ABB
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April 20, 1994
ML-94-019

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 - Criticality Changes**

Dear Dr. Tokar:

This letter provides changes to the Hematite License Renewal Application criticality safety chapters and other changes as discussed during our meeting of February 10, 1994, and in subsequent conversations with your staff.

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. Six (6) copies of this document are provided for your use.

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Ltr. Encl.
Change: LA 6 0

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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.

Verv truly yours,

COMBUSTION ENGINEERING, INC.

for

Robert W. Sharkey
Manager
Regulatory Compliance

Enclosures: As Stated

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

Enclosure I to
ML-94-019

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE RENEWAL APPLICATION

CRITICALITY CHANGES

DESCRIPTION OF CHANGES

April 1994

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

DESCRIPTION OF CHANGES

This submittal provides changes to the Hematite License Renewal Application criticality safety chapters and other changes as discussed with the Nuclear Regulatory Commission staff. 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.

The Hematite License Renewal Application consists of two parts. Part I, License Conditions, is comprised of Chapters 1 through 8. Part II, Safety Demonstration, is comprised of Chapters 9 through 15.

In Section 1.6, item (c) was reworded to conform to the intent of the third recommended license condition of the Environmental Assessment (NRC letter dated March 17, 1994). In addition, a provision was added to reflect the NRC approved CE procedure for sampling of spent limestone as it is unloaded from the dry scrubbers. Item (f) of this section was revised to refer to the "Guidance on Fire Protection for Fuel Cycle Facilities", dated August 19, 1992.

Chapters 2 and 11, Organization, were revised consistent with the organizational amendment request to the existing license application, in accordance with our letter of March 22, 1994. The delegation statement of Section 2.1 was revised for clarity. In addition, the resume of R. J. Klotz has been removed from Chapter 11 in light of his recent retirement. Although "retired", Mr. Klotz currently continues to provide consulting services as needed. Mr. M. R. Eastburn is the Hematite Nuclear Criticality Specialist.

The Radiation Work Permit provisions of Section 3.1.2 were revised to clarify that RWPs are also used for short term non-routine activities for which an operating sheet or special evaluation traveler is not required. Controls of such RWPs are specified.

In Section 3.2.2, the commitment for changing filters and prefilters was reworded.

In Section 3.2.5, the action level for external exposure is specified.

The wording of the last sentence in Section 3.2.9 was revised.

Changes to Chapter 4, Nuclear Criticality Safety, are summarized below:

1. In Section 4.2.1.1 and 4.2.1.2, statements were added that a conservative process density will be used in criticality calculations, and a conservative operating margin of safety will be achieved.

2. Items (i) through (l) were added in Section 4.2.1.3 to specify additional criteria.

3. Former item (f), concerning the dissolver vessels, was deleted from Section 4.2.2; subsequent items were renumbered. New items (u) through (w) were added.

4. New Section 4.2.5 was added to specify the criticality control variables for plant processes. This Section refers to the new Tables 4-4 and 4-5, which list the control variables and Safe Individual Unit plant processes.

Table 5-1 of Chapter 5, concerning the environmental monitoring program, was revised to add the first recommendation of the Environmental Assessment.

In Section 12.2, the action level for lung burden is revised to be 80% of the ALI.

The heading of the table of Section 12.12.1 was revised.

In Section 12.12.2, a paragraph was added concerning the new 10 CFR 20 limits and recent operator exposure data.

In Section 13.3, a statement was added regarding sending copies of NPEDS monitoring reports to the NRC. This is in response to the second recommendation of the Environmental Assessment.

The following changes are provided to Chapter 15:

1. In the Nuclear Safety portion of Section 15.2.2.1, the criticality analysis of the UF_6 vaporizer was substantially revised.

2. In Section 15.2.2.2, the Description and the Nuclear Safety sections were expanded to describe the off-gas filtration system in more detail.

3. In Section 15.2.3, the Nuclear Safety description of the receivers was expanded to provide additional detail.

4. In Sections 15.7.2.6 and 15.7.4.3, the Nuclear Safety descriptions with respect to the hold and evaporation tanks were expanded to provide additional detail.

Enclosure II to
ML-94-019

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE RENEWAL APPLICATION

LIST OF EFFECTIVE PAGES

April 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 1-4	0	3/21/94
1-5	0	4/20/94
1-6	0	3/21/94
1-7	0	4/20/94
Chapter 2		
2-1 through 2-15	0	4/20/94

Pages	Revision	Date
Chapter 3		
3-1	0	3/21/94
3-2	0	4/20/94
3-3	0	4/20/94
3-4 through 3-7	0	3/21/94
3-8	0	4/20/94
3-9 through 3-10	0	3/21/94
3-11	0	4/20/94
3-12 through 3-13	0	3/21/94

Pages	Revision	Date
Chapter 4		
4-1 through 4-6	0	1/28/94
4-7 through 4-10	0	4/20/94
4-10a	0	4/20/94
4-11 through 4-18	0	1/28/94
4-19 through 4-23	0	4/20/94
4-23a	0	4/20/94
4-24 through 4-26	0	1/28/94
4-27 through 4-28	0	4/20/94
Chapter 5		
5-1 through 5-3	0	1/14/94
5-4	0	4/20/94
Chapter 6		
6-1 through 6-3	0	10/29/93
Chapter 7		
7-1	0	1/14/94

Pages	Revision	Date
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 11-28	0	4/20/94
11-29 through 11-33	0	3/21/94
11-34	0	4/20/94

Pages	Revision	Date
Chapter 12		
12-1 through 12-4	0	3/21/94
12-5	0	4/20/94
12-6 through 12-12	0	3/21/94
12-13 through 12-15	0	4/20/94
12-16 through 12-17	0	3/21/94
Chapter 13		
13-1	0	3/21/94
13-2	0	4/20/94
13-3 through 13-25	0	3/21/94
Chapter 14		
14-1 through 14-97	0	1/28/94

Pages	Revision	Date
Chapter 15		
15-1 through 15-12	0	1/14/94
15-13	0	4/20/94
15-13a	0	4/20/94
15-14	0	4/20/94
15-15	0	4/20/94
15-16 through 15-19	0	1/14/94
15-20	0	4/20/94
15-20a	0	4/20/94
15-21 through 15-23	0	1/14/94
15-24	0	4/20/94
15-24a	0	4/20/94
15-25 through 15-269	0	1/14/94
15-270	0	4/20/94
15-270a	0	4/20/94
15-271 through 15-292	0	1/14/94
15-293	0	4/20/94
15-294 through 15-299	0	1/14/94
15-300	0	4/20/94
15-301 through 15-309	0	1/14/94

Enclosure III to
ML-94-019

COMBUSTION ENGINEERING, INC.

