Docket 70-754
License SNM-960

Mr. Gene E. Cunningham
Senior Licensing Manager
Vallecitos Nuclear Center
P.O. Box 460
Vallecitos Road
Pleasanton, CA 94566

JAN 2 1 1994

Dear Mr. Cunningham:

SUBJECT: FINDING OF NO SIGNIFICANT IMPACT AND ENVIRONMENTAL ASSESSMENT (TAC NO. L21419)

Enclosed are copies of the Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) prepared to support the issuance of the renewal of Materials License SNM-960. The FONSI, which was forwarded to the Office of the Federal Register for publication on January 13, 1994, also contains a Notice of Opportunity for Hearing in accordance with Subpart L of 10 CFR Part 2. If you have questions regarding this action, I can be reached on (301) 504-2649. Please reference the above TAC No. in future correspondence related to this request.

Sincerely,

ORIGINAL SIGNED BY

Charles Gaskin
Licensing Section 1
Licensing Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

Enclosures:
1. EA dtd 12/93
2. FONSI dtd 1/12/94

Distribution: w/encls.

Docket 70-754	PDR	NRC File Center	FCSS R/F
FCLS1 R/F	NMSS R/F	Region V	FCLB R/F

OFC	FCLB	E	FCLB	E	FCLB	E		
NAME	AHoadley		EKeegan		CGaskin			
DATE	1/21/94		1/14/94		1/14/94			

C = COVER E = COVER & ENCLOSURE N = NO COPY
[G:\geltr.ah]

NF05 '/1

7590-01

U.S. NUCLEAR REGULATORY COMMISSION
FINDING OF NO SIGNIFICANT IMPACT AND
NOTICE OF OPPORTUNITY FOR A HEARING
RENEWAL OF SPECIAL NUCLEAR MATERIALS
LICENSE SNM-960
GENERAL ELECTRIC COMPANY
VALLECITOS NUCLEAR CENTER
PLEASANTON, CALIFORNIA
DOCKET 70-754

The U.S. Nuclear Regulatory Commission is considering the renewal of Special Nuclear Materials License SNM-960 for General Electric Company, Vallecitos Nuclear Center (VNC), Pleasanton, California for a period of 10 years.

SUMMARY OF THE ENVIRONMENTAL ASSESSMENT

Identification of the Proposed Action: The proposed action is the renewal of VNC's operating license for a period of 10 years authorizing the receipt, possession, use, and transfer of special nuclear material and associated byproduct material. Authorized activities include assembly, modification, cleaning, and repair of unirradiated, encapsulated experimental assemblies; chemical, metallurgical, health physics, and hot laboratory operations; research and development; and waste treatment.

The Need for The Proposed Action: Operations at VNC primarily support GE Nuclear Fuels Programs through fuel specimen examination and evaluation. The demand for these operations will continue as long as GE-designed and fabricated fuels continue to be used in commercial nuclear power reactors. Renewal of the license allows continued research into nuclear technologies and materials which may hold the promise of more efficient and less polluting energy producing facilities. The products of continued research may produce positive effects in the years to come, not only through expanding knowledge and refining technologies applicable to energy generation, but also by providing alternatives to technologies that contribute to acid rain.

Environmental Impacts of the Proposed Action: Liquid waste streams are managed to preclude radioactive contamination under normal operating conditions. Monitoring is conducted on the industrial wastewater stream (non-contact cooling water) to confirm the absence of significant levels of radioactivity.

Both VNC's operating procedures and the facility's NPDES Permit require confirmatory sampling prior to any release from the retention basins. Prior to the discharge of this stream, grab samples are collected and analyzed for gross alpha and gross beta-gamma radioactivity to verify that radioactivity concentrations do not exceed limits specified by Appendix B of 10 CFR Part 20. All discharge samples for the week are accumulated as a weekly composite and analyzed for ^{131}I. Monthly basin composites are analyzed for gross alpha and gross beta-gamma concentrations, and quarterly composites are analyzed for tritium, ^{137}Cs, and ^{60}Co. The effectiveness of effluent controls is illustrated by the fact that the measured radioactivity concentrations of liquid releases from VNC do not exhibit a statistically significant difference when compared to influent samples from the San Francisco water supply system.

In addition to the industrial wastewater stream at the retention basins, monitoring is also conducted on the sanitary wastewater stream. Grab samples are collected and analyzed for gross alpha and gross beta-gamma radioactivity to verify that radioactivity concentrations do not exceed limits specified by Appendix B of 10 CFR Part 20.

Potentially contaminated liquids are routed to VNC's Radioactive Liquid Waste Evaporator Plant for processing. Post-processing condensate from the evaporator is sampled and analyzed for radioactivity. If levels of radioactivity are less than the values specified in Appendix B of 10 CFR Part 20, the condensate is vaporized and emitted as steam through a continuously sampled stack.

Operations with potential to generate airborne radioactive contaminants are conducted within a confined, ventilated structure with exhausts routed to a filtered and monitored stack. The number of stacks actually monitored or sampled in a given year will vary dependent upon usage of the facilities. Annual average emission levels as measured by the airborne radioactive effluent monitoring program indicate that levels are significantly less than values specified in Appendix B of 10 CFR Part 20.

VNC has maintained an environmental surveillance program since 1956 in order to determine the impact, if any, of site operations on radiation levels in the environment surrounding the facility, and verify the effectiveness of its radiation control and release point monitoring programs. The program includes routine collection and analysis of water, vegetation, soil, stream bottom, and air samples from strategic onsite and offsite locations.

In order to assess whether recent VNC operations may have caused cumulative impacts on the surrounding environment, recent surveillance data for the period 1986 through 1990 was reviewed. During this time, radioactive concentrations in the environment have remained well below background statistical levels and action levels.

Nonradiological effluents from current GE VNC operations include airborne emissions from building exhaust stacks, a gasoline pump, a spent photochemical storage tank and a solvent cleaning facility; and liquid discharges include industrial wastewater and sanitary wastewater, as well as clean water discharges. Emissions from stacks are not monitored for nonradiological pollutants. GE VNC is exempt from continuous emissions monitoring under Regulation 1, Section 520 of the Rules and Regulations of the Bay Area Air Quality Management District. Industrial wastewater releases from GE VNC are monitored in accordance with the California Regional Water Quality Control Board Order 90-0058 and NPDES Permit. Prior to discharge, water is sampled from each basin and tested for acceptable pH and radioactivity levels. Aliquots from all basin discharges are composited and analyzed for chlorides, chromium, lead, mercury, zinc, nickel, silver, and total dissolved solids. In addition, at specific intervals, grab sampling is performed for dissolved copper, dissolved oxygen, turbidity, oil and grease, fish toxicity, and temperature. All sanitary wastes are routed to an Imhoff tank; and, after undergoing sand filtration, chlorination, and pH adjustments, are land disposed on site by irrigation. The NPDES permit requires no analysis for sanitary waste sprinkled onsite and establishes no requirements for sampling or analysis. VNC does, however, sample and analyze for pH, radioactivity, and coliform bacteria.

During routine operations at VNC, small quantities of radioactive material are released to the environment. Release levels, however, have historically resulted in only a small fraction of the offsite concentration limits specified by regulation. The offsite radiological impacts associated with airborne emissions during a typical recent year of normal operations at VNC were assessed by calculation of the committed effective dose equivalents to the nearest site boundary, and to the nearest resident, who represents the maximally exposed individual from VNC operations. Impacts were additionally assessed by calculation of the collective dose to the population residing within an 80-km (50-mile) radius of the site.

The dose delivered to a hypothetical individual, situated about 360 meters distance from the site boundary, is estimated at one millirem per year. The highest organ dose is estimated at 1.2 millirem to the gonads. The nearest actual resident to VNC is considered the maximally exposed individual, and is situated 450 meters south-southeast of Stack 102A. The annual effective dose to this resident is about 0.8 millirem from airborne effluents. The highest organ dose is about 0.9 millirem delivered to the gonads.

To assess the dose delivered to individuals as a result of airborne emissions from VNC operations, annual average emissions data for the year 1990 and representative meteorological data were input to the computer, Code AIRDOS-PC35. The code applies a Gaussian plume dispersion model to calculate downwind ambient concentrations in air, and surface depositions. Various pathways for the possible uptake of radionuclides by an individual, and the effects of irradiation by plume immersion and ground deposition are then analyzed to estimate the dose delivered to an individual as a result of the annual release. During normal operations at VNC, no realistic pathway exists for the offsite discharge of radioactive materials in liquid effluents. Monitoring of the liquid pathway has shown that no measurable or significant concentrations of radioactivity are being discharged. For these reasons, the offsite impact of radioactive materials discharged via liquid effluent pathways is considered to be negligible.

<u>Conclusion</u>: Operational and administrative controls at VNC are designed to ensure that radioactive materials are stored and utilized in such a manner as to minimize radiation exposures to workers and the surrounding population. During routine operations at VNC, small quantities of radioactive material are released to the environment. Release levels, however, have historically

resulted in only a small fraction of the offsite concentration limits specified by regulation.

Exposure to airborne emissions is assumed to be the only significant radiological effluent pathway. This pathway was assessed for impacts to an individual at the site boundary, at the nearest residence, and to the population within an 80-km radius. The highest dose at a site boundary location was calculated based on current stack emissions data. The resulting dose is less than 1 millirem effective, with the highest organ dose being about 1.2 millirem to the gonads. From environmental perimeter TLD measurements, a conservative estimate of gamma-ray dose is 9 millirem for the northern boundary. Both methods show that doses from facility operations are well within the standards of 40 CFR Part 190, and indicate that VNC will readily comply with the new requirements of 10 CFR 20.1301.

No significant nonradiological impacts are expected with the continued operation of the GE VNC. The proposed action would result in continuation of the current baseline conditions, with no change to the socioeconomic character of the community. Land currently grazed and cultivated would continue to be used in the same manner as it has been in the past. Traffic on area roads, along with its inherent emissions and noise, would continue as it has in the past. Water use would continue, with peaks reaching only 4.5 l/s, and with a peak discharge of only 2.2 l/s. The nonradioactive gaseous emissions from the GE VNC facilities are relatively minor and will result in only slight increases of regulated pollutants, and are not expected to contribute to further deterioration of local air quality.

Alternatives to the Proposed Action: The alternative of no license renewal would end light-water reactor fuel research and development activities at VNC, particularly the examination of irradiated fuels, and would remove from service unique research facilities. Accordingly, GE would be required to seek other hot cell facilities capable of and willing to do the work (e.g., a facility not connected with a competitor), to build new facilities (necessitating proliferation of sites and commitment of new resources), or abandon reactor fuel improvement research programs altogether.

Another alternative would be to consider licensing with restrictions in order to mitigate any unacceptable adverse environmental impacts.

Agencies and Persons Consulted: The following outside agencies were contacted for supporting documentation:

Alameda County Flood Control and Water Conservation District
Alameda County Planning Department
Bay Area Air Quality Management District
Cal-EPA Department of Toxic Substances Control
City of Livermore Planning Department
Office of the California State Demographer
U.S. Bureau of the Census

Finding of No Significant Impact: The Commission has prepared an Environmental Assessment related to the renewal of Special Nuclear Materials License SNM-960. On the basis of the assessment, the Commission has concluded that environmental impacts that would be created by the proposed licensing action would not be significant and would not warrant the preparation of an Environmental Impact Statement. Accordingly, it has been determined that a Finding of No Significant Impact is appropriate.

The Environmental Assessment and the above documents related to this proposed action are available for public inspection and copying at the Commission's Public Document Room at the Gelman Building, 2120 L Street N.W., Washington, DC.

OPPORTUNITY FOR A HEARING

Any person whose interest may be affected by the issuance of this renewal may file a request for a hearing. Any request for a hearing must be filed with the Office of the Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555, within 30 days of the publication of this notice in the Federal Register; be served on the NRC staff (Executive Director for Operations, One White Flint North, 11555 Rockville Pike, Rockville, MD 20852); on the licensee (General Electric Company, Vallecitos Nuclear Center, P.O. Box 460, Vallecitos Road, Pleasanton, California 94566), and must comply with the requirements for requesting a hearing set forth in the Commission's regulation, 10 CFR Part 2, Subpart L, "Informal Hearing Procedures for Adjudications in Materials Licensing Proceedings."

These requirements, which the requestor must address in detail, are:

1. The interest of the requestor in the proceeding;
2. How that interest may be affected by the results of the proceeding, including the reasons why the requestor should be permitted a hearing;
3. The requestor's areas of concern about the licensing activity that is the subject matter of the proceeding; and
4. The circumstances establishing that the request for hearing is timely, that is, filed within 30 days of the date of this notice.

In addressing how the requestor's interest may be affected by the proceeding, the request should describe the nature of the requestor's right under the Atomic Energy Act of 1954, as amended, to be made a party to the proceeding; the nature and extent of the requestor's property, financial, or other (i.e., health, safety) interest in the proceeding; and the possible effect of any order that may be entered in the proceeding upon the requestor's interest.

Dated at Rockville, Maryland, this 12 day of January 1994.

FOR THE NUCLEAR REGULATORY COMMISSION

Robert C. Pierson, Chief
Licensing Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

ENVIRONMENTAL ASSESSMENT RELATED TO THE RENEWAL OF SPECIAL NUCLEAR MATERIALS LICENSE SNM-960 FOR THE VALLECITOS NUCLEAR CENTER

DOCKET 70-754
GENERAL ELECTRIC COMPANY

DECEMBER 1993

TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

TABLE OF CONTENTS

(Continued)

LIST OF FIGURES

Page

LIST OF TABLES

1.0 INTRODUCTION

1.1 DESCRIPTION OF THE PROPOSED ACTION

In March 1989, General Electric Company (GE or the Applicant) submitted a request to the Nuclear Regulatory Commission to extend Special Nuclear Materials (SNM) License, SNM-960, to continue operating Vallecitos Nuclear Center (VNC) for an additional 10 years[1]. With this renewal, GE VNC will continue to support the GE Nuclear Fuels Programs. License renewal equates to a continuity of the current condition; no new ground breaking is authorized or anticipated under license renewal.

In support of an application for license renewal, 10 CFR Part 51[2] requires that an environmental impact appraisal be performed to determine whether an environmental impact statement or a finding of no significant impact will be prepared. Part 51 further states that the determination shall be guided by the Council on Environmental Quality Guidelines, 40 CFR Part 1500.6[3]. In accordance with these regulations, this Environmental Assessment (EA), prepared independently by the staff of the NRC Office of Nuclear Material Safety and Safeguards, evaluates the expected environmental impact of the proposed licensing action, i.e., extension of the license to handle SNM, and alternatives to license renewal.

1.2 BACKGROUND INFORMATION

In March 1956, GE began construction of radioactive materials handling facilities near Pleasanton, California. These facilities were known collectively as the Vallecitos Atomic Laboratory. In 1967, the name of the site was changed to the present name of Vallecitos Nuclear Center.

Each of the individual units was granted a license to operate on a case-by-case basis by the U.S. Atomic Energy Commission (AEC) as it was completed. In September 1966, the AEC granted a Special Nuclear Materials License, SNM-960, to cover all activities involving uranium and plutonium at the Vallecitos site. The SNM license replaced all previously issued individual licenses for activities covered by the requirements of Title 10, Part 70 of the Code of Federal Regulations (10 CFR Part 70)[5], and has remained in effect in accordance with the renewal provisions of 10 CFR Part 70, paragraph 70.33(b). Presently, all radiological activities at the GE VNC site are covered by either (1) California License 0017-59, (2) 10 CFR Part 50 Reactor License, or (3) the SNM-960 License.

1.3 PREVIOUS ENVIRONMENTAL ASSESSMENTS AND SUPPORTING DOCUMENTS

Since GE first began operating VNC, various studies have been conducted to consider the environmental impact of operation of the facility. This EA is built upon the previous environmental documentation and related safety evaluations.

An environmental report was not required of the Applicant with respect to this license renewal application; however, the Applicant was required to submit various information in response to a number of questions/data requests issued by the NRC[26].

2.0 NEED FOR THE PROPOSED ACTION

Operations at VNC primarily support GE Nuclear Fuels Programs through fuel specimen examination and evaluation. The demand for these operations will continue as long as GE-designed and fabricated fuels continue to be used in commercial nuclear power reactors. Renewal of the license allows continued research into nuclear technologies and materials which may hold the promise of more efficient and less polluting energy producing facilities. The products of continued research may produce positive effects in the years to come, through expanding knowledge and refining technologies applicable to energy generation, providing alternatives to technologies that contribute to acid rain.

3.0 ALTERNATIVES TO THE PROPOSED ACTION

The alternative of no license renewal would end light-water reactor fuel research and development activities at VNC, particularly the examination of irradiated fuels, and would remove from service unique research facilities. Accordingly, GE would be required to seek other hot cell facilities capable of and willing to do the work (e.g., a facility not connected with a competitor), to build new facilities (necessitating proliferation of sites and commitment of new resources), or abandon reactor fuel improvement research programs altogether.

Another alternative would be to consider licensing with restrictions in order to mitigate any unacceptable adverse environmental impacts.

4.0 EXISTING ENVIRONMENT

This section provides a discussion of the existing environment, including land use and terrestrial resources; water use and aquatic resources; socioeconomic, historical, and archaeological resources; demography; climatology; meteorology; severe weather, air quality; geology, hydrology, soils, and mineral resources; seismicity; and background radiation. An assessment of impacts to the environment due to operational activities at VNC is presented in Section 6.

