GENERAL ELECTRIC
VALLECITOS NUCLEAR CENTER
SAFETY EVALUATION REPORT

CHAPTER I

INTRODUCTION

1.1 Background

General Electric Company (GE) has been engaged in nuclear energy work at Vallecitos Nuclear Center (then called Vallecitos Atomic Laboratory) since the mid-50s. The original licensing of operations that involved special nuclear material (SNM) was done on a case-by-case basis as each new facility was constructed or activity was planned. A series of SNM licenses were issued to GE for fuel development work, engineering studies, and applied research and development services.

On September 14, 1966, the U.S. Atomic Energy Commission granted Special Nuclear Material License No. SNM-960 to cover all activities involving uranium and plutonium. The broad materials license superseded 10 specific licenses. The broad license permitted GE considerable latitude in making changes without the necessity of obtaining license amendments. The license allowed GE to change equipment, facilities and operating procedures providing certain standards, criteria and administrative procedures which are specified as license conditions are followed. A review of GE compliance history and of the related NRC inspection reports demonstrates the successfulness of the broad license concept with respect to the Vallecitos Nuclear Center's (VNC's) operations.

GE has applied for renewal of License No. SNM-960 with the intent of continued operation under the broad license concept. The current and proposed licensed SNM activities and possession limits are much reduced as compared to VNC's past authorizations. The NRC has reviewed this application with associated addenda and information submitted by GE for license renewal support. The review focuses on GE's safety-related functions and administrative controls as used at VNC to assure adequate health and safety protection to GE personnel, the public and the environment.

1.2 Authorized Activities

The renewed license will authorize GE to continue research and development activities, irradiated fuel and component examinations, and support services for reactor development. More specifically, the following activities will be authorized:

Product Processing Operations

- Development Shop. Fabrication, assembly, modification, cleaning and repair of unirradiated encapsulated (including encapsulation) experimental assemblies. Assembly, modification, cleaning, and repair (but not fabrication) of fuel elements for use in licensed facilities.

Laboratory Operations

- Chemical. Analysis of the chemical and isotopic composition, concentration and behavior of special nuclear materials by wet chemistry and physical measurement techniques.

- Metallurgical. Physical analysis and testing of physical and metallurgical properties of special nuclear materials.

- Physics and Health Physics. Measurements of radiation and its effects on instruments and on the structure and composition of materials.

- Hot Laboratories. Post-irradiation examination, testing and analysis of fuel elements and materials in shielded enclosures by remote manipulative techniques; research and development and/or pilot plant activities involving recovery and recycling of waste or nonspecification material.

- Research and Development. Including but not limited to the above.

General Services Operation

- Equipment Maintenance and Engineering. Design, fabrication and testing of equipment containing special nuclear materials and maintenance of such equipment.

- Storage. Storage of special nuclear materials other than wastes in shielded containers and/or at locations as applicable and in designated general purpose storage areas.

- Transportation and Transfer. Inspection of packaging and preparation for shipment and/or transfer of special nuclear materials.

- Decontamination. Decontamination of equipment and facilities.

Waste Treatment

- Liquids. Concentration of the radioactive constituents of liquid wastes by evaporation, chemical treatment, sedimentation, filtration and ion exchange; agglomeration and packaging of concentrates and discharge of processed effluents.

- Solids. Packaging and storage of wastes contaminated with or containing nonreclaimable special nuclear materials, excluding direct burial in soil.

Offsite Activities

- Nonnuclear, nondestructive modification, demonstration and testing of materials and devices containing unirradiated uranium and plutonium provided that:
  1. Such materials and devices shall be under the supervision of General Electric at all times, and
  2. Plutonium shall be fully enclosed at all times in containment devices of adequate integrity to reduce to an acceptably low level the possibility of release and/or to mitigate the consequences of containment failure.

1.3 Possession Limits and Places of Use

The quantities of special nuclear materials that will be authorized by the license renewal are as follows:

Vallecitos Nuclear Center

- U-235. 50 kilograms enriched to less than or equal to 10 percent for authorized activities. The material may be in the form of irradiated special nuclear material with its attendant by-product and reactor-produced transuranics.
- U-235. 4 kilograms enriched to more than 10 percent for authorized activities. The material may be in the form of irradiated special nuclear material with its attendant by-product and reactor-produced transuranics.
- Plutonium. 500 grams in any form in addition to the irradiated quantities as referred to above.
- U-233. 200 grams in any form.

Locations Other Than Vallecitos Nuclear Center

- Up to 15 grams of U-235 and plutonium and up to 170 grams of plutonium as encapsulated plutonium-beryllium sources may be used at other sites within the limits of the United States except where the material is subject to licensing by an Agreement State as defined in 10 CFR 150.
- SNM fully packaged as for transport in containers meeting all of the general license requirements of 10 CFR 71 or in containers owned by the General Electric Company and certified for transport under the provisions of 10 CFR 71 in accordance with the conditions of a certificate of compliance authorizing delivery of such containers to a carrier for Fissile Class I transport may be stored at locations within the United States which minimize the possiblity of mechanical damage and flooding providing such locations are controlled by the General Electric Company including provisions of adequate safeguards against theft or loss. Storage at nuclear reactor sites subject to the financial protection and indemnity

provisions of 10 CFR 140 shall be limited to possession for purposes of delivery to a carrier for transport. The requirements of 10 CFR 70.24 are waived insofar as this section applies to the materials contained in the above containers.

1.4 Scope of Review

The safety review of GE's license renewal application included an evaluation of: the revised application transmitted by letter dated April 5, 1984 and as supplemented by letter dated April 20, 1984, the VNC Nuclear Safety Procedures manual, VNC Emergency Plans manual, and the appropriate sections of the VNC Environmental Information Report. Also included was a review of the compliance history, certain in-plant records, the VNC organization, administrative controls; and radiation protection, criticality safety and fire safety capability. The staff utilized various site visits to inspect and review all facilities used in the handling of SNM and to review GE capabilities in the areas of radiation protection, criticality safety and fire protection.

An assessment of the capability of the VNC facilities to withstand natural phenomena events was performed. The results are presented in NUREG-0866, "The Effects of Natural Phenomena on the General Electric Company Vallecitos Nuclear Center at Pleasanton, California," dated December 1981. At the time the analysis was performed, GE VNC was authorized to possess 150 kilograms of plutonium and to conduct plutonium processing and fuel fabrication activities. The assessment was based on that level of operation. Currently and for the purpose of this review, GE VNC is authorized 500 grams of separated plutonium and is not authorized to conduct plutonium processing and fuel fabrication activities.

Comparative assessments were made against the requirements of 10 CFR 20, 10 CFR 70, the guidelines of applicable regulatory guides, and industrial standards and practices. Those used are identified in the appropriate sections of the evaluation.

1.5 Modifications as a Result of Regulatory Staff Review

The review of the VNC facilities and operations did not identify a need for modification.

1.6 Compliance History

The staff reviewed NRC inspection reports of VNC's activities under License No. SNM-960 and supplemented this analysis by discussion with Region V and VNC personnel. The review covered the period commencing September 1966 to the present. The following areas were examined:

- frequency of exposure incidents
- location of incidents
- causes of incidents
- Region V citations issued to VNC

In the review, the staff did not identify a pattern of chronic or repetitious problems with respect to the NRC regulations and license conditions.

CHAPTER 2

CONDUCT OF OPERATION

2.1 Introduction

GE currently operates within the regulatory sphere utilizing the broad license concept to meet or surpass the protective guidelines applicable for maintaining the health and safety of the public and to protect the environment. This concept of using certain standards, criteria and administrative procedures, which are specified as license conditions, to evaluate certain equipment, facility and operating procedure changes without obtaining a specific license amendment is a desired approach for an R&D operation; since by its nature GE is constantly modifying and upgrading the processes they are developing.

The broad license concept requires that the licensee, in addition to having adequate technical qualifications, should demonstrate competency through adequate internal administrative control procedures. The staff in its review compared the licensee's organization and controls with draft ANSI N299, Draft 6, "American National Standard Administrative and Managerial Controls for Operations of Nuclear Fuel Reprocessing Plants," dated April 19, 1976. This document is concerned with nuclear fuel reprocessing plants; however, items concerning organization, audit and review, and policies and procedures are generally applicable to all nuclear facilities. In its reference to organization, ANSI-N299 generally states that the facility organization should be clearly described. The positions and related responsibilities should be defined, the authority for discharging the responsibilities should be delegated in writing, the generic competence criteria for persons who are assigned to the position should be established, the individuals assigned as replacements on a temporary or continuing basis shall have the minimum training and experience required for the position, and the support functions should report to management independently of the operating organization. In that context, the following description of the current management organization and administrative procedures is provided.

2.2 Management Organization

All Vallecitos Nuclear Center (VNC) activities are conducted under the management of three organization components of the General Electric Company. They are as follows:

- Nuclear Engineering Division (NED),
- Nuclear Fuel and Special Projects Division (NF & SPD),
- Nuclear Services Operation (NSO).

The NF & SPD is primarily represented by the Irradiation Processing Operation (IPO). The IPO is responsible for the operation of the General Electric Nuclear Test Reactor, radioactive materials handling and inspection, radioisotope encapsulation, nuclear safety, and landlord activities at VNC. Another segment of the NF & SPD represented at VNC is the Advanced Nuclear Technology Operation (ANTO). The ANTO is engaged in the technological development for advance reactor fuels, performs materials testing and properties studies, and performs process development demonstrations. The other two GE components represented at VNC are primarily involved in BWR support activities. The NED provides the technical definition, quality requirements, and the design for all standard BWR product offerings except control and instrumentation. This includes the supporting research and development activities at the VNC site. The NSO provides consulting, retrofit, and upgrade services to operating nuclear power plant customers. This includes the radiological and special services and startup chemistry training for BWRs. The NSO does not conduct any SNM activities on site.

All Three organizational components (NED, NF & SPO and NSO) report directly to the Nuclear Energy Business Operations (located in San Jose, California).

An organizational chart illustrating the components discussed above and their relationship is given in Figure 2.2-1. The components shown under the dashed line on the chart are located at VNC.

The General Managers of the components at VNC have established a policy of protection of employees, the public, and the environs from potential industrial, radiation, and nuclear hazards that could occur through activities conducted in each component's facilities. They have delegated the responsibility for implementing this basic policy through line managers to the manager and supervisor of each activity in which radioactive materials are handled, used, or stored. Additionally, IPO has experienced and competent staff personnel to provide expert advice and guidance to all components in matters of radiation and criticality safety. The Manager, IPO, has been delegated in writing, the responsibility to act as the Chief Executive Safety Officer for all VNC operations involving radioactive materials. Industrial safety is provided for VNC by the Industrial Safety and Hygiene component at San Jose, California.

2.2.1 Nuclear Safety Organization

The Nuclear Safety Organization contains the appropriate functions and responsiblities that are associated with the conduct of a safe operation. This component reports directly to the IPO Manager (Chief Executive Safety Officer). It contains the appropriate expertise and provides the necessary safety and technical support so that the Chief Executive Safety Officer may effectively carry out his responsibilities. An organizational schematic of the Nuclear Safety Organization is shown in Figure 2.2-2. The pertinent responsibilities of this organizational component are as follows:

- Radiation Safety - Establish and administer a radiation safety program to insure the protection of employees and the general public. Provide monitoring support, a dosimetry program, an environmental monitoring program, and employee training in the methods for minimizing exposure through proper use of survey instruments and protective clothing and devices. Maintain all radiation exposure records required by regulatory agencies.

- Nuclear Safety Compliance and Review - Provide review of reportable incidents, new facilities or major changes to facilities and operations control standards, and professional advice and counsel on nuclear and radiation safety policy.

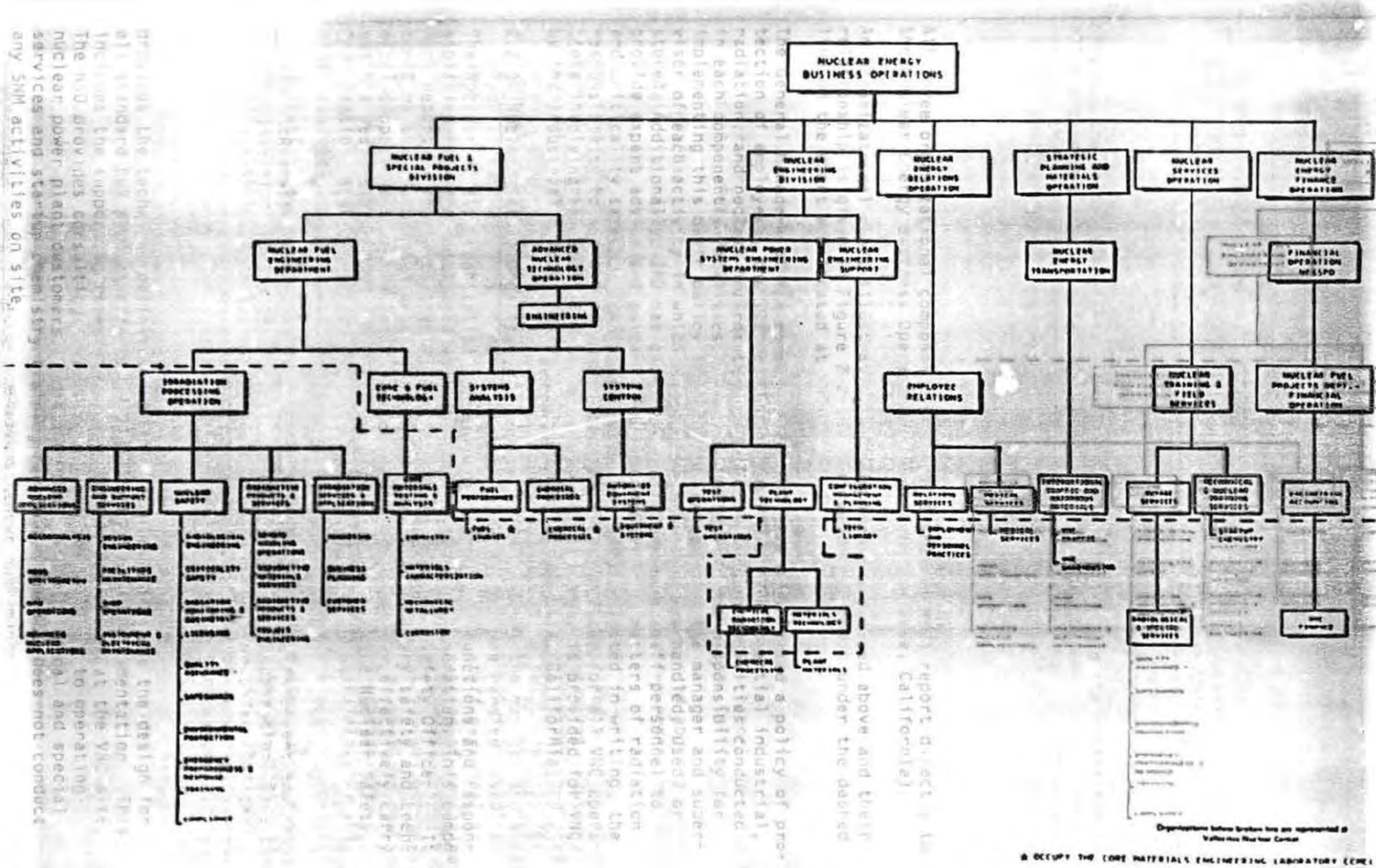


Figure 2.2-1 Vallecitos Nuclear Center Administrative Organization Chart

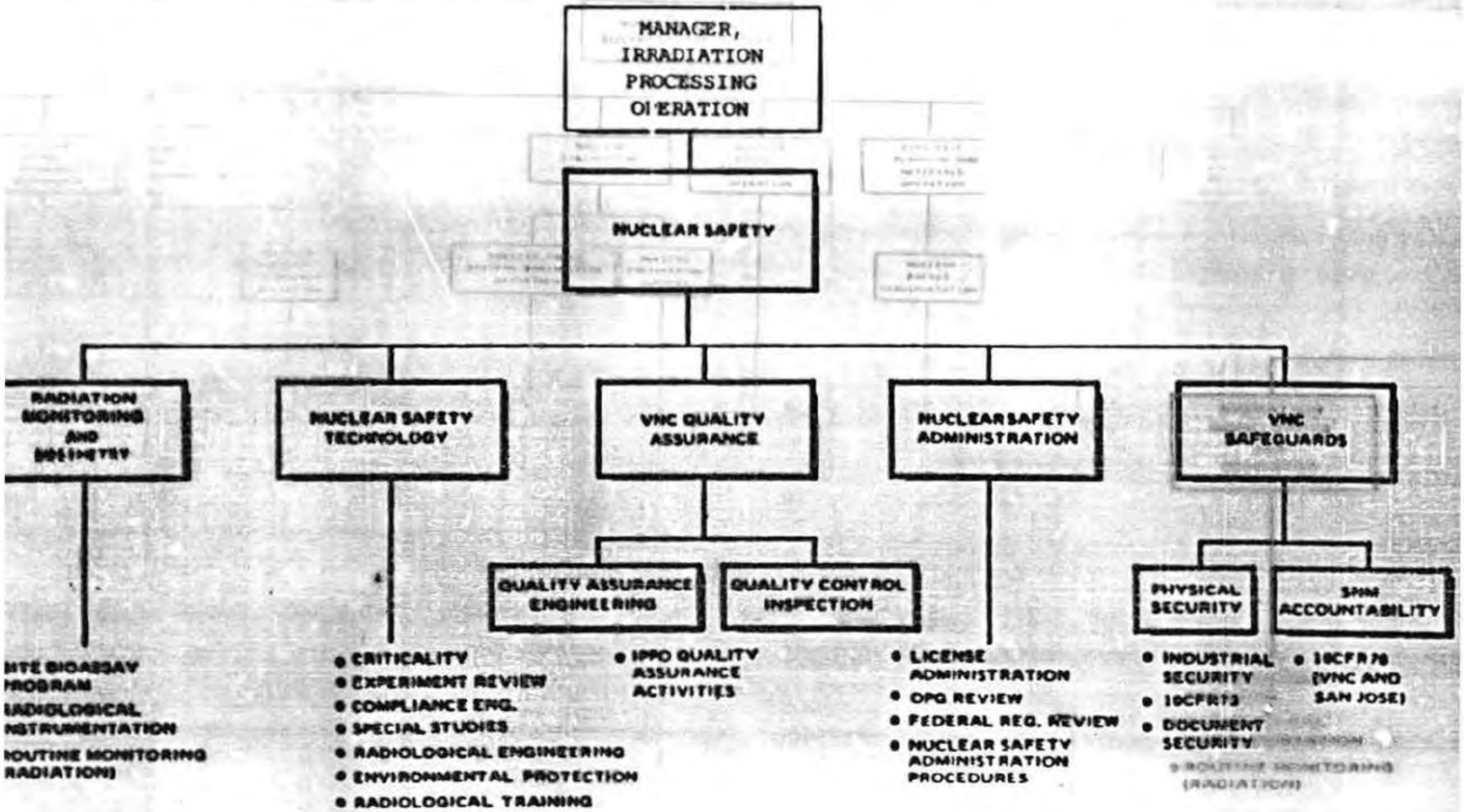


Figure 2.2-2 Nuclear Safety Organization

- Licensing - Represent VNC components in regulatory activities concerning radiation protection and licensing. Procure, administer and interpret NRC licenses and regulations, state and local government licenses and regulations and provide advice and counsel to VNC components and their customers on regulatory matters.

- Radiological Engineering - Assist in improving operation of VNC facilities and the overall radiation protection program through the analyses of existing systems, equipment and operation thereof and the recommendation of improved systems, equipments or methods.

- Training - Establish and administer a site-wide training program at VNC to ensure adequate knowledge of radiation control procedures.

- Criticality Safety - Perform criticality control analyses to establish safe batches, geometries, concentrations, and spacing of SNM and equipment. Audit the criticality control environment and conduct educational programs in criticality matters.

- Emergency Preparedness and Response - Maintain the site emergency plans current; coordinate and audit training, tests, drills, and exercises.

- Nuclear Material Safeguards - Establish and administer the basic SNM control system. Assure that SNM control policies and practices of all components are coordinated with the requirements of nuclear safety, licensing and shipping groups. Perform reviews of compliance with internal control procedures and regulatory requirements.

- Physical Security - Develop and operate security programs to safeguard classified information, SNM, and corporate property.

In addition to the Nuclear Safety Organization's safety functions as described above, other components located in San Jose, California, make significant contributions to the overall safety program. They are as follows:

- Transportation and Materials Distribution - Within traffic regulations, plan the transportation and receiving of incoming materials and shipments of outgoing products. Assure all radioactive materials shipments are in compliance with applicable Federal and State regulations.

- Industrial Health and Safety - Develop programs to protect the employees from industrial hazards, including operation of medical and safety education programs.

2.2.2 Vallecitos Technological Safety Council

While the Nuclear Safety Organization provides the necessary input to the administration for proper management of day-to-day activities, the Vallecitos Technological Safety Council, which is composed of senior site management and technical personnel, reviews changes in product design or services that are first of a kind or that require deviation from established parameters and reflect critically on product or operational safety. Assigned functions include site-wide management reviews and evaluations of VNC activities to assure that major areas of concern are identified, considered, and resolved. It also includes an annual review of the program performance, effluent releases and occupational exposures in terms of ALARA and focus on trends for corrective actions.

