70-36

ABB
ASEA BROWN BOVERI

March 21, 1994
ML-94-012

Docket No. 70-36
License No. SNM-33

Dr. Michael Tokar, Section Leader
Licensing Section II, Licensing Branch
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Materials Safety and Safeguards
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: **Hematite License Renewal - Radiological Changes**

Dear Dr. Tokar:

This letter provides changes to the Hematite License Renewal Application radiological chapters as discussed during our meeting of February 10, 1994.

Enclosure I provides an explanation of substantive changes from the previous renewal submittals. A revised "List of Effective Pages" is provided as Enclosure II for your information. Enclosure III provides the replacement pages of the renewal application. The replacement pages consist of complete chapters. Six (6) copies of this document are provided for your use.

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Change: LA Ltr Encl. 6 0 NF04 1/1

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If there are any questions or comments concerning this matter, please do not hesitate to call me or Mr. Mark A. Michelsen of my staff at (203) 285-5261.

Very truly yours,

COMBUSTION ENGINEERING, INC.

John F. Conant

John F. Conant
Manager
Nuclear Materials Licensing

Enclosures: As Stated

cc: G. France (NRC - Region III)
S. Soong (NRC)

Enclosure I to
ML-94-012

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE RENEWAL APPLICATION

RADIOLOGICAL CHANGES

DESCRIPTION OF CHANGES

March 1994

COMBUSTION ENGINEERING, INC.
HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY
LICENSE RENEWAL APPLICATION
RADIOLOGICAL CHANGES

DESCRIPTION OF CHANGES

This submittal provides changes to the Hematite License Renewal Application radiological chapters as discussed in a meeting with the Nuclear Regulatory Commission staff on February 10, 1994. Complete chapters are submitted. Enclosure II provides a List of Effective Pages for information. The substantive changes to the Hematite License Renewal Application which are submitted herein are discussed below.

In Section 1.1, the post office box for the Hematite address has been deleted since such is not part of the facility's location.

The table of possession limits in Section 1.4 has been changed to clarify that the quantity of the second item is in terms of grams of contained U-235.

The wording of the special authorization of item (b) in Section 1.6 has been modified for consistency of terminology with 10 CFR 20.

The former license condition concerning the decontamination of the two evaporation ponds has been met. Therefore, the former item (e) in Section 1.6 has been eliminated. The other items of this section have been renumbered accordingly.

In Section 2.1.2, the fourth sentence regarding the responsibility of the Manager, Regulatory Compliance, for radiological and criticality safety training has been reworded.

The former second sentence in Section 2.7 may have implied that it was the engineering discipline's responsibility to secure management review and approval. It has been reworded to eliminate that implication. Section 11.6 has also been revised to clarify that engineering typically initiates plant change requests.

In Section 2.8, the sentence concerning the qualifications of the auditing radiation specialist has been reworded for clarity.

The Radiation Work Permit provisions in Section 3.2.1 have been changed to provide examples of RWPs which are not OSs or SETs. Such RWPs are approved only by Regulatory Compliance.

In Section 3.2.2, a further limitation on the replacement of filters is provided, namely that the filters are normally replaced when the filter differential pressure reaches 6 inches of water, or as recommended by the manufacturer if less than 6 inches. Also, all HEPA systems now have DOP testing ports, so the condition with respect to new HEPA systems has been deleted. The second paragraph was reworded for consistency with 10 CFR 20 terminology.

In Section 3.2.3.1, former item c. was deleted.

Former item a. of Section 3.2.3.2 was deleted; the remaining items of the section were renumbered. Former item c. of this section (new item b.) was revised to specify the frequency of assessment of airborne radioactivity concentration and to clarify that the requirement applies to operations involving soluble uranium compounds. The frequency of assessment of airborne radioactivity concentration for soluble uranium is given in Section 12.3.

In Section 3.2.5, the first paragraph has been changed to differentiate the limits associated with soluble and insoluble uranium, and to specify action limits. The former provisions concerning 40 CFR 190.10 in Section 3.2.5 are deleted (this had been license condition number 20.b. of the existing license certificate).

In Section 3.2.6.1, the former second and fourth sentences of the second paragraph have been deleted as extraneous.

In Section 3.2.6.2, the wording of the table of survey frequencies has been revised for consistency of terminology with 10 CFR 20. This section was also changed to specify the action levels for removable surface contamination in accordance with Table 2 of Regulatory Guide 8.24 and to specify quarterly direct beta-gamma surveys.

Section 3.2.8 has been changed to clarify that respiratory protection equipment shall be used as required by regulation.

A new Section 3.2.9 has been added to address the bioassay program; former Section 3.2.9 has been renumbered to 3.2.10.

In Part II, Chapter 11 has been changed to describe the functions of the process engineers (new Section 11.1.3; succeeding sections renumbered). The process engineering function is shown on the revised organization chart of Figure 11-1.

In order to address the new methods of radiation and control in the new 10 CFR 20, the order of sections in Chapter 12 has been substantially revised. In particular, the description of the bioassay program has been moved to Section 12.2 and has been somewhat reworded. The description of air sampling has been moved to 12.3; suceeding section have been renumbered. The description of the bioassay program in Section 12.2 has been revised concerning in-vivo lung counting, and provisions for fecal analysis and urinalysis. In Section 12.3, the air sampling provisions concerning action limits have been revised.

Figure 12-1 has been revised to depict the contamination control areas of the entire plant site and terminology has been changed from "restricted area" to "contamination control area". Former Figure 12-2 has been deleted and the text in former Section 12.4 (new Section 12.6) has been changed accordingly. The text of former Section 12.14 has been moved to this section, and former Section 12.14 has been eliminated.

The discussion of instrumentation used in the air sampling program has been moved from former Section 12.13 (new Section 12.3), Air Sampling, to Section 12.6, Instruments. Clarification is provid`d that sources not traceable to the National Institute of Standards and Technology are used for operability checks. A description of operability checks for health physics instrumentation is provided. In addition the checks and calibration of flowmeters is described.

Action levels have been added to Section 12.10.

In new Section 12.12.1, the table summarizing the history of external radiation exposures has been revised to clarify that the data is in terms of the percent of the number of personnel in the ranges given. In addition, the data for annual doses of greater than 1.00 Rem are given (i.e., zero for each year) and a typographical error for the total number of personnel for the year 1990 has been corrected.

In Section 12.12.2, the tables of quarterly average air concentrations and in-vivo counting results have been revised to clarify that the data is in terms of the percent of the number of personnel in the ranges given. In addition, a conclusion concerning the historical uranalysis results is provided. Much of the former text in this section concerning in-vivo lung counting has been moved to the bioassay description in Section new 12.2.

In Chapter 13, more recent historical information is given in Sections 13.1 and 13.2.

Enclosure II to
ML-94-012

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE RENEWAL APPLICATION

LIST OF EFFECTIVE PAGES

March 1994

COMBUSTION ENGINEERING, INC.
HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY
LICENSE RENEWAL APPLICATION

LIST OF EFFECTIVE PAGES

Combustion Engineering, Inc., provides changes to the Hematite license renewal application. The following is a comprehensive List of Effective Pages, summarizing the latest applicable submittal dates for each page of the application.

Pages	Revision	Date
License Application Title Page		
Table of Contents		
i through xii	0	1/28/94
Part I Title Page		
Chapter 1		
1-1 through 1-7	0	3/21/94
Chapter 2		
2-1 through 2-15	0	3/21/94

Pages	Revision	Date
Chapter 3		
3-1 through 3-13	0	3/21/94
Chapter 4		
4-1 through 4-26	0	1/28/94
Chapter 5		
5-1 through 5-4	0	1/14/94
Chapter 6		
6-1 through 6-3	0	10/29/93

Pages	Revision	Date
Chapter 7		
7-1	0	1/14/94
Chapter 8		
8-1	0	10/29/93
Part II Title Page		
Chapter 9		
9-1 through 9-20	0	11/24/93
Chapter 10		
10-1 through 10-23	0	1/14/94
Chapter 11		
11-1 through 11-34	0	3/21/94
Chapter 12		
12-1 through 12-16	0	3/21/94
Chapter 13		
13-1 through 13-25	0	3/21/94
Chapter 14		
14-1 through 14-97	0	1/28/94
Chapter 15		
15-1 through 15-309	0	1/14/94

Enclosure III to
ML-94-012

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE RENEWAL APPLICATION

AFFECTED PAGES

March 1994

CHAPTER 1 STANDARD CONDITIONS AND SPECIAL AUTHORIZATIONS

1.1 Name, Address and Corporate Information

The name of the applicant is Combustion Engineering, Inc. (C-E). The applicant is incorporated in the state of Delaware with principal corporate offices located at 900 Long Ridge Road, Stamford, Ct 06904. The Nuclear Fuel offices are headquartered at 1000 Prospect Hill Road, Windsor, Ct 06095. The address at which the licensed activities will be conducted is:

Combustion Engineering, Inc.
3300 State Road P
Hematite, Missouri 63047

1.2 Site Location

The Hematite fuel manufacturing facility of Combustion Engineering, Inc. is located on a site of about 212 acres in Jefferson County, Missouri, approximately 3/4 mile northeast of the unincorporated town of Hematite, Missouri and 31 miles south of the city of St. Louis, Missouri. Activities with special nuclear materials are conducted within an 8 acre, controlled access area near the center of the site and adjacent to the access road, State Road P. Nuclear fuel manufacturing activities occur within the fenced, controlled area. These activities include conversion of UF_6 to UO_2, fabrication of UO_2 nuclear fuel pellets, fabrication of nuclear fuel assemblies, and related processes.

1.3 License Number and Period of License

This application is for renewal of Special Nuclear Material License (SNM) No. SNM-33 (NRC Docket 70-36). Renewal is requested to cover a period of ten (10) years.

1.4 Possession Limits

Combustion Engineering, Inc. requests authorization to receive, use, possess, store and transfer at its Hematite site, the following quantities of SNM and source materials:

Material	Form	Quantity
Uranium enriched to maximum of 5.0 weight percent in the U^{235} isotope	Any *	8,000 kilograms contained U^{235}
Uranium to any enrichment in the U^{235} isotope	Any *	350 grams contained U^{235}
Source material Uranium and Thorium	Any *	50,000 kilograms
Cobalt 60	Sealed sources	40 millicuries total
Cesium 137	Sealed sources	500 millicuries total
Mixed Activation and Fission Product Calibration Sources Including Am-241	Solid Sources	200 microcuries total
Californium 252	Sealed Sources	4.0 milligrams total

* Excluding metal powders

1.5 Authorized Activities

This license application requests authorization for Combustion Engineering, Inc. to receive, possess, use, store and transfer Special Nuclear Material under Part 70 of the Regulations of the Nuclear Regulatory Commission in order to manufacture nuclear reactor fuel utilizing low-enriched uranium (up to 5.0 weight percent in the isotope U^{235}) and to receive, possess, use, store, and transfer Source Material under Part 40 of the Regulations of the Nuclear Regulatory Commission. Source materials are generally used for the start-up testing of a new process. Sealed cobalt-60 sources and solid sources are generally used for instrument calibration and testing. Sealed cesium 137 and californium 252 sources are used for performing quality checks on completed fuel rods. Authorized activities are conducted in the following buildings and facilities on the Hematite site:

Number	Name	Primary Utilization
101	Tile Barn	Emergency center and equipment storage
110	Office Building	Guard station and offices
115	Emergency Utilities	Water pump for fire suppression, emergency generator
120	Wood Barn	Equipment storage
-	Oxide Building and Dock	UF_6 to UO_2 conversion, UF_6 receiving

Number	Name	Primary Utilization
230	Rod Load and Bundle Assembly Building	Fuel rod loading, fuel bundle assembly, storage, shipping/receiving
235	West Vault	Source material storage
240	240-1	Laboratory, offices and cafeteria
	240-2	Recycle and recovery area
	240-3	Incinerator and storage
	240-4	Maintenance Shop
252	South Vault	SNM and miscellaneous other storage
253	Utility Building	Steam supply, SNM storage, offices, and recycle blending
254	254-1	UO_2 storage, blending, and pressing
	254-2	Pellet oxidation, dewaxing, and sintering
	254-3	Pellet grinding
255	Pellet Plant	Special pellet fabrication, UO_2 storage, packaging and operating supplies
256	256-1	Pellet drying, preparation for transport and packaging
	256-2	Shipping, receiving, and storage

1.6 Exemptions and Special Authorizations

The following are specific exemptions and special authorizations of this license application:

(a) Treat or dispose of waste and scrap material containing uranium enriched in the U^{235} isotope, and/or source material, by incineration pursuant to 10 CFR 20.2002.

(b) Release of equipment and materials from restricted areas to controlled areas or off-site in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated April 1993.

(c) Release calcium fluoride (spent limestone) from the conversion process dry scrubbers for use as fill materials on site, providing the uranium alpha activity is less than 30 picoCuries per gram.

(d) At 2 year intervals from the date of NRC approval of this renewal application, the licensee shall update the demonstration sections of the renewal application to reflect the licensee's current operations. The updates to the application shall, as a minimum, include information for the health and safety section of the application as required by 10 CFR 70.22(a) through 70.22(f) and 70.22(i) and operational data and information on environmental releases as required by 70.21. In lieu of an update at the end of the 10-year renewal period, the licensee may file a renewal application on or before ten years from the date of NRC approval of this renewal application.

(e) Combustion Engineering shall submit a schedule to the NRC within six months of the NRC's approval of the renewal application for the performance of Integrated Safety Assessments (ISA) for plant processes. New or significantly modified plant processes (as determined by the Manager, Regulatory Compliance) shall include such ISA's.

(f) C-E shall evaluate the safety program against the "Guidance On Management Controls/Quality Assurance, Requirements for Operation, Chemical Safety, and Fire Protection for Fuel Cycle Facilities", Federal Register, March 21, 1989. CE shall propose license conditions within one year of renewal approval.

(g) Documentation of validation of the calculational methods of Section 4.2.3 of the license application shall be provided via application for amendment to the license within 18 months after the date of NRC approval of the renewal application.

CHAPTER 2 ORGANIZATION AND ADMINISTRATION

2.1 Organizational Responsibilities and Authority

The President, Nuclear Fuel has the ultimate responsibility for ensuring that corporate operations related to Nuclear Fuel are conducted safely and in compliance with applicable regulations. The President has delegated the safety and compliance responsibility for nuclear fuel manufacturing to the Vice President, Manufacturing Operations, who in turn has delegated this responsibility to the Plant Manager, Hematite.

2.1.1 Plant Manager, Hematite

The Plant Manager, Hematite reports to the Vice President, Manufacturing Operations. He directs and has the overall responsibility for the safe operation of the Hematite facility including production, accountability, security, criticality safety, industrial safety and radiological safety, environmental protection, transportation, training, materials handling and storage, licensing, process and equipment engineering and maintenance. He fulfills these functions by delegation to a staff at Hematite that reports to the Plant Manager. He may also request support from the Windsor, CT staff to provide functions that may include criticality analysis, production methods, nuclear licensing and others as needed.

2.1.2 Manager, Regulatory Compliance

The Manager, Regulatory Compliance reports to the Plant Manager. He manages radiological protection, industrial safety, SNM accountability, criticality safety, licensing, emergency planning, and environmental protection. His activities include review and approval of procedures for control, sampling, measurement and physical inventory of SNM, and auditing of plant operations. He is responsible for radiological and criticality safety training. He reviews results from personnel and environmental monitoring and facility activities to ensure compliance with the requirements of License No. SNM-33. To enforce compliance, he has authority to halt any operation at the Hematite facility, and the operation shall not restart until approved by the Plant Manager or a duly authorized alternate.

2.1.3 Manager, Focused Factory

There are three Focused Factories, whose Managers report to the Plant Manager: Chemical Operations, Ceramic Operations and Assembly Operations. These Focused Factory Managers direct production operations in accordance with the content of Operation Sheets and Traveler documents. The Focused Factory Managers' activities include scheduling of Production Supervisors, recommending improvements to equipment, processes and procedures, training and qualification of production operators through their Production Supervisors, and periodically directing the cleanout of the production equipment in conjunction with the physical SNM inventory. They are responsible for the engineering of new equipment and of modifications to existing equipment. With support from Nuclear Fuel staff, activities include recommendation, development and qualification of manufacturing processes, specification of process control methods and design, procurement and installation of processing equipment.

2.1.4 Nuclear Criticality Specialist

The nuclear criticality specialist function reports to the Manager, Regulatory Compliance. The nuclear criticality specialist verifies that equipment, processes and procedures satisfy the criticality criteria in Chapter 4 by performing the review described in Section 2.6. Alternatively, for criticality analyses that require elaborate computational techniques, the specialist may supervise and/or review the analysis. The specialist may also perform the annual audit at Hematite required by Section 2.8.

2.1.5 Supervisor, Health Physics

The Supervisor of Health Physics reports to the Manager of Regulatory Compliance. He/she supervises the health physics technicians in the radiological surveillance of activities that involve radioactive materials, in personnel radiation monitoring and in the collection and measurement of environmental samples. He/she has the authority to suspend unsafe operations.

2.1.6 Health Physicist

The Health Physicist reports to the Manager of Regulatory Compliance. Activities include observation of plant operations and evaluation of results from personnel and environmental monitoring. Quantitative measurements and other observations of facility activities are compared with the requirements of License No. SNM-33.

2.1.7 Health Physics Technicians

The Health Physics Technicians report to the Supervisor, Health Physics. The Technicians are responsible for the day-to-day monitoring of operations. Monitoring is accomplished through the collection of data which allows the effectiveness of radiological and criticality safety, environmental protection and emergency planning programs to be assessed. Technicians also monitor the proper implementation of radiation work permits (called Special Evaluation Travelers).

2.2 Personnel Education and Experience Requirements

Table 2-1 lists the minimum education and experience requirements for the positions described in Section 2.1.