4.1 SITE LOCATION AND ENVIRONS

VNC is located approximately 35 miles east-southeast of San Francisco and 20 miles north of San Jose, lying entirely within Alameda County. Its relative location is shown in Figure 4.1-1. The site is north of and adjacent to Vallecitos Creek, an intermittent stream. Figure 4.1-2 indicates the topographic setting with VNC situated in the Vallecitos Valley surrounded by low hills. The local topography is marked by low hills and shallow valleys with mountains in the area not exceeding 4000 feet. The land adjacent to VNC, to the north, east, and west, is hilly. From north-northwest through east-northeast, the site is separated from the much larger Livermore Valley by the Pleasanton Hills. Except for its connection to the Livermore Valley, and its connection through Niles Canyon to the Santa Clara Valley and the Bay area, the site is almost totally surrounded by mountains beginning with the Black Hills in the north, the Diablo Range extending out to 80 km (50 miles) from the east through south, the Santa Cruz Mountains to the south, and the Sunol-Pleasanton ridges from southwest to north. The land to the south is flat until the far side of Vallecitos Valley is reached, whereupon the land is hilly again. Elevation changes on the order of several hundred meters occur rapidly, and there are often several of these within an area of a few square kilometers.

The VNC site consists of 645 hectares (1,594 acres, about 2 1/2 square miles). From the lower southwestern corner of the site the elevation increases from 124 m to about 180 m (406 feet to about 600 feet) above mean sea level (MSL) in the northeast corner. Vallecitos Road (State Highway 84, a two-lane paved highway) forms the southern boundary of the site, with 2.1 km (1.3 miles) frontage. The east and west boundaries run due north, with an extended section in the northwest corner. The majority of the site is leased for grazing. The buildings are located in the southwest portion of the site, a fenced area of about 200 acres to prevent intrusion by cattle. Figure 4.1-3 provides a layout of VNC buildings.

The site is predominantly grassland without areas of dense vegetation or forests. Being an arid area, stream beds are frequently dry. Alameda Creek runs through the site seasonally. Lake Lee, a small man-made surface impoundment, was dry for many years, but has been allowed with NRC concurrence, to collect water since 1981. The arid climate has restricted most of the native and naturalized growth of vegetation in the valley to the creek and ditch channels.

4.2 LAND USE

Land use in the vicinity of VNC is agricultural including orchards, vineyards, and pastures, although grazing is predominant. Highway 84 is used by local commuters traveling east to the Livermore Valley. The state plans to widen Highway 84, but no date or schedule is available at this time. Numerous water projects (reservoirs, aqueducts and irrigation ditches) punctuate the land around VNC because it lies between water supplies (the Coastal Range and the Sierra Nevada) and major population centers (San Francisco, San Jose and Sacramento). Many of these water projects also support local and regional agricultural activities. The Hetch Hetchy aqueduct, a major regional water supply (to San Francisco) passes within 5 km (3.1 miles), south of VNC. The Hetch Hetchy aqueduct also supplies water to VNC. Other local land use includes a bicycle obstacle race course across Route 84 from VNC property which operates on a very restricted basis. The closest airport, Livermore Municipal Airport, is 6.3 miles north-northeast.

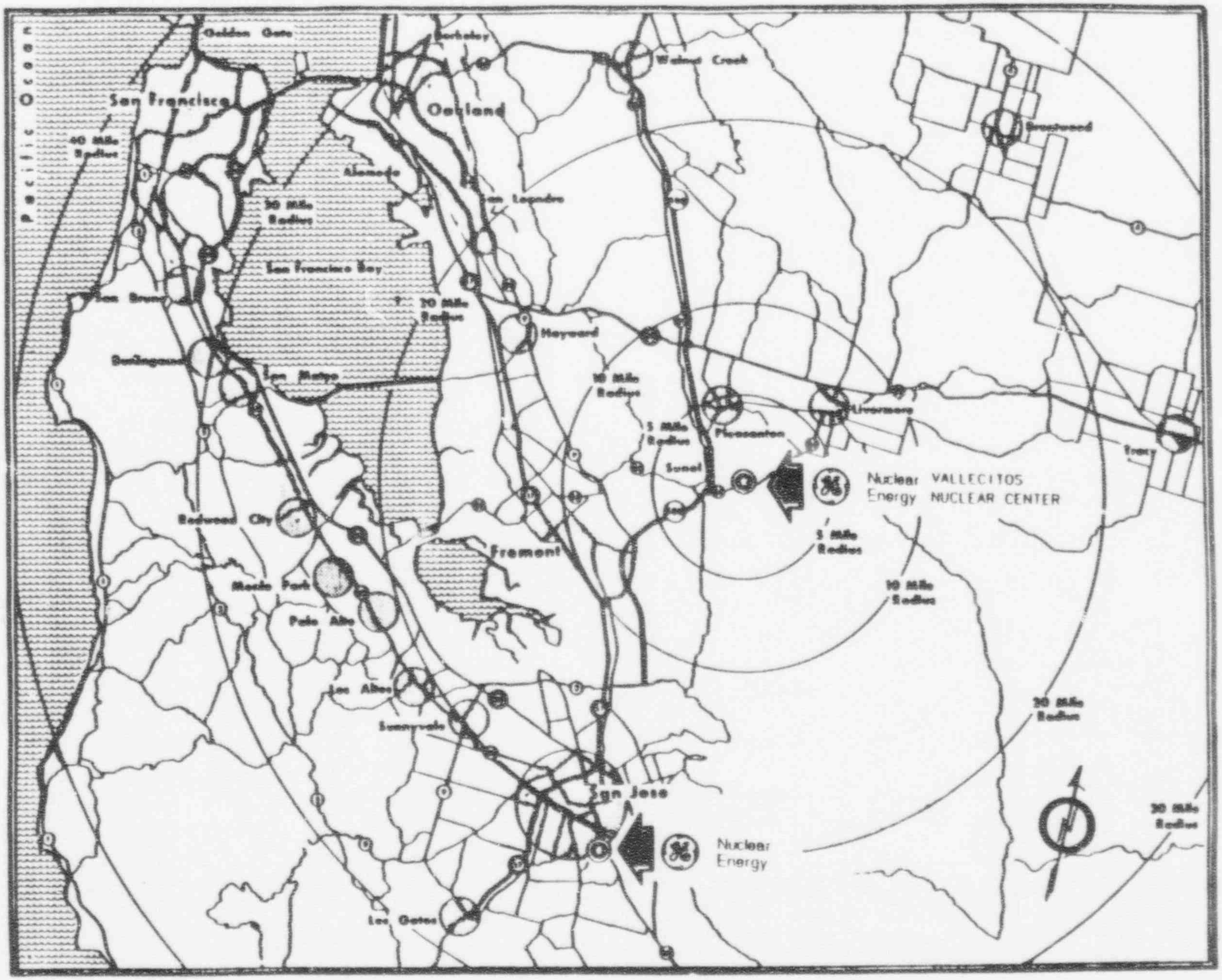
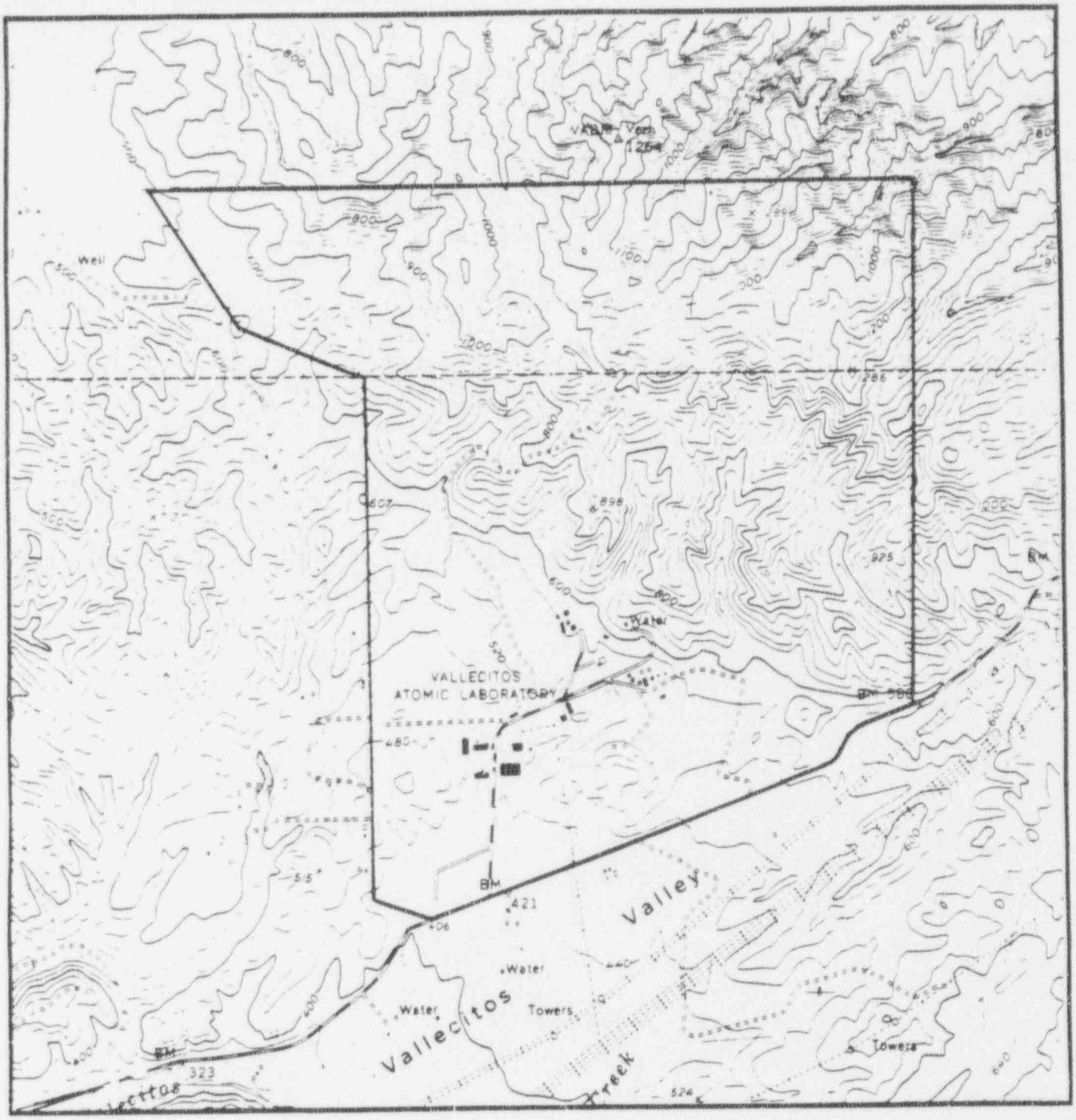
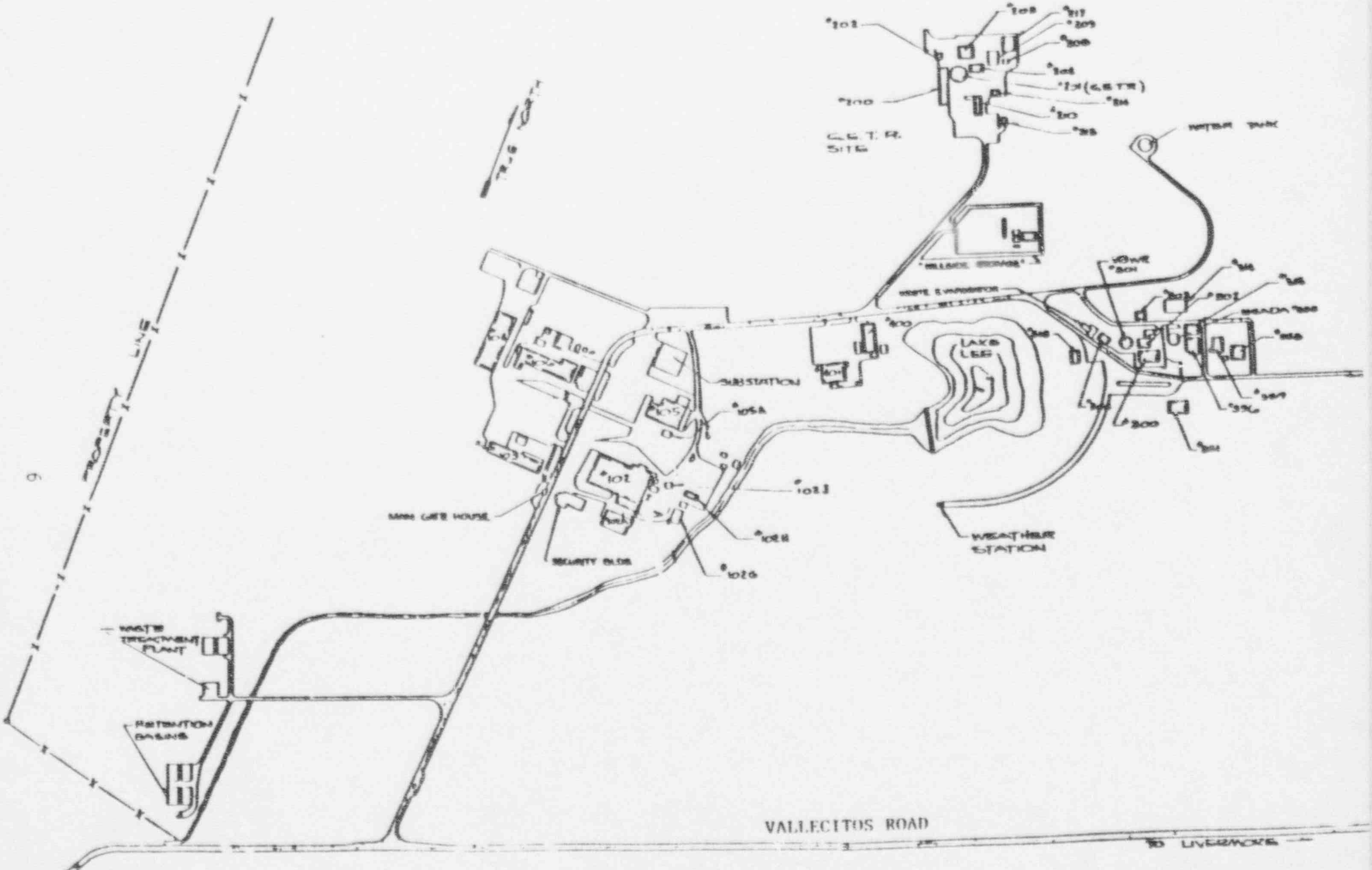


Figure 4.1-1. Relative Location of GE VNC



Scale 1" - 2000'

Figure 4.1-2. Topographic Setting of GE VNC



Scale 1" ~ 500'

Figure 4.1-3. Layout of Buildings at GE VNC

4.3 AQUATIC AND TERRESTRIAL RESOURCES

Wetlands

Wetlands in the immediate vicinity are limited due to stream diversion by upstream dams and reservoirs, and by the severe lack of precipitation in this region. Industrial wastewater released from VNC frequently comprises the only water flowing in the Vallecitos Creek as it crosses VNC property. Downstream of VNC, the creek receives contributions from a turnout from the South Bay Aqueduct.

The average industrial wastewater discharge rate in 1989 during the peak month averaged 2.2 liters/second (l/s), down from 9.3 l/s in 1979. The wastewater discharge consists solely of noncontact cooling water, and is regulated by National Pollutant Discharge Elimination System (NPDES) permit (Permit Number CA0006246), for discharge to a drainage ditch leading to Vallecitos Creek. During dry months this discharge is of insufficient volume to reach the site boundary due to evaporation and percolation.

Lake Lee is an artificial lake fed by a spring on VNC property with abundant cattails along its shores. Noncontact cooling water is occasionally used for Lake Lee level maintenance. This area and the adjacent ditch provide habitat for amphibians (e.g., frogs and salamanders) during a portion of the year.

Water use in the immediate vicinity of the site is agricultural/domestic in nature and supplied by private wells. VNC has no data on the level of use, current or future. Due to increasing demand in the region, most domestic water is now imported while groundwater is still used in some areas to support agriculture.

Aquatic Species

Lake Lee, Vallecitos Creek, Alameda Creek, retention basins, and numerous connecting ditches support a healthy population of cattails. Observations of these marshy-aquatic habitats indicate the presence of the following birds: geese; mud hens; mallards, canvas back, and butterball ducks. The following species of fish have also been reported in Lake Lee: catfish, crappie, and bluegill (all warm water species). These habitats also may be expected to support amphibians (newts, salamanders, frogs, and toads) and a wide variety of aquatic macroinvertebrates[6].

Terrestrial Resources

The majority of the property is leased for grazing, primarily by cattle. The number of cattle varies from 600 to 1200 depending on conditions. Several horses graze on a small southern portion of the site, and auction pens for sheep and cattle are located about 0.8 km (0.5 mile) from the site entrance.

The characteristic plant communities present at the site include grasslands and chaparral in the hills adjacent to the site.

As a result of overgrazing in the past, introduced annual grasses (Brome Grass, Wild Oats, Italian Rye Grass, and Foxtails) have largely replaced native grasses (Needlegrasses, Bluegrasses, California Fescue, and Foxtail Fescue). Nonweedy herbaceous plants with showy flowers include, but are not limited to, the California Poppy and the California Buttercup. In addition to the grasses and forbs, a few trees, such as live oaks may also be found scattered in the hills, canyons, and along intermittent drainages, as may be several hundred species of flowering plants[7].

The replacement of native species due to past land management practices has resulted in a corresponding reduction in the land's capability to support diverse wildlife. However, due to the largely unspoiled nature of much of the land in the surrounding region, much wildlife is still present including mice, shrews, moles, squirrels, kangaroo rats, rats, rabbits, bats, raccoons, snakes, lizards and amphibians, and occasionally larger mammals including deer and cougar. Bird species outnumber mammal species, although many are strictly transitory. Insect species and other invertebrates may be expected in wide diversity and abundance.

