comments, please contact me at (804) 499-8742.

Sincerely,

Remo A. Masiello

Remo A. Masiello
Director, Division of
Water Control Mananement

/sch

cc: L. S. McBride
E. A. Siudyla

[illegible] INSTRUCTIONS:

A) Please review the document carefully. If the proposal has been reviewed earlier (e.g., if the current document is a Final EIS), please consider previous comments.

B) Prepare your agency's comments in a form which would be acceptable for responding directly to a project sponsoring agency.

C) Use the space below for your comments. If additional space is needed, please attach extra sheets.

Return your comments to:

Charles H. Ellis III
Environmental Programs Analyst
Council on the Environment
903 Ninth Street Office Building
Richmond, Virginia 23219

Charles H. Ellis III
Environmental Programs Analyst

COMMENTS

The staff of the State Air Pollution Control Board has reviewed the Draft EIS concerning the proposed Continuous Electron Beam Accelerator Facility project by the U.S. Department of Energy.

It appears that there will be minimal impact to the ambient air quality once the construction has been completed. Temporary measures due to construction should be taken to:

(a) Reduce fugitive dust from transportation of dirt, sand, stone, gravel, etc., both into and out of the construction site, including the wetting down, when practicable, of the loads during loading and unloading operations, the frequent wash down of truck bodies, and the use of attached hinged covers or tarpaulins to cover loads while in transit.

(continue page 2)

(SIGNED) [illegible] (DATE) 12/27/84

(TITLE) Staff Engineer

(AGENCY) State Air Pollution Control Board

(page 2)

(COMMENTS continued)

COMMENTS

(b) Prevent transport of fugitive dust from the construction site, work areas, material storage areas, and haul roads by use of water dampening, oil, calcium chloride, liquid latex, or other known effective techniques.

(c) Dispose of land clearing debris by means other than burning at the construction site, if at all feasible. If not feasible, a burn permit from the State Air Pollution Control Board must be obtained.

Virginia Commonwealth University

RECEIVED MAY 09 1985 OFFICE OF DR. DANA HAMEL

May 9, 1985

To: Dr. Dana Hamel

From: Dan Mouer

Subject: Archeological survey of SURA linear accelerator project area

Dr. Hamel,

Please excuse my taking so long to get back to you. We've been taking advantage of the Spring weather to get some badly needed fieldwork in, and I have been neglecting deskwork.

I have carefully studied plans for the accelerator project site and after spending the day on the site with you and the SURA staff who accompanied us, it is my opinion that no archeological work should be required. There is a slight chance that there are some archeological remains on the property, but I feel that the cost and effort required to locate and evaluate these is not justified by the types of sites likely to be found.

Approximately 1/3 of the project area has been seriously impacted by former use as a missile base. This area is paved or bulldozed, or both. No survey can be done on that area until paving has been removed, and even then, it seems unlikely that archeological sites with any structural integrity will be found there.

The remainder of the property is equally divided between undrained, swampy flats, which cannot be tested without extensive, and expensive, use of power equipment and some form of hydrological engineering. These areas are undrained because they are formed of old marine bed deposits capped by impermeable clays. The last time these beds would have been sufficiently above sea level to have been utilized as living sites would have been prior to ca. 6000 years ago. Even at that time, this area would not have been prime land for prehistoric occupation.

The remaining 100 acres or so are today classifiable as poorly to moderately drained flatlands. These areas may contain remains of prehistoric campsites. However, all of

College of Humanities and Sciences • 900 Park Avenue • Richmond, Virginia 23284-0001 • (804) 257-1674

Virginia Commonwealth University

this land is covered with large amounts of fill, apparently trucked in during use of the site by the Army. A 30-40 year old mixed hardwood and pine forest is growing on the fill. I suspect that the fill was brought in because the land was very low and undrained. Any archeological sites would have to be located beneath 3-6 feet of fill, using hand testing methods (heavy equipment could not be brought in without deforesting the site first). Such testing would be expensive and, I feel, not very rewarding.

There are no historic roads, structures, or sites dating to the early nineteenth century, or earlier, in the vicinity of the site, so there is little likelihood of there being any significant historic sites on the property. It is my honest opinion that the most historic resource on the property is the BOMARC Missile base itself.

I have spoken about this to Mr. Bruce Larsen of the VARC, and he has asked me to forward my comments to you, I am sending him a courtesy copy. Should Mr. Larsen feel that a survey is needed, VCU will be glad to provide the service. The cost for such a survey would be in the neighborhood of $15,000, assuming the VARC would want to have a statistically valid stratified random sample of the project area. We will have crews available to do this work throughout the summer, but our schedule is most clear next August or early September.

