Region III

1819 2D
70-36

C-E Power Systems
Combustion Engineering, Inc.
Route 21-A
Hematite, Missouri 63047

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NIS/83/1008

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POWER SYSTEMS

February 21, 1983

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W. T. Crow, Section Leader
Uranium Process Licensing Section
Uranium Fuel Licensing Branch
Division of Fuel Cycle and
Material Safety, NMSS
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Docket No. 70-36

Dear Mr. Crow:

Enclosed are revised pages to our application for renewal of SNM-33, in response to your questions of December 29, 1982, and discussions with members of your staff. The analysis requested in Item 5.2 will be completed within 15 days and will be submitted at that time.

We are also requesting that Byproduct Material License No. 24-16206-01 be cancelled and authorization for possession and use of calibration sources be included in SNM-33. Pages revised to reflect this change are enclosed.

Please advise if further information is required.

Very truly yours,

COMBUSTION ENGINEERING, INC.

H. E. Eskridge

H. E. Eskridge
Supervisor, Nuclear Licensing, Safety & Accountability

-01

RECEIVED BY LFMS
Date. 3/11/83
Ltr. March 9 III
By. Brown
Orig. To.
Action Compl. 5/11/83 Terminated

SNM-33
3/11/83
May 3 Amend
Enclosure

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Applicant. 017245
Check No.
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Date Check Rec'd. 5/11/83
Received By. Brown

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MAY 2 1983

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FOIA- 2004-0234

SNM-33 LICENSE APPLICATION - REVISION 1

The following pages of Revision 0, dated 1/29/81, are replaced by Revision 1, dated 1/24/83:

Part I, Chapter 1	:	2, 3, 4
Part I, Chapter 2	:	5, 6, 7, 9, 10
Part I, Chapter 3	:	1, 2, 3, 6, 7, 8, 9, 10
Part I, Chapter 4	:	1, 4, 5, 7, 8, 9
Part I, Chapter 5	:	1, 2, 3, 4
Part I, Chapter 8	:	1
Part II, Chapter 2	:	4, 5, 6
Part II, Chapter 3	:	13, 14
Part II, Chapter 5	:	1
Part II, Chapter 7	:	8, 12, 14, 15, 18
Part II, Chapter 8	:	4, 7, 20, 25

The following Revision 0 pages are deleted:

Part II, Chapter 7	:	9, 10, 11, 19

The following Revision 1 pages are added:

Part I, Chapter 3	:	11
Part I, Chapter 5	:	5, 6
Part II, Chapter 2	:	9
Part II, Chapter 9	:	32

1.4 Possession Limits

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

Material	Form	Quantity
Uranium enriched to maximum of 4.1 weight percent in the U-235 isotope	Any*	8,000 kilograms contained U-235
Uranium to any enrichment in the U-235 isotope	Any*	350 grams
Source material	Uranium and/or Thorium, Any*	20,000 kilograms
Cobalt-60	Sealed Sources	40 millicuries total *

1.5 Location Where Material Will Be Used

All manufacturing activities are carried out within the security fenced area located on the central site tract. Manufacturing activities utilizing radioactive materials are housed in several buildings containing equipment for conversion of UF_6 to UO_2, fabrication of UO_2 nuclear fuel pellets and related processes. Section 1.7 contains a list of the buildings, identified by number and name, showing their present utilization.

1.6 Definitions

Terminology is as defined in standard references (e.g., Title 10 of the Code of Federal Regulations) or is explained in the section where it appears if unique to this application.

*Excluding metal powders *

1.7 Authorized Activities

Receive, possess, use and transfer Special Nuclear Material under Part 70 of the Regulations of the Nuclear Regulatory Commission in order to manufacture nuclear reactor fuel utilizing low-enriched uranium (up to 4.1 weight percent in the isotope U-235).

Receive, possess, use and transfer Source Material under Part 40 of the Regulations of the Nuclear Regulatory Commission. Source materials are used for the same purposes as SNM, and are generally used for start-up testing of a new process. Sealed cobalt-60 sources are used for instrument calibration and testing. * *

Authorized activities are conducted in the following buildings and facilities on the Hematite site:

Number	Name	Present Utilization
101	Tile Barn	Emergency Center and equipment storage
110	New Office Building	Guard Station and offices
120	Wood Barn	Equipment storage
-	Oxide Building and Dock	UF_6 to UO_2 Conversion, UF_6 receiving
235	West Vault	Source material storage
240	240-1	Offices and Cafeteria
	240-2	Recycle and Recovery area
	240-3	Incinerator and storage
	240-4	Laboratory and Maintenance Shop
250	Boiler Room	Steam supply,
	and Warehouse	Storage
251	Warehouse	Shipping and Receiving, storage
252	South Vault	Radioactive waste storage
255	Pellet Plant	Pellet Fabrication, storage and packaging.

1.8 Exemptions and Special Authorizations

The following specific authorizations are requested:

(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 20.302.

(b) We propose to authorize release of equipment and materials from the plant to off-site or from controlled to uncontrolled areas on-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 July 1982.

2.2 Organization Responsibilities and Authority (continued)

Primary responsibility and authority to suspend unsafe operations is placed with Operating Supervision. Within their respective responsibilities, members of NLS&A also have authority to suspend operations not being performed in accordance with approved procedure.

2.3 Safety Review

On-site safety review is performed by the NLS&A Supervisor. Other plant management and support personnel are involved as determined by the Plant Manager or the NLS&A Supervisor. The safety review function is described in subsequent sections of this chapter. An annual safety review is performed by a team appointed by the Vice President-Nuclear Fuel. The annual review is described in Section 2.8.

2.4 Approval Authority for Personnel Selection

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

2.5 Personnel Education and Experience Requirements

The minimum qualification of the Plant Manager and first line management shall be a B.S. degree in a technical field with two years experience in nuclear plants and laboratories, or high school with ten years nuclear industry experience.

The NLS&A Supervisor shall hold a B.S. degree in science or engineering and have at least five years experience in a responsible position in the nuclear industry, at least three years of which have been in an activity which involved nuclear criticality safety and health physics evaluations. An under- *

2.5 Personnel Education and Experience Requirements (continued)

standing of industrial safety problems and controls is also required. The NLS&A Sueprvisor is responsible for implementing the radiation safety and criticality safety programs. *

The Nuclear Criticality Specialist shall hold a degree in science or engineering and have a minimum of three years experience in plant nuclear criticality safety.

2.6 Training

Indoctrination of new employees in the safety aspects of the facility shall be conducted by, or under the supervision of, specialists in the various topics. The indoctrination topics shall include nuclear criticality safety, fundamentals of radiation and radioactivity, contamination control and ALARA practices, emergency procedures. After determining by testing that a new employee has obtained sufficient knowledge in the above topics, the new employee begins on-the-job training under direct line supervision and/or experienced personnel. Adequate performance is monitored by the Foreman and NLS&A prior to permitting work without close supervision.

The training and personnel safety program is continued with on-the-job training supplemented by regularly scheduled meetings conducted by line supervision and specialists in the subjects covered. Personnel protective equipment,

2.6 Training (continued)

Industrial safety and accident prevention and other safety topics are included. Foremen receive a formal course in radiation safety and criticality control. Sufficient knowledge to enable them to carry out their training functions is determined by testing. All operating personnel receive a re-training course in criticality control and radiation safety on an annual basis. The effectiveness of retraining is determined by testing. All formal training shall be documented. *

2.7 Operating Procedures

Operating procedures are prepared by the responsible function and issued and controlled by Quality Assurance, provide detailed instructions for equipment operation and material handling, including specific safety requirements. Operating Sheets are the basic control document; before issuance or revision they require Engineering, Production, Quality Assurance, Nuclear Licensing and Safety and Accountability approval by signature. Sheets shall be reviewed and updated every 2 years. *

Supervision at all levels is required to assure that all handling, processing, storing and shipping of nuclear materials is given prior review and approval by NLS&A, that suitable control measures are prescribed, and that all pertinent regulations and control procedures relative to nuclear criticality safety or radiological safety are followed.

Supervision is further required to assure that, prior to the start of any new activity involving nuclear materials,

2.7 Operating Procedures (continued)

The minimum frequency for updating all operating procedures involving Special Nuclear Materials shall be every two (2) years.

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 all safety-related and environmental programs. Qualified personnel having no direct responsibility for the function and/or area being audited shall be used to ensure unbiased and competent audits.

Daily checks for safety-related problems are made by NLS&A technicians, who observe, note and make general observations in addition to their other duties. Problems are normally corrected on the spot by the shift Foreman. More significant problems are listed on the daily exception report distributed to the Plant Manager and all Supervisors. The Production Superintendent is responsible for corrective action.

Monthly inspections, performed by the NLS&A Supervisor or his designated representative, cover all aspects of criticality control, radiation safety and industrial safety. Items requiring corrective action are documented in a report distributed to the Plant Manager and all Supervisors and Foremen. The Production Superintendent is responsible for corrective action, except where another Supervisor is specifically designated. Followup actions taken by the Production Superintendent, or responsible Supervisor, shall be documented. *

2.8 Audits and Inspections (continued)

An inspection will be conducted twice per year by the Nuclear Criticality Specialist covering all phases of nuclear criticality safety and control, including results of previous inspections and follow-up action taken.

These semi-annual inspections are documented and reports distributed to the General Manager, Plant Manager, NLS&A Supervisor and other Supervisors. The Production Superintendent and the NLS&A Supervisor are responsible for any corrective actions required.

Annual audits are conducted in which the results of previous inspections of audits are reviewed, as an evaluation of the effectiveness of the program. These audits may also involve a detailed review of non-safety documents such as operating procedures, shop travelers, etc., and are documented by a formal report to the Vice President-Nuclear Fuel. Annual audits are performed by a team appointed by the Vice President-Nuclear Fuel. The team shall include, as a minimum, a Nuclear Criticality Specialist and a Radiation Specialist from Windsor who shall audit all phases of Radiation and Nuclear Criticality Safety. The annual audit will review ALARA requirements in conformance with Regulatory Guide 8.10, as applicable. Qualifications of Windsor Specialists are provided in License SNM-1067. The NLS&A Supervisor shall be responsible for followup of recommendations made by the audit team. *

2.9 Investigations and Reporting of Off-Normal Occurrences

All events specified by applicable regulations or license conditions shall be investigated and reported to NRC.

3.0 RADIATION PROTECTION

3.1 Administrative Requirements

3.1.1 Radiation Work Permit Procedures

Operations not covered by an effective operating procedure shall be conducted under a Special Evaluation Traveler (S.E.T.). Prepared by the responsible function, it shall contain detailed instructions for the procedure and shall include all safety requirements to assure that the proposed operation is conducted in a safe manner. The same approvals as required for Operating Sheets shall be required on all S.E.T.s. Completion of the operation shall be appropriately documented as indicated on the traveler. *

3.1.2 ALARA Commitment

C-E's commitment to ALARA pertaining to employees is part of the policy statement in Section 2.1. The annual audit team, described in Section 2.8 considers ALARA requirements in conformance with the intent of Regulatory Guide 8.10.

3.2 Technical Requirements

3.2.1 Access Control

The facility shall be zoned to define contamination areas and clear areas. Protective clothing shall be worn in the contamination areas. * A sink and alpha survey meter or alpha monitor shall be provided at the exit from the contamination area. All personnel are required to wash and monitor their hands, and to monitor other body surfaces and personal clothing as appropriate, when exiting a contaminated area. Except for hand contamination which is easily removed on the first rewashing, health physics assistance and approval for release above background levels shall be required.

3.2.2 Ventilation Requirements

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. All 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 by HLS&A, except during periods when not in use. This effectively limits HEPA filter pressure differential to less than 8 inches of water. *

Glove boxes under negative pressure will be used where airborne material is actively generated such that ventilated hoods would not be adequate.

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

Air effluents from process areas and process equipment involving uranium in a dispersible form shall be subject to air cleaning. Exhaust air cleaning shall include use of high efficiency filters except where the effluents, evaluated individually, do not contribute significantly to the total emission. Low velocity blowers are used to preclude filter damage if heavy loading occurs. All exhaust stacks shall be continuously monitored when in operation. Air cleaning equipment that may be used is: *

a. Cyclone Collectors.
   Used to remove particulates from exhaust streams that are heavily loaded.

b. High Efficiency Particulate Air Filters
   Used in the majority of cases for highest efficiency air cleaning, normally in conjunction with roughing filters to extend useful life and improve reliability.

3.2.2 Ventilation Requirements: (continued)

c. Wet Scrubbers.
Used to clean heavily loaded air streams that are not suited, due to air quality or temperature, to other cleaning methods.

d. Dry Scrubbers.
Used primarily for cleaning air streams containing corrosive agents that render wet scrubbing impractical.

e. Fabric Filters.
Normally used in systems where material impinging on them can be returned to the process using reverse jet, pulsed air or other disloding methods.

f. Special Filters.
Ceramic or metallic frit filters, usually an integral part of process equipment, may be used for special air cleaning requirements.

3.2.3 Instrumentation

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

a. Nuclear Alarm System
The nuclear alarm system consists of gamma sensitive detectors, audible alarms and a remote indicator panel at the guard station. The requirements for this alarm system are:

1) Detector units shall have a pre-set alarm level of not less than 5 mR/hr or greater than 20 mR/hr.

2) Detector units shall also have a response time no greater than 3 seconds at a radiation level of 20 mR/hr.

3.2.4 Internal and External Exposure

3.2.4.1 Special Surveys

All non-routine operations not covered by operating procedures shall be reviewed by NLS&A and a determination made by NLS&A if radiation safety monitoring is required.