<u>Endangered, Threatened, and Rare Species</u>

The VNC vicinity provides potential or actual habitat for four species listed on the Federal or State endangered, threatened, or rare species lists: the San Joaquin Kit Fox, the Southern Bald Eagle, the American Peregrine Falcon, and the Alameda Whipsnake[7,8]

The San Joaquin Kit Fox is listed as endangered on the Federal list and listed as threatened on the California list, and is principally found in native grasslands in the San Joaquin Valley. Although the range of this fox is thought to include portions of Alameda County, the grassland composition in the vicinity of VNC is not indicative of the preferred habitat (i.e., native grasslands which support a large population of kangaroo rats). Therefore, use of this site by this species would be expected to be transitory (at most), or brought about by unusual circumstances (e.g., perhaps after a disaster in a nearby preferred habitat).

The Southern Bald Eagle and the American Peregrine Falcon, both listed as endangered on the State and Federal lists, could make transitory use of the site since it is within the range of these species, but does not support important food and nesting habitats which they require.

The Alameda Whipsnake (formerly known as the Alameda Striped Racer) is listed as threatened by the state of California. It is typically found in vegetative communities dominated by chaparral in the foothills, but is also found in grasslands. It is unknown if the habitat provided by the introduced grasses present at VNC would sustain the Whipsnake. This California threatened species feeds on frogs, lizards, other snakes, small mammals, birds, and probably some insects, and finds shelter among rocks or in a burrow. The Alameda Whipsnake has been found in several locations in Alameda County, though its presence has not been confirmed at VNC.

4.4 SOCIOECONOMICS, AND HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Socioeconomics

The 1991 workforce at VNC consists of 225 people, with no changes currently anticipated. Most of these individuals commute from the nearby communities of Livermore, Pleasanton, and Sunol. The average salaries at VNC have historically been close to double the state-wide average.

Historical and Archaeological Resources

No areas of historic significance lie within the property boundary or adjacent to VNC. The nearest site, the Pleasanton Race Track, built in the 1800s while the area was still under Spanish rule, is 7.2 km (4.5 miles) northwest of the site. VNC has not been investigated or surveyed for sites of archaeologic significance.

4.5 DEMOGRAPHICS

The population density in the vicinity of VNC is low. The nearest residences are adjacent to the fenceline on the south and west boundaries. The area within a one-mile radius of the facility remains sparsely populated at 53 (1990) with less than two dozen homes. Within a two-mile radius, the number only slightly more than doubles, totaling 123 (1990). The two-mile radius reaches the outskirts of Sunol, an unincorporated area with a population of 583[10].

The closest towns and their populations, distances, and directions are:

	1990 Population	Distance	Direction
Sunol	583	4.5 km (2.8 miles)	west-southwest
Pleasanton	50,553	6.6 km (4.1 miles)	north-northwest
Livermore	56,741	9.9 km (6.1 miles)	east-northeast

The Veterans Administration Hospital located 7.6 km (4.7 miles) east-northeast of the site normally has 190 beds with an additional 120-bed nursing home facility. The normal staff is approximately 435.

The Alameda County Planning Commission is currently revising the County Growth Plan for the Livermore-Amador planning area which wholly encompasses the GE VNC. The planning commission does not foresee any changes to the current zoning of the site or the surrounding areas which are now zoned industrial (at the site) and agricultural (at the site and surrounding areas)[11]. Growth in the area is restricted by a limited water supply, by limited sewage treatment capacity, and local topography.

Historical growth in Alameda County and twelve neighboring counties is summarized in Table 4.5-1, from information gathered from U.S. Census data (1980 and 1990), and State of California Demographic Report 91P-1[10,12,13].

4.6 CLIMATOLOGY, METEOROLOGY AND AIR QUALITY

Climatology

The climate of the San Francisco Bay Area, which includes GE VNC, is classified as Mediterranean with warm dry summers and mild rainy winters. The local climate for the Vallecitos area is controlled by the position and strength of a semi-permanent high-pressure center in the northeastern Pacific Ocean, the local topography, and by the proximity of the site to large bodies of water (the Pacific Ocean and San Francisco Bay). In summer, the Pacific high-pressure area controls airflow over the region and prevents rain-producing weather systems from entering the area. Summer weather is typically a succession of clear, cool nights and warm, sunny days, with light to moderate winds and no rain. In winter, the high pressure area weakens and moves to the south and west. This enables storms originating over the Pacific Ocean to enter the area and produce periods of clouds, rain, and occasional strong winds.

Long-term climatological data from the nearby community of Livermore (9.9 km, or 6.1 miles, east-northeast) are considered representative of those at the site. Climatological normals (for 1931-1960) and other climatological data have been extracted from records of the National Weather Service cooperative station at Livermore. Those data show that the normal annual temperature is 15.1 °C (59.1 °F). Temperature extremes, based on more than six decades of data, are 46 °C (115 °F) and -7 °C (19 °F). The average annual precipitation is 36.6 cm (14.41 inches), most of which falls as rain during the winter months. Summers are very dry; only 0.9% of the annual average precipitation falls in June through August. Year-to-year variations of rainfall are quite often very large. For example, annual rainfall from 1952 to 1953 varied from 57.1 cm to 22.2 cm (22.48 to 8.74 inches)[6].

In addition to the Livermore data, GE VNC measures air temperature and rainfall, although it should be noted their equipment is maintained but not calibrated. Only rainfall data are reported. Table 4.6-1 lists annual rainfall at the GE VNC facility for the current five-year period[14].

Meteorology

Onsite wind speed and direction are measured on a well-exposed small hill just east of Building 102 and south of Lake Lee. The wind sensor is mounted 12 m (40 feet) above grade. Based on one year of data (1974) collected onsite, wind direction at the Vallecitos site is predominantly from the southwest, with winds from the south through west occurring 58 percent of the time. The measured annual average wind speed is about 3.4 m/s (7.6 mph). Calms (winds less than 0.4 m/s or 0.9 mph) are reported about 10 percent of the time. Atmospheric dispersion is restricted in this area by a combination of relatively high winds (greater than 1.6 m/s or 3.6 mph) and stable atmosphere conditions[5].

Table 4.5-1. General Electric Vallecitos
Population of Neighboring Counties

County	1980 Census	1990 Census	% Growth 1980 to 1990	2000 Projected	Projected % Growth 1990 to 2000
Alameda	1,105,379	1,279,182	16	1,420,000	11
Contra Costa	656,380	803,732	22	978,200	22
Marin	222,592	230,096	3	243,600	6
Napa	99,199	110,765	12	127,600	15
Sacramento	783,381	1,041,219	33	1,382,200	33
San Francisco	678,974	723,959	7	680,500	-6
San Joaquin	347,342	480,628	38	621,700	29
San Mateo	587,329	649,623	11	712,700	10
Santa Clara	1,300,200	1,502,200	16	1,716,800	14
Santa Cruz	188,141	229,734	22	273,800	19
Solano	235,203	340,421	45	471,900	39
Sonoma	299,681	388,222	30	494,300	27
Stanilaus	265,900	338,700	27	502,300	48

Table 4.6-1. Annual Rainfall at GE VNC

Date	Time Period	Rainfall (inches)
1985-1986	July to July	16.90
1986-1987	July to July	9.20
1987-1988	July to July	6.51
1988-1989	July to July	7.95
1989-1990	July to July	8.90
1990-1991	July to January	2.25

Severe Weather

Severe weather is comparatively rare in the region. Strong winds (greater than 8 m/s or 18 mph) are infrequent, occurring only 2 percent of the time, and mostly from the southwest quadrant. Thunderstorms are reported about 5 days/yr at Livermore. The 100-year return wind is estimated by Fujita at about 24 m/s (54 mph), and the corresponding gust at about 29 m/s (65 mph)[15].

During the years 1950-1975, 29 tornados were reported to have occurred within 230 km (144 miles) of the GE VNC site. The average frequency based on this data is 1.1 tornados per year, irrespective of tornado site or intensity. Because of the proximity of the site to San Francisco Bay and the Pacific Ocean, a radius of increasing distance from the facility encompasses proportionately larger water surface. In recognition of this, the numbers of tornados versus distance from GE VNC have been prorated to show the tornado frequency as if the entire area within any range of the site had no water areas. Based on this assumption and the 1950-1975 tornado data, the estimated probability of any point within a radius of 230 km (144 miles) experiencing any tornado damage is 2.52×10^{-7}/year[6]. The probability of a tornado with wind speeds of about 80 m/s (180 mph) occurring within 161 km (100 miles) of the GE VNC site is estimated at 1.0×10^{-7}/year[15].

Air Quality

The general flow of air from west to east in the region carries pollutants generated in the heavily populated areas around San Francisco Bay to inland areas; air quality standards for oxidants and suspended particulates near the site are frequently exceeded.

Air quality is measured against the National Ambient Air Quality Standards (NAAQS) and standards set by the California Air Resources Board (CARB). The U.S. Environmental Protection Agency (EPA) established the NAAQS primary standards to protect human health and welfare, and secondary standards to protect against damage to the environment and facilities. The pollutants regulated under NAAQS are total suspended particulates. (now defined as inhalable particulate matter with aerodynamic diameter less than 10 microns, ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead. In general, CARB standards are stricter than NAAQS for all of the above listed pollutants except nitrogen oxides. The Bay Area Air Quality Management District (BAAQMD), where the GE Vallecitos facility is located, has been designated as a nonattainment area for ozone and carbon monoxide, by both the CARB (state) standards, and the NAAQS (federal). The state classifies the district as a "severe" non-attainment area for ozone and carbon monoxide, while the federal classification is "moderate" for these pollutants.

4.7 GEOLOGY, HYDROLOGY, SOILS, AND MINERAL RESOURCES

Geology

The structural geology of the area is characterized by a series of northwest-trending folds and fault zones. Most of VNC, including the flatter area (120 to 180 m MSL) with buildings, is in the Vallecitos groundwater subbasin. A small northeastern portion of VNC is in the

Amador groundwater subbasin. Both subbasins are structurally controlled and bounded by faults. Both resulted from movement along these faults or erosion of materials within the fault zones. The Maguire Peaks fault strikes north-northwest just west of VNC, and the Verona fault, passing roughly between the Amador and Vallecitos subbasins, strikes northwest as it passes through the north-eastern hilly portion of VNC[7].

Hydrology

Probable-maximum-precipitation and probable-maximum-flood values were determined for a study in 1981 by the NRC[16]. These results indicate there is no threat to structures from natural floods.

Soils

The Vallecitos Valley floor, on which most VNC buildings are located, is covered by alluvial deposits of recent and pleistocene ages, consisting of sand, clay, and gravel, probably less than 100 m thick. These deposits cover the Livermore gravel formation of plio-pleistocene age, which is exposed in the adjacent uplands. At VNC the iron-rich Livermore gravel consists of rounded clasts of Franciscan debris in a brown buff sandstone matrix. Sand and clay are also present. The Livermore gravel rests with angular unconformity upon Jurassic-Cretaceous marine sandstones, shales, and conglomerate. The continentally derived alluvium and Livermore gravels are water-bearing, but the marine formations are not. In addition to underlying VNC, the marine (nonwater-bearing) formations occur on all sides of the valley[7].

Soils on the flatter alluvial area of VNC are probably partly of the Positas-Perkins soil association. These are gravelly loams and silt loams of shallow-to-moderate depth with good-to-excessive drainage and low-to-moderate fertility. Their agricultural use is limited to grazing, with some grain and hay production. Soils in the hilly portions of the site are probably partly of the Altamont-Diablo soil association. These are moderately deep, fine textured soils of surface clay and very hard subsurface clay. Drainage is poor in valleys and good-to-excessive along slopes. Fertility is moderate-to-high, but agricultural use is limited to dry-farmed grain and grazing because of topography and lack of irrigation water[7].

Mineral Resources

Local geology provides a number of mineral resources. The coalescing alluvial-fan deposits, formed by Arroyo Mocho and Arroyo del Valle between Livermore and Pleasanton, are one of the major sources of sand and gravel for the San Francisco Bay Area. In 1970 the Livermore Valley oil field produced 28,000 m^3. The coal, magnesite, and manganese that have been locally mined in the past are uneconomical to mine at present[7].

4.8 SEISMICITY

A detailed two-part seismic risk analysis was completed in 1980 by the TERA Corporation for the VNC site vicinity[17,18]. Results of these analyses as detailed in "The Effects of Natural Phenomena on the General Electric Company Vallecitos Nuclear Center at Pleasanton, California," are summarized below[6].

The historical seismic record was established after a review of available literature, consultation with operators of local seismic arrays, and examination of appropriate seismic data bases including those of the U.S. Geological Survey, the University of California, and the National Earthquake Information Service. Earthquake occurrence frequency relations, attenuation functions, and specification of local source regions were input to the probabilistic seismic risk assessment. Results are expressed in probabilistic terms, that is, force or offset versus likelihood of occurrence.

The results of the analysis indicate that the Vallecitos facility will experience 0.3 g every 130 years and 0.6 g every 700 years from earthquakes on the Calaveras, Hayward, or San Andreas Faults and from smaller unassociated earthquakes that could not be attributed to these specific faults. The study further analyzed two types of loads imparted by the postulated existence of a capable Verona Fault: vibratory loads, and rupture-displacement loads. Because historic data descriptive of the seismicity of the sources are incomplete, inaccurate, and of short time span, the analysis was based on geological, as well as seismological data to increase the reliability and predictability of the seismicity. The results of the analysis show the occurrence of peak accelerations exceeding 0.3 g and 0.6 g may be associated with return periods of 2,000 and 60,000 years, respectively[9].

4.9 BACKGROUND RADIATION

Ambient levels of radiation in the VNC environs are typical of those encountered in the general geographic region. Natural sources of external radiation consist primarily of cosmic rays and terrestrial sources. External radiation levels from these natural sources, as measured by environmental thermoluminescent dosimeters (TLDs) in the VNC environs, average 70 to 75 mrem/yr. Ambient radiation levels and radionuclide concentrations in environmental media are monitored as part of the GE VNC environmental surveillance program. A description of this program, including background monitoring results, is provided in Section 5.3.

Additional sources of radiological exposure consist of radionuclides occurring present in the human body (primarily K-40); naturally occurring radionuclides which are inhaled (primarily radon daughters); and radionuclides which are formed by the interaction of cosmic rays with matter in the upper atmosphere (primarily C-14). Radionuclides in the body result in an average effective dose equivalent of about 40 millirem/year (mrem/yr), while cosmogenic radionuclides contribute about 1 mrem/yr. Radon daughter exposures are highly variable, with average dose rates of about 1.7 rem/yr delivered to the bronchial epithelium, which is equivalent to an effective dose to the body of about 200 mrem/yr. The average individual dose commitment in the U.S. from all sources of radiation, including medical exposures, is estimated to be about 360 mrem/yr[10].

5.0 DESCRIPTION OF GENERAL ELECTRIC COMPANY VALLECITOS NUCLEAR CENTER

5.1 DESCRIPTION OF THE CURRENT OPERATION

GE VNC is operated in conjunction with the operation of a 100-kW research reactor for the development and examination of reactor fuels, and to provide nuclear products and services. For the purpose of this description, current site operations are categorized into principal SNM operations and other site operations. Principal SNM operations are those operations involving potentially frequent or significant use or handling of SNM. Accordingly, other site operations involve use or handling of SNM to a much lesser extent. The SNM-960 license, however, permits the use of SNM throughout the site, provided the appropriate evaluations and precautions are performed and enforced through the GE VNC change authorization procedure.

5.1.1 Principal SNM Operations

Principal SNM operations are conducted in: Building 102, which houses the Radioactive Materials Laboratory (RML) and the Radiochemistry Laboratory (RL); Building 103, which houses the Chemistry, Metallurgy, and Ceramics Laboratory (CMCL); and at the Solid Radioactive Waste Facility, also referred to as Hillside Storage. Irradiated fuel specimen examinations and associated fission product handling are performed in shielded facilities (hot cells) of the RML on the main floor of Building 102. Hillside Storage is used for temporary storage of SNM waste and other radioactive wastes.

Building 102

Building 102 consists of a main floor and a basement, housing administrative offices and the RML. The RML consists of nine hot cells, the RL, a pool facility, and an in-floor dry storage pit. RML operations include hot cell and storage operations supporting the examination of irradiated reactor fuel specimens and irradiated hardware, radioisotope production, and equipment maintenance. SNM is handled during the examination of irradiated reactor fuel specimens in the hot cells, during analysis of samples of irradiated fuel in the RL, and during storage operations conducted in the pool facility. The in-floor dry storage pit is available for temporary storage of irradiated fuel assemblies, rods, or other rod-shaped materials.

Hot cells 1, 2, 3, and 4 are the main cells used to handle SNM. These are high-level cells designed to safely contain in excess of 1 million curies of 1 MeV gamma. Cell walls are 36 inches thick with a 24-inch thick ceiling and are made of high density concrete. The cell configuration includes a 36-inch thick lead glass viewing window, remote manipulators and periscopes. Each of these high-level cells has a 6-foot long radiation lock to provide safe entry of materials and exit of wastes. The radiation locks are formed by hydraulically operated bi-parting steel shielding interlocking doors. The outer door is 18 inches thick, and the inner door is 15 inches thick. The floor is also equipped with a radiation lock to accommodate very large casks and permit long irradiated assemblies to be withdrawn, opening into a 3.5-foot diameter by 9-foot deep pit. An inter-cell transfer system is provided in the common wall between each pair of cells.

A smaller hot cell, Cell 5, is used for metallographic work that may include SNM. Operations in this cell include preparation of samples for metallographic examination and micro-hardness testing. It contains remotely operated equipment for sample mounting, polishing, cleaning, and etching, and a remotely operated micro-hardness tester. The cell walls are 18-inch thick high density concrete. The front wall contains two 18-inch by 13-inch lead glass windows for direct observations of the working area. The back of the cell opens onto the access corridor, through a heavy metal door (much like that of a safe), for equipment and personnel access. Metallographic or micro-hardness test samples are introduced through this entry port by means of a special transfer cask.