If I can be of further assistance, please do not hesitate to call.

College of Humanities and Sciences • 900 Park Avenue • Richmond, Virginia 23284-0001 • (804) 257-1674

PLANNING DISTRICT 21

COMMONWEALTH of VIRGINIA

Department of Conservation and Historic Resources

Division of Historic Landmarks
H. Bryan Mitchell, Director

Research Center for Archaeology

May 30, 1985

MEMORANDUM

TO: Mr. W. Nelson Lingle

FROM: Bruce J. Larson, Review & Compliance Coordinator

PROJECT: DOE Contract For Operation of Continuous Electron Beam Accelerator Facility

LOCATION: Newport News

[X] An archaeological field survey will not be necessary for this project. If, however, archaeological resources are unexpectedly encountered during construction, the VRCA should be notified immediately.

[ ] Due to the archaeological potential of this location, as well as the project impacts, a Phase I archaeological field survey is necessary. This survey should locate all archaeological resources which may be impacted by the project as it is presently planned. Please find enclosed a list of persons who have expressed an interest in doing contract archaeological work in Virginia. A copy of the resulting report should be forwarded to the VRCA for comment. All necessary archaeological work must be completed, reviewed and approved by this office prior to the commencement of any construction related activities.

[ ] The VRCA has completed its review of the Phase I archaeological survey report on the above project. No further work will be necessary.

COMMENTS:

This Revaluation is Based Upon Dr. D. Mouer's (VCU) Field Inspection of the Proposed Project Areas As Discussed in his Recent Memorandum to Dr. Hammel.

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF:

October 24, 1986

Waterways Inspection Section (Big Bethel Reservoir)

Bryan Walker, Senior Engineer
U.S. Department of Energy
Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37831

Dear Mr. Walker:

This is in reference to an October 17, 1986 on-site meeting between Mr. Harold Jones of my staff and Messrs. Ronald O. Hultgren and Otto Metherny at the CEBAF project site located on Jefferson Avenue, Newport News, Virginia. The purpose of the meeting was to provide a jurisdictional determination and to determine whether a Department of the Army permit would be required for your proposed work.

Based on the site inspection, we have determined that the project site contains no waters or wetlands within the jurisdiction of the Army Corps of Engineers. Therefore, no further authorization will be required from this office for your proposed development. However, you should obtain all required State and local permits prior to the implementation of any work.

Should you have additional questions regarding this matter, please contact Mr. Jones at (804) 441 3777, FTS 827-3777.

Thank you for your interest in this matter.

Sincerely,

Steve Walls
for Gene R. Cocke
Chief, Waterways Inspection
Section

Copy Furnished:

Virginia Marine Resources Commission, Newport News

Attachment 4

COMMONWEALTH of VIRGINIA

STATE WATER CONTROL BOARD
2111 Hamilton Street

Richard N. Burton
Executive Director

Post Office Box 11143
Richmond, Virginia 23230-1143
(804) 257-0056

Please reply to: Tidewater Regional Office
287 Pembroke Office Park
Suite 310 Pembroke No. 2
Virginia Beach, Virginia 23462
(804)[illegible]

September 2, 1986

L. Paul Page, Ph.D.
Department Manager, Administrative Services
Continuous Electron Beam Accelerator Facility
12070 Jefferson Ave.
Newport News, Virginia 23606

Dear Dr. Page:

This letter will confirm the topics we discussed in our meeting of 26 August. Also, for your information I am enclosing a copy of the memo I wrote summarizing our meeting. If you find any discrepancies in my memo please advise accordingly.

Federal facilities do come under the purview of the Virginia State Water Control Board. Therefore the storm water runoff retention pond you are planning would require a NPDES permit. There is a 30 day notice period required for advertising the permit; that fee will be charged to you. There is a possibility that because of the advertising enough public interest will be generated to warrant a public hearing. If a hearing is required, the application would be acted upon at the next regularly scheduled Board Meeting; the time necessary for the process will be extended at least 30 and possibly 60 days. By law, the Agency has 120 days to process a completed application.

The question of groundwater contamination and a possible variance to the standards would be handled via a No Discharge Certificate. The method used would probably require the issuance of the Certificate with requirements for groundwater monitoring and conditions necessary for a "groundwater mixing zone" or a variance to the standard. Time periods required here would be the same as outlined above. A request for a mixing zone or a variance to the standard would also have to go before a regularly scheduled Board meeting.

If you have any further questions please call.

Sincerely,

Remo A Masiello

Remo A. Masiello, Supervisor
Water Resources Development

cebaf/electron