C-E Power Systems
Combustion Engineering, Inc.
Route 21-A
Hematite, Missouri 63047
Tel. 314/937-4691
314/296-5640

70-36

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Region

POWER SYSTEMS FEB AM 11 33

U.S. NUCLEAR REG. COMMISSION NMSS MAIL SECTION

DOCKETED USNRC FEB 09 1982 NMSS MAIL SECTION DOCKET CLERK

January 27, 1982

R. G. Page, Chief
Uranium Fuel Licensing Branch
Division of Fuel Cycle & Material Safety
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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

Dear Mr. Page:

In accordance with the NRC Order to Modify License SNM-33 dated February 11, 1981, and the Modification of Order, dated May 13, 1981, we are submitting 6 copies of our Radiological Contingency Plan. This plan has been prepared in conformance with the "Standard Format and Content for Radiological Contingency Plans for Fuel Cycle and Materials Facilities", dated January 9, 1981, and will become a condition of License SNM-33 after NRC approval.

Very truly yours,

COMBUSTION ENGINEERING, INC.

H. E. Eskridge

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

/wg
Enclosure

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Combustion Eng
Hematite

Radiological Contingency
Plan

CE HEMATITE

DOCKET: 70-0036

PAPER

Exemption 6

SECTION II. EMERGENCY CALL-IN LIST

A. Names under each position are to be called in order until one is contacted.

Emergency Director

Arlon Noack

Security Officer

Bob Miller

Radiological and Safety Advisor

Harold Eskridge

Nuclear and Industrial Safety*

1. Gary McKay
2. Rick Stokes
3. Nancy Wilper
4. Gerald Boyer

*Alternate Radiological and Safety Advisors and Fire Marshals

Fire Marshals (Also act as Alternate Emergency Directors)

1. Don Dixon
2. Charles Lovell
3. R. Betlock

Plant Manager

J. A. Rode

B. The following are to be called as required.

Maintenance Assistance

1. R. Moore
2. E. Szramkowski
3. C. Patterson
4. R. Wagner
5. R. Tyner
6. R. Duvall

Guard Force Assistance (Also act as Alternate Security Officers)

1. R. Bess
2. R. Rode
3. O. Young
4. R. Parks

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Medical Assistance

1.	Ambulance - Joachim-Plattin Districe	937-3666 (Festus)
2.	Jefferson Memorial Hospital	933-1111 (Crystal City)
3.	Barnes Hospital (Emergency Department)	362-2604 (St. Louis)

		Office	Home
4.	Dr. Albano	937-1766 (Crystal City)	
	Dr. Knowlton	362-7252 (St. Louis)	
	or	361-7660 (St. Louis)	

Exemption 6

Exemption 6

Fire Fighting Assistance

Local Fire Departments — 937-9619 (Hematite)
937-4622 (Festus)

Police Assistance

1.	Sheriff's Office	789-3346 (Hillsboro)
2.	Highway Patrol (Emergency Number)	434-3344 (Creve Coeur)
3.	FBI	241-5357 (St. Louis)

Utilities Assistance

1.	Missouri Natural Gas Company	937-7662 (Festus)
2.	Union Electric Company	937-4654 Ext. 2 (Festus)
3.	Southwestern Bell Telephone Company	1-571-1200 (St. Louis) (Must be called on 937 line)

Management Notification (by Title)

Exemption 6

1.	J. A. Rode	Plant Manager	
2.	R. C. Fromm	Q. A. Manager	
3.	R. W. Griscom	Engineering Supervisor	
4.	L. F. Duel	Engineer	
5.	R. C. Miller	Prod. & Mat'l Control Supv.	
6.	H. E. Eskridge	Supervisor, NLS&A	
7.	A. J. Noack	Production Supervisor	
8.	R. J. Klotz	Criticality Specialist	203-285-5535 (Windsor, CT)

NRC Notification

Region III (If no answer, call number below) — 312-790-5500

Headquarters Emergency Co-ordinator — 202-951-0550

Other Agencies

Missouri State Emergency Management Agency (All Hours)	751-2748 (Jefferson City)
Missouri Division of Health Bureau of Radiological Health	751-8208 (Jefferson City)
Missouri Department of Natural Resources Emergency Response (24 hrs.)	751-3241 (Jefferson City) 634-2436 (Jefferson City) 849-1313 (St. Louis)
U. S. Environmental Protection Agency Region 7 (Spill Emergency Number)	816-374-3307 (Kansas City) 913-236-3778 (Kansas City)
American Nuclear Insurers	203-677-7305 (Farmington, Conn.)
Non-Nuclear Emergency (Fire, etc.)	1-800-243-3172
Windsor Central Security Control or	203-285-4561 (Windsor) 203-285-4562 (Windsor)
Windsor PSG Marketing Communication	203-285-3824 (Windsor)

NOTE: Contact with other than local agencies will normally be made as advised by the Radiological and Safety Advisor, and as directed by the Emergency Director.

RADIOLOGICAL CONTINGENCY PLAN

LICENSE NO. SNM-33

DOCKET 70-36

COMBUSTION ENGINEERING, INC.
Hematite, Missouri

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

INTRODUCTION

The Nuclear Fuel Manufacturing operations of Combustion Engineering, Inc., licensed uner NRC Material License SNM-33 and located in Hematite, Missouri submits this Radiological Contingency Plan as directed by NRC Order dated February 11, 1981. The plan has been prepared in accordance with the "Standard Format and Content for Radiological Contingency Plans For Fuel Cycle and Materials Facilities", dated January 9, 1981. After final approval by the Division of Fuel Cycle and Material Safety of the U.S. Nuclear Regulatory Commission, the plan will become a condition of Materials License SNM-33.

1.0 GENERAL DESCRIPTION OF THE PLANT/LICENSED ACTIVITY

1.1 Licensed Activity Description

Licensed activities conducted at the Hematite Plant of Combustion Engineering, Inc., are:

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.

Deliver materials to a carrier for transportation under Part 71 of the Regulations of the Nuclear Regulatory Commission.

1.1.1 Possession Limits

Combustion Engineering, Inc., has requested 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	20,000 kilograms

1.1.2 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.

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 and Warehouse	Steam supply, Storage
251	Warehouse	Shipping and Receiving, storage
252	South Vault	Radioactive waste storage
255	Pellet Plant	Pellet Fabrication, storage and packaging.

1.1.3 Exemptions and Special Authorizations

The following specific authorizations were 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) Release of equipment and materials from the plant to off-site or from controlled to uncontrolled areas on-site.

1.2 Site and Facility Description

1.2.1 Location of Plant

The C-E Hematite site is located in Jefferson County, Missouri, approximately 35 miles south of the City of St. Louis. Figure 2-1 indicates the location of Jefferson County within the state of Missouri. Figure 2-2 illustrates an expanded section of the area within a 5-mile radius of the site and shows the location of small towns and settlements within this area. The plant is located on Highway 21A about 3/4 mile northeast of the unincorporated town of Hematite. Figure 2-3 shows the site boundaries with respect to the town of Hematite.

1.2.2 Regional Demography

Jefferson County is predominately rural and characterized by rolling hills with many sizable woodland tracts. The land area is classified as 51% forrest, 33% agricultural with crops such as grain and hay, and approximately 16% as urban, suburban, commercial and unused or undeveloped.

The county is part of a dynamic, growing urban region of the St. Louis Standard Metropolitan Statistical Area. Although extensive development has resulted from this growth, agricultural land use is still predominant in the site's environs. Some areas, generally 1/2 to 5 miles from the plant site, have been developed as small to moderate-size subdivisions within the past decade.

1.2.2 Regional Demography (continued)

The average population density is 219 people per square mile based on a total population of 145,924 persons and an area of 666.6 square miles. As shown in Figure 2-2, several towns and unincorporated settlements are wholly or partly within the 5-mile radius of the Hematite site. Festus/Crystal City, located 3.5 miles east of the site and having a population of about 11,000 people, is the nearest town of significant size.

Towns and settlements within a 5-mile radius of the C-E Hematite site are:

Town	General Direction From Site	Distance (Miles) From Site	Population
Crystal City	E	4.5	3678
Deerfield	E	1.5	100
DeSoto	SW	5.0	6150
Festus	E	3.5	7021
Hematite	SW	0.5	225
Hillsboro	NW	5.0	759
Horine	NE	5.0	350
Lake Wauwanoka	NW	3.5	200
Mapaville	N	3.5	50
Olympia Village	S	5.0	150
Victoria	SW	3.0	100

1.2.3 Land Use on Site

All manufacturing operations are conducted within the fenced area located on the center site tract. The fenced area, parking lot and barns occupy about 5 acres. The remainder of the 16 acre center tract is a grassy area which is kept mowed, as is the two acre West tract. The North, East and South tracts, totaling 136 acres, remain undisturbed. Thus only about 3% of the site is being utilized, while the remaining 97% consists of wood lands, streams and open spaces.

1.2.4 Locations of Buildings on Site

Figure 2-4 shows the location of and identifies the buildings and facilities on the Hematite site. A general description of the major buildings follows:

The Oxide Plant (Powder Production Area) is a four-level building, 31' x 36', with a concrete floor, corrugated plas-steel siding, and a metal roof. This building is an addendum to the original Building 255 and opens directly into the pelletizing facility. The Oxide Building is approximately 50' in height.

Adjoining the Oxide Plant is a 31' x 55' dock area which also has a concrete floor and a metal roof.

Building 255, the Pellet Plant, measures 83' x 161' and is 17' high. This building has concrete flooring, concrete block walls, and a concrete-on-metal roof. The Pellet Production Area occupies a portion of this building -- an area approximately 83' wide by 83' long. The remainder of the building area is used for offices, storage, work-break area, UO_2 product storage in sealed containers, and the supply room.

Building 240, the Recycle/Recovery Areas and Laboratory, is 83' x 215' and is 16' high. The building has concrete flooring, exterior concrete block walls with windows, and a concrete-on-metal roof. About 6,000 square feet of the area is utilized for uranium recycle and recovery operations with the remainder of the building used for office area, clothing change and locker rooms, showers, maintenance shop, laboratory space, the site laundry, and utilities.

1.2.4 Locations of Buildings on Site (continued)

The Quality Control Laboratory is located in the southwest corner of Building 240. An area of approximately 2,500 square feet is utilized for testing of the chemical and physical properties of uranium oxide, powders, pellets and other materials.

Building 251 is the warehouse and is used for shipping container storage. The building is 32' wide x 110' long. It is a prefabricated steel structure with galvanized metal walls and roof and has a concrete floor. Shipping and receiving quarters are also housed in this building.

1.3.2.1 Radiological Waste Water Effluent (continued)

residues, and water from the change room sinks and showers.

Liquid radiological wastes generated as mop water, cleanup water and grinder coolant water are collected and then evaporated to recover the uranium. Liquids with higher uranium content are chemically processed to recover the uranium, usually by precipitation and filtration. Flocculation, sedimentation and other appropriate removal techniques may also be used.

Process filtrates, including wet recovery system filtrate and spent scrubber solutions, are routed to a calibrated tank, mixed and sampled. They are then evaporated and solidified with concrete in a 55-gallon drum for shipment to licensed burial. Discharge to the storm drain system, although not currently practiced, may be allowed if the fractional MPC for alpha activity (3×10^{-5} µCi/cc) plus the fractional MPC for beta activity (2×10^{-5}µCi/cc) does not exceed unity:

$$\frac{\text{Alpha Activity}}{3 \times 10^{-5}} + \frac{\text{Beta Activity}}{2 \times 10^{-5}} < 1$$

Liquids are no longer discharged to the evaporation ponds.

Untreated liquid effluents originate from the storm drains, showers, change room floor drains, and lab sink drains. Disposal of lab analytical residues to the sink drains is not practiced, as they are recycled for recovery.

Laundry water is filtered to remove particulate uranium prior to discharge to the storm drain system.

1.3.2.1 Radiological Waste Water Effluent (continued_

Liquid wastes from cleaning of glassware in the laboratory are discharged to the industrial waste drain system, which also carries equipment cooling water and serves as the storm drain system. 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.

Liquid wastes from the sinks and showers is discharged directly to the site sewage treatment plant. The outfall of this plant is routinely sampled and analyzed for gross alpha and beta activity. The sanitary sewer discharges into the site creek directly below the site pond.

The site creek discharges into Joachim Creek at the southern site boundary. Joachim Creek ultimately discharges into the Mississippi River.

1.3.2.2 Radiological Airborne Waste Effluent

Airborne radiological wastes are discharged from the Oxide Building as a result of the UF_6 to UO_2 conversion process, and from Building 255 as a result of the UO_2 pellet fabrication processes. There are four release points of airborne radioactive materials from the Oxide Building. Offgases from the UF_6 to UO_2F_2 conversion process pass through two sets of porous metal filters and are then routed through dry scrubbers. The dry scrubbers are filled with limestone which reacts with hydrofluoric acid in the filtered offgases to form calcium fluoride.

1.3.2.2 Radiological Airborne Waste Effluent (continued)

Process ventilation air from the Oxide Building is passed through absolute filters (99.97% efficient for removal of 0.3 micron particles) and vented through exhaust stacks to the atmosphere. Continuous sampling is provided for each exhaust stack.