Water is piped to hot cells 1, 3 and 5 by an independent supply system. A 25-gallon vented storage tank, located on top of Cell 1, is filled by a water line not directly connected to the tank. This tank feeds an adjacent 42-gallon pressure tank through a connecting check-valved pump line, which in turn supplies pressurized water to a process water header with branches to each hot cell. This independent system provides positive assurance against feedback of cell water to the potable water system, as well as preventing large quantities of water (in excess of 42 gallons) to enter the cells in the event of piping failure. This system currently serves only cells 1, 3 and 5, but can be expanded to serve cells 2 and 4.

The RL, located immediately adjacent to the RML operating area, is used principally for the analysis of samples of irradiated fuel and other irradiated materials from the RML.

The pool facility is a 16-foot by 8-foot by 16-foot deep water pool lined with stainless steel, designed for underwater cask transfer, visual irradiated fuel examination, and storage of irradiated materials. The pool is equipped with the necessary underwater portable tools and lights to properly service casks and their contents. An overhead crane is available to handle casks in the pool or on the room floor. A filtered exhaust port is located adjacent to the pool. The pool water is circulated at a rate of approximately 30-gallons per minute through a strainer and a tank containing 6 cubic feet of nuclear grade ion exchange resin that maintains the quality of the water. Spent resin is removed as necessary to waste drums for proper disposal.

The in-floor dry storage pit is used for temporary storage of irradiated fuel segments and consists of 19 recessed tubes arranged to provide a minimum center to center spacing of 18-inches. The pit rests on a ledge cast in the concrete floor so that the top surface is flush with the floor, with the tubes extending downward below the floor surface. Tubes are fabricated of 6-inch schedule 40 steel pipe, 46.5 inches long, attached to two horizontal circular steel plates.

Building 103
The CMCL, Building 103, is a two-story building with a partial basement located across an access road from Building 102. Operations requiring the handling of SNM include those laboratory activities supporting RML and RL analytical requirements, equipment calibration, preparation of standards and sources necessary for research and development programs, and storage.

Chemistry laboratory operations on the first floor are those of typical chemistry laboratories and require the use of electron microscopes, typical lab chemicals, x-ray equipment, microscopes, machine shop equipment, ultrasonic equipment, electrochemical equipment, mounting presses, gas purification trains, hoods, and other experimental equipment. The second floor laboratory operations are also those of typical chemistry laboratories and, in addition, include a counting and an instrument room. Equipment utilized includes spectrophotometers, fluorimeters, gas chromatographs, a plasma emission spectrometer, lead caves, glove boxes, vacuum systems, hoods, counting instrumentation, and mass spectrometers.

A concrete storage vault on the first floor is used for the temporary storage of SNM and other radioactive materials. The vault wall and ceiling are made of concrete with a minimum thickness of 8 inches, without penetrations, and a single locked door.

Hillside Storage
Hillside Storage is used for the temporary storage of irradiated fuel specimens and solid radioactive waste materials. It consists of a bunker with horizontal tubes and a covered facility. Irradiated fuel specimens and waste materials that include significant quantities of SNM are placed in waste liners and inserted into the tubes. The covered facility is used to store lower level waste, including waste containing SNM, that have been placed in 55-gallon drums and boxes.

5.1.2 Other Site Operations

Other site operations are conducted in Buildings 104, 105 and 106, and in Areas 200, 300 and 400.

Building 104
Building 104 is used for warehousing operations.

Building 105
The Nuclear Test Reactor (NTR), Advanced Nuclear Applications (ANA), and offices for NTR and ANA support personnel are the principal operations housed in Building 105. The NTR is a 100-kW reactor used primarily for neutron radiography and the ANA is used primarily in support of outside contract work.

SNM, in the form of commercially-available sealed sources used for instrument calibration, is handled in the building. Due to the relative insignificance of that activity, Building 105 is not considered a location of principal SNM operation.

Building 106
Building 106 houses general shop operations including machine, welding, sheet metal, carpenter, and instrumentation shops. SNM is not normally handled in shop operations.

200 Area
The 200 Area includes a domed containment building and a cooling tower for the General Electric Test Reactor (GETR) and several buildings for the support of GETR operations. There are currently no operations of significance in the 200 Area as the GETR was shutdown in 1977 and will not be reactivated.

300 Area
The 300 Area consists of a radiochemistry training laboratory, the Radioactive Liquid Waste Evaporator Plant (or Waste Evaporator Plant (WEP), in Building 349), the VBWR (shutdown since 1963), and the Empire State Atomic Development Vallecitos Experimental Superheat Reactor (EVESR, shutdown since 1967), and several buildings for the support of VBWR and EVESR. The VBWR and EVESR are permanently shutdown and the buildings intended for operational support of these reactors are not being used.

For a discussion of the Waste Evaporator Plant refer to "Radiological Waste Management" in Section 5.4.2 of this document.

400 Area
The 400 area consists of Buildings 400 and 401. Building 400 is currently closed down. Building 401 houses general laboratories, which do not handle radioactive materials, and administrative offices.

5.2 CONFINEMENT SYSTEMS

General Design Considerations
The design of facilities includes primary and secondary barriers of confinement to prevent the spread and release of contamination throughout the facilities as well as to the environment. Primary barriers of confinement are process equipment and ventilation systems, hoods and glove boxes. Exhaust from hoods and glove boxes is passed through at least two stages of high efficiency particulate air (HEPA) filters before release to the atmosphere. A HEPA filter is also installed at the inlet of glove boxes. Secondary barriers providing confinement are rooms, buildings, and building ventilation systems. The exterior walls are of concrete or cinder-block construction and the roofs are of flat decking covered with rigid insulation and built-up roofing with a top coating of gravel.

VNC ventilation system design practices require that all SNM process enclosures include a HEPA filter at their exhaust. Also, additional final filtration of a minimum of one stage of HEPA filters must be provided. Exhaust from hoods or glove boxes where alpha emitting particulates are handled requires three stages of HEPA filtration before exhaust to the atmosphere. All ventilation exhaust HEPA filters at VNC are dioctyl sebacate (DOS) testable and must pass routine DOS tests of 99.97% efficiency for a single filter and 99.95% for an installed filter bank. Furthermore, the filters are constructed of fire-resistant materials and are housed in noncombustible duct work.

The ventilation systems are designed to provide air flow from areas of low potential for contamination to those of higher potential. This is accommodated with a system balanced to maintain negative pressure differentials, isolating clean areas from potentially and progressively more contaminated areas. Accordingly, relatively small negative pressure differentials are maintained for the isolation of general work areas (approximately 0.01 to 0.03 inch of water), moderate pressure differentials are maintained to isolate areas such as hot cell areas (approximately 0.02 to 0.20 inch of water), and maximum pressure differentials are used at glove boxes (approximately 0.5 to 1.0 inch of water). To enhance contamination control, back flow preventers are also used.

Buildings 102, 103, and Hillside Storage are the principal locations of operations using SNM. At GE VNC, ventilation systems, in concert with glove boxes and hoods, are an integral part of confinement for SNM operations. Therefore, the ventilation systems, for Building 102 and 103, will be addressed separately below. Hillside Storage, an out-of-doors area, does not utilize a ventilation system where SNM is stored and handled.

Building 102

Inlet air to Building 102 is provided by air conditioning units, supplying air at a rate of 6 to 40 changes per hour, with an integrated capacity of 65,000 cubic feet per minute. In a push-pull mode, air flow is directed from areas of low potential for contamination to those of higher potential. Air flow is once-through, with the exception of air to the RML operating gallery where a fraction is recirculated through HEPA filters for reuse. Exhaust air from RML hot cell operations exhausts through two parallel HEPA filters at each cell, then through an intermediate stage of 10 HEPA filters in series with two parallel, activated charcoal beds, before release through the final exhaust system, that serves all operations in Building 102. Currently, as there are no operations involving the use or release of iodine, the charcoal beds are bypassed. Two booster fans are available, as required, to transfer air out of hot cells. The final exhaust system is in an annex, Building 102A, and consists of three parallel banks of 30 HEPA filters (90 total), six exhaust fans, and a 66-inch diameter 75-foot stack. Two of the six exhaust fans are used to provide normal exhaust flow with the other fans in standby.

Fire protection is provided to the exhaust system by: (1) a carbon dioxide (CO2) fire suppression system and a water fog fire suppression system for the hot cell basement exhaust filter bank; (2) a water spray fire suppression system for the hot cell charcoal filters; and (3) a water fog spray for the main exhaust ducting from Building 102. None of the water fire suppression systems can discharge into hot cells, glove boxes, etc. containing SNM.

In the event of loss of utility power, emergency power is provided by a 335-kW diesel-driven electric generator. The generator is activated automatically upon power loss and is designed to reach full capacity within one minute, serving all critical equipment normally supplied with power through the main building switchboard. This equipment includes two exhaust fans, fans supplying air to areas where radioactive materials are handled, and the main stack monitoring equipment. The generator is supplied with fuel from a 1,000-gallon storage tank and is sufficient for at least 40 hours of continuous, full-load operation.

Building alarm panel and exhaust fans are supplied with normal power through a Motor Control Center (MCC). The solid-state logic portion of the MCC is a solid-state, battery-powered computer that provides for automatic switching of equipment during transitions between normal and emergency conditions. During normal and emergency power operations, it performs the following functions automatically:

- o If one of the operation fans should fail, it will provide an audible and visual alarm; identify and shut down the failed fan; and start a standby fan. The control panel will indicate which fan has failed.
- o In case a fire is identified by a detector in the exhaust ducting, the computer operates the exhaust system on reduced flow until the "fire" condition is cleared manually.

Building 103

Inlet air to Building 103 is provided by air conditioning units at a rate from 9 to 12 changes per hour, and again, air flow is directed from areas of low potential for contamination to those of higher potential. Air flow is once-through passing from office areas through fiberglass filters in laboratory door grills. Three glove boxes, located in Building 103, are no longer used, but remain a part of the ventilation system. SNM was handled in these glove boxes in the past, however, they are currently not in use and there are no plans for their future use. In the laboratory, air is drawn through hoods and glove boxes, with HEPA filters at each glove box air intake. Exhaust from hoods and glove boxes is directed to one or two parallel banks of 40 HEPA filters and discharged through a five-foot diameter, 48-foot high stack.

As in Building 102, glove boxes are maintained at a negative pressure differential of approximately 0.5 inch of water with respect to the room. Negative pressure differentials are maintained between office areas and laboratories with no specific value or setting having been identified. Ventilation system failure results in actuation of an automatic evacuation alarm, although there is no emergency power supply.

5.3 EFFLUENT MONITORING AND ENVIRONMENTAL SURVEILLANCE PROGRAMS

The monitoring programs at GE VNC include programs for radiological effluent monitoring, environmental surveillance, and non-radiological monitoring and sampling. These are described below.

5.3.1 Radiological Effluent Monitoring Programs

VNC generates airborne and liquid effluent waste streams which may contain quantities of radioactive materials. The VNC radiological monitoring program has been developed to monitor or sample those pathways of concern to ensure that compliance with regulatory limits on release concentrations is achieved, and that all releases are maintained at levels which are as low as reasonably achievable (ALARA). Federal regulatory limits on annual average concentration of effluents at the site boundary are listed in Table 5.3-1.

For each release point, VNC has established administrative radioisotope concentration limits, which represent suitably conservative fractions of the maximum permissible annual average concentrations allowed by 10 CFR Part 20 for releases to unrestricted (offsite) areas. If an administrative control limit is exceeded, corrective action is initiated to reduce the effluent concentration at the point of release.

Site data acquired during effluent monitoring and environmental surveillance sampling was reported annually to NRC[20,21,22,23,24]. The monitoring program and program results are discussed below. Several of the standard methods used by VNC for data collection and assimilation should be noted, as they contribute a positive bias to the results, tending to overestimate actual concentrations or their effects.

- o Radiation monitoring data as reported by VNC does not generally distinguish between the actual contribution from activities under License SNM-960, and effects from other licensed operations at VNC. For purposes of this EA, it is conservatively assumed that all consequences are the result of activities under SNM-960.

- o Airborne and liquid effluent release data are often reported as monthly or annual averages, but these averages are developed by compiling results of measurements taken over shorter intervals. These averages are in fact based on multiple summations of effluent stream measurement results, many of which were found to be less than standard instrumentation detection limits, but which were conservatively recorded as being equal to the detection limit.

- o With a few noted exceptions, VNC follows a standard practice of monitoring and sampling radioisotopes which are grouped according to their types of emissions. For purposes of assessment, all of the detected activity is conservatively assumed

Table 5.3-1. Annual Average Effluent Concentration Limits in pCi/l[1,2] Specified by Current and Revised 10CFR20

	Isotope	Airborne	Water	Releases to Sewers[3] (monthly avg)
Current Requirements (10CFR20.303 and Appendix B to 10CFR20)	Pu-239	6 E-05	5 E+03	1 E+05
	Sr-90	3 E-02	3 E+02	1 E+04
	Kr-88	20	---	---
	H-3	200	3 E+06	1 E+05
	I-131	1 E-01	100	6 E+04
Revised Requirements (Appendix B to 10CFR20.1001-2401)	Pu-239	2 E-05	20	200
	Sr-90	6 E-03	500	5 E+03
	Kr-88	9	---	---
	H-3	30	6 E+05	6 E+06
	I-131	2 E-01	1 E+03	1 E+04

1. Most restrictive solubility or inhalation class
2. 1 pCi/l = 1 x 10^{-9} μCi/ml
3. Soluble forms only; included only for comparison.

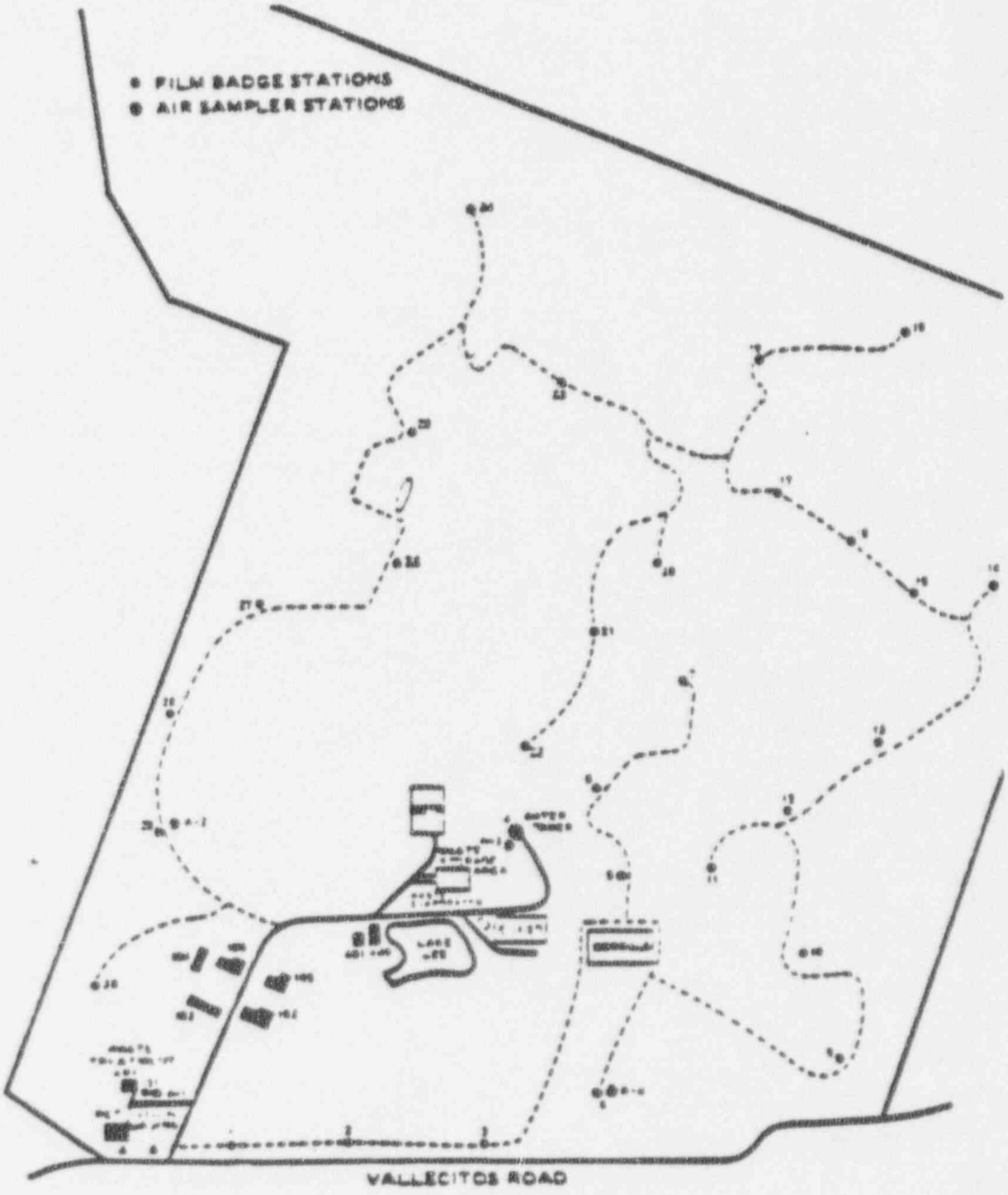


Figure 5.3-1. Environmental Air Stations and TLD Locations

to be comprised of the worst-case, or most limiting radionuclide of that emission type present at VNC. Alpha emissions detected from particulate samples are assumed to originate from Pu-239. Similarly, gross beta-gamma particulate emissions are assumed to result from Sr-90; noble gases are assumed to consist of Kr-88; and iodine isotopes are assumed to consist of I-131.