2.3 Administrative Controls and Procedures

VNC has developed an internal set of controls to assure continuity of operation and consistency in review techniques and administrative methods of operation within the VNC Nuclear Safety Organization. Procedures have been developed for initiation and review of all changes in existing and new equipment, design or location, storage areas, emergency procedures, limits, and or operating procedures authorizing change in nuclear criticality or radiation protection controls. These may be administered by VNC without specific review and approval of the NRC.

As part of procedure, a change authorization must be prepared, reviewed and approved prior to the initiation of the proposed change. This is the VNC mechanism for independently reviewing and documenting changes. Knowledgeable individuals prepare change authorizations which describe in sufficient detail the nature of the changes and the effects on safety. All change authorizations are reviewed by the initiating component, by the Nuclear Safety Organization and, as appropriate, by Industrial Safety, and are approved by the appropriate facility manager or his designated alternate. Qualifications or restrictions to improve safety may be added by the reviewers. The Nuclear Safety Organization has the responsibility for determining whether a proposed change constitutes an unreviewed safety question or license or technical specification violation. No change authorization may be implemented until review is completed and the change authorization is signed by the Manager of the Nuclear Safety Organization or his designated alternate.

VNC has also developed a series of VNC site safety standards as part of their nuclear safety program. The following categories are included in the VNC site safety standard framework: administration, dosimetry and bioassay, radiation surveying, air sampling, instrumentation, audits, reviews, training and emergency coordination. The principal features of several of these standards, representative of most of the categories, are summarized as follows:

- Administrative - These standards describe the VNC Nuclear Safety Program and are intended to promote a more formal approach to keeping doses ALARA, to identify and promote continuance of good practices, and to promote further improvements where practicable.

- Dosimetry and Bioassay - There are several standards in this category including the administration of the VNC bioassay program for monitoring possible internal contaminants by urine and fecal analysis and whole body counting, and the issuance, collection, and data control of film badge and other dosimeters for monitoring external exposures.

- Radiation Surveys and Air Sampling - Standards in this category define radiation survey work routines, air sampling routines, special survey actions, action to be taken when performing personnel decontamination, and transfers, shipments and receipts of radioactive material.

- Instrumentation - Included in this category are standards describing various types of radiation protection instrumentation, and their operation and calibration.

- Audits - Included in this category is a standard describing the independent review and audit functions performed by the Nuclear Safety Organization.

- Reviews - There are several standards and procedures in this category all dealing with informal and formal review activities of the Nuclear Safety Organization against operating component procedures activities, technical specifications, and appropriate regulations. Included are compliance reviews, radiological safety reviews, criticality safety reviews, experiment reviews and change authorization reviews.

- Radiological Contingency Plan - This procedure describes the detailed functions and responsibilities of nuclear safety personnel during emergency situations.

2.4 Personnel Training Programs

VNC has established training programs for those personnel responsible for handling radioactive material and those providing support to the various activities. The training programs are designed to assure an adequate understanding by the employees of the hazards and complexities of handling radioactive materials from the standpoint of both radiological and nuclear criticality safety. The initial and continuing training program is designed to develop an understanding of rules and procedures and to promote safety consciousness and sound safety practices.

Responsibility for training in radiation and criticality safety lies with the individual area managers. The VNC safety standards require the area managers to evaluate radiation hazards associated with radiation areas under their supervision and to ensure that employees are instructed in specific hazards in their work areas. In support of the area managers, the GE organization provides for a criticality safety component and a radiation safety component that have the expertise and the obligation to provide training for VNC employees as appropriate.

Records of individuals receiving training courses are kept in a central computerized record file.

2.4.1 Radiological Safety Training

Every new employee at VNC receives a radiation safety orientation, "New Employees Radiological Safety Orientation," within thirty days of reporting to the site. Employees who handle radioactive materials or whose duties involve aspects that may affect radiological and/or criticality safety are instructed in radiation protection and as appropriate criticality safety (see Section 2.4.2, "Criticality Safety Training") such that he is able to protect himself and is made aware of the degree of hazard involved. A training program entitled, "Radiological Safety At Vallecitos Nuclear Center," must be successfully completed by each such employee before he may enter posted radiation areas unless escorted by an individual who has successfully completed this training. This course is scheduled and conducted by the radiation safety component.

The training course includes the following elements:

- Basic principles of radiation and criticality safety,
- Company policies and operating procedures,
- Radioactive materials handling methods and shielding requirements,
- Emergency procedures,
- Requirements of NRC regulations, and
- NRC license requirements.

Follow-up training commensurate with the work environment and the employee's work performance is determined by employee supervision. The employee also receives on-going training in the form of on-the-job demonstrations, periodic safety meetings, etc.

Employees whose work assignments may include the need for the use of respiratory protection equipment also receive the "Respiratory Protection Training Course" (RPTC). The course provides both instruction and hands-on experience in the proper use and fitting of the respiratory protective equipment. RPTC includes the following topics:

- Regulatory requirements on respirator usage,
- Qualification of respirator users,
- Description and selection of respiratory equipment,
- Use and care of respiratory equipment, and
- Mask fitting.

2.4.2 Criticality Safety Training

Those employees whose duties involve aspects that may affect criticality safety are instructed in the principles of criticality safeguards and are made aware of the degree of hazard involved. This instruction normally is completed within one year after the employee's starting date at that facility. Prior to completion of this course the same restrictions placed on employee access to radiation areas apply as discussed in Section 2.4.1, "Radiological Training." The instruction is established by the criticality safety component and includes:

- Nuclear fission,
- Conditions for achieving nuclear criticality,
- Hazards associated with criticality,
- Prevention of accidental criticality,
- Criticality detection systems, and
- Case histories of criticality accidents.

Area supervisors are responsible for informing all personnel at work, or otherwise present in their area, of the specific procedures for criticality control and for appropriate administrative action to assure compliance with these procedures.

2.4.3 Training for Handling Radiation Emergencies

GE has established procedures detailing the response of employees to radiation emergencies. In general, employees evacuate buildings and assemble in designated locations. Individuals designated by the Nuclear Safety Organization are responsible for assessing the magnitude of the hazard and evaluating exposures or contamination of employees, for which several rapid analysis techniques are used. Emergency drills are conducted, and the records and critiques of each drill are retained by GE.

2.4.4 Other Training Programs

Radiation monitors receive the "Radiation Monitoring Technicians Certification Course." This is an intensive six-week training program designed to qualify participants as VNC certified radiation monitoring technicians.

Other courses are available from the radiation safety component on an as-needed basis. Some examples are training in radiation detection instrumentation and work in high dose-rate fields.

2.5 Radiological Contingency Plan

On February 11, 1981, the NRC issued an Order to GE to submit a radiological contingency plan in accordance with NUREG-0762, "Standard Format and Content for Radiological Contingency Plans for Fuel Cycle and Materials Facilities," dated July 1981. The review of that plan was performed independent of the license renewal review and the results of that review are presented in Appendix A, "Safety Evaluation Report - Radiological Contingency Plan Specific to License No. SNM-960." Based on that review, the following determinations were made:

- VNC is properly configured to limit releases of radioactive materials and radiation exposures in the event of an accident,
- Capability exists for measuring and assessing the significance of accidental releases of radioactive materials,
- Appropriate emergency equipment and procedures are provided onsite to protect workers against radiation hazards that might be encountered following an accident, and
- Necessary recovery actions will be taken in a timely fashion to return the plant to a safe condition following an accident.

Incorporated into the proposed renewed license is a condition which requires GE-VNC to implement, maintain, and execute the response measures of the radiological contingency plan.

2.6 Audits and Reviews

Written review and audit programs have been prepared by VNC. They define the scope of the programs, designate the personnel and their area of competence, the frequency of audits, required audit documentation, and define the areas to be audited. The specific areas audited include the operations and controls for: personnel and environmental radiation protection, nuclear criticality safety, industrial health and safety, quality assurance, and the overall safety program.

The Vallecitos Technological Safety Council (VTSC) reviews annually the site safety and compliance program performance. This includes effluent releases and occupational exposures in terms of ALARA and focuses on trends for corrective action as necessary. The VTSC consists of at least five senior members of GE's technical and/or management personnel appointed by the Manager, Irradiation Processing Operation, and includes completence in the physics, chemistry and engineering disciplines.

Further details on the conduct of VNC radiation safety and criticality safety programs are presented in Chapters 4 and 5 of this evaluation.

2.7 Conduct of Operations Evaluation

The staff concludes on the basis of the review and comparison with the proposed guidelines in the draft ANSI-N299 standard that the management organization and administrative controls are adequate to protect health and minimize danger to life and property [10 CFR 70.23(a)(2) and 10 CFR 70.23(a)(4)].

CHAPTER 3

SITE AND FACILITY CONSIDERATIONS

Licensed activities are conducted by General Electric at Vallecitos Nuclear Center (VNC) near Pleasanton, California. This chapter discusses the type of facilities, their uses and engineered safety related features.

3.1 Site Description

The site for the activities licensed under SNM-960 consists of 1594 acres about 7 miles southwest of the town of Livermore, Alameda County, California. The location of the VNC site related to surrounding communities is shown in Figure 3.1-1. The site perimeter is shown in Figure 3.1-2. Vallecitos Road, State Highway 84, forms the southern boundary of the site with approximately 7000 feet of road frontage. The east and west site boundaries run due north with an extended section in the northwest corner as shown on the map. All the structures and facilities at VNC are located in the southwest corner of the property.

3.2 Facility Description

Figure 3.2-1 depicts the various areas and structures. A general view (looking toward the northeast) of the VNC building complex is shown in the aerial photograph, Figure 3.2-2. The large group of buildings in the foreground of the photograph is the 100 Area, consisting of laboratories, the Nuclear Test Reactor (NTR), shops, and a warehouse. In the upper left corner is the 200 Area with the large domed reactor containment building for the General Electric Test Reactor (GETR) and its cooling tower just to the left (shut down since 1977). The two domes and tall stack in the upper right corner are the Vallecitos Boiling Water Reactor (VBWR) and the Empire State Atomic Development Vallecitos Experimental Superheat Reactor (EVESR) in the 300 Area. Both of these reactors are shut down, for an indefinite period. The liquid waste evaporator facility for the entire site is housed in Building 349. In front of this area are the man-made reservoir, Lake Lee, and Buildings 400 and 401. Buildings 400 and 401 house laboratories and administrative offices.

The principal SNM operations are in Buildings 102, 103, and 400. Irradiated fuel examination and associated fission product handling are performed in the hot cells of the Radioactive Materials Laboratory on the main floor of Building 102. The Chemistry, Metallurgy, and Ceramics Laboratory is in Building 103; and the Plant Chemical and Radiation Technology Laboratory is in Building 400.

An important fire safety feature common to all VNC facilities is that they are equipped with a fire sprinkler system.

Plutonium processing was performed primarily in the former Advanced Fuels Laboratory in the basement of Building 102. GE has discontinued its mixed oxide fuel fabrication operations and has decontaminated and decommissioned that part of the VNC operation. The NRC staff evaluation of the decontamination and termination of the plutonium activities is presented in Appendix B. The Advanced Fuels Laboratory, now designated the Core Materials Engineering Laboratory, will be used for developmental work using depleted, natural and/or low enriched