HEMATITE NUCLEAR FUEL MANUFACTURING FACILITY

LICENSE RENEWAL APPLICATION

AFFECTED PAGES

April 1994

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 of calcium fluoride (spent limestone) from the conversion process dry scrubbers for use as fill materials on site, providing the average total uranium alpha activity is less than 30 picoCuries per gram. Spent limestone with an average activity greater than 30 picoCuries per gram shall be dispositioned as low level radioactive waste. The procedure for sampling spent limestone as it is unloaded from the scrubbers shall be consistent with that described in CE letter dated August 9, 1991.

(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, as modified with respect to fire safety per "Guidance on Fire Protection for Fuel Cycle Facilities", Federal Register, August 10, 1992. 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 Vice President, Fuel Operations has complete responsibility for ensuring that corporate operations related to nuclear fuel manufacturing are conducted safely and in compliance with applicable regulations. The Vice President has delegated the safety and compliance responsibility for nuclear fuel manufacturing to the three Focused Factory Managers, and the Managers of Production Support and Regulatory Compliance.

2.1.1 Focused Factory Managers

The Focused Factory Managers, report to the Vice President, Fuel Operations. There are three Focused Factories, whose Managers are responsible for Chemical Operations, Ceramic Operations and Assembly Operations. These Focused Factory Managers direct production operations. Each Manager directs and has the overall responsibility for safe operation of the Hematite facility, especially in the factory under his cognizance. This includes criticality safety, radiological and industrial safety, environmental protection, production, accountability, security, transportation, training, materials handling and storage, process and equipment engineering and maintenance.

2.1.2 Manager, Production Support

The Manager, Production Support reports to the Vice President, Fuel Operations. He provides production support to the Focused Factory Managers. Responsibilities may include, but are not limited to, administration of security, shipping and receiving, packaging and shipment of SNM products and waste, facilities engineering and maintenance, and laboratory services. He has the responsibility to assure safe operation of the Hematite facility, especially in the plant areas under his cognizance. This includes criticality safety, radiological and industrial safety, environmental protection, production, accountability, security, transportation, training, materials handling and storage, process and equipment engineering and maintenance.

2.1.3 Manager, Regulatory Compliance

The Manager, Regulatory Compliance reports to the Vice President, Fuel Operations. 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, auditing of plant operations. 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 Regulatory Compliance, a Focused Factory Manager, or a duly authorized alternate.

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 appropriate Focused Factory Manager and the Manager, Regulatory Compliance for action.

The Committee Chairman 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 Vice President, Fuel Operations. The Committee Chairman appoints the committee members to represent, as a minimum, engineering, production, health physics, and criticality safety. He or she may also approve alternate(s) for the members.

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

2.4 Approval Authority for Personnel Selection

Personnel for safety-related staff positions are approved by the next level of management or higher.

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 under the direction of 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 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 mincr 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 cognizant Focused Factory 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 Focused Factory Managers 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, Fuel Operations. Annual audits are performed by a team appointed by the Vice President, Fuel 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	Focused Factory Managers	Bachelors, Science, Engineering or Manufacturing	5/Nuclear manufacturing industry
2.1.2	Manager, Production Support	Bachelors, Science, Engineering or Manufacturing	2/Facilities Management
2.1.3	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
2.1.4	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 Engineering, or Manufacturing	5/Nuclear manufacturing industry

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 short term non-routine activities which do not require an OS or SET may be controlled by a Radiation Work Permit (RWP) approved by Regulatory Compliance management. 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. Such RWPs specify applicable radiological controls for the activity, such as special radiological equipment, special personnel monitoring devices, protective clothing or air sampling requirements. RWPs which remain open for more than a month are reviewed on a monthly basis and are closed if no longer needed.

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 will be 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.

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. The action level for investigation and possible work restrictions shall be 1 rem for deep dose equivalent (DDE) on an annual basis.

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.

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 breathing zone air sampling 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.

Parameter	Safety Margin
Mass	2.3
Volume	1.3
Slab Thickness	1.2
Cylinder Diameter	1.1

For SIUs determined from calculated data, the calculations shall be performed using validated computer analysis methods. In this case, the subcritical (safe) limit values shall be calculated consistent with paragraph 4.2.3.3 (a). A conservative process density shall be used.

The resulting units of SNM are Safe Individual Units when isolated from other units by distance or shielding (see Section 4.2.2).

4.2.1.2 Subcritical Units (Subcrits)

Other subcritical units may use multiparameter controls to achieve criticality safety. The controlled parameters may include, for example, U-235 mass limit or concentration, container volume, limits on internal and/or external moderator, etc.

The configuration and composition of these subcritical units may depend upon the process involved. Criticality safety is assured through defined limits and controls. These limits and controls may include allowed individual SNM unit geometries which are less conservative than safe geometry, defined configurations of individual SNM units in a given process layout, engineered safeguards where necessary, and administrative controls in the form of written and approved instructions sheets and postings.

Uranium concentration control safe units shall be limited to a maximum of 25 grams of uranium per liter. The effect of evaporation and/or precipitation shall be considered in the nuclear safety analysis, such that if precipitated a safe mass will not be exceeded. Concentration controlled safe units shall not be considered to contribute to interacting arrays, but shall be located outside exclusion areas assigned by the surface density method.

4.2.1.3 Criteria

(a) The possibility of accumulation of fissile materials in not readily accessible locations shall be minimized through equipment design or administrative controls or included in the nuclear safety evaluation of the process.

(b) Nuclear safety evaluations shall include credible sources of internal moderation.

(c) Criticality safety evaluations shall consider the neutron reflection properties of the environment as well as the heterogeneity of the fissile material within the subcrit on the effective multiplication factor. A conservative process density shall be used.

(d) Nuclear criticality safety margins shall include consideration of credible accident conditions consistent with the double contingency criterion. Safety margins for SIUs are defined in 4.2.1.1. For subcrits defined in 4.2.1.2, the highest effective multiplication factor, under normal or abnormal credible operating conditions, shall be less than 0.95 including a two-sigma statistical calculational uncertainty as well as any other applicable uncertainties and biases. A conservative operating margin of safety shall be achieved when K_{eff} calculations are utilized to demonstrate safety.

(e) Reactivity hold-down by other than fixed poisons shall not be employed in criticality evaluations. Borosilicate Glass Raschig Rings may be employed in solutions of fissile material in a manner consistent with ANSI/ANS 8.5-1986. The effect of structural parasitics, either normal or enhanced, shall be evaluated in a manner which examines both elastic and inelastic scattering contributions to the multiplication factor. Use of enhanced structural parasitics, e.g., boron stainless steel, shall be contingent upon a program to periodically verify the presence of the parasitic additive.