Process ventilation air from the Pellet Plant, Building 255, is exhausted through two new manifold systems which were installed in May, 1975. These new consolidated systems replaced 15 individual exhaust stacks. Each system contains two banks of absolute filters and a bank of prefilters. Prefilters are also located near the ventilated equipment to preserve the effectiveness and longevity of the final filters in the consolidated exhaust systems. The final filters are equipped with pressure differential measuring devices to detect filter loading. The three exhaust points in Building 255 are continuously monitored whenever operations involving dusting or potential release of radioactive material are in progress.

Air borne radiological wastes released from Building 240 are generated as a result of wet scrap recovery processing, incineration, and the oxidation-reduction and pyrohydrolysis processing of recycle material. Ventilation and process air is exhausted through double absolute filters and continuously sampled. The offgases from oxidation-reduction and pyrohydrolysis boxes and incinerator are routed through wet scrubbers and continuously sampled.

All stacks used for exhausting of radioactive effluents are equipped with continuous samplers, with the exception of laboratory fume hoods handling wet chemicals and two of the

1.3.2.2 Radiological Airborne Waste Effluent (continued)

three room air exhausts for the Pellet Plant dewaxing and sintering furnace area. All stacks have single or double absolute filters except for the laboratory fume hoods, the Pellet Plant furnace area and Oxide Building room air exhaust, and the Oxide Building offgas exhaust which has other filtration and scrubbers as discussed above.

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
B.dg. 255 Dry Recycle	3,657
Bldg. 240 Wet Recovery	5,807

1.3.2.3 Radiological Solid Waste Effluent

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.

A gas-fired incinerator has been installed to reduce the volume of combustible contaminated wastes for shipment to

1.3.2.3 Radiological Solid Waste Effluent (continued)

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.

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.

1.3.3 Chemical Usage Resulting in Liquid and Gaseous Effluents

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.

Sulfuric Acid - approximately 5,000 pounds used per year in regeneration of demineralizer resins.

Hydrochloric Acid - approximately 850 pounds used per year in cleaning heat exchanger tubes in the steam boiler.

Nitric Acid - approximately 9,850 pounds used per year to dissolve the U_3O_8 wet recovery process feed material.

Hydrogen Peroxide - approximately 20,100 pounds per year used to adjust pH in the wet recovery process.

Trichlorethane - approximately 9,500 pounds per year used in preparing UO_2 powder for pelletizing.