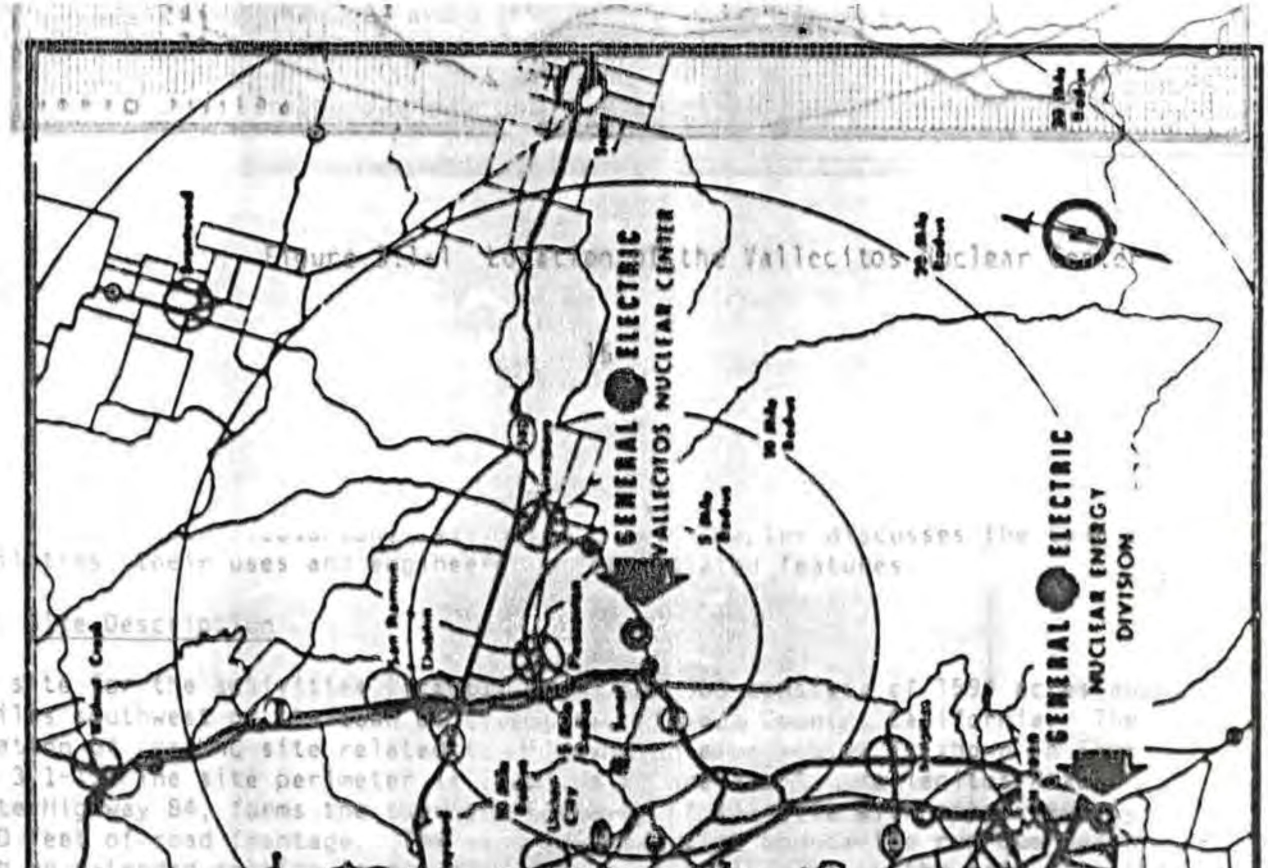


Figure 3.1-1 Location of the Vallecitos Nuclear Center

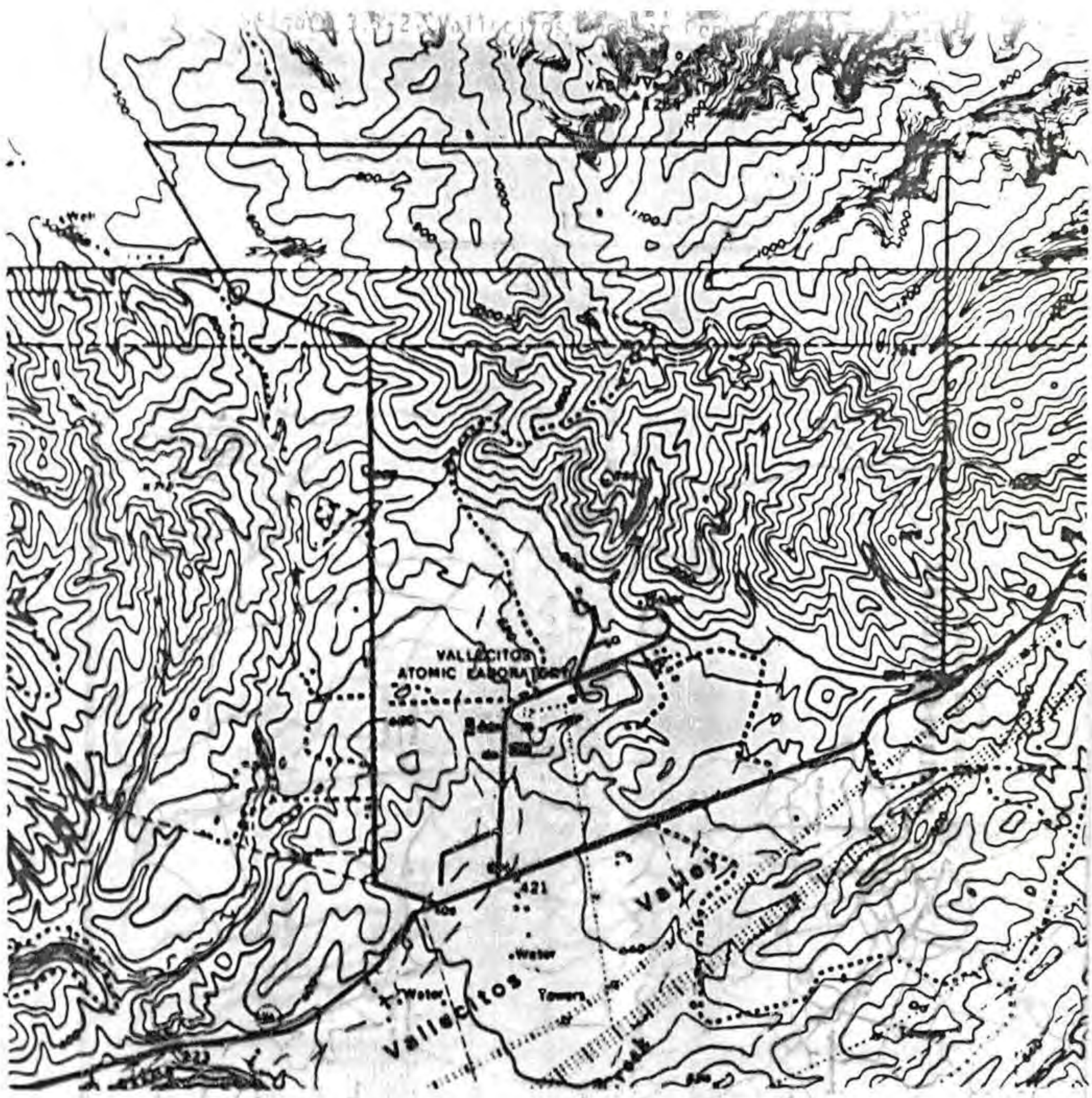


Figure 3.1-2 Vallecitos Nuclear Center Site Perimeter

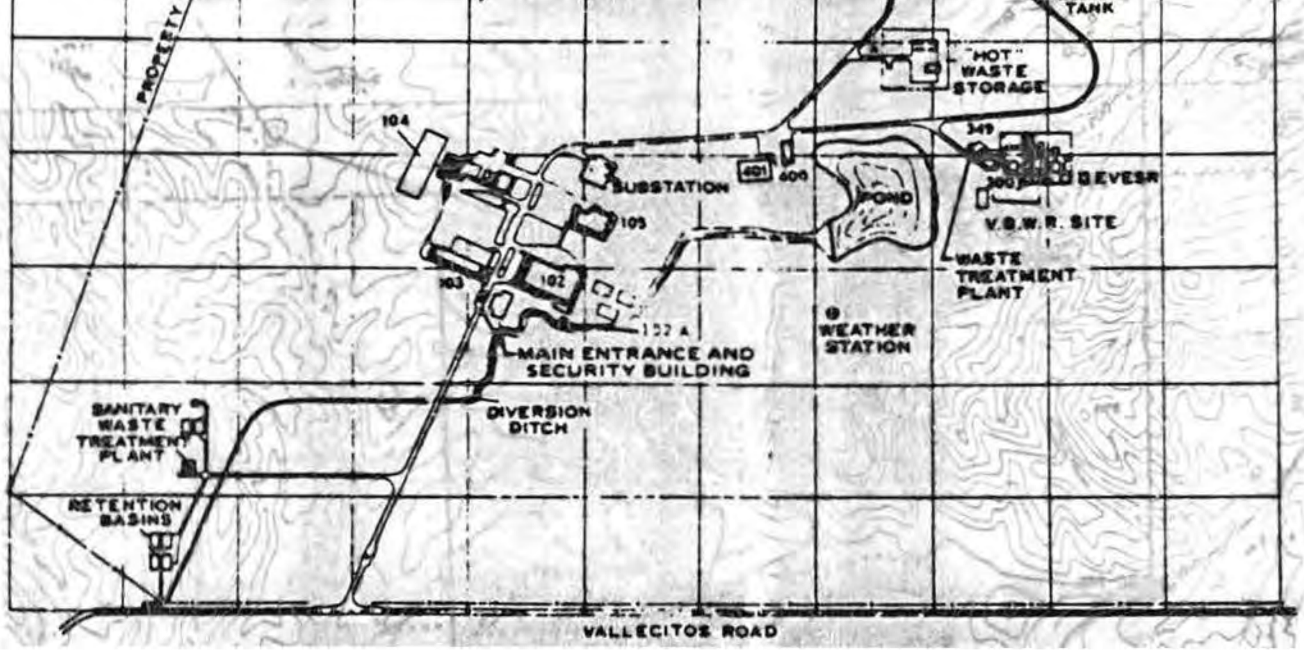
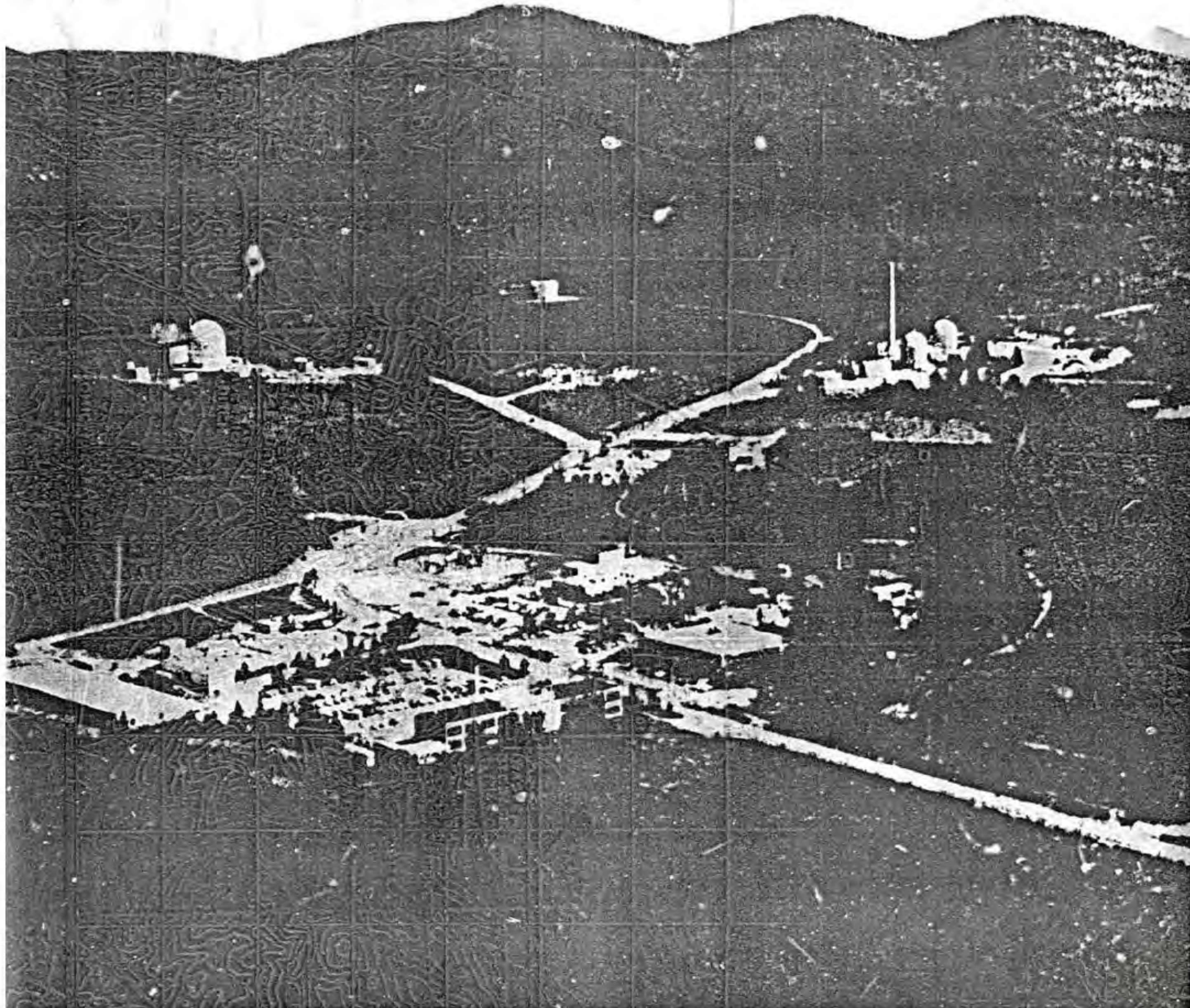


FIGURE 3.2-1 Vallecitos Nuclear Center Building Locations



allecitos Nuclear Center Building Complex - Aerial Photograph

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uranium materials. Incorporated into the renewal license is a condition which requires GE-VNC to inform NRC of any planned activities using unencapsulated plutonium in the Core Materials Engineering Laboratory.

3.3 Research and Development Operations

The requirements of 10 CFR 70.22, the judgment of the staff based on experience in similar operations, and the safety history of VNC's specific operations (an in-depth review was made of the VNC's operations documentation and the NRC inspection reports) were used in assessing the safety of the operations discussed below.

3.3.1 Operations Description

Major SNM operations at Vallecitos Nuclear Center are conducted in the Core Materials Engineering Laboratory and Radioactive Materials Laboratory in Building 102; the Chemistry, Metallurgy, and Ceramics Laboratory in Building 103; and the Plant Chemical and Radiation Technology Laboratory in Building 400. The staff reviewed the safety of normal operations and the capability for safe shutdown during abnormal conditions. The review included the following:

- Reliability and maintainability of process systems and components,
- Testability and redundance of safety-related systems and controls,
- Introduction of feed materials into the process,
- Normal inventories and control of fissile material in the process,
- Removal of waste streams to appropriate waste handling systems, and
- Specific unit operations in each process step.

3.3.2 Core Materials Engineering Laboratory - Building 102

The Core Materials Engineering Laboratory (CMEL) facilities are located in the basement of Building 102. The material received, processed and used in the CMEL are restricted to uranium as depleted, natural and/or $\leq$ 5% enriched and natural thorium. With special permission from the nuclear safety component, small quantities of higher enriched uranium (>5% $\leq$ fully enriched) also may be brought into the CMEL for testing purposes. The laboratory is used for a variety of materials testing and properties studies, and process development demonstrations. These materials generally are in the form of pelletized solids (oxides), but other forms including nitrates and powdered oxides occasionally may be used. The received materials are stored in their containment vessel in the CMEL vault, or in Building 102J in their shipping containers.

Materials are confined, contained, and controlled by means of glove boxes, fume hoods, and similar equipment designed and constructed to meet the needs of the types and quantities of materials being used. Procedures have been established which provide for the transfer of materials to or from storage containers or between process development operations. Fume hoods and special glove box-like enclosures are available for decontamination of equipment or containers. The fume hoods and special enclosures have a minimum airflow face velocity of 125 linear feet per minute.

Fire extinguishers are available where there is a potential for fire generation. The CMEL is equipped with a fire sprinkler system. This system is interconnected to the site alarm system.

3.3.3 Radioactive Materials Laboratory - Building 102

The Radioactive Materials Laboratory (RML), located on the main floor of Building 102, provides a high-level shielded facility for non-nuclear testing and examination of irradiated reactor fuels, materials and components. Figure 3.3-1 provides the layout of the RML. Although there are a number of hot cells in the RML complex, special nuclear material under License No. SNM-960 is handled predominately in Hot Cells 1, 2, 3, 4, and 5. The work in these cells is mainly post-irradiation fuel examination work and work involving various radioisotopes including encapsulation and the examination of experimental fuel capsules. Cell No. 5 is used for metallographic and micro-hardness examinations. The type of special nuclear material used in connection with the RML operations are principally in the form of oxides.

Occasionally, other cells, Nos. 6, 9, 10 and 11, are used in support of research and development activities as authorized under License No. SNM-960. The quantities of SNM associated with these activities are limited to contamination adhering to such items as test specimens (e.g., irradiated fuel cladding samples).

The primary safety consideration employed in this review was the adequacy of the equipment and facilities used in the aforementioned activities. The following sections discuss important characteristic features associated with the RML.

High Level Cells

The High Level Cells (Hot Cells 1, 2, 3 and 4) are the principal locations where work on irradiated material is performed. Each of these cells can safely handle more than 1×10^6 Ci of 1 - MeV gamma activity. The cell walls are 36 inches thick up to a height of 12 feet, where they are reduced to 24 inches to take advantage of reduced shielding requirements and to provide a set-back for overhead manipulator rails. The shielding material is a high-density concrete made with ferro-phosphorous aggregate. The windows in the observation, manipulator, and periscope ports are 3-foot-thick of 6.2 gm/cc density lead glass. Shielding is provided in the vertical direction by a 3-foot-thick concrete roof above the cells.

Each of the cells has a 6-foot-long radiation lock for entry from the access corridor. The radiation locks are formed by hydraulically operated bi-parting steel shielding doors.

Services are generally introduced to the cells through specially adapted shielding plugs.

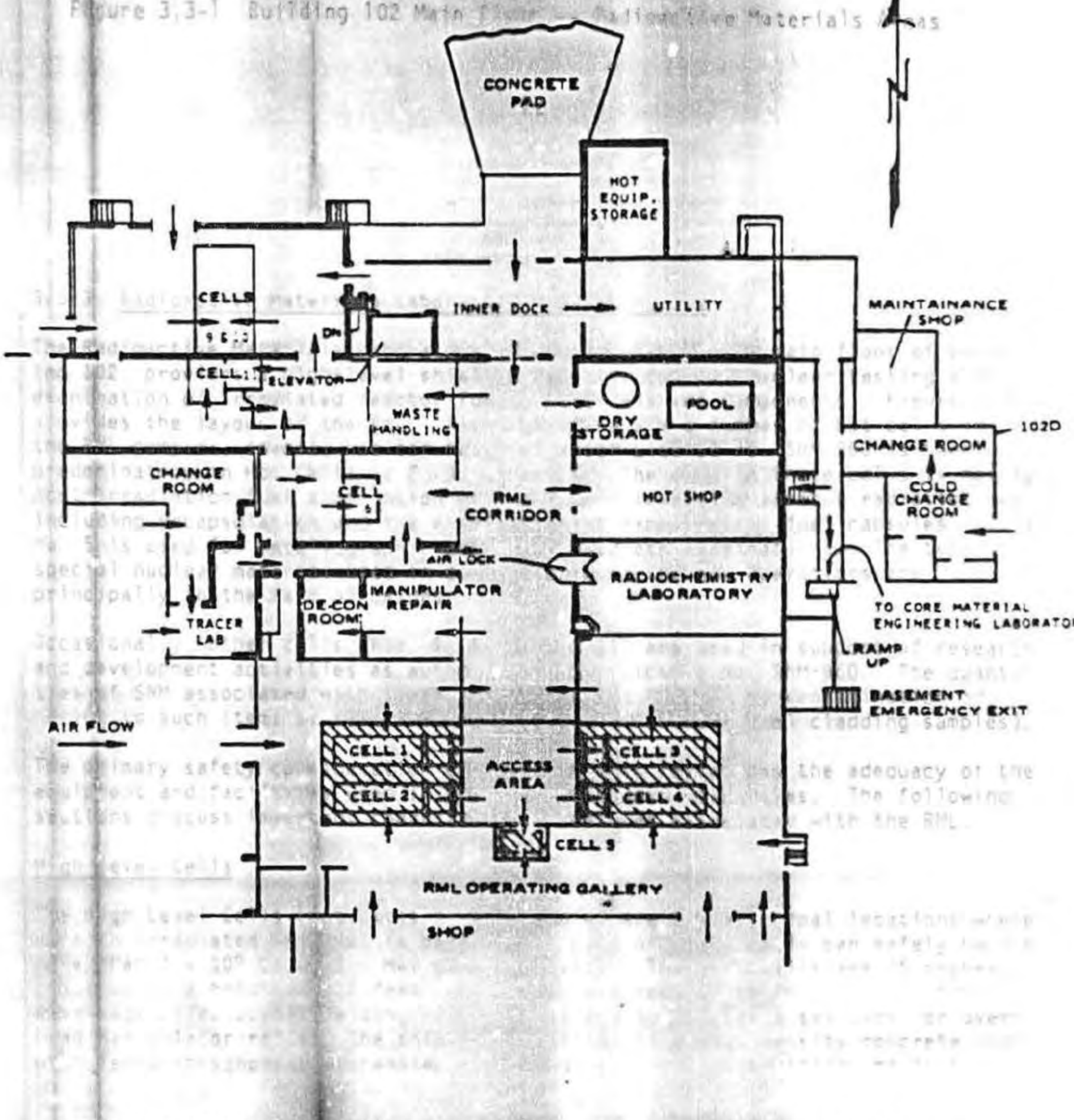

Figure 3.3-1 Building 102 Main Floor -- Radioactive Materials Areas

Metallographic Cell

A smaller cell, No. 5, is use for metallographic work. In particular, this cell is used for the preparation of samples for metallographic examination and micro-hardness testing. It contains remotely operated equipment for sample mounting, polishing, cleaning, and etching, and a 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, which opens onto the access corridor, contains a safe-type door for equipment and personnel access. Metallographic or micro-hardness test samples are introduced through this entry port by means of a special transfer cask.

Pool Facilities and Dry Storage Pit

In support of the RML operations is a 16-foot by 8-foot by 16-foot deep water pool used for underwater cask transfer, examination, repairs, assembly or disassembly, and storage of irradiated material.

The pool is equipped with the necessary underwater portable tools and lights to properly service the casks and their contents. An overhead crane is available to handle the cask in the pool or on the room floor. A filtered exhaust port is located adjacent to the pool. The pool water is circulated at about 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.

A shielded in-floor dry storage pit is located immediately adjacent to the RML water storage pool for temporary storage of irradiated fuel assemblies, rods, or other rod-shaped material.

Radiochemistry Laboratory

The Radiochemistry Laboratory, used principally for the analysis of samples of irradiated fuel materials from the RML, is located immediately adjacent to the RML area. Only sample quantities of special nuclear material are handled in this laboratory, and all material is handled in hood or glove boxes. The hoods and glove boxes (should a glove fail) are designed to provide a minimum face velocity of 125 linear feet per minute.

3.3.4 Chemistry, Metallurgy and Ceramics Laboratory - Building 103

Special nuclear material is used in research and development (R&D) activities including analytical chemistry, test specimen fabrication, instrument maintenance and calibration work, and for sources of radiation necessary to support R&D programs. At the conclusion of experiments, radioactive materials are reworked, reused, stored, transferred offsite to authorized persons, or discarded as wastes. No isotopic separation or processing of special nuclear material is conducted except as necessary for experimental and analytical purposes.

Safety considerations include positive control of limited quantities and types of samples being handled. Only standard analytical procedures are carried out in the glove boxes and hoods. Toxic or flammable chemicals are allowed and used only in limited quantities. Liquid waste streams resulting from the laboratory activities are analyzed and transferred to the waste treatment facility at Building 349.

Handling of Special Nuclear Material

Only microgram quantities of plutonium are handled in the Chemistry, Metallurgy, and Ceramics Laboratory Building 103. Small quantities of other relatively low-level radioactive materials are also handled in support of many diverse research and development projects, and monitoring and surveillance programs.

Storage Facilities

A storage vault is provided on the ground floor of the building for storage of special nuclear material. Specific limits are established and imposed on the storage of enriched uranium and source material for criticality, accountability, and safeguards control.

3.3.5 Plant Chemical and Radiation Technology Laboratory - Building 400

The Plant Chemical and Radiation Technology Laboratory (PC & RTL) is used for the development of chemical processes and prototype equipment to support fuel manufacturing components of General Electric. The PC & RTL contains mostly specialized laboratories. A scrap recovery pilot process used for research and development activities is located along the south wall of the high bay area in Building 400. This is an experimental facility used to investigate scrap recovery processes for low-enriched uranium oxide fuel scrap.

Handling of Special Nuclear Material

The only activity performed under License No. SNM-960 at the PC & RTL is an enriched uranium scrap-recovery chemical process. This recovery process is carried out in a pilot plant that receives most of the feed material from GE's fuel fabrication plant at Wilmington, North Carolina. There is a maximum inventory limit of 500 grams of enriched uranium permitted in this building at any one time. No criticality control procedures are performed other than accurate maintenance of the inventory. The scrap-recovery operation is a solvent extraction process normally using 30% tributyl phosphate and 70% dodecane as the organic phase and HNO_3 (0.15 M to 8 M) as the aqueous phase. As a safety measure, the organic solvent is maintained at 74°C or lower. Any nitrous oxide from this process is converted by a catalytic converter to nitrogen and water. Contaminated waste material is placed in DOT-specification 55-gallon drums for delivery to the "Hillside" waste storage area.

3.4 Service and Support Systems

The principal service and support systems are:

- ventilation,
- confinement,
- electrical,
- compressed air and gases,

- steam,
- water, and
- cold chemical.

3.4.1 Ventilation

GE has provided ventilation systems that incorporate High Efficiency Particulate Air (HEPA) filters whenever special nuclear material is handled at Vallecitos Nuclear Center. The staff considered all SNM activities that have a potential for contaminating the ventilation air and concluded that the significant activities are in Building 102, 103, and 400. These three locations are the only ones where special nuclear material is handled in unencapsulated form or in single-wall containers. Therefore, the evaluation is focused on these three buildings.

The ventilation systems provided by GE-VNC condition the air supply, direct air flow from office areas to areas of progressively higher potential for contamination, and filter the exhaust to the environment through two to three stages of HEPA filters.

Staff Review

The ventilation systems at the buildings where special nuclear material is handled were reviewed using Regulatory Guide 3.12, "General Design Guide for Ventilation Systems of Plutonium Processing and Fuel Fabrication Plants," August 1973; ERDA 76-21, "Nuclear Air Cleaning Handbook," and "Industrial Ventilation - A Manual of Recommended Practice," as standards for comparison. The review included the following:

- System Capacities and Flow Direction. The supply and exhaust fans operate in a push-pull mode at a capacity sufficient for the design flow rates of the systems. Final exhausts from Building 102, Building 103, and Building 400 are normally 56,400, 36,000, and 16,000 cubic feet per minute, respectively. The system backflow preventers, dampers, and flow paths are adequate to direct air flow from areas of lesser to areas of higher potential for contamination. The operating areas are supplied at a minimum of 6 air changes per hour and a maximum of 40 changes per hour. A minimum of 6 air changes per hour is being exhausted from the Radioactive Materials Laboratory's cell spaces. This amount of airflow through the cells is adequate for control of contamination.

- Air Pressure and Balance. Small static negative pressure differentials with respect to the atmosphere (0.01 to 0.03 inch of water) are maintained for the isolation of the thin-walled general work areas. Intermediate negative pressure differentials (0.02 to 0.2 inches of water) are used to isolate hot cells. (See "System Capacities and Flow Directions" for hot cells contamination control via airflow through the cells.) Maximum negative pressure differentials (from 0.5 to 1.0 inch of water) are used at the glove boxes to maintain contamination control and to assure the maintenance of minimum air velocities (125 linear feet per minute) across any opening during normal or accident conditions.

Appropriate instrumentation to indicate air flow direction and/or differential pressure has been provided. Operating area managers have the responsibility to assure that air pressure and flow balance are maintained for the ventilation systems in their area.

Emergency Safety Features. At Building 102, in the event of the loss of utility power, emergency power is provided by a 335 kW diesel-driven electric generator. The generator is activated automatically by power loss. All critical equipment normally supplied with normal power through the main building switchboard will be supplied with emergency power. This equipment includes two exhaust fans, fans supplying air to areas where radioactive materials are handled, and the main stack monitoring equipment. The emergency generator also provides emergency power to the criticality alarms, the breathing air alarm (loss of pressure alarm), the fire alarms, and an annunciator panel which transmits these alarms to the security building. Emergency power is not available at Buildings 103 and 400.

Air Filtration. In Building 102, the exhaust air is routed to Building 102A via overhead ducts. At Building 102A, this exhaust air is passed through a filterbank of 90 HEPA filters and then discharged to the atmosphere through a 66-inch diameter, 75-foot stack. Exhaust air from the Radioactive Materials Laboratory Hot Cells is prefiltered at the outlet of each cell and is routed to a filter bank of 10 HEPA filters in the Building 102 basement before it joins the main exhaust stream and is routed to Building 102A. Two activated charcoal filters are available as needed.* Exhaust air from the glove boxes and hoods located in the Core Materials Engineering Laboratory-East is filtered first through HEPA filters located on each glove box or hood and then is passed through a HEPA filterbank in the laboratory's exhaust duct before joining the main Building 102 exhaust stream. The exception to this is the pressurized glove boxes. The pressurized glove boxes are not equipped with filters and rely on the building filtration system (i.e., the glove box exhaust air passes through the HEPA filter bank in the laboratory's exhaust duct then through the HEPA filter bank in Building 102A). The pressurized glove boxes are not permitted to contain plutonium as per license condition specified in Appendix A, Table 1, "Equipment and Facility Design Criteria and Guidelines" of the renewal application. Exhaust air from glove boxes and hoods located in other Core Materials Engineering Laboratory areas is filtered at the glove box or hood and then routed to Building 102A for final filtration.

In Building 103, air is drawn from the hoods and glove boxes through individual HEPA filters at each outlet. The exhaust flow is then passed through a final stage of 40 HEPA filters and discharged through a 5-foot diameter, 48-foot high stack.