(f) Whenever nuclear criticality safety is directly dependent on the integrity of a fixture, container, storage rack or other structure, design shall include consideration of structural integrity. The fulfillment of structural integrity requirements shall be established by physical test or by analysis by an engineer knowledgeable in structural design.

(g) Computer analysis methods shall be validated in accordance with the criteria of Section 4.2.3.2 and Regulatory Guide 3.4, Revision 2, dated March 1986, "Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities". The highest effective multiplication factor derived by the validated analytical methods for credible operating conditions shall be less than or equal to 0.95 including applicable biases and calculational uncertainties.

(h) The analytical method(s) used for the safety evaluation of SIUs and the source of validation of the methods shall be specified.

(i) Mass control is administered by using a calibrated mass measurement instrument.

(j) Volume control is administered the following methods:

1) geometric devices to restrict the volume; or
2) engineered devices or instrumentation to limit the accumulation of SNM.

(k) Moderation control is administered by the following methods to restrict or measure moderation:

1) instrumentation;
2) physical structure; or
3) a sampling program.

(1) When geometry control or less than full neutron reflection is utilized as a means of fulfilling the double contingency principle, assurance of criticality safety shall be provided through a demonstration that:

1) if bulging or an increase in neutron reflection is credible, at least one other failure is required before a criticality is credible; or

2) it is not credible that a geometric bulge or a change in neutron reflection will result in a criticality.

4.2.2 <u>Multiple Units and Arrays</u>

Criticality safety of the less complex manufacturing operations may be based on the use of limiting parameters which are applied to simple geometries. This approach employs safe units which assume optimum moderation and full reflection using published criticality data. Safe units may be arrayed using the surface density method. An alternate empirical method is the Solid Angle Method.

A more rigorous method is based on two dimensional transport and/or three dimensional Monte Carlo methods. These methods permit the evaluation of more complex geometric configurations of SNM and the evaluation of multiparameter control methods.

cooler in the oxide building will be set to alarm at a dew point no higher than 15 °C and checked on a 6 month period. Upon alarm, automatic or manual action stops the process. The source of alarm must be investigated and the problem corrected before the process can be continued.

(c) The R-2 steam line will have two (redundant) fail-safe shut-off valves, each activated by two independent high and low temperature alarm setpoints on the R-2 reactor. The operability of this system will be ascertained at least once every 6 months.

(d) The moisture content of the UO_2 powder transferred into the bulk storage hoppers and the recycle storage hoppers will be verified as being ≤ 1 w/o. The instruments used for measuring moisture in UO_2 shall be calibrated on a 6 month interval. Loading and unloading of hoppers shall be done with hoods that prevent water ingress.

(e) The R-1, R-2 and R-3 inlet pressure switches will be calibrated at least once every 6 months.

(f) Dual independent verifications of moisture content in UO_2 shall be made prior to transfer of material into the bulk storage hoppers or into the blenders in Buildings 254 or 255.

(g) All moderation controlled containers shall be covered such that no moderator can enter the container when external to protective hoods.

(h) The number of 5 gallon or less containers allowed on the second and third floors of Building 254 shall be limited as follows: lubricant and/or poreformer, 12 on each floor; UO_2 powder, 24 spaced on 2 foot centers on each floor. Additionally, the second and third floors of Building 254 shall be limited on each floor to a maximum of 10 gallons total of water, cleaning solutions, paints and powder moderators (exclusive of lubricant and poreformer) when the poreformer or lubricant mixing operations have material in process.

(i) UO_2 powder charges added to each poreformer mixer in Building 254 shall not exceed 4.4 Kg U-235.

(j) Fissile aqueous solution transfers from safe to unsafe geometry vessels in the wet recovery system shall have at least two independent methods for control of the fissile content of the solution prior to release of the solution to the unsafe geometry vessel; solution transfers shall be limited such that the unsafe vessels never contain more than a fraction of the calculated critical mass. Physical barriers in piping systems shall exist to prevent the inadvertent transfer of fissile aqueous solutions to unsafe geometry vessels.

(k) Process systems shall be designed to minimize the likelihood for accumulation of fissile material within the system. In addition, process procedures shall have provisions for verifying that fissile material has not accumulated within the system, especially in those systems employing unsafe geometry containers.

(l) Measurement controls shall be used whenever geometry controls are not used to ensure criticality safety. Such measurement controls include both weight controls and moisture controls. Instrumentation used to measure parameters as part of such measurement controls is maintained as part of the calibration program or instrumentation qualification program.

(m) Pellets and pellet scrap transferred in quantities greater than a safe mass between Building 230 and non-contiguous buildings shall be transported within a container that maintains a safe slab geometry.

(n) Storage of sintered pellets in the Kardex storage device shall be limited to Kardex storage pans with a maximum of 70 Kgs of UO_2 in each pan. There shall be a minimum of two physical water barriers over Kardex pans to prevent the ingress of water. No more than 4 pounds of moderating media are allowed in each shelf in the Kardex storage device.

(o) Criticality safety evaluations for ventilated hoods may be based on either the limits of Table 4-1, Part B, or have specific safety evaluations. For hoods employing more than one limit, but based on Table 4-1, Part B, mechanical devices shall be employed to ensure that the required minimum separation distance between SNM containers in accordance with Section 4.2.2.1 is maintained.

(p) The rod box storage matrix shall be limited to 112 rod storage boxes and prestack boxes. There shall be a minimum of two physical water barriers over the rod storage boxes and prestack boxes to prevent the ingress of water. No unnecessary moderating material shall be stored within the rod box storage matrix. The limit shall be 20 pounds of moderating material in and around each storage location, of which no more than 5 pounds shall be stored in the fuel rod array. For the prestack boxes, the 20 pounds moderating material limit is in addition to the polyethylene spacers, which shall be a maximum number of 13 in each prestack box and shall be nominally one inch thick. The horizontal spacing between stored boxes shall be at least 3 inches. The vertical pitch of the stored boxes shall be at least 17 inches. The space between the bottom of the bottom box and the concrete floor shall be at least 15 inches. The horizontal spacing between adjacent storage boxes between matrix modules shall be at least 9 inches.

(q) Fuel assemblies, when wrapped and stored in the Fuel Assembly Storage Area shall have the bottom end open to ensure drainage of water.

A minimum spacing of 9.75 inches center to center shall be maintained between fuel assemblies within a row. A minimum center to center distance of 35.0 inches shall be maintained between rows of fuel assemblies within the double row racks. A minimum center to center distance of 37.0 inches shall be maintained between double row racks. The Fuel Assembly Storage Area shall be limited to a maximum of 320 14 x 14 and/or 16 x 16 fuel assemblies, unless otherwise analyzed.