With the exception of incidents requiring immediate evacuation, spills or other accidental releases shall be cleaned up immediately. Criticality restrictions on the use of containers and water shall be followed at all times. The Foreman and NLS&A must be notified immediately of such incidents. Appropriate precautions such as use of respirators shall be observed.

3.2.4.2 Routine Surveillance

Surveys shall be conducted on a regularly scheduled basis consistent with plant operation and survey results. The frequency of survey depends upon the contamination levels common to the area, the extent to which the area is occupied, and the probability of personnel exposures. The minimum frequency for contamination surveys in plant operating areas shall be as specified in Table 1 of Regulatory Guide 8.24, where applicable. Clear areas with high potential for tracking of contamination may be surveyed more frequently. Areas with a low use factor may be surveyed less frequently. *

Cleanup action for restricted areas shall be initiated when surface contamination exceeds the action limits specified in Table 2 of Regulatory Guide 8.24. *

3.2.4 Internal and External Exposure

3.2.4.2 Routine Surveillance (continued)

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

Contamination limits for release of equipment and materials from the plant to off-site or from controlled to uncontrolled areas on-site shall be 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 July 1982. *

3.2.4.3 Air Sampling Criteria

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

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

a. Fixed location samplers shall be used where uranium handling operations are pursued for extended periods of time, or where short term operations occur frequently. These samples shall be located in or as near as practical to the breathing zone of the person performing the operations. Fixed sampling may also be used for investigative purposes. In this case, the samples may be collected near the point of suspected release of material.

b. Lapel samplers may be used for supportive measurements and special studies, and air monitors for early warning of unexpected releases. *

c. Emphasis shall be placed on sampling new operations or processes until adequate, effective, control of airborne contamination is assured.

3.2.4.4 Airborne Concentrations

a. Airborne levels in excess of 25% of the maximum permissible concentration shall require posting in accordance with 10CFR20 and an investigation of the causes.

b. Airborne levels in excess of the maximum permissible concentration shall require exposure evaluation. Controls to restrict the personnel to less than 40 MPC-hours per week shall be required.

c. Effective air control by ventilation systems shall be assured by face velocity checks performed at least weekly. These checks may be supplemented by pressure drop measurements across air cleaning devices or inspection of such devices for continued integrity or loading that would impair their effectiveness. When ventilation control suffers or effluent concentrations rise, cleaning devices shall be cleaned or replaced.

d. The room air in all areas where unclad licensed material is processed and where operations could result in worker exposure to the intake of quantities of radioactive material exceeding those specified in 10 CFR 20.103, shall be regularly sampled and analyzed for airborne concentration of radioactivity. The survey frequency shall be in accordance with Table 1 of Regulatory Guide 8.24 dated October 1979, where applicable. *

3.2.4.6 Bioassay

The bioassay program shall satisfy the requirements of Regulatory Guide 8.11, "Applications of Bioassay for Uranium", except that in Table 2 semi-annual in-vivo frequencies may be replaced by annual frequencies for minimum programs only.

3.2.4.7 Respiratory Protection

The respiratory protection program shall be conducted in accordance with Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection".

4.0 NUCLEAR CRITICALITY SAFETY

4.1 Administrative Requirements

4.1.1 Double Contingency Policy

Process designs shall, in general, incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.

4.1.2 Criticality Safety Review

Final design, initial installation, modification, or relocation, of special nuclear material processing, handling or storage equipment, or related operations, shall be reviewed and approved by the NLS&A Supervisor. Such changes as could effect nuclear criticality safety shall be reviewed by the Criticality Specialist prior to implementation. The review and approval procedure is described in Section 2.7 of this part. *

4.1.3 Posting of Limits

Signs listing approved nuclear criticality safety limits shall be posted such that information thereon is readily discernible to employees. This posting may be for individual pieces of equipment or groups of equipment, depending on the nature of the operations covered.

4.2.3 Safety Margins for Individual Units

Except as specified, safety margins applied to units calculated to be two percent subcritical, and incorporated in the SIUs shall be as follows:

Mass	2.3
Volume	1.3
Cylinder Dia.	1.1
Slab Thickness	1.2

These valves shall be further reduced where necessary to assure maximum fraction critical values of 0.4 for geometrically limited units, and 0.3 for mass limited units (when based on optimum water moderation). An additional reduction has been applied to several mass and volume limits to assure that spacing requirements remain constant for all enrichments.

For validated computer calculations, the highest K_{eff} for a single unit or an array shall be 0.95 including a 2 sigma statistical uncertainty and including all applicable uncertainties and bias. Consideration shall be given to greater safety factors where there are large uncertainties. *

The basic assumptions and criteria used in establishing safe parameters for single units and arrays shall be as follows: *

a) The possibility of accumulation of fissile materials shall be evaluated and, if the possibility exists for the accumulation of fissile materials, design changes or administrative controls must be imposed to eliminate the accumulation problem. *

b) Nuclear safety shall be independent of the degree of moderation within the process unit when addition of moderating materials is considered to be credible.

4.2.3 Safety Margins for Individual Units (continued)

c. Nuclear safety shall be independent of the degree of moderation between units up to the maximum credible mist density. The maximum mist density will be determined by studying all the sources of water in the vicinity of the single units or arrays. The maximum mist density may be limited by design and/or by administrative controls. *

d. Criteria used in the choice of fire protection in areas of potential criticality accidents (when moderators are present) shall be justified.

e. Nuclear safety shall be independent of neutron reflector thickness for the reflector of interest.

f. Optimum conditions (limiting case) of water moderation and heterogeneity credible for the system shall be determined in all calculations.

g. The analytical method(s) used for criticality safety analysis and the source of validation of the method(s) shall be specified.

h. Safety margins for individual units and arrays shall be based on accident conditions such as flooding, multiple batching, and fire.

i. The method of deriving applicable multiplication factors shall be specified.

4.2.4 Limits for Safe Individual Units (SIUs)

Table 4.2.4

Safe Individual Unit Limits for ≤ 4.1% enriched UO_2 at optimum moderation. All Mass and Volume limits have been adjusted to provide constant spacing areas for the enrichment shown. Heterogeneous limits have been developed with optimum rod sizes (up to 0.4" diameter) taken to allow for pellet chips, etc.

4.2.5 Surface Density Method (continued)

moderator, if "smeared" over the allowed spacing area, would not exceed 50% of the minimum water reflected infinite slab surface density, based on optimum moderation. For cylinder and volume limited SIUs, a spacing limit based on 25% of the minimum water reflected infinite slab thickness applies. Horizontal slab limited SIUs require no additional spacing and may border the spacing boundary for any other array unit.

Modified limits, designated for use with the surface density method, are provided in Table 4.2.4. These limits apply under conditions of "in-plant-reflection" where the floor is 16"-thick concrete, and the roof is the equivalent of less than 4" of concrete. Spacing requirement for the limits specified in Table 4.2.4 are provided in Table 4.2.5.

Table 4.2.5

Spacing requirements for mass, volume, or cylinder SIUs specified in Table 4.2.4.

Limit	Spacing Area
Mass	3.5 ft^2
Volume	9.0 ft^2
Cylinder (per ft. of length)	5.0 ft^2

Spacing areas shall be established to provide equal distances from the edges of the units to the spacing boundary in all directions. Co-planar slabs specified in Table 3-1 require no additional spacing. Non-Co-planar slabs within 4 feet of each other are limited to a maximum of 12-inch vertical differences, and must be separated by a 6-inch minimum horizontal spacing. *

4.2.5 Surface Density Method (continued)

Mass limited SIUs may be stacked on a vertical centerline with at least 10-inch edge separation. Maximum allowed volume for stacked SIUs shall be 20 liters.

Vessels and other items of equipment requiring exclusion areas shall have the limits of these areas clearly marked on the floor. SIUs in transit shall not be permitted to enter an exclusion area. This rule shall be covered in operator training and operating procedures.

4.2.6 Solid Angle Method

Where either the SIU "fraction critical" value or the "smeared" slab thickness limitation cannot be met, the spacing of an array may be established by the solid angle criteria of TID7016, Rev. 2. Subcritical limit values may also be established using methods described in this guide.

4.2.7 Minimum Spacing Requirement

Any SIU shall be spearated by at least 12 inches from any other SIU, unless a smaller spacing is specifically analyzed and incorporated into the array design.

4.2.8 Concentration Control

Uranium concentration control SIUs shall be limited to a maximum concentration 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 SIUs shall not be considered to contribute to interacting arrays, but shall be located outside exclusion areas assigned by the surface density method.

Fixed poisons may be used in liquid fissile material systems provided the system shall be maintained in accordance with ANSI Standard N16.4-1979, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material". *

A safe mass of uranium shall be used for aqueous solutions under only administrative control. The safe mass limit does not apply to fixed poison systems. *

4.2.9 Fire Hazards

Evaluation of proposed changes in facilities, equipment or operations shall include consideration of fire hazards. All equipment and operations shall be designed, and materials selected, to minimize fire hazards.

5.0 ENVIRONMENTAL PROTECTION

5.1 Effluent Control Systems

5.1.1 ALARA Commitment

Gaseous, liquid, and solid waste streams shall be handled such that radioactivity exposures to plant workers, visitors, and the general public are kept as low as reasonably achievable.

5.1.2 Air and Gaseous Effluents

Exhaust air effluents from process areas and process equipment shall be sampled continuously during operations. These stack samples shall be changed at least weekly, except that new operations shall be sampled more frequently until effective control is assured.

All samples shall be counted after suitable delay for decay of radon daughters, and the results evaluated. The lower limit of detection shall be no more than 10% of 10 CFR 20, Appendix-B, limits. *

The control limit for gross alpha activity in exhaust air effluent shall be 4×10^{-12} µCi/cc.

If the control limit is exceeded, averaged over a two week period, an investigation shall be conducted and corrective action taken.

A further control limit for total plant exhaust stack effluents shall be 150 µCi per calendar quarter. If this control limit is exceeded, a report shall be prepared and submitted to the commission, within 30 days, which identifies the cause and the corrective actions taken or to be taken.

5.1.3 Liquid Effluents

Levels of contamination in liquid effluents shall be measured by representative grab sampling of batch discards, by proportional sampling of continuous discharges, or both. Samples shall be collected at or prior to the point of discharge from the waste handling system. Samples shall be analyzed for gross alpha and gross beta activity. The lower limit of detection shall be no more than 10% of 10 CFR 20, Appendix B, limits. *

The control limits for alpha and beta activity in liquid effluents shall be:

alpha - 3.0×10^{-5} µCi/mℓ
beta - 2.0×10^{5} µCi/mℓ

A further control limit for liquid effluent streams which discharge to Joachim Creek (NPDES Outfalls 001 and 002) shall be:

alpha - 3.0×10^{-6} µCi/mℓ
beta - 2.0×10^{-6} µCi/mℓ

If these control limits are exceeded, averaged over a calendar quarter, an investigation shall be conducted and corrective action taken.

5.1.4 Solid Wastes

Low level solid wastes shall be packaged in accordance with all applicable regulations and delivered to a carrier for transport to an approved disposal site.

LOUIS J. SWALLOW - QUALITY ASSURANCE MANAGER - HEMATITE

M.S., Mechanical Engineering, Washington University, 1955

B.S., Mechanical Engineering, Washington University, [redacted] ex.6

Nuclear Criticality Safety School, Oak Ridge National Laboratory, 1959

PROFESSIONAL EXPERIENCE:

<u>Combustion Engineering, Inc., 1974 to Present</u>

<u>Quality Assurance Manager - Hematite</u>

Responsible for all Quality Assurance activities in Nuclear Fuel Manufacturing-Hematite. Supervises Quality Control Engineering, Quality Assurance Engineering, and Chemical and Physical Test and Inspection, provides technical support for SNM Measurement, SNM Measurement Control and Statistical Evaluations.

<u>Gulf United Nuclear Fuels Corporation 1970-1974</u>

Responsible for Process Engineering, Facilities & Equipment Engineering, Capital budgets. Assigned as Acting Plant Manager during extended absences of the Plant Manager.

During this period, the plant produced 200 MTM of pellets for light water reactor fuel and several thousand kgs of special naval reactor fuel.

<u>United Nuclear Corporation 1968-1970</u>

<u>Nuclear & Industrial Safety Manager, Commercial Products Division</u>

Responsible for establishing the overall Nuclear Criticality, Health Physics & Industrial Safety programs for the three manufacturing plants operated by the division. Including AEC license applications and approval, Nuclear Criticality Safety Analysis, and Health Physics Monitoring and Analysis.

<u>United Nuclear Corporation 1967-1968</u>

<u>Construction Manager, SWOPP Task Force, Chemical Operations</u>

Responsible for design, planning, scheduling and contracting the construction of the UF_6 conversion plant and UO_2 pellet plant.

LOUIS J. SWALLOW (continued)

United Nuclear Corporation 1964-1967
Operations Control Manager, Chemical Operations

Responsible for Quality Control, Nuclear Safety & Health Physics Program, Special Nuclear Material Licensing, Special Nuclear Materials Accountability, Scrap Recovery, Nuclear Criticality Safety Evaluations.

United Nuclear Corporation 1958-1964
Research & Development Engineer, Chemical Operations

Responsible for UO_2 pellet encapsulation, Quality Control, Nuclear Safety and Health Physics, Nuclear Criticality Safety Evaluations.

Mallinckrodt Chemical Works 1955-1958
Project Engineer, Uranium Division

Responsible for design and installation of uranium metal production equipment in the Feed Materials Plant.