2.3 Hematite Plant Safety Committee

The Hematite Plant Safety Committee meets at least once each calendar quarter to review plant operations, to compare them with selected safety requirements of Part I and the License Conditions and to consider other aspects of safety the Committee believes appropriate. The Plant Safety Committee shall perform an annual review of each of the following:

- o Environmental protection trends
- o Radiation safety trends
- o Criticality safety practices
- o Industrial safety trends
- o Adequacy of emergency planning and drills
- o Effectiveness of ALARA program
- o Internal inspection and audit reports
- o Abnormal occurrences and accidents including recommendations to prevent recurrence
- o Review of significant physical facility changes in the pellet shop and significant changes to operations involving radiation and/or nuclear criticality safety

The review of findings and recommendations of corrective action shall be reported to the Plant Manager for action.

The Committee Chairman or Plant Manager determines which committee members, as a minimum, shall attend each quarterly meeting, according to the topics to be considered. The Committee submits a quarterly meeting report to the Hematite manager level personnel and the Plant Manager at Hematite. The Plant Manager appoints the committee members to represent, as a minimum, engineering, production, health physics, and criticality safety. He may also approve alternate(s) for the members.

Minimum education and experience requirements for the Chairman are in Table 2-1. The Committee is composed of senior personnel from the technical staff of Combustion Engineering's Nuclear Fuel organization who have at least five (5) years experience in the nuclear industry. The Committee Chairman or Plant Manager may invite participation by others from within Hematite or from the staff at Windsor.

2.4 Approval Authority for Personnel Selection

Two higher levels of management shall approve personnel for safety-related staff positions.

2.5 Training

Hematite staff conduct or supervise the indoctrination of new employees in the safety aspects of the facility. The indoctrination topics shall include nuclear criticality, safety, fundamentals of radiation and radioactivity, contamination control, ALARA practices and emergency procedures. After test results demonstrate that a new employee has sufficient knowledge in the above topics, the new employee begins on-the-job training under direct line supervision and/or experienced personnel. The Supervisor monitors performance until it is adequate to permit work without close supervision.

The training and personnel safety program continues with on-the-job training supplemented by training in specialized topics such as personnel protective equipment, accident prevention, and other safety topics. Production Supervisors receive formal training in radiation and criticality control. Testing determines when they have sufficient knowledge to enable them to carry out their training functions. Operating personnel receive a re-training course in criticality control and radiation safety on a biennial basis. The effectiveness of retraining is determined by testing. Formal training shall be documented. The health physics technicians will receive professional related training at least biennially.

2.6 Operating Procedures

Operations which affect licensed material shall be conducted in accordance with approved written procedures. Operating Procedures, called Operation Sheets, are issued and controlled by Quality Coordinators. These Operations Sheets provide the detailed instructions for equipment operation and material handling and the limits and controls required by the License. Operation Sheets are the basic control document; before issuance or revision they require signed approval by the appropriate Focused Factory Manager and the Manager, Regulatory Compliance. In the Manager's absence, another individual meeting the Manager's minimum education and experience requirements, or the Plant Manager, may provide approval. Health Physics activities will be conducted in accordance with approved written procedures; these procedures must be approved by the Manager, Regulatory Compliance or the Health Physicist.

Procedures concerning the handling, processing, storing and shipping of nuclear materials are given prior review and approval by the Manager of Regulatory Compliance. Suitable control measures are prescribed, and pertinent control procedures relative to nuclear criticality safety and radiological safety are followed.

Primary responsibility and authority to suspend unsafe operations is placed with line supervision. Within their respective responsibilities, members of Regulatory Compliance also have authority to suspend operations not being performed in accordance with an approved procedure.

Prior to the start of a new activity affecting nuclear materials, approved procedures are available. A review procedure has been established for changes in processes, equipment and/or facilities prior to implementation. Regulatory Compliance authorization must be obtained for each change involving nuclear safety or radiological safety. Regulatory Compliance reviews shall be documented, except for minor changes within existing safety parameters.

The Regulatory Compliance Manager shall grant approval only when:

a. A nuclear criticality safety evaluation has been performed based on the criteria and standards of Chapters 3 and 4 by a person who meets the education and experience requirements for a Nuclear Criticality Specialist (and who may be the Regulatory Compliance Manager). This evaluation shall be in sufficient detail to permit subsequent review.

b. The criticality safety evaluation has been reviewed by a person who fulfills the education and experience requirements for a Nuclear Criticality Specialist (and who may be the Regulatory Compliance Manager). This individual will be different from the person who performed the evaluation. This review is based on the criteria and standards of Chapter 4 and includes verification of each of the following:

1) assumptions
2) correct application of criteria of Chapter 4
3) completeness and accuracy of the evaluation
4) compliance with the double contingency criteria

c. The Regulatory Compliance Manager has concluded that the operation can be conducted in accordance with applicable health physics criteria.

Review and verification shall include written approval by the reviewer.

The Manager of Regulatory Compliance has the authority to determine whether other cognizant individuals, such as the Nuclear Criticality Specialist and/or the Health Physicist, have the appropriate experience and expertise to provide approvals in the stead of the Manager of Regulatory Compliance for their areas of expertise. If he so determines, he may delegate his approval authority.

The minimum frequency for review, for the purpose of updating of operating procedures affecting Special Nuclear Materials and health physics procedures, shall be every two (2) years. Updating of operating procedures is the responsibility of the cognizant manager.

2.7 Plant Modifications

The Manager, Regulatory Compliance is responsible for determining the necessary safety reviews (e.g., for criticality and/or radiological safety) for proposed changes or modifications to equipment for SNM processing, handling, or storage, or related operations. The necessary management and safety reviews and approvals shall be performed prior to implementation of the change. Significant changes, as determined by the Manager, Regulatory Compliance, to operations affecting radiological and/or criticality safety are also reviewed by the Hematite Plant Safety Committee. Facility change requests requiring a criticality safety review shall be evaluated by a Nuclear Criticality Specialist.

If it is deemed necessary, by any reviewer, that an inspection of equipment, procedures, and postings to assure completeness prior to startup of a new or modified process, the requirement for such an inspection will be so designated in the Change Request. Such inspections shall be documented as part of the records for this facility change.

A modified process is defined as one involving a change in equipment design, SNM amount and/or configuration, or process controls when that change invalidates any aspect of the previous safety analysis.

2.8 Audits and Inspections

Audits and inspections shall be performed to determine if plant operations are conducted in accordance with applicable license conditions, C-E policies, and written procedures. Audits shall apply to safety-related and environmental programs. Qualified personnel having no direct responsibility for the plant operation being audited shall be used to ensure unbiased and competent audits.

Daily checks for safety related problems are made by Health Physics Technicians, who observe, note and make general observations in addition to their other duties. Problems are normally corrected on the spot by the Production Supervisor. More significant problems are listed on the daily exception report distributed to the Plant Manager and manager level staff. The appropriate Focused Factory Manager is responsible for corrective action.

Planned and documented quarterly inspections, performed by an individual who meets the education and experience requirements of the Regulatory Compliance Manager, cover criticality control and radiation safety. The inspection of criticality control shall be performed by an individual meeting at least the education and experience requirements of a Nuclear Criticality Specialist and at least one of the quarterly inspections per year regarding criticality control will be by an individual who is not the Regulatory Compliance Manager. Items requiring corrective action are documented in a report distributed to the Plant Manager and manager level staff. The appropriate Focused Factory Manager is responsible for corrective action, except where another manager is specifically designated. Follow-up actions taken by the appropriate Focused Factory Manager, or other responsible manager, shall be documented.

Annual audits, in which the results of previous inspections or audits are reviewed, are conducted as an evaluation of the effectiveness of the program. These audits may also involve a detailed review of non-safety documents such as operation procedures, shop travelers, etc., and are documented by a formal report to the Vice President, Manufacturing Operations. Annual audits are performed by a team appointed by the Vice President, Manufacturing Operations. Personnel on the team will not have direct responsibility for the function and areas being audited. The team shall include, as a minimum, a Nuclear Criticality Specialist and a radiation specialist who shall audit criticality and radiation safety, respectively. The radiation specialist who conducts the annual audit shall have as a minimum a Bachelor's degree in Science or Engineering with two years experience in operating health physics, including experience with uranium bioassay techniques, internal exposure controls and radiation measurement techniques. The annual audit will review ALARA requirements in conformance with Regulatory Guide 8.10, Revision 1-R, dated May 1977, as applicable. The Regulatory Compliance Manager shall be responsible for follow-up of recommendations made by the audit team.

2.9 Investigations and Reporting

Events specified by applicable regulations or license conditions shall be investigated and reported to NRC. The Regulatory Compliance Manager shall be responsible for conducting the investigation and documentation of reportable events.

Non-reportable occurrences shall be investigated and documented as appropriate. Such reports shall be available for NRC inspection.

2.10 Records

Retention of records required to be maintained by the regulations, and by the conditions of this license, shall be the responsibility of the cognizant manager. Records of Regulatory Compliance evaluations and approvals shall be retained for a period of at least six months after use of the operation has been terminated, or for two years, whichever is longer. Other safety significant records shall be retained for at least two years.

TABLE 2-1

MINIMUM EDUCATION AND EXPERIENCE REQUIREMENTS FOR KEY PERSONNEL

POSITION			
Described In Section No.	Title	Education	Experience (Years/Field)
2.1.1	Plant Manager	Bachelors, Science or Engineering	5/Nuclear manufacturing
2.1.2	Manager, Regulatory Compliance	Bachelors, Science or Engineering	4/Health Physics with 2/Operational health physics with uranium bioassay techniques, internal exposure control, and radiation measurement techniques
2.1.3	Focused Factory Managers	Bachelors, Science, Engineering or Manufacturing	4/Nuclear manufacturing industry
2.1.4	Nuclear Criticality Specialist	Bachelors, Science or Engineering	2/Nuclear criticality evaluations, including 6 months applicable to fuel manufacturing
2.1.5	Supervisor, Health Physics	High School Diploma	5 Total/Nuclear industry, with 3/Health Physics Technician
2.1.6	Health Physicist	Bachelors, Science or Engineering	2/Operational Health Physics applicable to fuel manufacturing
2.1.7	Health Physics Technician	High School Diploma or GED Equivalent	6 months/Training and experience in radiation protection activities
2.3	Chairman, Plant Safety Committee	Bachelors, Science or Engineering	5/Nuclear manufacturing industry

CHAPTER 3 RADIATION PROTECTION

3.1 Special Administrative Requirements

3.1.1 ALARA Policy

It is the policy of Combustion Engineering to maintain a safe work place and healthful work environment for each employee and to keep radiation exposures to both employees and the general public As Low As Reasonably Achievable (ALARA). The annual audit team described in Section 2.8 considers ALARA requirements in conjunction with the intent of Regulatory Guide 8.10.

A written report shall be made by the Manager, Regulatory Compliance to the Plant Manager every six months providing employee radiation exposure (internal and external) and effluent release data. Trends in the reported data may reveal areas where exposures and releases can be lowered in accordance with the above ALARA commitment. The data may also help to identify problems in personnel exposure, in effluent release, in process control or in equipment for measuring effluents and exposures.

3.1.2 Radiation Work Permit Procedures

Operations not covered by an operating procedure shall be conducted under a Special Evaluation Traveler (SET) prepared by the responsible function. The SET shall contain detailed instructions for the procedure and shall include safety requirements to assure that the proposed operation is conducted in a safe manner. The same approvals as required for Operation Sheets (OS) shall be required on SETs. Completion of the operation shall be appropriately documented as indicated on the traveler.

Other activities which do not require an OS or SET may be controlled by a Radiation Work Permit (RWP) approved by Regulatory Compliance. Examples of activities which may be controlled by such RWPs include non-routine maintenance or repair operations on equipment involved with handling radioactive materials and non-routine maintenance operations in which ventilated containment systems are breached.

3.2 Technical Requirements

3.2.1 Contamination Control

The facility shall be zoned to define contamination control areas and clear areas. Appropriate protective clothing shall be worn in the contamination areas. An alpha survey meter or alpha monitor shall be provided at the exit from a contamination area. All personnel are required to monitor their hands, and to monitor other body surfaces and personal clothing as appropriate, when exiting a contaminatation control area. Except for hand contamination which is easily removed with cleaning, health physics assistance and approval for release above background levels shall be required.

3.2.2 Ventilation

Air flow shall be from areas of lower to areas of higher contamination. Hoods, glove boxes, or local exhaust will be used to control contamination and airborne concentrations. Dispersible forms of uranium will be handled in ventilated enclosures having sufficient air flow to assure minimum face velocities of 100 fpm. Face velocities will be checked weekly, except during periods when the ventilated enclosure is not in use. High Efficiency Particulate Air (HEPA) filters and pre-filter banks are provided with differential pressure gauges for diagnostic purposes. Filters/ prefilters are normally changed if the differential pressure across the filter exceeds six (6) inches of water, or as recommended by the manufacturer if less than 6 inches. HEPA ventilation systems shall be Dioctylphthalate (DOP) tested in place after any disturbance of the HEPA filters.

Air which is recycled in the contamination control areas shall be passed through HEPA filters and monitored. Monitoring will be accomplished by use of continuous air monitors, or alternately by continuous sampling and analysis at the end of each sampling period.

The direction of air flow in the process buildings shall be checked at least annually and documented. Major design changes having a potential to impact air flow direction may require a re-check of the air flow direction once the design change has been completed. If the air flow direction is not acceptable, action will be taken.

Fire prevention and the potential for generating explosive atmospheres will be considered in ventilation design.

Air effluents from process areas and process equipment involving uranium in a dispersible form shall be subject to air cleaning. Exhaust stacks shall be continuously sampled when in operation.

3.2.3 Work - Area Air Sampling

3.2.3.1 Air Sampling Criteria

Air sampling shall be performed using fixed location samplers, personal (lapel) samplers, and air monitors.

The type of air sample collected at a specific operation or location shall depend on the type, frequency, and duration of operations being performed. One or more of these sample methods shall be employed at intervals prescribed by the Regulatory Compliance Manager or Health Physicist. General criteria for sampling are:

a. Fixed location samplers shall be used where uranium handling operations are pursued for extended periods of time, or where short term operations occur frequently. If a fixed position air sampler is used for assigning intake, the sampler shall be located in or as near as practical to the breathing zone of the person performing the operations. A means for measuring the flow rate (such as rotameter or critical orifice) will be installed at each fixed air sampling head.

b. Lapel air samplers may be used where work stations are not defined or for supportive measurements and special studies. Continuous air monitors may be used for early warning of unexpected releases.

3.2.3.2 Airborne Radioactivity

a. Where fixed air sampling equipment is used to determine concentration in a worker's breathing zone, the locations of the fixed air sampling heads shall be reexamined for representativeness at least every 13 months or whenever licensed process or equipment changes are made or at the commencement of operations in an area that has been shut down for more than 6 months, whichever comes first.

b. During operations involving soluble uranium in airborne radioactivity areas, the airborne radioactivity concentration in the areas shall be assessed on a working shift basis to identify any unexpected concentration level of radioactive material. Air samples that are suspected of reflecting releases and high concentrations shall be counted at once to determine the radioactivity concentration.

3.2.4 Radioactivity Measurement Instruments

The minimum instrumentation required for operational surveillance is listed below. All instruments shall be calibrated at least every 6 months and after each repair that would affect the accuracy, except for criticality detectors, which are calibrated annually and operationally checked quarterly. The manufacturer's calibration of flowmeters, velometers, rotameters and orifices is used.

a. Nuclear Alarm System

The Nuclear Alarm System satisfies the recommendations of Regulatory Guide 8.12, Revision 2, dated October 1988, "Criticality Accident Alarm Systems".

b. Alpha Counting System

Minimum detectable activity for at least one system shall be 10 disintegrations per minute (dpm) α.

c. Alpha Survey Meters

Minimum counting efficiency: 20% of 2 π geometry
Minimum Range: 0 - 100,000 counts per minute

d. Air Sampling Equipment

Lapel samplers: Average greater than or equal to 2 liters per minute
Fixed air samplers: 10 - 100 liters per minute

e. Beta-Gamma Survey Meters

Minimum range: 0 - 60,000 counts per minute
0 - 20 mR/hr

f. Beta-Gamma Counting System

Minimum detectable activity of at least one system shall be 200 dpm β^-.

g. Neutron Survey Meter
Minimum range: 0 - 5 Rem/hr

Emergency instrumentation is listed in the Emergency Plan (see Chapter 8.0).

3.2.5 Radiation Exposures

The intake of radioactive material shall be monitored for individuals likely to receive in excess of 10% of the applicable Annual Limit on Intake (ALI). Class D uranium intake shall be limited to less than 10 milligrams per week per individual. Work activity restrictions shall be imposed when an individual reaches 80% of the applicable limit; i.e., 0.8 ALI (1,600

DAC-hours) for Class W and Class Y uranium and 8 milligrams per week for Class D uranium. A diagnostic study to evaluate intakes shall be started at these levels.

Exposure to radiation shall be monitored for individuals likely to receive, in one year from sources external to the body, in excess of 10% of the occupational dose limits of 10 CFR 20. The personnel monitoring device may be either a film badge (changed monthly) or a thermoluminescent dosimeter (TLD; changed quarterly). Film badges and TLDs shall be processed by a National Voluntary Laboratory Accreditation Program (NVLAP) accredited dosimetry processor.

Total Effective Dose Equivalent for occupational exposures shall be calculated in accordance with 10 CFR 20 using a combination of representative air sampling data, personnel radiation exposure data and/or bioassay measurement data.

3.2.6 Surface Contamination

3.2.6.1 Special Surveys

Non-routine operations not covered by operating procedures shall be reviewed by Regulatory Compliance and a determination made by Regulatory Compliance if radiation safety monitoring is required.

With the exception of incidents requiring immediate evacuation, spills or other accidental releases shall be cleaned up immediately. The Production Supervisor and Regulatory Compliance must be notified immediately of such incidents.