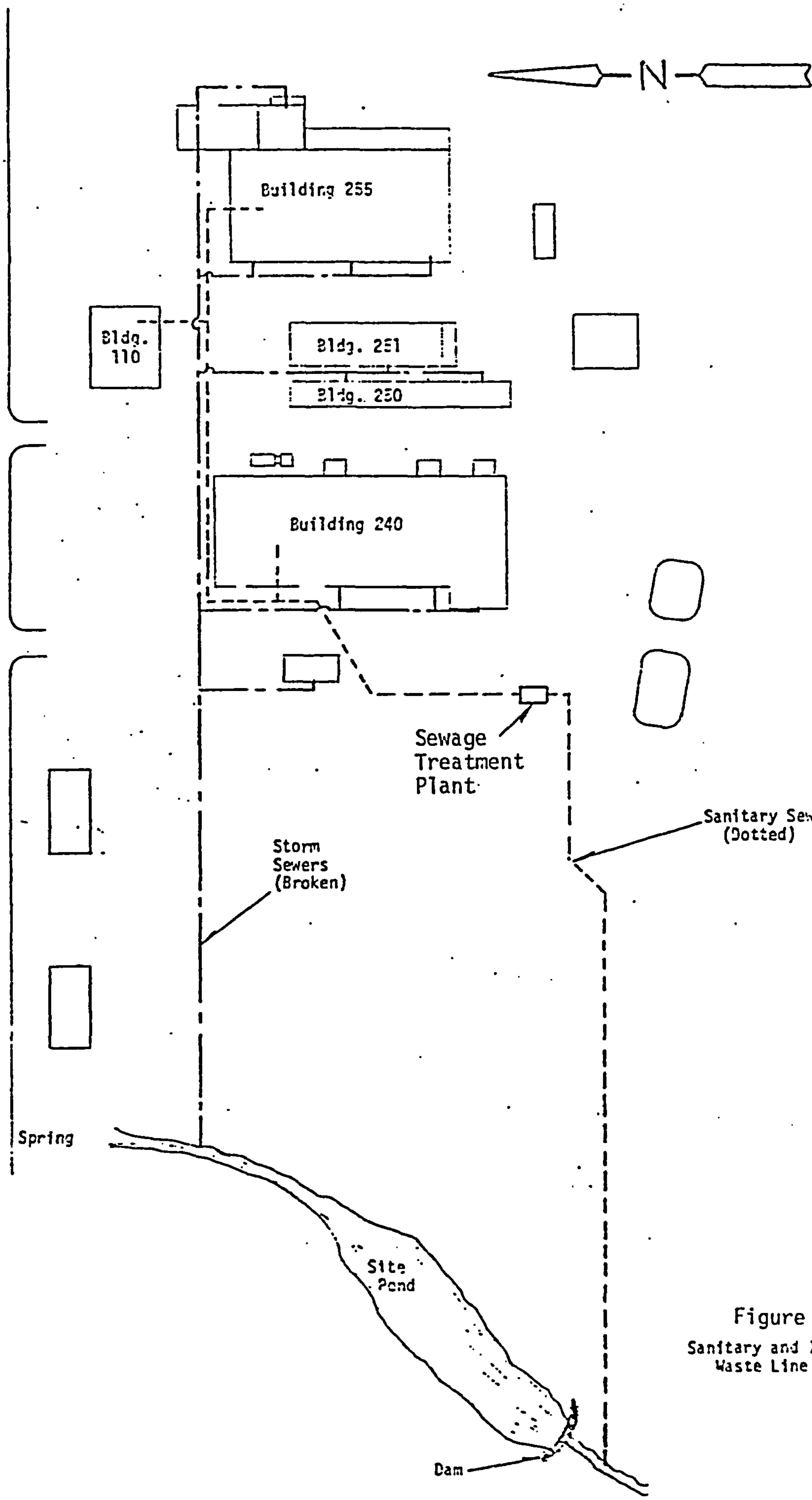


Figure 1-5

Sanitary and Industrial Waste Line Flows

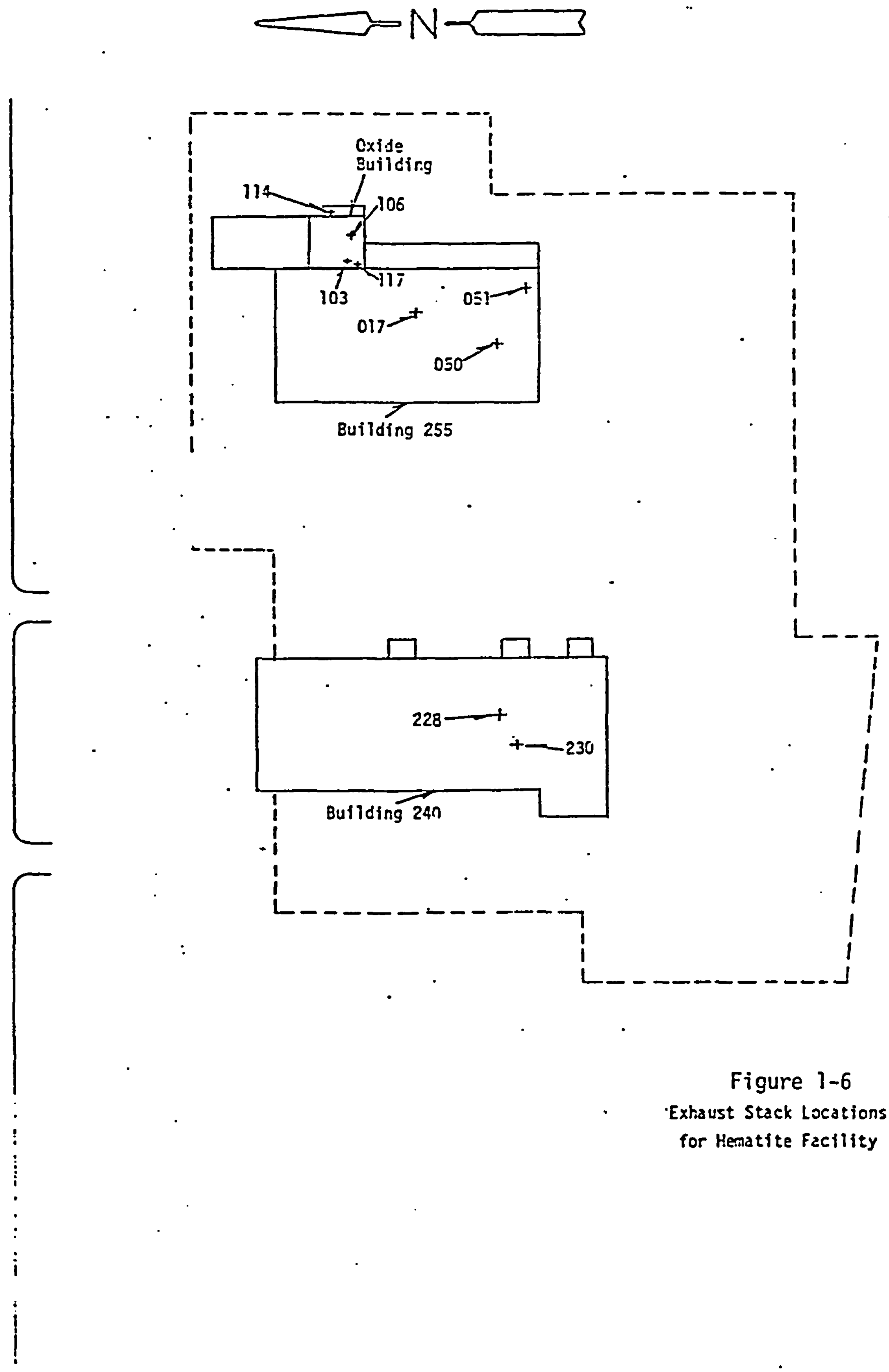


Figure 1-6
Exhaust Stack Locations
for Hematite Facility

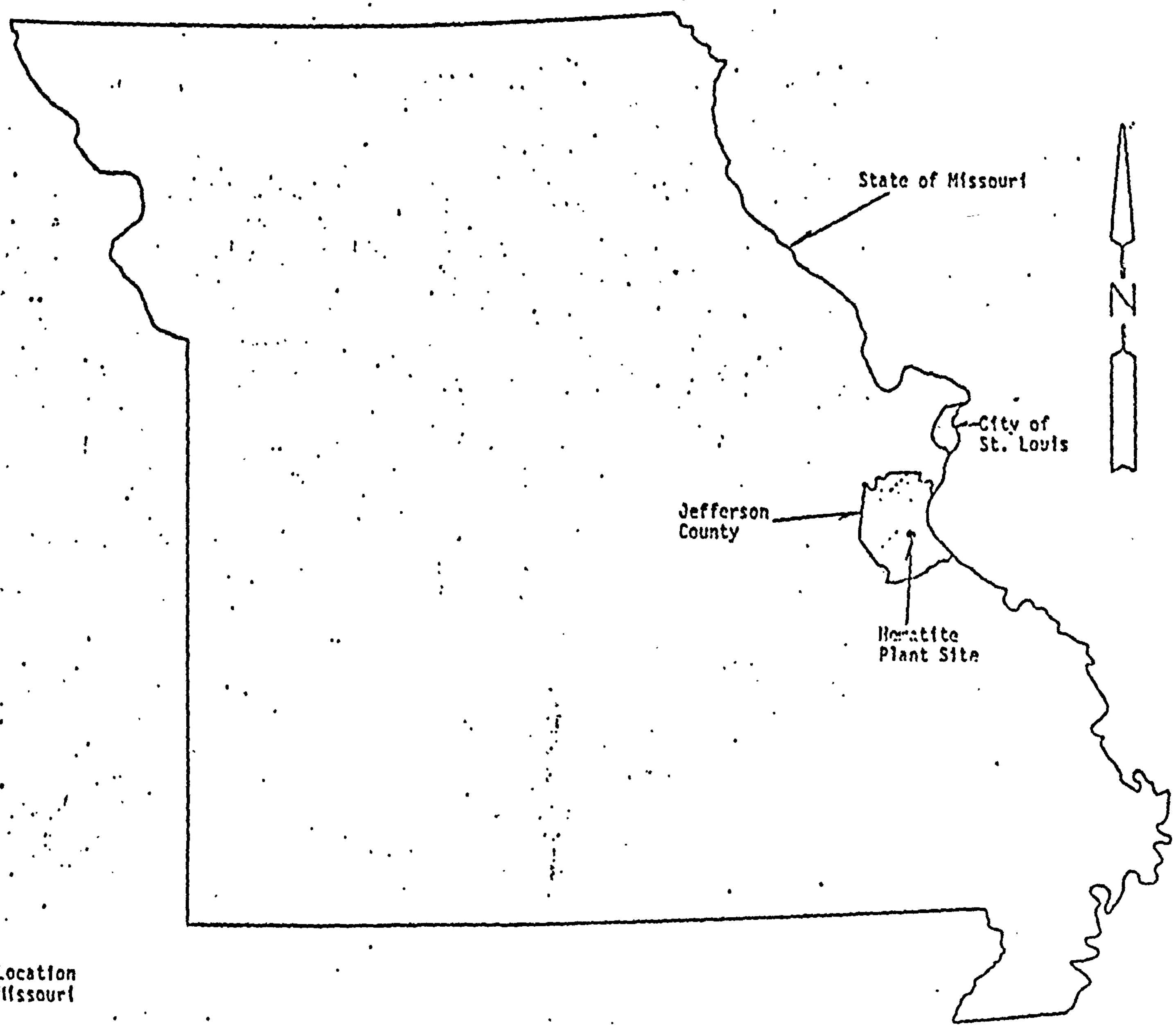


Figure 1-1
Hematite Plant Site Location
Within the State of Missouri

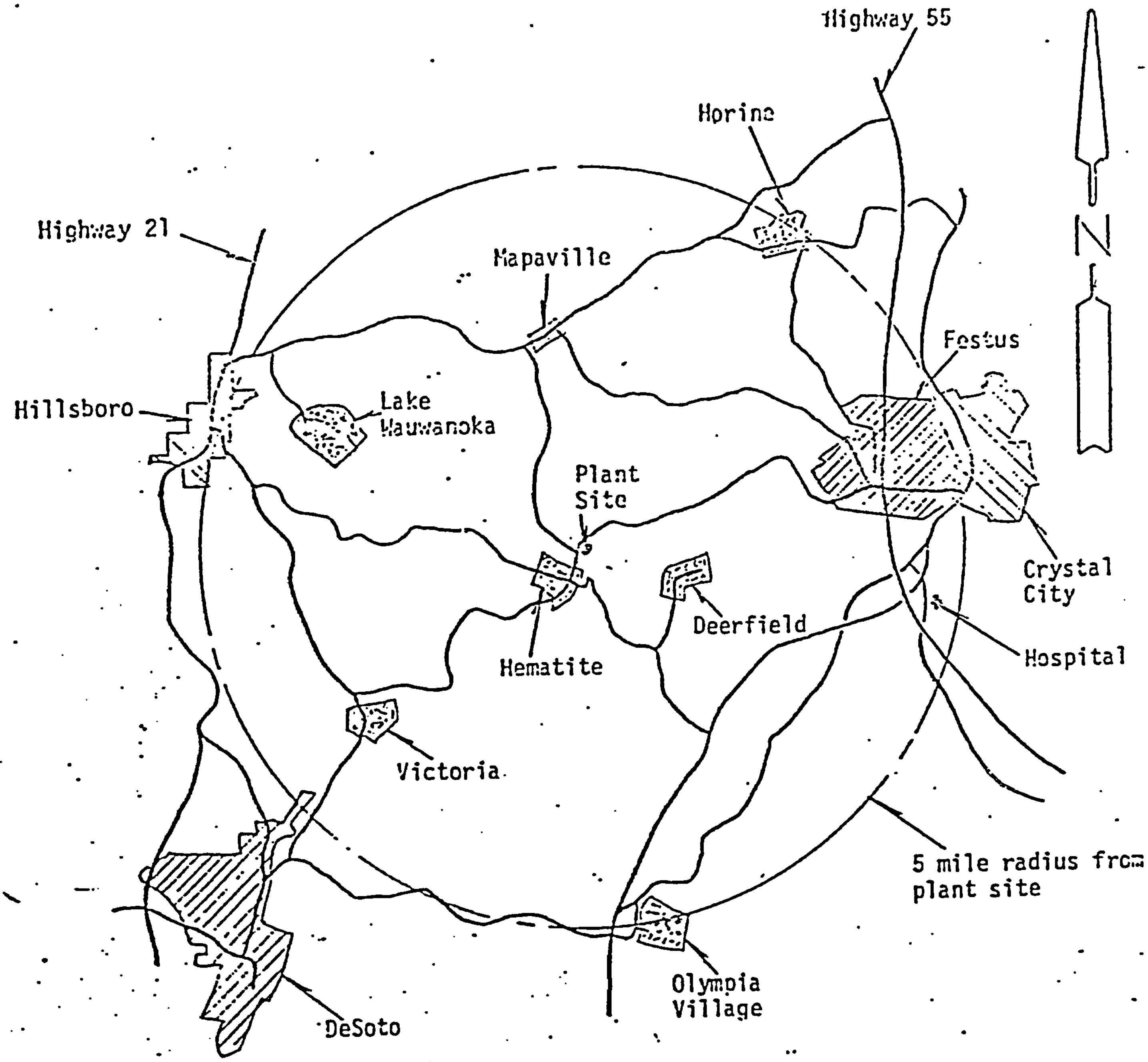


Figure 1-2

Area Within 5 Mile Radius of Combustion Engineering Plant Site

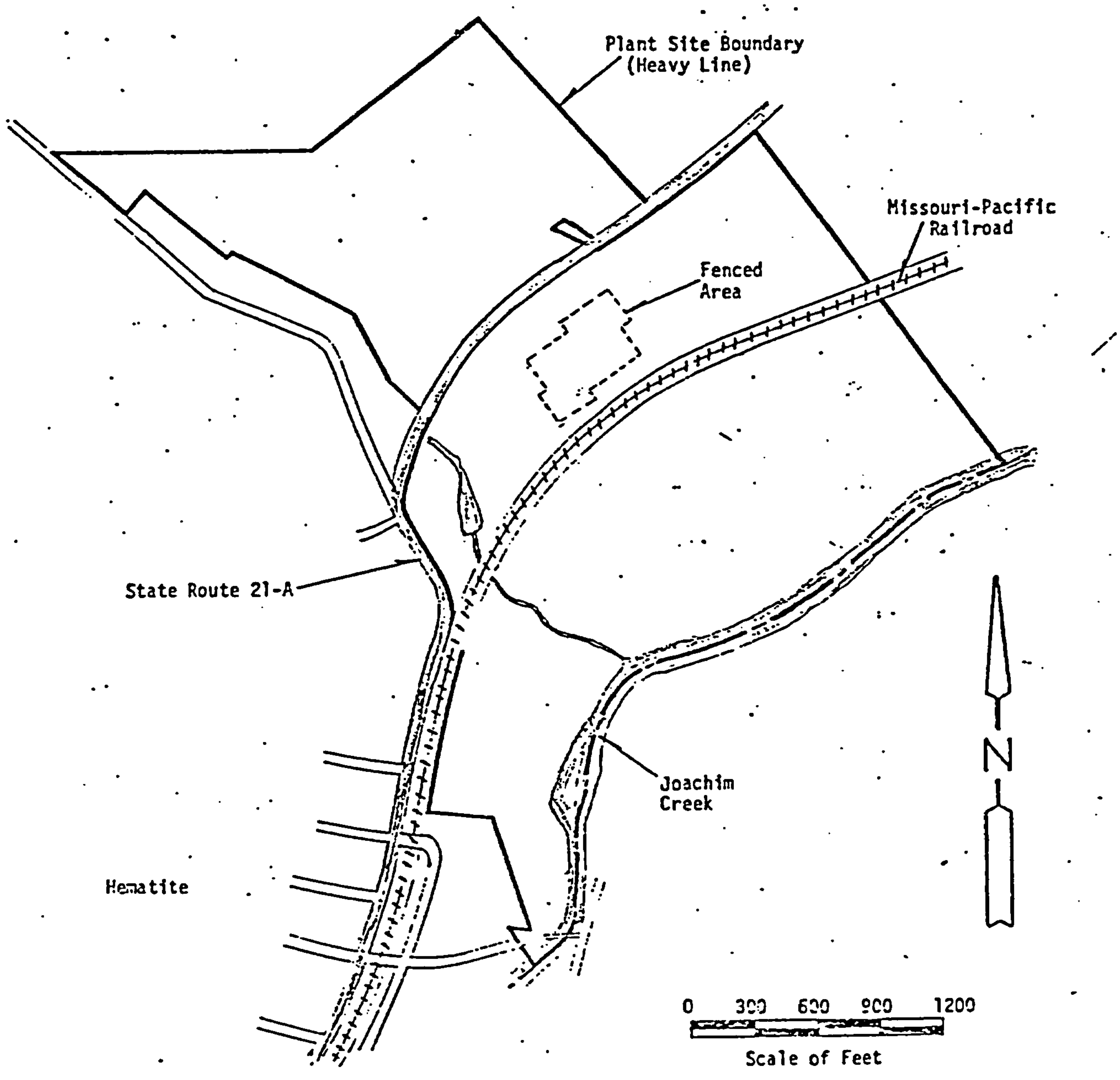


Figure 1-3

Site Boundaries and Location
With Respect to the Town of Hematite

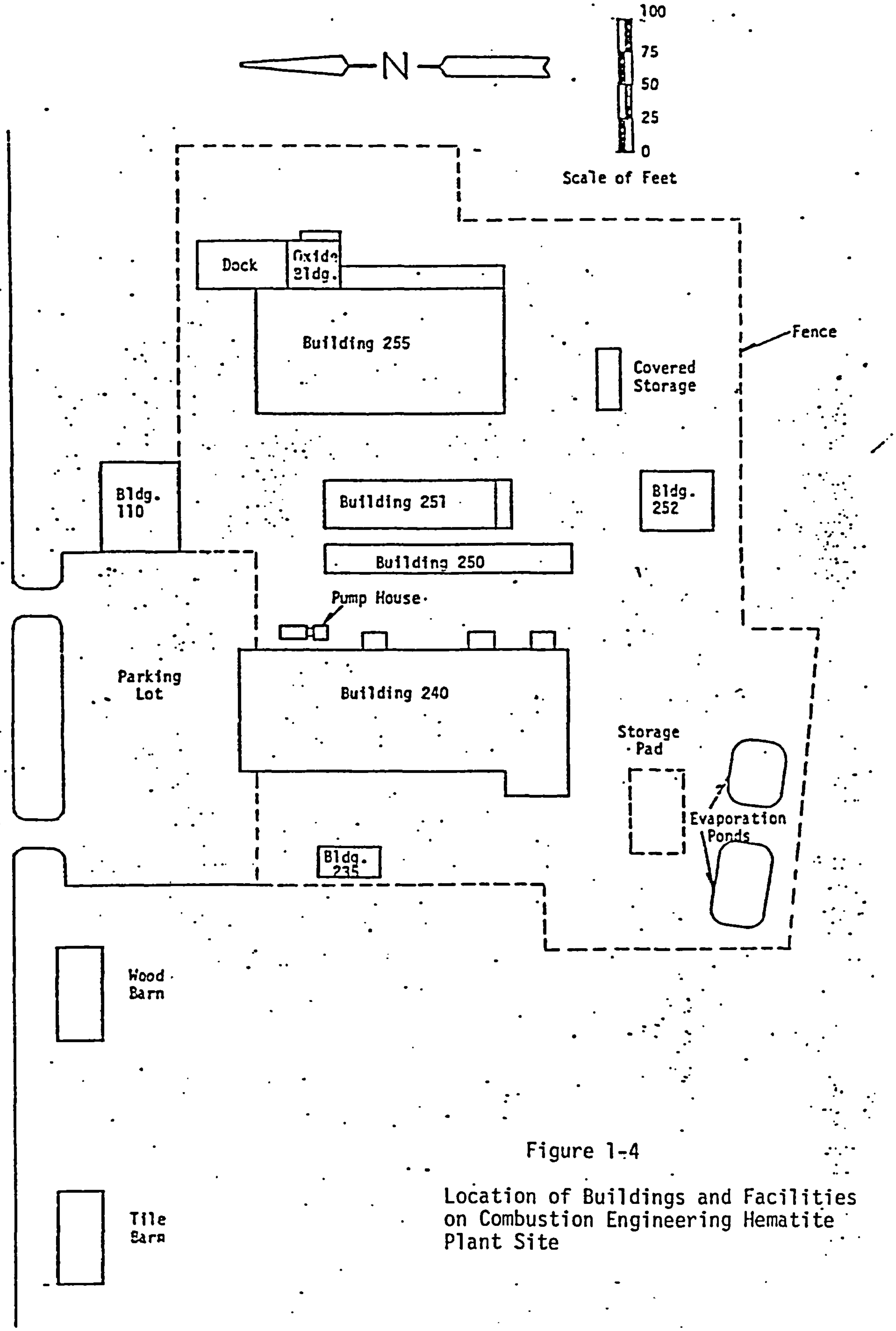


Figure 1-4

Location of Buildings and Facilities on Combustion Engineering Hematite Plant Site

2.0 ENGINEERED PROVISIONS FOR ABNORMAL OPERATIONS

2.1 Criteria for Accommodation of Abnormal Operations

2.1.1 Process Systems

2.1.1.1 Administrative Requirements

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.

Written Procedures and Approval Authority - All process operations involving SNM shall be covered by a shop traveler and/or an operation sheet which shall be followed. Precautions and limits regarding criticality and radiological safety shall be included in these procedures. In addition, all procedures shall provide for the labeling of mass limited containers to indicate the enrichment and the uranium content.

Geometry limited containers will be handled as though they are full unless specifically labeled otherwise. Labeling shall be carried out under the direction of the cognizant foreman.