5.0 OCCUPATIONAL RADIATION EXPOSURES

Due to the low levels of penetrating radiation which exist in the plant, the greatest emphasis in exposure control has been directed towards minimizing inhalation of airborne uranium particulates. To this end, CE has maintained airborne exposures as low as reasonably achievable through the use of ventilated hoods and process containment and an extensive breathing zone (BZ) air sampling program. Fixed air samplers are strategically placed throughout the facility to provide indications of general airborne activity levels. A continuous air monitor with an alarm is utilized in the Oxide Building to more rapidly detect an increase in the airborne activity level.

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

5.1 External Radiation Exposures

External radiation exposures are measured by film badges which are changed monthly. Results of monitoring for 1979, 1980, and 1981 were:

Annual Dose Ranges (Rem)	% of Personnel in Range		
	1979	1980	1981
No measurable exposure	18	25	29
Less than 0.100	75	59	41
0.100 - 0.250	5	16	30
0.250 - 0.500	2	0	0
Greater than 0.500	0	0	0

*

7.4 (This Section reserved for future use)

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7.5 (This section reserved for future use)

7.6 Mass Limited Units on Single Levels

Mass limited units having a maximum fraction critical (f) of 0.3 are to be spaced to a maximum array surface density of 50% of the optimum critical surface density based on mass per unit area. This criteria is supported as follows:

Consider the following infinite planer arrays of units containing moderated UO_2 having an enrichment of 5%. For these arrays, the following parameters apply:

7.6 Mass Limited Units on Single Levels (continued)

From these analysis and recalling that "in plant reflection" is some 1.5% less reactive than the fully reflected cases described above, it is concluded that use of a limit equal to 50% of the minimum critical slab surface density (at optimum moderation) expressed in terms of mass per unit surface area is safe, with a maximum nominal array reactivity of 0.935.* These calculations clearly demonstrate that the license criteria provides adequate safety for plant applications. However, reviews of calculated arrays as described in Reference 1 could call these limits into question, and therefore require further attention.

Specifically, several arrays of under moderated low enriched uranium show surface densities which, in some cases, are less than 50% of the infinite slab thickness for material of like moderation and density. However, the license criteria specifically limits use of the method to spacing based on optimum mass per unit area moderation. Examination of the spacings in Reference 1 show that when compared to slabs having optimum mass per unit area moderation all arrays have surface densities at or above 85% of the optimum infinite slab value. This is shown in Table II.7-4 and Figure II.7-3.

(a) At the given sphere spacing, a 16" concrete reflector in contact with the sphere array produced no significant change in reactivity.

*The bias is negative therefore the array is less than 0.95 k_{eff}. *

5.1.4 Solid Wastes (continued)

Non-contaminated solid wastes are disposed of by a commercial waste disposal firm. Old items of non-contaminated equipment may be disposed of to commercial scrap dealers.

Inspection of conditions of storage of waste, waste containers, and contaminated equipment shall be included in the monthly NLS&A audit. *

5.2 Environmental Monitoring

Locations of air particulate, soil, vegetation, well water, surface water and liquid effluent sampling stations shall be established and kept part of the Demonstration Section of this license.

Monitoring locations may be changed only if a documented evaluation by NLS&A demonstrates that a new location provides data that are as representative (or more representative of) conditions likely to impact on the general public, as was the data from the original location.

The minimum environmental monitoring program shall consist of the following samples:

5.2 Environmental Monitoring

Environmental samples shall be collected and analyzed as shown in Table I.5-1, at locations shown in Figure I.5-1.

Sample frequency may vary due to inclement weather, plant shutdown, or operating conditions. More frequent or additional samples may be taken as required for special studies and evaluations.

Table I.5-1 Environmental Monitoring Program

OPERATIONAL EFFLUENTS MONITORING PROGRAM

Sample Medium	No. of Sampling Points	Collection & Analysis Frequency	Sample Type	Type of Analysis	Action Level
Air Effluent	8 Exhaust Stacks	Continuous & analyze weekly	Particulate	Gross alpha	Two week average MPC
Air Effluent	Conversion offgas stack	Continuous & analyze weekly	Particulate	Fluoride	
Liquid Effluent	Site dam Sewage treatment outfall	Continuous & analyze weekly	Composite	Gross alpha & beta	Above MPC
Solid Waste	Limestone disposed onsite Waste in 55-gal. drums (<25 uCi/package) to licensed burial ground				

OPERATIONAL ENVIRONMENTAL MONITORING PROGRAM

Sample Medium	No. of Sampling Points	Collection & Analysis Frequency	Sample Type	Type of Analysis
Air	2 onsite remote	Continuous & analyze quarterly	Particulate	Gross alpha
Surface Water	Joachim Creek above and below site creek outfall.	Monthly	Grab	Gross alpha & beta
	Joachim and site creek confluence	Quarterly	Grab	Gross alpha & beta
Ground Water	Plant well	Monthly	Grab	Gross alpha & beta
	Offsite well (Hematite)	Quarterly	Grab	Gross alpha & beta
	3 monitoring wells for evaporation ponds	Monthly	Grab	Gross alpha & beta
Soil	4 locations surrounding plant	Quarterly	Grab	Gross alpha & beta
Vegetation	4 locations surrounding plant	Quarterly	Grab	Gross alpha & beta
	4 locations surrounding plant	Quarterly	Fluoride	

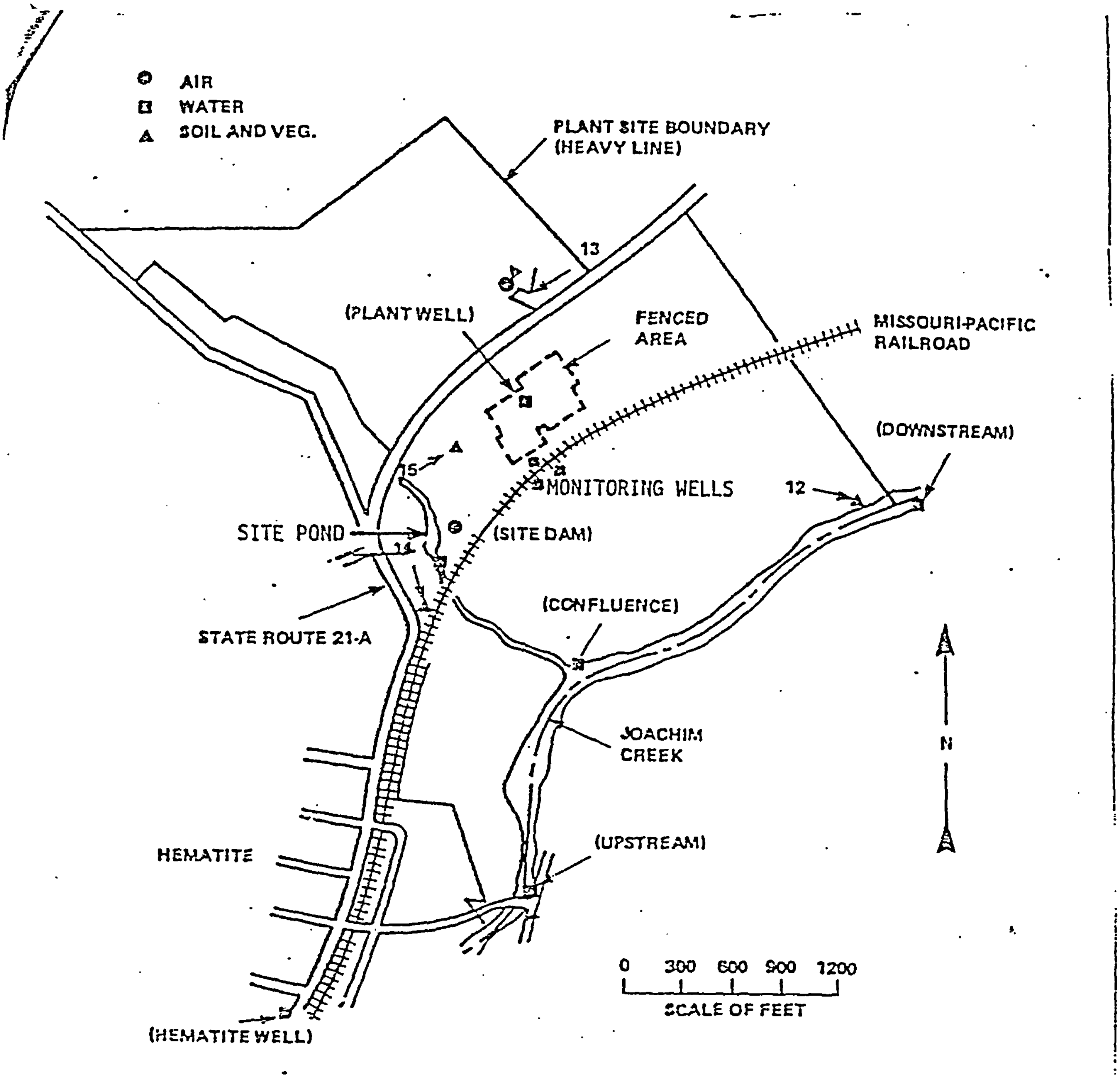

Figure I.5-1 Location of Monitoring Sites Around Hematite Facility

8.0 EMERGENCY PLAN

Combustion Engineering's approved "Radiological Contingency Planning Information", dated January 1982, which was revised September 1982, should be considered part of this application for license renewal. *

2.3 Heating, Ventilation, and Air Conditioning (continued)

The Oxide Building also has an unfiltered room air exhaust which is operated only infrequently during periods of hot weather, at times when release of contamination is unlikely, and is monitored when used. A continuous air monitor, located on the 4th floor, will alarm should a release occur. *

All exhaust stacks are continuously monitored when in operation.

Exhaust stacks have the following flow rates:

Stack Identification	Flow Rate (CFM)
Oxide Main Exhaust	9,773
Oxide Powder Unloading	4,909
Oxide Roof Exhaust	7,068
Bldg. 255 Roof Exhaust	9,032
Bldg. 255 West Manifold	12,020
Bldg. 255 East Manifold	9,773
Bldg. 240 Dry Recycle	3,657
Bldg. 240 Wet Recovery	5,807

2.4 Waste Handling

2.4.1 Liquid Wastes

Cleanup and mop water are evaporated to recovery the uranium. Process water from wet recovery is evaporated for concentration of the chemical content, and then solidified for shipment to licensed burial. Laundry water is filtered prior to discharge to the industrial waste system (storm drains). *

2.4.1 Liquid Wastes (continued)

Cooling water, chemically unchanged, is discharged to the storm drain system. Water from change room sinks and showers is routed to the sanitary waste system. *

Small quantities of liquids from cleaning glassware in the laboratory are discharged to the industrial waste system Disposal of lab analytical residues to the sink drains is not practiced, as they are recycled for recovery. *

The storm drain system discharges into the site pond which overflows to form the site creek. The overflow is continuously proportionately sampled and analyzed for gross alpha and beta activity. The sanitary waste effluent enters the site creek immediately below the site pond. It is also sampled and analyzed for gross alpha and beta activity. *

Sanitary and industrial waste line flows are shown in Figure II.2.2.

2.4.2 Solid Wastes

Solid wastes which are potentially contaminated are generated throughout the controlled area. These wastes consist mostly of rags, papers, packaging materials, worn-out shop clothing, equipment parts, and other miscellaneous materials that result from plant operations. After passive assay (gamma-counting) to determine the U-235 content, wastes are compacted in 55-gallon drums, or packaged in plastic-lined wooden crates for shipment to a licensed low-level burial site. Bulky items with only low levels of surface contamination are placed directly in the lined wooden crates.

2.4.2 Solid Wastes (continued)

A gas-fired incinerator has been installed to reduce the volume of combustible contaminated wastes for shipment to licensed burial. This incinerator also supplements the oxidation/reduction furnaces used to reduce wastes containing recoverable quantities of uranium. The incinerator is equipped with a wet scrubber system to clean offgases prior to routing to the wet recovery stack.

Calcium fluoride and limestone from the conversion process dry scrubbers are used as fill materials on site. These materials, referred to as spent limestone, do not contain detectable contamination and are not considered to be radiological solid waste. (Less than 100 dpm per 100 cm^2 of rock surface). Contaminated limestone is held within the controlled area. *

Non-radioactive solid waste is disposed of by a commercial waste disposal firm. Old items of non-contaminated equipment may be disposed of to commercial scrap dealers.

2.5 Chemical Storage

Chemicals will be stored in accordance with all pertinent federal and state regulations. Chemicals currently used are:

Ammonia - approximately 420,000 pounds used per year as a reducing gas in the production of UO_2 powder, pellets, and in preparation of material for recycle.

Potassium Hydroxide - approximately 3,500 pounds used per year. Mixed with process water and used as wet scrubber liquor to remove hydrofluoric acid from the recycle pyrohydrolysis process effluent.