3.2.6.2 Routine Surveillance

Surveys shall be conducted on a regular basis consistent with plant operations and prior survey results. The frequency of survey depends upon the contamination levels common to the area, the extent to which the area is occupied, and the probability of personnel exposures.

Material on processing equipment or fixed on surfaces shall be limited as required to control airborne radioactivity and external radiation exposures.

The following minimum frequency schedule shall be applied to the plant contamination survey program:

Area	Survey Frequency
Contamination control areas	Weekly
Clear areas	Monthly
Lunchrooms, snack area, step-off pad areas	Daily

Clean up action shall be started no later than the beginning of the next work shift when removable surface contamination exceeds the limits of Table 2 of Regulatory Guide 8.24, Revision 1, dated October 1979.

The frequency of direct beta-gamma surveys shall be quarterly.

3.2.7 <u>Intake Assessment</u>

Individuals who are likely to receive, in one year, an intake in excess of 10 percent of the Annual Limit on Intake (ALI) shall be monitored for exposures to radioactive material. For individuals likely to receive an intake in excess of 10 percent of the ALI, internal dose will be assessed by taking suitable and timely measurements of:

3.2.7.1 Concentrations of radioactive materials in the air of the work area; or

3.2.7.2 Quantities of radionuclides in the body; or

3.2.7.3 Quantities of radionuclides excreted from the body; or

3.2.7.4 Any combination of measurements specified in 3.2.7.1 through 3.2.7.3 above.

3.2.8 Respiratory Protection

The use of respiratory protection equipment will be in accordance with written operations sheets and appropriate training as required by regulation (10 CFR 20 Subpart H). Only respirators certified by the National Institute for Occupational Safety and Health/Mine Safety Administration shall be used. Protection factors from Appendix A of 10 CFR 20 (§§ 20.1001 - 20.2402) may be used when assigning actual intakes.

3.2.9 Bioassay Program

A bioassay program shall be maintained for confirmation and evaluation of intakes. The primary method of calculating Committed Effective Dose Equivalent is by using air sample results.

3.2.10 Nonexempt Sealed Source Control

3.2.10.1 Use of nonexempt sources for training and instrument calibration shall be limited to, or under the supervision of, the Regulatory Compliance department.

3.2.10.2 Sources utilized as a functional component of devices designated for manufacturing and quality control purposes shall be operated only by personnel who have been qualified for safe practices. Health Physics shall provide appropriate monitoring support during maintenance or other operations that may entail increased exposure levels over that for normal operations.

3.2.10.3 When not in use, sources shall be stored in a manner to prevent unauthorized removal or use. Adequate posting of the source container and storage/operation area shall be maintained to insure compliance with appropriate regulations.

3.2.10.4 Leak checking of sealed sources shall be performed as required below:

A. Each source shall be tested for leakage at intervals not to exceed 6 months. In the absence of a certificate from a transferor indicating that a test has been made within 6 months prior to the transfer, the sealed source shall not be put into use until tested.

B. The test shall be capable of detecting the presence of 0.005 microcurie of contamination on the test sample. The test sample shall be taken from the source or from appropriate accessible surfaces of the device in which the sealed source is permanently or semipermanently mounted or stored. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.

C. If the test reveals the presence of 0.005 microcurie or more of removable contamination, the licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired by a person appropriately licensed to make such repairs or to be disposed of in accordance with the Commission's regulations. Within 5 days after determining that a source has leaked, the licensee shall file a report with the Director, Division of Fuel Cycle Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington D. C. 20555, describing the source, test results, extent of contamination, apparent or suspected cause of source failure, and corrective action taken. A copy of the report shall be sent to the Administrator of the nearest NRC Regional Office listed in Appendix D of Title 10, Code of Federal Regulations, Part 20.

D. The periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources excepted from this test shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within 6 months prior to the date of use or transfer.

3.2.10.5 The above requirements for leak checking of sealed sources also applies to californium 252 sources, which shall be checked for alpha contamination.

CHAPTER 11 ORGANIZATION AND PERSONNEL

11.1 Organizational Responsibilities

Figure 11-1 is the Hematite plant organizational chart. In general, higher level management may assume the responsibilities and authorities of key personnel in their absence. Either the individual key person or higher level management may assign one or more other suitable individual(s) to temporarily assume the responsibilities and authorities of key personnel who are absent.

Descriptions of the responsibilities of selected supervisory and higher level positions that were not included in Section 2.1 are provided below.

11.1.1 Manager, Administration

The Manager, Administration reports to the Plant Manager. He manages the control of SNM from receipt at the Hematite facility, through the production process until it is shipped as product or waste. His activities include scheduling of production, selection of SNM for use in the production process, specification of the product lot makeup, scheduling of SNM shipments from the supplier to Hematite and from Hematite to the customer, coordination of the packaging and shipment of SNM waste and residues to a commercial, licensed disposal facility and development of procedures for packaging, shipping and receiving. He also performs facility administration duties including the supervision of the guards, site purchasing and personnel services.

11.1.2 Quality Coordinators

The Quality Coordinators report administratively to their respective Focused Factory Mangers, and also report functionally to the Director, Quality Systems to maintain independent management oversight. The Quality Coordinators manage the measurement activities which verify that the product conforms to specification. These activities may include development of the Operation Sheets that are the procedures for acquisition of product data, approval of laboratory measurement methods, approval of statistical methodology for data evaluation and establishment of the system for control and distribution of data documentation. The Quality Coordinators maintain separation between their measurement activities and the production activities that they monitor.

11.1.3 Process Engineers

The process engineers report to their respective focused factory manager. They are responsible for the efficient operation of their cognizant plant processes. They oversee proposed equipment and process modifications.

11.1.4 Coordinator of Nuclear Materials Accountability

The Coordinator of Nuclear Materials Accountability reports to the Manager of Regulatory Compliance. He maintains the SNM accounting records, prepares NRC required reports on material balance, transfer and inventory, periodically verifies current knowledge of the presence of SNM and computes Inventory Differences.

11.1.5 Supervisor, Materials

The Supervisor, Materials reports to the Manager, Administration. He implements the production schedules provided by the Manager through supervision of the production clerk and the material handlers. He monitors the sequence of steps in the processing and handling of each material unit including the proper use of the Traveler that documents each process step.

11.1.6 Manager, Facilities

The Manager, Facilities reports to the Plant Manager. The duties of this function include facilities engineering and maintenance for the entire plant, including such support for the focused factories as requested.

11.1.7 Supervisor, Laboratory

The Laboratory Supervisor reports to the Plant Manager. He/she supervises and trains the laboratory technicians, recommends sampling procedures, establishes laboratory methods and reviews and approves all chemical measurements on SNM. He/she also selects subcontractors and qualifies and coordinates their measurement services.

11.1.8 Supervisor, Maintenance

The Supervisor, Maintenance reports to the Manager, Facilities. He supervises technicians in the maintenance activities related to the facility and the production equipment within the constraints of applicable radiation and industrial safety practice.

11.2 Functions of Key Personnel

The functions, responsibilities and authorities of key personnel positions are described in Section 2.1. Succession to each position in the event of absence is authorized in writing by the person holding the position and is done with the knowledge of the plant manager.

11.3 Education and Experience of Key Personnel

Resumés of key personnel important to safety are provided in this section for the following personnel:

- J. A. Rode - Plant Manager
- S. G. Borell - Manager, Chemical Operations
- G. F. Palmer - Manager, Ceramic Operations
- G. C. Kersteen - Manager, Assembly Operations
- R. W. Sharkey - Manager, Regulatory Compliance
- R. J. Klotz - Nuclear Criticality Specialist (located in Windsor, CT)
- M. R. Eastburn - Nuclear Criticality Specialist
- A. M. Keklak - Health Physicist
- E. W. Criddle - Supervisor, Health Physics

JAMES A. RODE - PLANT MANAGER, HEMATITE

EDUCATION:

B.S., Chemical Engineering, University of Texas, 1953

EXPERIENCE:

COMBUSTION ENGINEERING, INC. — 1974 to Present
Plant Manager, Nuclear Fuel Manufacturing, Hematite

Responsible for all Nuclear Fuel Manufacturing activities at the Hematite Plant. Manages three Focused Factories (Chemical Operations, Ceramic Operations and Assembly Operations) and the supporting services of Facilities, Regulatory Compliance, Laboratory and Administration.

GULF UNITED NUCLEAR FUELS CORPORATION — 1968 to 1974
Technical Consultant

Responsible for establishing process flow sheets and capacities for production of UO_2, UO_2 pellets, and uranium recovery; and coordinating development activities. Also responsible for preparation of stable density pellets and development of process modifications. Technical Assistant to the Manager of Chemicals Operations on major operational problems.

JAMES A. RODE (continued)

UNITED NUCLEAR CORPORATION

Manager of Facilities Development and Technical Director — 1964 to 1968

Responsible for design, construction and startup of the first large scale fluidized-bed process for the production of UO_2 from UF_6 and of companion facilities for converting oxide to pellets.

Responsible as Technical Director for Chemicals Operations for process engineering supervision and development activities including design, construction, and operations of a pilot plant for preparation of UO_2 via the reaction of UF_6 and steam and for development, design, construction and startup of a fluid-bed vapor phase coating system.

Assistant Technical Director — 1962 to 1964

Responsible for process and equipment design in the Rhode Island Scrap Recovery Facility, development work on process for producing pyrolytic carbon coated UO_2, and for continuing development work in Naval Fuel Program.

Project Leader — 1961 to 1962

Assumed total responsibility for salvaging a non-operative Naval Fuels Plant including production, quality control, development and customer contacts. The facility was converted into the primary source of profits for the Chemical Operations.

JAMES A. RODE (continued)

MALLINCKRODT CHEMICAL WORKS

Group Leader and Production Superintendent 1958 to 1961

Responsible for the startup of high enrichment metal production and development and startup of the Hematite Pellet Plant.

Responsible as Production Superintendent for detailed supervision of production in both high and low enrichment conversion operations.

Process Engineer and Research Chemist 1953 to 1958

Participated in preparation of proposals for production of yttrium metal and conversion of 5000 tons per year of UF_6. Responsible for operation of the first ADU pilot plant and startup of the Hematite Oxide Plant.

STEN G. BORELL - MANAGER CHEMICAL OPERATIONS

EDUCATION

M.S., Chemical Engineering, Lund Institute of Technology, Sweden, 1974

EXPERIENCE

ABB COMBUSTION ENGINEERING NUCLEAR FU

Manager Chemical Operations - Hematite — 1993 to Present

Responsible for this focused factory consisting of Conversion and Recycle/Recovery operations.

Manufacturing Operations Senior Consulting Engineer — 1992 - 1993

Lead engineer for the Integrated Safety Analysis covering the conversion process and its new computerized control system.

ABB ATOM AB

Manager Process Development — 1990 - 1992

This office consisted of groups for Chemical Processes, Welding and Non-Destructive Testing, Metallographic Laboratory, Process Control Computers, Mechanical Design of process equipment and Electric Design of process equipment.

Established standards for the design of criticality-related circuits and computer programs to be used in the plant.

Responsible for preparing and reviewing safety analysis reports for all uranium-containing systems in the plant.

STEN G. BORELL (continued)

Project Manager Rod Manufacturing Shop 1988 - 1990

Started this $10 Million project to modernize the Rod Manufacturing shop. This project included all Non-Destructive Testing equipment for rod manufacturing. Had this job in parallel with being the manager for Chemical Process Development. A new project manager was appointed when the Process Development office was formed.

Manager Chemical Process Development 1987 - 1990

Responsible for Chemical Processes used in the plant. Also, responsible for preparing and reviewing safety analysis reports for all uranium-containing systems.

Process Engineer, Stationed at Westinghouse Nuclear Fuel, SC 1986 - 1987

Stationed at the Westinghouse South Carolina Plant for one year as a part of a technical exchange program. Responsible for conversion line number five which was converting uranyl nitrate into uranium dioxide. Developed a theoretical model of the interaction between the precipitation and the calciner and used this model to control the product properties.

Development Engineer, Conversion and Recovery Systems 1978 - 1986

Designed and implemented chemical recovery systems for the ABB ATOM NUCLEAR FUEL Plant; distillation to recover ammonium carbonate, distillation to purify methanol filtrates and cracking to produce hydrogen from the recovered methanol.

Designed and implemented a safe geometry water cleanup system to serve all active areas in the plant. The system consists of several mechanical separation steps to remove suspended solids and ion exchangers to remove soluble uranium.

Designed and implemented a safe geometry uranium recovery system based on leaching with nitric acid followed by chromatographic extraction in fixed bed columns.

Development Engineer, Reactor Systems 1974 - 1977

Participated in the design work on the reactor primary systems and the waste systems for the Swedish BWR reactors.

ADDITIONAL EDUCATION

Numerous national and international courses on technical issues. Management training classes every year in management position.

PUBLICATIONS

Nuclear Europe Worldscan March/April 1992: ABB Atom adapts it's fuel factory for the future.

PATENTS

Holder and co-holder of several patents and pending patents.

GEORGE F. PALMER - CERAMIC OPERATIONS MANAGER

EDUCATION:

B.S., Ceramic Engineering, Georgia Tech, 1967

EXPERIENCE:

ABB COMBUSTION ENGINEERING NUCLEAR FUEL

Ceramic Operations Manager - Hematite 1993 to Present

Responsible for the fabrication process and the quality of UO_2 and Er_2O_3-UO_2 pellets in the Ceramic Focus Factory. This includes directing the ceramic processes to ensure that the product is fabricated in accordance with the requirements of Operation Sheets and Traveler documents.

Production activities include overseeing process fabrication, process and personnel scheduling, procedure writing, equipment modifications; process, equipment and personnel qualification, and the training of personnel. Act as a liaison to Facilities Group for the repair and maintenance of process equipment in the Ceramic Operation.

Quality activities include, in conjunction with the Quality Control Coordinator, overseeing the quality of the product, verification of product certification, quality procedures, and customer interface.

Periodically directing clean-out of production equipment in conjunction with physical SNM inventory.

Process Engineering Supervisor - Hematite 1990-1993

Responsible for the process engineers and the production process for the oxide plant, pellet plant, and the recycle areas of the Hematite Plant. Activities included writing operation sheets, travelers, qualification plans and reports, maintenance procedures; overseeing the day-to-day operation of the processing areas, dispositioning Deviation Notices, training of operators, selection of process equipment, and defining the process flow.

Work on the process layout for the pellet drying and transport process associated with the Consolidation Project at Hematite.

Project Manager for the Erbia Pellet Line installation. Worked on design and installation of equipment to startup a new pellet processing line at the Hematite Production Facility. Worked on the start-up and qualification of the new pellet line as part of the revitalization project.

Process Engineer - Windsor 1970-1990

Worked on design and installation of equipment to start up a new pellet processing line at the Windsor Production Facility. Worked on the startup and qualification of the new pellet line.

Primary responsibilities covered the fabrication of UO_2 pellets into fuel tubes, recycling of clean UO_2 scrap, and the handling of low level waste. Activities included writing operation sheets, travelers, qualification plans and reports, maintenance procedures; overseeing the day-to-day operation of the processing areas, dispositioning Deviation Notices, training of operators, selection of process equipment, and defining the process flow.

GEORGE F. PALMER (continued)

UNITED NUCLEAR CORP.

Process Engineer - New Haven & Hematite 1967-1970

Responsibilities included overseeing the process to produce fuel and fuel components for the nuclear navy program. Activities included overseeing the day-to-day processes, writing procedures and travelers, dispositioning Deviation Notice.

GARY C. KERSTEEN - ASSEMBLY OPERATIONS MANAGER

EDUCATION:

B.S., Mechanical Engineering, Trinity College, Hartford, CT, 1968

Supplemental Education:

Advanced Course - Nuclear Materials Safeguards, Argonne Labs
Effective Middle Management Courses
Financial Management Course
Crosby Quality Education Instructor's Course (taught Quality Improvement Process to more than 100 employees)
Worcester Polytechnic Institute, Statistical Process Control
Motorola Management Institute, Motorola University

EXPERIENCE:

COMBUSTION ENGINEERING, INC.

Assembly Operations Manager - Hematite 1993 - Present

Directs the production operations of the Assembly Operations Focused Factory, including scheduling of Production Supervisors, processes and procedures, training and qualification of production operators through their Production Supervisors, and periodically directing cleanout of the production in conjunction with the physical SNM inventory. With support from staff, responsible for engineering of new equipment, modifications to existing equipment, recommendation, development and qualification of manufacturing processes, specification of process control methods and design, procurement and installation of processing equipment.

Uranium Plant Manager - Windsor 1992 - 1993

Had overall responsibility for the safe conduct of all activities that are regulated by the Nuclear Regulatory Commission. Responsibilities encompassed the following functions: operations, accountability, security, training, criticality, radiological and industrial safety, environmental protection, transportation, engineering and maintenance.

Director, Planning and Materials 1990 - 1992

Directed the master planning of all nuclear fuel manufacturing activities. Managed the planning and procurement of contract materials and other supplies and services. Coordinated uranium management activities. Directed manufacturing-related information systems development and support including installation of Statistical Process Control (SSP) and Material Requirements Planning (MRP) systems.

Production Manager 1982 - 1990

Managed all aspects of production control, material control and the manufacturing work force at the Windsor Plant. During this time, installed real-time fuel rod information systems, moved pellet operations to Hematite, MO, Plant and initiated the fuel rod automation project. Developed a sophisticated fabrication planning system. Initiated the C-E Quality Improvement Process and developed Improvement Teams at the Windsor Plant to encourage employee empowerment, involvement and communications.

Production Control Manager 1979 - 1982

Managed the production control section, the material control group and the warehouse activities.

Supervisor, SNM Accountability 1975 - 1979

Started the Windsor Plant accountability department. Wrote the first Fundamental Nuclear Material Control Plan. Brought the first distributed data processing system to the Windsor Plant to automate accountability of special nuclear material. Developed the initial limit of error methodologies used at Windsor.