*The Change Authorization procedure (see Section 2.3, "Administrative Controls and Procedures") is the VNC control function used to assure that, if charcoal filters are necessary for a new activity, they will be incorporated into the design of that activity prior to the initiation of that operation.

In Building 400, room air is withdrawn through selected hoods that have HEPA filters at the outlet. Exhaust from the high bay area is also HEPA - filtered. All the effluent air is collected in a central duct and exhausted through a single stage bank of 18 HEPA filters to a 45-foot high stack. An auxiliary exhaust system consisting of 6 HEPA filters and another 45-foot high stack is provided as a standby.

- Filter Testing. All ventilation exhaust HEPA filters at Vallecitos Nuclear Center are dioctyl sebacate (DOS) testable and must pass routine DOS tests of 99.97% efficiency for a single filter and 99.95% for a filter bank.

Ventilation Evaluation Conclusions

Based on the Regulatory Guide and Industrial Standards used for comparison and on the judgment of the staff, we conclude that the ventilation systems provided by GE for Vallecitos Nuclear Center's special nuclear material handling facilities are satisfactory for normal and potential abnormal operating conditions. Emergency power to the stack samplers at Buildings 103 and 400 is not deemed necessary because of the type of operations, quantity and type of material used in these two buildings does not warrant stack sampler data during a power outage (see Sections 3.3.4 and 3.3.5).

3.4.2 Confinement

Primary barriers for SNM confinement at the facility are provided by the process equipment, hoods and most importantly, glove boxes. The glove box system works with the ventilation system described in Section 3.4.1, so that leakage of air is normally into the glove box. The glove boxes are sealed enclosures constructed of welded stainless steel or aluminum framework onto which are clamped gasketed panels or windows. Manual operations within the gloves boxes are performed through gloves that are sealed to open ports in the glove box panels. HEPA filters are installed at supply and exhaust ports in each glove box. Fume hoods and special glove box-like enclosures are provided with an airflow of at least 125 linear feet per minute face velocity.

The exception to this is the two pressurized glove boxes in the CMEL. The uranium is not in a readily dispersible form. The operations conducted in the glove boxes are pyrophoric metals work in one and special welding techniques in the other. Both require an inert atmosphere, particularly the glove box housing the pyrophoric metals work. Plutonium is not permitted in either glove box.

The secondary confinement barrier consists of rooms, building walls, and the building ventilation systems. The exterior walls are of concrete or cinder block construction, and the roofs are flat decking covered with rigid insulation and built-up roofing with a top coating of gravel.

The confinement barriers and standard methods of containment in the GE process buildings were reviewed using as a standard for comparison Regulatory Guide 3.18, "Confinement Barriers and Systems for Fuel Reprocessing Plants," February 1974.

Conclusions

The controls used to maintain the integrity of the primary confinement system, consisting of process equipment, glove boxes, and the ventilation system, meet the intent of the applicable portions of Regulatory Guide 3.18.

The integrity of secondary confinement barriers and systems in all process buildings is adequate. Well-engineered equipment and responsible operation and control of the systems have contributed to safe confinement practices.

3.4.3 Electrical Systems

Electrical power is required to sustain important safety functions such as exhaust fan operations, alarm systems, other instruments for equipment control, and security operations. Alternate supply systems and emergency generators are used to provide reliable operation of these systems even under abnormal load conditions. The plant is serviced by a single feeder line from a Pacific Gas and Electric distribution line to the site's main substation.

In the event of the loss of utility power, emergency power is provided to Building 102-102A by a 335 kW diesel-driven electric generator. The generator is activated automatically by power loss and will reach full capacity within 1 minute. All critical equipment supplied with normal power through the main building switchboard will be supplied with emergency power. This equipment includes two exhaust fans, fans supplying air to areas where radioactive materials are handled, and the main stack monitoring equipment. The Building 102 emergency generator also provides emergency power to the criticality alarms, the breathing air alarm (loss of pressure alarm), the fire alarms, and an annunciator panel which transmits these alarms to the security building.

Procedures and equipment exist in the Radioactive Materials Laboratory to allow sequential startup of safety-related systems powered by the emergency generator. Plant experience has shown a minimum number of outages in recent years, and GE has no significant problems in maintaining control of the necessary emergency equipment. In the other buildings where there are no battery back-up systems (except for emergency lighting), operating procedures require shutdown in the event of a power loss.

GE has provided the appropriate emergency power system to support the type and level of SNM activities conducted in Building 102. With respect to the SNM activities conducted in locations other than Building 102, the level and type of SNM used permits an orderly and safe shutdown of activities if a loss of power occurs. In the judgment of the staff, GE has provided adequate electrical systems.

3.4.4 Compressed Air and Gases

Breathing Air

Breathing air is required for certain activities such as cell clean-up and decontamination. The respiratory equipment currently in use at VNC is approved by the National Institute of Occupational Safety and Health (NIOSH). U.S.

Divers Company's Survivair self-contained breathing appratus (SCBA) are available for emergency situations. Master cylinders of breathing air are obtained from a commerical vendor.

Service Air

Air compressors to supply process or instrument air are very limited. Instead, nitrogen gas is used for these purposes. To prevent over-pressurization of glove boxes, double pressure regulating valves (PRVs) and limited-supply tanks are used.

Forming Gas

Bottled preblended gas obtained from an offsite vendor is used to supply a mixture of 6% hydrogen - 94% inert gas, or argon-CO_2. This provided a reducing atmosphere for uranium trioxide (UO_3), thus oxygen-to-metal (O:U) ratios may be determined by reducing the UO_3 and weighing powdered pellets. The preblended gas is analyzed by both the supplier and GE before being used.

Hydrogen, Natural Gas and Other Flammable Supplies

All hydrogen gas used in laboratory work has been preblended with an inert gas. Flammable gases used for laboratory bench operations are supplied from standard gas bottles. There are natural gas lines to all buildings containing special nuclear material. However, all of these lines have been plugged and bottled gas is used. This minimizes the need for flammable gas detectors.

3.4.5 Steam Systems

The only significant use of steam in SNM-960 operations is in the radioactive waste evaporator in Building 349. Steam condensate is collected in monitoring tanks. It is sampled and analyzed before release as liquid industrial waste. If the condensate is contaminated it is recycled through the waste evaporator and analyzed. It is not released and flash evaporated until radioactive contaminants are essentially eliminated.

3.4.6 Water Systems

In considering the water systems layout, the major concern is preventing backflow of a contaminated stream into an entering water line. Most of the water lines to contaminated processes or areas are connected to limited tank volumes of 30 to 40 liters. The use of air breaks in conjunction with limited volume systems and backflow preventers is adequate in preventing backflow of a contaminated stream.

3.4.7 Cold Chemical Systems

Because the Vallecitos Nuclear Center is primarily a research and development facility rather than a production facility, no significant quantities of any particular chemical are handled. Chemicals are handled on a small batch basis, prepared as needed by laboratory or production personnel for the widely diversified processes and operations in Buildings 102, 103, and 400.

Safety practices reviewed included chemical handling procedures and the use of air breaks between the cold supply tanks and the end-use points inside a glove box or hood to avoid contamination of cold chemical supplies. In the judgment of the staff, the GE method for handling cold chemicals is safe and compatible with radiological safety requirements.

3.5 Radioactive Waste Management

The staff reviewed the controls GE has provided for reducing radioactive contaminants in airborne and liquid effluents to the environment and in solid waste shipments to offsite burial facilities.

3.5.1 Airborne Radioactive Effluents

All normal ventilation exhaust from glove boxes containing plutonium passes through a minimum of three stages of HEPA filters. Ventilation exhaust from sources of lesser potential for special nuclear material contamination is filtered through a minimum of two stages of HEPA filters.

The staff examined the historical records of the airborne effluent from the GE operations at Vallecitos Nuclear Center from 1971 through 1983. During that period GE has maintained release concentrations well below the 10 CFR 20 Appendix B limits for concentrations in air above natural background in unrestricted areas (site boundary). For the purpose of this review, the 1983 effluent data was used since it should best represent current and projected levels of operation at VNC. The total airborne releases (stack emmissions) for 1983 are as follows:

Alpha Particulates:	<2.90 µCi	(Predominately radon-thoron daughter products)
Beta-Gamma Particulates:	<59.4 µCi	
Iodine-131	<0.50 µCi	
Noble Gases:	1.14×10^{3} Ci	

The data above are derived by summing data obtained from measurements of short-interval releases. Many of the measurements on these releases were found to be less than the detection limits of standard laboratory instruments. The data listed include the multiple summation of these detection limits and therefore represent the maximum releases possible from VNC activities during the calendar year. The noble gas activities recorded integrate background readings with the actual releases, which, in some cases, account for 40 to 50% of the activity recorded. The Nuclear Test Reactor (operating under License No. R-33), located in Building 105, and the xenon processing (conducted under the California State Source and Byproduct Material License No. 0017-59), performed in Building 102, are the primary contributors to the noble gas releases. There are no License No. SNM-960 activities conducted in Building 105.

The data include all active stacks at the site. It is estimated that only 23% of the alpha release is from SNM-960 activities. Similarly, 37% of the beta-gamma release, and 5% of the iodine-131 releases are attributed to the SNM activities.

The principal source of airborne radionuclides from special nuclear material activities may be attributed to the Radioactive Materials Laboratory operations. Assuming that all of the airborne radionuclides, except for noble gas releases from the xenon processing, released through Building 102 exhaust ventilation system is from SNM-960 activities and averaging the concentrations over one calendar year, the following concentrations are derived for Building 102A stack release point:

Alpha Particulates:	8×10^{-16} μCi/cm^3
Beta-Gamma Particulates:	3×10^{-14} μCi/cm^3
Iodine-131:	3×10^{-14} μCi/cm^3

Depending on the atmospheric dispersion factor, the stack concentration will be diluted by a factor of from 1,000 to 10,000 on reaching the site boundary. Thus, the average annual Vallecitos Nuclear Center (VNC) effluents will be a small fraction of the 10 CFR 20 Appendix B limits for concentrations in air above natural background in the unrestricted area (site boundary) and radiation doses to members of the public attributable to these releases will be negligible.

3.5.2 Liquid Radioactive Waste Management

Industrial liquid waste released from the site contains only trace quantities of radioactivity at small fractions of 10 CFR 20, Appendix B limits for concentrations in water above natural background in the unrestricted area. There is no release of waste solutions that have come in direct contact with special nuclear material.

Waste solutions from the process are solidified in 55-gallon drums for disposal, and other contaminated waste waters are collected for treatment at the Radioactive Liquid Waste Evaporator Plant, Building 349. Waste water that is normally not contaminated is collected in one of four retention basins for sampling and analysis to assure that contamination limits are not exceeded upon subsequent release. Each retention basin has a capacity of 60,000 gallons. The industrial waste water collected in the retention basins is monitored for gross alpha, gross beta, gamma, ^{89}Sr, ^{90}SR, ^{3}H, ^{137}Cs, and ^{60}Co. The influent waters from the San Francisco water supply system is also monitored for the same type of radionuclides as is the effluent waters. The results of the radioactivity measurements indicate essentially no difference between measurements of influent and monthly composites of industrial effluent. Table 3.5-1, "Water Effluent-Three Month Composite," shows the quarterly effluent composites for 1983 and compares them to the 10 CFR 20, Appendix B limits for concentrations in water above natural background in the unrestricted area.

3.5.3 Solid Radioactive Waste Management

The wastes containing the most significant quantities of special nuclear material are items such as irradiated fuel specimens, which have been examined and analyzed at the Building 102 hot cell complex. Some of the wastes are delivered to a licensed waste contractor while others are stored at the Hillside Storage complex. Other radioactive wastes ordinarily contain only gram or milligram quantities of special nuclear materials. The majority of the wastes fits the Low Specific Activity (LSA) category as defined in the Department of Transportation regulations.

TABLE 3.5-1 WATER EFFLUENT - THREE MONTH COMPOSITE

			pCi/l		
PERIOD	^{239}Pu	$^{89/90}Sr$	^{3}H ($\times 10^4$)	^{137}Cs	^{60}Co
1/1/83 - 3/31/83	0.109	0.743	0.0243	4.55	-0.74**
4/1/83 - 6/30/83	0.092	0.625	0.0572	5.74	1.16
7/1/83 - 9/30/83	0.0324	0.332	0.0271	-4.28**	-1.48**
10/1/83 - 12/31/83	0.0014**	0.819	0.0367	1.71	0.143**
MPC*	5000	300	300	20,000	30,000

* Maximum permissible concentration.

**Actual measured values within the statistical background.

Dry contaminated wastes are placed in sealable drums, tubes, boxes, or casks available at each laboratory or facility where such wastes may be generated. Small amounts of liquid wastes incompatible with evaporation are solidified directly in 55-gallon drums. Each laboratory or facility maintains a designated area for temporary waste storage.

Liquid waste concentrates from the evaporator at the Radioactive Liquid Waste Evaporator Plant, Building 349, are collected in a receiver and discharged into plastic-lined DOT Specification 17-H 55-gallon drums. The concentrates then are 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. The drums, as loaded, are in compliance with appropriate DOT regulations. Solidified waste contained in drums is monitored, tagged with type, curie content and radiation level, and stored awaiting removal from the Vallecitos site by a licensed waste disposal contractor or other approved methods. Waste drums are not buried at the VNC site.

The final holding place for the solid waste is the site radioactive material storage facility, Hillside Storage. This facility consists of two parts: (1) a vertical well facility for storage of 55-gallon drums of waste, and (2) a horizontal tube facility for storage of high level radioactive material contained in sealed encapsulations called "waste liners." Appropriate measures in terms of radiological and criticality considerations are taken to assure safe storage prior to shipment.

For each waste accumulation, the generating component is responsible for maintaining a list of all materials in the accumulation. Each accumulation with its listing is forwarded to an organization component, referenced as the Waste Handling Function (WHF), for final inspection and/or repackaging. (This is done at Building 102.) The WHF is a single organizational component that has been lesignated by VNC management as responsible to assure that all solid wastes eaving the site meet the 10 CFR Part 20, 10 CFR Part 61, and DOT regulatory equirements.

3.5.4 Conclusions

Based on Vallecitos Nuclear Center effluent release data and experience with similar facilities, the staff concludes that the High Efficiency Particulate Air (HEPA) filtration of airborne effluents, the evaporator treatment and solidification of radioactive liquids, the collection and monitoring of potentially contaminated liquid effluents, and the handling and shipment to offsite burial of solid radioactive wastus practiced by GE provides an acceptable radioactive waste management program for Vallecitos Nuclear Center SNM-960 activities.

3.6 Fire Protection

The SNM-960 operations at Vallecitos Nuclear Center are carried out in several buildings, each of which is considered in GE's fire protection program. The fire protection program emphasizes tight control over the use of combustible materials, installation of engineered safety devices, and training of personnel. Automatic water sprinkler system protection is provided throughout the site.

The principal locations where special nuclear material is handled in a releasable form are Buildings 102, 103, and 400. In these buildings, fire could result in releases of radioactive material. Therefore, the fire protection features at these buildings were compared to industrial practice as well as Regulatory Guide 3.16, "General Fire Protection Guides for Plutonium Processing and Fuel Fabrication Plants."

3.6.1 Building Construction and Equipment

The SNM-960 activities of primary concern are conducted in Building 102, the Chemical, Metallurgy, and Ceramics Laboratory in Building 103, and the Plant Chemical and Radiation Technology Laboratory in Building 400. These buildings are constructed of concrete block and metal including the roofs, which are precast slabs on concrete beams or on steel bar joists. The roof coverings are of builtup asphalt and gravel. Interior partitions are concrete block or metal on metal studs.

In the Radioactive Materials Laboratory (RML) of Building 102, the special nuclear material is contained in hot cells that are constructed of walls built to a minimum thickness of 18 inches of high density concrete and of leaded glass windows of the same thickness. In the Core Materials Engineering Laboratory (CMEL) of Building 102, the SNM activities are conducted in glove boxes and hoods. Buildings 103 and 400 are constructed of concrete, but plexiglas windows and polyvinyl chloride (PVC) tubing are used in the process equipment.

3.6.2 Engineered Fire Protection

Automatic water sprinkler system protection is provided throughout the site. In addition to these systems, other conventional fire protection devices are included as discussed below.

Fire Detection

Automatic fire detection and alarm systems are installed in critical areas of the VNC. The operations in Building 102 and its final ventilation exhaust filter system in Building 102A are monitored by detectors that are strategically located throughout the two buildings. The types of detectors used to protect the RML and CMEL operations are:

- Fixed temperature (Notifier Model A135 and Model A200),
- Ionization (PYR-A-LARM Model DIS 315A), and
- Rate of rise (PYR-A-LARM Model DTR 180P).

The detectors are supplemented by manual alarm boxes at exit doors. The detection system is grouped into subzones for location identification. The associated alarms are annuciated locally and displayed remotely at the security building. No automatic fire suppression systems are activated by this fire detection system.

Filters in the ventilation system of Building 102 are protected by fire detectors that, in addition to alarming, also automatically activate fire suppression systems. The RML Hot Cell ventilation exhaust HEPA filters, charcoal filters, and the exhaust ducts leading from the RML to Building 102A are protected by coincidence-type detectors (Kidde ATMO Model 500-1 and Model CSD thermistor tube) or by set-point type detectors (MERCOID MX 51-R-153) that activate the fire suppression devices described in the next section.

Fire Suppression

Availability of water for fire suppression is assured by the location of the normal drain of a 500,000-gallon domestic water supply storage tank. Pipe drainage from the tank is so designed that the bottom 100,000 gallons of water can only be used for fire protection. The main source of water for VNC is the 200 million gallons per day capacity Hetch-Hetchy aqueduct of the San Francisco Water and Power Department System located approximately 3 miles south of the site. Water is supplied from the Hetch-Hetchy aqueduct by means of a 14-inch line capable of supplying over 3,000,000 gallons per day.

Manual fire suppression is provided by the following capabilities.

- Trained site personnel fire crews are available.
- Mutual aid support arrangements with fire departments in the surrounding communities have been organized.
- Portable fire extinguishers are provided in strategic locations throughout the site. The extinguisher types are water, dry chemical, Met-L-X, and carbon dioxide (CO_2).
- When a fire in one of the RML hot cells is detected, personnel are alerted through the alarm systems to initiate fire suppression action with the extinguishers provided.

- Adequate fire hydrants and hose houses are provided at buildings throughout the site including Buildings 102, 103, and 400.

- Final exhaust HEPA filters in Building 102A are protected by a manually operated water spray system.

- Each ventilation duct leading from Building 102 to the final exhaust HEPA filters in Building 102A is provided with manually actuated water mist systems.

Automatic fire suppression is provided in the following locations.

- The rooms in Buildings 102, 102A, 103, and 400 are protected by automatic sprinkler systems.

- RML Hot Cell exhaust HEPA filters in the basement of Building 102 are protected by a two-ton Cardox CO_2 fire suppression system controlled by a set of coincidence detectors.

Buildings 103 and 400 rely on the automatic water spray systems and do not include additional spray protection for the final ventilation exhaust HEPA filter systems.

3.6.3 Administrative Controls

The fire protection component at Vallecitos Nuclear Center is part of the Industrial Safety component. (This component is located in San Jose, California.) An individual is assigned as site Fire Marshal and as Specialist, Industrial Safety and Fire Prevention. This individual is responsible for developing fire protection programs, procedures, and evaluations. In addition, the ultimate responsibility for operational safety lies with the supervisor or manager of each activity at the site.

3.6.4 Conclusions

The fire protection at Vallecitos Nuclear Center was compared with industrial practice as well as Regulatory Guide 3.16, "General Fire Protection Guides for Plutonium Processing and Fuel Fabrication Plants." The fire protection component at Vallecitos Nuclear Center includes an individual who, as Site Fire Marshall, maintains fire protection activities at acceptable levels such that the facility is assigned a preferred risk category by its insurance agency. The staff concludes that the systems provided by GE-VNC for fire detection and suppression are acceptable.

REFERENCES, CHAPTER 3

1. C. A. Burchsted, A. B. Fuller, and J. E. Kahn, "Nuclear Air Cleaning Handbook," ERDA-76-21 (March 1976).

2. M. M. Schuman, Chairman, Committee on Industrial Ventilation, "Industrial Ventilation - A Manual of Recommended Practice," 14th Ed., American Conference of Governmental Industrial Hygienists, Lansing, Michigan (1974).

CHAPTER 4

RADIATION SAFETY

The review covered the description of the GE-VNC management policy, design of facilities, organizational structure regarding radiation protection, and the use of operating experience in reducing occupational exposure. Also examined were the method and techniques used for developing plans and procedures for assuring that occupational radiation exposure will be As Low As Reasonably Achievable (ALARA). The review included an analysis of VNC's policy, plans, and organization as compared with Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," December 1975. Also, where appropriate, it was compared with applicable portions of Regulatory Guide 8.8, "Information Relevant to Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," December 1975, and Battelle Pacific Northwest Laboratories Report entitled, "A Guide to Good Practices at Plutonium Facilities," BNWL-208, September 1977.