The VNC radiological monitoring program is summarized in Table 5.3-2. In addition, VNC maintains an analytical counting room at the site for sample analysis, and supplements this capability with offsite vendor support when required. Table 5.3-3 summarizes the lower limits of detection under normal configurations and counting times for radioactive sample analyses performed in the analytical counting room. Both airborne and liquid effluent release data are obtained by summing results obtained from measurement of short-interval releases. Included in tables provided in this section are the multiple summations of many measurements which were found to be less than standard instrumentation detection limits, but were conservatively recorded as equal to the detection limit.

5.3.1.1 Liquid Effluent Monitoring

As discussed in Section 5.2, liquid waste streams are managed to preclude radioactive contamination under normal operating conditions. Monitoring is conducted on the industrial wastewater stream (noncontact cooling water) to confirm the absence of significant levels of radioactivity. Both VNC's operating procedures and the facility's NPDES Permit require confirmatory sampling prior to any release from the retention basins. Prior to the discharge of this stream, grab samples are collected and analyzed for gross alpha and gross beta-gamma radioactivity to verify that radioactivity concentrations do not exceed limits specified by Appendix B of 10 CFR Part 20[25]. All discharge samples for the week are accumulated as a weekly composite and analyzed for I-131. Monthly basin composites are analyzed for gross alpha and gross beta-gamma concentrations, and quarterly composites are analyzed for H-3, Cs-137, and Co-60. The effectiveness of effluent controls is illustrated by the fact that the measured radioactivity concentrations of liquid (aqueous) releases from VNC do not exhibit a statistically significant difference when compared to influent samples from the San Francisco water supply system (Table 5.3-4)[26].

In addition to the industrial wastewater stream at the retention basins, monitoring is also conducted on the sanitary wastewater stream at the retention basin. Grab samples are collected and analyzed for gross alpha and gross beta-gamma radioactivity to verify that radioactivity concentrations do not exceed limits specified by Appendix B of 10 CFR Part 20. Similarly, grab samples would be taken if noncontact cooling water were to be used for irrigation purposes (i.e., bypassing the retention basin).

Potentially contaminated liquids are routed to VNC's Radioactive Liquid Waste Evaporator Plant, (Building 349) and processed as described in Section 5.4.2 of this document. Post-processing condensate from the evaporator is sampled and analyzed for detectable (in excess of 10 CFR Part 20 Appendix B Table II, Column II) concentrations of radioactivity. If

Table 5.3-2 Summary of Current VNC Radiological Monitoring Program

Sampling Medium	Number of Stations	Collection Frequency	Sample Type	Type of Analysis
Gaseous Releases	7	Weekly	Continuous	Gross α, Gross Beta-gamma
Incoming Water	1	Monthly	Grab	Gross α, Gross Beta-gamma
Waste Water (Retention Basins)	3	Prior to each Release, then:	Grab	Gross α, Gross Beta-gamma
		Monthly	Composite	Gross α, Gross Beta-gamma
		Quarterly	Composite	H-3, Cs-137, Co-60

Table 5.3-3. Sampling Program Detection Limits

Type of Sample	**Instrument**	**Detection Limit**
Air and Exhaust Stack Samples	Alpha Proportional Beta Proportional	3E-15 μCi/cc 7E-15 μCi/cc
Charcoal Cartridges (for Iodine isotopes)	NaI(tl) Scintillation	2E-13 μCi/cc
Surface Contamination Smear Samples	Alpha Proportional Beta Proportional	7E-08 μCi/cc 3E-06 μCi/cc
Water (Retention Basin)	Alpha Proportional Beta Proportional	3E-08 μCi/cc 3E-08 μCi/cc

Table 5.3-4. Average Annual Radioactivity Concentrations in Effluent/Influent Waters (pCi/liter)

Receiving Waters (Fresh Water Influent)				Industrial Wastewater Effluent		
	Alpha	Beta-Gamma	H-3	Alpha	Beta-Gamma	H-3
1983	0.48	4.56	253	< 30	< 50	< 1600
1984	0.98	6.83	281	0.67	3.59	< 640
1985	0.69	2.34	245	0.62	3.50	83
1986	0.68	2.95	352	0.72	5.12	33
1987	1.22	3.23	232	0.49	3.13	79
1988	0.613	1.40	NR*	0.35	1.56	24
1989	0.607	1.36	NR	0.58	1.28	33
1990	0.396	0.785	NR	0.76	1.14	32

*NR = not reported

Table 5.3-5. Airborne Effluent Radiological Monitoring Program Results

Average Annual Airborne Radioactive Effluents for the Period 1986 - 1990					
	1986	1987	1988	1989	1990
Alpha Particulates	2.31 μCi	2.01 μCi	2.07 μCi	3.09 μCi	3.27 μCi
Beta-Gamma Particulates	37.2 μCi	22.5 μCi	26.6 μCi	18.1 μCi	15.8 μCi
Iodine-131	200 μCi	200 μCi	170 μCi	182 μCi	188 μCi
Noble Gases	561 μCi	478 μCi	530 μCi	689 μCi	526 μCi

approved, the condensate is vaporized and emitted as steam through a continuously sampled stack. Offsite consequences of this emission pathway are included in the assessment of airborne releases (Section 6.2.1.2).

5.3.1.2 Airborne Effluent (Stack) Monitoring

Operations with potential to generate airborne radioactive contaminants are conducted within a confined, ventilated structure with exhausts routed to a filtered and monitored/sampled stack. The number of stacks actually monitored or sampled in a given year will vary, dependent upon usage of the facilities. In 1990, 7 stacks were sampled or monitored for radioactive emissions: 102, Remote Handling Operation; 105, NTR; GETR; Building 103; WEP; Hillside Storage Facility; and Building 300, Training Laboratories. All of these stacks were continuously sampled for alpha particulates, beta-gamma particulates, and iodine. Additionally, Stack 102A is continuously monitored for noble gas and beta-gamma particulate emissions. A summary of annual average emissions as measured by the airborne radioactive effluent monitoring program are provided in Table 5.3-5.

5.3.2 Environmental Surveillance Program

VNC has maintained an environmental surveillance program since 1956 in order to (a) determine the impact, if any, of site operations on radiation levels in the environment surrounding the facility, and (b) verify the effectiveness of its radiation control and release point monitoring programs. The program includes routine collection and analysis of water, vegetation, soil, stream bottom, and air samples from strategic onsite and offsite locations. The GE VNC environmental surveillance program is summarized in Table 5.3-6.

In September, 1979, GE published a statistical evaluation of the VNC Environmental Sampling (Surveillance) Program[27]. That report updated previous evaluations and concluded that the results obtained by the sampling program through 1979 reflected the natural radiation background of the site environs (see Table 5.3-7). Statistical methods, based upon a moving 6-year average of sample data, were applied to identify levels of significance for a given sample or medium. Action level criteria (see Table 5.3-8) were developed based upon upper tolerance limits. These action levels are measurement results, which if detected indicate that further investigation of impacts is warranted for the sample or medium in question.

In order to assess whether more recent VNC operations may have caused cumulative impacts on the surrounding environment, recent surveillance data for the period 1986 to 1990 was reviewed for comparison with 1979 baseline concentrations and action levels. During that time, radioactive concentrations in the environment have remained well below background statistical levels and action levels, as calculated from 1973 through 1979 surveillance data.

Table 5.3-6 Summary of GE VNC Environmental Surveillance Program

Sampling Medium	Radioactive Analyses	Frequency	Sample Designator	Location
Ground Water	H-3, gross alpha, gross beta-gamma	Quarterly	G-2N1 G-10A1 G-10H1 G-10P3	Well SE of Bldg. 105 Well SSW of Bldg. 102 Well S of site entrance Well 0.6 mi SW of site entrance
Stream Bottom Sediments	Cs-137, Co-60, gross alpha, gross beta-gamma	Annually	S-4 S-6	Outfall of retention basins, south boundary Vallecitos Creek, 0.6 mi W of site
Vegetation	Cs-137, Co-60, gross alpha, gross beta-gamma	Annually	V-2 VAL-1V	Easternmost stream crossing, south side boundary West of site boundary
Environmental Air Samples	gross alpha, gross beta-gamma	Continuous, changed monthly	——	Peripheral to operating facilities
Environmental Gamma Perimeter TLDs	gamma	Continuous, changed annually (TLD #4, quarterly)	——	31 stations in 16 sectors at perimeter of facility. (See Figure 5.3-1.)

Table 5.3-7. Background Statistical Levels for VNC, 1973 - 1979

Sample Source	Alpha	Beta-Gamma
Surface Water (pCi/l)	10 ± 0	37.964 ± 3.395
Ground Water (pCi/l)	10.0064 ± 0.0069	30 ± 0
Soil (pCi/g)	13.90 ± 0.32	17.39 ± 1.03
Stream Bottom (pci/g)	12.44 ± 0.17	19.70 ± 0.34
Vegetation (pCi/g)	13.43 ± 0.04	357.63 ± 6.64
Marine Flora (pCi/g)	14.53 ± 0.59	366.8 ± 51.8
Air ($\mu Ci/cm^3$)	$4.28 \pm 0.09 \times 10^{-15}$	$7.20 \pm 0.84 \times 10^{-13}$

Source: Mohr 1979[27].

Table 5.3-8. VNC Environmental Sampling Action Levels

Sample Source	Alpha	Beta-Gamma
Surface Water (pCi/l)	30.0	90.0
Ground Water (pCi/l)	30.0	90.0
Soil (pCi/g)	39.0	39.0
Stream Bottom (pci/g)	39.0	39.0
Vegetation (pCi/g)	39.0	371.26
Marine Flora (pCi/g)	39.0	571.18
Air ($\mu Ci/cm^3$)	4.47 ± 10^{-15}	8.98×10^{-13}

Source: Mohr 1979[27].

5.3.3 Nonradiological Monitoring and Sampling Programs

Nonradiological effluents from current GE VNC operations include airborne emissions from building exhaust stacks, a gasoline pump, a spent photochemical storage tank and a solvent cleaning facility; and liquid discharges including industrial wastewater and sanitary wastewater, as well as clean water discharges. Emissions from stacks are not monitored for nonradiological pollutants. GE VNC is exempt from continuous emissions monitoring under Regulation 1, Section 520 of the Rules and Regulations by the BAAQMD[28]. Industrial wastewater releases from GE VNC are monitored in accordance with the California Regional Water Quality Control Board (CRWQCB) Order 90-0058 and NPDES Permit[29]. Prior to discharge, water is sampled from each basin and tested for acceptable pH and radioactivity levels. Aliquots from all basin discharges are composited and analyzed for chlorides, chromium, lead, mercury, zinc, nickel, silver, and total dissolved solids. In addition, at specific intervals, grab sampling is performed for dissolved copper, dissolved oxygen, turbidity, oil and grease, fish toxicity, and temperature. All sanitary wastes are routed to an Imhoff tank; and, after undergoing sand filtration, chlorination, and pH adjustments, are land disposed onsite by irrigation. The NPDES permit requires no analysis for sanitary waste sprinkled onsite and establishes no requirements for sampling or analysis. VNC does, however, sample and analyze for pH, radioactivity, and coliform bacteria. Waste management is further described in Section 5.4.

Nonradioactive solid wastes are routinely screened for possible radioactive contamination by direct frisk with portable detection instruments before release for shipment to sanitary landfills. If radioactivity is detected, then the waste is treated as radioactive solid or liquid waste and processed and controlled as described in Section 5.4 of this document.

5.4 HAZARDOUS MATERIALS MANAGEMENT PROGRAM

VNC has prepared the following programs/plans for the handling of hazardous materials and management of waste streams:

- Best Management Practice Plan
- Site Emergency Procedures
- Hazardous Materials Business Plan
- Waste Minimization Plan
- Hazardous Chemicals Training Program
- Contingency Plan for Liquid Hazardous Materials
- Hazardous Waste Emergency Procedure
- Procedure for Control of Chemical or Oil Spills

The VNC policy against the discharge of solvents and chemicals down drains is accomplished through procedures, instruction of employees, and the use of warning signs on sinks[26].

5.4.1 Hazardous Chemical Storage

Hazardous chemicals are used at VNC mostly on a laboratory scale, with the following exceptions: petroleum products (e.g., oils and gasoline), chemicals used for wastewater pH adjustment (hydrochloric acid and sodium hydroxide), and photochemicals. The water treatment chemicals are stored in two 250-gallon polyethylene tanks in a covered fenced area. The gasoline is stored in a 1,000-gallon bermed tank. Diesel fuels are stored in four bermed tanks or in 55-gallon drums[30].

5.4.2 Waste Management

GE VNC has programs in-place to manage the various wastes generated by activities at the site. These program are under the jurisdiction of various agencies including NRC, Cal-EPA, State of California Department of Health Services, CRWOCB, and the BAAQMD.

Wastes Regulated under the Resource Conservation and Recovery Act
GE has filed a Notification of Hazardous Waste Activity for the VNC site with EPA in accordance with Resource Conservation and Recovery Act (RCRA) requirements. Hazardous wastes are accumulated in 55-gallon drums and stored in a fenced area. The storage area is constructed of concrete. The drums sit on a grated floor with sumps below. The storage capacity is 20 drums (approximately 150 cubic feet); the sump capacity is 180 cubic feet. Some equipment containing PCBs is located at VNC. All such equipment is stored or located in areas meeting EPA standards. Photochemicals are collected in a 1,200-gallon polyethylene double-walled storage tank adjacent to the darkroom facility (GE 1990)[30]. These are transported by EPA-registered shippers to appropriate disposal facilities.

In California, the RCRA program is administered by Cal-EPA, formally the Department of Health Services. This agency has inspected the VNC facility and recently issued penalties for 15 violations including improper management of incompatible hazardous waste, failure to inspect containers of mixed wastes (low-level radioactive waste and hazardous wastes), failure to provide decontamination equipment, labeling deficiencies for hazardous waste and mixed waste, storage without a permit, and contingency plan and training deficiencies (California Environment Insider 1991)[31]. These penalties are for actions which are administrative in nature and do not involve the uncontrolled release of hazardous materials. GE and Cal-EPA are in negotiations at this time concerning required corrective actions.

Radiological Waste Management
Hillside Storage is used for the temporary storage of irradiated fuel specimens and solid radioactive waste materials. A complete discussion is provided in Section 5.1.1.
The Radioactive Liquid Waste Evaporator Plant (WEP), which is located in Building 349, is used to concentrate and solidify liquid waste. Liquid waste is collected from the various site accumulation tanks and transported to the waste evaporator. The liquids are pumped continuously from a feed tank or chemical treatment tanks, directly into the evaporator. There the wastes are concentrated through a vertical-tube, natural convection evaporator.

Vapor is directed to a high efficiency demister, entrainment separator, and a condenser. Liquid effluent from the evaporator is collected in the monitoring tanks for analysis and disposal by evaporation, or if further decontamination is necessary, the water is re-routed to the feed storage tank for reprocessing or ion exchange treatment, prior to disposal by evaporation.

Liquid radioactive waste transferred to the WEP is not EPA-regulated hazardous waste. The pH of the liquid is adjusted to 7 $\pm$ 1 prior to transfer. Normally, the liquid is greater than pH 2 and less than pH 12.5 and does not exhibit the characteristic of corrosivity. Only those laboratory chemicals reviewed and approved by the Area Manager are authorized for disposal in the radwaste drain. Approval is based on the chemical not being an EPA-listed material and not possessing a hazardous characteristic (other than radioactivity). The WEP concentrate is solidified in media approved by the disposal site and EPA for retention of any heavy metals present[26].

Liquid waste concentrates from the evaporator are collected in a receiver and discharged into Department of Transportation (DOT), Specification 17-H, 55-gallon drums, or other approved containers. The concentrates are then mixed with a cement-diatomaceous earth mixture or equivalent, for solidification. After solidification, the drums are sealed and prepared for disposal as dry solid waste. Small amounts of liquid waste incompatible with evaporation may be solidified directly in 55-gallon drums.

Storage of dry wastes at the Waste Evaporator Plant is limited to packages having surface dose rates or 100 mrem per hour or less. Waste drums having radiation readings in excess of 100 mrem per hour are transferred promptly to Hillside Storage.

Nonradiological and Nonhazardous Solid Waste

Nonradiological and nonhazardous solid wastes, consisting of trash from offices, shipping, receiving, and utility areas, are transported offsite for landfill disposal to the Pleasanton Garbage Service Transfer Station, Pleasanton, California. Nonradioactive solid wastes are routinely screened for possible radioactive contamination by direct frisk with portable detection instruments before release for shipment to sanitary landfills. If radioactivity is detected, then these wastes are treated as radioactive solid waste as described in this section.

Nonradiological Airborne Effluents

Nonradiological airborne effluents from current GE VNC operations include emissions from building exhaust stacks, a gasoline pump, a spent photochemical storage tank and a solvent cleaning facility. The gasoline pump, spent photochemical storage tank, and solvent cleaning facility are regulated under permits issued by BAAQMD. Pollutants from the combustion of natural gas used for heating, from operation of the diesel-driven electric generator used to supply emergency power to Building 102, and from two small propane-driven emergency electric generators are considered negligible.

Nonradiological Liquid Effluents

Wastewater effluents generated by GE VNC are classified as industrial wastewater, sanitary wastewater, or clean wastewater. Figure 5.4-1, GE VNC Wastewater Management, illustrates the management of those wastewaters.