These procedures shall be approved by the NLS&A Supervisor. However, procedures involving a change in the criticality safety controls used for that particular process in the past shall also be approved by the Criticality Safety Specialist. Each foreman shall instruct his people to assure their understanding of the operations and their safety limits and restrictions. The adequate performance of individuals is continually ascertained by the foreman.

2.1.1.1 Administrative Requirements (continued)

It shall be the responsibility of the foreman to assure that each work station is properly posted, and that operations are performed in compliance with posted limits and written instructions.

Request for Changes and Criticality Analysis - All proposed changes in process, equipment, and/or facilities that could affect nuclear criticality, radiological or industrial safety shall be approved in accordance with written requirements. The necessary analysis and resultant safety limits shall be established by a person having the minimum qualifications of a Criticality Safety Specialist.

Procedures have been established for requesting changes and all request forms, approval forms, and associated documentation shall be maintained under the supervision of the NLS&A Supervisor.

Posting of Limits - All work stations and storage areas shall be posted with a nuclear safety limit approved by the NLS&A Supervisor or the Criticality Safety Specialist. The NLS&A Supervisor maintains records of the review and approval of each posted safe nuclear criticality safety limit.

Internal Review Requirements - All process/equipment/facility changes which affect nuclear criticality safety shall be reviewed and approved in writing by the NLS&A Superivsor. An independent review shall be performed by the Criticality Safety Specialist.

2.1.1.1 Administrative Requirements (continued)

Records of all approvals shall be maintained under the supervision of the NLS&A Supervisor.

Marking and Labeling of SNM - All mass-limited containers shall be labeled as to enrichment and content. All geometry limited containers and processes are safe up to the maximum allowable enrichment of 4.1% U-235.

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

2.1.1.1 Administrative Requirements (continued)

Audits and Inspections (continued)

Production Superintendent is responsible for corrective action, except where another Supervisor is specifically designated.

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, 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 retraining course in criticality control and radiation safety on an annual basis.

All formal training shall be documented.

2.1.1.2 Technical Requirements

Preferred Approach to Design - It is the intent of Combustion Engineering to use physical controls and permanently engineered safeguards on processes and equipment in the establishment of safety limits wherever practical.

Basic Assumptions and Analytical Methods - Written health and safety restrictions for all operations on radioactive materials shall be provided in the form of approved detailed procedures, and appropriate operational limits shall be posted in the vicinity of work stations.

Criticality safety of the less complex manufacturing operations is based on the use of limiting parameters which are applied to simple geometries. Safe Individual Units (SIU) shall be selected on the basis of optimum moderation and full reflection using published nuclear criticality safety data. These units shall be spaced using the surface density method or the solid angle method.

The remaining manufacturing operations are evaluated using the solid angle method or two dimentional transport and/or 3 dimensional Monte Carlo Codes. The sixteen group Hansen-Roach cross section library is used for homogeneous systems while the CEPAK Code is used to generate multigroup cross sections for heterogeneous systems. All calculational methods involving computer codes shall be validated in accordance with the criteria established in Regulatory Guide 3.41 "Validation of Calculational Methods for Nuclear Criticality Safety".

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:

2.1.1.2 Technical Requirements (continued)

Safety Margins for Individual Units (continued)

Mass	2.3
Volume	1.3
Cylinder Dia.	1.1
Slab Thickness	1.2

These values 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 $0.95 \pm 2\sigma$ including all applicable uncertainties and bias. Consideration shall be given to greater safety factors where there are large uncertainties.

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

a. The possibility of accumulation of fissile materials in inaccessible locations shall be minimized.
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.
c. Nuclear safety shall be independent of the degree of moderation between units up to the maximum credible mist density.

2.1.1.2 Technical Requirements (continued)

Safety Margins for Individual Units (continued)

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.

Moderation Control

Moderation controlled SIUs shall not be considered to contribute to interacting arrays when the following restrictions exist:

a. In closed containers or configurations which would not retain water, or in other systems designed to provide moderation controls.
b. No use of water (or other hydrogeneous agents) for firefighting purposes.
c. Control of water and other moderating materials introduced into the area.

2.1.1.2 Technical Requirements (continued)

Moderation Control (continued)

d. Location outside of exclusion areas assigned by the surface density method.
e. Appropriate nuclear criticality safety signs posted in the controlled area.

Minimum Spacing Requirement

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

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.

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, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material".

A mass limit of 16 kilograms of uranium shall be used for aqueous solutions under only administrative control.

2.1.1.2 Technical Requirements (continued)

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.

Structural Integrity

Whenever nuclear criticality safety is directly dependent on the integrity of a fixture, container, storage rack or other structure, design shall include consideration of structural integrity. The fulfillment of structural integrity requirements shall be established by physical test or by analysis and certification by an engineer knowledgeable in structural design. Fixtures, containers, storage racks and other structures which maintain a safe geometry or spacing shall be checked by NIS personnel during inspections and audits to assure continued reliability of such devices.

2.1.2 Alarm Systems and Release Prevention

2.1.2.1 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) Detectors shall be located so as to be capable of detecting and operating the alarm from an incident of the magnitude that would result in a gamma flux of 3×10^5 mR/hr one (1) foot from the source of radiation.
4) Detectors shall be installed within 120 feet of every location where 500 grams or more of Special Nuclear Material is handled, used, or stored.
5) Whenever possible, the location and spacing of the detectors is chosen to avoid the effect of shielding by massive equipment or materials. Low density materials of construction such as 2 x 4 stud construction walls, plaster or metal corrugated panels, asbestos panels, doors, panel walls and steel office partitions are disregarded in determining the spacing. The spacing is reduced where high density building materials such as brick, concrete, or cinder blocks shield a potential accident area from the detector.

2.1.2 Alarm Systems and Release Prevention (continued)

2.1.2.1 Nuclear Alarm System (continued)

6) The detector and alarm circuits shall be equipped with an auxiliary self starting diesel generator which will automatically supply power to the system in the event of disruption of primary power. This backup power system shall be checked at least quarterly.
7) The system shall be tested by sounding the alarm at least monthly and at the time of each practice evacuation drill.
8) Automatic monitors shall give warning in case of any malfunction which renders the system inoperable.
9) The alarm shall be clearly audible in all portions of areas in which Special Nuclear Materials are handled, used, or stored and in all adjacent areas where significant exposure to radiation may result from an incident.

2.1.2.2 UF_6 Vaporizer Condensate Alarm System

In the event of a UF_6 leak, steam condensing in the vaporizer will take SNM to the condensate drain line. When the conductivity cell in the drain line senses increased conductivity from the SNM present, the system will close the automatic shut-off valve, start the UF_6 scrubber and shut off the steam supply. There are both visible and audible alarms in the control room. The system may also be operated manually.

2.1.3 Support Systems

2.1.3.1 Structural Performance vs. Site Environmental Factors

Severe Natural Phenomena

The consequences of severe natural phenomena on site structures were examined. In all cases, the probability of release of radioactive materials was found to be extremely low.

A postulated 100-year flood would be expected to result in only minimal water velocities of less than 0.1 ft/sec. These velocities are not expected to be able to tip material storage containers or transport any loose material. No structural damage would be expected.

Although some structural damage would occur in the event of a tornado or earthquake, the radiological impact would be minor. Nearly all uranium on the site is contained in UF_6 cylinders, sealed metal cans, pellet trays, or silos with sound structural characteristics.

2.1.3.2 Accidents at Neighboring Activities

There are no neighboring facilities at which accidents could have adverse effect on C-E Hematite structural elements.

2.1.3.3 Confinement Barriers and Systems

This Section contains detailed descriptions of all manufacturing operations in the Hematite facility. Sufficient detail is provided to permit an independent verification of the adequacy of controls for the purpose of assuring safe operations.

Nuclear criticality limits are taken from Chapter I.4.0.* However, the intricacies of the equipment in certain operations require further analysis, which is provided in Chapter II.9.0.* Details of specific calculations used to support various aspects of this analysis are also provided in Chapter II.9.0.*

Present arrangements of equipment are shown in the drawings provided in Chapter II.10.0.* Several proprietory drawings are included; these are identified as proprietory. These arrangements may be changed in accordance with the procedures of Part I. Therefore, this is considered to be a typical analysis for operations conducted within the scope of this license.

UF_6 to UO_2 Conversion

This system is designed to convert uranium hexafluoride to UO_2 powder suitable for pressing into fuel pellets. The equipment is designed to handle a maximum enrichment of 4.1% U-235. The operation is depicted schematically in Figure II.8-1.

Receive and Store UF_6

UF_6 is received in standard 2-1/2 ton cylinders in approved shipping packages. Upon receipt, the cylinders are placed in the UF_6 cylinder storage area which holds up to 54 cylinders. Eighteen additional cylinders may be located adjacent to the vaporizers near the cylinder scale, or in shipping packages

*NOTE: For chapters, drawings, and other references in this Section, see License No. SNM-33, Docket 70-36.

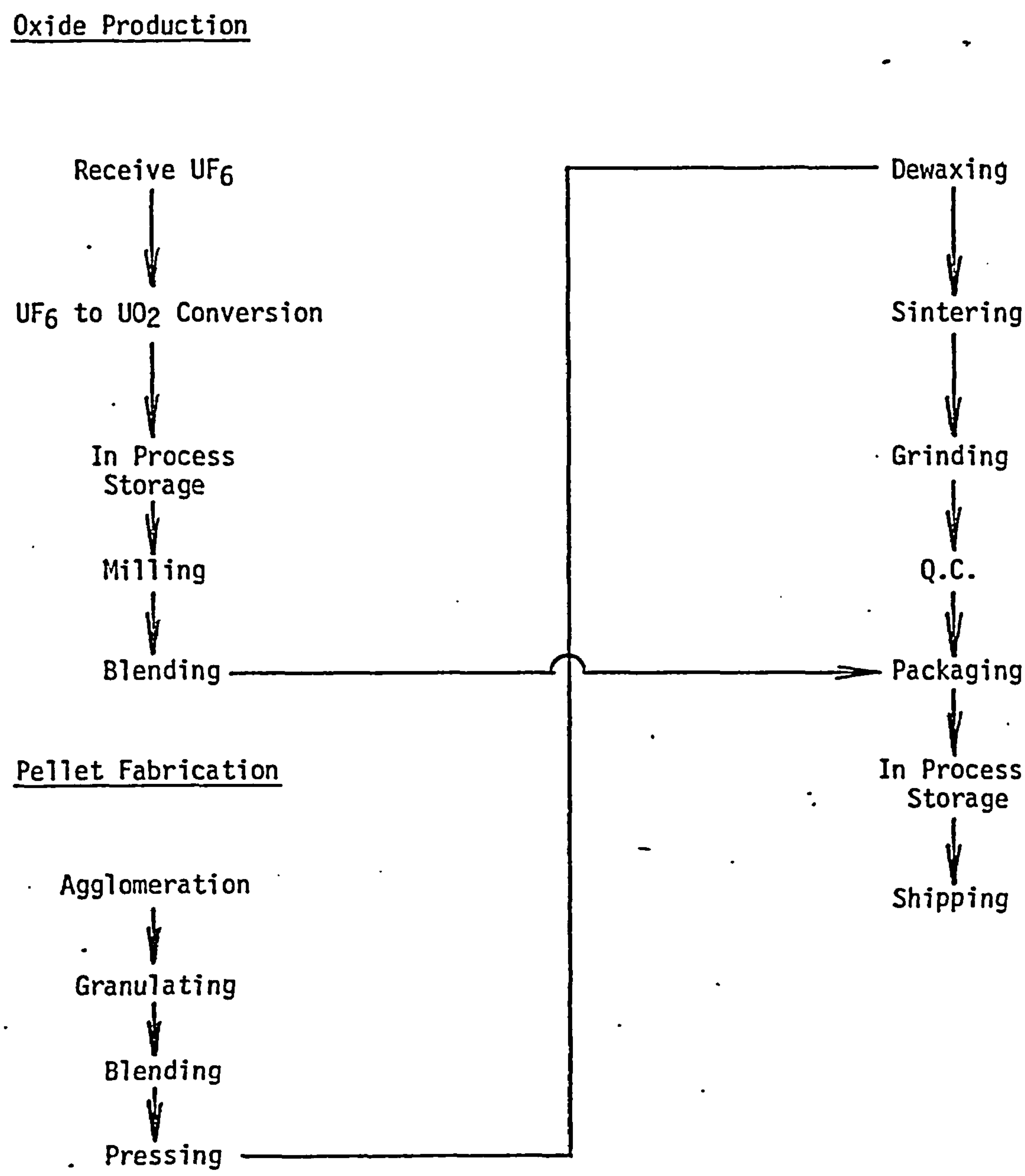


Figure II. 8-1
Schematic Flow Diagram

on the Oxide Building dock.

As required, a UF_6 cylinder is removed from its shipping package or storage and connected to the conversion equipment.

The UF_6 storage area is separated from the dock by more than 12 feet.

According to K-1686, at least 63 cylinders are the minimum number critical in a water moderated and reflected array. Therefore, the UF_6 cylinder storage area and the Oxide Building dock storage are nuclearly safe.

UF_6 Conversion Process

Vaporization of the UF_6 by heating the UF_6 cylinder in a steam chamber is the first step of this process. There are two chambers but only one cylinder is on line at a time. When one cylinder is almost empty the second cylinder starts on line. Valving arrangement prevents the two cylinders from being interconnected.