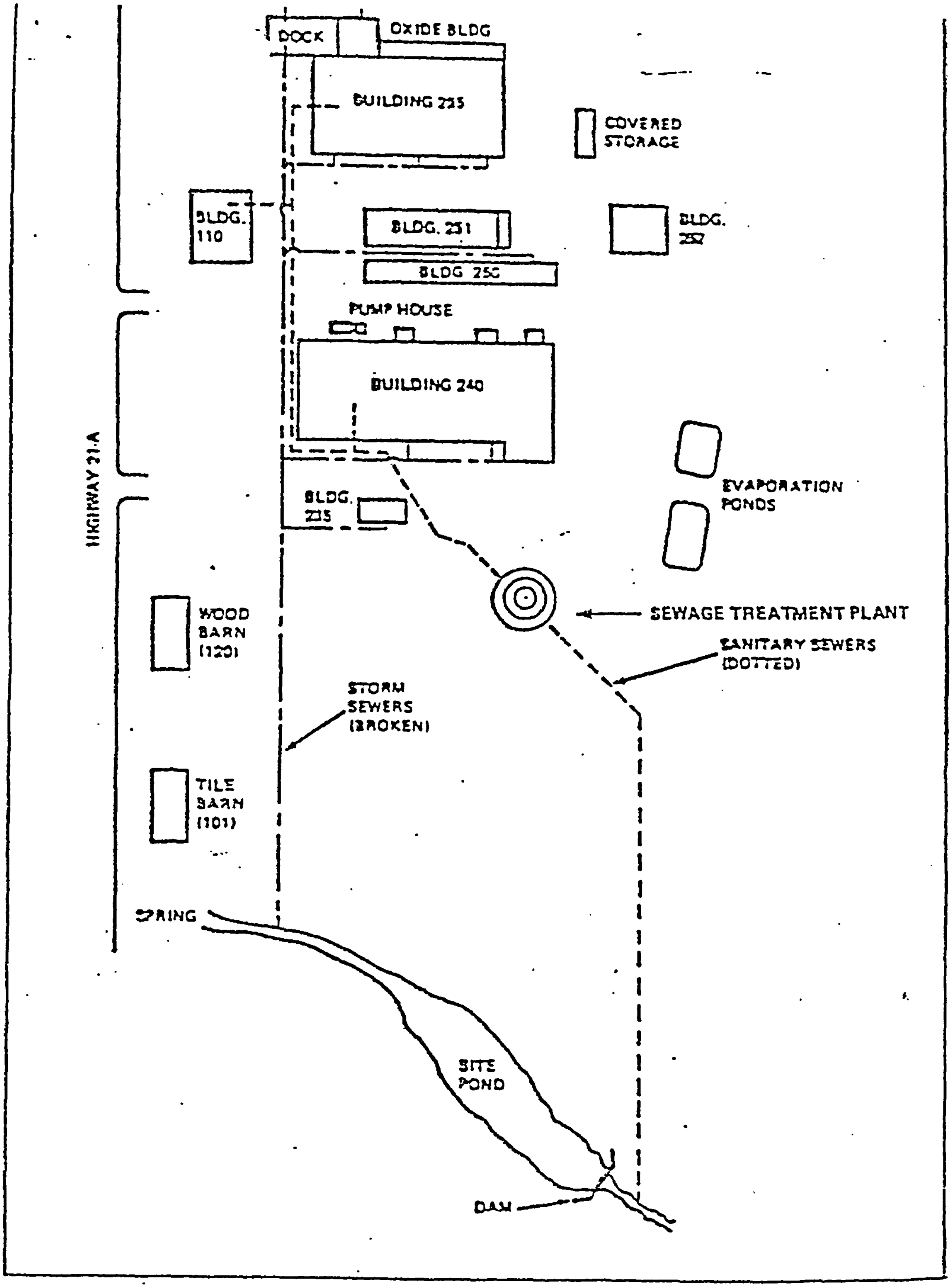

Figure II.2.2 Sanitary and Industrial Waste Line Flows

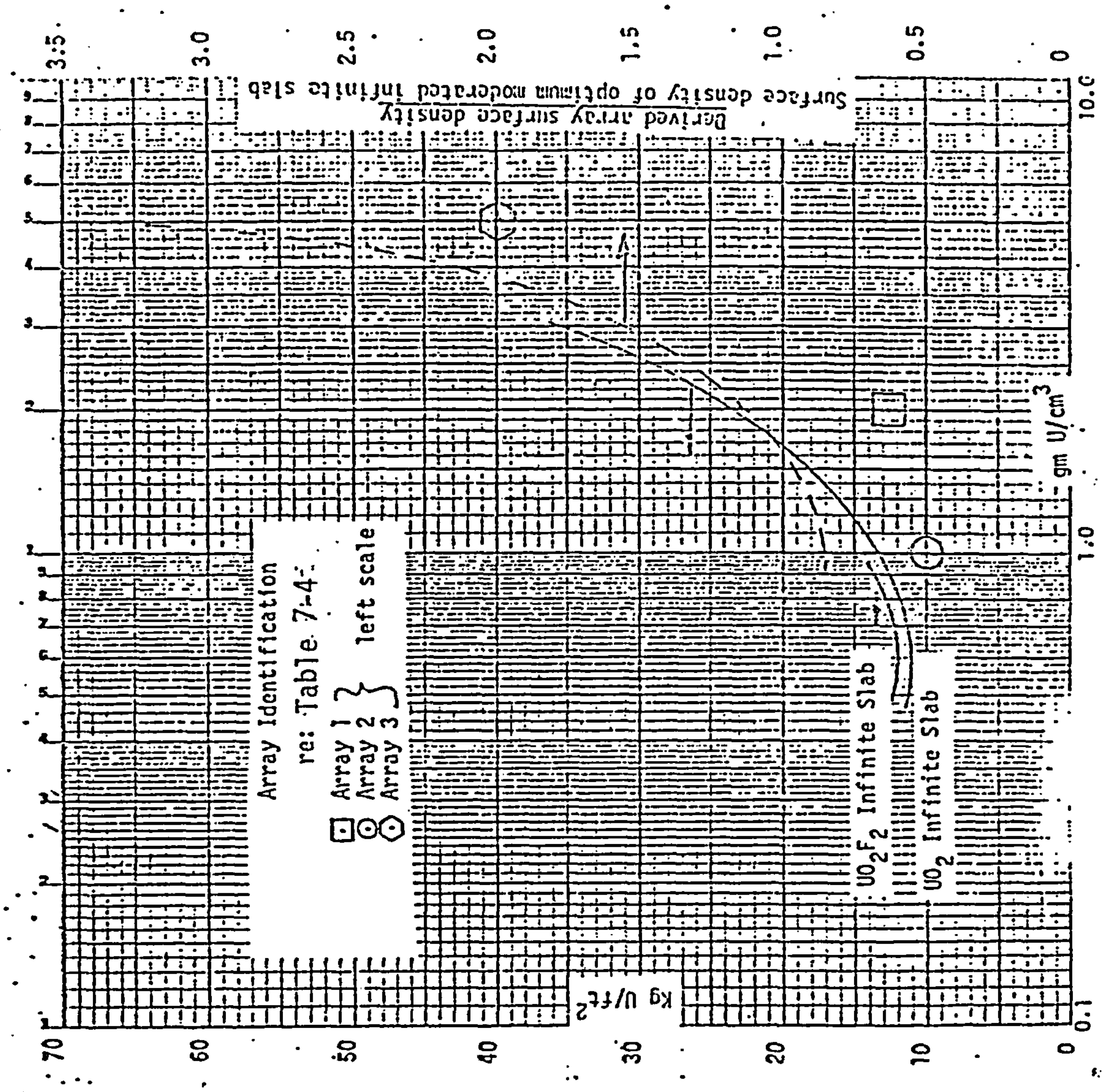

Figure II.7-3

Comparison of derived array surface densities with infinite slab values

7.7 (This section reserved for future use)

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8.1.2 UF_6 Conversion Process (continued)

A 4-inch diameter exhaust duct is also attached from the steam chamber to a wet scrubber. In the event of a UF_6 leak, condensing steam will take SNM to the condensate line. When the conductivity cell in the drain line senses SNM, it will close the automatic shut-off valve, start the scrubber and shut off the steam supply.

Air, steam and UF_6 vapor from the vaporizer station are then mixed with the scrubber liquor in a 6" diameter eductor-venturi type scrubber. The separation of the condensate containing the SNM from the washed air is accomplished in a baffled separator, 23 inches x 9 inches x 15 inches deep. The condensate drains to a 10 inch diameter hold tank where it is recirculated to the eductor. The washed non-condensables exhaust from the separator through a 6 inch diameter duct through a blower to atmosphere. This diameter is safe as per Table I.4.2.4

Any overflow from the hold tank drains through a one-inch pipe line to the building sump.

That portion of steam and SNM that continue to condense in the vaporizer will drain through the condensate line and overflow onto the concrete pad from the air gap to the closed drain line. (See Section II.9-8) *

During normal operation, the vaporized UF_6 leaves the cylinder through a 3/8 inch line and enters a heated pipe chase into the Oxide Building. It passes through metering valves, picks up carrier gas and is carried vertically along the wall to the top level of the Oxide Building and directly into the conversion equipment. The UF_6 control station and subsequent UF_6 piping are wrapped with a steam tracing line and covered

8.1.5 Blending (continued)

Blenders are arranged on six foot centers forming an inline array and are located at least four feet from other SNM-bearing equipment.

8.1.6 Packaging and Storage

Dry UO_2 product is transferred into stainless steel cans (9.75" ø X 11" long) in the ventilated powder packaging hoods. A 4 mil poly bag may be used as an inner liner. If used, it is sealed at the top with tape. The can lid is a friction-fit type which is sealed on the outside with tape. This precludes any in-leakage of moisture from atmospheric humidity (the powder is not hygroscopic) or flooding. Thus, the UO_2 product is kept dry (typically <.05% moisture) and moderation control is assured under all conditions. Section II.9.7 describes all moderation controls in detail. *

The sealed cans of dry UO_2 product are then transferred to one of 5 roller conveyors on the north side of Building #255 as shown in Drawing D-5007-2001, Sheet 9 of 9. The entire building is above the 100 year flood level as determined by the U.S. Army Corps of Engineers in their Special Study for Joachim Creek, dated March 1980. Even if flooding were possible, the 30 Kg weight of the cans containing high density UO_2 would prevent them from floating and being moved. Building #255 is not sprinklered and firefighting would be by dry chemical means. Thus, criticality safety is assured through moderation control ($\leq$ 4.1% enriched UO_2 cannot be made critical without moderation).

8.7.3 Dissolution (continued)

Both the slurry and dissolver vessels have smaller diameters than the allowable 9.8 inches, and have assigned spacing areas greater than 5 ft^2 per ft. of length.

8.7.4 Filtration, Storage, and Dilution

After allowing digestion time to insure complete uranium dissolution, the $UO_2(NO_3)_2$ solution may still contain acid insolubles and is pumped through a filter press to remove these solids. The filter press is 8" x 8" x 8-1/2" and has an active volume of less than the allowable safe volume for non-homogeneous material.

After filtration, the solution is pumped into two safe diameter (6" diameter by 5' long) Pyrex clarity check vessels. If any evidence of suspended solids remaining in the solution is observed, it will be recirculated through the filter until a clear solution is obtained prior to release to the holding tank. The holding tank has a maximum capacity of 1285 gallons, and is also used for dilution and blending.

The holding tank is poisoned with Raschig rings in accordance with ANSI Standard N16.4-1979. Two Raschig ring sample tubes are provided to enable inspection for accumulation of solids and to provide samples for testing the physical and chemical properties of the rings. These inspections and tests will be conducted in accordance with the ANSI Standard. *

8.7.6 UO_4 Separation (continued)

The filtrate is pumped through the UO_4 polish filter for additional clarification before being pumped into one of two filtrate hold tanks. These 580 gallon hold tanks are filled with Raschig Rings in accordance with ANSI Standard N16.4-1979. These tanks are similar to the one described in Section 8.7.4. Inspections and tests previously described in Section 8.7.4 are also performed on these tanks and their Raschig Rings. *

The filtrate is mixed prior to sampling for uranium concentration and transfer to the filtrate treatment and furnace scrubber hold tank. The filtrate is mixed, neutralized and sampled for uranium concentration before discharge to the evaporation tanks.

The alternate method of UO_4 separation will be utilization of the UO_4 filter press as the primary filter and the UO_4 polish filter for the final filtration.

8.7.7 Filtrate Treatment

In the event of filtrates containing recoverable quantities of uranium, the filtrate is pumped back into the UO_4 precipitator and the uranium is precipitated with ammonium hydroxide from the NH_4OH makeup. The impure ADU slurry is pumped into the centrifuge or the filter press for separation.

9.8 UF_6 Vaporizers

A leak of UF_6 into the steam chamber will not produce a criticality event. If a break occurs the UF_6 will be released in the form of a gas which has a density of about 7 pounds per cubic foot as compared to the solid UF_6 density of 292 pounds per cubic foot. The steam chamber is three inches thick. Assuming the entire chamber is full of UF_6 gas and converting the gas into an equivalent UF_6 solid thickness results in only a 0.2 inch increase in radius of the cylinder and a 0.4 inch increase in length. Since the reflector saving, assuming a water reflector is on the order of 1.5 inches, the amount of UF_6 in the steam chamber will have very little effect on the reactivity.

The design of the chamber also will limit the accumulation of water since the chamber has drains. The amount of equivalent water from the steam in the gap is insignificant since the steam is at atmospheric pressure. The density of steam is 0.03734 pounds per cubic foot compared to 62.4 pounds per cubic foot for water.

Valve covers are not used in handling and storage of cold UF_6 cylinders. Damage to the valve is very unlikely with our limited handling. Even if a valve were to be broken or cracked, no significant release of UF_6 would occur. The cylinders are filled under vacuum, with a substantial void space remaining. The vapor pressure of UF_6 at ambient temperatures is less than the remaining vacuum, so initial leakage would be inward. A crack would rapidly seal with UO_2F_2 from hydrolysis of atmospheric moisture. CO_2 to freeze the UF_6 and wooden plugs to replace a broken valve are readily available.