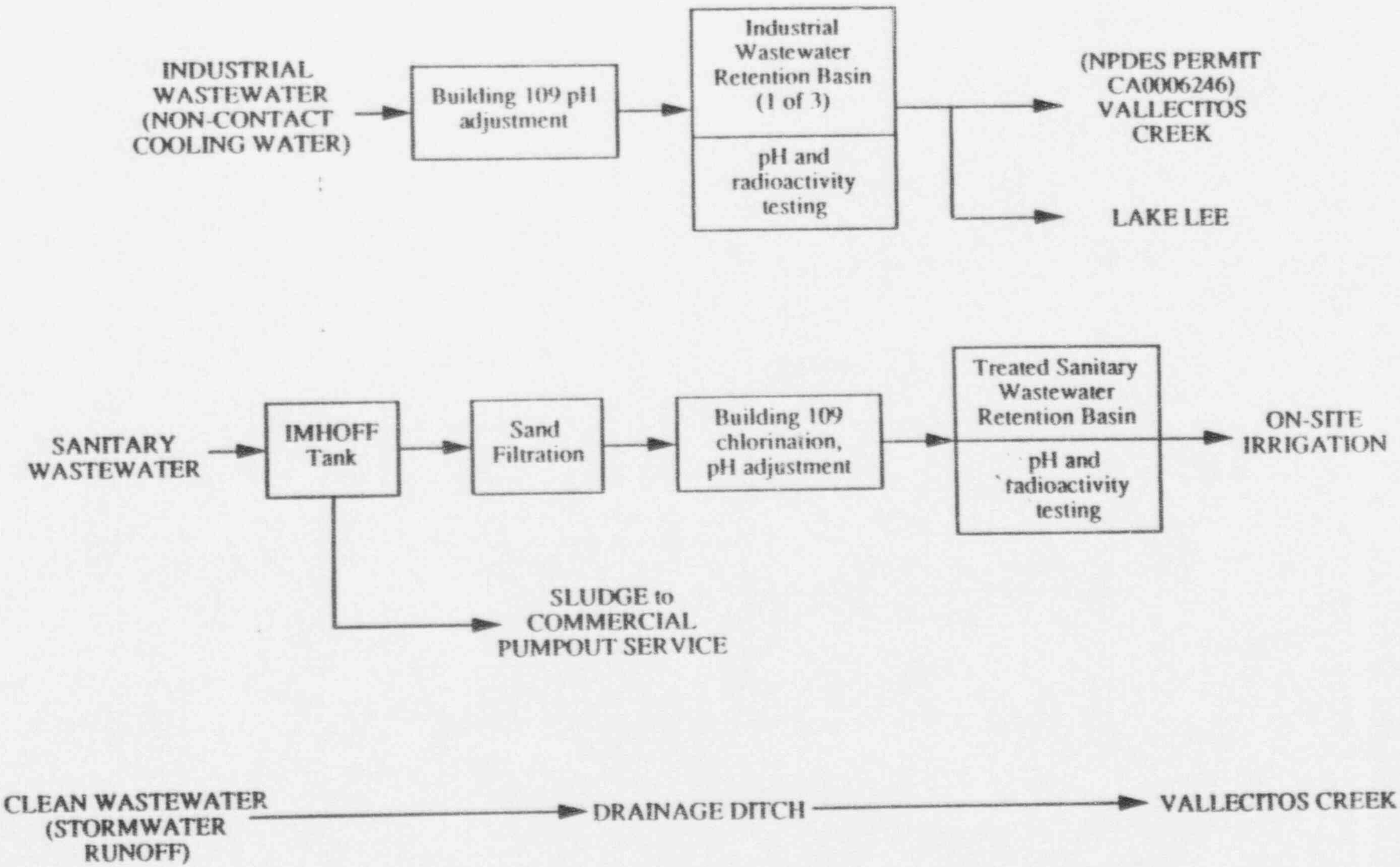


Figure 5.4-1. GE VNC Wastewater Management

Industrial wastewater releases from GE VNC are regulated by the California Regional Water Quality Control Board (CRWQCB). Discharge parameters are established by CRWQCB Order 90-0058 and NPDES Permit. Industrial wastewater is non-hazardous and consists of non-contact cooling water which, after having been pH adjusted, is discharged from one of three industrial wastewater retention basins to Vallecitos Creek. By definition, noncontact cooling water is not utilized by the facility in processes which might impart radioactive materials to the waste stream. Prior to discharge, water is sampled from each basin and tested for acceptable pH and radioactivity levels. Additional monitoring and sampling activities are discussed in Section 5.3.3. Organic chemical waste such as acetone, methanol, petroleum ether and machine oil are not mixed with industrial wastewater effluent. They are collected for offsite shipment to commercial disposal facilities.

The noncontact cooling water also may be collected at the point of origin and used for nonpotable purposes such as landscape watering. Although allowed by NPDES permit, this is not currently done, nor has it been done in the past. If instituted in the future, these waters would be tested for radiological content before discharge.

Sanitary wastewaters are those wastewaters from restrooms, wash rooms, drinking fountains, and janitorial sinks. (Emergency shower wastes, which are generated in areas where SNM operations are conducted, are not considered sanitary wastes. These remain segregated and are handled as radioactive waste.) All sanitary wastes are routed to an Imhoff tank; and, after undergoing sand filtration, chlorination, and pH adjustments, are land disposed onsite by irrigation. Monitoring and sampling activities are discussed in Section 5.3.3. Sludge from the tank is taken offsite via a commercial pumpout service.

Clean water discharges consist of storm runoff and small quantities of water known to contain no contaminants. This includes condensate from building air conditioning equipment. These waters flow directly to drainage ditches which enter Vallecitos Creek.

6.0 ENVIRONMENTAL IMPACTS

This section considers the environmental impacts of routine operation, and radiological consequences of accidents.

6.1 CONSTRUCTION IMPACTS RELATED TO THE PROPOSED ACTION

The license renewal does not include authorizing new construction or a change in the character of site activities. Thus the current environmental setting is not subject to change.

6.2 OPERATIONAL IMPACTS RELATED TO THE PROPOSED ACTION

6.2.1 Radiological Impacts From Normal Operations

6.2.1.1 Occupational Impacts

For operations at VNC, whole body dose is the most limiting category of occupational exposure. All other categories of dose received by workers represent substantially smaller fractions of the regulatory limits under 10 CFR Part 20 than whole body dose. A review of the past 5 years of annual occupational exposure reports as submitted to NRC (see Table 6.2-1) indicates that the facility has consistently met a standard of good practices established by the Institute of Nuclear Power Operators, by maintaining individual annual whole body doses below 5 rem per year. Only 44 individuals during the period have received whole body doses in excess of 2 rem per year. Under the revision of 10 CFR Part 20 to become effective January 1994, occupational whole body dose will be limited to 5 rem per year, and will add a requirement that dose acquired from inhalation or ingestion of radioactive material will be conditionally included in the 5 rem annual limit.

Within the scope of its current mission, the facility should have no difficulty in complying with these revised requirements, or even a 2 rem per year average limit currently recommended by the International Commission on Radiological Protection (ICRP), should it become incorporated by future regulations[35].

6.2.1.2 Radiological Impacts to Members of the Public

Release of radioactive material from VNC to the environment represents a potential risk to the public health and safety. The primary component of this impact is a potential increase in carcinogenic risk resulting from exposure to low levels of radiation. Impacts considered in this section are those which might result from long-term releases during normal operations at the facility. The primary unit of measure for assessing impacts is the 50-year committed effective dose equivalent delivered to an individual, or collectively to a population, as a result of one year's effluent releases from the facility.

During routine operations at VNC, small quantities of radioactive material are released to the environment. Release levels, however, have historically resulted in only a small fraction of the offsite concentration limits specified by regulation. Because no significant increases in the level of facility operations are projected, it is appropriate to use past effluent monitoring and sampling data to provide a reasonable estimate of future impacts.

Regulatory criteria for the assessment of impacts to the public from radiological effects are provided by the following regulations:

- **10 CFR 20.1301(a)**, effective January 1994, will require each NRC licensee, including GE-VNC, to conduct operations so that the total effective dose equivalent (TEDE) to individual members of the public from the operation does not exceed 100 millirem in a year, as calculated or measured. As an alternative, a facility can comply with this requirement by demonstrating that (a) the annual average concentrations of gaseous and liquid effluents at the restricted area boundary do not exceed the values of Appendix B,

Table 2, and also that (b) dose from sources do not exceed 2 millirem in any hour, or 50 millirem in a year[33].

- o **40 CFR 190.10, Subpart B**, as a standard for nuclear fuel cycle facilities, can be used as a guideline, although not strictly applicable. It states that normal operations should be conducted in such a way as to provide reasonable assurance that the annual dose equivalent will not exceed 25 millirem to the whole body, 75 millirem to the thyroid, and 25 millirem to any other organ of any member of the public as a result of radiation from these operations, and as the result of planned discharges of radioactive materials (radon excepted)[34].

Airborne Emissions
The offsite radiological impacts associated with airborne emissions during a typical recent year of normal operations at VNC were assessed by calculation of the committed effective dose equivalents (doses) to the nearest site boundary, and to the nearest resident, who represents the maximally exposed individual (MEI) from VNC operations. Impacts were additionally assessed by calculation of the collective dose to the population residing within an 80-km (50-mile) radius of the site. The methods used and the results of these calculations are summarized below. A more detailed discussion of the methodology is provided as Appendix A of this document.

Table 6.2-1. Annual Collective Occupational Dose at VNC, 1986-1900[1,2]

Year	Whole Body Dose, Person-Rem	Persons Monitored	Persons with Dose > 2 Rem
1986	132.3	457	0
1987	73.4	706	9
1988	74.1	769	9
1989	87.2	643	9
1990	102.8	655	17
Avg	**94.0**	**646**	

(1) TLD-badged visitors to the facility are by regulation included in the occupational exposure data, and represent a substantial fraction of the total persons monitored annually, with negligible levels of accrued dose.

(2) Under new requirements of 10 CFR 20, internal dose is to be considered in calculating the 5 rem limit if the internal dose will exceed a threshold of 0.5 rem per year.

To assess the dose delivered to individuals as a result of airborne emissions from VNC operations, annual average emissions data for the year 1990, and representative meteorological data were input to the computer code, AIRDOS-PC35. The code applies a Gaussian plume dispersion model to calculate downwind ambient concentrations in air, and surface depositions. Various pathways for the possible uptake of radionuclides by an individual, and the effects of irradiation by plume immersion and ground deposition are then analyzed to estimate the dose delivered to an individual as a result of the annual release.

The dose delivered to a hypothetical individual, situated about 360 meters distance at the site boundary, is estimated at one millirem per year. The highest organ dose is estimated at 1.2 millirem to the gonads. The nearest actual resident to VNC is considered the maximally exposed individual, and is situated 450 meters south-southeast (SSE) of Stack 102A. The annual effective dose to this resident is about 0.8 millirem from airborne effluents. The highest organ dose is about 0.9 millirem delivered to the gonads.

To assess dose to the offsite population as a result of operations, a projected population distribution for the year 2000 was developed for the area bounded by an 80-km radius from the facility. The population distribution was grouped into polar grids defined by 16 radial sectors and 10 gradient distances. Dose was calculated for a hypothetical individual positioned at the centerline of each radial sector and at each gradient distance. The entire population residing within that zone was conservatively assumed to receive the same centerline dose. The collective dose commitment to the offsite population as a result of VNC operations is estimated at about 2.9 person-rem per year.

Liquid effluents

During normal operations at VNC, no realistic pathway exists for the offsite discharge of radioactive materials in liquid effluents. Monitoring of the liquid pathway, as described in Section 5.3, has shown that no measurable or significant concentrations of radioactivity are being discharged. For these reasons, the offsite impact of radioactive materials discharged via liquid effluent pathways is considered to be negligible.

Irradiation from Onsite Storage of Radioactive Material

Operational and administrative controls at VNC are designed to ensure that radioactive materials are stored and utilized in such a manner as to minimize radiation exposures to workers and the surrounding population. Integral dose measurements from thermoluminescent dosimeters (TLDs) positioned around the site boundary confirm that direct radiation doses from facility operations are very low, and are generally indistinguishable from variations in natural background levels. Environmental radiation level monitoring results are provided in Table 6.2-2[20,21,22,23,24].

In recent years, environmental TLDs positioned along the northern quadrant have measured annual average gamma-ray doses up to 13 millirem (for 1989) above control TLD background measurements. This small increment of dose may be caused by the release and transport of noble gases in the direction of prevailing winds. This measured increment may also be due, at least in part, to propagation of error associated with multiple dose measurements close to the TLD's detection limit.

The results may also reflect some contribution of direct irradiation from nearby storage facilities, although a significant contribution by this mode is unlikely.

For purposes of assessing upper bounding dose conditions for this EA, it is assumed that the dose increment is a valid indicator of radiation levels attributable to VNC, and that the principal pathway of exposure is noble gas cloud immersion. The TLD stations of interest are situated at an average distance of about 1200 meters from VNC stacks, and are within the northern site boundary by a distance of about 700 meters. The dose at the boundary is estimated by factoring the measured dose at 1200 meters by the amount of additional atmospheric dispersion which occurs between 1200 and 1900 meters. In this manner, the resultant dose at 1900 meters is estimated at 9 millirem.

If the measured dose of 13 millirem represents direct irradiation effects (as opposed to cloud immersion), doses from the same source delivered to the site boundary location 700 meters away would be significantly less than the 9 millirem estimated for the cloud immersion case.

Summary and Assessment of Radiological Impacts

As an active licensed facility, VNC has continued to conduct operations in a manner which produces minimal radiological impacts, and complies with applicable regulatory criteria. The facility is sufficiently isolated from other nuclear facilities so that cumulative dose effects from other licensees are not a factor.

Table 6.2-2. Environmental TLD Results

	Process Bkgd TLD (mrem)	Environmental TLD Results (mrem above background, from gamma)			
		South	East	North	West
1986	78	0	0	9.2	0
1987	72	0	0.83	11.7	0
1988	67	0.83	5.8	4.2	0.83
1989	72	0.83	4.2	13	1.67
1990	72	1.67	3.3	12	0

Exposure to airborne emissions is assumed to be the only significant radiological effluent pathway. This pathway was assessed for impacts to an individual at the site boundary, at the nearest residence, and to the population within an 80-km radius. The highest dose at a site boundary location was calculated based on current stack emissions data. The resultant dose is less than 1 millirem effective, with the highest organ dose being about 1.2 millirem to the gonads. From environmental perimeter TLD measurements, a conservative estimate of gamma-ray dose is 9 millirem for the northern boundary. Both methods show that doses from facility operations are well within the standards of 40 CFR Part 190, and indicate that VNC will readily comply with the new requirements of 10 CFR 20.1301.

Dose impacts to the population from normal operations are negligible. An assessment using population data projected for the year 2000 indicates that facility emissions will result in a population dose commitment of only 2.9 rem. This represents a negligible fraction (less than 3×10^{-6}) of the annual dose commitment which will normally be received by this population from background radiation.

6.2.2 Radiological Impacts of Postulated Accidents

In order to evaluate possible sources of radiological risk to the surrounding population, accidents postulated for VNC which could in theory cause releases to the environment of radioactive materials have been analyzed[36]. Possible mechanisms for the unplanned airborne dispersion of radioactive materials were screened by event tree analysis to identify accident types which might warrant further evaluation. The events identified in this manner include a spectrum of accidents. Accident scenarios were developed for these mechanisms, and those with the highest potential for significant release, independent of their probability of occurrence, were selected for further assessment.

The estimated offsite consequences from any of these accident scenarios would be less than those of a worst-case accidental criticality, which represents the bounding accident event at the facility. The scope of operations which require the use of radioactive materials has been reduced substantially since the development and analysis of these scenarios, and is projected to remain at reduced levels.

An evaluation of the effects of a postulated accidental criticality at Building 103 is presented as Attachment C of the SNM-960 License Renewal Application dated April 21, 1989[1]. The assessment was based upon actual possession limits at VNC, and served as justification for eliminating the requirement under 10 CFR 70.22 for maintaining a radiological accident emergency plan, a license modification which was approved by NRC on December 20, 1990.

For purposes of the current relicensing, VNC staff were requested to demonstrate, under the assumption that the actual quantity of uranium stored onsite equalled the SNM-960 possession limit of 50 kilograms, that the criticality controls and physical arrangements at VNC would justify the continued acceptance of this scenario as the bounding accident case.

The VNC staff demonstrated that the facility's safe mass limit of 95 kilograms for storage of uranium significantly exceeds the 50 kilogram possession limit as proposed for this license renewal[1]. Therefore, safe mass conditions could not be exceeded as long as this possession limit was observed. Furthermore, it was asserted that with this distribution, none of the storage arrays would create conditions under which a criticality event could exceed in severity the standard criticality accident postulated for assessment purposes by Regulatory Guide 3.34[37]. In considering the possibility of assessing the accident at a location other than Building 103, it was noted that other storage locations at VNC were situated more distant from the nearest site boundary, and/or had been provided with significantly more shielding than Building 103. The retention of the Building 103 scenario, therefore, with the standard assumptions of Regulatory Guide 3.34, is justified for assessment as the bounding accident event at VNC. The scenario and results of its assessment are summarized below, with a more detailed description provided in the SNM-960 License Renewal Application.

The probability of an actual occurrence of the postulated criticality accident is nil. It would require the simultaneous failure of two or more design features and/or operational criticality controls in place at VNC. All SNM at VNC is maintained in dry storage, and there are no mechanisms for the accumulation of SNM in sufficient concentrations and under the appropriate conditions of moderation, reflection, and geometry as assumed for the scenario. Nevertheless, for purposes of assessment as the upper bounding accident event, it is postulated that some unknown event occurs in Building 103 which allows a fuel vault to contain a quantity of SNM equal to twice the maximum limit of the vault, in some physically impossible configuration which would allow a criticality burst to occur. The single criticality burst generates 1.0E+17 fissions. Prompt neutron and gamma irradiation doses are mitigated by 8 inches of concrete shielding and a minimum distance to the site boundary of 427 meters. The burst would deliver a gamma-ray dose of about 0.001 millirem and a neutron dose of about 0.002 millirem to an individual at the boundary.