Manufacturing Engineer 1974 - 1975

Initial assignment at Nuclear Fuel Manufacturing developing fixtures and processes for fabrication activities.

MILITARY EXPERIENCE

U. S. Army 1969 - 1974

U. S. Army Officer Candidate School - Engineering, Fort Belvoir, VA

Commander, 575 Ordnance Company (Guided Missile Repair), Germany

ROBERT W. SHARKEY - MANAGER, REGULATORY COMPLIANCE

EDUCATION:

University of Lowell
M.S. - Radiological Science and Protection, 1990
B.S. - Radiological Health Physics, 1988

LICENSE:

U.S. Nuclear Regulatory Commission, Reactor Operator, License No. 10723

EXPERIENCE:

COMBUSTION ENGINEERING, INC.
Manager, Regulatory Compliance - Hematite 1993 - Present

Responsible for licensing, safety, and safeguards at Nuclear Fuel Manufacturing - Hematite. Responsible for development and implementation of the health physics, criticality and industrial safety, and accountability programs for the Hematite facility. Audits manufacturing operations and supervises safety and safeguards personnel in day-to-day operations.

Manager, Radiological Protection and Industrial Safety - Windsor 1990 - 1993

Provides information, advice, and assistance to fuel manufacturing operating personnel and management to ensure personnel and environmental protection measures are adequate. Maintains records documenting safety related facility operations. Defines programs and standards related to radiological, criticality and industrial safety, environmental protection and emergency planning for both the fuel manufacturing facility and product development laboratory.

JACOBS ENGINEERING GROUP, INC.
Health Physicist 1989 - 1990

Developed the Weldon spring site internal dosimetry program. Developed worker health and safety plans for remediation activities. Developed air monitoring plan to comply with 40 CFR 61 radionuclide NESHAPS. Provided radiation safety training for all site personnel.

UNIVERSITY OF LOWELL
Nuclear Reactor Operator 1988 - 1989

Setup and conducted experiments using the ULR 1MW research reactor and a 800,000 Curie Co-60 gamma source. Maintenance of all electrical and mechanical facilities. Inspect, repair and calibrate nuclear instrumentation and radiation detection equipment. Training of undergraduate engineers in nuclear reactor operations.

Teaching Assistant 1987 - 1988

Instruction of the laboratory course, Nuclear Instrumentation.

E.I. DuPONT de NEMOURS & COMPANY, NEN PRODUCTS
BILLERICA, MASSACHUSETTS
Radiochemistry Technologist 1987 - 1988

Utilization of radiation detection equipment and smear surveys to minimize exposure and contamination. Preparation of radiopharmaceuticals in a hot cell proton bombardment. Radioassy of pharmaceuticals using nuclear instrumentation.

U.S. AIR FORCE
Avionic Navigation Systems Specialist 1980 - 1985

Test, troubleshoot and repair avionics to component level. One year special assignment as an aircraft maintenance controller directing all flight maintenance activities.

MEMBERSHIP

St. Louis Chapter, Health Physics Society

ROBERT J. KLOTZ - NUCLEAR CRITICALITY SPECIALIST

EDUCATION

Graduate, Oak Ridge School of Reactor Technology, 1957
M.S. Physics, Kansas State College, 1954
A.B. Physics and Mathematics, Kansas State Teachers College of Emporia, 1952
Graduate Studies, Texas Christian University

EXPERIENCE

COMBUSTION ENGINEERING, INC. — 1965 to Present
Windsor, Connecticut
Principal Consulting Physicist — 1977 to Present

Responsible for the physics design of new and spent fuel racks, fuel transfer machines, and other equipment involved in moving, testing or storing fuel. As Nuclear Criticality Specialist, provides technical support and criticality audit function at both the Windsor Manufacturing and Hematite Fuel Manufacturing facilities. Involved in solving special physics problems.

Section Manager, Radiation and Criticality Physics — 1965 to 1977

Responsible for radiation shielding, the ex-core criticality, and determination of source terms for Nuclear Steam Supply Systems. Also responsible for providing nuclear heat generation rates for structures in the NSSS, and radiation dose rates for assessing physical changes in NSSS materials and equipment in the radiation environment.

ROBERT J. KLOTZ (continued)

GENERAL NUCLEAR ENGINEERING CORPORATION
Physicist 1959 to 1965

Responsible for the shield design of the heavy water research reactor at the Georgia Institute of Technology and the thermal and biological shield design analysis for the Boiling Nuclear Superheat Reactor (BONUS) located in Rincon, Puerto Rico. Reviewed all the literature on radiation shielding for the publication Power Reactor Technology.

CONVAIR DIVISION OF GENERAL DYNAMICS
Physicist 1954 to 1959

Responsible for the design of a shield for a mobile reactor of the Army Compact Core Design and for a Nuclear Ramjet Missile. Performed analysis of aircraft nuclear shielding experiments, developed shielding programs for computers, and contributed to the Aircraft Shield Design Manual.

MICHAEL R. EASTBURN - NUCLEAR CRITICALITY SPECIALIST

EDUCATION:

M.S. Nuclear Engineering, University of Missouri at Rolla, 1976

M.S. Physics, University of Missouri at Rolla, 1975

B.S. Physics, University of Missouri at Rolla, 1967

EXPERIENCE:

ABB COMBUSTION ENGINEERING NUCLEAR FUEL — 1993 to Present

Nuclear Criticality Specialist

Responsible for verification that equipment, processes and procedures satisfy the criticality criteria of a Special Nuclear Materials license. Performs criticality analyses of new or modified equipment, processes and procedures, or reviews the analyses of others.

ENTERGY OPERATIONS, INC. — 1982 - 1993

Senior Nuclear Engineer

As part of the Nuclear Analysis Department, responsible for physics calculations and computer code development. Developed and installed modifications to EPRI NODE-P nodal code for use in physics calculations. Developed FORTRAN coding which calculates boundary conditions for Combustion Engineering's CECOR program and performs a computer check of the CECOR coefficient library. Participated in the development of a personal computer based system to run CECOR for startup and core follow of CE reactors. Generated CECOR coefficient libraries and participated in the startup testing of Arkansas Nuclear One - Unit 2 nuclear reactor. Performed criticality analyses of spent and fresh fuel storage racks using diffusion and Monte Carlo codes. Analyzed the effect of Boraflex gaps on spent fuel rack criticality. Modified the Oak Ridge SCALE 4 Criticality Safety Analysis Sequences (CSAS) codes for installation on an IBM RISC 6000 workstation.

BABCOCK & WILCOX 1977 to 1982

Nuclear Engineer

As part of the Nuclear Analysis Department, responsible for generating nuclear core physics constants for reactor startup and operation. Analyzed heat production and nuclear composition of spent fuel. Evaluated nuclear source designs. Developed several data handling FORTRAN codes which saved more than five man-days per reload analysis.

AWARDS AND HONORS:

Recipient Entergy Peak Performer Award, 1991

Recipient Entergy Corporate Cup Award, 1990

Nuclear Engineering Honor Society

Phi Kappa Phi (Scholastic Honorary)

President, Sigma Pi Sigma (Physics Honorary)

Cum Laude Graduate, University of Missouri at Rolla, 1967

ANN MARIE KEKLAK - HEALTH PHYSICIST

EDUCATION:

M.S. Radiation Science, Rutgers University, 1990

B.S. Public Health, West Chester University, 1987

A.S. Nuclear Medicine Technology, 1981

EXPERIENCE:

ABB COMBUSTION ENGINEERING NUCLEAR FUEL — 1993 to Present

Health Physicist

Responsible for observation of plant operations and evaluation of results from personnel and environmental monitoring, including comparing quantitative measurements and other observations of a licensee's facility activities with the requirements of a Nuclear Regulatory Commission Special Nuclear Materials license.

PUBLIC SERVICE ELECTRIC AND GAS — 1990 - 1993

Health Physics Supervisor

First Line Supervisor at Salem Nuclear Generating Station (2 unit PWR). Directly supervised both bargaining unit and contractor personnel. Responsible for ALARA/RWP work, shielding, dose assessment, report preparation, training, new 10 CFR Part 20 implementation, and technical support.

ROER PHARMACEUTICAL COMPANY — 1989 to 1990

Radiation Safety Officer

Functioned as Radiation Safety Officer. Responsible for developing a comprehensive radiation safety program for a rapidly developing pharmaceutical firm. Duties included implementation of NRC license, developing and providing radiation worker training program, development of a bioassay program, establishment of an environmental surveillance program, compliance audits, and active membership of the industrial hygiene/safety committee.

Other Employment During Education:

Nuclear Medicine Technologist, 1989
Co-Chief Nuclear Medicine Technologist and Assistant RSO, 1989
Radiation Safety Technician, 1988 - 1989
Health Physics Intern, 1987
Staff Nuclear Medicine Technologist, 1981 - 1985
Nuclear Medicine Technologist Intern, 1979 - 1981

AWARDS AND HONORS:

Recipient 1987 - 1988 Health Physics Society Fellowship
1987 Distinguished Student Writer Award (West Chester)
Eta Sigma Gamma Honor Society, 1987

CERTIFICATION:

Board Certified Nuclear Medicine Technologist - American Registry of Radiation Technologists (1981) and Society of Nuclear Medicine (1981)

PROFESSIONAL SOCIETY MEMBERSHIPS:

Delaware Valley Society for Radiation Safety
Health Physics Society
American Nuclear Society

ANN MARIE KEKLAK (continued)

ADDITIONAL TRAINING:

- Certified Health Physics Review Course, Delaware Chapter of the Health Physics Society, 1991
- Numerous local and national symposia, meetings and short courses

ENOS W. CRIDDLE - SUPERVISOR, HEALTH PHYSICS

EDUCATION:

Cape Girardeau Central High School, Graduated 1981
Naval Nuclear Power School, 1982
Naval Nuclear Power Prototype Training, 1983
Naval Nuclear Engineering Laboratory Technician, 1983
Naval Damage Control School, 1984
Naval Fire Fighting Training, 1985

EXPERIENCE:

ABB COMBUSTION ENGINEERING NUCLEAR POWER, 1988 to Present

Health Physics Supervisor, 1990 to Present

Responsible for the daily operations management of the health physics department and staff at Nuclear Fuel Manufacturing - Hematite. Implements health physics and industrial safety program through training, supervision, and daily audit. Develops and revises departmental operations procedures and emergency plan implementing procedures.

Health Physics Technician, 1988 to 1990

Responsible for radiological and industrial safety at Nuclear Fuel manufacturing - Hematite. Duties includeed instrument calibration, environmental sampling, documenting employee exposures, maintaining health physics documents, and performing routine radiological and industrial safety monitoring.

ENOS W. CRIDDLE (continued)

U.S. Navy Engineering Laboratory Technician, 1981 to 1987

Stationed on board USS Lafayette, SSBN 616 (G), responsible for radiological safety throughout the ship. Qualified supervisor for administration and control of radiological materials and records. Responsible for instrument and gauge calibration program, chemical inventory and storage, and water chemistry controls for reactor plant and steam plant.

11.4 Operating Procedures

The preparation, review and approval of operating procedures is described in Section 2.6. Procedures for equipment operation may be posted locally at the equipment and these and the more general procedures may be presented during personnel training as appropriate.

Process Operating Sheets (OS's) and Maintenance Procedures are originated by the the Focus Factories and support departments. Operating sheets and procedures are being revised where appropriate to a standard format which includes sections on:

- I Process Outline
- II Nuclear Safety
- III Industrial Safety
- IV Radiological Safety
- V Equipment
- VI Process Operation

The operating sheets are developed to define the operating parameters and to operate the manufacturing processes. All procedures not defined in the operating sheets are done by means of a Special Evaluation Traveler. This traveler is used to cover any operation involving SNM or other safety considerations, including process development of experimental procedures. The maintenance procedures cover daily, weekly, monthly, quarterly, semi-annual, and annual preventative maintenance of equipment throughout the facility and provide checklists for maintenance verification. These procedures cover material handling and process equipment and general support utilities such as plant air supply systems, electrical distribution equipment, ammonia storage and cracking equipment, nuclear safety and redundant systems for the Oxide Plant R-2 reaction vessel, calibration of moisture sensors for moderation control and other general maintenance operations.

Operating procedures developed by Regulatory Compliance include training programs for training plant personnel in nuclear criticality safety, radiological safety, fire protection, and chemical safety. The Regulatory Compliance procedures cover nuclear safety parameters, health physics controls, industrial safety, UF_6 release procedure, a review of process and equipment/facility change and procedures for testing emergency and criticality alarms systems and maintenance of radiological monitoring equipment.

The nuclear Material Control Procedures define how material is controlled throughout the plant for processing and accountability. Material identification, scrap control physical inventory, and calculations used for inventory, tamper proof seals, SMN measurement control, scale operation, and indoctrination and training for personnel performing activities affecting accountability and safeguards.

The Focus Factories also develop the procedures for training personnel in the operation of processes and equipment. The training procedures include operator qualification requirements and training outlines for all plant manufacturing processes and related functions.

Quality control procedures are developed by Quality Coordinators and detail the procedures for receiving inspection, sampling plan, pellet plant quality control, pellet physical inspection programs, using and maintaining special gauging equipment, control and calibration of gauging equipment and the document control system. The document control system is part of the Quality Assurance Manual and is used to describe the details and implementation of the system. It defines responsibilities, controlled documents and the operating sheet acknowledgement system.

After the procedures have been developed, they are reviewed and approved by an engineering function, Regulatory Compliance, Quality Coordinator, and factory management to assure that the procedure is complete, correct, and meets all the criteria for industrial and nuclear safety. The original procedure is approved, by signature of the above department managers, and forwarded to document control. Document control issues controlled copies of the procedures for plant operations in accordance with the document control procedure. Engineering indoctrinates the shift supervisors and operators on operation of the process and equipment. Quizzes are given to the personnel involved to test their understanding of the process and meet the qualification requirements. These quizzes along with the personnel qualification records and the operator retraining programs are maintained by Document Control.

Procedures are revised whenever a change in the process or equipment operation is initiated. A formal review and update is performed, for all procedures, every two years.

11.5 Training

The training program for employees is described in Section 2.5.

11.6 Changes in Facilities and Equipment

An engineering discipline typically initiates plant change requests. The review procedure for changes in processes, equipment and/or facilities is described in Section 2.7. It includes provisions for analysis, review, approval, verification and recording.

11.7 Configuration Control

The Configuration Control Program includes the accuracy of engineering flow diagrams and drawings which show special equipment, equipment layout, ventilation, and process control circuits. As part of the design of new equipment and processes, also for any major change in existing processes, an integrated safety analysis with respect to criticality safety, industrial safety, radiological safety and fire protection is performed. This integrated safety analysis includes identifying safety concerns from equipment malfunction and human error scenarios. The necessary safety related equipment to address these problems is listed together with appropriate frequency for periodic testing and calibration of this equipment. The drawings and design information are originated by an engineering discipline and reviewed and approved by the managers of the applicable focus factory, Regulatory Compliance and also by the cognizant Quality Coordinator if applicable. Each department performs the review with respect to it's specialist knowledge and responsibilities. Revisions of existing equipment follow the same procedures as for new equipment.

Approval for installation of new or modified equipment is requested by use of "Request for Nuclear and Industrial Safety Review" form. This form is used to make facility, structural, process, equipment and procedural changes that do not require a license amendment. The form is completed by an engineering discipline(s) and forwarded, complete with drawings and design information, to the Regulatory Compliance Manager for review and approval. A second review and approval by a criticality specialist is also required for all requests relating to nuclear safety. Major changes require additional review and approval by the safety committee.

Operating procedures are revised and submitted for approval during installation of equipment or facility changes. Focus Factory management is responsible for the inspection of all new equipment and facility changes. Startup and testing of new or revised equipment or processes is done under supervision of an applicable safety discipline as determined by the Manager, Regulatory Compliance. Indoctrination and training of operating and maintenance personnel is also done under supervision of engineering personnel to assure understanding, safe operation and safe maintenance of the modified equipment.