A condensate line drains the steam chambers through an air gap to take steam condensate to the drain. The drain line contains a conductivity cell and an automatic shut-off valve.

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.

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 with pipe insulation.

Any UF_6 leak is either visually detected from its typical "UF_6 cloud" formation or is detected by changes at the control panel board. In the event of such leak, an emergency alarm will be sounded, the area evacuated and the emergency procedure put into effect. Self contained breathing apparatus and protective clothing will be worn to correct the leak. UF_6 flow can be terminated from the control panel or at the vaporization chamber.

Air sampling and decontamination will be done according to the standard procedure for coping with suspected or actual releases of airborne activity.

The UF_6 to UO_2 conversion is accomplished in reactor vessels of maximum 12-inch diameter.

UO_2 product from the final reactor passes through water jacketed cooler prior to transfer to the inprocess storage vessels.

Offgases from the conversion process are routed to limestone-packed scrubbers for hydrogen fluoride removal.

Material transfers from vessel to vessel is through maximum two inch diameter piping.

Refer to the Nuclear Safety Evaluation, UF_6 to UO_2 conversion, in Section II. 9.1.

In-Process Storage

UO_2 powder is stored in long silos with 12-inch diameters. Transfer lines connecting individual pieces of equipment will be two inches in diameter or less. This is a dry operation and is nuclearly safe for enrichments not exceeding 5% as per TID-7028. Silos are spaced on four foot centers, forming an inline array. The Nuclear Safety Evaluation is provided in Section II.9.1.

Milling

Process milling equipment consists of 10-inch diameter hoppers which taper to three inch discharge openings to the mill. Scrap recycle charge containers are five gallon pails (19 liters) which attach to tapered hoppers, which discharge to the mill. This also is a dry operation with the exception that the recycle material may contain up to five weight percent moisture. Milling equipment is spaced at least four feet edge-to-edge from other SNM bearing equipment.

The Nuclear Safety Evaluation is provided in Section II.9.1.

Blending

Blenders are 14 inches in diameter. The blending operation involves no hydrogeneous material except for the moisture contained in agglomerated press feed recycled to the mill. The atmosphere is continuously monitored for humidity and an increase in moisture will cause an alarm and subsequent cessation of the blending operation. The Nuclear Safety Evaluation is provided in Section II.9.1.

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.

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.9.2 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 Items 58, 59 and 60 of Drawing D-5008-2001, Sheet 9, Revision 1, dated 5/22/81. 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).

Pellet Fabrication

UO_2 from the conversion process may also be withdrawn in 5 gallon pails to be agglomerated and granulated to provide feed for pellet pressing.

After pressing, pellets are dewaxed, sintered, ground and inspected. They are then packaged for shipment. Process flow is shown in Figure II.8.2.

Agglomeration and Granulation

UO_2 powder from the blenders is transferred to a V-blender having a total volume of 25.7 liters. The blender is mounted on a scale, and the operation is mass limited. Binders and other materials are added in predetermined quantities. The agglomerated material is discharged through a hopper to a drying belt which can contain up to a 1/2 inch thickness of material. The dry material is then dropped to a 15 liter granulator. This agglomerated press feed is then transferred to a press feed blender or into metal buckets (11" ø x 13" long) equipped with metal lids (which are tightly sealed with a locking clamp-ring) for storage on a 1/4" thick steel mezzanine located above the product storage conveyors. This mezzanine is 8-1/2 feet above the concrete floor and the buckets are stored in a 13 x 13 array on 24-inch centers. Metal rings are used to maintain this spacing.

The agglomerated press feed contains various hydrocarbon additives with a maximum equivalent moisture content of less than 2% H_2O by weight. This highly under-moderated array of buckets was analyzed using the KENO-IV Code with 16 group

Agglomeration and Granulation (continued)

Hansen-Roach cross sections. Using moisture content of 2% H_2O by weight, variable density external water mist was then introducted to determine the maximum reactivity of the system. A two tier array was assumed to account for interaction with the dry UO_2 in stainless steel cans stored on the roller conveyors below (see Section II.8.1.6). The array was assumed to be infinite in the horizontal plane. The floor was modeled as an 8 inch thick concrete reflector and a 4" thick concrete ceiling was assumed to be located directly over the array (10 feet above the floor). The maximum k_{eff} of 0.5920± 0.0074 at 2σ occurred at an external water mist density of .05 gm/cc. Criticality safety of the press feed mezzanine is thus assured under all conditions.

Each agglomeration blender and associated hopper is assigned seven square feet of floor area, thereby permitting one mass in the blender and one in the hopper.

This multiple unit approach is discussed in Appendix A. This equipment has also been shown to be nuclearly safe by solid angle calculations.

The V-blenders are enclosed in a ventilated hood having sufficient air flow to assure a minimum face velocity of 100 ft/min.

Pressing

Granulated material, contained in 5-gallon pails, is considered to be homogeneous for criticality safety evaluations. The 5-gallon pails of blended material are attached to the press-feed hopper mounted above each press. From this hopper the

Pressing (continued)

material is gravity-fed to the press. The pressed pellets are then stacked onto sintering trays.

Each press consists of a 29 liter press-feed unit and several sintering trays, having a total volume of less than four liters. Accordingly, each press is assigned a minimum clear area of 14 feet^2. Although this spacing is not taken from Table I.4.2.4, it is based on the same criteria and constitutes a special unit spacing.

Dewaxing and Sintering

Pressed pellets are dewaxed and then sintered to achieve the specified ceramic properties. Pellets are loaded onto sintering trays which may be stacked to a maximum safe slab height. The pellet containers are charged in a single line through the controlled atmosphere furnaces.

Grinding

Sintered pellets are transferred to the grinder feed system and ground under a stream of coolant. The coolant is recirculated at a uranium concentration of considerably less than one gram per liter. The infeed, grinder and the outfeed have pellet configurations limited to a safe slab thickness.

Grinder sludge is removed by a centrifuge and stored in mass limited SIUs. This material is subsequently loaded into trays to a maximum safe slab depth, dried in an oven and stored awaiting final disposition.

A complete enclosure is provided around the grinder to preclude

Grinding (continued)

dusting of UO_2. This enclosure is maintained at a slight negative pressure with respect to the room.

The centrifuge is limited to a safe volume of less than 10 liters and is provided with a spacing area of 4.0 $ft.^2$. Water from the centrifuge collects in a 19 liter sump and is pumped back to the grinder. The centrifuge sump is provided with a spacing area of 8.0 feet. The centrifuge is cleaned periodically as required to permit continued operation.

Properly sized pellets are transferred on a conveyor to trays which are then moved to the inspection area. The pellets move in a safe slab configuration during inspection operations. After inspection, the pellets are stored in a safe slab and then packaged for shipment.

Packaging

The pellets awaiting packaging will form a safe slab with a thickness less than the safe thickness shown in Table I. 4.2.4.

The pellets are packaged in licensed shipping containers in accordance with the applicable certificate of compliance.

Support Operations

Filter Clean Out Hood

This is an Oxide Building hood used to clean process filters. A filter housing is attached to the top of the hood. The assembly (less than 12 inches in diameter) is lowered into the hood and material falls to the bottom where it is collected in a 5-gallon receiver attached to the bottom. This hood is located on at least 4 foot centers from other SNM bearing equipment.

Trench and Sump

A trench and sump are provided for Oxide Building floor cleanup operations. It is located N-S along the center of the building. The trench is 6 inches X 6 inches X 18 feet wide with a 9 inch diameter X 1.5 foot deep sump located in the center. Clean-up water is pumped out of the sump and trench to 5-gallon pails for disposition determination. There will be no more than two containers of sump water in the area stored a minimum of one foot apart. Because of the low uranium concentrations, a mass SIU is conservatively utilized.

Vacuum Sweepers

Vacuum sweepers used for equipment cleanup are provided for at each Oxide Building level. They will be five (5) gallons or less in capacity, and have an absolute filter on the discharge. No more than two vacuum sweepers will be in use on a level at any one time. Each is effectively one mass SIU.

Weigh and Sample Hood

Two such hoods exist; one each on the ground and third levels of the Oxide Building.

These hoods will be normally used to work with samples. These samples will be in 1 gallon or smaller containers. When necessary, two containers not exceeding 5-gallons in capacity may be in this hood and will be separated by one foot edge-to-edge. However, all other SNM bearing containers will be removed when working with 5-gallon pails.

Recycle Operations

All clean scrap is accumulated for reprocessing and recycle with the feed material. Scrap may be milled to yield desired particle size best suited for reprocessing, oxidized and reduced to assure removal of volatile additives and to achieve the desired ceramic properties of the resulting recycle UO_2, and blended to assure uniformity. The following equipment is included in these operations:

a. Oxidation and reduction and pyrohydrclysis furnaces.
b. Milling equipment
c. Boildown equipment
d. General purpose hoods
e. Filter knockdown hoods
f. Storage facilities

Furnace operation is described in Section II.8.7.2. All operations are carried out in hoods with sufficient ventilation to assure a face velocity of 100 Fpm. These operations are controlled by use of mass or volume limits in accordance with Table I.4.2.4. Positive spacing fixtures are used to assure spacing whenever more than one SIU is allowed in any given hood or furnace reactor box.

UF_6 Heel Removal

The 2-1/2 ton cylinders are cold-trapped into an 8A cylinder to reduce the UF_6 heel prior to their return to the enrichment facility for refilling.

UF_6 Cylinder Washing

Prior to their 5-year recertification, 2-1/2 ton cylinders may be washed to remove the UF_6 heel. This will only be performed when the uranium content of the heel does not exceed 12 kilograms of uranium. Such determination will be made by weight difference on the empty cylinder. This quantity of uranium is one-half the safe mass limit as shown in Table I.4.2.4.

Cylinders are washed by introducing 4 gallons of water, rolling on the cylinder roller, and pumping the resulting solution into a 5-gallon pail. This pail is transferred to approved storage. The above steps are repeated until the heel is removed. The following specific procedures apply:

a) No cylinder containing a heel greater than 12 kilograms of uranium will be released for washing, as determined by weighing on the calibrated UF_6 cylinder scales.

b) The cylinders will be washed successively with four gallons of water until the uranium concentration in the wash solution is <5 gm U/ℓ. Each batch will be returned to its container until sampled. Washing will cease if water cannot be removed.

c) The wash water will be sampled and on this basis wash water from only two cylinders consolidated into a precipitation tank and diluted. Each run will thus be limited to a safe mass based on the sample results.

UF_6 Cylinder Washing (continued)

d) The uranium in the wash solution will be precipitated by the addition of Anhydrous Ammonia.

The precipitate will be filtered on a 12" X 12" filter press.

e) Filtrate will be concentrated by evaporation, sampled and alpha and beta counted. It will then be solidified by adding cement and packaged for shipment to licensed burial.

Analytical Services

Analytical services are provided in several laboratory areas. SNM of any enrichment may be handled in these areas.

The laboratories are divided into sections consistent with the testing techniques employed. There are a general lab area, physical testing areas, office areas and storage.

The material handled includes feed material samples, process control samples, final product samples, and residue samples. Such samples may be liquid or solid.

Analyses are performed using destructive and non-destructive techniques. Unused sample portions are returned to the process streams. Analytical residues are collected, analyzed, and removed from the area for solidification for shipment to a licensed burial site or stored for recovery.

a. General Laboratory

Wet and dry analytical methods are used. The quantity of SNM in this area will be limited to 740 grams of U-235. However, for enrichments in excess of 4.1%, a limit of 350 gm U-235 applies.

a. General Laboratory (continued)

It may be necessary to bring a greater quantity of SNM into this area to (1) obtain precision weighing or (2) remove a portion for analysis. When removing SNM for analysis, one container at a time will be brought into the area, a portion of the SNM will be removed for analysis and the container will be returned to storage or processing. The container will be limited to a volume of 5 gallons.

b. Physical Testing

All operations in these areas are normally dry, except for liquid samples to be analyzed on the atomic absorption spectrophotometer. SNM will be limited to 740 grams of U-235 maximum in each area.

c. Storage Areas

Samples will be stored in safe geometry racks in these areas.

d. Contract Analytical Services

Contract analytical services may be performed by outside laboratories. These laboratories will be licensed to handle and process SNM.

Scrap Recovery

System Description

The Scrap Recovery Process is designed for wet recovery and blending of scrap materials containing uranium having a maximum enrichment of 4.1%. Clean dry scrap recycle (Section II.8.4) and UF_6 cylinder wash precipitation (Section II.8.5.1d) operations are also conducted in the Recycle/Recovery Area (240-2). Except as specified, all units of equipment conform to the limits specified for safe mass, volume or cylinder diameter, and are spaced to conform with spacing requirements for SIUs. The uranium bearing units and their associated spacings are shown on Dwg. D-5009-2012, Rev. 5, and the equipment layout is shown on Dwg. D-5009-2010, Rev. 4. Material flow diagrams are shown on the following drawings:

D-5009-1011 Rev. 2 240-2 R/R Equipment Flow Diagram
B-5009-1007 Rev. 1 240-2 R/R Process Flow
B-5009-1008 Rev. 2 240-2 R/R Wet Recovery System
B-5009-1009 Rev. 1 240-2 R/R UF_6 Cylinder Wash

Oxidation and Reduction

Wet recovery operations will be performed on all types of scrap materials such as contaminated uranium compounds, clean-up residues and combustible materials with recoverable uranium content. Most of these materials require oxidation and reduction prior to introduction into the Wet Recovery System, and are loaded into furnace trays in the muffle box hood. This hood is operated on a mass limit.