The postulated accident also results in the release of a cloud of radioactive iodine and noble gase isotopes. This cloud is emitted as a ground-level release, and flows in the direction of the nearest site boundary. An eight-hour exposure period is assumed for calculation of internal doses from inhalation and external doses from submersion i the cloud. The dose resulting from exposure to this cloud for the duration of the event is estim ed at 0.32 rem to the lens of the eye, and 1.24 rem to the skin. A committed dose of 0.30 rem is delivered to the thyroid, principally from the inhalation of radioiodine.

Relevant criteria for offsite consequences of postulated accidents are provided in 10 CFR 70.22. This regulation specifies that in order to be exempt from the requirement of maintaining a radiological accident emergency plan, a licensee must provide an evaluation which shows that the maximum dose delivered offsite to a member of the public due to a release of radioactive materials would not exceed 1 rem effective dose equivalent, or result in an intake of soluble uranium of 2 milligrams.

The resulting whole-body dose to an individual at the controlled area boundary from this postulated accident is less than the 1 rem criterion specified by 10 CFR 70.22 for exemption from development of a radiological accident emergency plan. Doses at the location of the nearest resident (i.e., at a distance of 450 meters SSE) would be comparable. Therefore, the release of radioactive materials from VNC due to accidents, even those with a very low probability of occurrence, would not result in any significant radiological consequences in the vicinity of the GE VNC.

6.2.3 Nonradiological Impacts

As stated previously, the proposed action would continue the current operational status. With the lack of any appreciable change in operations, this results in continuation of the current baseline conditions. For completeness, many of these impacts of current operation are described qualitatively below. Media or conditions which are not impacted by current operation are not discussed.

6.2.3.1 Land Use and Terrestrial Resources

Land currently grazed and cultivated would continue to be used in the same manner as it has been used in the past. It is incumbent on the grazing leasees not to overgraze their cattle (and other animals) or further deterioration in land use and habitat quality could occur. Releases of effluents (liquids, particulates, or gases) at VNC are not anticipated to affect land use.

Continued operation of VNC will result in continuation of the present traffic patterns on areal roads used by employees and vendors. This traffic produces effects on the local environment. The small VNC workforce and supply network is a minor contributor to impacts which include noise, automotive emissions (carbon monoxide, hydrocarbons, particulates, and nitric oxides) and disturbance to vegetation (primarily along the highway right-of-ways) and animals (particularly road kills).

6.2.3.2 Water Use and Aquatic Resources

VNC purchases water from the San Francisco water supply out of the Hetch Hetchy aqueduct. On average, VNC consumes 30 l/s (1979) from the aqueduct. This represents about 0.3% of the normal flow of water in the aqueduct. VNC received 21,540,000 gallons of Hetch Hetchy water during 1990[14]. A secondary supply of water (for back-up purposes only) is available from the Calaveras Resenoir, south of VNC (and south of the aqueduct). Of the 30 l/s said to be drawn from the aqueduct in 1979, 9.6 l/s was discharged from VNC (1979). The difference between the influent and effluent was cooling tower water lost as vapor, drifting mist, and evaporation. The bulk of the discharge water, 5.7 l/s, was characterized to be blowdown from the cooling tower. Examination of the NPDES monitoring records indicate that water consumption has declined significantly, with peak consumption being only 4.5 l/s in 1989, peak discharge being only 2.2 l/s and peak sanitary disposal being 0.15 l/s. Of the 9.6 l/s discharged from VNC in 1979, 9.3 l/s was discharged into the ditch leading to Vallecitos Creek. The remainder (0.3 l/s) consists of sanitary waste which was sprayed onsite. Vallecitos Creek's ephemeral nature is diminished by some of these releases, but these are still insufficient to keep it flowing throughout the year.

VNC has adopted general water conservation measures (e.g., use of treated sanitary wastewater for irrigation, and cooling water recirculation). The NPDES permit allows the use of appropriately sampled and neutralized cooling waters for landscape watering, Lake Lee level maintenance, and other nonpotable applications. The treated sanitary waste functions as a fertilizer and provides irrigation. The elevated level of nitrate in any liquid that percolates into the local aquifer, after uptake by surface plants, is of too small a magnitude to significantly impact the groundwater. The total volume released in 1979 would be on the order of 2 acre-feet.

The NPDES permit limits the effluent discharged to noncontact cooling water only, and the site is treated as a single discharge source. The quality of the industrial wastewater appears to be good. The analytical results of samples from the effluent discharge compliance point indicate that the quality conforms to permit requirements in all but a minor percent of samples. In 1990, industrial wastewater effluent compliance tests failed only twice, once each in February and March. In the instances where analytical results were not acceptable, it appeared that artifacts of sample handling and processing were as likely to be the cause of unacceptable results as an actual release of water of unacceptable quality. This position is supported by the lack of change in processes at VNC and the inability to identify a credible source[26].

6.2.3.3 Air Quality

The nonradioactive gaseous emissions from the GE VNC facilities are relatively minor and will result in only slight increases in concentrations of regulated pollutants and other toxic air contaminants. These contributions are similar to those that would occur from any small industrial facility and are not expected to contribute to further deterioration of local air quality.

6.2.3.4 Commitment of Resources

Water use has been summarized in Section 6.2.3.2. GE VNC gas therm and kilowatt-hour power usages are summarized below[26].

	Gas therms/month		kwhr/month	
Year	Average	Peak	Average	Peak
1989	9,100	22,000	455,000	530,000
1990	11,000	28,000	460,000	510,000

6.3 IMPACTS OF ALTERNATIVES

As discussed in Section 3, the alternative of no license renewal would end light-water reactor fuel research and development activities at VNC, particularly the examination of irradiated fuels, and would remove from service unique research facilities. The decision to not renew the license would require that the facility be decontaminated and decommissioned in accordance with 10 CFR 70.385. Significant engineering effort, and possibly new construction-related activities to handle storage and disposal of high- and low-level waste would be required. The long-term effects of a re-use of the facility and land are unknown. Some facilities could be easily converted to alternate uses, (e.g., office space and some laboratories), without need for decontamination. Others would need to be decontaminated prior to transfer to alternate use. There is no foreseeable difference in impact to the environment, of decommissioning now, or 10 years from now.

Locally this action would cause a disruption in the economy. Although associated with some potential for short-term increases in employment during decommissioning, license denial equates to a long-term reduction in the local workforce, followed by a decline in the tax base and associated rippling effects in the economy.

The alternative of licensing with restrictions does not seem to be a reasonable option, because there are no deleterious environmental impacts which must be mitigated.

7.0 DECONTAMINATION AND DECOMMISSIONING

VNC staff maintain an ongoing project to decontaminate, or reduce radioactive contamination levels, in relevant facility areas. This not only represents a good waste reduction and ALARA practice, but also should serve to mitigate eventual impacts from the process of decommissioning.

License conditions require that the licensee observe the "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material"[33]. GE is committed to decommission the facilities operated under this license in accordance with the general decommissioning plan for License SNM-960 as submitted by letter dated February 17, 1982[39]. The financial commitment to assure that such decommissioning is accomplished is documented by letter to NRC[40].

At such time that facilities covered by this license are decontaminated for proposed unrestricted release in accordance with the aforementioned guidelines for decontamination, GE shall submit a report that identifies the facilities where radioactive materials were used and stored, briefly describe operations conducted and radioactive materials used in the facilities, and assess results of the decontamination activities. Decontamination activities will be conducted in a manner to provide for protection of the environment and public health and safety. Contamination will be reduced to acceptable levels per criteria applicable at the time of license termination. Following completion of decontamination activities, a comprehensive radiological survey will be completed and a report documenting clean-up to the target levels, including a description of sampling and survey methods and instrumentation used, will be produced for NRC review. The report shall provide the basis for unrestricted release of the facilities and the site.

8.0 SUMMARY AND CONCLUSIONS

8.1 SUMMARY OF ENVIRONMENTAL IMPACTS

Operational and administrative controls at VNC are designed to ensure that radioactive materials are stored and utilized in such a manner as to minimize radiation exposures to workers and the surrounding population. During routine operations at VNC, small quantities of radioactive material are released to the environment. Release levels, however, have historically resulted in only a small fraction of the offsite concentration limits specified by regulation.

Exposure to airborne emissions is assumed to be the only significant radiological effluent pathway. This pathway was assessed for impacts to an individual at the site boundary, at the nearest residence, and to the population within an 80 km radius. The highest dose at a site boundary location was calculated based on current stack emissions data. The resultant dose is less than 1 millirem effective, with the highest organ dose being about 1.2 millirem to the gonads. From environmental perimeter TLD measurements, a conservative estimate of gamma-ray dose is 9 millirem for the northern boundary. Both methods show that doses from facility operations are well within the standards of 40 CFR Part 190, and indicate that VNC will readily comply with the new requirements of 10 CFR 20.1301.

Dose impacts to the population from normal operations are negligible. An assessment using population data projected for the year 2000 indicates that facility emissions will result in a population dose commitment of only 2.9 rem. This represents a negligible fraction (less than 3 x 10^{-6}) of the annual dose commitment which will normally be received by this population from background radiation.

A review of the past 5 years of annual occupational exposure reports as submitted to NRC indicates that the facility has consistently met a standard of good practices established by the Institute of Nuclear Power Operators, by maintaining individual annual whole body doses below 5 rem per year. Within the scope of its current mission, the facility should have no difficulty in complying with the revision of 10 CFR Part 20 to become effective January 1993, or even a 2 rem per year average limit currently recommended by the International Commission on Radiological Protection (ICRP), should it become incorporated by future regulations[32].

No significant nonradiological impacts are expected with the continued operation of the GE VNC. The proposed action would result in continuation of the current baseline conditions, with no change to the socioeconomic character of the community. Land currently grazed and cultivated would continue to be used in the same manner as it has been in the past. Traffic on areal roads, along with its inherent emissions and noise, would continue as it has in the past. Water use would continue, with peaks reaching only 4.5 l/s, and with a peak discharge of only 2.2 l/s. The nonradioactive gaseous emissions from the GE VNC facilities are relatively minor and will result in only slight increases of regulated pollutants, and are not expected to contribute to further deterioration of local air quality.

License renewal involves no new construction; therefore, no construction impacts are associated with this action.

8.2 BASIS FOR FINDING OF NO SIGNIFICANT IMPACT

The Commission has reviewed the proposed action (renewal of SNM-960 for an additional 10 years) relative to the requirements set forth in 10 CFR Part 51 and 10 CFR Part 70, and based on this assessment have determined that renewal of SNM-960 under 10 CFR 70.21 and 70.22 for the use of SNM at GE VNC will not significantly affect the quality of the human environment. Therefore, an environmental impact statement is not warranted, and pursuant to 10 CFR Part 51.32, a Finding of No Significant Impact is appropriate.

9.0 REFERENCES

1. General Electric Company Vallecitos Nuclear Center, "Special Nuclear Materials License Renewal Application for the Vallecitos Nuclear Center," License SNM-960, Docket 70-754, March 27, 1989.

2. U.S. Nuclear Regulatory Commission, "Licensing and Regulatory Policy and Procedures for Environmental Protection," 10 CFR Part 51.

3. U.S. Council on Environmental Quality, "Purpose, Policy, and Mandate," 40 CFR Part 1500.

4. U.S. Nuclear Regulatory Commission, "Domestic Licensing of Production and Utilization Facilities," 10 CFR Part 50.

5. U.S. Nuclear Regulatory Commission, "Domestic Licensing of Special Nuclear Material," 10 CFR Part 70.

6. U.S. Nuclear Regulatory Commission, Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards, "The Effects of Natural Phenomena on the General Electric Company Vallecitos Nuclear Center at Pleasanton, California," NUREG-0866, Docket 70-754, December 1981.

7. General Electric Company Vallecitos Nuclear Center, "Environmental Assessment," SNM-960, Docket 70-754, draft March 1979.

8. U.S. Department of the Interior, U.S. Fish and Wildlife Service, "Endangered and Threatened Wildlife and Plants," 50 CFR 17.11 and 17.12, July 15, 1991.

9. State of California, Fish and Game Commission, "Listing of Endangered and Threatened Species," CCR Title 14, Section 670.5, April 1, 1990.

10. U.S. Bureau of the Census, 1990 Census.

11. McElligott, L. and W. Saba, City Planners for Livermore, California, Personal communication, August 26, 1991.

12. U.S. Bureau of the Census 1980 Census.

13. State of California, Department of Finance, Demographic Research Unit, "Interim Population Projections for California and Counties 1990 - 2005," Report 91 P-1, April 1991.

14. Mindt, A.F., "Effluent Monitoring and Environmental Surveillance Programs Annual Summary Report - 1990," Vallecitos Nuclear Center, January 1991.

15. Fujita, T.T., "Review of Severe Weather Meteorology at General Electric Company, Vallecitos, California," May 1977, (as cited in Reference item 5).

16. Mishima, J., et al., "Source Term and Radiation Dose Estimates for Postulated Damage to the 102 Building at the General Electric Vallecitos Nuclear Center," Battelle Pacific Northwest Laboratory, PNL 2844, February 1979.

17. TERA Corporation, "Seismic Risk Analysis for the General Electric Plutonium Facility, Pleasanton, California - Part I," Berkeley, California, report submitted to Lawrence Livermore Laboratory, June 27, 1980, (as cited in Reference item 9).

18. TERA Corporation, "Final Report Seismic Risk Analysis for the General Electric Plutonium Facility, Pleasanton, California - Part II," Berkeley, California, report submitted to Lawrence Livermore Laboratory, June 27, 1980, (as cited in Reference item 9).

19. National Council on Radiation Protection and Measurements (NCRP), USA, NCRP 93, "Ionizing Radiation Exposure of the Population of the United States," September 1987.

20. Gest, R.E., "Effluent Monitoring and Environmental Surveillance Programs Annual Summary Report - 1986," Vallecitos Nuclear Center, January 1987.

21. Gest, R.E., "Effluent Monitoring and Environmental Surveillance Programs Annual Summary Report - 1987," Vallecitos Nuclear Center, January 1988.

22. Gest, R.E., "Effluent Monitoring and Environmental Surveillance Programs Annual Summary Report - 1988," Vallecitos Nuclear Center, January 1989.

23. Gest, R.E., "Effluent Monitoring and Environmental Surveillance Programs Annual Summary Report - 1989," Vallecitos Nuclear Center, January 1990.

24. Gest, R.E., "Effluent Monitoring and Environmental Surveillance Programs Annual Summary Report - 1990," Vallecitos Nuclear Center, January 1991.

25. U.S. Nuclear Regulatory Commission, "Standards for Protection Against Radiation," 10 CFR Part 20, Appendix B.

26. General Electric Company Vallecitos Nuclear Center, "Responses to Environmental Questions for SNM-960 License Renewal," June 24, 1991.

27. Mohr, H.C., General Electric Company Vallecitos Nuclear Center, "Statistical Evaluation of the Vallecitos Nuclear Center Environmental Sampling Program, 1973 1979," September 1979.

28. Bay Area Air Quality Management District Rules and Regulations, Regulation 1, "General Provisions and Definitions," Section 520, "Continuous Emission Monitoring," March 17, 1982, (still in effect 1991 without amendments).

29. California Regional Water Quality Control Board, San Francisco Bay Region, NPDES Permit No. CA0006246, 1989.

30. General Electric Company, Best Management Practice Plan for the GE Vallecitos Nuclear Center, Pleasanton, California, September 8, 1990.

31. California Environment Insider, "Cal-EPA Proposed Fines for Hazardous Waste Violations," Volume 5, No. 7, September 15, 1991.

32. International Commission on Radiological Protection (ICRP), Annals of the ICRP, 1990 Recommendations of the International Commission on Radiological Protection, Volume 21, No. 1-3, Pergamon Press, 1991.

33. U.S. Nuclear Regulatory Commission, "Standards for Protection Against Radiation," 10 CFR Part 20.

34. U.S. Environmental Protection Agency, "Environmental Radiation Protection Standards for Nuclear Power Operations," 40 CFR 190.

35. EPA, 1989, "User's Guide for AIRDOS-PC, Version 3.0," EPA/520/6-89-035, December 1989.

36. General Electric Company. "Plant Accident Involving Potential Radioactive Material Release," GE Vallecitos Nuclear Center Accident Analysis Report, Final Draft, October 1978.

37. Nuclear Regulatory Commission, Regulatory Guide 3.34, "Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Uranium Fuel Fabrication Plant," Revision 1, July 1979.

38. USNRC, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," 1982.

39. General Electric Company, Decommissioning Plan General Electric Company Vallecitos Nuclear Center License SNM-960, January 1982.

40. Beaton, R.H., General Electric, Letter to W.J. Dircks, Director Office of Nuclear Material Safety and Safeguards, USNRC, May 4, 1979.

10.0 LIST OF AGENCIES AND PREPARERS

Those NRC staff members principally responsible for the preparation of this EA are listed below:

Name	Responsibility
G. Comfort	Project Manager - EA
T. Clark	Project Manager- EA
E. Schum	Project Manager - EA

The following outside agencies were contacted for supporting documentation. Their support is appreciated.