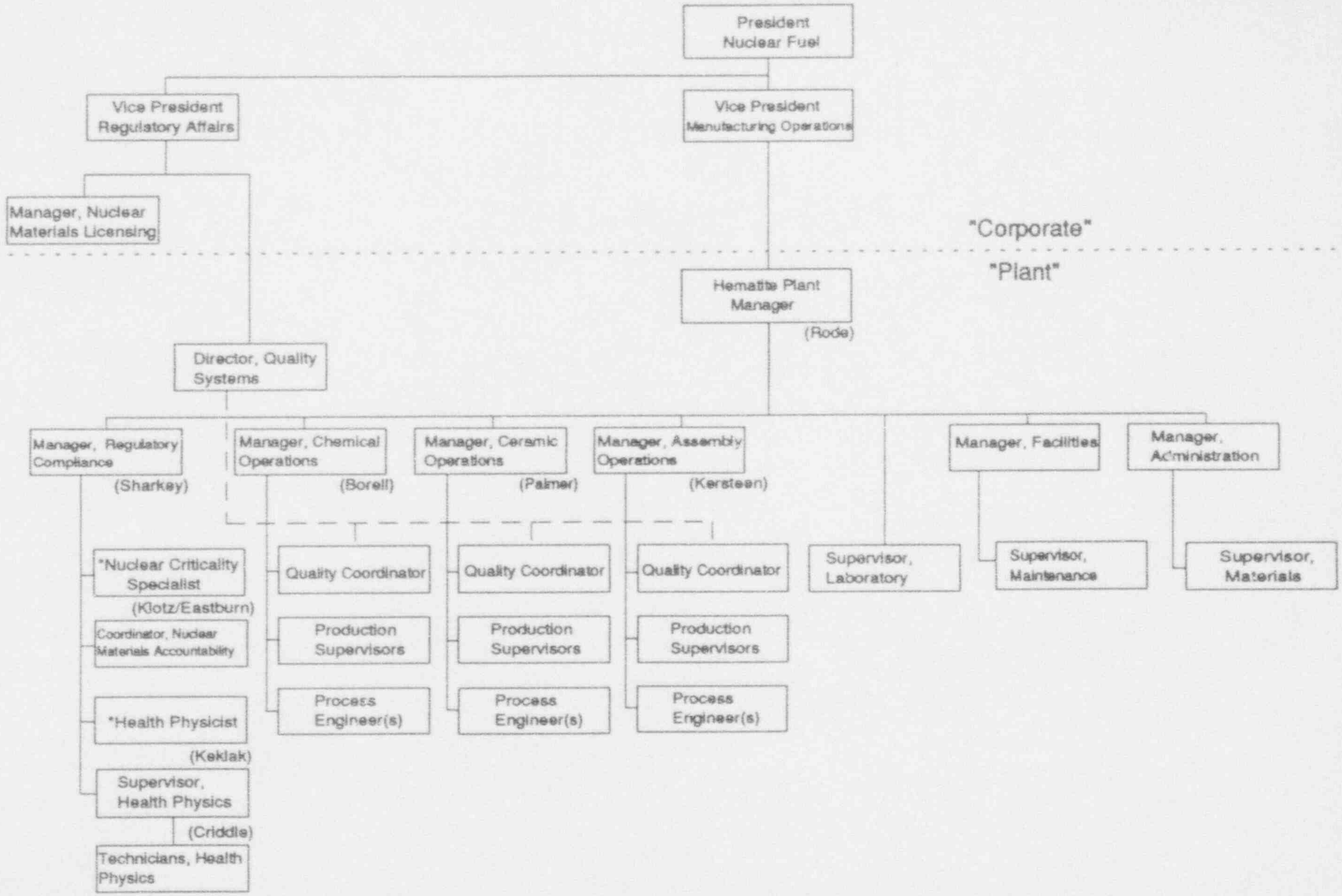


Figure 11-1

Hematite Plant Organization Chart

*May be Windsor Based Support

CHAPTER 12 RADIATION PROTECTION

12.1 Program

The ALARA policy is described in Section 3.1.1. A manual containing procedures necessary to implement the radiation safety program described in Part I of this renewal application is maintained by Regulatory Compliance. Following are some of the types of procedures which are used:

- Fixed Workstation Air Sample Collection and Logging
- Exhaust Stack Sampling
- Lapel Air Sampling
- Annual Ventilation System Stack Velocity Measurements
- Ventilation System Filter Efficiency Measurement
- Performing Smear Surveys
- Performing Trailer Surveys
- Surveying Items for Release from the Plant
- Survey of Incoming UF_6 Shipments
- Quarterly Beta/Gamma Survey
- Calculating Employee Weekly Cumulative Exposures
- Employee Bioassay Sampling
- Instrument Calibration
- Alarm Testing
- Environmental Sampling: Water, Soil, Vegetation and Air

Routine operations involving SNM handling are covered by an Operation Sheet (OS) and/or by a Special Evaluation Traveler (SET). A separate OS covers plant-wide radiation safety procedures, while procedures specific to a certain operation are covered in the OS for that operation. OSs and SETs prepared for operations/processes involving radiological safety are reviewed for consistency with the ALARA policy.

The Regulatory Compliance Manager or Health Physicist reviews OSs and SETs regarding aspects of safety, including radiological (ALARA) and criticality. The Nuclear Criticality Specialist overchecks the criticality safety controls. Approvals are documented.

The Production Supervisors instruct operators to assure their understanding of the operations and of the operations' safety limits and restrictions. The Production Supervisors also ensure that operations are performed in compliance with posted limits and written instructions.

12.1.1 Special Evaluation Travelers

A description of Special Evaluation Travelers (SET) is provided as an example of the contents of procedures. SETs are used to define procedural controls for many processes which do not necessitate radiological controls, but SETs are also used as radiation work permits for those activities which require radiological controls. The content of each SET is dependent upon the process being controlled. In general, the content includes the Purpose of the procedure, specification of any Special Equipment Required, the location of Source Material to be used for the operation, and a Detailed Operations procedure. The Disposition of the SET is noted on its cover sheet. Approval of SETs is performed in the same manner as for OSs. SET cover sheets also include a record of Operator and Supervisor acknowledgement of the SET requirements.

The Detailed Operations section of the SET is the step-by-step procedure to be used by the operator to perform the process. The types of information included in the Detailed Operations section are a Process Description, Nuclear Safety and Radiological Safety Requirements, including specification of radiological protection equipment and special Health Physics monitoring requirements, if any. Industrial Safety and Material Control Requirements are included as appropriate, as are appropriate Limits and Acceptance Criteria. The operator uses the SET as both a detailed procedure and a traveler, to record process parameters, if needed, and to record accomplishment of procedural steps via signature and date.

12.2 Bioassay Program

The primary method of assessing intake is by the measurement of breathing zone air samples. Intake is tracked for each operator and action is taken as described below concerning in-vivo lung counting for Class Y uranium.

Plant practice is to perform in-vivo lung counts for operators where air sampling shows an intake of 0.5 ALI or more on an annual basis unless one of the following criteria for more frequent counting are met:

1. The operator has been exposed to > 80% of the ALI, or

2. The operator has worn a respirator during the year and his/her intake prior to taking credit for a respiratory protection factor exceeds 1 ALI, or

3. The operator has been involved in an airborne release incident.

If any of the above criteria is met, the operator would be in-vivo lung counted at the next convenient opportunity. Fecal analysis may be used in lieu of in-vivo counting when it is necessary to obtain results faster following an airborne release incident. The practice for non-operator employees that enter the restricted area on a limited basis is a biennial in-vivo lung count unless one of the above criteria for more frequent monitoring is met.

The purpose of in-vivo lung counting is to confirm the viability of the air sampling program. Our experience has been that the calculated exposures from the sampling program are consistently conservative with respect to the in-vivo lung counting results. This is most likely due to a larger particle Activity Median Aerodynamic Diameter (AMAD) than the reference value of 1 μm AMAD.

A lung content of 100 micrograms U^{235} is the action level for investigation and possible work activity restriction.

Routine monthly urine samples are requested from individuals working in the oxide conversion plant. NUREG/CR-4884 is used for the retention factors in interpretation of bioassay measurements.

Diagnostic bioassay samples are requested when air sampling indicates that a significant intake (more than 40% of the weekly limit) of Class D uranium may have occurred. The action level for further investigation of routine monthly samples is 10 μg/liter. Work restrictions will depend on the analysis of a qualified individual.

In-vivo lung counts are currently performed by Helgeson Nuclear Services. Helgeson's quality assurance program consists of counting standards for calibration and counting Livermore type phantoms to compare their results to the test criteria set forth in draft ANSI N13.30. This data is routinely furnished with the report for each counting session.

In-vitro urinalyses are performed by our Windsor Nuclear Laboratories by the fluorometric method. Calibrations are performed by running blanks and standards. A standard is counted with each sample by spiking with a known quantity. The laboratory participates in the EPA intralaboratory comparison program for uranium.

12.3 Air Sampling

The air sampling program is a combination of fixed position general air sampling, fixed position breathing zone sampling, continuous air monitoring with alarming monitors, and lapel air sampling.

Fixed position general air sampling is used to measure the concentration of uranium in air in the general areas of the plant. Fixed position breathing zone air sampling or lapel sampling is used to assign intake for specific operations. The locations of fixed position breathing zone air samplers are selected so that the air sample is representative of the work area air. Continuous air monitoring is conducted in areas where there is the potential for significant airborne releases. The continuous air monitors warn operators to clear the area. When lapel air samplers are worn to assign intake, they are considered representative of the breathing zone. Fixed position breathing zone air samples used to assign intake are changed each shift.

Based on representative air sampling, an administrative limit of 40 DAC-hours is used as a weekly control limit. Operator exposures are tracked to assure that the weekly average remains below 40 DAC-hours per week for the entire year. Single exposures exceeding 40 DAC-hours are investigated. The DAC for Class Y uranium is also used to control exposures to Class D uranium on a weekly basis, which is a conservative limit, representing about 40% of the Class D DAC.

12.4 Posting and Labeling

Areas involving nuclear fuel handling or storage are posted with criticality safety limits. Radiological posting of areas is in accordance with 10 CFR 20.1902. Mass-limited containers of SNM are labeled as to their contents. Areas and equipment for which criticality safety is assured by moderation control are appropriately posted to prevent the introduction of water or excessive hydrogenous materials.

Other signs containing summary instructions, cautions, and reminders relating to safety are posted as appropriate throughout the plant.

12.5 External Radiation - Personnel Monitoring

Personnel are required to monitor their hands and monitor for contamination before exiting the contaminated area. Alpha personnel monitors are located beyond the step-off pad at each change area. Any person having contamination must cleanse and recheck for contamination. If contamination persists, a member of the Regulatory Compliance group will assist in decontamination.

Shallow doses are shown to be less than the annual limit via an annual study of each work station where an individual may receive appreciable shallow doses of radiation (i.e., from beta). The study is performed using ring badges to detect exposure to the fingers (extremities)). Personnel are monitored and shallow dose exposure data is evaluated in terms of both the work station and the individual operators.

12.6 Radiation Surveys

Figure 12-1 depicts contamination control areas and identifies exit points from contaminated areas, where radiation monitoring is provided.

Control of surface contamination is described in Section 3.2.6. Change areas, where personnel exit from contamination control areas, are normally surveyed for alpha contamination on a daily basis during use. Removable contamination on surfaces in plant areas and on items to be released to unrestricted areas are determined by smearing. Limits are provided in Chapter 3.

Direct radiation surveys of plant environs and sealed sources are made as necessary to comply with 10 CFR 20.1501. All survey results are documented.

Contamination surveys are performed using filter paper smears over a known area. Surveys are performed primarily for alpha contamination, but beta surveys are also performed when appropriate. The smears are counted, usually using proportional counters, and the data is recorded. Follow-up surveys are taken after decontamination when limits are exceeded.

Trailers used for shipment of radioactive material are surveyed prior to release from the facility. For closed trailers, alpha contamination surveys are performed on the inside trailer floor and walls, and in particular at the extreme rear floor of the trailer after loading. Beta/gamma readings also are taken around the periphery of the trailer, at the trailer's sides, both at the surface and at six feet from the sides, the rear and the cab. Survey results are recorded. Open trailers are surveyed similarly. For pellet shipments, each drum of pellets is surveyed for alpha contamination and each lot of drums of a new enrichment is surveyed for beta/gamma radiation. For burial shipments (boxes or drums), each box or drum is surveyed for alpha and beta contamination and trailer smears are counted for both alpha and beta contamination.

Potentially contaminated items leaving the plant are surveyed for both fixed and removable contamination. Fixed contamination is determined using an alpha survey meter. Removable contamination is determined by smearing and counting the smear for alpha activity. Contamination surveys are also performed on UF_6 cylinders or overpacks for incoming UF_6 shipments to determine removable alpha contamination. Other surveys may also be performed, according to the transportation requirements unique to the shipment.

Quarterly beta/gamma surveys are also performed throughout the plant using a beta/gamma survey meter. Readings are taken at standard locations and recorded. Equipment readings are taken on contact and hood readings are taken at the opening of the hood where the operator would be standing. General area readings are taken in the open floor space of the room or area being surveyed.

12.7 Reports and Records

Most records required by NRC regulations and this license are retained by the Regulatory Compliance group. These records include alterations or additions made, abnormal occurrences and events associated with radioactivity release, criticality analyses, audits and inspections, instrument calibrations, ALARA findings, employee training and retraining, personnel exposure, routine and special radiation surveys, and SNM control records required by 10 CFR 70.51. Some records may be retained by others, e.g., records of calibration of moisture detectors, records of testing of the emergency generator and fire pumps, etc.

Retention of records is described in Section 2.10.

12.8 Instruments

Types of radiation detection instruments used, their capabilities, and frequency of calibration are described in Section 3.2.4. Instruments are selected to have a sensitivity which is a fraction of the measurement limit.

Flowmeters and orifices used for the air sampling program are calibrated at least once every six months by comparison with a precision rotameter. Operability checks of flowmeters are performed on a more frequent basis.

The minimum detectability for instrumentation is given in Section 3.2.4. Calibration sources are purchased with the requirement that the accuracy be a minimum ±5 percent of the stated value and traceable to the National Institute of Standards and Technology (NIST). Some existing sources which are used for operability checks are traceable to other laboratories with absolute alpha counting capability or the value has been determined by intralaboratory comparisons.

12.9 Protective Clothing

Protective clothing is worn as specified by Regulatory Compliance, posting, or as specified by the Operation Sheet for a particular operation, including: coveralls, lab coats, safety shoes, shoe covers, cotton and rubber gloves, safety glasses, face shields, respirators, supplied-air breathing apparatus, rubber aprons, and acid suits.

12.10 Administrative Control Levels, Including Effluent Control

External occupational exposure is monitored by individual personnel dosimeters. A film badge or TLD and an identification badge with indium foil is worn by personnel when they are within the controlled area. Visitors also wear an I.D. badge. Film badges are processed monthly or more frequently; TLDs are processed quarterly or more frequently. Internal exposure is controlled by process controls, administrative controls and, when required, respiratory protection. Intakes that are likely to cumulatively exceed 10% of the ALI are monitored by measuring concentrations of radioactive materials in the air of the work area, bioassay, or a combination of air concentration measurements and bioassay. For both external and internal exposures, 80% of the applicable limit is used as an action level.

Frequency of measurement, action levels and actions to be taken are given in Chapter 3 for personnel radiation protection and in Chapter 5 for effluent control.

Procedures to be followed in case of a criticality accident are described in the Emergency Procedure Manual.

12.11 Respiratory Protection

Respiratory protective equipment includes full-face respirators, half-mask respirators, and supplied-air breathing apparatus.

The respirator fitting program satisfies the guidance of Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection", and NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials".

12.12 Occupational Exposure Analysis

Due to the low levels of penetrating radiation which exist in the plant, the greatest emphasis in exposure control has been directed towards minimizing inhalation of airborne uranium. To this end, C-E has maintained airborne exposures as low as reasonable achievable through the use of ventilated hoods, process containment and an extensive breathing zone (BZ) air sampling program. Fixed air samplers are strategically placed throughout the facility to provide indications of general airborne activity levels. Continuous air monitors with alarms are utilized in the Oxide Building and in both pellet buildings to more rapidly detect an increase in the airborne activity level.

Information regarding internal deposition of radioactive materials is provided by a bioassay program which includes periodic urinalysis and in-vivo counting.

12.12.1 External Radiation Exposures

The exposure to radiation from external sources is measured using film badges or TLDs. The film badges are changed monthly. Results of monitoring for 1990, 1991 and 1992 were as follows:

	Percent of #Personnel in Range		
Annual Dose Ranges, gamma (REM)	1990	1991	1992
No measurable exposure	33	37	37
Less than 0.100	38	42	53
0.100 - 0.250	19	21	31
0.250 - 0.500	9	10	10
0.500 - 0.750	1	1	1
0.750 - 1.000	0	0	1
> 1.000	0	0	0
Number of employees monitored	100	111	133

12.12.2 Internal Radiation Exposures

Air concentration levels are measured using Breathing Zone (BZ) monitors and Fixed Work Station Air samplers. The quarterly average air concentrations for reporting years 1990, 1991 and 1992 were as follows:

Quarterly Exposure Range MPC hrs/% of Limit	Percent of # Operators in Range											
	1990				1991				1992			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Oxide Plant Operators												
0 - 52 / 0% - 10%	12	0	0	0	0	0	0	0	20	18	0	0
52 - 130 / 10% - 25%	44	89	44	22	33	67	33	90	50	64	100	100
130 - 260 / 25% - 50%	44	11	56	78	67	33	67	10	30	18	0	0
260 - 520 / 50% - 100%	0	0	0	0	0	0	0	0	0	0	0	0
Pellet Plant Operators												
0 - 52 / 0% - 10%	0	25	19	6	7	0	0	5	5	14	5	5
52 - 130 / 10% - 25%	100	75	69	47	40	69	59	84	78	77	90	78
130 - 260 / 25% - 50%	0	0	12	47	53	31	41	11	17	9	5	17
260 - 520 / 50% - 100%	0	0	0	0	0	0	0	0	0	0	0	0
Recycle Plant Operators												
0 - 52 / 0% - 10%	33	14	17	0	0	17	0	0	10	11	0	0
52 - 130 / 10% - 25%	67	86	66	50	80	50	78	56	60	67	89	82
130 - 260 / 25% - 50%	0	0	17	50	20	33	22	44	30	22	11	18
260 - 520 / 50% - 100%	0	0	0	0	0	0	0	0	0	0	0	0
Material Control Operators												
0 - 52 / 0% - 10%	100	100	67	0	25	25	25	50	33	50	50	33
52 - 130 / 10% - 25%	0	0	33	100	75	75	75	50	67	50	50	67
130 - 260 / 25% - 50%	0	0	0	0	0	0	0	0	0	0	0	0
260 - 520 / 50% - 100%	0	0	0	0	0	0	0	0	0	0	0	0
Utility Operators												
0 - 52 / 0% - 10%	12	17	38	0	13	0	0	10	8	17	18	0
52 - 130 / 10% - 25%	88	83	62	92	60	80	50	70	77	83	64	78
130 - 260 / 25% - 50%	0	0	0	8	27	20	50	20	15	0	18	22
260 - 520 / 50% - 100%	0	0	0	0	0	0	0	0	0	0	0	0
Maintenance												
0 - 52 / 0% - 10%	30	25	10	0	11	0	10	0	80	80	90	100
52 - 130 / 10% - 25%	70	75	90	100	56	75	70	88	20	20	10	0
130 - 260 / 25% - 50%	0	0	0	0	33	25	20	12	0	0	0	0
260 - 520 / 50% - 100%	0	0	0	0	0	0	0	0	0	0	0	0

The maximum quarterly exposure for 1990 was 195 MPC hrs, or 38% of the allowable limits set forth in 10 CFR 20.103. For 1991 the maximum quarterly exposure was 230 MPC hrs, or 44% of the quarterly limit. For 1992 the maximum quarterly exposure was 217 MPC hrs, or 42% of the limit.