Oxidation and Reduction (continued)

Additional nuclear safety provisions for assuring that the mass limits are not exceeded are:

a. Material to be processed is weighed on the scrap recycle scales. These scales are included in the Accountability Measurement Control Program and receive frequent checks for accuracy.

b. The total batch weight of raw scrap is assumed to be pure UO_2 in determining the safe batch weight.

c. Each container transferred to 240-2 for processing has a tag showing the enrichment, physical description, and the container gross, tare and net weights.

d. The identity and weight is checked by the operator prior to loading into the furnace trays. Any discrepancy noted must be resolved before loading into the trays.

e. Safe batch limits for material with unverified enrichment will be based on the highest enrichment in process or in storage for recovery.

As the trays are filled, they are placed into a muffle box, with six trays loaded into the front, and six into the rear of the box. Each group of six trays comprises one mass limit. A physical barrier in the center of the box assures the required separation. Sealed boxes are furnaced and then cooled.

Oxidation and Reduction (continued)

Cooled boxes are unloaded in the muffle box hood, and the material processed through such steps as granulation, magnetic separation, sampling, weighing, and blending, as appropriate. Each of these operations is performed under a safe mass limit.

Material thus prepared is now ready for introduction into the first step of the Wet Recovery System.

Dissolution

A preweighed charge of homogeneous material is introduced into a 9-3/4" diameter X 16" long vessel which is located in the slurry feed hood. This hood is limited to one safe mass. The material is slurried with water and transferred to a dissolver. The dissolver is 9-3/4" diameter x 51" long. With the addition of nitric acid, the uranium is dissolved into a solution having a concentration of 50 to 250 grams per liter. Concentrations of uranium in the 300 gram/liter range and higher form slurries which cannot be pumped by the centrifugal transfer pump.

Non-homogeneous material (e.g., pellets) will not be introduced into the dissolution step. This material will first be processed as discussed above (Section II.8.7.2), and screened. Also the slurry vessel has a volume smaller than the SIU limit of 18 liters, and thus is a safe volume for hetrogeneous material. Even if pellets were introduced into the slurry vessel, they could not be transferred through the centrifugal pump to the larger volume dissolver vessel.

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.

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 N16.4-1971. 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.

Filtration, Storage, and Dilution (continued)

The acid insoluble filter and the clarity check vessels are assigned exclusion areas conforming with surface density spacing requirements. These exclusion areas are shown on Dwg. D-5009-2012, Rev. 5. There are no sumps nor floor drains in the 240-2 area to which process material could flow from leaks or rupture of the equipment.

UO_4 Precipitation

Diluted $UO_2(NO_3)_2$ solution is transferred to a horizonal trough precipitator (8-3/8" x 12-5/8" x 10' long). An overflow is located at a height of 9 inches to assure an active cross sectional area no greater than that of a safe diameter 9.8" cylinder. Any overflow from this trough is collected in a safe diameter (9-3/4" diameter x 39" long) overflow vessel.

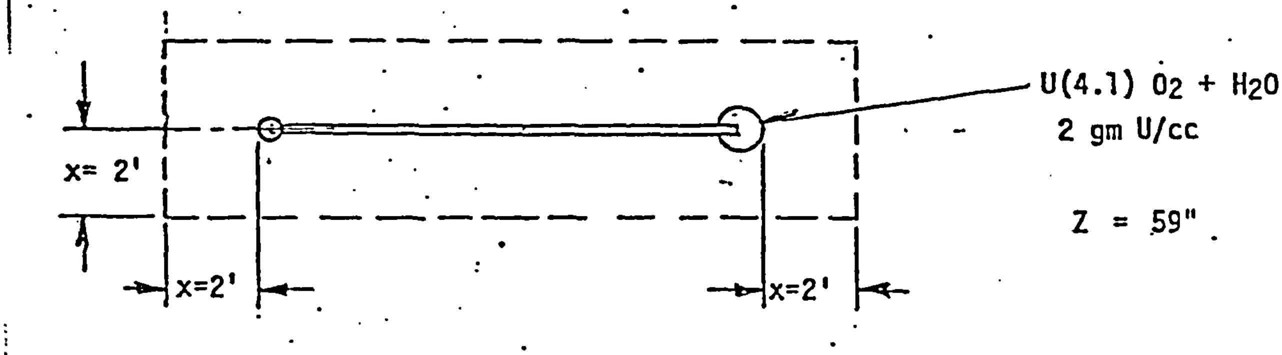
The pH of the solution is adjusted with ammonium hydroxide from the ammonium hydroxide makeup system. This system consists of a sealed tank with a vent to the atmosphere. Additional makeup solutions are introduced from tank 4-2 to precipitate the uranium as UO_4. After aging and the final pH adjustment is completed, the UO_4 slurry is discharged to a 9-3/4" diameter x 33" long centrifuge feed vessel.

UO_4 Separation

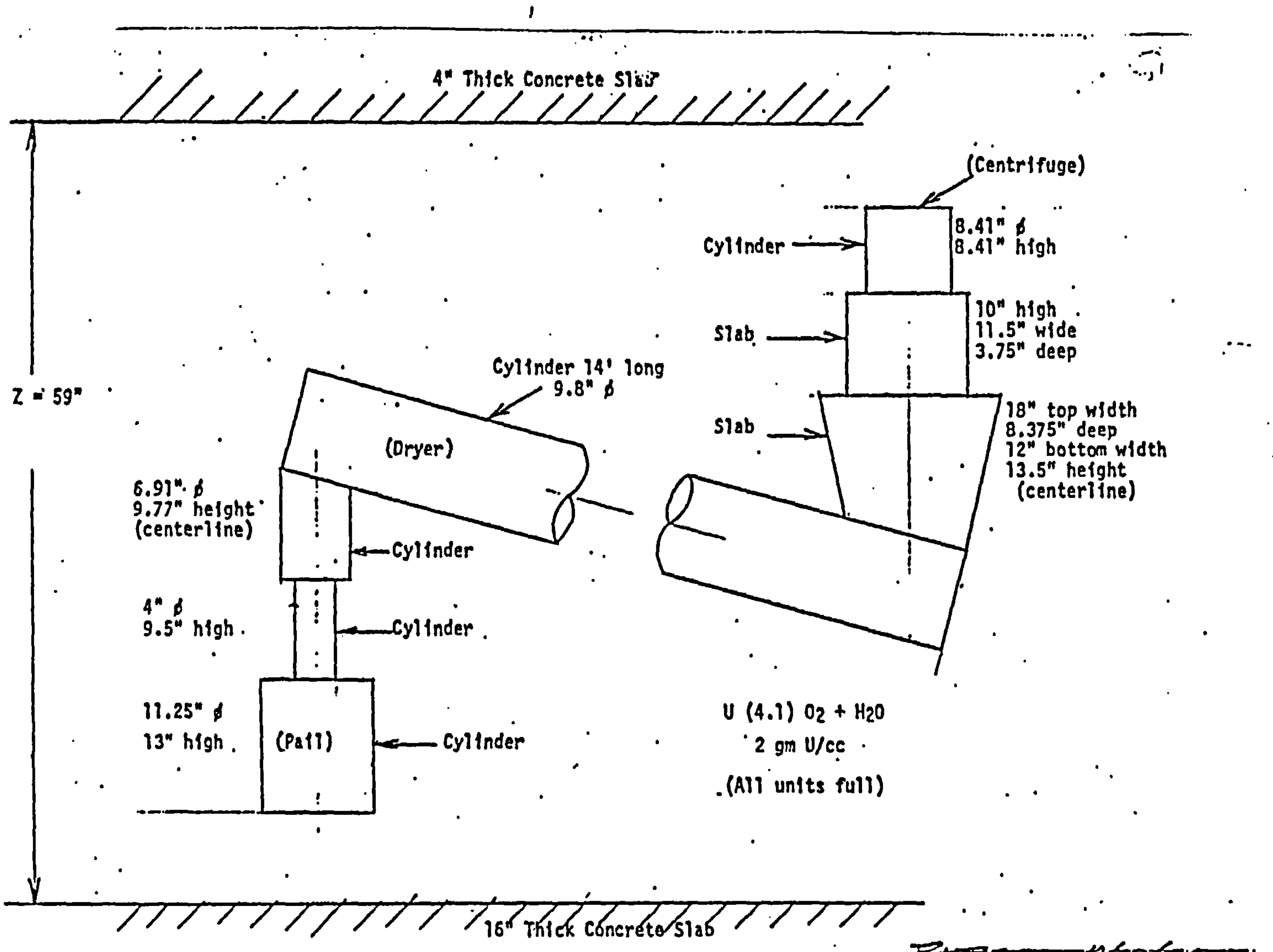
The precipitated slurry is transferred from the centrifuge feed vessel into a centrifuge which has a maximum volume of 7.63 liters. The cake is discharged, by gravity, from the centrifuge into a steam heated screw conveyor dryer.

The dryer has a total cross sectional area of 75.17 in^2 (this includes the internal screw conveyor) which is equivalent to the allowed 9.8" diameter. The actual net internal volume available for uranium is 107.62 liters, based on the manufacturer's design data, and allowing for the volume displaced by the internal screw mechanism. The centrifuge is located in line with the dryer, and has an internal volume of 7.63 liters.

The UO_4 centrifuge-dryer-pail complex, as sketched below, has been evaluated in a 1000 x 1000 array to establish safe spacing requirements. The evaluation was made using KENO with Hansen-Roach cross sections. The geometrical model used in the KENO calculations is shown in Figure II.8-2



Reflector assumptions used were a 16" thick concrete slab below and a 4: thick concrete slab above the complex.



SKETCH 4 - KENO MODEL - CENTRIFUGE/DRYER/PAIL COMBINATION

R.L. REED 11/29/76
SCALE 1/2" = 1'

UO_4 Separation (Continued)

The KENO calculation gave $k_e = 0.8483 \pm .0051$. Other uranium densities were also used:

$U(4.1)O_2 + H_2O$	k_e
1.8 gm U/cc	0.8383
2.0 gm U/cc	0.8483
2.2 gm U/cc	0.8355

Accordingly, a minimum spacing of x = 2.0' will be provided for the centrifuge-dryer pail combination unit, giving a total exclusion area of 72 ft^2 for this unit. This spacing is more than adequate, as the KENO model used was conservative[1]. After drying, the UO_4 is transferred to safe volume containers in the dryer discharge hood. This hood is limited to one such container. These containers are moved to approved storage spaces to await additional processing. Centrifuge supernate is discharged to a safe diameter (9-3/4" diameter x 39" long) overflow and filter recycle vessel. It is then pumped through a filter press for further clarification.

This filter press is limited to a safe volume and is assigned exclusion area spacing of greater than 9 ft^2. Solids from this press are treated in the same manner as solids from the centrifuge.

[1] Reflector assumptions were conservative, no credit was taken for material displaced by the dryer central screw conveyor, and UO_2 instead of UO_4 was assumed.

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 N16.4-1971. 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.

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.

Miscellaneous Operations

Several hoods and locations are provided for analytical, utility, and blending operations. All operations are mass limited, and any hoods with multiple mass limits are provided with physical spacers to assure adequate spacings. Mass limited storage locations are also provided throughout the area.

Utility and Support

Several utility or support tanks or vessels are located in the 240-2 R/R process area. These tanks or vessels are:

1) Raw water feed
2) 45% KOH feed
3) D.I. water storage
4) H_2O_2 and NH_4OH make up
5) NH_4OH make up
6) Nitric acid bulk storage

All of these vessels will be totally enclosed with a vent if required. Accidental introduction of uranium into these tanks and vessels is not considered credible.

Furnace Scrubbers

The gaseous emission from the muffle boxes in furnaces are passed through packed bed scrubbers with a counter-current flow of KOH solution. KOH is utilized to neutralize hydrofluoric acid in the offgases. The scrubber solution is sampled on a routine basis and analyzed for uranium to assure that the uranium concentration does not exceed 1 gm U/liter. The pH of the scrubber solution is monitored to

Furnace Scrubber (continued)

assure that an excess of KOH is present. Spent scrubber solution is pumped out of the scrubbers into the filtrate treatment and furnace scrubber hold tank. The scrubbers are then replenished with KOH solution to maintain a constant liquid level. The scrubbers are inspected annually for accumulation of solids. No accumulation has been observed.

Analyses of the scrubber solution for uranium content have averaged 0.03 to 0.04 gm U/liter, with a maximum value of 0.7 gm U/liter.

Thus, the nuclear safety of the furnace scrubbers and hold tank system is based on the following factors:

1) No physical mechanisms exist that would allow significant quantities of uranium to concentrate in the furnace scrubber solution.

2) Furnaces are operated on a safe batch limit (see Section II. 8.7.2). Residence time per furnace load is 14 to 24 hours. Any increase in uranium concentration in the scrubber solution would thus occur very slowly.

3) Frequent replacement of scrubber liquor precludes concentrations exceeding 1 gm U/liter from being reached in the scrubber solution.