DOCKET NO. 70-36

CONTROL NO. 21981

DATE OF DOC. 02/21/83

DATE RCVD. 02/28/83

FCUF ✓ PDR ✓

FCAF LPDR

WM I&E REF. ✓

WMUR SAFEGUARDS ✓

FCTC OTHER

DESCRIPTION:

Enclosed is revised pages to their application for renewal in response to questions of 12/29/82

05/23/83 INITIAL CEC

SNM-33 LICENSE APPLICATION - REVISION 1

The following pages of Revision 0, dated 1/29/81, are replaced by Revision 1, dated 1/24/83:

Part I, Chapter 1 : 2, 3, 4

Part I, Chapter 2 : 5, 6, 7, 9, 10

Part I, Chapter 3 : 1, 2, 3, 6, 7, 8, 9, 10

Part I, Chapter 4 : 1, 4, 5, 7, 8, 9

Part I, Chapter 5 : 1, 2, 3, 4

Part I, Chapter 8 : 1

Part II,Chapter 2 : 4, 5, 6

Part II,Chapter 3 : 13, 14

Part II,Chapter 5 : 1

Part II,Chapter 7 : 8, 12, 14, 15, 18

Part II,Chapter 8 : 4, 7, 20, 25

The following Revision 0 pages are deleted:

Part II,Chapter 7 : 9, 10, 11, 19

The following Revision 1 pages are added:

Part I, Chapter 3 : 11

Part I, Chapter 5 : 5, 6

Part II,Chapter 2 : 9

Part II,Chapter 9 : 32

1.4 Possession Limits

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

Material	Form	Quantity
Uranium enriched to maximum of 4.1 weight percent in the U-235 isotope	Any*	8,000 kilograms contained U-235
Uranium to any enrichment in the U-235 isotope	Any*	350 grams
Source material	Uranium and/or Thorium, Any*	20,000 kilograms
Cobalt-60	Sealed Sources	40 millicuries total

*

1.5 Location Where Material Will Be Used

All manufacturing activities are carried out within the security fenced area located on the central site tract. Manufacturing activities utilizing radioactive materials are housed in several buildings containing equipment for conversion of UF_6 to UO_2, fabrication of UO_2 nuclear fuel pellets and related processes. Section 1.7 contains a list of the buildings, identified by number and name, showing their present utilization.

1.6 Definitions

Terminology is as defined in standard references (e.g., Title 10 of the Code of Federal Regulations) or is explained in the section where it appears if unique to this application.

*Excluding metal powders *

1.7 Authorized Activities

Receive, possess, use and transfer Special Nuclear Material under Part 70 of the Regulations of the Nuclear Regulatory Commission in order to manufacture nuclear reactor fuel utilizing low-enriched uranium (up to 4.1 weight percent in the isotope U-235).

Receive, possess, use and transfer Source Material under Part 40 of the Regulations of the Nuclear Regulatory Commission. Source materials are used for the same * purposes as SNM, and are generally used for start-up testing of a new process. Sealed cobalt-60 sources are used * for instrument calibration and testing.

Authorized activities are conducted in the following buildings and facilities on the Hematite site:

Number	Name	Present Utilization
101	Tile Barn	Emergency Center and equipment storage
110	New Office Building	Guard Station and offices
120	Wood Barn	Equipment storage
-	Oxide Building and Dock	UF_6 to UO_2 Conversion, UF_6 receiving
235	West Vault	Source material storage
240	240-1	Offices and Cafeteria
	240-2	Recycle and Recovery area
	240-3	Incinerator and storage
	240-4	Laboratory and Maintenance Shop
250	Boiler Room	Steam supply,
	and Warehouse	Storage
251	Warehouse	Shipping and Receiving, storage
252	South Vault	Radioactive waste storage
255	Pellet Plant	Pellet Fabrication, storage and packaging.

1.8 Exemptions and Special Authorizations

The following specific authorizations are requested:

(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 20.302.

(b) We propose to authorize release of equipment and materials from the plant to off-site or from controlled to uncontrolled areas on-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 July 1982. *

2.2 Organization Responsibilities and Authority (continued)

Primary responsibility and authority to suspend unsafe operations is placed with Operating Supervision. Within their respective responsibilities, members of NLS&A also have authority to suspend operations not being performed in accordance with approved procedure.

2.3 Safety Review

On-site safety review is performed by the NLS&A Supervisor. Other plant management and support personnel are involved as determined by the Plant Manager or the NLS&A Supervisor. The safety review function is described in subsequent sections of this chapter. An annual safety review is performed by a team appointed by the Vice President-Nuclear Fuel. The annual review is described in Section 2.8.

2.4 Approval Authority for Personnel Selection

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

2.5 Personnel Education and Experience Requirements

The minimum qualification of the Plant Manager and first line management shall be a B.S. degree in a technical field with two years experience in nuclear plants and laboratories, or high school with ten years nuclear industry experience.

The NLS&A Supervisor shall hold a B.S. degree in science or engineering and have at least five years experience in a responsible position in the nuclear industry, at least three years of which have been in an activity which involved nuclear criticality safety and health physics evaluations. An under- *

2.5 Personnel Education and Experience Requirements (continued)

standing of industrial safety problems and controls is also required. The NLS&A Sueprvisor is responsible for implementing the radiation safety and criticality safety programs. *

The Nuclear Criticality Specialist shall hold a degree in science or engineering and have a minimum of three years experience in plant nuclear criticality safety.

2.6 Training

Indoctrination of new employees in the safety aspects of the facility shall be conducted by, or under the supervision of, specialists in the various topics. The indoctrination topics shall include nuclear criticality safety, fundamentals of radiation and radioactivity, contamination control and ALARA practices, emergency procedures. After determining by testing that a new employee has obtained sufficient knowledge in the above topics, the new employee begins on-the-job training under direct line supervision and/or experienced personnel. Adequate performance is monitored by the Foreman and NLS&A prior to permitting work without close supervision.

The training and personnel safety program is continued with on-the-job training supplemented by regularly scheduled meetings conducted by line supervision and specialists in the subjects covered. Personnel protective equipment,

2.6 Training (continued)

Industrial safety and accident prevention and other safety topics are included. Foremen receive a formal course in radiation safety and criticality control. Sufficient knowledge to enable them to carry out their training functions is determined by testing. All operating personnel receive a re-training course in criticality control and radiation safety on an annual basis. The effectiveness of retraining is determined by testing. All formal training shall be documented. *

2.7 Operating Procedures

Operating procedures are prepared by the responsible function and issued and controlled by Quality Assurance, provide detailed instructions for equipment operation and material handling, including specific safety requirements. Operating Sheets are the basic control document; before issuance or revision they require Engineering, Production, Quality Assurance, Nuclear Licensing and Safety and Accountability approval by signature. Sheets shall be reviewed and updated every 2 years. *

Supervision at all levels is required to assure that all handling, processing, storing and shipping of nuclear materials is given prior review and approval by NLS&A, that suitable control measures are prescribed, and that all pertinent regulations and control procedures relative to nuclear criticality safety or radiological safety are followed.

Supervision is further required to assure that, prior to the start of any new activity involving nuclear materials,

2.7 Operating Procedures (continued)

The minimum frequency for updating all operating procedures involving Special Nuclear Materials shall be every two (2) years.

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 all safety-related and environmental programs. Qualified personnel having no direct responsibility for the function and/or area being audited shall be used to ensure unbiased and competent audits.

Daily checks for safety-related problems are made by NLS&A technicians, who observe, note and make general observations in addition to their other duties. Problems are normally corrected on the spot by the shift Foreman. More significant problems are listed on the daily exception report distributed to the Plant Manager and all Supervisors. The Production Superintendent is responsible for corrective action.

Monthly inspections, performed by the NLS&A Supervisor or his designated representative, cover all aspects of criticality control, radiation safety and industrial safety. Items requiring corrective action are documented in a report distributed to the Plant Manager and all Supervisors and Foremen. The Production Superintendent is responsible for corrective action, except where another Supervisor is specifically designated. Followup actions taken by the Production Superintendent, or responsible Supervisor, shall be documented. *

2.8 Audits and Inspections (continued)

An inspection will be conducted twice per year by the Nuclear Criticality Specialist covering all phases of nuclear criticality safety and control, including results of previous inspections and follow-up action taken.

These semi-annual inspections are documented and reports distributed to the General Manager, Plant Manager, NLS&A Supervisor and other Supervisors. The Production Superintendent and the NLS&A Supervisor are responsible for any corrective actions required.

Annual audits are conducted in which the results of previous inspections of audits are reviewed, as an evaluation of the effectiveness of the program. These audits may also involve a detailed review of non-safety documents such as operating procedures, shop travelers, etc., and are documented by a formal report to the Vice President-Nuclear Fuel. Annual audits are performed by a team appointed by the Vice President-Nuclear Fuel. The team shall include, as a minimum, a Nuclear * Criticality Specialist and a Radiation Specialist from Windsor who shall audit all phases of Radiation and Nuclear Criticality Safety. The annual audit will review ALARA requirements in conformance with Regulatory Guide 8.10, as applicable. Qualifications of Windsor Specialists are provided in License SNM-1067. The NLS&A Supervisor shall be responsible for followup of recommendations made by the audit team.

2.9 Investigations and Reporting of Off-Normal Occurrences

All events specified by applicable regulations or license conditions shall be investigated and reported to NRC.

3.0 RADIATION PROTECTION

3.1 Administrative Requirements

3.1.1 Radiation Work Permit Procedures

Operations not covered by an effective operating procedure shall be conducted under a Special Evaluation Traveler (S.E.T.). Prepared by the responsible function, it shall contain detailed instructions for the procedure and shall include all safety requirements to assure that the proposed operation is conducted in a safe manner. The same approvals as required for Operating Sheets shall be required on all S.E.T.s. Completion of the operation shall be appropriately documented as indicated on the traveler. *

3.1.2 ALARA Commitment

C-E's commitment to ALARA pertaining to employees is part of the policy statement in Section 2.1. The annual audit team, described in Section 2.8 considers ALARA requirements in conformance with the intent of Regulatory Guide 8.10.

3.2 Technical Requirements

3.2.1 Access Control

The facility shall be zoned to define contamination areas and clear areas. Protective clothing shall be worn in the contamination areas. * A sink and alpha survey meter or alpha monitor shall be provided at the exit from the contamination area. All personnel are required to wash and monitor their hands, and to monitor other body surfaces and personal clothing as appropriate, when exiting a contaminated area. Except for hand contamination which is easily removed on the first rewashing, health physics assistance and approval for release above background levels shall be required.

3.2.2 Ventilation Requirements

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. All 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 by NLS&A, except during periods when not in use. This effectively limits HEPA filter pressure differential to less than 8 inches of water. *

Glove boxes under negative pressure will be used where airborne material is actively generated such that ventilated hoods would not be adequate.

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

Air effluents from process areas and process equipment involving uranium in a dispersible form shall be subject to air cleaning. Exhaust air cleaning shall include use of high efficiency filters except where the effluents, evaluated individually, do not contribute significantly to the total emission. Low velocity blowers are used to preclude filter damage if heavy loading occurs. All exhaust stacks shall be continuously monitored when in operation. Air cleaning equipment that may be used is: *

a. Cyclone Collectors.
   Used to remove particulates from exhaust streams that are heavily loaded.

b. High Efficiency Particulate Air Filters
   Used in the majority of cases for highest efficiency air cleaning, normally in conjunction with roughing filters to extend useful life and improve reliability.

3.2.2 Ventilation Requirements: (continued)

c. Wet Scrubbers.
Used to clean heavily loaded air streams that are not suited, due to air quality or temperature, to other cleaning methods.

d. Dry Scrubbers.
Used primarily for cleaning air streams containing corrosive agents that render wet scrubbing impractical.

e. Fabric Filters.
Normally used in systems where material impinging on them can be returned to the process using reverse jet, pulsed air or other disloding methods.

f. Special Filters.
Ceramic or metallic frit filters, usually an integral part of process equipment, may be used for special air cleaning requirements.

3.2.3 Instrumentation

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

a. Nuclear Alarm System
The nuclear alarm system consists of gamma sensitive detectors, audible alarms and a remote indicator panel at the guard station. The requirements for this alarm system are:

1) Detector units shall have a pre-set alarm level of not less than 5 mR/hr or greater than 20 mR/hr.

2) Detector units shall also have a response time no greater than 3 seconds at a radiation level of 20 mR/hr.

3.2.4 Internal and External Exposure

3.2.4.1 Special Surveys

All non-routine operations not covered by operating procedures shall be reviewed by NLS&A and a determination made by NLS&A if radiation safety monitoring is required.

With the exception of incidents requiring immediate evacuation, spills or other accidental releases shall be cleaned up immediately. Criticality restrictions on the use of containers and water shall be followed at all times. The Foreman and NLS&A must be notified immediately of such incidents. Appropriate precautions such as use of respirators shall be observed.