4.1 Radiation Safety Administration

4.1.1 Organization and Authority

GE has established a policy of protection of employees, the public, and the environment from potential radiation and nuclear hazards that could occur through activities conducted at VNC. GE has delegated the responsibility for implementing this basic policy through line managers to the manager and supervisor of each activity in which radioactive materials are handled, used or stored. The basic line and staff relationships for the radiation safety program is illustrated in Figure 4.1-1. The Manager, Irradiation Product Operation, has been delegated responsibility to act as the Chief Executive Safety Officer for all VNC operations involving radioactive materials.

The program for protection against radiation hazards is implemented by means of functional responsibility assignments. Managers are responsibile for integrating and measuring the effectiveness of line and staff participants in the program. More specifically, it is the responsibility of the manager to:

- Take all necessary steps to plan and organize the work of his component in accordance with approved radiation safety standards and operational procedures,
- Identify needs for operational procedure revisions when there is a planned change in process conditions such as types or quantities of radioactive materials or equipment modifications, and
- Integrate the results of reviews, inspections, engineering assessments and investigations made by the radiation safety component to correct or improve operational procedures, controls and performance.

An area manager is required to be proficient in the application of the VNC radiation protection program as it relates to limitations and radiological controls on work activities in his assigned radiation or radioactive materials area.

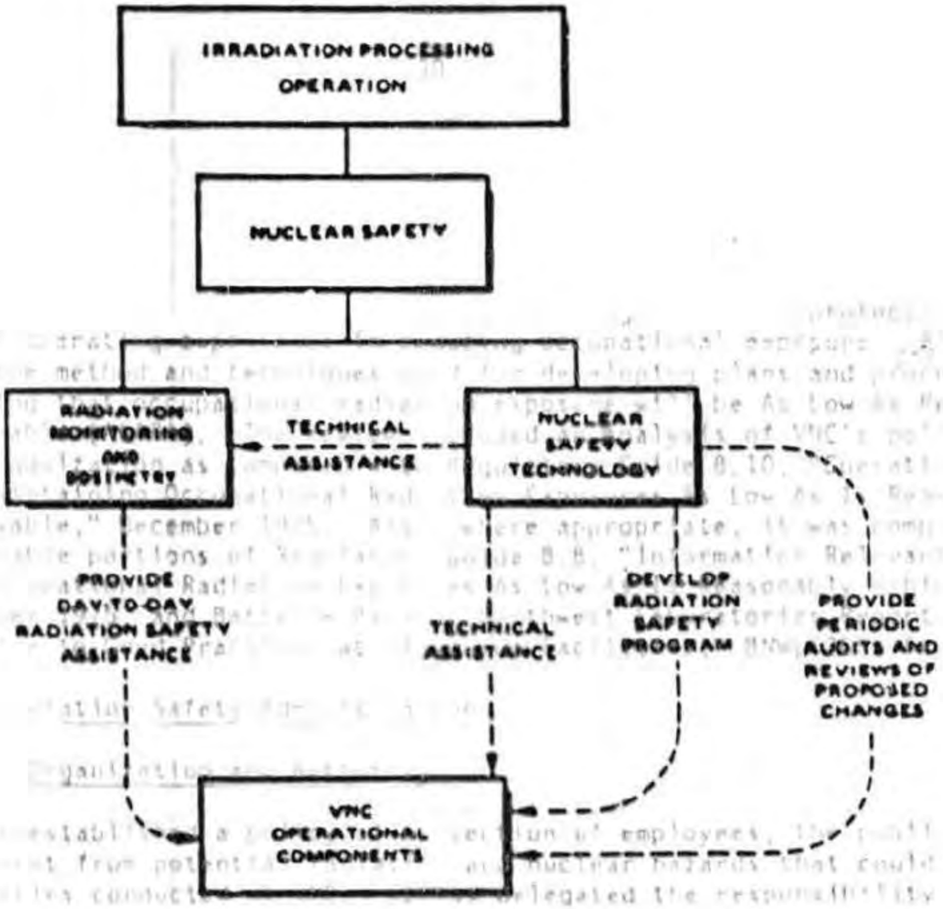

Figure 4.1-1 Radiation Safety Structure

The responsibilities of the radiation safety component are as follows:

- Establish and administer, through a system of instructions, a radiation control program and maintain all radiation exposure records required by regulatory agencies,

- Review and approve new operations in the design stage, identifying potential hazards and providing recommendations for their avoidance through education, training methods, and equipment application,

- Review and approve requests for allocations of radioactive materials, within licensed quantities, to individual user groups after thorough investigation of the proposed detailed procedures, equipment and the qualifications of persons who will be responsible for using such materials. Maintain records of allocated quantities,

- Inspect each radiation area to assure compliance with radiation safety procedures and limits, and

- Provide GE management with reports of inspection results showing trends in activities involving radioactive materials.

The minimum qualifications of personnel assigned functional responsibilities in the radiation safety component are as follows:

- Manager - B.S. degree in science or engineering with five years experience in assignments involving radiation protection,

- Specialists - B.S. degree in science or engineering with two years experience in assignments involving radiation protection or eight years of experience in health physics or radiation protection, and

- Monitors - High School with two years monitoring experience or two years of college and four months experience; and successful completion of a General Electric certification program which includes written and oral examinations covering radiation protection procedures and/or criticality procedures.

4.1.2 Radiation Work Permit

In addition to the change authorization and other related review procedures that are discussed in Chapter 2, "Organization and Administrative Procedures," VNC uses a Radiation Work Permit (RWP) system. This permit system requires authorization to undertake a specific operation which will require special consideration for radiological safety. The RWP system provides a formal way in which to communicate the required precautions, and other information necessary for the radiation protection of the personnel. The RWP also provides VNC with a method of regulating access to controlled radiation areas, and a mechanism for evaluating the training, area familiarization, experience, and qualifications of personnel who will be working with radioactive materials at the site.

4.1.3 ALARA Commitment

GE management subscribes to the philosophy of maintaining occupational radiation exposures as low as reasonably achievable (ALARA). The principal mechanism for reducing radiation exposures is through the use of the Change Authorization systems, as discussed in Chapter 2, "Organization and Administrative Procedures." As part of the Change Authorizations procedures, consideration of ALARA is an important factor in the review and approval of a Change Authorization request. Basic implementation of the policy of keeping exposures ALARA is accomplished by three means:

- A site-wide Nuclear Safety Organization that performs the independent review required by VNC licenses and provides professional health and safety related judgment of VNC activities,
- A senior safety council, Vallecitos Technological Safety Council, that reviews the effectiveness and relevance of site safety programs, and
- Periodic safety meetings and employee bulletins used to remind employees of the importance of maintaining exposures ALARA.

Operations and activities are also reviewed for exposure reduction potential. The nuclear safety procedures at VNC call for five ways to approach ALARA exposures at VNC. They are as follows:

- Maintain a viable radiation protection program,
- Establish VNC exposure limits,
- Improve general housekeeping practices around VNC activities,
- Provide training, education, and incentive programs, and
- Improve performance in those areas and for those activities identified as high dose-producing.

4.2 Radiation Safety Controls

4.2.1 External Radiation Exposure Control

Whole body dose from external radiation is minimized by limiting the exposure rate at each work station and by tracking the accumulated dose for each individual by means of dosimeter and film badge results. Monthly compilation of film badge and dosimeter results are used to identify those areas in which personnel are receiving the highest exposures and to administratively control the total accumulated doses. These data are also used to predict annual totals and to evaluate trends.

Radiation dose rates have been measured at all work stations and other routinely occupied locations within the radiation areas for normal and anticipated glove box inventories. In general, the radiation levels in Buildings 102, 103, and 400 are low, with dose rates higher than 2 mR/hr in only a few locations.

4.2.2 Internal Radiation Exposure Control

VNC uses a confinement approach, when possible, to minimize the possibility of bodily intake. The confinement system consists of primary containers, glove boxes, hot cells, and the ventilation system. This provides barriers between the workers and potentially hazardous materials. To monitor the effectiveness of the confinement techniques, alpha and beta-gamma continuous air monitors (CAMS) are located in areas where there is a possibility for airborne radioactive material. The filters on the CAMS are changed daily and the recorder charts are examined for trends. Source checks are performed weekly. The CAMS are fitted with audible alarms.

Continuous air sampling, contamination surveys and a bioassay program are also used as part of the radiation surveillance program. VNC is extensively covered by fixed air sample locations. Filters are changed at frequencies from daily to weekly with most being semiweekly. Routine contamination surveys and a bioassay program provide back-up measurements for internal exposure monitoring. These are discussed later in this chapter.

In the conduct of the research and development program, occasions arise requiring personnel entry to areas with airborne contamination in excess of the concentrations listed in 10 CFR 20, Appendix B, Table 1. For those occasions, through the Radiation Work Permit system, provisions for respirators, protective clothing and lapel air samplers are made. The VNC respirator program is conducted in accordance with 10 CFR 20.103(c). The respiratory equipment currently in use at VNC is approved by the National Institute of Occupational Safety and Health (NIOSH). As a policy, VNC has adopted only equipment that is approved by NIOSH. The VNC respirator program follows the applicable recommendations of Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection."

4.2.3 Contamination Control

Daily smear surveys are used for areas where contamination might first be expected, such as glove ports, laboratory and change room floors, and other working locations. Weekly smear surveys cover all laboratory space including flat surfaces, tops of glove boxes, and seams and joints of glove boxes where there could be leakage. Special surveys are also conducted as warranted by the suspected or potential presence of radiation or radioactive material.

Presented in VNC's nuclear safety procedures are detailed instructions addressing smear surveys and related action levels for various types of areas being surveyed. In the event that local area smears indicate activity levels exceeding the specified action level for that area, the individual performing the survey will notify the area supervisor for corrective actions (i.e., decontamination of the area as appropriate). Examples of prescribed action levels are as follows:

- Contamination free areas such as offices, hallways and lunch room are smear surveyed and checked to assure that no detectable, loose contamination (alpha, beta and gamma) is present,
- Clean Areas such as hot cell operating areas, Core Materials Engineering Laboratory and the Building 102A filter room must have smear results < 100 cpm beta-gamma and < 200 dpm alpha, and

- Normally contaminated areas such as the Hot Cells main operating corridor are controlled to < 10K cpm beta-gamma and < 200 dpm alpha for total area smears. (Beta-gamma is counted with a HP-210 probe.)

4.2.4 Bioassay Program

The VNC bioassay program serves as a backup for the radioactive material contamination surveys as well as serving to establish the quantities of internal contaminants from known exposures. Bioassay at VNC includes both urine and feces; however, only urine is sampled on a regular basis, whereas feces samples are taken when an overexposure is suspected. The sampling frequency is quarterly, semiannually, or annually depending upon the individual's required work. Samples are screened monthly. A commercial laboratory is used for plutonium and americium analysis, whereas the VNC Analytical Laboratory performs the analysis for uranium, gross beta, and specific alpha, beta, and gamma emitters.

Nasal smears are taken following unusual operations or suspected exposures. The nasal smears are first checked with portable instruments and then sent to the site counting room. As a matter of course, all employees suspected of having inhaled radioactive material are given a whole body count and/or a bioassay schedule as appropriate for the involved isotopes. In the case of possible alpha inhalation, lung counts may be obtained at Lawrence Livermore National Laboratory (LLNL), Livermore, California. The need for lung counts is determined on an individual case basis.

In vivo analysis is also used at VNC to evaluate potential internal exposures of employees. All VNC employees are given a whole body count upon employment and again upon termination. Individuals who enter areas that handle radioactive material are counted at least once a year and may be required to be counted semiannually or quarterly, depending on their assignment.

Contractor personnel are given an in-vivo count both before and after entering process areas if on a previous job they were required to wear protective clothing. If protective clothing was not required on their previous jobs, they are counted only after entry.

4.3 Radiation Protection Evaluation

Upon completion of the radiation safety review of the licensee's application, supportive information and compliance history, the staff has concluded that VNC has the necessary technical staff, administrative and technical procedures and equipment to provide effective and safe radiation programs. Conformance by VNC to their proposed conditions should ensure a safe operation and ensure that unfavorable trends or effects can be detected quickly by VNC and corrective action initiated.

CHAPTER 5

NUCLEAR CRITICALITY SAFETY

5.1 Introduction

The nuclear criticality control system at VNC is based on:

- Technical criteria using established policies, analytical methods, data and safety margins,

- Qualified nuclear criticality safety staff with specified responsibility and authority, and

- Administrative requirements for written operating procedures, review of nuclear safety analyses, audits of operations, posting of limits and training.

An important element, listed in the third item is that the VNC nuclear criticality safety criteria provide for reviews by two different qualified reviewers of changes which involve nuclear safety considerations.

5.2 Technical Criteria

The technical criteria that the reviewers will use to establish the criticality safety of a proposed revised or new operation are provided in Section 6, "Criticality Control Conditions - Technical and Analytical Requirements," of Appendix A, "License Conditions," of the license application. The important criteria are as follows:

1. The basic policy is the double contingency policy. This is the basic policy endorsed by Regulatory Guide 3.4. "Nuclear Criticality Safety for Operations with Fissionable Materials Outside Reactors."

2. Where double batching is possible, mass limits are held to no more than 0.45 of the minimum critical mass. Where double batching is not possible, the mass is limited to no greater than 0.74 of the critical mass. Mass limits have been based on data and calculations reported in Documents ARH-600, TID-7028 and the Handbook of Criticality Data (UK AHSB) as well as on validated calculations by GE using methods demonstrated in Section 5, "Criticality Safety Program Technology," of the license application.

3. Cylinder diameters, slab thicknesses and unit volumes are limited to 90%, 88%, and 76%, respectively, of the critical values. These margins and those given in paragraph 2 above are comparable to those used in the Nuclear Safety Guide, TID-7016, Rev. 1, and widely used throughout the nuclear industry.

4. The optimum (limiting case) conditions of water moderation credible for the system are assumed in setting limits.

5. Unit limits are based on full water reflection, if such reflection is credible, under normal or accident conditions.

6. Where unit limits are based on reactivity, the normally subcritical reactivity is limited to 0.95.

7. For accumulations limited by concentration, the normally subcritical concentration is limited to that concentration which is equivalent to the following atomic ratios of hydrogen to fissile material: H/U-235, 5200; H/U-233, 7600; and H/Pu (fissile), 7600.

8. The licensee spaces the process equipment and stored units to meet one of the following criteria:

   a. When the indicator of the reactivity of the array is the critical number of units in the array, the allowable number of units does not exceed 0.50 of the calculated critical number.

   b. Not more than 50% of the critical number of units in any array calculated by the density analog method.

   c. The number of accumulations determined by the solid angle method as described in TID-7016, Revision 2.

9. Isolation criteria include twelve inches of water and the commonly used distance criterion based on array or unit sizes.

5.3 Organization and Administrative Requirements

The GE policy of protection of employees, the public and the environs from potential criticality hazards follows the same philosophy as described in Chapter 4, "Radiation Safety," of this evaluation. The Manager, Irradiation Product Operation, has been delegated responsibility to act as the Chief Executive Safety Officer for all VNC operations involving radioactive materials. The basic policy associated with the handling, using and storing radioactive material is implemented through line managers to the manager and supervisor of each of the activities involving radioactive materials. The basic line and staff relationships for the criticality safety program is illustrated in Figure 5.3-1.

The minimum qualifications of the safety related positions for the nuclear criticality safety program are as follows:

- Area Manager - In addition to the qualifications discussed in Chapter 4 (p. 37), "Radiation Safety," each area manager of a criticality area is required to be proficient in the application of criticality control procedures and to be knowledgeable in the procedures applicable to the criticality area under his management.

- Criticality Safety Component Manager - Holds a bachelor's degree in science or engineering, has at least five years experience in a responsible position in a nuclear field such as engineering, physics or chemistry, and has sufficient expertise in the field of criticality safety to provide the necessary criticality review functions, and

- Criticality Safety Specialist - Technically trained person with a bachelor's degree in science or engineering and three years experience

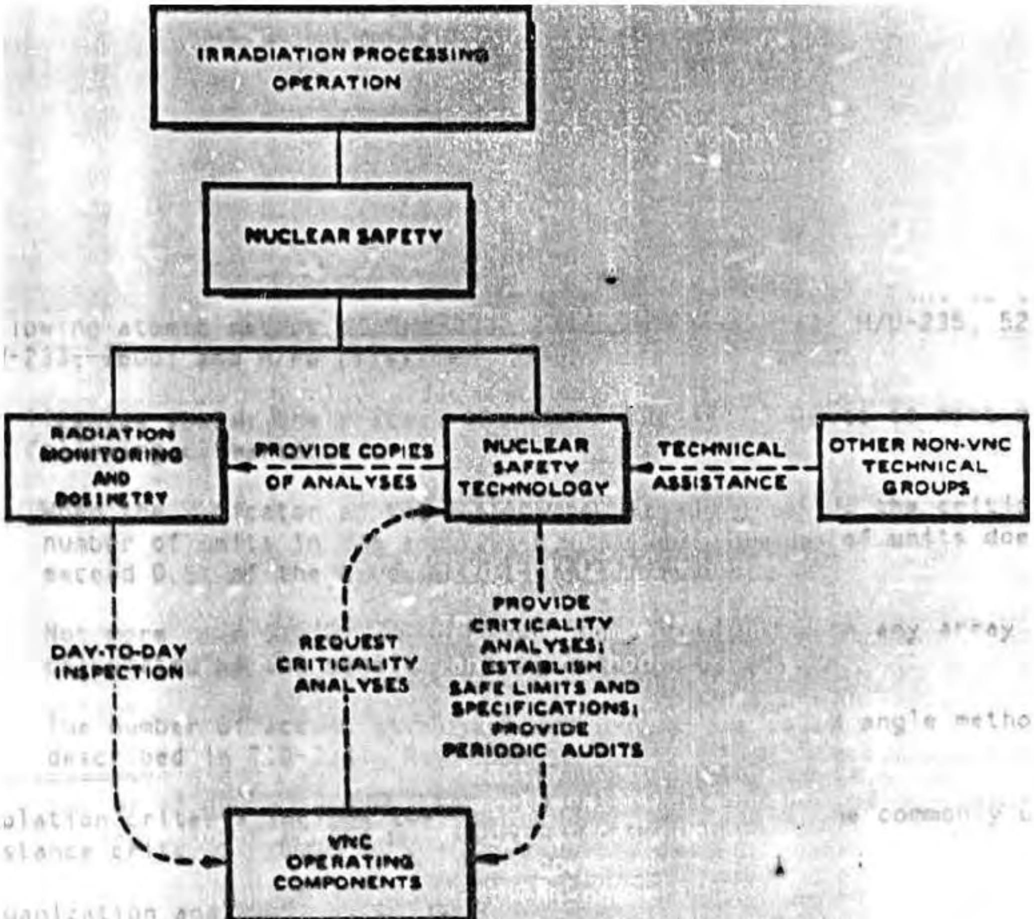

Figure 5.3-1 Criticality Safety Structure

in the nuclear field including one year of directly relevant criticality safety experience.

The first level nuclear safety responsibility for the VNC is the criticality safety specialist in the criticality safety component, who must meet stated requirements of education and experience comparable to those required for that position in other SNM licenses. This specialist reports to the manager of the criticality safety component who in turn reports to the Manager, Nuclear Safety Organization. Conditions in the license application concerning the criticality safety component require that the component not have direct responsibility for operations or report to an area manager. These requirements help to assure objective reviews by Nuclear Safety staff and access to upper level management and are met by the VNC organization.

The criticality safety specialist is responsible for nuclear criticality safety analyses and for periodic inspections of the laboratories. Inspection reports, which are furnished to the area managers, include identification of situations requiring corrective actions. Corrective or follow-up actions are taken in accordance with VNC site safety standards and/or site nuclear safety practices. The inspection program includes determination that actual operations conform to the physical situations on which calculations of criticality limits are based.

The manager of the criticality safety component is responsible for arranging review of the analyses by the specialist.

The area managers are responsible for the maintenance of written criticality control procedures incorporating limitations established by the criticality safety component and for the availability of procedures to concerned personnel through posting of criticality safety limits or other means.

Technicians of the radiation safety component are responsible for inspecting each criticality area on a continuous basis to assure compliance with procedures, including posting of limits, labeling of SNM containers and general criticality work procedures.

In addition to the requirements for qualified staff and the established technical criteria, GE's criticality safety requirements for VNC involve several important administrative requirements:

- All changes involving nuclear criticality safety considerations must be analyzed by a qualified analyst and reviewed by a qualified reviewer,
- In addition to preoperational audits, there is an in-depth system of audits of operations at stated intervals by the nuclear criticality safety specialist and the monitors of the radiation safety component,
- Requirements to ensure incorporation of the criticality safety limits in operating procedures,
- Requirements for the posting of nuclear criticality safety limits,
- Requirements for training of operations personnel, and

- Safety policies, abnormal events or problems, new facilities or major changes to facilities, and operation control standards are reviewed by the Vallecitos Technological Safety Council (VTSC). The VTSC consists of at least five senior members of GE's technical and/or management personnel appointed by the Manager, Irradiation Products Operation.