In-vivo counting is performed by an outside contractor using gamma spectrometry. Results for 1990, 1991 and 1992 were:

Range (μg U-235)	Percent of #Operators in Range											
	Jan 1990	Apr 1990	Jul 1990	Oct 1990	Jan 1991	Apr 1991	Jul 1991	Oct 1991	Jan 1992	Apr 1992	Jul 1992	Oct 1992
Less than 50	6	7	17	16	17	21	19	20	25	33	27	32
50 - 100	2	4	5	9	7	7	6	9	5	3	6	8
100 - 125	0	7	0	0	0	0	0	0	1	3	6	8
125 - 240	0	0	0	0	0	0	0	0	0	0	0	0
Greater than 240	0	0	0	0	0	0	0	0	0	0	0	0

Urinalysis has been conducted conducted for operators on a monthly schedule. Results for 1990, 1991 and 1992 were as follows:

Operation	Average Concentration (μgU/liter)					
	1990		1991		1992	
	Average of Conc.	Number of Operators	Average of Conc.	Number of Operators	Average of Conc.	Number of Operators
Maintenance	0.6	12	/.7	10	1.4	10
Material Control	0.6	7	0.6	4	0.7	3
Oxide Plant	1.0	9	1.3	10	1.2	9
Recycle Plant	0.5	7	0.8	9	0.8	9
Pellet Plant	0.5	15	0.5	18	0.6	18
Utility	0.9	12	0.7	10	0.6	9
Total Employees		62		61		49

It is observed from the above uranalysis results that the average concentration, on the order of 1 μg/l, is very small.

In-vivo counting is performed by an outside contractor using gamma spectrometry. Results for 1990, 1991 and 1992 were:

Range				Percent of #Operators in Range								
(μg U-235)	Jan 1990	Apr 1990	Jul 1990	Oct 1990	Jan 1991	Apr 1991	Jul 1991	Oct 1991	Jan 1992	Apr 1992	Jul 1992	Oct 1992
Less than 50	6	7	17	16	17	21	19	20	25	33	27	32
50 - 100	2	4	5	9	7	7	6	9	5	3	6	8
100 - 125	0	7	0	0	0	0	0	0	1	3	6	8
125 - 240	0	0	0	0	0	0	0	0	0	0	0	0
Greater than 240	0	0	0	0	0	0	0	0	0	0	0	0

Urinalysis has been conducted conducted for operators on a montnly schedule. Results for 1990, 1991 and 1992 were as follows:

Operation	Average Concentration (μgU/liter)					
	1990		1991		1992	
	Average of Conc.	Number of Operators	Average of Conc.	Number of Operators	Average of Conc.	Number of Operators
Maintenance	0.6	12	0.7	10	1.4	10
Material Control	0.6	7	0.6	4	0.7	3
Oxide Plant	1.0	9	1.3	10	1.2	9
Recycle Plant	0.5	7	0.8	9	0.8	9
Pellet Plant	0.5	15	0.5	18	0.6	18
Utility	0.9	12	0.7	10	0.6	9
Total Employees		62		61		49

It is observed from the above uranalysis results that the average concentration, on the order of 1 μg/L, is very small.

12.13 Measures Taken to Implement ALARA

C-E has made numerous changes to equipment and procedures to improve containment and to reduce airborne exposures. Personnel radiation exposure levels are reviewed periodically by the Health Physics Supervisor and the Manager, Regulatory Compliance. This is a continuous process of evaluation and change, and reflects the C-E operating philosophy to keep occupational radiation exposures as low as reasonably achievable.

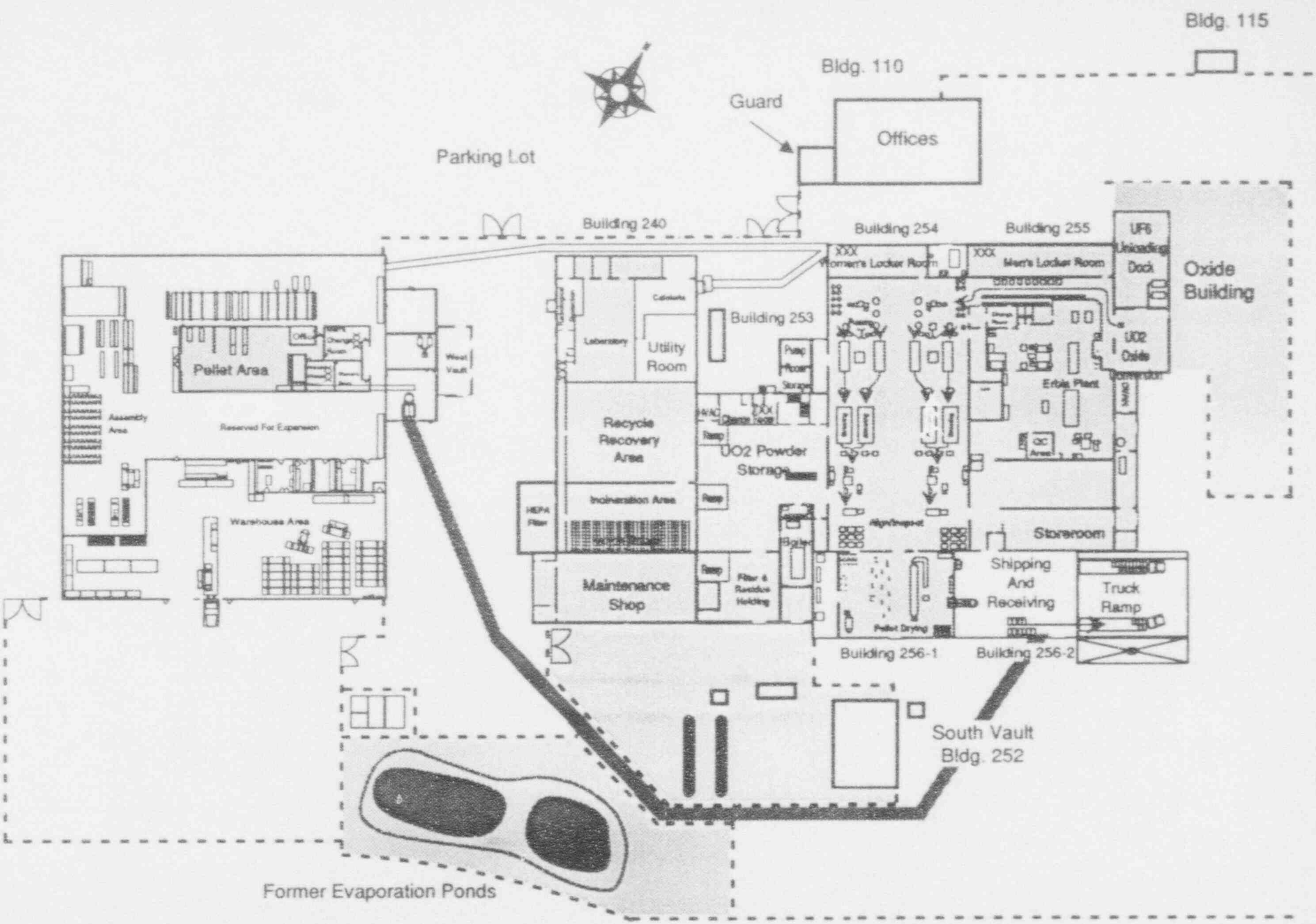


Figure 12-1
Contamination Control Areas and Control Points

Contamination Control Areas

XXXX Control Point

CHAPTER 13 ENVIRONMENTAL SAFETY - RADIOLOGICAL

13.1 Airborne Releases

During routine plant operations, gaseous effluents containing insoluble uranium radionuclides are the primary releases that could radiologically affect humans and the surrounding environment. Maximum individual dose commitments were calculated based on measured releases from all exhaust stacks. Dose commitments for 1987 through 1992 were:

	COMMITTED LUNG DOSE (mrem)	
	North Onsite Monitoring Station (100 m)	Nearest Low Population Zone Resident (800 m)
1987	10	0.1
1988	12	0.1
1989	13	0.1
1990	10	0.1
1991	9	0.1
1992	11	0.1

The critical organ for routine insoluble releases is the lung. As shown above, the nearest low population zone resident received a maximum lung dose commitment of 0.1 mrem annually during the period 1987 through 1992. This is less than 1% of the 40 CFR 190 limit of 25 mrem/year.

13.2 Liquid Releases

Liquids containing trace quantities of uranium are discharged from the plant storm sewer and the sewage treatment plant. Average concentrations of the site dam overflow were less than 0.25% of 10 CFR 20 limits for 1987 and 1988. Further diluted in Joachim Creek, these levels would result in an insignificant dose to an individual downstream of the plant.

13.3 Non-Radiological Releases

The only release of non-radiological materials of environmental concern is hydrogen fluoride (HF), which is released as an offgas of the UF_6 to UO_2 conversion process. HF releases for 1987 were 18.1×10^3 pounds and for 1988 were 21.0×10^3 pounds.

These releases would indicate a ground level concentration of less than 5.2 $\mu g/m^3$ at 100 meters and less than 1.0 $\mu g/m^3$ at the nearest low population zone residence. Damage to vegetation is unlikely at these concentrations.

13.4 Environmental Monitoring Summary

Environmental monitoring for the 1985-1993 period is summarized in the tables on the following pages.

TABLE 13-1

STACK MONITORING - RADIOACTIVITY[1][2]

(MICROCURIES RELEASED)

MONTH\YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993
JAN	13.6	9.2	27.2	31.3	23.7	48.3	28.9	16.3	18.3
FEB	9.2	5.6	26.5	39.2	15.3	15.3	12.0	16.7	56.7
MAR	7.3	16.6	15.0	25.8	22.2	14.6	21.4	42.0	61.5
APR	8.6	19.0	20.7	35.2	23.9	12.0	22.4	28.6	11.1
MAY	8.2	6.9	16.8	42.1	40.8	18.0	19.4	23.3	34.4
JUN	12.7	8.8	20.8	28.5	17.5	18.9	13.8	15.1	22.3
JUL	5.9	10.4	15.9	30.8	16.3	20.0	19.8	19.7	73.4
AUG	8.7	10.2	20.9	18.3	41.6	24.6	27.4	76.5	47.5
SEP	9.5	5.7	21.9	16.0	22.7	27.2	24.5	35.5	10.7
OCT	12.3	33.9	46.3	16.5	47.1	29.8	27.4	25.3	
NOV	9.3	15.2	30.7	38.5	40.9	20.2	16.0	10.7	
DEC	21.6	17.3	14.5	25.3	62.3	21.0	17.7	13.3	
TOTALS	126.9	158.8	277.2	347.5	367.1	288.3	250.5	323.0	335.9

SITE BOUNDARY CONCENTRATION[3]

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Value (10^{-15} μCi/m)	0.4	0.5	0.8	1.1	1.1	0.9	0.8	1.0	1.0
Percent of MPC	0.010	0.012	0.021	0.026	0.028	0.022	0.019	0.024	0.025

(1) Determined by gross alpha counting after allowing at least 8 hours for decay of radon daughters.
(2) For location, see Figure 13-1.

TABLE 13-2

ENVIRONMENTAL AIR MONITORING - RADIOACTIVITY[1][2]

(10^{-15} MICROCURIES PER MILLILITER)

OFFSITE EAST

MONTH\YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993
JAN	10	17	5	2	3	1	3	1	2
FEB	2	27	4	3	4	3	2	1	1
MAR	23	6	2	4	3	3	2	1	2
APR	10	11	4	3	3	2	2	1	1
MAY	25	7	4	3	2	2	2	1	2
JUN	13	6	2	3	2	4	2	3	1
JUL	14	9	4	5	2	3	2	2	3
AUG	6	9	5	3	5	5	10	1	1
SEP	7	6	3	4	3	3	1	1	3
OCT	10	2	5	2	2	2	2	3	
NOV	8	3	4	3	1	3	1	2	
DEC	15	4	3	5	2	6	1	3	
AVERAGE CONC.	12	9	4	3	3	3	3	2	2

OFFSITE WEST

MONTH\YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993
JAN	13	31	6	2	2	1	4	1	3
FEB	5	37	4	3	1	2	2	1	3
MAR	26	11	3	3	2	2	2	1	2
APR	5	13	3	5	3	2	1	2	2
MAY	21	10	5	3	3	1	1	2	1
JUN	6	18	2	3	3	4	2	3	1
JUL	5	26	2	7	1	3	2	2	3
AUG	31	28	3	12	2	2	11	3	2
SEP	20	17	2	5	2	1	2	1	2
OCT	9	4	4	3	1	2	2	1	
NOV	11	4	4	2	1	1	2	1	
DEC	49	5	4	3	2	4	1	2	
AVERAGE CONC.	17	17	4	4	2	2	3	2	2

(1) Determined by gross alpha counting after allowing a 72 hour period for decay of radon and thorium daughters.
(2) For location, see Figure 13-1.

TABLE 13-2 (continued)

ENVIRONMENTAL AIR MONITORING - RADIOACTIVITY[(1)(2)]

(10^{-15} MICROCURIES PER MILLILITER)

OFFSITE SOUTHEAST

MONTH\YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993
JAN	--	--	--	--	--	--	3	2	2
FEB	--	--	--	--	--	2	2	4	3
MAR	--	--	--	--	--	2	4	1	5
APR	--	--	--	--	--	2	2	3	2
MAY	--	--	--	--	--	2	8	3	1
JUN	--	--	--	--	--	2	1	2	2
JUL	--	--	--	--	--	2	2	2	5
AUG	--	--	--	--	--	2	3	2	2
SEP	--	--	--	--	--	2	2	2	3
OCT	--	--	--	--	--	3	2	1	
NOV	--	--	--	--	--	1	2	1	
DEC	--	--	--	--	--	6	5	2	
AVERAGE CONCENTRATION					2	3	2		

-- Not sampling yet

(1) Determined by gross alpha counting after allowing a 72 hour period for decay of radon and thorium daughters.
(2) For location, see Figure 13-1.

TABLE 13-3

SITE DAM OVERFLOW MONITORING - RADIOACTIVITY[(1)]

(PICOCURIES PER LITER)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	4	7	29	28	10	5	5	9	6	8	33	15	4	13	7	4	10	6
FEB	7	23	65	88	12	14	14	15	21	15	7	14	3	5	22	26	9	5
MAR	5	10	22	18	5	4	31	14	22	11	45	11	6	6	9	4	3	5
APR	4	47	22	16	13	11	115	14	35	21	12	10	8	6	7	5	12	11
MAY	23	21	37	40	172	108	34	28	27	16	10	12	13	9	13	6	17	20
JUN	7	16			83	52	122	81	42	24	9	8	44	11	25	8	10	8
JUL	29	32	115	160	18	38	94	55	24	31	21	12	55	18	50	19	11	11
AUG	29	28	40	166	36	20	134	53	75	93	53	51	40	16	32	8	11	12
SEP	15	10	80	163	69	46	132	31	35	41	25	15	28	11	42	23	23	34
OCT	81	28	8	7	285	150	65	33	24	19	37	19	56	15	228	39		
NOV	37	33	10	12	153	48	59	32	27	27	19	12	25	10	74	66		
DEC	6	5	10	7	21	34	11	11	57	46	7	10	14	7	10	9		
AVE. CONC.	21	22	37	64	73	44	60	31	33	29	23	16	25	11	43	18	12	12
% MPC	1	1	1	2	2	1	1	1	1	1	1	0	1	0	1	0	0	0

(1) For location, see Figure 13-2.

TABLE 13-4

JOACHIM CREEK MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER) UPSTREAM

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	<1	<3	<1	4	<3	4	<4	3	<3	8	1	4	3	4	2	2	<3	<4
FEB	<1	22	<2	4	<5	4	<3	3	<2	3	<3	3	<2	2	<2	4	<2	<3
MAR	<3	3	<2	3	<4	2	<4	3	<2	3	<1	3	<2	2	3	3	<2	3
APR	<1	7	<2	4	<5	6	<3	4	<3	5	<4	2	<3	2	<3	4	<2	3
MAY	<1	3	<2	3	<4	4	<3	3	<2	5	5	4	4	4	<3	<2	<2	3
JUN	<4	5	<3	3	<4	4	<3	6	<4	<3	<1	4	<3	3	<2	3	<4	3
JUL	<1	3	<2	2	<4	3	<2	5	<2	4	<2	3	<3	3	<2	3	<2	3
AUG	<1	3	<2	4	<3	4	<3	6	<4	9	<2	2	4	2	<1	3	<1	4
SEP	<1	<3	<3	3	<3	4	<3	5	<4	4	<2	3	<2	3	3	4	4	4
OCT	<2	<3	<4	6	<5	5	<4	6	<4	5	<1	<1	<2	<1	<3	4		
NOV	<1	2	<2	12	<4	4	<3	4	<4	4	2	2	<2	2	<2	3		
DEC	<1	2	<5	9	<2	5	<3	5	<4	<3	<2	3	<2	3	<3	3		

(1) For location, see Figure 13-2.