3.2.4.2 Routine Surveillance

Surveys shall be conducted on a regularly scheduled basis consistent with plant operation and survey results. The frequency of survey depends upon the contamination levels common to the area, the extent to which the area is occupied, and the probability of personnel exposures. The minimum frequency for contamination surveys in plant operating areas shall be as specified in Table 1 of Regulatory Guide 8.24, where applicable. Clear areas with high potential for tracking of contamination may be surveyed more frequently. Areas with a low use factor may be surveyed less frequently. *

Cleanup action for restricted areas shall be initiated when surface contamination exceeds the action limits specified in Table 2 of Regulatory Guide 8.24. *

3.2.4 Internal and External Exposure

3.2.4.2 Routine Surveillance (continued)

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

Contamination limits for release of equipment and materials from the plant to off-site or from controlled to uncontrolled areas on-site shall be 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 July 1982. *

3.2.4.3 Air Sampling Criteria

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

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

a. Fixed location samplers shall be used where uranium handling operations are pursued for extended periods of time, or where short term operations occur frequently. These samples shall be located in or as near as practical to the breathing zone of the person performing the operations. Fixed sampling may also be used for investigative purposes. In this case, the samples may.be collected near the point of suspected release of material.

b. Lapel samplers may be used for supportive measurements and special studies, and air monitors for early warning of unexpected releases. *

c. Emphasis shall be placed on sampling new operations or processes until adequate, effective, control of airborne contamination is assured.

3.2.4.4 <u>Airborne Concentrations</u>

a. Airborne levels in excess of 25% of the maximum permissible concentration shall require posting in accordance with 10CFR20 and an investigation of the causes.

b. Airborne levels in excess of the maximum permissible concentration shall require exposure evaluation. Controls to restrict the personnel to less than 40 MPC-hours per week shall be required.

c. Effective air control by ventilation systems shall be assured by face velocity checks performed at least weekly. These checks may be supplemented by pressure drop measurements across air cleaning devices or inspection of such devices for continued integrity or loading that would impair their effectiveness. When ventilation control suffers or effluent concentrations rise, cleaning devices shall be cleaned or replaced.

d. The room air in all areas where unclad licensed material is processed and where operations could result in worker exposure to the intake of quantities of radioactive material exceeding those specified in 10 CFR 20.103, shall be regularly sampled and analyzed for airborne concentration of radioactivity. The survey frequency shall be in accordance with Table 1 of Regulatory Guide 8.24 dated October 1979, where applicable. *

3.2.4.4 Airborne Concentrations (continued)

e. If a single air sample indicates the airborne concentration of radioactivity for that area exceeds MPC_{air} specified in Table 1, Column 1 of 10 CFR 20, Appendix B, an investigation of the cause shall be made and documented. *

f. Where fixed air sampling equipment is used to determine concentration in a worker's breathing zone, the fixed air sampling head shall be reexamined for its representativeness whenever any licensed process or equipment changes are made. *

g. Any air samples that are suspected of reflecting releases and high concentrations shall be counted at once to identify any samples with quantities of uranium greater than expected for the sampling location and volume. *

3.2.4.5 Personnel Monitoring

Personnel monitoring shall be supplied to each individual who is likely to receive a dose in excess of 25% of the applicable limits in 10CFR20 and those personnel who routinely work in process areas. The personnel monitoring device may be either a film badge (changed monthly) or a TLD (changed quarterly). *

The personnel dosimeters shall be sensitive to an exposure of 25 millirem. Hand exposures will be determined by surveys. Exposures in excess of 25% of the applicable limits shall be investigated to prevent the total occupational dose from exceeding the standard specified in 10 CFR 20.101. *

3.2.4.6 Bioassay

The bioassay program shall satisfy the requirements of Regulatory Guide 8.11, "Applications of Bioassay for Uranium", except that in Table 2 semi-annual in-vivo frequencies may be replaced by annual frequencies for minimum programs only.

3.2.4.7 Respiratory Protection

The respiratory protection program shall be conducted in accordance with Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection".

4.0 NUCLEAR CRITICALITY SAFETY

4.1 Administrative Requirements

4.1.1 Double Contingency Policy

Process designs shall, in general, incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.

4.1.2 Criticality Safety Review

Final design, initial installation, modification, or relocation, of special nuclear material processing, handling or storage equipment, or related operations, shall be reviewed and approved by the NLS&A Supervisor. Such changes as could effect nuclear criticality safety shall be reviewed by the Criticality Specialist prior to implementation. The review and approval procedure is described in Section 2.7 of this part. *

4.1.3 Posting of Limits

Signs listing approved nuclear criticality safety limits shall be posted such that information thereon is readily discernible to employees. This posting may be for individual pieces of equipment or groups of equipment, depending on the nature of the operations covered.

4.2.3 Safety Margins for Individual Units

Except as specified, safety margins applied to units calculated to be two percent subcritical, and incorporated in the SIUs shall be as follows:

Mass	2.3
Volume	1.3
Cylinder Dia.	1.1
Slab Thickness	1.2

These valves shall be further reduced where necessary to assure maximum fraction critical values of 0.4 for geometrically limited units, and 0.3 for mass limited units (when based on optimum water moderation). An additional reduction has been applied to several mass and volume limits to assure that spacing requirements remain constant for all enrichments.

For validated computer calculations, the highest K_{eff} for a single unit or an array shall be 0.95 including a 2 * sigma statistical uncertainty and including all applicable uncertainties and bias. Consideration shall be given to greater safety factors where there are large uncertainties.

The basic assumptions and criteria used in establishing * safe parameters for single units and arrays shall be as follows:

a) The possibility of accumulation of fissile materials * shall be evaluated and, if the possibility exists for the accumulation of fissile materials, design changes or administrative controls must be imposed to eliminate the accumulation problem.

b) Nuclear safety shall be independent of the degree of moderation within the process unit when addition of moderating materials is considered to be credible.

4.2.3 Safety Margins for Individual Units (continued)

c. Nuclear safety shall be independent of the degree of moderation between units up to the maximum credible mist density. The maximum mist density will be determined by studying all the sources of water in the vicinity of the single units or arrays. The maximum mist density may be limited by design and/or by administrative controls. *

d. Criteria used in the choice of fire protection in areas of potential criticality accidents (when moderators are present) shall be justified.

e. Nuclear safety shall be independent of neutron reflector thickness for the reflector of interest.

f. Optimum conditions (limiting case) of water moderation and heterogeneity credible for the system shall be determined in all calculations.

g. The analytical method(s) used for criticality safety analysis and the source of validation of the method(s) shall be specified.

h. Safety margins for individual units and arrays shall be based on accident conditions such as flooding, multiple batching, and fire.

i. The method of deriving applicable multiplication factors shall be specified.

4.2.4 Limits for Safe Individual Units (SIUs)

Table 4.2.4

Safe Individual Unit Limits for ≤ 4.1% enriched UO_2 at optimum moderation. All Mass and Volume limits have been adjusted to provide constant spacing areas for the enrichment shown. Heterogeneous limits have been developed with optimum rod sizes (up to 0.4" diameter) taken to allow for pellet chips, etc.

4.2.5 Surface Density Method (continued)

moderator, if "smeared" over the allowed spacing area, would not exceed 50% of the minimum water reflected infinite slab surface density, based on optimum moderation. For cylinder and volume limited SIUs, a spacing limit based on 25% of the minimum water reflected infinite slab thickness applies. Horizontal slab limited SIUs require no additional spacing and may border the spacing boundary for any other array unit.

Modified limits, designated for use with the surface density method, are provided in Table 4.2.4. These limits apply under conditions of "in-plant-reflection" where the floor is 16"-thick concrete, and the roof is the equivalent of less than 4" of concrete. Spacing requirement for the limits specified in Table 4.2.4 are provided in Table 4.2.5.

Table 4.2.5

Spacing requirements for mass, volume, or cylinder SIUs specified in Table 4.2.4.

Limit	Spacing Area
Mass	3.5 ft^2
Volume	9.0 ft^2
Cylinder (per ft. of length)	5.0 ft^2

Spacing areas shall be established to provide equal distances from the edges of the units to the spacing boundary in all directions. Co-planar slabs specified in Table 3-1 require no additional spacing. Non-Co-planar slabs within 4 feet of each other are limited to a maximum of 12-inch vertical differences, and must be separated by a 6-inch minimum horizontal spacing. *

4.2.5 Surface Density Method (continued)

Mass limited SIUs may be stacked on a vertical centerline with at least 10-inch edge separation. Maximum allowed volume for stacked SIUs shall be 20 liters.

Vessels and other items of equipment requiring exclusion areas shall have the limits of these areas clearly marked on the floor. SIUs in transit shall not be permitted to enter an exclusion area. This rule shall be covered in operator training and operating procedures.

4.2.6 Solid Angle Method

Where either the SIU "fraction critical" value or the "smeared" slab thickness limitation cannot be met, the spacing of an array may be established by the solid angle criteria of TID7016, Rev. 2. Subcritical limit values may also be established using methods described in this guide.

4.2.7 Minimum Spacing Requirement

Any SIU shall be spearated by at least 12 inches from any other SIU, unless a smaller spacing is specifically analyzed and incorporated into the array design.

4.2.8 Concentration Control

Uranium concentration control SIUs shall be limited to a maximum concentration 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 SIUs shall not be considered to contribute to interacting arrays, but shall be located outside exclusion areas assigned by the surface density method.

Fixed poisons may be used in liquid fissile material systems provided the system shall be maintained in accordance with ANSI Standard N16.4-1979, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material". *

A safe mass of uranium shall be used for aqueous solutions under only administrative control. The safe mass limit does not apply to fixed poison systems. *

4.2.9 Fire Hazards

Evaluation of proposed changes in facilities, equipment or operations shall include consideration of fire hazards. All equipment and operations shall be designed, and materials selected, to minimize fire hazards.

5.0 ENVIRONMENTAL PROTECTION

5.1 Effluent Control Systems

5.1.1 ALARA Commitment

Gaseous, liquid, and solid waste streams shall be handled such that radioactivity exposures to plant workers, visitors, and the general public are kept as low as reasonably achievable.

5.1.2 Air and Gaseous Effluents

Exhaust air effluents from process areas and process equipment shall be sampled continuously during operations. These stack samples shall be changed at least weekly, except that new operations shall be sampled more frequently until effective control is assured.

All samples shall be counted after suitable delay for decay of radon daughters, and the results evaluated. The lower limit of detection shall be no more than 10% of 10 CFR 20, Appendix B, limits. *

The control limit for gross alpha activity in exhaust air effluent shall be 4×10^{-12} μCi/cc.

If the control limit is exceeded, averaged over a two week period, an investigation shall be conducted and corrective action taken.

A further control limit for total plant exhaust stack effluents shall be 150 μCi per calendar quarter. If this control limit is exceeded, a report shall be prepared and submitted to the commission, within 30 days, which identifies the cause and the corrective actions taken or to be taken.

5.1.3 Liquid Effluents

Levels of contamination in liquid effluents shall be measured by representative grab sampling of batch discards, by proportional sampling of continuous discharges, or both. Samples shall be collected at or prior to the point of discharge from the waste handling system. Samples shall be analyzed for gross alpha and gross beta activity. The lower limit of detection shall be no more than 10% of 10 CFR 20, Appendix B, limits. *

The control limits for alpha and beta activity in liquid effluents shall be:

alpha - 3.0×10^{-5} μCi/mℓ
beta - 2.0×10^{5} μCi/mℓ

A further control limit for liquid effluent streams which discharge to Joachim Creek (NPDES Outfalls 001 and 002) shall be:

alpha - 3.0×10^{-6} μCi/mℓ
beta - 2.0×10^{-6} μCi/mℓ

If these control limits are exceeded, averaged over a calendar quarter, an investigation shall be conducted and corrective action taken.

5.1.4 Solid Wastes

Low level solid wastes shall be packaged in accordance with all applicable regulations and delivered to a carrier for transport to an approved disposal site.

5.1.4 Solid Wastes (continued)

Non-contaminated solid wastes are disposed of by a commercial waste disposal firm. Old items of non-contaminated equipment may be disposed of to commercial scrap dealers.

Inspection of conditions of storage of waste, waste containers, and contaminated equipment shall be included in the monthly NLS&A audit. *

5.2 Environmental Monitoring

Locations of air particulate, soil, vegetation, well water, surface water and liquid effluent sampling stations shall be established and kept part of the Demonstration Section of this license.

Monitoring locations may be changed only if a documented evaluation by NLS&A demonstrates that a new location provides data that are as representative (or more representative of) conditions likely to impact on the general public, as was the data from the original location.

The minimum environmental monitoring program shall consist of the following samples:

5.2 Environmental Monitoring

Environmental samples shall be collected and analyzed as shown in Table I.5-1, at locations shown in Figure I.5-1.

Sample frequency may vary due to inclement weather, plant shutdown, or operating conditions. More frequent or additional samples may be taken as required for special studies and evaluations.