5.4 Nuclear Criticality Safety Evaluation

The nuclear criticality safety review and the staff's conclusion that the controls are acceptable are based on the following:

- The license conditions as revised to improve clarity, correct discrepancies and ensure continued compliance with accepted practice. The basic policy underlying these conditions is in accordance with Regulatory Guide 3.4, "Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors,"

- The demonstrated qualifications of the nuclear criticality safety personnel and the depth of expertise available in the GE organization for the solution of problems, including personnel competent in the use of accepted computer codes, and for auditing,

- The conformance of the technical criteria for nuclear criticality safety with established U.S. practice,

- The validity of the nuclear criticality safety analyses made under the license, including the demonstration sections, and

- The history of safe plant operation with respect to nuclear criticality safety since the original license was issued.

CHAPTER 6

RADIOACTIVE EFFLUENT AND ENVIRONMENTAL MONITORING

The review covered the organization of the VNC programs, the procedures for monitoring effluents and releases, the equipment, instrumentation and counting facilities associated with the programs. A study of the concentrations of airborne radioactive materials in the effluent stacks and the concentrations of radioactive materials in the liquid retention basins prior to release directly to the environment (Vallecitos Creek) is presented in Section 3.5, "Radioactive Waste Management," of Chapter 3. This review also compared the elements of VNC's programs with the following regulatory guides:

- Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," dated April 1975,
- Regulatory Guide 4.5, "Measurements of Radionuclides in the Environment Sampling and Analysis of Plutonium in the Soil," dated May 1974, and
- Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment," dated December 1977.

6.1 Organization and Authority

The Specialist, Environmental Protection (EP), is responsible for ensuring that an effective effluent monitoring program and a representative environmental surveillance program are established and maintained. The EP of the VNC organizational structure implements and maintains the radiological and the environmental protection programs at the VNC site. The radiological program involves data collection and evaluation of film badges, bioassay, and in vivo counting. The environmental monitoring program involves the changing and collecting of stack sample filters and cartridges, collection of batch samples of water from holding tanks and retention basin, and the prompt evaluation of the data generated. Additionally, environmental samples from onsite and offsite locations are obtained and analyzed, including air, water, soil and vegetation samples. Certain water quality parameters not involving radioactive materials are also monitored by EP, to assure compliance with applicable discharge limits.

6.2 Administrative Program - Methods and Procedures

6.2.1 Radioactive Effluents Monitoring

The radiological effluent monitoring program at VNC was developed to ensure that 10 CFR Part 20 limits are not exceeded and that the releases are ALARA. This program includes measurements of the quantities of radioactivity that are released to the environment.

There are 11 stacks that can release radioactive materials to the atmosphere. Each of these stacks is equipped with a sampling line that contains a particulate filter, and selected stacks also contain charcoal cartridges and/or noble-gas monitoring system. The charcoal cartridges and filters are changed weekly and counted for ^{131}I, gross α and gross βγ. The noble gases are counted continuously, and a recording system provides a readout of the quantity being released from each monitored stack. Action points have been established on the basis of sample activity that may indicate damage to the filter system or the possibility of some operational event that must be immediately investigated to determine the cause of the elevated activity.

The only liquid discharged from VNC is that released from three of the four site retention basins. The other retention basin is used for sanitary waste water. Processed sanitary waste water is discharged by land disposal (irrigation) onto VNC property. Prior to discharging any basin, a water sample is taken and analyzed for gross α and gross βγ to ensure that the activity is below the limits specified in 10 CFR Part 20. A weekly composite of samples from all basins released during the week is analyzed for ^{131}I. Monthly basin composites are analyzed for gross α and gross βγ, quarterly basin composites for ^{239}Pu, ^{89}Sr, ^{90}Sr, ^{3}H, ^{137}Cs, and ^{60}Co, and a yearly basin composite for gross α, gross βγ and ^{90}Sr. A monthly sample of incoming water is taken and analyzed for gross α and gross βγ. Table 6.2-1 summarizes the VNC radiological monitoring program.

TABLE 6.2-1 Radiological Monitoring Program

Sampling Medium	Number of Stations	Collection Frequency	Sample Type	Type of Analysis
Gaseous Releases	11	Weekly	Continuous	Gross α, Gross βγ noble gases and ^{131}I
Incoming Water	1	Monthly	Grab	Gross α and Gross βγ
Waste Water (Retention Basins)	3	Sampled prior to release	Grab	Gross α and Gross βγ
		Monthly	Composite	Gross α and Gross βγ
		Quarterly	Composite	^{239}Pu, $^{89/90}Sr$, ^{3}H, ^{137}Cs and ^{60}Co

6.2.2 Environmental Monitoring Programs

The environmental program consists of monitoring surface water, ground water, vegetation, stream bottom sediment, site perimeter air, and cloud-gamma radiation. A summary of the radiological surveillance program including collection frequency and type of analysis performed is presented in Table 6.2-2.

Routine environmental monitoring for radiological impact has shown VNC to be in compliance with all applicable regulations. GE performed a statistical evaluation of the VNC environmental sampling program for the years 1973 to 1983. The data indicated no accumulations or reconcentration of radionuclides over that period of time.

Table 6.2-2 SUMMARY RADIOLOGICAL SURVEILLANCE PROGRAM

Sampling Medium	Number of Stations	Collection Frequency	Sample Type	Type of Analysis
Surface Water	4	2-quarterly	Grab	Gross α, gross βγ, and ^{3}H
		1-May and October	Grab	Gross α, gross βγ, and ^{3}H
		1-yearly	Grab	Gross α, gross βγ, and ^{3}H
Groundwater	7	quarterly	Grab	Gross α, gross βγ, and ^{3}H
Vegetation	8	yearly	Grab	Gross α, gross βγ, ^{90}Sr, ^{137}Cs, ^{60}Co, and ^{40}K
Stream Bottom (Sediment)	4	1-quarterly	Grab	Gross βγ, ^{60}Co, ^{137}Cs, $^{89/90}Sr$, and ^{239}Pu
		1-May and October	Grab	Gross βγ, ^{60}Co, ^{137}Cs $^{89/90}Sr$, and ^{239}Pu
		1-May and October	Grab	Gross α, gross βγ, ^{60}Co, and ^{137}Cs
		1-yearly (May)	Grab	Gross α, gross βγ, ^{60}Co, and ^{137}Cs
Site Perimeter Air Sampler	4	weekly	Continuous	Gross α, and gross βγ,
Dosimeters (Cloud γ TLD)	31	1-quarterly 30-yearly	Continuous Continuous	γ radiation γ radiation

6.3 Equipment, Instrumentation and Counting Facilities

VNC utilizes various fixed and portable instruments for monitoring quantities or concentrations of radioactivity and for scheduled calibration and maintenance. The types of equipment installed for monitoring radioactivity include:

- Air samplers and monitors utilizing GM, proportional, scintillation, and semiconductor detection modes, with moving and fixed filtering units which are capable of alarming at air concentrations equivalent to MPC in less than four hours for most of the commonly encountered radioisotopes. Units consist of 2-inch diameter millipore filters and constant flow control regulators. Stack sampling-monitoring units

include isokinetic probes with GM, proportional, scintillation, semiconductors and/or flow-through ion chambers and appropriate filter media.

- Fixed gamma monitors with ranges from 0.1 mR/h to 10^6 R/h are located in potential gamma fields.

- Hand and shoe counters are provided at principal exit points for beta-gamma and alpha, as required.

- A whole body counter (shadow shield principle) utilizing a 5" x 5" NaI crystal is capable of detecting 0.01-0.1 of 1% of the maximum permissible body burden of several common gamma emitters and 1% for most other gamma emitters.

- Environmental surveillance is provided by a number of TLD dosimeter located on the VNC site and at its perimeter. Four fixed air sample stations are also located on site.

The portable monitoring instruments that are used for essential monitoring and for scheduled calibration and maintenance are listed in Table 6.3-1.

TABLE 6.3-1 PORTABLE MONITORING INSTRUMENTS

Instrument	Range
GM Detector	0-500 k cpm, beta-gamma
Ionization Chamber (low energy)	0-300 mrad/h, beta-gamma
Ionization Chamber (CP)	1-250 k mR/h, gamma 4-1000 k mrad/h, beta
Ionization Chamber (gas multiplication)	1-1000 k mR/h, gamma 20,20,000 k mrad/h, beta
Geiger Tube (telescopic)	1-1000 k mR/h, gamma
Scintillation Counter - Sodium Iodide (TI)	0-500 k cpm, gamma
Neutron Rem Meter (BF_3)	0.5-5000 mRem/h, neutron
Alpha Survey Probes (gas proportional and Zn_s)	200-1,000,000 dpm, alpha
Portable Air Samplers	0-8 cfm

A summary of the VNC Analytical Laboratory's counting equipment and capabilities for radiation safety samples is presented in Table 6.3-2.

Table 6.2-2 SUMMARY RADIOLOGICAL SURVEILLANCE PROGRAM

Sampling Medium	Number of Stations	Collection Frequency	Sample Type	Type of Analysis
Surface Water	4	2-quarterly	Grab	Gross α, gross βγ, and ^{3}H
		1-May and October	Grab	Gross α, gross βγ, and ^{3}H
		1-yearly	Grab	Gross α, gross βγ, and ^{3}H
Groundwater	7	quarterly	Grab	Gross α, gross βγ, and ^{3}H
Vegetation	8	yearly	Grab	Gross α, gross βγ, ^{90}Sr, ^{137}Cs, ^{60}Co, and ^{40}K
Stream Bottom (Sediment)	4	1-quarterly	Grab	Gross βγ, ^{60}Co, ^{137}Cs, $^{89/90}Sr$, and ^{239}Pu
		1-May and October	Grab	Gross βγ, ^{60}Co, ^{137}Cs $^{89/90}Sr$, and ^{239}Pu
		1-May and October	Grab	Gross α, gross βγ, ^{60}Co, and ^{137}Cs
		1-yearly (May)	Grab	Gross α, gross βγ, ^{60}Co, and ^{137}Cs
Site Perimeter Air Sampler	4	weekly	Continuous	Gross α, and gross βγ,
Dosimeters (Cloud γ TLD)	31	1-quarterly 30-yearly	Continuous Continuous	γ radiation γ radiation

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include isokinetic probes with GM, proportional, scintillation, semiconductors and/or flow-through ion chambers and appropriate filter media.

- Fixed gamma monitors with ranges from 0.1 mR/h to 10^6 R/h are located in potential gamma fields.

- Hand and shoe counters are provided at principal exit points for beta-gamma and alpha, as required.

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Ionization Chamber (CP)	1-250 k mR/h, gamma 4-1000 k mrad/h, beta
Ionization Chamber (gas multiplication)	1-1000 k mR/h, gamma 20,20,000 k mrad/h, beta
Geiger Tube (telescopic)	1-1000 k mR/h, gamma
Scintillation Counter - Sodium Iodide (TI)	0-500 k cpm, gamma
Neutron Rem Meter (BF_3)	0.5-5000 mRem/h, neutron
Alpha Survey Probes (gas proportional and Zn_s)	200-1,000,000 dpm, alpha
Portable Air Samplers	0-8 cfm

A summary of the VNC Analytical Laboratory's counting equipment and capabilities for radiation safety samples is presented in Table 6.3-2.

TABLE 6.3-2 ANALYTICAL LABORATORY COUNTING EQUIPMENT AND CAPABILITIES

Sample Type	Instrument	Detection Limit*
Air and Exhaust Stack Samples (Millipore)	Alpha Proportional Beta Proportional	3×10^{-15} μCi/cc 7×10^{-15} μCi/cc
Charcoal Cartridges (I-131)	NaI (Tl)	2×10^{-13} μCi/cc
Smears	Alpha Proportional Beta Proportional	7×10^{-8} μCi 3×10^{-6} μCi
Water (Retention Basin)	Alpha Proportional Beta Proportional	3×10^{-8} μCi/cc 5×10^{-8} μCi/cc

*Based on standard sample size and counting times.

6.4 Radioactive Effluent and Environmental Monitoring Evaluation

Upon review of the VNC effluent and environmental program, and its implementation and past performance, the staff concludes that VNC has an adequate program for normal operation and has procedures established should abnormalities be identified. The basis for acceptance is conformance to current industrial practice and the recommendations of applicable regulatory guides.

CHAPTER 7

ACCIDENT ANALYSIS

7.1 Introduction

This chapter presents a summary of safety evaluations examining postulated accident scenarios and natural phenomena including radioactive material release scenarios related to the GE-Vallecitos Nuclear Center's (VNC's) past plutonium and radioisotope production activities. Other release scenarios concerning uranium and irradiated fuel examination activities (as is currently conducted under License No. SNM-960) were considered in these evaluations. The reports demonstrated the containment features of VNC facilities under accident conditions and in part were written in support for this licensing action. The reports pertinent to this safety evaluation report are as follows:

- NUREG-0866, "The Effects of Natural Phenomena on the General Electric Company Vallecitos Nuclear Center at Pleasanton, California," dated December 1981.
- NRC Final Draft, "Accident Analysis for the General Electric Company Vallecitos Nuclear Center at Pleasanton, California, Related to License Renewal of Special Nuclear Materials, License No. SNM-960," dated October 1978.
- Office of Nuclear Material Safety and Safeguards Director's Decision under 10 CFR 2.206 responding to petitioners request to suspend the activities conducted under License No. SNM-960. Supporting safety evaluation is included in the Decision. Date of document is June 29, 1979.
- NRC's "Preliminary Safety Evaluation by the Office of Nuclear Material Safety and Safeguards, in regard to General Electric's Company Special Nuclear Material License No. SNM-960, Docket No. 70-754," dated November 7, 1977. Issued as a result of the Commission's October 24, 1977 Order to Show Cause.

These reports are presented in Appendix C.

7.2 Discussion

The referenced safety evaluation reports cover a wide spectrum of accidents (plant and natural phenomena induced) defining bounding cases (i.e., operations that had the greatest potential for release of radioactive materials) for the VNC's activities under License No. SNM-960. The bounding cases have been discontinued by GE. These activities were conducted in the former Advanced Fuels Laboratory (AFL), Plutonium Analytical Laboratory (PAL), and in the Radioactive Materials Laboratory (RML), and are described as follows:

- AFL. Plutonium processing and mixed oxide fuel fabrication in the former AFL has been terminated. The laboratory has been decontaminated and surveyed for levels of plutonium contamination. The GE-VNC surveys have shown that, with regard to plutonium, the AFL area is decontaminated to levels below that required for unrestricted use. NRC Regional Office-Region V conducted a confirmatory survey which verifies this. The NRC-Headquarters evaluation of the decontamination and termination of plutonium activities in the AFL, dated February 28, 1983, is presented in Appendix B of this safety evaluation. The former AFL is now named the Core Materials Engineering Laboratory. A license condition requiring GE-VNC to notify NRC if they plan to introduce plutonium into this area has been incorporated into the proposed renewed license.

- PAL. Analytical chemistry work performed to analyze plutonium solutions and compounds was conducted in the PAL. This work, which was done in support of the mixed oxide activities, has been terminated and the area has been decontaminated. The PAL was surveyed completely except for the area behind the metal wall. (This metal wall was put into place as part of the Safeguards upgrade program for increased security.) The former PAL is now named the Hot Shop Facility and is used for the repair of contaminated equipment.

- RML - Radioisotope Separations Activities. Medical isotope production activities were conducted in the RML hot cells. This work has been discontinued because of the General Electric Reactor (GETR) shutdown. The GETR has been shut down since October 1977 as a result of the Commission's Order to Show Cause issued based on new seismic information concerning the VNC site. The GETR has not been restarted since. GE-VNC has no present plans to restart their radioisotope production processes using special nuclear material as target material and, accordingly, has eliminated this activity in the revised license renewal application.

At the time the reference evaluations were performed GE-VNC was authorized the following possession limits:

U-235:	1000 kilograms
U-233:	500 grams
Pu:	150 kilograms

Amendment No. 20 to License No. SNM-960, issued on June 19, 1981, reduced the VNC possession limits to:

U-235:	50 kilograms enriched to less than or equal to 10%
U-235:	4 kilograms enriched to more than 10%
U-233:	200 grams
Pu:	500 grams

The amendment also eliminated the following activities:

- Fuel processing and fabrication, and
- UF_6 conversion.

GE's revised license renewal application incorporates the changes as referenced in Amendment No. 20. Also, radioisotope separations activities (i.e., medical isotope production) involving the use of special nuclear material have been eliminated as an authorized activity. The proposed renewal license reflects these changes.

With the reduction of the plutonium limit and the elimination of fuel processing, fabrication and radioisotope separations as authorized activities, coupled with the decontamination and decommissioning of equipment and areas (former AFL and PAL) of high potential, the material at risk and the subsequent accident analysis considerations have been greatly reduced. No new processes or activities have been initiated or are planned that would introduce a safety concern that has not been previously identified and evaluated in the referenced evaluations.

7.3 Conclusions

Based on the results of the referenced reports and in consideration of the current activities and possession limits that will be authorized under the proposed renewed license, the staff finds that the containment features of the VNC facilities are properly configured to limit releases of radioactive materials and radiation exposures in the event of an accident.

This conclusion is also supported by the results of an independent evaluation concerning the Radiological Contingency Plan specific to License No. SNM-960. This review was conducted by the Environmental Radiation and Emergency Support Section, Uranium Fuel Licensing Branch, NMSS, NRC and states the following:

> The revised Radiological Contingency Plan submitted on October 29, 1982, is adequate to demonstrate that the licensee has accomplished the purposes of onsite radiological contingency planning. With the October 29, 1982 submittal, the licensee has demonstrated (1) that his plant is properly configured to limit releases of radioactive materials and radiation exposures in the event of an accident, (2) that a capability exists for measuring and assessing the significance of accidental releases of radioactive materials, (3) that appropriate emergency equipment and procedures are provided onsite to protect workers against radiation hazards that might be encountered following an accident, and (4) that necessary recovery actions will be taken in a timely fashion to return the plant to a safe condition following an accident.

The safety evaluation report, documenting the NRC's review of the VNC Radiological Contingency Plan, is presented in Appendix A.

Table 6.2-2 SUMMARY RADIOLOGICAL SURVEILLANCE PROGRAM

Sampling Medium	Number of Stations	Collection Frequency	Sample Type	Type of Analysis
Surface Water	4	2-quarterly	Grab	Gross α, gross βγ, and ^{3}H
		1-May and October	Grab	Gross α, gross βγ, and ^{3}H
		1-yearly	Grab	Gross α, gross βγ, and ^{3}H
Groundwater	7	quarterly	Grab	Gross α, gross βγ, and ^{3}H
Vegetation	8	yearly	Grab	Gross α, gross βγ, ^{90}Sr, ^{137}Cs, ^{60}Co, and ^{40}K
Stream Bottom (Sediment)	4	1-quarterly	Grab	Gross βγ, ^{60}Co, ^{137}Cs, $^{89/90}$Sr, and ^{239}Pu
		1-May and October	Grab	Gross βγ, ^{60}Co, ^{137}Cs $^{89/90}$Sr, and ^{239}Pu
		1-May and October	Grab	Gross α, gross βγ, ^{60}Co, and ^{137}Cs
		1-yearly (May)	Grab	Gross α, gross βγ, ^{60}Co, and ^{137}Cs
Site Perimeter Air Sampler	4	weekly	Continuous	Gross α, and gross βγ,
Dosimeters (Cloud γ TLD)	31	1-quarterly 30-yearly	Continuous Continuous	γ radiation γ radiation

6.3 Equipment, Instrumentation and Counting Facilities

VNC utilizes various fixed and portable instruments for monitoring quantities or concentrations of radioactivity and for scheduled calibration and maintenance. The types of equipment installed for monitoring radioactivity include:

- Air samplers and monitors utilizing GM, proportional, scintillation, and semiconductor detection modes, with moving and fixed filtering units which are capable of alarming at air concentrations equivalent to MPC in less than four hours for most of the commonly encountered radioisotopes. Units consist of 2-inch diameter millipore filters and constant flow control regulators. Stack sampling-monitoring units

include isokinetic probes with GM, proportional, scintillation, semi-conductors and/or flow-through ion chambers and appropriate filter media.

- Fixed gamma monitors with ranges from 0.1 mR/h to 10^6 R/h are located in potential gamma fields.

- Hand and shoe counters are provided at principal exit points for beta-gamma and alpha, as required.

- A whole body counter (shadow shield principle) utilizing a 5" x 5" NaI crystal is capable of detecting 0.01-0.1 of 1% of the maximum permissible body burden of several common gamma emitters and 1% for most other gamma emitters.

- Environmental surveillance is provided by a number of TLD dosimeter located on the VNC site and at its perimeter. Four fixed air sample stations are also located on site.

The portable monitoring instruments that are used for essential monitoring and for scheduled calibration and maintenance are listed in Table 6.3-1.

TABLE 6.3-1 PORTABLE MONITORING INSTRUMENTS

Instrument	Range
GM Detector	0-500 k cpm, beta-gamma
Ionization Chamber (low energy)	0-300 mrad/h, beta-gamma
Ionization Chamber (CP)	1-250 k mR/h, gamma 4-1000 k mrad/h, beta
Ionization Chamber (gas multiplication)	1-1000 k mR/h, gamma 20,20,000 k mrad/h, beta
Geiger Tube (telescopic)	1-1000 k mR/h, gamma
Scintillation Counter - Sodium Iodide (TI)	0-500 k cpm, gamma
Neutron Rem Meter (BF_3)	0.5-5000 mRem/h, neutron
Alpha Survey Probes (gas proportional and Zn_s)	200-1,000,000 dpm, alpha
Portable Air Samplers	0-8 cfm

A summary of the VNC Analytical Laboratory's counting equipment and capabilities for radiation safety samples is presented in Table 6.3-2.