(r) For isolated fuel assemblies, the fuel assembly rod array dimensions shall be limited to a maximum of 8.048" x 8.048", independent of the number of rods and independent of pellet diameter, for pellet diameters less than or equal to 0.40" and greater than or equal to 0.3224". Fuel assembly designs outside this envelope shall require a criticality safety evaluation to ensure the assembly and storage processes have adequate subcriticality margin.

(s) Fuel assembly shipping containers other than the 927A1 and 927C1 containers, shall be stored in an array size not exceeding a total transportation index (TI) of one hundred. The spacing between arrays of these loaded containers and other types of loaded shipping containers shall be at least twelve feet.

(t) The 927A1 and 927C1 shipping container arrays shall be stored within the security fence, in Building 230 or in the parking lot south of Building 230. The loaded 927A1 and 927C1 shipping containers shall be stored no more than three high. There are no container orientation restrictions in the horizontal plane.

(u) The volume of UO_2F_2 solution in the vaporizer chest following a UF_6 leak and continuing steam flow into the chest is controlled by a conductivity cell and level monitor which shut off steam flow into the vaporizer.

(v) Receivers No. 1 and No. 2 shall each have a barrier to ensure that no significant moderating material can be brought within 1 foot of the vessel surface.

(w) The reactor gas filtration system shall have a barrier to ensure that no significant moderating material can be brought within 1 foot of the vessel surface.

4.2.5 Criticality Control Variables for Plant Processes

Table 4-4 lists the criticality control variables for various major plant processes. Table 4-5 lists major plant processes which are controlled as Safe Individual Units (SIUs).

Table 4-4

Criticality Control Variables for Plant Processes

Plant Process	Control Variable
UF_6 Vaporizer	Volume - Note 1
Reactors R1 and R3	Geometry and Partial Reflection - Note 2
Reactor R2	Note 1
Reactor Offgas Filteration	Geometry and Partial Reflection - Note 2
Receivers No. 1 and No. 2	Geometry and Partial Reflection - Note 2
Bulk Storage and Recycle Hoppers	Moderation
Micronizer and Blender	Moderation
Buildings 254 and 255 Oxidation/Reduction Furnaces	Geometry
Slugging, Granulation and Pressing	Batch and Moderation
SNM Shipment Offsite and Receipt Onsite	Per Shipping Container Certificate of Compliance
Kardex Storage	Moderation - Note 1
Rod Box Storage Matrix	Moderation - Note 1
Fuel Assembly Rack Storage	Geometry - Note 1
UO_4 Dryer Assembly	Geometry

Notes
1. See also Special Controls, Section 4.2.4.
2. See also the Design Critera associated with Partial Reflection, Section 4.2.1.3(c).

Table 4-5

SIU Controlled Plant Processes

UF_6 Scrubber
UO_2 Cooler - Oxide Building
UO_2 Cooler Discharge Hopper - Oxide Building
Pellet Press Oil Sump
Pellet Handling in Buildings 254 and 255
Grinder Sludge Centrifuge
Pellet Grinding Sump
UF_6 Heal Removal
Incinerator
Oxide Building Trench and Sump
Vacuum Cleaners
Mop Buckets
Building 240 Oxidation/Reduction Furnaces
Filter Presses
Dissolution Vessels
UO_4 Precipitation Tank
UO_4 Centrifuge
Hold and Evaporation Tank Complex
ADU Precipitation Tank
Steam Cooker
Analytical Laboratory

Table 5-1
Environmental Monitoring Program

Sample Medium	Sampling Points	Collection & Analysis Frequency	Sample Type	Type of Analysis	Action Level	Table No. - Note (4)
Operational Effluents Monitoring Program:						
Air Effluent	Exhaust Stacks	Continuous & Analyze Weekly	Particulate	Note (1)	5×10^{-14} µC/ml - Note (2)	13-1
Air Effluent	Conversion Offgas Stack	Continuous & Analyze Weekly	Gaseous & Particulate	Note (1)		13-17 - Note (5)
Liquid Effluent	Site Dam	Continuous & Analyze Weekly	Composite	Note (1)	3×10^{-7} µC/ml - Note (3)	13-3, 13-18
	Sewage Treatment Outfall	Weekly	Grab	Note (1)	3×10^{-7} µC/ml - Note (3)	13-14
Operational Environmental Monitoring Program						
Air	3 On-site Remote	Continuous & Analyze Weekly	Particulate	Note (1)		13-2
Surface Water	Joachim Creek Above & Below Site Creek Outfall	Monthly	Grab	Note (1)		13-4, 13-5
	Joachim & Site Creek Confluence	Quarterly	Grab	Note (1)		13-6
Ground Water	Plant Well	Monthly	Grab	Note (1)		13-10
	Offsite Well (Hematite)	Quarterly	Grab	Note (1)		13-6
	3 Monitoring Wells For Evaporation Ponds	Monthly	Grab	Note (1)		13-7, 13-8, 13-9
	South Vault Sample Monitoring Well	Monthly	Grab	Note (1)		13-11
	4 Burial Ground Monitoring Wells	Monthly	Grab	Note (1)		13-12, 13-13
Soil	4 Locations Surrounding Plant	Quarterly	Grab	Note (1)		13-15
Vegetation	4 Locations Surrounding Plant	Quarterly	Grab	Note (1)		13-16, 13-19
Sediment	Site Creek Below Site Dam	Annual	Grab	Note (1)		

Notes:
(1) One or more of the analysis types given in Section 5.1.3.
(2) Action Level applies in the accessible unrestricted areas.
(3) Action Level is average at the site boundary.
(4) This column correlates sample points with data tables in Chapter 13 - "for information only."
(5) Monitoring results for this stack are included in Table 13-1 as "Total Microcuries" released for all stacks.

CHAPTER 11 ORGANIZATION AND PERSONNEL

11.1 Organizational Responsibilities

Section 2.1 describes the key positions important to safety and the line of authority to top management. Section 2.2 lists the education and training requirements for those positions. For all positions and functions, it is assumed that education and training requiements may be met specifically or with equivalent credentials.

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 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.

11.1.2 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.

11.1.3 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.

11.1.4 Superintendent, Facilities Services

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

11.1.5 Supervisor, Laboratory

The Laboratory Supervisor reports to the Manager, Production Support. 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.

11.1.6 Supervisor, Maintenance

The Supervisor, Maintenance reports to the Superintendent, Facilities Services. 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 with the knowledge of his/her superior.