Alameda County Flood Control and Water Conservation District
Alameda County Planning Department
Bay Area Air Quality Management District
Cal-EPA Department of Toxic Substances Control
City of Livermore Planning Department
Office of the California State Demographer
U.S. Bureau of the Census

11.0 ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
ANA	Advanced Nuclear Application
BAAQMD	Bay Area Air Quality Management District
BWR	Boiling Water Reactor
CARB	California Air Resources Board
CCR	California Code of Regulations
CFR	Code of Federal Regulations
Ci	Curie
cm	centimeter
CMCL	Chemistry, Metallurgy, and Ceramics Laboratory
Co	cobalt
CO_2	carbon dioxide
CRWQCB	California Regional Water Quality Control Board
Cs	cesium

DOS	dioctyl sebacate
DOT	Department of Transportation
EA	Environmental Assessment
EIR	Environmental Information Report
EPA	Environmental Protection Agency
EVESR	Empire State Atomic Development Vallecitos Experimental Superheated Reactor
g	force of gravity
GE	General Electric Company
GETR	GE Test Reactor
HEPA	high efficiency particulate air (filter)
HSF	Hillside Storage Facility
I	iodine
ISFSI	Independent Spent Fuel Storage Facility
km	kilometer
Kr	krypton
kw	kilowatt
kwhr	kilowatt-hour
l	liter
l/s	liters per second
m	meter
MCC	Motor Control Center
MEI	maximally exposed individual
mph	miles per hour
mrem	millirem
mrem/yr	millirem per year
m/s	meters per second
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NCRP	National Council on Radiation Protection and Measurements, USA
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NTR	Nuclear Test Reactor
Pu	plutonium
RCRA	Resource Conservation and Recovery Act

RL	Radiochemistry Laboratory
RML	Radioactive Materials Laboratory
SNM	Special Nuclear Materials
Sr	Strontium
TEDE	total effective dose equivalent
TLDs	thermoluminescent dosimeters
VBWR	Vallecitos Boiling Water Reactor
VNC	Vallecitos Nuclear Center
WEP	Waste Evaporator Plant
Xe	xenon

Appendix A

Calculation of Offsite Dose from Airborne Effluents

The AIRDOS-PC computer code is used to compute radiation dose rates resulting from the release of radionuclides in airborne effluents. A modified Gaussian plume equation is used to estimate both horizontal and vertical dispersion of radionuclides released from facility stacks, radionuclide concentrations, ground surface deposition, and intake rates for both the inhalation and ingestion intake modes.

Doses to individuals are estimated for the following exposure pathways and intake modes: immersion in air, irradiation from ground surface contamination, immersion in water containing radionuclides, inhalation of airborne radionuclides, and ingestion of contaminated food products[1]. Radionuclide concentrations in meat, milk and fresh produce consumed by people are estimated by coupling the output of the atmospheric transport models with the terrestrial food chain models of NRC Regulatory Guide 1.109[2].

The data used for input to AIRDOS-PC for stack and emissions parameters are listed in Table A-1. A population distribution, projected for the year 2000 (see Table A-2), was developed for an 80 km radius around VNC. The distribution for 1980 was adjusted with year 2000 population projection data for cities and counties in the vicinity of VNC[3,4].

Site-specific meteorological data are not available, but data approved by EPA for assessment of impacts due to releases from the nearby Lawrence Livermore National Laboratory were used in conjunction with the AIRDOS-PC code. This data set, acquired from Fairfield/Travis Air Force Base, California, is included as Table A-3.

AIRDOS-PC calculates dose at a plume centerline location of the downwind direction for each of 16 compass sectors. A calculation of sector-averaged dose is not performed for population dose assessments. Rather, a conservative overestimation of population dose is applied in that it is assumed that the total population for each sector grid receives the maximum dose delivered to that grid.

The effective dose equivalent as calculated by AIRDOS-PC for an individual at each sector grid is presented in Table A-4. The collective population dose, by sector grid, is presented in Table A-5. The collective dose matrix was developed by multiplying each dose in Table A-4 by the corresponding population value in Table A-2. For purposes of simplification and conservatism, it has been assumed that all alpha emissions were of the worst-case (most restrictive) isotope, Pu-239, Similarly, beta-gamma doses are assumed to have been the result of Sr-90, and with the exception of the 102A stack where noble gases are known to be Xe-133, all other noble gas emissions are assumed to be Kr-88.

References:

1. EPA, 1989, "User's Guide for AIRDOS-PC, Version 3.0", EPA/520/6-89-035, December, 1989.

2. NRC, 1977, Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I."

3. General Electric Company Vallecitos Nuclear Center, "Environmental Assessment", SNM-960, Docket No. 70-754, draft March 1979.

4. State of California, Department of Finance, Demographic Research Unit, "Interim Population Projections for California and Counties 1990 - 2005", Report 91 P-1, April 1991.

Table A-1. AIRDOS-PC Input Data Parameters

Stack Emission Data						
Isotope	Class	AMAD	Stack 102A Ci/Yr	Stack 103 Ci/Yr	NTR (Bldg 105)	All Others Ci/Yr
Xe-133	*	0	290	0.0	0.0	0.0
Kr-88	*	0	0.0	0.0	230	0.0
Sr-90	Y	1.0	1.0E-05	2.3E-06	4.6E-07	2.9E-06
I-131	D	1.0	1.1E-04	5.3E-05	1.3E-05	8.4E-06
Pu-239	Y	1.0	1.9E-06	8.9E-07	1.0E-07	4.1E-07
Stack Height (m)			22.90	14.80	13.70	0.00
Stack Diameter (m)			1.68	1.52	0.38	1.27
Momentum (m/s)			8.6	7.5	5.9	5.8

Table A-2. Projected Population Distribution Around GE VNC for the Year 2000

	Distance (km)									
	0-1.6	1.6-3.2	3.2-4.8	4.8-6.4	6.4-8	8-16	16-32	32-48	48-64	64-80
N	0	0	0	1090	209	453	1098	61755	451	17276
NNE	3	0	0	58	526	6892	263	13080	7346	8019
NE	5	0	0	35	1035	32289	650	1107	112783	111852
ENE	0	0	0	14	68	16	637	21329	22664	17896
E	0	0	0	0	55	163	728	924	3131	150289
ESE	0	0	0	7	0	25	185	0	1444	11781
SE	9	0	0	1	6	15	0	334	0	148
SSE	0	0	0	5	0	32	714	1198	18077	20905
S	6	0	0	3	19	6	238621	272021	4064	94730
SSW	4	0	11	28	73	5300	179889	350191	23101	55545
SW	0	4	10	57	18	50125	96197	115921	1353	367
WSW	10	0	363	17	15	35231	76150	230521	8126	0
W	5	57	102	0	51	11797	57495	143530	250850	0
WNW	4	5	27	361	256	131	259873	318187	652945	130328
NW	7	7	304	331	744	2858	4932	276627	258349	94513
NNW	0	0	271	3138	12037	20195	23913	213652	70397	108947
Annular Totals	53	73	1088	5145	15112	165528	941345	2020377	1435081	822596
Grand Total										5406398

Table A-3. Meteorological Data

FREQUENCY OF ATMOSPHERIC STABILITY CLASSES FOR EACH DIRECTION

Sector	Fraction of Time in Each Stability Class						
	A	B	C	D	E	F	G
N	0.0103	0.0679	0.0726	0.4940	0.0834	0.2717	0.0000
NNW	0.0102	0.0410	0.0314	0.7130	0.0493	0.1550	0.0000
NW	0.0095	0.0564	0.0552	0.6801	0.0463	0.1525	0.0000
WNW	0.0279	0.1258	0.0769	0.5162	0.0358	0.2175	0.0000
W	0.0037	0.1054	0.1201	0.5675	0.0303	0.1730	0.0000
WSW	0.0160	0.1141	0.1111	0.5443	0.0300	0.1846	0.0000
SW	0.0129	0.1538	0.1596	0.4496	0.0370	0.1871	0.0000
SSW	0.0132	0.1267	0.1798	0.4231	0.0578	0.1994	0.0000
S	0.0135	0.0797	0.1151	0.5135	0.0776	0.2005	0.0000
SSE	0.0239	0.1117	0.0698	0.2612	0.1366	0.3968	0.0000
SE	0.0545	0.1489	0.0868	0.0970	0.0638	0.5489	0.0000
ESE	0.1007	0.1979	0.0945	0.1266	0.0472	0.4332	0.0000
E	0.0375	0.1298	0.1288	0.3830	0.1014	0.2195	0.0000
ENE	0.0060	0.0345	0.1268	0.6362	0.0997	0.0967	0.0000
NE	0.0122	0.0397	0.0969	0.5419	0.1514	0.1578	0.0000
NNE	0.0161	0.0682	0.0739	0.3536	0.1267	0.3615	0.0000

FREQUENCIES OF WIND DIRECTIONS
AND RECIPROCAL-AVERAGED WIND SPEEDS

Wind Toward	Direction Frequency	Wind Speeds for Each Stability Class (Meters/Sec)						
		A	B	C	D	E	F	G
N	0.036	0.930	1.010	1.420	2.230	2.840	0.900	0.000
NNW	0.016	0.990	0.960	1.330	2.460	2.600	0.910	0.000
NW	0.017	0.990	0.870	1.370	2.140	2.640	0.900	0.000
WNW	0.011	0.910	0.850	1.390	1.360	2.620	0.860	0.000
W	0.027	0.900	0.960	1.410	1.290	2.940	0.920	0.000
WSW	0.020	0.910	0.970	1.560	1.370	3.010	0.910	0.000
SW	0.029	0.850	1.050	1.830	1.440	2.860	0.960	0.000
SSW	0.041	0.940	1.290	2.190	1.780	2.980	0.940	0.000
S	0.096	0.970	1.260	2.380	3.570	3.450	0.960	0.000
SSE	0.020	0.970	1.220	2.120	2.900	3.700	0.990	0.000
SE	0.012	0.940	1.100	1.530	1.640	3.320	1.000	0.000
ESE	0.011	0.950	1.010	1.650	1.590	3.070	0.980	0.000
E	0.068	0.970	1.330	2.800	4.290	3.630	1.020	0.000
ENE	0.306	1.020	1.660	4.060	6.250	3.910	1.120	0.000
NE	0.241	0.980	1.510	3.110	5.550	3.890	1.110	0.000
NNE	0.049	1.010	1.260	1.770	2.820	3.240	1.010	0.000

Table A-3. Metec ·logical Data (Continued)

FREQUENCIES OF WIND DIRECTIONS AND TRUE-AVERAGE WIND SPEEDS

Wind Toward	Direction Frequency	Wind Speeds for Each Stability Class (Meters/Sec)						
		A	B	C	D	E	F	G
N	0.036	1.210	1.510	2.300	4.080	2.980	1.140	0.000
NNW	0.016	1.330	1.330	2.350	4.540	2.620	1.170	0.000
NW	0.017	1.330	1.080	2.200	4.170	2.690	1.140	0.000
WNW	0.011	1.170	1.020	2.000	2.340	2.660	1.040	0.000
W	0.027	1.130	1.340	2.120	2.060	3.120	1.200	0.000
WSW	0.020	1.170	1.350	2.480	2.210	3.200	1.170	0.000
SW	0.029	1.010	1.570	2.900	2.430	3.020	1.290	0.000
SSW	0.041	1.240	2.090	3.250	3.420	3.170	1.240	0.000
S	0.096	1.290	2.010	3.810	6.630	3.680	1.280	0.000
SSE	0.020	1.300	1.910	3.470	5.410	3.910	1.340	0.000
SE	0.012	1.220	1.640	2.590	3.220	3.560	1.350	0.000
ESE	0.011	1.250	1.420	2.640	3.440	3.290	1.310	0.000
E	0.068	1.300	2.110	4.130	6.080	3.850	1.400	0.000
ENE	0.306	1.400	2.720	5.440	7.200	4.070	1.580	0.000
NE	0.241	1.320	2.490	4.780	6.900	4.050	1.560	0.000
NNE	0.049	1.380	1.970	2.940	4.700	3.470	1.390	0.000

Table A-4. Distance/Direction Matrix for AEDE to an Individual

	Distance in meters										
	361	1600	3200	4800	6400	8000	16000	32000	48000	64000	80000
N	2.3E-01	5.9E-02	2.1E-02	1.1E-02	6.9E-03	4.6E-03	1.3E-03	2.7E-04	1.0E-04	5.2E-05	3.3E-05
NNE	2.2E-01	8.3E-02	3.0E-02	1.6E-02	1.0E-02	7.1E-03	2.0E-03	4.6E-04	1.8E-04	9.4E-05	5.9E-05
NE	8.4E-01	2.1E-01	7.5E-02	4.1E-02	2.6E-02	1.8E-02	5.6E-03	1.5E-03	6.4E-04	3.4E-04	2.1E-04
ENE	9.8E-01	1.9E-01	6.8E-02	3.7E-02	2.4E-02	1.6E-02	5.2E-03	1.4E-03	6.3E-04	3.3E-04	2.1E-04
E	2.9E-01	7.7E-02	2.7E-02	1.5E-02	9.4E-03	6.5E-03	1.9E-03	4.6E-04	1.9E-04	9.9E-05	6.3E-05
ESE	6.1E-02	2.1E-02	7.8E-03	4.2E-03	2.6E-03	1.8E-03	4.9E-04	1.0E-04	3.8E-05	2.0E-05	1.3E-05
SE	5.0E-02	2.6E-02	9.6E-03	5.2E-03	3.3E-03	2.2E-03	6.2E-04	1.3E-04	4.8E-05	2.5E-05	1.6E-05
SSE	8.4E-02	3.6E-02	1.3E-02	7.1E-03	4.4E-03	3.0E-03	8.6E-04	1.9E-04	7.5E-05	3.9E-05	2.5E-05
S	4.5E-01	1.1E-01	3.9E-02	2.1E-02	1.3E-02	9.2E-03	2.7E-03	6.4E-04	2.6E-04	1.4E-04	8.9E-05
SSW	2.9E-01	5.6E-02	1.9E-02	1.0E-02	6.4E-03	4.3E-03	1.2E-03	2.7E-04	1.1E-04	5.4E-05	3.5E-05
SW	2.6E-01	4.3E-02	1.5E-02	7.6E-03	4.7E-03	3.2E-03	8.7E-04	1.9E-04	7.0E-05	3.5E-05	2.2E-05
WSW	1.9E-01	3.2E-02	1.1E-02	5.6E-03	3.5E-03	2.3E-03	6.0E-04	1.2E-04	4.4E-05	2.1E-05	1.4E-05
W	2.8E-01	4.5E-02	1.5E-02	7.6E-03	4.7E-03	3.1E-03	8.1E-04	1.6E-04	5.8E-05	2.8E-05	1.8E-05
WNW	1.1E-01	2.0E-02	6.7E-03	3.5E-03	2.1E-03	1.4E-03	3.7E-04	6.9E-05	2.4E-05	1.2E-05	7.6E-06
NW	1.3E-01	2.2E-02	7.6E-03	4.0E-03	2.5E-03	1.7E-03	4.7E-04	1.0E-04	4.2E-05	2.0E-05	1.3E-05
NNW	1.1E-01	2.0E-02	6.7E-03	3.6E-03	2.2E-03	1.5E-03	4.3E-04	9.7E-05	3.9E-05	1.9E-05	1.3E-05

AEDE = Annual Effective Dose Equivalent, in millirem

Table A-5. Collective Population Dose (Millirem) Distributed by Sector and Distance (kilometers) from VNC

	0-1.6	1.6-3.2	3.2-4.8	4.8-6.4	6.4-8	8-16	16-32	32-48	48-64	64-80
N	0.00E+00	0.00E+00	0.00E+00	1.20E+01	1.44E+00	2.08E+00	1.43E+00	1.67E+01	4.51E-02	8.98E-01
NNE	6.60E-01	0.00E+00	0.00E+00	9.28E-01	5.26E+00	4.89E+01	5.26E-01	6.02E+00	1.32E+00	7.54E-01
NE	4.20E+00	0.00E+00	0.00E+00	1.44E+00	2.69E+01	5.81E+02	3.64E+00	1.66E+00	7.22E+01	3.80E+01
ENE	0.00E+00	0.00E+00	0.00E+00	5.18E-01	1.63E+00	2.56E-01	3.31E+00	2.99E+01	1.43E+01	5.91E+00
E	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.17E-01	1.06E+00	1.38E+00	4.25E-01	5.95E-01	1.49E+01
ESE	0.00E+00	0.00E+00	0.00E+00	2.94E-02	0.00E+00	4.50E-02	9.07E-02	0.00E+00	5.49E-02	2.36E-01
SE	4.50E-01	0.00E+00	0.00E+00	5.20E-03	1.98E-02	3.30E-02	0.00E+00	4.34E-02	0.00E+00	3.70E-03
SSE	0.00E+00	0.00E+00	0.00E+00	3.55E-02	0.00E+00	9.60E-02	6.14E-01	2.28E-01	1.36E+00	8.15E-01
S	2.70E+00	0.00E+00	0.00E+00	6.30E-02	2.47E-01	5.52E-02	6.44E+02	1.74E+02	1.06E+00	1.33E+01
SSW	1.16E+00	0.00E+00	2.09E-01	2.80E-01	4.67E-01	2.28E+01	2.16E+02	9.46E+01	2.54E+00	3.00E+00
SW	0.00E+00	1.72E-01	1.50E-01	4.33E-01	8.46E-02	1.60E+02	8.37E+01	2.20E+01	9.47E-02	1.28E-02
WSW	1.90E+00	0.00E+00	3.99E+00	9.52E-02	5.25E-02	8.10E+01	4.57E+01	2.77E+01	3.58E-01	0.00E+00
W	1.40E+00	2.57E+00	1.53E+00	0.00E+00	2.40E-01	3.66E+01	4.66E+01	2.30E+01	1.45E+01	0.00E+00
WNW	4.40E-01	1.00E-01	1.81E-01	1.26E+00	5.38E-01	1.83E-01	9.62E+01	2.20E+01	1.57E+01	1.56E+00
NW	9.10E-01	1.54E-01	2.31E+00	1.32E+00	1.86E+00	4.86E+00	2.32E+00	2.77E+01	1.09E+01	1.89E+00
NNW	0.00E+00	0.00E+00	1.82E+00	1.13E+01	2.65E+01	3.03E+01	1.03E+01	2.07E+01	2.75E+00	2.07E+00
Totals	1.38E+01	2.99E+00	1.02E+01	2.97E+01	6.58E+01	9.70E+02	1.16E+03	4.67E+02	1.38E+02	8.33E+01

2.94E+03