TABLE 13-5

JOACHIM CREEK MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER) DOWNSTREAM

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	<2	<3	<1	3	<3	4	<4	2	<3	3	1	3	3	2	<2	3	<3	<4
FEB	<1	4	<2	4	<4	4	<4	4	<2	2	<3	3	<2	2	<2	2	<2	3
MAR	<3	3	<2	5	<4	4	<4	4	<2	4	1	2	<3	<1	<2	3	<2	3
APR	<0.8	3	<2	4	<5	3	<3	3	<3	5	<4	3	<3	2	<3	3	<2	3
MAY	<1	3	<2	3	<4	3	5	33	<4	5	<3	<3	3	3	<3	<2	<3	6
JUN	<4	9	<3	<3	<4	4	<3	3	<2	3	2	2	<3	3	<2	6	<4	2
JUL	<1	3	<2	5	<4	4	<2	3	<3	3	3	3	<3	4	<2	8	<6	4
AUG	<1	4	<2	3	<3	5	5	3	<2	5	2	2	5	3	<1	4	3	5
SEP	<1	<3	<3	3	<3	4	<3	7	<4	5	3	4	<2	4	3	3	2	4
OCT	<2	4	<3	4	<5	6	<4	5	<3	3	<1	<1	<2	7	<3	3		
NOV	<1	2	8	18	<4	6	<3	5	<4	4	3	3	<2	5	<3	4		
DEC	<1	2	<4	5	<4	4	<3	5	<4	<3	<2	3	<2	4	<3	4		

(1) For location, see Figure 13-2.

TABLE 13-6

QUARTERLY LIQUID ENVIRONMENTAL MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER)

JOACHIM CREEK/SITE CREEK CONFLUENCE

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
Qtr	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
1ST QTR	<2	6	<2	5	<2	<3	<2	11	<2	6	3	3	4	4	<3	4	<2	4
2ND QTR	<4	9	<2	4	<2	<3	<2	<3	<2	<3	11	11	*	*	3	13	4	6
3RD QTR	<2	<3	<2	<3	<2	<3	<3	3	<4	3	3	6	<2	4	3	3	<3	4
4TH QTR	2	5	<2	5	<2	8	<2	<3	<2	<3	<3	3	<2	5	2	4		

HEMATITE WELL

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
Qtr	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
1ST QTR	<2	<3	<2	3	<2	<3	<2	14	<4	10	7	4	<3	4	<2	3	<6	6
2ND QTR	<2	6	<2	<2	<2	<3	<2	<3	<4	9	2	2	<4	3	<5	15	2	5
3RD QTR	<1	<3	<2	<3	5	<3	<3	10	<5	5	9	5	2	5	12	4	6	<6
4TH QTR	<2	5	<2	<3	<2	<3	--	--	8	7	5	4	3	3	<7	4		

* Data not available for this period.

(1) For location, see Figure 13-2.

TABLE 13-7

RETENTION POND WELL MONITORING - RADIOACTIVITY(1)
SAMPLE WELL NORTH

(PICOCURIES PER LITER)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	4	137	<2	229	10	150	26	331	<2	321	4	336	4	396	3	335	<2	321
FEB	4	157	4	207	61	246	10	22	4	368	5	212	<3	309	<4	346	<3	361
MAR	6	72	5	187	60	241	15	44	3	347	<2	315	<3	255	<4	239	3	4
APR	7	66	<2	178	40	243	12	393	18	250	<2	261	<2	424	<3	471	8	213
MAY	4	327	7	280	<2	329	<2	423	3	368	2	210	4	266	<3	465	<3	297
JUN	5	325	<2	277	76	370	<2	520	<2	363	5	152	<4	297	<4	509	<4	269
JUL	<2	238	6	413	6	539	<2	547	3	354	4	273	<11	275	<6	391	<3	254
AUG	4	166	8	131	263	617	<4	238	4	342	<2	460	5	524	<4	159	5	349
SEP	5	142	19	338	<2	642	10	190	5	456	<3	496	3	602	5	292	<3	313
OCT	3	127	5	85	<2	729	38	596	3	38	<2	382	<5	253	<5	290		
NOV	6	223	4	114	62	334	<2	248	3	226	<1	407		463	<7	361		
DEC	3	173	12	290	55	376	4	266	3	227	<2	328	<3	482	<4	595		

(1) For location, see Figure 13-2.

TABLE 13-8

RETENTION POND WELL MONITORING - RADIOACTIVITY[1]
SAMPLE WELL SOUTHEAST

(PICOCURIES PER LITER)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	<2	<3	95	55	28	18	<2	<3	<2	<3	*	*	<3	<1	2	5	<2	6
FEB	<2	4	<20	4	19	17	3	25	<2	5	5	9	4	3	<2	3	4	8
MAR	<2	<3	4	5	7	5	11	<3	5	10	<2	5	3	2	<2	4	<1	4
APR	<2	<3	4	5	<2	<3	<2	<3	<2	<3	3	6	<3	3	<3	2	4	3
MAY	<2	<3	<2	4	<2	<3	252	132	<2	4	4	2	5	8	<2	<1	2	4
JUN	3	<3	5	6	65	55	*	*	14	103	<2	3	<4	3	<2	5	<2	3
JUL	<2	<3	<2	11	34	22	*	*	10	14	*	*	<11	162	<2	3	3	4
AUG	4	6	4	4	14	21	*	*	*	*	12	12	4	6	<3	2	17	16
SEP	<2	<3	7	8	*	*	*	*	5	10	18	24	<2	7	6	8	3	6
OCT	<2	7	45	17	*	*	*	*	*	*	<2	4	2	5	5	8		
NOV	92	16	16	10	*	*	*	*	*	*	3	5	3	7	<4	8		
DEC	33	10	10	7	19	19	15	12	*	*	5	5	2	5	<3	7		

* Well dry at this time

(1) For location, see Figure 13-2.

TABLE 13-9

RETENTION POND WELL MONITORING - RADIOACTIVITY[(1)]
SAMPLE WELL SOUTHWEST

(PICOCURIES PER LITER)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	4	4	19	21	27	31	<2	<3	<2	<3	3	4	<3	3	2	6	<1	4
FEB	4	4	5	<3	1[illegible]	24	27	423	<2	<3	<2	3	<3	2	5	6	2	7
MAR	<2	3	10	13	17	21	<2	<3	5	5	<2	2	3	4	<1	4	4	9
APR	<2	5	5	10	<2	<3	<2	29	5	<3	<2	1	<3	6	4	7	4	5
MAY	5	8	16	10	17	20	<2	<3	<2	5	1	2	11	20	2	3	<2	4
JUN	12	28	10	15	49	62	*	*	89	55	<2	3	10	20	13	19	6	5
JUL	10	6	11	14	12	8	*	*	11	20	3	5	7	15	<2	5	3	5
AUG	13	15	12	11	<2	<3	9	13	6	11	<2	<3	14	18	3	7	5	6
SEP	11	8	<2	7	13	21	30	17	3	6	3	4	<2	3	2	7	<2	5
OCT	4	5	<2	<3	<2	14	20	97	<2	293	<2	1	2	4	4	4		
NOV	<2	4	<2	4	32	23	<2	5	4	8	<2	4	4	7	3	3		
DEC	6	7	11	13	3	5	8	9	3	7	<2	3	45	9	3	3		

* Well dry at this time

(1) For location, see Figure 13-2.

TABLE 13-10

SITE WATER SUPPLY WELL MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	<2	<3	2.7	3	<2	<3	<4	<2	<3	7	4	2	4	5	<2	3	<2	2
FEB	<2	5	<2	3	<4	<2	<4	<2	<2	<2	<3	2	3	3	<2	2	<2	<3
MAR	<3	<2	<2	2	<4	<2	<4	4	<2	<2	<1	<2	<2	2	<2	3	7	2
APR	<2	3	<2	2	<4	<3	<3	3	<3	3	<4	<2	<3	1	<3	2	<4	<1
MAY	1.2	2	<2	2	<4	<2	<2	2	<2	3	12	2	2	2	<2	1	<3	1
JUN	<4	11	<2	<2	<3	3	<2	3	<3	<2	1	2	<3	2	<2	2	<1	<1
JUL	<1	<2	<2	<2	<4	2	<2	<2	<2	<3	14	14	<3	3	2	<2	3	2
AUG	5.3	<2	<2	2	<3	<2	<3	<3	2	<2	2	2	3	3	<1	2	4	4
SEP	<2	5	<3	2	<3	4	<3	<2	<3	<2	<2	3	<2	4	4	2	<2	3
OCT	<2	<3	<3	3	<4	3	<3	<3	<3	<2	2	6	<2	2	<3	3		
NOV	<1	<1	<2	<3	<3	<2	<3	<2	<3	<2	<2	1	<2	2	<3	4		
DEC	<1	<1	<2	<3	<2	3	<3	4	<3	<3	2	<1	<2	3	<3	4		

(1) For location, see Figure 13-2.

TABLE 13-11

SOUTH VAULT SAMPLE WELL MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER)

YEAR	1991*		1992		1993		1994		1995		1996	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	5	15	<6	17	<3	735						
FEB	4	15	<3	17	5	32						
MAR	<3	3	4	19	4	27						
APR	3	631	3	18	5	28						
MAY	<3	731	<4	27	<5	29						
JUN	<3	21	5	30	<5	29						
JUL	4	20	<5	51	7	45						
AUG	<3	92	6	39	6	87						
SEP	4	39	4	52	3	63						
OCT	6	14	<4	69								
NOV	<3	31	<4	100								
DEC	20	17	<4	49								

* New sampling site

(1) For location, see Figure 13-2.

TABLE 13-12

BURIAL GROUND WELL MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER)

BURIAL GROUND WELL #1

YEAR	1990		1991		1992		1993		1994		1995	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	<2	2	<3	3	1	3	5	14				
FEB	4	12	<3	3	2	5	<2	6				
MAR	2	5	<3	2	<1	3	<1	6				
APR	<2	2	<3	5	2	3	2	6				
MAY	3	4	10	14	<2	3	<2	10				
JUN	4	11	<2	<1	2	5	<2	6				
JUL	3	4	20	29	<2	8	2	5				
AUG	2	3	30	46	2	5	2	5				
SEP	5	9	5	9	<2	13	2	5				
OCT	3	6	5	10	2	11						
NOV	<2	6	2	6	66	13						
DEC	2	5	24	10	3	7						

BURIAL GROUND WELL #2

YEAR	1990		1991		1992		1993		1994		1995	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	<3	73	3	19	7	17	<4	9				
FEB	<3	72	8	18	5	13	5	16				
MAR	<1	374	<3	11	<4	9	9	5				
APR	5	34	9	14	<2	10	26	3				
MAY	5	17	<3	15	<4	7	<4	7				
JUN	<2	12	5	12	<4	9	<3	16				
JUL	<3	15	21	30	<3	11	<4	6				
AUG	5	12	5	20	<4	9	13	6				
SEP	<3	17	12	27	55	11	5	12				
OCT	<2	15	7	14	3	5						
NOV	<3	<1	<1	21	<5	10						
DEC	5	18	4	13	<4	11						

* New sampling site

(1) For location, see Figure 13-2.

TABLE 13-13

BURIAL GROUND WELL MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER)

BURIAL GROUND WELL #3

YEAR	1990		1991		1992		1993		1994		1995	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	4	20	<3	5	2	5	8	15				
FEB	<3	5	<3	7	2	6	2	5				
MAR	2	5	<3	5	<1	5	<1	4				
APR	<2	5	<2	8	<2	5	3	6				
MAY	2	73	5	15	<1	5	<2	5				
JUN	2	8	6	<1	4	14	<1	9				
JUL	<3	8	33	50	<5	15	<1	6				
AUG	1	7	22	41	5	33	2	2				
SEP	3	9	9	20	7	4	4	7				
OCT	<2	6	1	6	2	9						
NOV	<3	6	7	18	<13	28						
DEC	2	6	7	8	<2	7						

BURIAL GROUND WELL #4

YEAR	1990		1991		1992		1993		1994		1995	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN			<3	519	5	1705	6	843				
FEB			<3	681	1	2033	7	1023				
MAR			<3	695	<2	1811	6	1084				
APR			2	1102	<2	2173	<2	571				
MAY			3	1180	9	1369	<2	492				
JUN			<3	1817	2	1871	<2	658				
JUL			<11	1650	<2	1749	<2	346				
AUG			<3	1551	4	896	5	543				
SEP			<2	733	44	2068	7	735				
OCT			<2	805	6	1229						
NOV	9	1123	5	2054	10	1093						
DEC	<2	1427	4	1714	<2	2360						

* New sampling site

(1) For location, see Figure 13-2.

TABLE 13-14

SEWAGE OUTFALL MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER LITER)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
MONTH	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
JAN	244	148	155	183	24	21	133	94	84	40	216	85	73	48	66	30	22	58
FEB	39	84	134	131	127	163	69	118	133	100	111	86	192	81	54	35	19	28
MAR	54	143	32	28	207	80	43	35	68	67	49	22	156	39	58	41	10	45
APR	82	80	129	59	28	39	91	95	110	69	24	30	63	22	56	76	18	42
MAY	77	67	135	168	43	56	39	47	61	37	47	44	82	40	34	46	10	39
JUN	213	266	*	*	79	75	56	61	30	24	52	56	121	131	42	38	17	39
JUL	97	103	17	36	17	75	55	40	13	30	52	32	76	24	106	32	17	44
AUG	97	112	46	182	109	93	33	31	6	18	53	46	141	52	96	41	19	28
SEP	189	90	50	401	43	36	71	25	29	41	105	43	40	30	55	39	83	51
OCT	219	96	16	117	87	62	171	106	23	29	31	28	49	146	25	42		
NOV	174	184	19	52	36	27	26	70	21	28	200	77	39	37	57	63		
DEC	405	177	46	42	76	150	31	87	281	209	38	35	84	33	32	56		

* These samples lost in shipping

(1) For location, see Figure 13-2.

TABLE 13-15

SOIL MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER GRAM)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
Station 12																		
1st Qtr	8.6	27	<5	17	11	40	12	28	8.3	35	14	33	13	36	17	32	11	32
2nd Qtr	9.7	25	<7	28	19	29	12	36	11	36	11	36	13	35	7.3	32	14	38
3rd Qtr	<4	21	14	38	11	28	6.7	17	10	25	16	38	28	68	14	38	12	36
4th Qtr	<6	29	18	34	25	51	16	41	9.8	36	11	38	8.4	42	13	40		
Station 13																		
1st Qtr	5.6	55	<5	30	5	36	18	36	11	37	7.9	32	13	24	25	38	6.8	35
2nd Qtr	8.1	22	10	27	25	32	6.6	33	6.4	35	11	34	16	38	7.8	27	11	37
3rd Qtr	<4	33	<7	31	15	30	7.4	19	7	23	13	5.7	12	93	8.8	42	15	35
4th Qtr	<6	32	13	35	12	30	8.2	39	14	40	48	4	14	40	10	40		
Station 14																		
1st Qtr	15	35	11	27	16	20	16	40	15	46	14	43	15	40	15	36	14	41
2nd Qtr	62	47	20	53	20	30	17	43	19	48	10	43	18	91	14	40	10	41
3rd Qtr	13	31	8.2	35	12	43	8.2	25	6	27	19	46	7.7	47	18	45	13	39
4th Qtr	<6	30	19	48	22	44	16	44	15	45	8.4	5	21	47	14	46		
Station 15																		
1st Qtr	9.2	38	9.4	35	17	38	46	50	12	52	13	33	13	37	16	46	14	36
2nd Qtr	19	35	14	31	15	41	11	40	16	46	18	47	14	39	8.9	45	12	48
3rd Qtr	7.6	31	19	33	12	43	24.4	34	11	29	34	150	8.4	48	13	41	15	45
4th Qtr	11	36	33	55	18	44	10	47	19	45	13	6	13	49	17	43		

(1) For location, see Figure 13-3.

TABLE 13-16

VEGETATION MONITORING - RADIOACTIVITY[1]

(PICOCURIES PER GRAM)

YEAR	1985		1986		1987		1988		1989		1990		1991		1992		1993	
	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA	ALPHA	BETA
Station 12																		
1st Qtr	0.4	17	1	18	1.1	16	0.8	13	<0.2	4	1.2	13	0.3	13	0.3	8	0.3	0.3
2nd Qtr	<0.2	3	<0.6	16	<0.2	11	<0.3	13	<0.2	12	1.1	15	0.4	9	<0.3	19	0.3	13
3rd Qtr	0.6	7	0.5	11	<0.2	6	1	13	0.5	30	0.9	10	10	98	0.4	8	0.2	11
4th Qtr	1.6	2	0.6	8	<0.6	17	0.8	12	0.2	16	<4	19	3.9	128	0.2	8		
Station 13																		
1st Qtr	0.5	17	<0.2	12	1.1	14	2.4	13	0.4	16	1.2	13	0.4	11	0.5	8	1.7	1
2nd Qtr	<0.2	17	0.4	13	<0.4	12	<0.2	12	0.5	15	0.5	18	0.2	10	0.2	17	<0.01	10
3rd Qtr	0.4	5	<0.6	14	<0.4	17	<0.4	15	1.4	35	0.4	11	21	390	0.2	9	0.2	15
4th Qtr	0.7	12	0.4	7	<0.5	10	0.4	9	0.4	11	7.3	16	3.3	99	0.3	12		
Station 14																		
1st Qtr	0.4	12	0.4	13	0.9	11	6.7	22	0.6	11	1.3	10	<0.03	14	0.4	7	0.3	0.3
2nd Qtr	0.8	10	1.5	55	<0.3	11	<0.1	12	<0.2	13	0.4	15	0.6	25	<0.1	13	<0.01	12
3rd Qtr	0.9	16	0.5	10	<0.2	11	<0.3	10	0.3	31	0.2	79	14	170	0.9	15	0.6	12
4th Qtr	11	18	0.8	12	<0.6	18	0.6	13	<0.4	14	<4	13	18.3	118	0.4	11		
Station 15																		
1st Qtr	0.2	11	<0.2	9	0.6	14	9	23	<0.2	16	2.7	15	0.9	15	0.6	12	0.5	0.4
2nd Qtr	0.4	10	<0.4	24	<0.2	11	<0.2	12	<0.2	14	0.8	15	1.1	33	<0.2	18	0.2	12
3rd Qtr	0.5	9	0.8	13	0.7	13	0.6	11	1.6	31	0.3	15	14	130	0.2	10	<0.1	10
4th Qtr	3.1	13	2	16	0.5	11	0.3	14	0.7	0.4	5.2	15	9.8	245	0.5	12		

(1) For location, see Figure 13-3.