11.3 Education and Experience of Key Personnel

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

S. G. Borell - Manager, Chemical Operations

G. F. Palmer - Manager, Ceramic Operations

G. J. Page - Manager, Assembly Operations

D. Stokes - Manager, Production Support

R. W. Sharkey - Manager, Regulatory Compliance

M. R. Eastburn - Nuclear Criticality Specialist

open - Health Physicist

E. W. Criddle - Supervisor, Health Physics

STEN G. BORELL - MANAGER CHEMICAL OPERATIONS

EDUCATION

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

EXPERIENCE

ABB COMBUSTION ENGINEERING NUCLEAR FUEL

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-Destructi - 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.

STEN G. BORELL (continued)

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

<u>Development Engineer, Reactor Systems</u> 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.

GEORGE F. PALMER (continued)

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.

<u>Process Engineer - New Haven & Hematite</u> 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.

GILLES J. PAGE, P.E. - ASSEMBLY OPERATIONS MANAGER

EDUCATION:

M.S., Mechanical Engineering, Rensselar Polytecnic Institute, 1985
B.S., Mechanical Engineering, University of Hartford, 1982
A.S., Mechanical Engineering, Waterbury State Technical College, 1975

EXPERIENCE:

COMBUSTION ENGINEERING, INC.
Manager, Assembly Operations - Hematite 1994 to Present

Responsible for all nuclear fuel manufacturing activities in the Assembly Operations Focused Factory. Manages Process Engineering, Planning, Budget, and Quality Control. Responsible for safe operation of the Assembly Operations facility, including criticality safety, radiological and industrial safety, environmental protection, production, accountability, security, transportation, training, materials handling and storage, process and equipment engineering and maintenance.

Manager, Grid and Cage Factory - Windsor 1993 - 1994

Responsible for all manufacturing activities within the Grid and Cage Factory.

Manager, Component Factory - Windsor 1992 - 1993

Responsible for all manufacturing activities within the Component Factory.

Principal Engineer 1985 - 1992

Responsible for process equipment, projects, selection, design and installation of new equipment within the Nuclear Fuel Facility.

UNIROYAL, INC.

Development Engineer, Corporate Research 1982 - 1985

Developed a radically new and improved puncture sealant process for factory introduction in 1986 which resulted in substantial profits - patent issued. Developed an automatic lubrication spray system for radial tire building which resulted in the ability to use bias tire equipment to produce radial tires. This system is now in operation in tire plants. Co-inventor of new non-pneumatic tire with projected earnings in multi-million dollar range - patent issued.

Research Technician, Corporate Research 1975 - 1982

Responsible for operation of tire test facility. Duties included failure analysis, evaluation of material, coordination of new equipment installation and design of test fixtures.

OTHER QUALIFICATIONS:

Registered Professional Engineer, State of Connecticut, No. 15868

DAVID W. STOKES - MANAGER, PRODUCTION SUPPORT

EDUCATION:

B. S., Metallurgical Engineering, Grove City College

Graduate MBA Studies, Plymouth State College (Division of University of New Hampshire)

ASQC Certified Quality Engineer; No. E-6808

Seminars and courses in statistics, Taguchi Methods and TQM

EXPERIENCE:

COMBUSTION ENGINEERING, INC.

Manager, Production Support - Hematite 1994 - Present

Responsible for administration of security, shipping and receiving, packaging and shipment of SNM products and waste, facilities engineering and maintenance, and laboratory services. He has the responsibility and authority to assure safe operation of the Hematite facility, including criticality safety, radiological and industrial safety, environmental protection, production, accountability, security, transportation, training, materials handling and storage, process and equipment engineering and maintenance.

Manager, Component Manufacturing Operations - Windsor 1993 - 1994

Responsible for all aspects of operation of the nuclear fuel manufacturing focused factory for Components.

DAVID W. STOKES (continued)

Manager, Process Improvement 1992 - 1993

Responsible for the process improvement operations of the nuclear fuel manufacturing facilities.

TEXTRON DEFENSE SYSTEMS

Manager, Quality Engineering Services 1987 to 1992

Product Assurance Program Manager 1986 to 1987

Manufacturer of electronic printed wiring, flex print component assemblies and cables, for Government Defense Programs in a MIL-Q-9858A environment. Managed Quality Engineering Services group. Applied Statistical Process Control (SPC), Computer Aided Design (CAD) and operator inspection techniques to improve quality and engineering efficiency. Taught Total Quality Management (TQM) Awareness, SPC and Analyzing Work Processes classes to division personnel. Lead team to assess the impact of MIL-STD-2000 on business, and then to implement this standard.

QUINLAN-STOKES, INC.

President 1985 to 1986

Business brokerage firm involved in mergers, acquisitions for individuals, investment groups and other businesses. Successfully started-up the operation and then developed and implemented marketing programs. Honed cost effective operations and efficiency skills.

DAVID W. STOKES (continued)

GENERAL BATTERY CORP.

Senior Quality Engineer (Corporate) 1982 to 1985

Leading manufacturer of lead-acid batteries for Consumer and Department of Defense markets. Served on corporate Quality staff. Successfully negotiated rewriting of DOD battery purchase specifications for M-1 and M-60 tanks to align them with current industry standards and practices. Coordinated new product qualification testing prior to market introduction and lead prototype project for production qualification of new plastic cased military battery.

GARDNER-DENVER COOPER INDUSTRIES

Manager, Quality Control 1980-1982

Senior Quality Engineer 1980

Commercial manufacturer of precision machined, hydraulic and pneumatic drill components and crawler rigs for the mining and construction industry. Managed plant quality assurance activities. Applied TQM basics and participated in development and implementation of a "Total Quality Program" for the division. Implemented formal quality planning processes including design reviews and value analysis of new products. Implemented process controls and effective procedures for capturing and reporting quality costs and implemented corrective action system.

ALLIS-CHALMERS, HYDROTURBINE DIVISION

Chief Inspector 1978 to 1980

Quality Engineer 1975 to 1978

Manufacturer of large fabricated and machined components for both commercial and government hydroelectric generation projects. Learned the basics of TQM through participation in the development of a "Total Quality Assurance" program to meet Allis-Chamlers certification requirements. Managed the division's inspection function, in a union environment. Successfully obtained sealed source license from the NRC and proceeded to cut NDT cost of heavy weldments.

ROBERT W. SHARKEY - MANAGER, REGULATORY COMPLIANCE

EDUCATION:

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

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.

ROBERT W. SHARKEY (continued)

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.

ROBERT W. SHARKEY (continued)

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

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.

MICHAEL R. EASTBURN (continued)

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

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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.