TABLE 6.3-2 ANALYTICAL LABORATORY COUNTING EQUIPMENT AND CAPABILITIES

Sample Type	Instrument	Detection Limit*
Air and Exhaust Stack Samples (Millipore)	Alpha Proportional Beta Proportional	3×10^{-15} μCi/cc 7×10^{-15} μCi/cc
Charcoal Cartridges (I-131)	NaI (Tl)	2×10^{-13} μCi/cc
Smears	Alpha Proportional Beta Proportional	7×10^{-8} μCi 3×10^{-6} μCi
Water (Retention Basin)	Alpha Proportional Beta Proportional	3×10^{-8} μCi/cc 5×10^{-8} μCi/cc

*Based on standard sample size and counting times.

6.4 Radioactive Effluent and Environmental Monitoring Evaluation

Upon review of the VNC effluent and environmental program, and its implementation and past performance, the staff concludes that VNC has an adequate program for normal operation and has procedures established should abnormalities be identified. The basis for acceptance is conformance to current industrial practice and the recommendations of applicable regulatory guides.

CHAPTER 7

ACCIDENT ANALYSIS

7.1 Introduction

This chapter presents a summary of safety evaluations examining postulated accident scenarios and natural phenomena including radioactive material release scenarios related to the GE-Vallecitos Nuclear Center's (VNC's) past plutonium and radioisotope production activities. Other release scenarios concerning uranium and irradiated fuel examination activities (as is currently conducted under License No. SNM-960) were considered in these evaluations. The reports demonstrated the containment features of VNC facilities under accident conditions and in part were written in support for this licensing action. The reports pertinent to this safety evaluation report are as follows:

- NUREG-0866, "The Effects of Natural Phenomena on the General Electric Company Vallecitos Nuclear Center at Pleasanton, California," dated December 1981.

- NRC Final Draft, "Accident Analysis for the General Electric Company Vallecitos Nuclear Center at Pleasanton, California, Related to License Renewal of Special Nuclear Materials, License No. SNM-960," dated October 1978.

- Office of Nuclear Material Safety and Safeguards Director's Decision under 10 CFR 2.206 responding to petitioners request to suspend the activities conducted under License No. SNM-960. Supporting safety evaluation is included in the Decision. Date of document is June 29, 1979.

- NRC's "Preliminary Safety Evaluation by the Office of Nuclear Material Safety and Safeguards, in regard to General Electric's Company Special Nuclear Material License No. SNM-960, Docket No. 70-754," dated November 7, 1977. Issued as a result of the Commission's October 24, 1977 Order to Show Cause.

These reports are presented in Appendix C.

7.2 Discussion

The referenced safety evaluation reports cover a wide spectrum of accidents (plant and natural phenomena induced) defining bounding cases (i.e., operations that had the greatest potential for release of radioactive materials) for the VNC's activities under License No. SNM-960. The bounding cases have been discontinued by GE. These activities were conducted in the former Advanced Fuels Laboratory (AFL), Plutonium Analytical Laboratory (PAL), and in the Radioactive Materials Laboratory (RML), and are described as follows:

- AFL. Plutonium processing and mixed oxide fuel fabrication in the former AFL has been terminated. The laboratory has been decontaminated and surveyed for levels of plutonium contamination. The GE-VNC surveys have shown that, with regard to plutonium, the AFL area is decontaminated to levels below that required for unrestricted use. NRC Regional Office-Region V conducted a confirmatory survey which verifies this. The NRC-Headquarters evaluation of the decontamination and termination of plutonium activities in the AFL, dated February 28, 1983, is presented in Appendix B of this safety evaluation. The former AFL is now named the Core Materials Engineering Laboratory. A license condition requiring GE-VNC to notify NRC if they plan to introduce plutonium into this area has been incorporated into the proposed renewed license.

- PAL. Analytical chemistry work performed to analyze plutonium solutions and compounds was conducted in the PAL. This work, which was done in support of the mixed oxide activities, has been terminated and the area has been decontaminated. The PAL was surveyed completely except for the area behind the metal wall. (This metal wall was put into place as part of the Safeguards upgrade program for increased security.) The former PAL is now named the Hot Shop Facility and is used for the repair of contaminated equipment.

- RML - Radioisotope Separations Activities. Medical isotope production activities were conducted in the RML hot cells. This work has been discontinued because of the General Electric Reactor (GETR) shutdown. The GETR has been shut down since October 1977 as a result of the Commission's Order to Show Cause issued based on new seismic information concerning the VNC site. The GETR has not been restarted since. GE-VNC has no present plans to restart their radioisotope production processes using special nuclear material as target material and, accordingly, has eliminated this activity in the revised license renewal application.

At the time the reference evaluations were performed GE-VNC was authorized the following possession limits:

U-235:	1000 kilograms
U-233:	500 grams
Pu:	150 kilograms

Amendment No. 20 to License No. SNM-960, issued on June 19, 1981, reduced the VNC possession limits to:

U-235:	50 kilograms enriched to less than or equal to 10%
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U-233:	200 grams
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The amendment also eliminated the following activities:

- Fuel processing and fabrication, and
- UF_6 conversion.

GE's revised license renewal application incorporates the changes as referenced in Amendment No. 20. Also, radioisotope separations activities (i.e., medical isotope production) involving the use of special nuclear material have been eliminated as an authorized activity. The proposed renewal license reflects these changes.

With the reduction of the plutonium limit and the elimination of fuel processing, fabrication and radioisotope separations as authorized activities, couple with the decontamination and decommissioning of equipment and areas (former AFL and PAL) of high potential, the material at risk and the subsequent accident analysis considerations have been greatly reduced. No new processes or activities have been initiated or are planned that would introduce a safety concern that has not been previously identified and evaluated in the reference evaluations.

7.3 Conclusions

Based on the results of the referenced reports and in consideration of the current activities and possession limits that will be authorized under the proposed renewed license, the staff finds that the containment features of the VNC facilities are properly configured to limit releases of radioactive materials and radiation exposures in the event of an accident.

This conclusion is also supported by the results of an independent evaluation concerning the Radiological Contingency Plan specific to License No. SNM-960. This review was conducted by the Environmental Radiation and Emergency Support Section, Uranium Fuel Licensing Branch, NMSS, NRC and states the following:

> The revised Radiological Contingency Plan submitted on October 29, 1982, is adequate to demonstrate that the licensee has accomplished the purposes of onsite radiological contingency planning. With the October 29, 1982 submittal, the licensee has demonstrated (1) that his plant is properly configured to limit releases of radioactive materials and radiation exposures in the event of an accident, (2) that a capability exists for measuring and assessing the significance of accidental releases of radioactive materials, (3) that appropriate emergency equipment and procedures are provided onsite to protect workers against radiation hazards that might be encountered following an accident, and (4) that necessary recovery actions will be taken in a timely fashion to return the plant to a safe condition following an accident.

The safety evaluation report, documenting the NRC's review of the VNC Radiological Contingency Plan, is presented in Appendix A.

CHAPTER 8

SUMMARY EVALUATION

ummary

on a review of the VNC application for renewal of License SNM-960, other ent documents, and the licensee's compliance history, the staff concludes

he issuance of a renewed license, subject to certain conditions, would ot be inimical to the common defense and security or to the health and afety of the public.

he licensee meets the requirements of the Atomic Energy Act of 1954, as mended, and the regulations of the Commission in that, in accordance ith the provisions of 10 CFR 70.23, "Requirements for the approval of pplications":

. The proposed use of special nuclear material is to be used for the conduct of research and development activities of a type specified in Section 31 of the Act,

. The licensee is qualified by reason of training and experience to use the special nuclear materials for the purpose requested in such manner as to protect health and minimize danger to life or property, and

. The licensee's equipment, facilities and procedures are adequate to protect health and minimize danger to life and property.

y virtue of having operated under the broad license concept from 1966 to he present in such a manner as to result in controlled effluent releases t acceptably low levels and low occupational radiation exposure, the icensee is considered to have demonstrated the ability to conduct the peration in substantially complete compliance with Commission regulations nd license specifications and conditions.

he licensee has a plan, approved by the NRC, for the accountability, hysical protection and security of special nuclear material.

he licensee appears to be financially qualified to engage in the proposed ctivities.

ecommendations

aff recommends that the General Electric Vallecitos Nuclear Center e No. SNM-960 be renewed in its entirety to incorporate reference to the ents, representations, procedures and conditions contained in the appli-

1. The licensee shall comply with the provisions of the attached Annex B, "License Conditions for Leak Testing Sealed Byproduct Material Sources and Sealed Plutonium Sources," for all sealed plutonium sources as authorized under this license and in the licensee's possession and/or supervision.

2. As part of the conditions presented in Section 8.12, "Contamination-Free Articles," of Appendix A, "License Conditions for the Vallecitos Nuclear Center," of the application, the licensee shall observe the "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Uses," dated July 1982, that are found in the attached Annex C.

3. Should the licensee decide to terminate this license and in addition to the requirements of 10 CFR 70.38, "Expiration and Termination of Licenses" (invoked as a result of said decision), the licensee shall decommission the facilities operated under this license in accordance with the general decommissioning plan for License No. SNM-960 as submitted by letter dated February 17, 1982. The financial commitment to assure that such decommissioning is accomplished is presented in the licensee's letter of May 14, 1979 and is hereby incorporated as a provision of this license, as renewed.

4. At such time that facilities covered by this license are decontaminated for proposed unrestricted release (in accordance with Annex C), the licensee shall submit a report that identifies the facilities where radioactive materials were used and stored, or disposed on the site. The report shall briefly describe operations conducted and radioactive materials used in the facilities and shall assess the results of the decontamination activities. The report shall provide the basis for unrestricted release of the facilities and the site, including a description of sampling and survey methods and instrumentation used, and shall include final contamination survey data for the facilities and grounds. The licensee may segment the report to obtain release of certain areas of facilities or individual structures if it is demonstrated that ongoing activities in other areas will not lead to recontamination of the area or structure proposed for release.

5. The licensee shall implement, maintain, and execute the response measures of his Radiological Contingency Plan submitted to the Commission on October 29, 1982. The licensee shall also prepare and maintain implementing procedures for his Radiological Contingency Plan as necessary to implement the Plan. (This Radiological Contingency Plan and associated implementing procedures incorporate the emergency planning requirements of 10 CFR 70.22(i) as they refer to onsite planning and notification.) The licensee shall make no change in his Radiological Contingency Plan that would decrease the response effectiveness of the Plan without prior Commission approval as evidenced by a license amendment. The licensee may make changes to his Radiological Contingency Plan without prior Commission approval if the changes do not decrease the response effectiveness of the Plan. The licensee shall maintain records of changes that are made to the Plan without prior approval for a period of two years from the date of the change and shall furnish the Chief, Advanced Fuel and Spend Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, NMSS, U.S. Nuclear

Regulatory Commission, Washington, DC 20555, and the NRC Regional Office - Region V at the address specified in Appendix D of 10 CFR Part 20, a report containing a description of each change within six months after the change is made.

6. The licensee shall inform NRC of any planned activities using unencapsulated plutonium in Building 102 - Core Materials Engineering Laboratory (formally the Advanced Fuel Laboratory).

7. The licensee shall provide to the NRC copies of its annual report summarizing the effluent monitoring and environmental surveillance programs at the Vallecitos Nuclear Center. This report shall be sent to the Chief, Advanced Fuel and Spent Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, NMSS, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and the NRC Regional Office - Region V at the address specified in Appendix D of 10 CFR Part 20.

In addition, the licensee has requested continuing authority under the renewed license for certain exemptions and special authorizations previously granted. These are specified below, with reference to the applicable sections of Appendix A of the licensee's application. It is recommended that these exemptions and special authorizations be granted.

1. The Licensee is hereby exempted from the requirements of 10 CFR 20.203 (c) (2) provided that the safety conditions described in Section 8.14, "High Radiation Alarm Exemption," of Appendix A of the application are satisfied.

2. Exemptions to the requirements of 10 CFR 70.24, "Criticality Accident Requirements," are hereby granted pursuant to 10 CFR 70.24(d). The exemptions are granted in accordance with Section 2.2, "Locations other than Vallecitos Nuclear Center," and Section 5.9, "Monitor Alarm System," of Appendix A of the application as follows:

   a. The following areas are exempted from monitor alarm requirements:

      i. Areas where SNM is stored at locations within the United States provided that the SNM is fully packaged as for transport in containers meeting all of the general license requirements of 10 CFR 71 or in containers owned by the General Electric Company and certified for transport under the provisions of 10 CFR 71 in accordance with the conditions of a certificate of compliance authorizing delivery of such containers to a carrier for Fissile Class I transport,

      ii. The Radioactive Products and Services Laboratory pool and hot cells,

      iii. For each area in which is stored one (1) shipment of packages containing special nuclear material licensed pursuant to 10 CFR 71 for transport outside the confines of the Vallecitos Nuclear Center insofar as the requirements of Section 70.24 pertain to the material contained in such shipments.

iv. For each area where there is not more than one "safe batch" (as defined in Section 3.11 of Appendix A of the application) of finished reactor fuel rods or assemblies, under conditions which protect against rearrangement of fuelbearing portions into more reactive configurations.

v. For each area which meets the requirements of a "subcritical area" as defined in Section 3.14 of Appendix A of the application.

b. Exception to the maximum preset alarm point of 20 millirems per hour specified in § 70.24 is granted for areas described in Section 5.9.3 of Appendix A of the application provided the maximum preset alarm point does not exceed 500 millirems per hour.

3. Pursuant to 10 CFR 20.106(b), the licensee is hereby authorized to release radioactive materials in accordance with Section 8.11, "Airborne Effluent Control," of Appendix A of the application.

With the incorporation of the above listed license conditions, exemptions and special authorizations, and based on the review results as presented in this Safety Evaluation Report, I recommend that Materials License No. SNM-960 be renewed for the full five-year term.

5-10-84

Robert T. Kratzke, Project Manager
Advanced Fuel and Spent Fuel
Licensing Branch
Division of Fuel Cycle and
Material Safety

Approval: Leland C. Rouse 5/10/84
Leland C. Rouse, Chief
Advanced Fuel and Spent Fuel
Licensing Branch

APPENDIX A

SAFETY EVALUATION REPORT -

RADIOLOGICAL CONTINGENCY PLAN

SPECIFIC TO LICENSE NO. SNM-960

JAN 19 1984

Docket No. 70-754

MEMORANDUM FOR: Leland C. Rouse, Chief
Advanced Fuel and Spent Fuel Licensing Branch
Division of Fuel Cycle and Material Safety

FROM: Glenn A. Terry, Acting Section Leader
Environmental Radiation and Emergency Support Section
Uranium Fuel Licensing Branch
Division of Fuel Cycle and Material Safety

SUBJECT: INCORPORATE RADIOLOGICAL CONTINGENCY PLAN INTO LICENSE NO. SNM-960, DOCKET NO. 70-754 GENERAL ELECTRIC COMPANY, VALLECITOS NUCLEAR CENTER AS A LICENSE CONDITION

We have reviewed the Radiological Contingency Plan submitted on October 29, 1982, by General Electric Company for their Vallecitos Nuclear Center. We find that the October 29, 1982 plan, specific to License No. SNM-960, meets the requirements of the Order dated April 17, 1981. Our Safety Evaluation Report (SER) is attached as Enclosure 1.

Please incorporate into License No. SNM-960 a condition, such as that in Enclosure 2, which requires the licensee to implement, maintain, and execute the response measures of his Radiological Contingency Plan. Since the license is presently being renewed, the condition can be incorporated directly into the license without the processing of an amendment.

/s/

Glenn A. Terry, Acting Section Leader
Environmental Radiation and
Emergency Support Section
Uranium Fuel Licensing Branch
Division of Fuel Cycle and
Material Safety, NMSS

Enclosures:
1. SER
2. Proposed condition

Enclosure 1

DOCKET NO.: 70-754

LICENSEE: General Electric Company
Vallecitos Nuclear Center
Vallecitos Road
Pleasanton, California

SUBJECT: REVIEW OF RADIOLOGICAL CONTINGENCY PLAN SPECIFIC TO SNM-960

1 Background

The General Electric Company, Vallecitos Nuclear Center, of Pleasanton California, is authorized by NRC License SNM-960 (Amendment #20, June 19, 1981) to possess 50 kgs of U-235 enriched to less than 10 percent, 4 kgs of U-235 enriched to more than 10 percent, 500 gms of Pu, and 200 gms of U-233, all in unsealed form. The actual holdings of SNM have decreased to a level below one effective kilogram as recognized by Safeguards License Amendment No. MPP-2. The Vallecitos Nuclear Center (VNC) is a research and development facility primarily in support of GE and customer nuclear energy programs. Byproduct sealed sources are also manufactured at the facility for commercial distribution. The license is currently active pursuant to the timely renewal provisions of 10 CFR 70.33(b) pending completion of the environmental and safety reviews of the license renewal application.

On February 11, 1981, the NRC issued an Order to GE to submit within 180 days of the effective date of the Order a Radiological Contingency Plan for its Pleasanton facility in accordance with a standard format and content (Enclosure 1 to the Order). This Order pertained only to those facilities and radioactive materials covered by License No. SNM-960. By letter dated April 17, 1981, the Director, Office of Nuclear Material Safety and Safeguards, modified the February 11, 1981, Order to allow the licensee to integrate the previously requested radiological contingency planning information into a site-wide emergency preparedness plan. The period of time to prepare and submit the requested information was extended to November 3, 1981. Subsequent to the revised Order, GE submitted, on October 30, 1981, a Radiological Emergency Plan for the Vallecitos Nuclear Center. Following staff review, the submitted plan was found to be largely deficient and a letter requesting additional information was sent on December 28, 1981. The licensee responded by letter of January 11, 1982, requesting an extension until NRR forwarded their guidance and criteria and established a submittal date for the site-wide Plan. The period to prepare and submit the requested supplemental data was extended by letters of January 22, 1982, and June 25, 1982, until such time as the emergency plan relative to their test and research reactor was due.

On October 29, 1982, GE sent NRR a site-wide Emergency Plan, specific to their test and research reactor, and sent NMSS a completely revised Radiological Contingency Plan, specific to license No. SNM-960. The NRR site-wide Emergency Plan has a number of deficiencies, while the revised Radiological Contingency Plan is in accordance with the provisions of the February 11, 1981 Order and subsequent guidance.

Discussion

The revised Radiological Contingency Plan submitted on October 29, 1982, is adequate to demonstrate that the licensee has accomplished the purposes of onsite radiological contingency planning. With the October 29, 1982 submittal, the licensee has demonstrated (1) that his plant is properly configured to limit releases of radioactive materials and radiation exposures in the event of an accident, (2) that a capability exists for measuring and assessing the significance of accidental releases of radioactive materials, (3) that appropriate emergency equipment and procedures are provided onsite to protect workers against radiation hazards that might be encountered following an accident, and (4) that necessary recovery actions will be taken in a timely fashion to return the plant to a safe condition following an accident.

The Vallecitos Nuclear Center is located on a 1,594 acre site in a predominately rural area. Approximately 1,500 acres of the site are leased for grazing and for cattle feed crops. The population density in the immediate vicinity is very low.

The Vallecitos Nuclear Center is a research and development facility primarily supporting GE and its customer's nuclear energy programs. However, certain byproduct radioisotopes are encapsulated for commercial distribution. Special nuclear materials are handled at VNC under License SNM-960. Activities conducted under the license include: (1) inspection of irradiated reactor fuels in hot cells; and (2) research and development activities involving reactor fuels.

Operations involving potentially airborne radioactive material are carried out in gloveboxes, hoods, hot cells or handled in controlled areas where any airborne radioactive material will be carried out of the area by way of the ventilation system. Absolute (HEPA) filters are used on all ventilation exhausts from VNC buildings housing operations with radioactive materials. The associated ventilation systems are equipped with backflow preventers and dampers, and are designed, constructed and operated such as to assure that air flow will always be from areas of lesser contamination potential to areas of higher contamination potential.

The principal location where licensed material is handled in a releasable form is the Radioactive Materials Laboratory (RML). Automatic water sprinkler protection is provided throughout the site. In addition, the ventilation filters in the RML are protected by fire detectors that alarm and automatically activate fire suppression systems.

By license condition, all ventilation systems for facilities handling unsealed radioactive materials are continuously monitored. The detectors and associated alarm systems are designed to respond to abnormal operational occurrences up to and including Design Basis Accidents. Alternate electrical supply systems and emergency generators are adequate to sustain important safety functions such as confinement air balance, alarm systems, other instruments for equipment control, and security operations even if offsite power is lost.