Table I.5-1 Environmental Monitoring Program

OPERATIONAL EFFLUENTS MONITORING PROGRAM

Sample Medium	No. of Sampling Points	Collection & Analysis Frequency	Sample Type	Type of Analysis	Action Level
Air Effluent	8 Exhaust Stacks	Continuous & analyze weekly	Particulate	Gross alpha	Two week average MPC
Air Effluent	Conversion offgas stack	Continuous & analyze weekly	Particulate	Fluoride	
Liquid Effluent	Site dam Sewage treatment outfall	Continuous & analyze weekly	Composite	Gross alpha & beta	Above MPC
Solid Waste	Limestone disposed onsite Waste in 55-gal. drums (<25 uCi/package) to licensed burial ground				

OPERATIONAL ENVIRONMENTAL MONITORING PROGRAM

Sample Medium	No. of Sampling Points	Collection & Analysis Frequency	Sample Type	Type of Analysis
Air	2 onsite remote	Continuous & analyze quarterly	Particulate	Gross alpha
Surface Water	Joachim Creek above and below site creek outfall.	Monthly	Grab	Gross alpha & beta
	Joachim and site creek confluence	Quarterly	Grab	Gross alpha & beta
Ground Water	Plant well	Monthly	Grab	Gross alpha & beta
	Offsite well (Hematite)	Quarterly	Grab	Gross alpha & beta
	3 monitoring wells for evaporation ponds	Monthly	Grab	Gross alpha & beta
Soil	4 locations surrounding plant	Quarterly	Grab	Gross alpha & beta
Vegetation	4 locations surrounding plant	Quarterly	Grab	Gross alpha & beta
	4 locations surrounding plant	Quarterly	Fluoride	

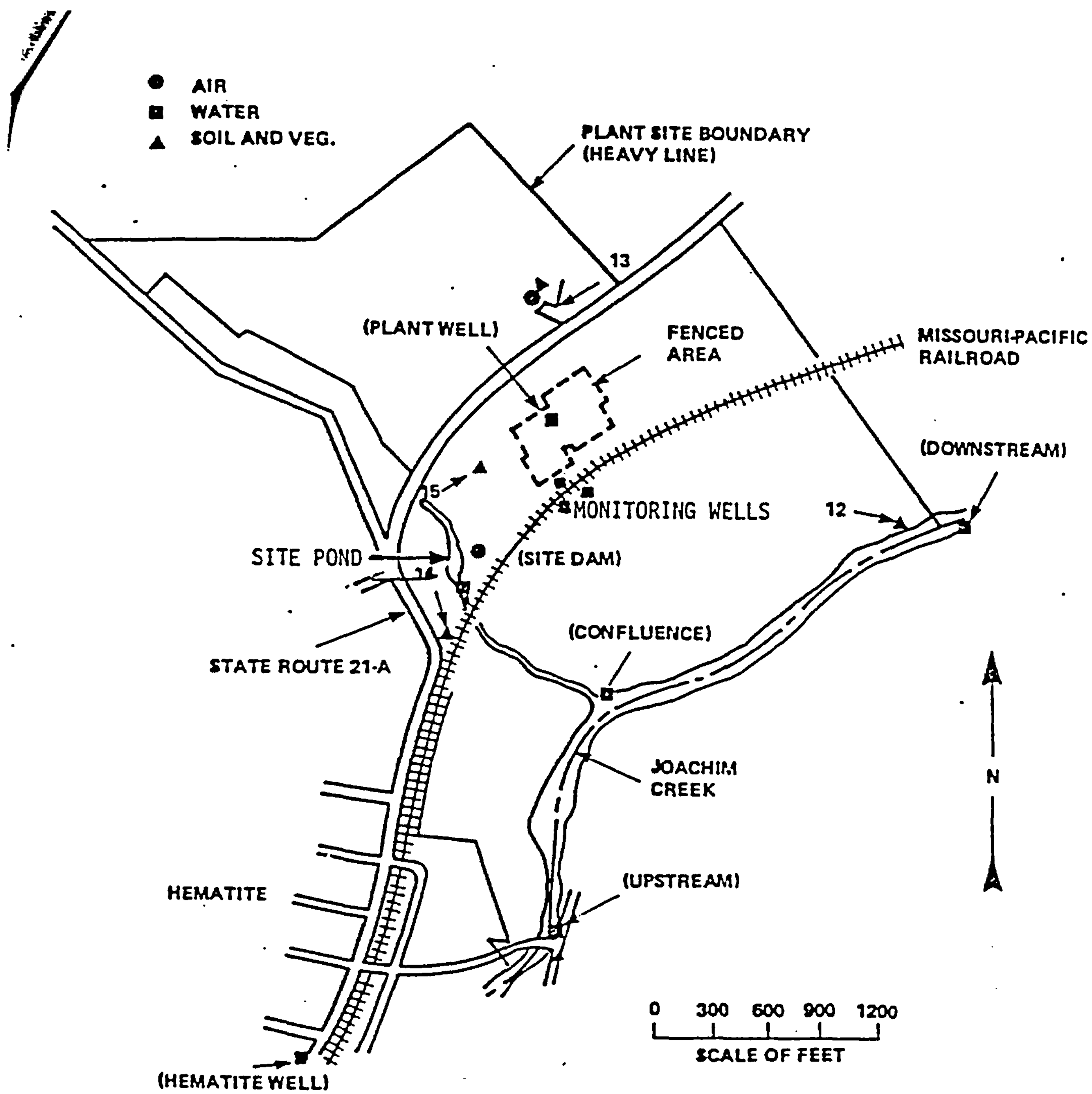

Figure I.5-1 Location of Monitoring Sites Around Hematite Facility

8.0 EMERGENCY PLAN

Combustion Engineering's approved "Radiological Contingency Planning Information", dated January 1982, which was revised September 1982, should be considered part of this application for license renewal. *

2.3 Heating, Ventilation, and Air Conditioning (continued)

The Oxide Building also has an unfiltered room air exhaust which is operated only infrequently during periods of hot weather, at times when release of contamination is unlikely, and is monitored when used. A continuous air monitor, located on the 4th floor, will alarm should a release occur. *

All exhaust stacks are continuously monitored when in operation.

Exhaust stacks have the following flow rates:

Stack Identification	Flow Rate (CFM)
Oxide Main Exhaust	9,773
Oxide Powder Unloading	4,909
Oxide Roof Exhaust	7,068
Bldg. 255 Roof Exhaust	9,032
Bldg. 255 West Manifold	12,020
Bldg. 255 East Manifold	9,773
Bldg. 240 Dry Recycle	3,657
Bldg. 240 Wet Recovery	5,807

2.4 Waste Handling

2.4.1 Liquid Wastes

Cleanup and mop water are evaporated to recovery the uranium. * Process water from wet recovery is evaporated for concentration of the chemical content, and then solidified for shipment to licensed burial. Laundry water is filtered prior to discharge to the industrial waste system (storm drains).

2.4.1 Liquid Wastes (continued)

Cooling water, chemically unchanged, is discharged to the storm drain system. Water from change room sinks and showers is routed to the sanitary waste system. *

Small quantities of liquids from cleaning glassware in the laboratory are discharged to the industrial waste system Disposal of lab analytical residues to the sink drains is not practiced, as they are recycled for recovery. *

The storm drain system discharges into the site pond which overflows to form the site creek. The overflow is continuously proportionately sampled and analyzed for gross alpha and beta activity. The sanitary waste effluent enters the site creek immediately below the site pond. It is also sampled and analyzed for gross alpha and beta activity. *

Sanitary and industrial waste line flows are shown in Figure II.2.2.

2.4.2 Solid Wastes

Solid wastes which are potentially contaminated are generated throughout the controlled area. These wastes consist mostly of rags, papers, packaging materials, worn-out shop clothing, equipment parts, and other miscellaneous materials that result from plant operations. After passive assay (gamma-counting) to determine the U-235 content, wastes are compacted in 55-gallon drums, or packaged in plastic-lined wooden crates for shipment to a licensed low-level burial site. Bulky items with only low levels of surface contamination are placed directly in the lined wooden crates.

2.4.2 Solid Wastes (continued)

A gas-fired incinerator has been installed to reduce the volume of combustible contaminated wastes for shipment to licensed burial. This incinerator also supplements the oxidation/reduction furnaces used to reduce wastes containing recoverable quantities of uranium. The incinerator is equipped with a wet scrubber system to clean offgases prior to routing to the wet recovery stack.

Calcium fluoride and limestone from the conversion process dry scrubbers are used as fill materials on site. These materials, referred to as spent limestone, do not contain detectable contamination and are not considered to be radiological solid waste. (Less than 100 dpm per 100 cm^2 of rock surface). Contaminated limestone is held within the controlled area. *

Non-radioactive solid waste is disposed of by a commercial waste disposal firm. Old items of non-contaminated equipment may be disposed of to commercial scrap dealers.

2.5 Chemical Storage

Chemicals will be stored in accordance with all pertinent federal and state regulations. Chemicals currently used are:

Ammonia - approximately 420,000 pounds used per year as a reducing gas in the production of UO_2 powder, pellets, and in preparation of material for recycle.

Potassium Hydroxide - approximately 3,500 pounds used per year. Mixed with process water and used as wet scrubber liquor to remove hydrofluoric acid from the recycle pyrohydrolysis process effluent.

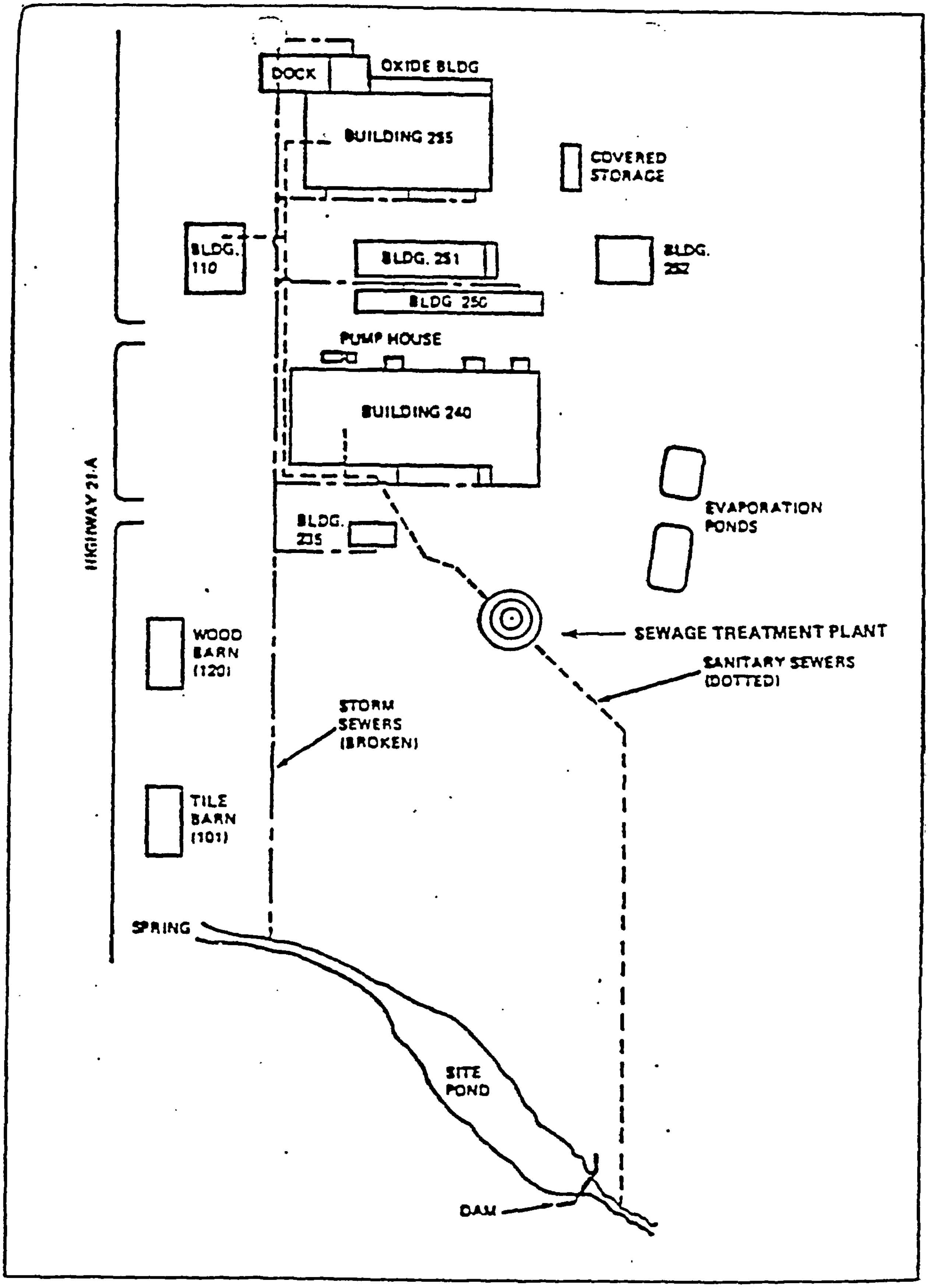

Figure II.2.2 Sanitary and Industrial Waste Line Flows

LOUIS J. SWALLOW - QUALITY ASSURANCE MANAGER - HEMATITE

M.S., Mechanical Engineering, Washington University, 1955
B.S., Mechanical Engineering, Washington University, [redacted] Ex. 6
Nuclear Criticality Safety School, Oak Ridge National Laboratory, 1959

Ex. 6

PROFESSIONAL EXPERIENCE:

Combustion Engineering, Inc., 1974 to Present
Quality Assurance Manager - Hematite

Responsible for all Quality Assurance activities in Nuclear Fuel Manufacturing-Hematite. Supervises Quality Control Engineering, Quality Assurance Engineering, and Chemical and Physical Test and Inspection, provides technical support for SNM Measurement, SNM Measurement Control and Statistical Evaluations.

Gulf United Nuclear Fuels Corporation 1970-1974

Responsible for Process Engineering, Facilities & Equipment Engineering, Capital budgets. Assigned as Acting Plant Manager during extended absences of the Plant Manager.

During this period, the plant produced 200 MTM of pellets for light water reactor fuel and several thousand kgs of special naval reactor fuel.

United Nuclear Corporation 1968-1970
Nuclear & Industrial Safety Manager, Commercial Products Division

Responsible for establishing the overall Nuclear Criticality, Health Physics & Industrial Safety programs for the three manufacturing plants operated by the division. Including AEC license applications and approval, Nuclear Criticality Safety Analysis, and Health Physics Monitoring and Analysis.

United Nuclear Corporation 1967-1968
Construction Manager, SWOPP Task Force, Chemical Operations

Responsible for design, planning, scheduling and contracting the construction of the UF_6 conversion plant and UO_2 pellet plant.