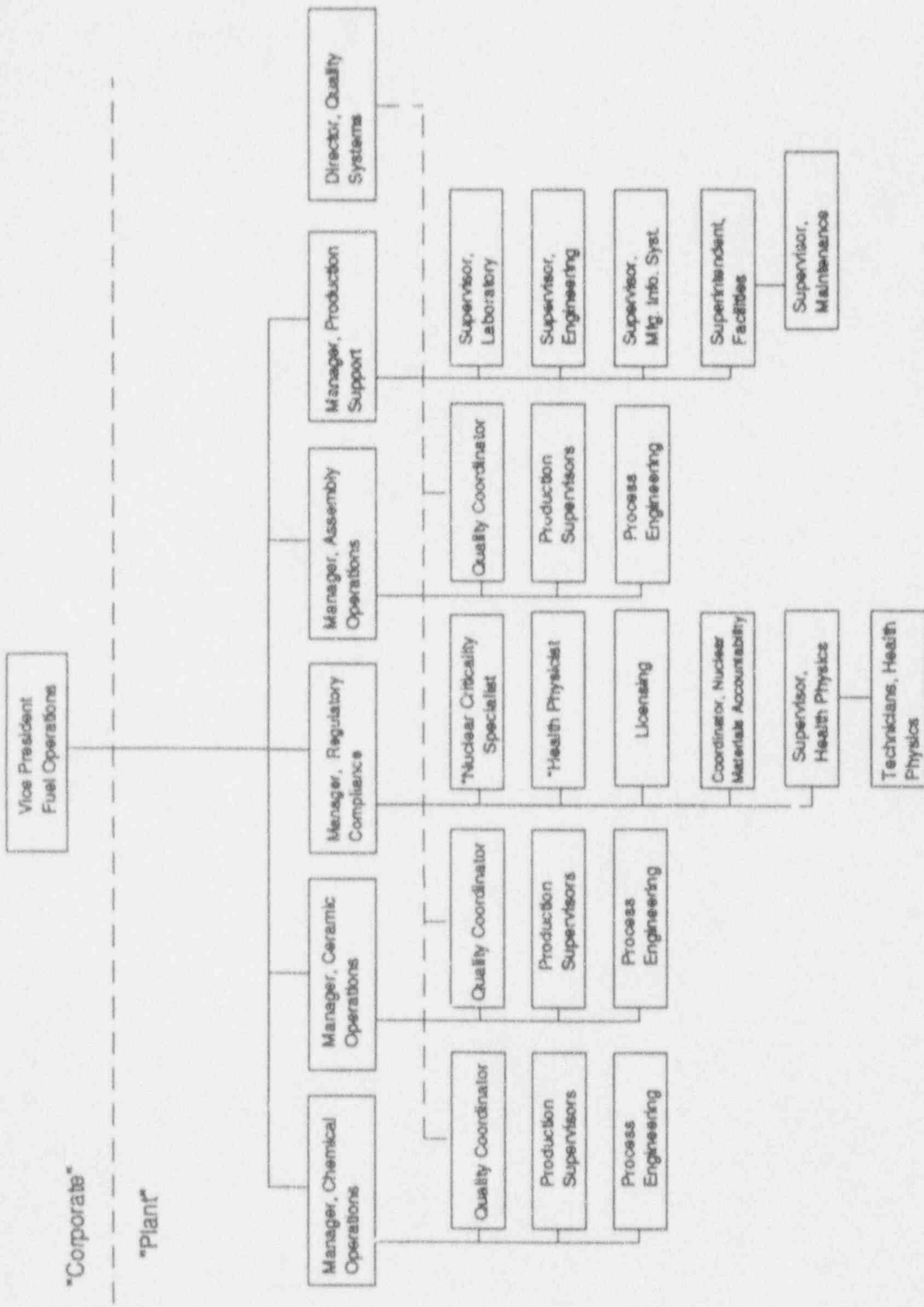
Health Physics Technician, 1988 to 1990

Responsible for radiological and industrial safety at Nuclear Fuel manufacturing - Hematite. Duties included 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.



*May be Windsor Based Support

Figure 11-1

Hematite Plant Organization Chart

A lung burden which indicates an intake of greater than 80% of the ALI 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.

12.12.1 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:

	Number 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.

The above data was based upon the 10 CFR 20 limits in effect prior to January 1, 1994, and does not take credit for particle size reductions. The newer limits are more restrictive. Measures taken to ensure operator exposure is within the new limits include additional operator training for radiological awareness, improvements in engineered controls such as ventilation and containment, process procedure and equipment improvements, improved housekeeping, and use of more efficient operator protective devices. The above steps have significantly reduced operator exposures. For example, operator exposures for the first quarter of 1994 were within the new limits. Investigation of causes of higher exposures and process, procedure, etc., changes continue as appropriate to minimize exposures.

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

Range (μg U-235)	Number 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: Average of Conc.	1990: Number of Operators	1991: Average of Conc.	1991: Number of Operators	1992: Average of Conc.	1992: 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.

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.

Copies of the National Pollution Elimination Discharge System (NPEDS) monitoring reports are sent to the Nuclear Regulatory Commission (NRC) for information. CE will inform the NRC if NPEDS permits are amended or revoked.

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
Table 13-2 Environmental Air Monitoring - Radioactivity
Table 13-3 Site Dam Overflow Monitoring - Radioactivity
Table 13-4 Joachim Creek Monitoring - Radioactivity, Upstream
Table 13-5 Joachim Creek Monitoring - Radioactivity, Downstream
Table 13-6 Quarterly Liquid Environmental Monitoring - Radioactivity
Table 13-7 Retention Pond North Sample Well Monitoring - Radioactivity
Table 13-8 Retention Pond South-East Sample Well Monitoring - Radioactivity
Table 13-9 Retention Pond South-West Sample Well Monitoring - Radioactivity
Table 13-10 Site Water Supply Well Monitoring - Radioactivity
Table 13-11 South Vault Sample Well Monitoring - Radioactivity
Table 13-12 Burial Ground Well Monitoring - Radioactivity
Table 13-13 Burial Ground Well Monitoring - Radioactivity
Table 13-14 Sewage Outfall Monitoring - Radioactivity
Table 13-15 Soil Monitoring - Radioactivity
Table 13-16 Vegetation Monitoring - Radioactivity
Table 13-17 Stack Monitoring - Fluoride
Table 13-18 Site Dam Overflow Monitoring - Fluoride
Table 13-19 Vegetation Monitoring - Fluoride

steam chamber. The steam flow is 7.9 pounds per hour. If one assumes that an infinite heat sink exists at the surface of the steam chamber, it would take approximately 5.6 days to precipitate a volume of water equivalent to the volume of the steam chamber. Any escaping UF_6 would react with moisture in the air, form a visible cloud, and activate a detector which would alarm at the control panel.