4) Scrubber liquor is sampled weekly. The scrubber will be drained and flushed if a sample exceeds 1.0 gm U/liter.

UO_4 Dryer Scrubber

Gaseous emissions from the UO_4 dryer are scrubbed in the UO_4 dryer scrubber. The gases are passed through a 9-3/4" diameter spray tower to reduce the uranium emission to an acceptable release level. Water is used as the scrubbing liquid. The recirculating liquid is continuously filtered and then is pumped into one of two 9-3/4" diameter UO_4 dryer scrubber hold tanks. It is analyzed for uranium concentration prior to being pumped to the filtrate treatment and furnace scrubber hold tank.

NO_x Scrubber

Oxides of nitrogen released from the dissolution vessels are absorbed in the NO_x scrubber. The 9-3/4" diameter NO_x scrubber is a packed tower with a countercurrent flow of recirculating water as the absorption liquid. The scrubber was designed to operate for maximum absorption efficiency. Compression of the gases is performed by a water sealed compressor. The scrubber liquid is used as feed in the D.I. water/dilute nitric acid feed vessel.

Exclusion Areas

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

Waste Incineration

The incinerator/scrubber system is used to reduce the volume of low level uranium contaminated waste with a maximum enrichment of 4.1% U-235. The system consists of a gas-fired incinerator, an air-cooled heat exchanger, an ejector-venturi scrubber and a packed tower scrubber. The engineering flow diagram is shown in Drawing D-5009-1020. The system is located in area 240-3. The equipment layout is shown in Drawing D-5009-2015.

Low level wastes are dispositioned for incineration after gamma counting. The wastes are logged in on the Incinerator/Scrubber Continuous Inventory Sheet and then subdivided into incinerator charges in the filter cut-up hood. Individual charges are packaged in plastic or paper bags.

The typical incinerator charge contains about 10 kilograms of combustible waste and only a few grams of U-235. The small size of the incinerator makes it necessary to vacuum out the ash long before the safe mass is reached. Operating procedures require removal of the ash when it reaches a depth of 3 to 4 inches (less than a safe slab configuration). No significant ash accumulation has been observed in the secondary combustion chamber. Operating procedures, however, require inspection of the secondary chamber each time the ash is removed from the primary chamber. The probability of moderation by water flooding is essentially zero.

Waste Incineration (continued)

The above considerations, including basing the mass limit on the highest licensed enrichment, negate the effect of any charge measurement or enrichment uncertainty.

Prior to introduction of the charge into the incinerator, the ejector-venturi scrubber recycle tank and the packed tower scrubber are filled to the operating level with D.I. water and recycle circulation in each system is initiated.

Cooling air for the heat exchanger is started to cool the flue gas prior to scrubbing. Uncontaminated cooling air is discharged to the atmosphere in warm weather and to the 240-3 area during cold weather.

The incinerator is preheated and the charge introduced into the primary combustion chamber.

As the charge is incinerated, flue gases are cooled by the heat exchanger and then enter the ejector-venturi scrubber. Recycle water in this scrubber removes the majority of the fly ash.

Scrubbed gases are then passed through a packed tower scrubber to remove any residual particulates before the effluent gases are discharged into the 240-2 wet recovery ventilation stack after the HEPA filter. This stack is continuously sampled.

Waste Incineration (continued)

Charging of the incinerator is terminated when the inventory sheet shows that a total of 850 grams U-235 has been introduced into the system, or when the ash nears a safe slab depth, as stated above.

Ash will be removed from the incinerator via the vacuum collection hood, analyzed for total uranium and dispositioned for burial or wet recovery.

The ejector-venturi scrubber and its recycle tank are less than or equal to a safe diameter for 4.1% enrichment.

The packed tower scrubber is very similar to the scrubber used with the furnaces in area 240-2. Thus, the same control procedures are used. The scrubber liquor is sampled weekly and analyzed for uranium concentration. The scrubber will be drained and flushed if the uranium concentration exceeds 1 gram per liter.

The heat exchanger, ejector-venturi separator box, and the packed tower scrubber are inspected at least annually for accumulation of uranium compounds.

No significant accumulation has been observed in over two years of operation.

Pressure indicators are located before and after each stage of the system. Operating procedures require frequent checks of these indicators to assure that the entire system remains under negative pressure.

2.1.3.4 Access and Egress of Operating Personnel and Emergency Response Teams

See Sections 3.0 and 4.0

2.1.3.5 Fire and Explosion Resistance and Suppression

Evaluation of proposed changes in facilities, equipment or operations includes consideration of fire and explosion hazards. All equipment and operations are designed, and materials selected, to minimize fire and explosion hazards.

Engineered safeguards include equipment features and control systems, use of non-combustible and fire resistant materials, and strict control of flammable liquids and combustible materials.

Routine inspections and audits are conducted to check for fire hazards.

2.1.3.6 Shielding

Shielding as such is not used. However, personnel dosimeters are worn by employees to determine actual exposure.

2.1.4 Control Operations

The criteria for maintaining the response capabilities of plant engineered systems is to reduce employee and environmental exposure levels to as low as reasonably achievable.

2.2 Demonstration of Engineered Provisions for Abnormal Operations

2.2.1 Process Systems

Capabilities of radiation detection and measuring equipment shall be as follows:

Alpha Counting System
Minimum detectability shall be 10 dpm

Alpha Survey Meters
Minimum counting efficiency - 30% (calibrated to read 2 Π)
Minimum Range - 0 - 100,000 counts per minute

Air Sampling Equipment
Lapel samples - - 2 liters per minute
Fixed air samples - - 10-100 liters per minute

Beta-Gamma Survey Meters
GM type with maximum window thickness of not more than thirty milligrams per square centimeter.
Minimum range - 0 - 60,000 counts per minute
0 - mR/hr

Beta-Gamma Counting System
Minimum detectability shall be 200 dpm

A sufficient number of the instruments, meters, and systems listed above shall be maintained operational to adequately conduct our Health Physics program.

The detectors for the criticality alarm system are calibrated annually and following any repair that affects the accuracy of the measurements.

2.2.1 Process System (continued)

Proper operation of the criticality alarm system is tested weekly. All other radiation detection and measurement instrumentation is calibrated quarterly and following any repair that affects the accuracy of the measurements.

All other instruments, including moisture detectors and conductivity meters, are calibrated/inspected at least twice per year and following any repair that affects the accuracy of the measurements. Proper operation is monitored during routine usage in process systems.

Alpha counting and survey equipment is checked daily, or prior to use, to verify background and efficiency.

2.2.2 Alarm System and Release Prevention Capability

All routine operations involving nuclear fuel handling are covered by a shop traveler and/or various operation sheets (O.S.) which are issued by Manufacturing Engineering or Quality Control.

These procedures include the necessary precautions which must be observed to assure that the operation is conducted in a safe manner, including proper response to process alarms and release prevention.

The NLS&A Supervisor will review these precautions regarding all aspects of safety and indicate his approval in writing. However, procedures involving a change in the criticality safety controls used for that particular process in the past shall be approved by the Nuclear Safety Specialist. Each

2.2.2 Alarm System and Release Prevention Capability (continued)

foreman shall instruct his people to assure their understanding of the operations and their safety limits and restrictions. The adequate performance of individuals is continually ascertained by the foreman.

It is the responsibility of the foreman to assure that each work station is properly posted, and that operations are performed in compliance with posted limits and written instructions.

Posting and Labeling

All work stations involving nuclear fuel handling will be posted with a Nuclear Safety Limit. All mass limited containers will be labeled as to contents and enrichment. Radiological posting of areas will be in accordance with 10 CFR 20.203. Other instructional posting is made, as appropriate, containing summary instructions, cautions, and reminders relating to safety are posted, as appropriate or required, throughout the plant.

Personnel Monitoring

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

2.2.2 Alarm System and Release Prevention Capability (continued)

Surveys

Removable contamination levels in plant areas and on items to be released to unrestricted areas are determined by smearing an area of 100 cm^2.

Direct radiation surveys of plant environs, sealed sources, and offsite shipments of radioactive materials are made as necessary to comply with 10 CFR 20.201. All survey results are documented.

Protective Clothhing

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

Dosimetry

A film badge and I.D. badge with indium foil is worn by personnel at all times they are within the fenced site area. Visitors also wear these badges, unless they are escorted when in the controlled areas or only visiting the office area. Film badges are processed monthly.

2.2.2 Alarm System and Release Prevention Capability (continued)

Breathing Zone Monitoring

Breathing zone monitoring of personnel will be conducted as necessary to insure compliance with regulatory requirements.

2.2.3 Support Systems

Utilities

Electrical power to the Hematite Plant is provided by the Union Electric Company via a substation located approximately 100 yards northeast of Building 255, adjacent to Highway 21-A.

The substation transformer steps down the voltage to 12.5 KV and from there is distributed to four stepdown transformers located on the site.

The 3-phase output of each stepdown transformer is then connected to metal clad switchgears for distribution to associated buildings.

Transformer Location	Input Voltage	Output Voltage	KVA Rating
Oxide Plant	12.5 KV	480 v	500 KVA
Bldg. 255	12.5 KV	208 v	750 KVA
Bldg. 240	12.5 KV	230 v	500 KVA
Bldg. 255 (unused)	12.5 KV	208 v	300 KVA

A further stepdown is made for lighting and general convenience power (208/120 volts).

Two natural gas-powered emergency generators provide backup emergency power to maintain critical loads such as emergency air, water, steam, instrumentation, alarms, etc. This natural gas supply is non-interruptable.

2.2.3 Support Systems

Utilities (continued)

One unit is located on the 4th floor level of the Oxide Building and produces 3-phase, 120/208 volts, and 7.5 KW.

The other unit is located in the Utilities Room in Building 240 and produces 3-phase, 100/208 volts, and 75 KW.

Both emergency generators feed their own respective distribution boards and are switched from normal power to generator (emergency) power by "Onan" automatic line transfer switches.

Generator startup and transfer takes approximately 25 seconds for the unit located in Building 240. Startup and transfer of the unit located in the Oxide Building takes about 5 seconds.

Both units are startup tested on a weekly basis.

Emergency Generators	Primary Loads
Oxide Building Unit	1. Instrumentation 2. Alarms 3. Emergency Lighting 4. Oxide Roof Exhaust
Building 240 Unit	1. Well Pump 2. Nuclear Alarms 3. Burner Blower-Boiler 4. Feed Water Pump-Boiler 5. Feed Water Control Panel-Boiler 6. Roof Exhaust above Generator 7. Air Compressor

2.2.3 Support Systems

Utilities (continued)

Water used on the C-E Hematite site is supplied by a well located within the fenced manufacturing area. On the average day, some 71,000 gallons are withdrawn from this well.

Water is stored in a 5,000 gallon tank and distributed as needed within the plant, primarily to Buildings 255 for cooling water and Building 240 for process water.

Water from the site well is analyzed for contamination on a monthly basis. An alternate source of water is the site spring.

All systems using the potable water supply utilize an air break to prevent inadvertent contamination.

Heating, Ventilation, and Air Conditioning

The Oxide Building is heated by a natural gas-fired heater located on the roof of the Pellet Plant. The Pellet Plant and Building 240 is heated by steam supplied by the site boiler located in the south end of Building 250. This boiler is natural gas-fired from an interruptable supply. Fuel oil is stored in an underground tank for use during periods of interruption of natural gas service. Only the offices, Laboratory, and Maintenance Shop are air conditioned.

Ventilation air from the Oxide Building, Pellet Plant,and Recycle/Recovery Areas is passed through absolute filters prior to release to the atmosphere, except for the pellet furnace room air exhausts.

2.2.3 Support Systems

Heating, Ventilation, and Air Conditioning (continued)

The Oxide Building also has an unfiltered room air exhaust which was designed to prevent accumulation of hydrogen in the top of the building should a leak occur. This exhaust blower is operated only infrequently during periods of hot weather, at times when release of contamination is unlikely. A continuous air monitor, located on the 4th floor, will alarm should a release occur.

All exhaust stacks are continuously monitored when in operation.

2.2.4 Control Operations

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.

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 monthly. Clear areas with high potential for tracking of contamination will be surveyed more frequently. Areas with a low use factor will be surveyed less frequently.

Corrective action and/or cleanup shall be initiated when surface contamination exceeds the following action limits:

Routine Surveillance (continued)

a. Restricted areas (As defined in 10CFR20)

Action	Contamination Action Level (Excluding Process Equipment)
Immediate Cleanup	10,000 alpha dpm/100 cm^2 removable (smear) 100,000 beta dpm/100 cm^2 removable (smear)
End of Shift Cleanup	5,000 alpha dpm/100 cm^2 removable (smear) 50,000 beta dpm/100 cm^2 removable (smear)

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

b. Unrestricted Areas (Release of Materials and equipment but not including the abandonment of buildings)

1) The maximum amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters shall not exceed 15,000.

2) The average amount of fixed alpha radioactivity in disintegrations per minute per 100 square centimeters shall not exceed 5,000.

3) The maximum amount of removable (capable of being removed by wiping the surface with a filter paper or soft absorbent paper) radioactivity (alpha or beta) in disintegrations per minute per 100 square centimeters shall not exceed 1,000.