III Conclusion and Recommendation

Since GE's Radiological Contingency Plan is specific to License No. SNM-960, and I&E's review of the Emergency Plan specific to GE's test reactor does not effect NMSS licensed material operations, the GE-VNC facility license, SNM-960, should be amended to incorporate the October 29, 1982, Radiological Contingency Plan as a condition of the license. The proposed condition should have no adverse effect on the public health and safety or on the quality of the environment and should improve GE's ability to protect against, respond to, and mitigate the consequences of an accident involving radioactive materials.

Ron Cardarelli

R. D. Cardarelli
Environmental Radiation and
Emergency Support Section
Uranium Fuel Licensing Branch
Division of Fuel Cycle and
Material Safety, NMSS

Approved: Glenn A. Terry
Glenn A. Terry-Acting Section Leader

Enclosure 2

The licensee shall implement, maintain, and execute the response measures of his Radiological Contingency Plan submitted to the Commission on October 29, 1982. The licensee also shall prepare and maintain implementing procedures for his Radiological Contingency Plan as necessary to implement the Plan. The licensee shall make no change in his Radiological Contingency Plan that would decrease the response effectiveness of the Plan without prior Commission approval as signified by a license amendment. The licensee may make changes to his Radiological Contingency Plan without prior Commission approval if the changes do not decrease the response effectiveness of the Plan. The licensee shall maintain records of changes that are made to the plan without prior approval for a period of two years from the date of the change and shall furnish the Chief, Advanced Fuel and Spent Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, NMSS, U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, and the appropriate NRC Regional Office specified in Appendix D of 10 CFR Part 20 a report containing a description of each change within six months after the change is made.

APPENDIX B

NRC EVALUATION REPORT - DECONTAMINATION AND TERMINATION OF PLUTONIUM ACTIVITIES IN THE FORMER ADVANCED FUELS LABORATORY, LICENSE NO. SNM-960

Previously filed on DCS/PDR

APPENDIX C

ACCIDENT ANALYSIS REPORTS AND RELATED SAFETY EVALUATIONS

FOR LICENSE NO. SNM-960

1. The Effects of Natural Phenomena on the General Electric Company Vallecitos Nuclear Center at Pleasanton, California, Docket No. 70-754 NUREG-0866. (PREVIOUSLY FILED ON DCS/PDR)

2. Accident Analysis Report, Final Draft Version Related to License Renewal of Special Nuclear Materials License No. SNM-960, October 1978. (attached for DCS/PDR)

3. Director's Decision Under 10 CFR 2.206, July 20, 1979. (PREVISIOUSLY FILED ON DCS/PDR)

4. Preliminary Safety Evaluation by the Office of Nuclear Material Safety and Safeguards, General Electric Company, Special Nuclear Material License No. SNM-960, Docket 70-754, November 7, 1977. (PREVIOUSLY FILED ON DCS/PDR)

1. The Effects of Natural Phenomena on the General Electric Company Vallecitos Nuclear Center at Pleasanton, California, Docket No. 70-754 NUREG-0866.

Previously filed on the DCS/PDR

2. Accident Analysis Report, Final Draft Version
Related to License Renewal of Special Nuclear

CIDENT ANALYSIS REPORT
FINAL DRAFT VERSION

GENERAL ELECTRIC
LLECITOS NUCLEAR CENTER
LEASANTON, CALIFORNIA

TED TO LICENSE RENEWAL OF
ECIAL NUCLEAR MATERIALS
LICENSE NO. SNM-960

ivision of Fuel Cycle
and Material Safety

October 1978

PLANT ACCIDENTS INVOLVING POTENTIAL RADIOACTIVE MATERIAL RELEASE

I. Introduction

This chapter presents the results of an analysis of postulated accidents at VNC that could release radioactive materials to the environment. An entire spectrum of accidents was analyzed to show what releases could occur for a range of circumstances. These postulated events cover the range from those that are quite probable to those that are highly unlikely, because they require that a series of improbable events occur in sequence. Guidance for selecting accidents to be analyzed comes principally from the historical record of past accidents.[1,2] Although this record provides a good basis for the selection of initiating events, past accidents have been terminated without serious consequence or exposure to the public. In this analysis, we forced the postulated accident to proceed to serious consequence to test the adequacy of backup and mitigatory systems. As part of the relicensing action, the operation and pertinent process safety features of the SNM-960 operations were reviewed to evaluate the safety of existing conditions. The plant operation history, reports of incidents involving control of radioactive materials, and inspection reports were reviewed to help establish conditions to be used for postulating accidents. In the 12 years that this plant has operated, there has been no release to the unrestricted area reportable to the NRC on the basis that it exceeded the specified concentration limits defined in 10 CFR 20.43.[3]

A key feature of any research and development facility accident analysis is a search for a mechanism that will disperse radioactive materials. Some agent such as uncontrolled chemical, nuclear, or mechanical energy must act on the radioactive material to cause it to become airborne in a form hazardous to man. Such a search was carried out for VNC using accident event tree analysis.[4] The results show that the accidents that should be considered are fire, explosion, criticality, mechanical disruption (spills), and external phenomena. The importance of the first four is also indicated by the historical accident record. To date, we know of no accidents or incidents involving plutonium in a research and development or fuel fabrication facility that were initiated by external events, such as earthquake, flood, tornado, airplane crash, or highway/railroad explosion. In the following section, both internal and external accident types are discussed in some detail.

II. Bounding Cases

A number of specific accident scenarios were examined for release potential. Many of these were discarded as trivial because it was determined early in the analysis that the releases would be insignificant. However, several cases were identified in which releases could be significant, and these were examined in considerable detail. These latter cases show the greatest potential for radioactive material release and therefore form the bounding upper-limit accident cases. These worst-case conditions dictate the building structural and process equipment design criteria required to effectively mitigate accident consequences and to "test" the adequacy of safety and backup systems. To conclude that the releases from a postulated accident exceed normally acceptable values (10 CFR 20), one must assume the failure of one or more safety systems. In most cases, multiple failures must be assumed.

The following presents specific bounding cases for fire, explosion, mechanical disruption, criticality, and natural phenomena.

A. Fire

Detailed fire scenarios were evaluated for five separate areas at VNC: the AFL, the PAL, the RML, the CMCL, and the CPEL. The most plutonium in dispersible form is located in the AFL. The PAL and CMCL have the most combustible material in contact with dispersible plutonium. The RML has within the cells the most radioactive material in the form of fission products. The CPEL contains the second largest amount of special nuclear material, and this material is in contract with solvents that could provide the dispersing mechanism.

1. AFL

The AFL, in the basement of Building 102, is the main area in which the plutonium is handled. Both wet chemical operations and dry powder operations take place here. Fuel contributing to the fire loading in this area includes rubber or plastic glove box gloves, plastic glove box windows, PVC bags and piping, and general laboratory equipment. The limited amounts of solvents allowed in the laboratory would not contribute greatly to the fire loading, but could provide a source for starting a fire. Burning plastics and PVC produce a sooty smoke that can plug the filters of the ventilation system and in turn reduce the air flow. Because the openings in glove boxes are closed by combustible materials (gloves and plastic windows), a fire that starts inside a glove box can burn its way out into the room and vice versa. The entire laboratory area is equipped with heat detection devices and automatic sprinklers.[5]

A fire that is quickly extinguished by VNC personnel or by the automatic sprinkler system will result in a trivial release of plutonium (0.1 mg). Even a glove box fire involving 30 kg of $Pu(NO_3)_4$ that burns out the glove box HEPA filter would result in only a nominal release (310 mg).

Only in the case of sprinkler system failure could a significant release occur. A major fire in the AFL was assumed to burn for 1 hour before the fire brigade could extinguish it. The quantity of plutonium made airborne in such a major fire could be as high as 150 g. The most probable course of events would be that the HEPA filters would plug from the sooty smoke and terminate the releases.[6] However, the intermediate filters located in the AFL exhaust could burn leaving the single stage of HEPAs in Building 102A as the only filtration before release. In this case the release could be as high as 56 milligrams (mg).

2. PAL

Analytical chemistry in support of research being carried out in AFL is performed in the PAL. The work is done mostly in hoods and glove boxes. Typical of chemical laboratories, the combustible loadings are high because of cleaning material such as Kimwipes, electrically powered analytical equipment, chemicals, and solvents. On the other hand, the plutonium at risk is small, being limited to 350 g for the whole laboratory. As with the AFL, heat detectors are provided in glove boxes, and the room is covered by automatic water sprinklers. Small fires have trivial consequences in terms of plutonium release (38 mg). The release for a major fire (must assume sprinkler system failure) is limited by the material present. Under the very pessimistic assumptions of sprinkler system failure and failure of the intermediate filters, the release could be as high as 220 mg.

3. RML

The hot cells of the RML provide a place for remote handling of highly radioactive materials such as irradiated reactor fuel. Combustible loadings are not particularly high, but the cells themselves are not protected by a sprinkler system. The operating areas are sprinkler protected. The exhaust is filtered by an intermediate set of HEPA filters that have a CO_2 cool-down system and a final stage of HEPA filters in Building 102A that have a manual water spray cool-down system.

Because only small quantities of special nuclear material are used in the cells and because of the two banks of HEPA filters in addition to the local filter, releases of uranium or plutonium from a postulated fire are quite small. However, releases of fission products could be significant by comparison. In the postulated worst-case accidental release caused by a fire, the dissolver tank seals are broken and 3000 Ci of ^{131}I and 6500 Ci of ^{133}Xe are released to the cell atmosphere. Because the release must pass through charcoal beds, 0.5% of 15 Ci of iodine is released to the environment, and it is assumed that all of the xenon passes through the filtration system to the environment.

4. CMC

The features of this laboratory that relate to potential accidental fires are very similar to those of the AFL discussed above. Presently the amount of plutonium in the building is somewhat less (10 g maximum) and is likely to remain less since Building 103 is not located in the safeguards area that surrounds Building 102. Because it is a research chemistry laboratory, the combustible loading and the number of ignition sources can be quite high at times. But it is fully covered by an automatic sprinkler system. Only in the case in which the sprinklers fail to function and the room filters fail as well do the releases come up to mg quantities (1.5 mg).

5. CPEL

Although this facility was examined in some detail because of the quantities of special nuclear material present, the radiological hazard presented by low-enriched uranium is thousands of times less per gram of material than plutonium. Even so, the building is fully protected by automatic sprinklers, and HEPA filters are provided both in room and hood exhausts and in a separate final stage located well away from the building itself. Because the gram quantities of ^{235}U (<1 kg) are less than the ^{239}Pu in the AFL (30 kg) and the radiological hazard is so very much less, the analysis was not carried further than to say the consequences would be far less than those analyzed for the AFL.

B. Explosion

Flammable gases, solvents, and IX resins are possible sources for explosions in the areas listed in Section 7.2.1. Such explosions might initially disperse radioactive materials and then develop into one of the fires described above. The consequences of an explosion would be comparable to those of a major fire in which the sprinklers fail. The amount of material made airborne will be limited by the amount that can be suspended in air. An explosion involving the nitrate conversion box in the AFL could lead to a release of 11 mg of plutonium. An explosion in the PAL could release 5.6 mg. The force of a postulated explosion was judged to be insufficient to demolish the building walls, although such an explosion might well damage them, as well as the glove box and local HEPA filters.

C. Mechanical Disruption

Several operations in the AFL and the RML could lead to a mechanical dispersion of plutonium. Machinery in the AFL includes mechanical blenders, slugging presses, granulators, and high-pressure pellet presses. This equipment could malfunction and disperse plutonium. Overhead cranes, forklifts, and grinding and polishing machinery are used in the RML. Operator error or equipment malfunction could cause containers or process equipment to be ruptured and to disperse plutonium or other radioactive material. An examination of the consequences of these events shows that they would be no worse than those for the explosions postulated above.

D. Criticality

Selby, et al.,[7] have estimated the probability of a fuel fabrication criticality accident at 9×10^{-3}/yr on the basis of four reported accidents and the number of years plants have operated. The reported accidents all occurred in wet systems. The probability of a criticality in dry systems was estimated[8] at less than 2.3×10^{-3}/yr. After a thorough review of the plutonium process system and controls in use at the plant, the staff has concluded that even under the two-contingency constraint they could not identify a credible situation that could produce a criticality. (See Section 4.1 for a complete discussion of Nuclear Criticality Safety.)

In spite of this, we have treated the criticality as a postulated design basis accident for this safety evaluation. The postulated criticality takes place inside the nitrate conversion line in the AFL. We assume that the glove box is breached, but the integrity of the building and ventilation system is maintained. The gaseous iodines and noble gases generated by 2×10^{18} fissions are transported through the ventilation system and out the stacks with no reduction in activity other than an assumed 50% reduction of iodine because of plate-out.

At a velocity of approximately 1.0 m/s, the gases take 7 minutes to reach the closest site boundary located 440 m downwind from the stack. A value for X/Q of 2.8×10^{-3} s/m^3 based on 5% meteorology is chosen. This accident results in a release of 470 Ci of iodine and 14,000 Ci of noble gases. The prompt radiation from this postulated excursion presents no significant hazard to the public at the fence line.

E. Natural Phenomena

Sections 70.22 and 70.23 of 10 CFR Part 70 requires that existing licensed plutonium fabrication plants be examined to determine their ability to withstand adverse natural phenomena. We have started an analysis of the effects of natural forces upon plant operation. The natural phenomena being considered are recurrent severe weather, earthquake, and flood.[9] The review will assess the likelihood that the plant will be damaged by one of these phenomena and the consequences to the public of that damage. It will also provide a basis for determining any necessary modifications to improve the plant's ability to withstand adverse natural phenomena.

III. Perspective

A. Historical Record

An in-depth review of accidents that have occurred in federal government facilities in the last 35 years shows that, although accidents such as those postulated above can occur, the resulting releases have never been as high as those described above. This is because protective systems have functioned as designed, thus mitigating releases. An excellent summary of the historical record has been presented by Selby, part of which is quoted below.

Loss-of-Control Incidents
Involving Plutonium and Its Compounds

"Various incidents have occurred involving plutonium and its compounds ranging from spread of contamination to major fires. In no case have hazardous quantities of plutonium been released to the environment. Three of the incidents were very serious in nature and involved different forms of plutonium.

"In November 1959, an estimated 500 mg of plutonium was blown through the open door and the operating holes of a cell during decontamination of an evaporator. The explosion was attributed to inadvertently using a nitrate organic cleaning agent. Although the nearby buildings, vehicles, roadway, and ground were contaminated, air samplers in the area did not indicate air concentrations above acceptable limits. Thus, although air concentrations near the contamination have exceeded limits for a short period of time, air concentrations exceeding established limits could not leave the site boundaries even under these rigorous conditions.

"Detonation of nitrated exchange resin initiated a fire that destroyed a plutonium purification facility in Richland, Washington, in November 1963. Many kilograms of plutonium as nitrate were involved. The integrity of the vessel and glove box were destroyed, and material could escape through a partially open door. Although alpha contamination was widespread throughout the facility, air samplers located at the site boundaries within one-quarter mile did not indicate air concentrations exceeding established limits. The alpha contamination in this instance appeared to be associated with soot, and the great number of soot particles generated in this incident may have effectively removed a large part of any plutonium which was airborne.

"The most serious and significant incident involving plutonium to date was the fire in a major plutonium fabrication facility at Rocky Flats, Colorado, in May 1969. Products of a fire in one area clogged the exhaust filters of one of three exhaust systems. Flammable vapors passed into other areas. Ultimately, a significant portion of the facility was involved. The supply fans operated during the initial phase of the fire, and loss in negative pressure allowed back diffusion into office areas. Hundreds of kilograms of plutonium as metal and compounds was involved with a significant quantity in unknown form involved with the equipment Material Unaccounted For (MUF). Only 200 mCi of airborne material (0.003 g) was released through a damaged exhaust system. Based on the author's personal observation and data, a maximum of 0.5% of the plutonium may have been airborne within the facility. This value was derived by making the highly conservative assumption that all contamination measured on the ceiling, walls, and floors of all contaminated areas of the facility and all surfaces outside the enclosure was caused by airborne material. The estimate does not include the negligible amounts of plutonium found in the water collected from extinguishment nor the unknown quantities in the exhaust system. The vast majority of the plutonium used to obtain this estimate was measured as floor contamination in the immediate fire area and is probably debris that fell or was washed from the enclosure during extinguishment."

B. Comparison to VNC

VNC is not a new facility. In many respects, it is comparable to facilities for which data are available. Improvements, such as the automatic fire-suppression system, and procedures based on much more experience are available to VNC. These improvements significantly reduce the potential for a hazardous release. The most pertinent comparison would be between the major facility fire postulated above and the Rocky Flats fire in 1969. At Rocky Flats, plutonium metal, which is pyrophoric, was intimately involved in the burning material. The oxide or nitrate forms of plutonium at VNC would not likely be so intimately mixed with the burning materials because they cannot burn and are usually separated from combustible materials by steel canisters. There were water sprinklers in the exhaust filter plenum at Rocky Flats. The ventilation systems at VNC are comparable to those at Rocky Flats in 1969. If the ventilation system at VNC were to respond to a fire as did the system at Rocky Flats (that is, by partial plugging and continued operation), then the releases from a 1-hour fire would be comparable.

IV. Consequence Summary

The releases and the resulting doses for the limiting case accidents postulated above are summarized in Table 1. Filter efficiencies have been taken as 95% for local filters and 99.95% for testable final filters. The above discussion of accident scenarios together with filter efficiencies leads to estimated releases from the buildings. Before any effect on people can be assessed, the released material must move from the release point to the location of a person and then interact with the person. These steps are termed environmental transport and radiological dose. Transport of radioactive materials from the point of release to the point of uptake or inhalation by humans was calculated using the Gaussian plume model. Meteorological data from the site were used to determine the probability distribution of wind speeds and stability conditions. In each case, the atmospheric dispersion factor used is that value that will not be exceeded 95% of the time. The wind is assumed to be blowing in the direction of the receptor. Dilution in the turbulent wake of the building has been taken into account. The meteorological dispersion factors used in each case are also shown in Table 1.

Radiological doses from plutonium were computed using the Task Group Lung Model as described in the International Committee on Radiation Protection Publication Number 19 (ICRP 19). A one-particle size was assumed. The deposition fraction was conservatively taken to be 1/4. The mix of radionuclides present in the VNC process lines was used as the basis for dose computation. In the case of insoluble plutonium (PuO_2), the critical organs are the lung and bone. For soluble plutonium ($Pu(NO_3)_4$), the critical organ is the bone. In each case the 50-year dose commitment is reported. This means that for materials that are absorbed and retained in the organs of the body, the dose accumulated over a 50-year period is computed.

Doses from inhalation of iodine or immersion in a cloud of noble gases were computed using the dose conversion factors listed in RG 1.109. A breathing rate of 3.47×10^{-4} m^3/s was assumed in all cases.

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11. The Metabolism of Compounds of Plutonium and Other Actinides, 1972, ICRP Publication 19, Pergamon Press.

Table 1

Summary of Postulated Accident Events

Scenario	Radioactive Material Involved	Release to Atmosphere	Site Boundary Dose[a] (rem)
FIRE - AFL LAB AREA - Fire in room; 65 lbs of contaminated materials burn; sprinklers douse fire.	1×10^{-4} kg $Pu(NO_3)_4$	1.1×10^{-7} g Pu-mix	9.8×10^{-5} [b]
FIRE - AFL GLOVE BOX - Fire in nitrate conversion and scrap recovery boxes; sprinklers fail; both local glove box and intermediate HEPA filters fail.	30 kg $Pu(NO_3)_4$	5.6×10^{-2} g Pu-mix	50[b]
FIRE - PAL LAB AREA - Fire burns entire lab, hoods and glove boxes; sprinklers fail; both local glove box and intermediate HEPA filters fail.	3×10^{-1} kg $Pu(NO_3)_4$	2.2×10^{-4} Pu-mix	2×10^{-1} [b]
FIRE - RML HOT CELL - Fire in cell 3 burns into disselver tank containing fresh charge of irradiated ^{235}U.	3000 Ci - ^{131}I 6500 Ci - ^{133}Xe	15 Ci ^{131}I 6500 Ci ^{133}Xe	22[c] 1.7×10^{-1} [b]
EXPLOSION - AFL GLOVE BOX - Nonspecific explosion in nitrate conversion area loads room air to capacity; local and intermediate HEPAs fail.	30 kg $Pu(NO_3)_4$	1.1×10^{-2} g Pu-mix	9.8[b]
EXPLOSION - CMCL LAB AREA - Chemical reaction disperses 10% of building inventory; room HEPA filters fail.	1×10^{-3} kg $Pu(NO_3)_4$	4×10^{-4} Pu-mix	3.6×10^{-1} [b]
CRITICALITY - AFL GLOVE BOX - Postulated criticality in nitrate conversion area yields 2×10^{-18} fissions	Fission Products	470 Ci I 14,000 Ci Xe, Kr	7.4[c] 2.2[d]

Notes: a. Site boundary taken as 440 m SSE. Relative annual dispersion factor at this location is 2.8×10^{-3} s/m^3 based on maximum 5% meteorology.

b. 50-yr commitment to bone. Thyroid dose commitment. Whole body dose commitment.

3. Director's Decision Under 10 CFR 2.206, July 20, 1979.

Previously filed on the DCS/PDR