An analysis was performed where it was assumed the UF_6 gas mixed with the steam, forming a mixture of UO_2F_2 and H_2O in the steam chamber of the vaporizer. It was conservatively assumed that the valve on the condensate drain closed but the UF_6 scrubber failed to start and the steam flow continued.

In the analysis, the most adverse composition of the UO_2F_2 and water mixture was determined by performing various K-infinity calculations over a wide range of H/U ratios. The highest K-infinity value occurred for the mixture at an H/U ratio of 11.65. It should be noted that during the reaction of UF_6 with H_2O, HF is created. However, when the contribution of HF is considered, the K-infinity decreases because the presence of HF is at the expense of the UO_2F_2.

The system was analyzed as a function of the UO_2F_2 and water mixture height in the steam chamber. The system was modelled in three dimensional space using the generalized option of the KENO-IV Monte Carlo code. All necessary aspects of the system were considered in the model, including the front and rear curvature of the UF_6 cylinder and the protective skirt surrounding it. Since the UF_6 cylinder is situated at a 12 degree angle relative to the floor (the front of the cylinder is higher than the back), a variable plane was incorporated into the model at the same angle to represent the different levels of the UO_2F_2-water mixture in the system. The result of the analysis is an eigenvalue of 0.93648 ± 0.00306 when the mixture reaches a height of 10 inches from the bottom of the front of the vaporizer. Based upon the steam flow rate of 7.9 lb/hr, and assuming that an infinite heat sink exists at the surface of the steam chamber, it would take approximately 70 hours for the mixture to build up to the 10 inch height.

The steam chamber has drains to prevent the accumulation of condensate. The chamber is not pressurized, consequently the amount of moderation present during normal operation is insignificant (approximately 0.04 pounds/ft^3) compared to full density water.

The 9.75 inch diameter hold tank on the wet scrubber is a safe geometry for UO_2F_2 (see Table 14-1).

Although the baffled separator has a total volume of 51 liters, it cannot be filled with scrubber liquor because of: (1) the drain to the hold tank, and (2) the 6 inch diameter duct on the side of the separator venting the gases to the atmosphere. Even if it were filled, the material in the baffled separator would be UO_2F_2, for which the critical volume is 68.5 liters for an optimally moderated unreflected system.

The 8A cylinder employed in the Cold Trap System is a safe cylinder for up to 115.67 Kg UF_6 net weight with a maximum enrichment of 12.5 wt% U-235.

15.2.2.2 UF_6 to UO_2 Reactors

Description - The UF_6 to UO_2 conversion is accomplished within the high temperature environments of the three series connected reactors: R-1, R-2, and R-3. These reactors are illustrated in the schematic flow diagram of the UF_6 conversion process shown in Figure 15.2-1 and in the elevation sketch, Figure 15.2-2.

The R-2 vessel and furnace are shown in cross section in Figure 15.2-3. For comparison, the upper end configuration of vessels R-1 and R-3 are shown in dotted lines. The active (reactor) region of all three vessels is the same diameter (10 inch) as is the primary disengaging region (12 inch diameter); only R-2 has a secondary (16 inch) disengaging region.

All three vessels are fitted with electrically heated furnaces. R-1 and R-3 have two independently controlled sections and R-2 has three independently controlled sections.

Off-gases from the conversion process are routed to filtration systems to remove UO_2 carryover and then to dry scrubbers packed with limestone to remove hydrogen fluoride. The off-gas filtration systems have an inside diameter of 10 inches. The outer casing, which encloses the vessel, the heating elements and the 5 inch thick ceramic fiber insulation (the insulation density is 10 pounds per cubic foot), is 28 inches in diameter. This structure limits the reflection of the SNM interior to the vessel.

All material transfers from one vessel to another are through piping having a diameter of less than 2 inches.

Safety Features - Steam is supplied to the three reactors from the main steam header in the plant. The reactor steam supply includes a two part condensate removal system. The first part of the condensate removal system for the reactors is a sintered metal filter in a pressure vessel with a bottom drain for condensate. The separated condensate is automatically removed by a steam trap.

The steam pipe after the filter has another steam trap in a low location just before the point where the steam pressure regulating valves for all reactors are connected. Each reactor has a block and bleed shut-off arrangement with two automated shut-off valves in series, and an automated bleed valve in between.

In addition, the R2 reactor has another condensate separator with automatic condensate removal located between the pressure reducing valve and the block and bleed valve assembly.

Only the reactors and directly related equipment are connected to the above-described part of the steam piping, to avoid back-feeding condensate to the reactors.

The same postulated overfill conditions in R-2 would result in a critical multiplication factor for this reactor in isolation because of the 16 inch disengaging section in addition to the 12 inch disengaging section as on R-3. Consequently, a redundant low temperature alarm setpoint and steam shut-off valve are added to the engineered safeguards to provide added assurance that the overfill condition could not occur on R-2.

With respect to the off-gas filtration systems, even if the filter vessel was filled with optimally moderated UO_2 and fully reflected, it would still not be critical. It is important, however, that the geometry of the vessel not change during operation. During normal and abnormal operation the vessel pressure can be no more than 18 psi, as limited by a rupture disc in the reactor. The nitrogen filter blow back pressure is limited to 36 psi; however, the filtration system does not ever actually reach this pressure since the system is open to the reactor and the HF scrubber system. The filter vessel walls range in thickness from 0.365 to 0.375 inches. Even at operating temperture, the vessel yield pressure would be in excess of 500 psi (ie., the vessel is very conservatively over-designed). Therefore, it is deemed not credible that the diameter of the filter vessels would, under normal and abnormal conditions, bulge to an increased diameter.

15.2.2.3 UO_2 Cooler

Description - The UO_2 cooler is a water cooled heat exchanger for reducing the temperature of the dry UO_2 granules exiting R-3 via the inline R-3 discharge hopper. The cooler has a water cooled jacket and a water cooled screw drive mechanism. The screw drive is activated by a temperature sensor in the cooler discharge hopper; if the temperature of the UO_2 in the hopper becomes too high, the screw drive is turned off. There is a coolant flow monitor in the water discharge line that alarms in the control room for a loss of flow condition. The cooler discharge hopper contains a level control which has three functions: (1) to close the cooler hopper discharge pinch-valve when the level is too low, (2) to open the discharge valve when the level is too high, and (3) after a short time delay, to stop the screw drive if the hopper level remains too high.