LOUIS J. SWALLOW (continued)

United Nuclear Corporation 1964-1967
Operations Control Manager, Chemical Operations

Responsible for Quality Control, Nuclear Safety & Health Physics Program, Special Nuclear Material Licensing, Special Nuclear Materials Accountability, Scrap Recovery, Nuclear Criticality Safety Evaluations.

United Nuclear Corporation 1958-1964
Research & Development Engineer, Chemical Operations

Responsible for UO_2 pellet encapsulation, Quality Control, Nuclear Safety and Health Physics, Nuclear Criticality Safety Evaluations.

Mallinckrodt Chemical Works 1955-1958
Project Engineer, Uranium Division

Responsible for design and installation of uranium metal production equipment in the Feed Materials Plant.

5.0 OCCUPATIONAL RADIATION EXPOSURES

Due to the low levels of penetrating radiation which exist in the plant, the greatest emphasis in exposure control has been directed towards minimizing inhalation of airborne uranium particulates. To this end, CE has maintained airborne exposures as low as reasonably achievable through the use of ventilated hoods and process containment and an extensive breathing zone (BZ) air sampling program. Fixed air samplers are strategically placed throughout the facility to provide indications of general airborne activity levels. A continuous air monitor with an alarm is utilized in the Oxide Building to more rapidly detect an increase in the airborne activity level.

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

5.1 External Radiation Exposures

External radiation exposures are measured by film badges which are changed monthly. Results of monitoring for 1979, 1980, and 1981 were:

Annual Dose Ranges (Rem)	% of Personnel in Range 1979	1980	1981
No measurable exposure	18	25	29
Less than 0.100	75	59	41
0.100 - 0.250	5	16	30
0.250 - 0.500	2	0	0
Greater than 0.500	0	0	0

*

7.4 (This Section reserved for future use)

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7.5 (This section reserved for future use)

7.6 Mass Limited Units on Single Levels

Mass limited units having a maximum fraction critical (f) of 0.3 are to be spaced to a maximum array surface density of 50% of the optimum critical surface density based on mass per unit area. This criteria is supported as follows:

Consider the following infinite planer arrays of units containing moderated UO_2 having an enrichment of 5%. For these arrays, the following parameters apply:

7.6 Mass Limited Units on Single Levels (continued)

From these analysis and recalling that "in plant reflection" is some 1.5% less reactive than the fully reflected cases described above, it is concluded that use of a limit equal to 50% of the minimum critical slab surface density (at optimum moderation) expressed in terms of mass per unit surface area is safe, with a maximum nominal array reactivity of 0.935.* These calculations clearly demonstrate that the license criteria provides adequate safety for plant applications. However, reviews of calculated arrays as described in Reference 1 could call these limits into question, and therefore require further attention.

Specifically, several arrays of under moderated low enriched uranium show surface densities which, in some cases, are less than 50% of the infinite slab thickness for material of like moderation and density. However, the license criteria specifically limits use of the method to spacing based on optimum mass per unit area moderation. Examination of the spacings in Reference 1 show that when compared to slabs having optimum mass per unit area moderation all arrays have surface densities at or above 85% of the optimum infinite slab value. This is shown in Table II.7-4 and Figure II.7-3.

(a) At the given sphere spacing, a 16" concrete reflector in contact with the sphere array produced no significant change in reactivity.

*The bias is negative therefore the array is less than 0.95 k_{eff}. *

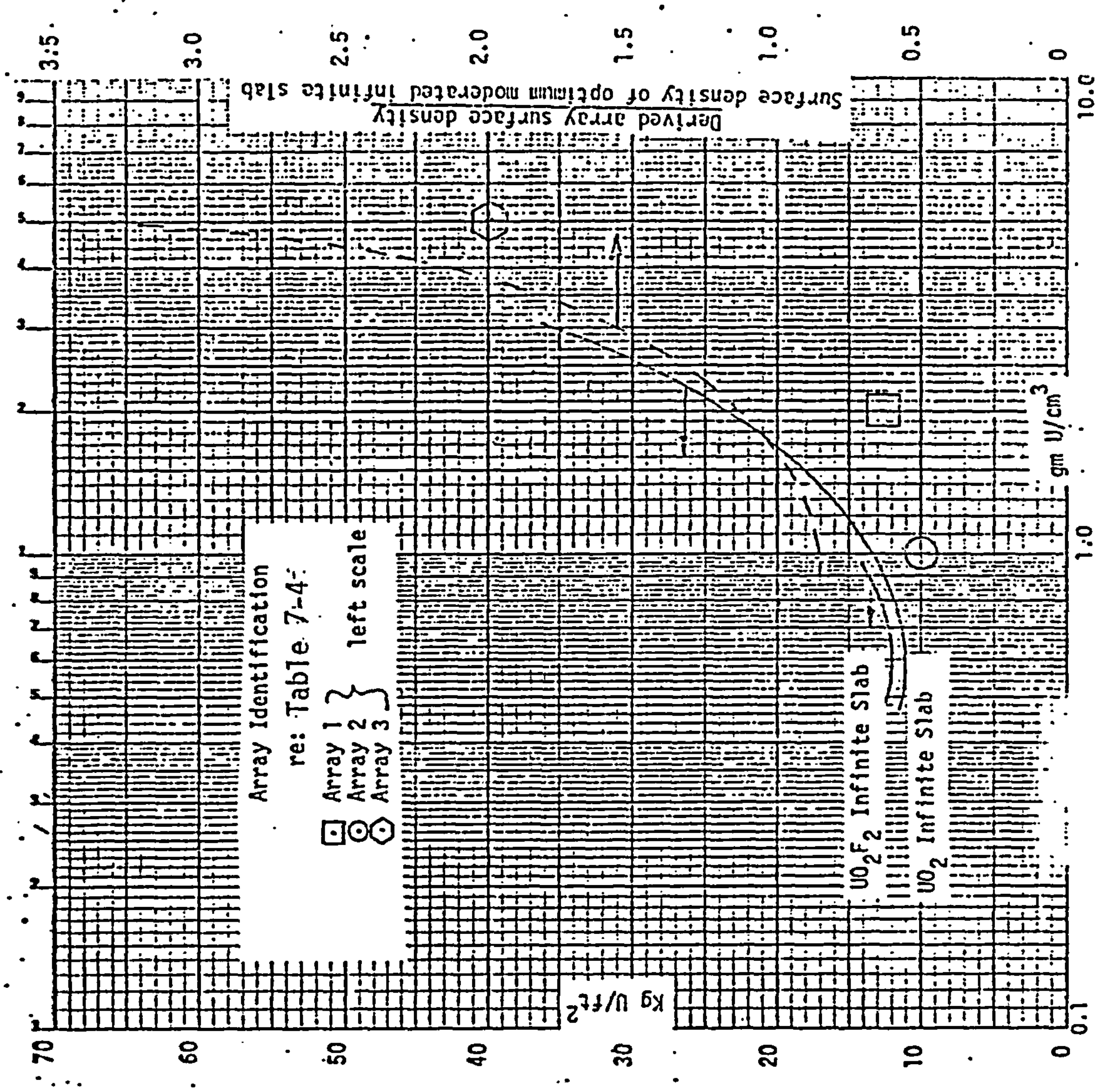

Figure II.7-3

Comparison of derived array surface densities with infinite slab values

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8.1.2 UF_6 Conversion Process (continued)

A 4-inch diameter exhaust duct is also attached from the steam chamber to a wet scrubber. In the event of a UF_6 leak, condensing steam will take SNM to the condensate line. When the conductivity cell in the drain line senses SNM, it will close the automatic shut-off valve, start the scrubber and shut off the steam supply.

Air, steam and UF_6 vapor from the vaporizer station are then mixed with the scrubber liquor in a 6" diameter eductor-venturi type scrubber. The separation of the condensate containing the SNM from the washed air is accomplished in a baffled separator, 23 inches x 9 inches x 15 inches deep. The condensate drains to a 10 inch diameter hold tank where it is recirculated to the eductor. The washed non-condensables exhaust from the separator through a 6 inch diameter duct through a blower to atmosphere. This diameter is safe as per Table I.4.2.4

Any overflow from the hold tank drains through a one-inch pipe line to the building sump.

That portion of steam and SNM that continue to condense in the vaporizer will drain through the condensate line and overflow onto the concrete pad from the air gap to the closed drain line. (See Section II.9-8) *

During normal operation, the vaporized UF_6 leaves the cylinder through a 3/8 inch line and enters a heated pipe chase into the Oxide Building. It passes through metering valves, picks up carrier gas and is carried vertically along the wall to the top level of the Oxide Building and directly into the conversion equipment. The UF_6 control station and subsequent UF_6 piping are wrapped with a steam tracing line and covered

8.1.5 Blending (continued)

Blenders are arranged on six foot centers forming an inline array and are located at least four feet from other SNM-bearing equipment.

8.1.6 Packaging and Storage

Dry UO_2 product is transferred into stainless steel cans (9.75" ø X 11" long) in the ventilated powder packaging hoods. A 4 mil poly bag may be used as an inner liner. If used, it is sealed at the top with tape. The can lid is a friction-fit type which is sealed on the outside with tape. This precludes any in-leakage of moisture from atmospheric humidity (the powder is not hygroscopic) or flooding. Thus, the UO_2 product is kept dry (typically <.05% moisture) and moderation control is assured under all conditions. Section II.9.7 describes all moderation controls in detail. *

The sealed cans of dry UO_2 product are then transferred to one of 5 roller conveyors on the north side of Building #255 as shown in Drawing D-5007-2001, Sheet 9 of 9. The entire building is above the 100 year flood level as determined by the U.S. Army Corps of Engineers in their Special Study for Joachim Creek, dated March 1980. Even if flooding were possible, the 30 Kg weight of the cans containing high density UO_2 would prevent them from floating and being moved. Building #255 is not sprinklered and firefighting would be by dry chemical means. Thus, criticality safety is assured through moderation control ($\leq$ 4.1% enriched UO_2 cannot be made critical without moderation).

8.7.3 Dissolution (continued)

Both the slurry and dissolver vessels have smaller diameters than the allowable 9.8 inches, and have assigned spacing areas greater than 5 ft^2 per ft. of length.

8.7.4 Filtration, Storage, and Dilution

After allowing digestion time to insure complete uranium dissolution, the $UO_2(NO_3)_2$ solution may still contain acid insolubles and is pumped through a filter press to remove these solids. The filter press is 8" x 8" x 8-1/2" and has an active volume of less than the allowable safe volume for non-homogeneous material.

After filtration, the solution is pumped into two safe diameter (6" diameter by 5' long) Pyrex clarity check vessels. If any evidence of suspended solids remaining in the solution is observed, it will be recirculated through the filter until a clear solution is obtained prior to release to the holding tank. The holding tank has a maximum capacity of 1285 gallons, and is also used for dilution and blending.

The holding tank is poisoned with Raschig rings in accordance with ANSI Standard N16.4-1979. Two Raschig ring sample tubes are provided to enable inspection for accumulation of solids and to provide samples for testing the physical and chemical properties of the rings. These inspections and tests will be conducted in accordance with the ANSI Standard. *

8.7.6 UO_4 Separation (continued)

The filtrate is pumped through the UO_4 polish filter for additional clarification before being pumped into one of two filtrate hold tanks. These 580 gallon hold tanks are filled with Raschig Rings in accordance with ANSI Standard N16.4-1979. These tanks are similar to the one described in Section 8.7.4. Inspections and tests previously described in Section 8.7.4 are also performed on these tanks and their Raschig Rings. *

The filtrate is mixed prior to sampling for uranium concentration and transfer to the filtrate treatment and furnace scrubber hold tank. The filtrate is mixed, neutralized and sampled for uranium concentration before discharge to the evaporation tanks.

The alternate method of UO_4 separation will be utilization of the UO_4 filter press as the primary filter and the UO_4 polish filter for the final filtration.

8.7.7 Filtrate Treatment

In the event of filtrates containing recoverable quantities of uranium, the filtrate is pumped back into the UO_4 precipitator and the uranium is precipitated with ammonium hydroxide from the NH_4OH makeup. The impure ADU slurry is pumped into the centrifuge or the filter press for separation.

9.8 UF_6 Vaporizers

*

A leak of UF_6 into the steam chamber will not produce a criticality event. If a break occurs the UF_6 will be released in the form of a gas which has a density of about 7 pounds per cubic foot as compared to the solid UF_6 density of 292 pounds per cubic foot. The steam chamber is three inches thick. Assuming the entire chamber is full of UF_6 gas and converting the gas into an equivalent UF_6 solid thickness results in only a 0.2 inch increase in radius of the cylinder and a 0.4 inch increase in length. Since the reflector saving, assuming a water reflector is on the order of 1.5 inches, the amount of UF_6 in the steam chamber will have very little effect on the reactivity.

The design of the chamber also will limit the accumulation of water since the chamber has drains. The amount of equivalent water from the steam in the gap is insignificant since the steam is at atmospheric pressure. The density of steam is 0.03734 pounds per cubic foot compared to 62.4 pounds per cubic foot for water.

Valve covers are not used in handling and storage of cold UF_6 cylinders. Damage to the valve is very unlikely with our limited handling. Even if a valve were to be broken or cracked, no significant release of UF_6 would occur. The cylinders are filled under vacuum, with a substantial void space remaining. The vapor pressure of UF_6 at ambient temperatures is less than the remaining vacuum, so initial leakage would be inward. A crack would rapidly seal with UO_2F_2 from hydrolysis of atmospheric moisture. CO_2 to freeze the UF_6 and wooden plugs to replace a broken valve are readily available.