TABLE 13-17

STACK MONITORING - FLUORIDE[1]
OXIDE PLANT DRY SCRUBBERS

(THOUSAND POUNDS RELEASED)

YEAR / MONTH	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
JAN	1.9	1.3	0.9	0.5	1.0	0.1	2.6	2.6	1.6	0.4	2.5	2.0
FEB	2.1	1.2	0.4	0.7	1.8	0.6	1.4	1.4	.8	1.2	1.0	4.2
MAR	1.6	0.7	0.1	1.0	1.4	1.4	2.1	2.1	6.4	0.0	3.2	2.9
APR	1.1	0.7	0.5	1.6	2.6	2.1	2.1	2.1	2.8	0.0	2.1	2.8
MAY	1.2	0.5	0.6	1.1	1.3	1.2	2.7	2.7	4.3	0.3	2.4	5.4
JUN	0.7	0.8	1.1	1.5	***	1.8	3.0	3.0	0.3	1.0	1.4	5.1
JUL	1.2	0.1	0.1	0.1	1.5	***	2.4	2.4	0.8	0.6	4.4	0.3
AUG	1.4	0.7	0.8	1.8	1.1	***	4.9	4.9	1.8	1.0	5.2	6.6
SEP	0.8	1.0	0.2	1.0	1.8	1.2	3.4	3.4	0.3	3.6	3.0	3.7
OCT	1.4	1.0	1.5	1.2	1.3	3.3	3.2	3.2	2.0	2.8	7.6	
NOV	1.0	1.0	1.9	0.9	0.3	2.5	2.5	2.5	0.4	1.6	3.7	
DEC	1.3	0.8	0.4	0.0	0.5	4.6	0.7	0.7	0.5	1.7	4.8	
TOTAL	15.7	9.8	8.5	11.4	14.6	10.0	31.0	22.0	31.0	14.2	41.3	33.0

*** Not in use this month

(1) For location, see Figure 13-3.

TABLE 13-18

SITE DAM OVERFLOW MONITORING - FLUORIDE[1]

(MILLIGRAM PER LITER)

YEAR / MONTH	1985	1986	1987	1988	1989	1990	1991	1992	1993
JAN	<1	<1	0.1	<1	<1	<1	<1	2.5	2.0
FEB	<1	<1	0.6	<1	<1	<1	<1	1.0	4.2
MAR	<1	<1	1.4	<1	<1	<1	<1	3.2	2.9
APR	<1	<1	2.1	<1	<1	<1	<1	2.1	2.8
MAY	<1	<1	1.2	<1	<1	<1	<1	2.4	5.4
JUN	<1	<1	1.8	<1	<1	***	<1	1.4	5.1
JUL	<1	<1	***	1.2	<1	<1	<1	4.4	0.3
AUG	<1	**	***	1.0	<1	<1	1	5.2	6.6
SEP	<1	**	1.2	<1	<1	<1	3.6	3.0	3.7
OCT	1.9	<1	3.3	<1	<1	<1	2.8	7.6	
NOV	<1	<1	2.5	<1	<1	<1	1.6	3.7	
DEC	<1	<1	4.6	<1	<1	<1	1.7	4.8	

*** Results lost

(1) For location, see Figure 13-3.

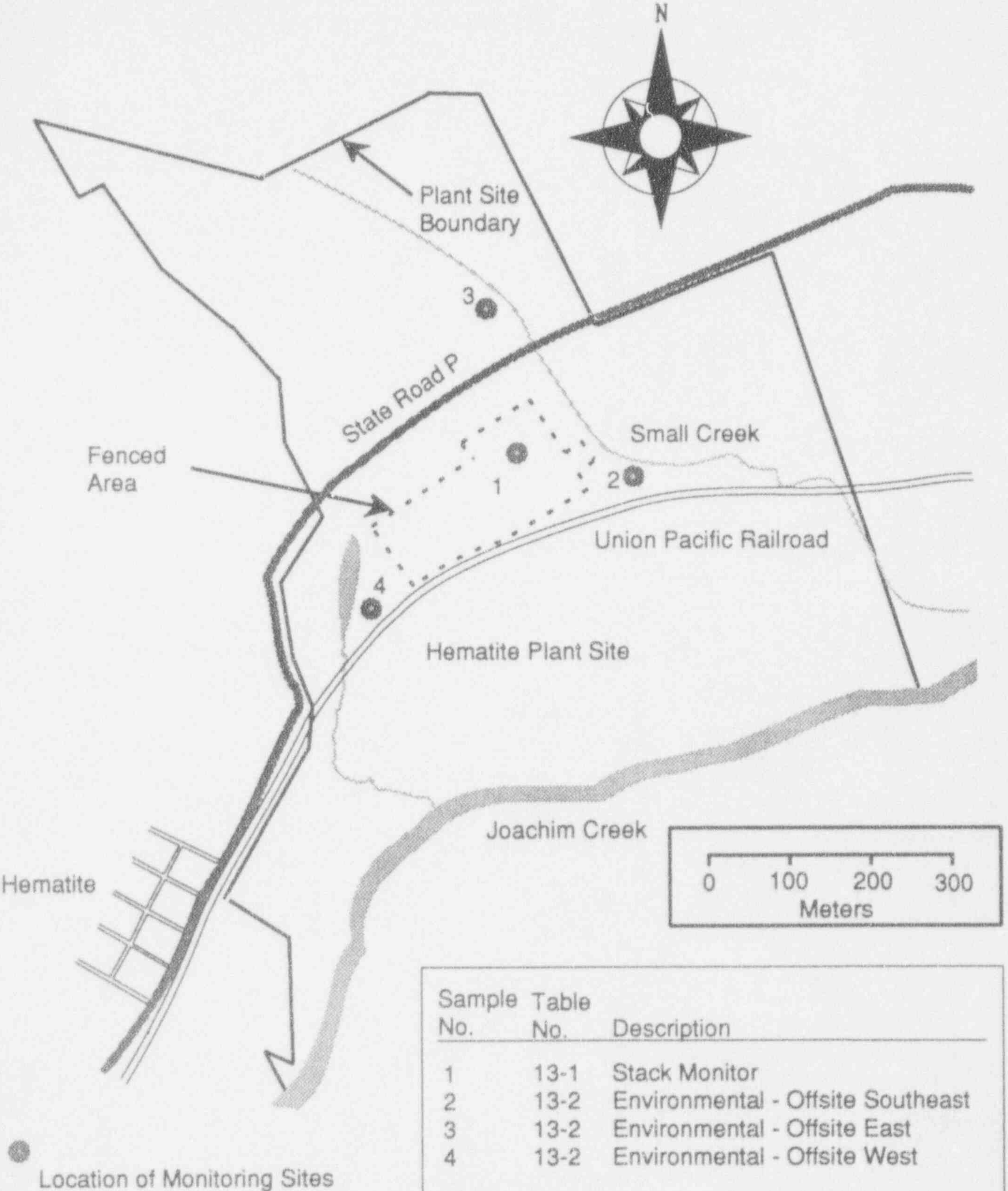
TABLE 13-19

VEGETATION MONITORING - FLUORIDE[1]

(PARTS PER MILLION)

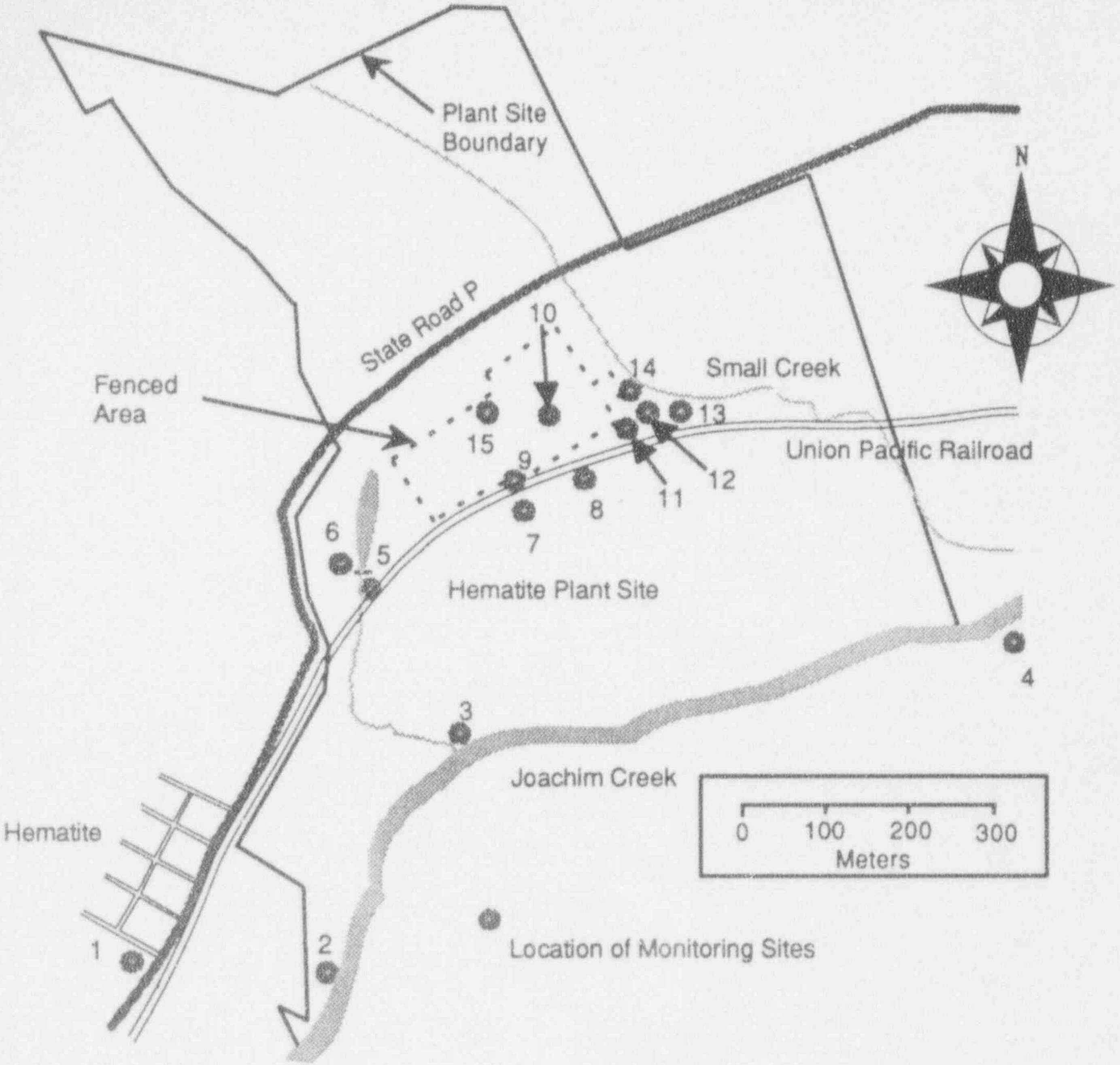
YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1st Quarter												
Station 12	12	14	35	16	6	14	12	<10	<10	23	10	48
Station 13	11	9	23	51	46	55	9.2	11	22	52	<10	28
Station 14	<10	12	67	19	41	20	18	<10	16	21	<10	24
Station 15	25	16	47	<10	14	51	33	<10	24	25	<10	21
2nd Quarter												
Station 12	13	8	<10	<10	4	<10	<10	<10	<10	8	<10	24
Station 13	11	29	<10	10	21	<10	<10	24	<10	17	13.6	31
Station 14	18	15	<10	10	30	31	10	<10	<10	23	12	66
Station 15	22	19	<10	<10	24	38	11	23	<10	23	46	44
3rd Quarter												
Station 12	14	15	10	<10	48	<10	<10	<10	<10	10	6.2	11
Station 13	<10	70	16	32	20	<10	<10	<10	<10	21	22	13
Station 14	<10	29	6	29	16	<10	<10	<10	<10	25	14	16
Station 15	12	31	7	<10	23	<10	12	11	12	20	14	17
4th Quarter												
Station 12	14	54	13	22	5	<10	2.4	22	10	15	8.4	
Station 13	14	39	43	11	17	14	4.6	14	96	37	17	
Station 14	12	480	74	22	7	<10	3	16	<10	32	9.6	
Station 15	5	72	50	50	33	<10	3.4	20	<10	28	37	

(1) For location, see Figure 13-3.



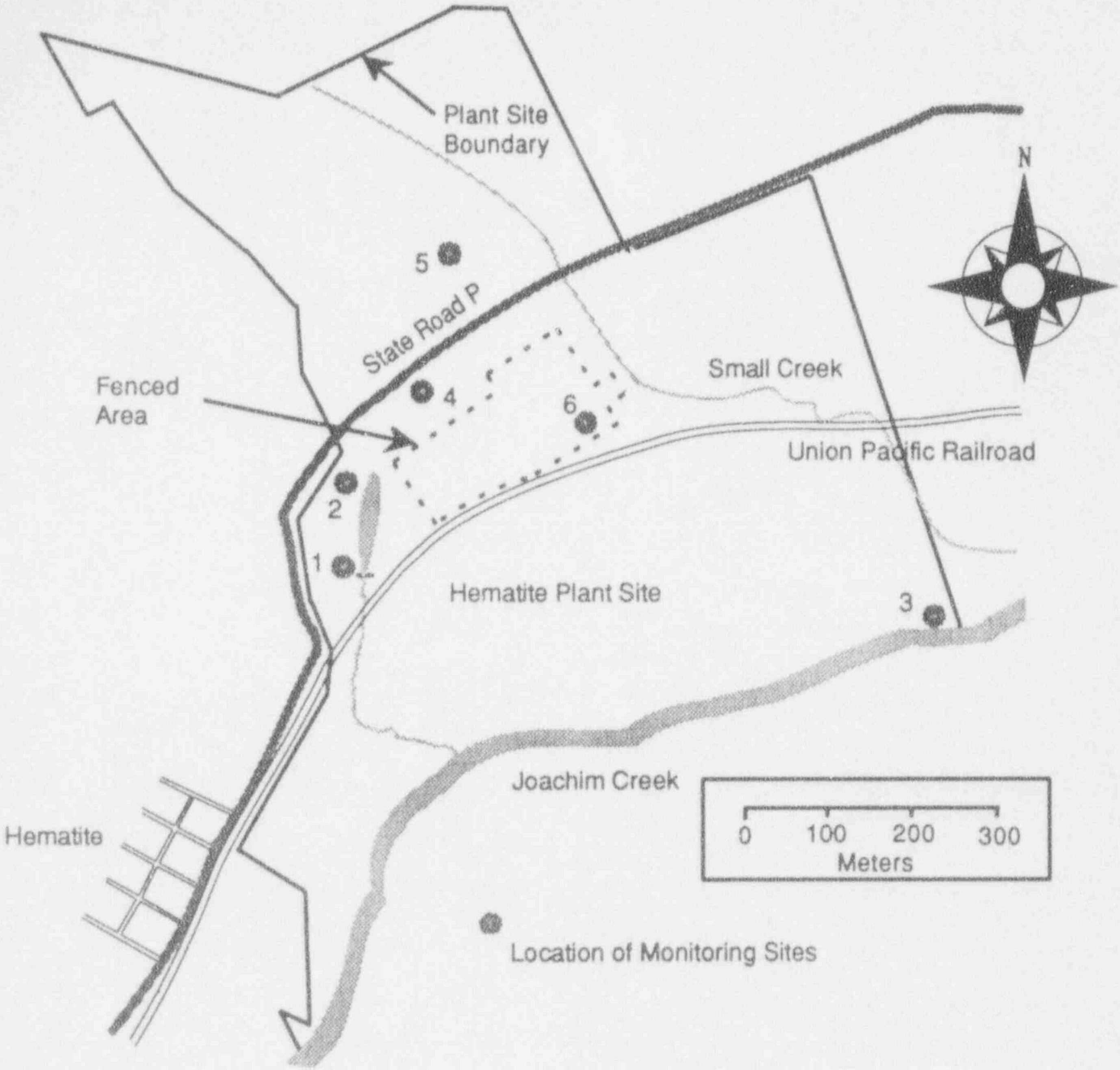
Sample No.	Table No.	Description
1	13-1	Stack Monitor
2	13-2	Environmental - Offsite Southeast
3	13-2	Environmental - Offsite East
4	13-2	Environmental - Offsite West

Figure 13-1
Locations of Air Monitoring Sites



Sample No.	Table No.	Description	Sample No.	Table No.	Description
1	13-6	Hematite Well	9	13-7	Retention Pond Well - North
2	13-4	Joachim Creek - Upstream	10	13-11	South Vault Well
3	13-6	Joachim Creek - Confluence	11	13-13	Burial Ground Well #4
4	13-5	Joachim Creek - Downstream	12	13-12	Burial Ground Well #1
5	13-14	Sewage Outfall	13	13-13	Burial Ground Well #3
6	13-3	Site Dam Overflow	14	13-12	Burial Ground Well #2
7	13-9	Retention Pond Well - Southwest	15	13-10	Site Well
8	13-8	Retention Pond Well - Southeast			

Figure 13-2 Locations of Water Monitoring Sites



Sample No.	Table No.	Description	Sample No.	Table No.	Description
1	13-15	Soil Station #14	4	13-15	Soil Station #15
	13-16	Vegetation Station #14		13-16	Vegetation Station #15
	13-19	Fluoride Station #14		13-19	Fluoride Station #15
2	13-18	Site Dam Overflow - Flouride	5	13-15	Soil Station # 13
3	13-15	Soil Station #12		13-16	Vegetation Station #13
	13-16	Vegetation Station #12		13-19	Fluoride Station #13
	13-19	Fluoride Station #12	6	13-17	Fluoride - Stack

Figure 13-3 Locations of Soil/Vegetation/Fluoride Monitoring Sites