Safety Features - UO_2 entering the cooler is normally at a temperature greater than 1000°F. Thus, as long as the mechanical integrity of the UO_2 region of the cooler is maintained, the moisture level of the UO_2 should remain well below 0.05 w/o H_2O. The cooler discharge hopper has a moisture measuring device to monitor the moisture content of the gas above the UO_2 level in the water. The unreflected data is used as it is not possible for people to get near the vessel because of physical constraints. The actual height of UO_2 in the upper portion of the receiver will be limited by the height of the transfer tube into the vessel. The typical amount of UO_2 transferred is 100 - 130 Kgs. In order to fill the receiver it would require about 6 transfers without removal.

A batchwise mode of operation is employed for filling Receiver No. 1. As each batch is transferred to this receiver, it is sampled for moisture content prior to transferring it to the bulk storage hopper. The nominal batch size is 100 - 130 Kg but they may vary up to approximately 160 Kg. Batch size amounts of UO_2 granules in the receiver can be conservatively approximated as a sphere and, for saturated UO_2 at a bulk UO_2 density of 3.0 g/cc, the mass of UO_2 must exceed 185 Kg before criticality is achieved (derived from Reference 2 of Chapter 14, Section 14.8). Since the 160 Kg batch size is only 86% of this quantity and system failures beyond cooler integrity must be postulated, the double contingency principle is satisfied.

The geometry of the cylindrical receivers is important in maintaining their safety, which is based upon maintaining their 14 inch inside diameter. As constructed, the vessels are capable of withstanding a pressure of over 500 psi. During operation, the pressure can vary from negative pressure to an abnormal maximum of 100 psi. The negative pressure occurs during vacuum transfer of the UO_2 into the vessel, and the positive pressure occurs during blow back of the sock filters. The peak pressure of the blow back air is 100 psi, however, the actual pressure in the receiver is well below this pressure. In light of the conservative over-design of the vessels, it is deemed not credible that the vessel diameter will change under any normal or abnormal conditions.

Since the receiver vessels and reactor vessels are in the same room, interactions between the vessels can occur. Section 5.2.4.2 contains an evaluation of interactions, including consideration of an overfilled condition of the reactors, receivers and piping. Under normal operating conditions, the multiplication factor for the reactors is less than 0.30.

The gas firing system is provided with standard fire safety controls. Both burners have thermocouple controlled valves which close in the event the flame goes out. The valves will not open if the pilot light is out. Gas supply is cut off automatically if there is an electric power failure. The incinerator room has cinder block walls and a fire door for entrance to Building 253.

There are no liquid or particulate discharges to the environs from the system. The used scrubber solution is evaporated to recover the solids contents.

Nuclear Safety - As noted above, a continuous inventory process is utilized to monitor the number of charges (≤800 g U-235) incinerated in a given incineration campaign. An incineration campaign is terminated either by input grams U-235 (≤ 800) or when the ash is removed. When all material dispositioned for incineration is incinerated, the incinerator is cleaned. Thus, the operation of the incinerator is predicated on a very conservative operational limit of 800 g U-235, or less.

The operating temperture of the incinerator prevents any significant accumulation of moderating material within the incinerator. Following shutdown for removal of the ash, due to ash accumulation or reaching the 800 gram U-235 limit, the introduction of water into the furnace is prevented by the roof and the incinerator superstructure; fire hoses are not permitted in the area. Therefore, the control of mass and moderator ensures the double contingency requirements are met.

15.7.1.3 Sock and Reactor Metal Filter Cleaning

Description - Most sock filters are cleaned in-place by pulsed air blowback; these filters are periodically inspected for integrity and replaced, when necessary. Failed sock filters are cleaned in a hood and dispositioned for incineration.

Metal filters in the backup filter system of the R-2 and R-3 reactors undergo a cleaning in place by a process which diverts the particulate matter to a safe volume hopper. The removed material is dispositioned to a recycle

Nuclear Safety - The hold and evaporation tanks in the outside complex are not safe volumes and are not poisoned. Consequently, special administrative controls are implemented for the use of these tanks. The amount of uranium is measured for each batch of material that is placed in the filtrate tanks. The amount of uranium is again measured before it is released to the hold and evaporation tanks. A continuous inventory is maintained for the hold tank and the two evaporator tanks that are interconnected. (Note that a third evaporator tank is in the complex but this tank is not interconnected with other tanks and has a 1 KgU mass limit; see Section 15.7.4.2). The hold tank and the two evaporator tanks that are interconnected have a uranium mass limit of 13.1 KgU. The total complex has a mass limit of 14.1 KgU or one safe mass based on 5 w/o enriched UO_2. All transfers to the complex and within the complex must be authorized by a supervisor.

As noted in Section 15.7.2.5, the filtrate from the UO_4 centrifuge is filtered to remove any insoluble materials and then is directed to the poisoned filtrate hold tanks. Also, the uranium concentration in this filtrate is normally well below 1.0 gU/liter. The filtrate hold tanks are poisoned with Raschig rings. After sampling, the contents of both filtrate hold tanks may be pumped to the evaporation hold tank.

15.7.3 Contaminated SNM Solids

Description - Contaminated solids may include material of the same form as clean heterogeneous scrap but, because of possible contaminants, chemical separation may be warranted. Solids removed from HEPA filters are treated as contaminated, hence the material is furnaced and milled. The milling provides a more uniform product for sampling. Solids from acid insoluble filters are

Nuclear Safety - The nuclear safety of the scrubber solution storage and processing is predicated on the inherently low gU/liter concentration of the scrubber solutions. The maximum value observed to date for either the KOH/KCO_3 or NH_4OH scrubber solution has been less than 2.0 gU/liter. This concentration in combination with the largest hold tank capacity results in less than 7.6 KgU in a batch of liquid to be processed. This mass is much less than the safe mass limit imposed on, for example, the Hold and Evaporation Tank Complex (14.1 KgU). Furthermore, the hold tank is sampled before release to the hold and evaporation tanks.

15.7.5 Clean SNM Powders and Solids

Description - Clean SNM powders and solids collected from various sources in the plant, and not recycled directly in the pelletizing line or via the continuous feed oxidation furnaces in Building 254, are processed in the recovery area, as illustrated in Figure 15.7-1. The material is batched and dispositioned for furnacing as described in Section 15.7.2.1. The resulting material may be dispositioned for temporary storage or recycling via the recycle hopper operation in Building 253.

The Safety Features and Nuclear Safety are discussed in Section 15.7.2.1.

15.7.6 Solid Waste Reduction

Description - Combustible contaminated solid waste is collected, assayed, and incinerated as described in Section 15.7.1.2. Analysis of the ash incinerator determines the basis for dispositioning the ash to either recovery or burial.