4) The maximum level at one centimeter from the most highly contaminated surface measured with an open-window beta-gamma survey meter through a tissue equivalent absorber of not more than seven milligrams per square centimeter shall not exceed one millirad per hour.

b. Unrestricted Areas (Release of Materials and equipment but not including the abandonment of buildings) continued

5) The average radiation level at one centimeter from the contaminated surface measured in the same manner shall not exceed 0.2 millirad per hour.

6) A reasonable effort shall be made to eliminate residual contamination.

7) Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering materials unless contamination levels, as determined by a survey and documented, are below the limits specified above prior to applying the covering. A reasonable effort must be made to minimize the contamination prior to the use of any covering.

Air Sampling Criteria

Air sampling shall be performed using fixed sample stations and lapel type samplers.

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 sample stations 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 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

Air Sampling Criteria (continued)

a. continued
samples may be collected near the point of suspected release of material.

b. Lapel samplers are the primary means of determining exposures. The sample head shall be attached to the lapel or upper torso as close to the breathing zone as practical. The resulting data shall be used to demonstrate that operator exposures are within acceptable limits.

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

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.

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 the process area.

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.

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.

Respiratory Protection

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

3.0 CLASSES OF RADIOLOGICAL CONTINGENCIES

3.1 Classification System

In processing low-enriched uranium, as used in the fabrication of fuel for nuclear reactors of the pressurized, light water type, the only significant amount of radioactive material present in the fuel fabrication facility is the uranium itself. Because of the low specific activity of low-enriched uranium, the radiological impact of most types of postulated accidents,with the exception of a criticality accident, would be insignificant as compared with the chemical impact. Therefore, the environmental impact which could result from postulated accidents has also been analyzed from the point of view of chemical effects. It should be noted that, in this respect, the Hematite facility does not differ significantly from any other manufacturing plant in which nonradioactive chemicals are processed and stored.

A spectrum of accidents which is possible in connection with the operation of the Hematite facility has been postulated and classified in to six categories, according to the potential for release of materials to the environment.

Class 1 - Minor accidents with no release within the facility.

Class 2 - Accidents which could release some materials inside the plant, but with no release to the environs.

Class 3 - Accidents which could release small amounts of materials outside the plant, but with no significant release offsite.

Class 4 - Accidents which could release materials offsite.

Class 5 - Radioactive materials shipping accident.

Class 6 - Natural phenomena.

Class 1 Accidents

Class 1 accidents may be expected to occur several times during the plant lifetime, but the consequences are small. Accidents in this class include outage of plant utilities and equipment failure.

Facility Power Outage

C-E receives electric power from the Union Electric Company (UE), and backup power is provided for critical services automatically by means of two onsite emergency generators. Complete power outages are infrequent and voltage fluctuations which would affect motors and circuit breakers rarely occur.

Services on the emergency generator systems include the nuclear criticality sensors and alarms, telephones, one air compressor, Oxide Building emergency lights, room air ventilation and control panel and instrument power. Most ventilation air systems are not on emergency power and would stop operating during a power outage. However, any backflow through the exhaust system would be so low that airborne material would not escape from process containment and hoods. This situation would be essentially the same as turning the power off for routine maintenance and absolute filter changes, where no problems are experienced.

In the unlikely event that UE power suffered an outage, and the emergency generators failed to pick up their loads, all ventilation systems and instrumentation would stop operating. Process valves used in the oxide conversion system are air-operated and spring-loaded to fail in the safe position. All processes would shut down with no loss of material containment. Thus, there would be no impact due to power outage.

Loss of Water Supply

Water is supplied to the Hematite facility by an onsite well. Loss of power would also result in loss of water supply, except for 5,000 gallons in the storage tank. Chemical extinguishers are used for fire fighting purposes, and a water tanker is available at the Hematite Fire Department if required.

In the event of total water supply failure from some unforeseen occurrence, damage to some water-cooled process equipment could occur. Such damage would not result in loss of material containment of the equipment involved.

Class 2 Accidents

Class 2 accidents could result in the release of small amounts of chemicals or radioactive materials within the plant with no release to the environment. Accidents in this class include a process line leak, a spill of uranium-bearing material, and a minor fire.

Process Line Leak

A process line leak inside the manufacturing buildings would be quickly detected by the operators and necessary corrective action would be taken to isolate the leaking section. Spilled material would then be cleaned up and retained for reprocessing. Some operational downtime might be required to make repairs or to replace damaged equipment or components. No release in detectable quantities outside the buildings would occur. Respiratory protection, including supplied breathing air, and protective clothing is available in the event of a leak involving hazardous chemicals.

Spills of Uranium-Bearing Materials

Spills of uranium-bearing materials are considered to be readily handled incidents. Procedures call for containment and immediate cleanup while employing standard health physics practices of air monitoring and respiratory protection. Such a spill would release a small quantity of uranium compounds to the working environment, only a small fraction of which would become airborne. No significant release to the environment would occur because of the filtered ventilation systems, the physical properties of the material, and the dilution factors involved.

Routine health physics monitoring is conducted of both controlled and clear areas to detect spread of contamination from incidents involving spills. Any contamination detected that is above control limits is promptly cleaned up. Personnel practices require clothing change, personal cleaning and use of contamination monitoring devices before leaving controlled areas. The possibility of significant spread of contamination to the environs is therefore considered unlikely.

Minor Fire Involving Uranium-Bearing Materials

Minor fires involving uranium-bearing materials could release small quantities of uranium inside the buildings, but the release of uranium compounds to the environs is improbable because of ventilation filtration systems, availability of portable fire extinguishing equipment, and the training of personnel in fire protection. Airborne uranium released within buildings as a result of a fire would be handled in the manner indicated in Section 6.1.2.2.

Class 3 Accidents

Class 3 accidents have a low probability of occurring, but could result in the release of small amounts of materials to the environs in the immediate vicinity of the plant. Accidents of this type include chemical accidents, a fire or explosion, and material spills on plant grounds.

Chemical Accidents

Potential accidents involving chemicals include a pipeline leak, a spill within the fenced manufacturing area, and partial or complete emptying of a storage tank.

A leak or spill outside the manufacturing buildings would again be quickly located by operators and corrective action taken. A small quantity of material could enter the storm drains and be carried to the site pond through the storm sewers. Dilution by equipment cooling water and pond water before discharge into Joachim Creek would make the environmental effects of such an occurrence negligible.

Accidents concerning bulk storage tanks are discussed below.

Anhydrous Ammonia - anhydrous ammonia is stored in a 10,000 gallon tank equipped with dual pressure relief valves. The exposure of this tank to an intense fire would result in bleeding of over-pressure through the relief valves. The release would cease as the fire was extinguished. Ammonia vapors could reach high concentrations in the vicinity of the tank, but would be rapidly dispersed. It is expected that concentrations at the nearest site boundary would be less than 500 ppm and have no permanent effect on personnel or the environs.

Liquid Nitrogen - Liquid nitrogen is stored in a 1,000 gallon tank equipped with pressure relief valves. Liquid nitrogen is nontoxic and nonflammable and rapidly evaporates and dissipates upon exposure to the atmosphere.

Hydrogen - Hydrogen is stored in a cylinder bank containing 26,300 cubic feet at standard temperature and pressure (STP). A tanker trailer, containing a maximum of 110,000 cubic feet of hydrogen at STP, is normally connected to the storage bank. Maximum storage pressure is 2200 psi. Hydrogen is nontoxic, but is highly flammable and forms an explosive mixture with air. As storage is in the open, a hydrogen leak would rise and disperse very rapidly. A jet of flame could occur if an ignition source were present, but lack of confinement of the hydrogen-air mixture would prevent an explosion. No significant environmental effect would be caused by a hydrogen leak. (This system has been removed but may be reinstalled at a different location).

Liquid Propane - Liquid propane is stored in a standard residential-type 300 gallon tank outside of the tile barn. It is used to provide heat to the Emergency Operations Center when required. The chance of a significant leak occurring is extremely low. Liquid propane is readily volatilized to a gas upon exposure to the atmosphere. Propane is highly flammable and would present a fire hazard should a large leak occur. The fire, however, would be restricted to the immediate vicinity of the tank and no significant environmental effect would be caused.

Fuel Oil - Fuel oil is stored in a 2,000 gallon underground tank for emergency use in heating the steam boiler in case of an interruption in the natural gas supply. No problems would be expected to be encountered with this type storage.

Acids - Nitric, hydrochloric, and sulfuric acids are stored in standard, approved shipping containers outside of Building 255. A spill of this material could enter the storm drains, but would be rapidly diluted and neutralized. No significant environmental effect would result.

Minor UF_6 Leak

Uranium hexafluoride cylinders arrive by truck in their protective shipping containers. The shipping container is opened and the cylinder is transferred by a stationary crane to the weighing area on the Oxide Building dock. It is then moved into a vaporization chamber or into the outside storage area. All customary handling precautions are observed, but a drop of no more than 12 feet is possible.

During testing, a 30-foot drop was required to cause even a hairline crack in a cylinder. UF_6 is a solid at ambient temperature (sublimes at 132°F) and therefore would evaporate out of a crack very slowly. Also, UF_6 reacts with atmospheric moisture to form UO_2F_2, a non-volatile solid. Thus, a slow leak in a UF_6 cylinder is self-sealing.

A leak within a steam-heated UF_6 vaporization chamber would be exhausted through the wet-scrubber prior to release to the atmosphere. No significant environmental effect would be caused by a minor UF_6 leak in the open or in a vaporization chamber.

Fire or Explosion

The primary explosion hazard within the plant is hydrogen, which is used as a reducing atmosphere in several processes. For example, a hydrogen explosion could occur in a furnace due to the presence of oxygen during furnace startup as a result of incomplete air purge. Preventive measures include flow monitoring, detailed procedures and personnel training, emergency cutoffs, and availability of portable fire fighting equipment.

The probability of a fire or explosion has been minimized through carefully engineered safeguards, strict control of combustible materials, and protective measures to control a fire if it does occur. A trained fire brigade and fire fighting equipment is maintained. Support agreements have been obtained with the Hematite, Festus and DeSoto Fire Departments and liason is maintained with these departments. Training of the onsite fire brigade is provided by St. Louis Fire Academy instructors.

A fire within a building, or a furnace explosion accompanied by fire, could result in a release of uranium-bearing materials being processed. Most of the larger particles would settle out within the building. A lesser quantity of smaller particles would be released to the atmosphere, where they would settle out on the plant site or rapidly be dispersed. No significant environmental effect offsite would be expected.

Outside Material Spills

Most material spills that could occur outside the buildings would be of the type easily cleaned up, with little release of radioactive material or chemicals to the environs. The majority of radioactive materials handled are of insoluble form in small containers.

The worst postulated situation would be a spill of a radioactive liquid which could enter the storm drains. Such an incident would be the release of the entire contents of a 55-gallon drum of cylinder wash filtrate, with all this solution entering the storm drains. The maximum concentration of beta activity observed in a drum of filtrate has been approximately 1000 times MPC. This would be diluted with the 64,000 gallons of industrial waste water flowing daily in the same line to the site pond. Additional dilution by mixing with several million gallons of water in the site pond would occur prior to release to the site creek. The concentration at this point would be several orders of magnitude below MPC. The same dilution would be achieved in the case of a chemical spill that entered the storm drain.

Class 4 Accidents

Class 4 accidents have a very low probability of occurring, but could result in the release of materials offsite. Accidents of this type include a massive UF_6 release, a major fire or explosion which destroys an entire building, or a criticality accident.

Massive UF_6 Release

Uranium hexafluoride (UF_6) is received at the Hematite site in standard 30-inch diameter cylinders, having a capacity of 5,000 pounds. In the case of a massive cylinder failure, the UF_6 would vaporize over a period of time, forming UO_2F_2 and HF upon contact with moisture in the atmosphere.

An incident resulting in a massive release of UF_6 is considered to be the bounding accident case for the release of uranium or fluoride. This accident would involve the release of UF_6 as might occur from valve or line failure of a heated cylinder being unloaded. Assuming that a full cylinder of UF_6 (2500 kg) at unloading temperatures started to leak and that no additional heat was supplied after cylinder failure, it is estimated that about 22 percent of the material would be released before the UF_6 could be considered to be cool enough to solidify and have a vapor pressure low enough so that the release stops. Such a release was estimated to last for 15 minutes and 540 Kg of UF_6 would be released. It was assumed the uranium released would react with water in the air and form UO_2F_2 of a respirable particle size.

The results of the dose assessment for the accidental massive UF_6 release are:

Organ	Organ Dose (Rem)
Lung	0.016
Bone	0.82
Kidney	0.20
Liver	0.05

It should also be noted there is another element of conservatism in that the postulated release would be visible as a white cloud. Hydrogen fluoride is very irritating to the lungs and mucous membranes. Thus, the natural reaction is to hold one's breath and run from the cloud. The actual maximum dose commitments are likely to be at least a factor of 100 lower than those calculated, as it is extremely unlikely that any individual would be exposed to the cloud for any length of time.

Major Fire or Explosion

A major fire or explosion that would destroy an entire building, or a major portion thereof, could release uranium compounds to the atmosphere. However, a fire or explosion of this magnitude has an exceedingly small probability of occurrence due to engineered safeguards and fire control practices.

As discussed previously, engineered safeguards include equipment features and control systems, use of noncombustible and fire resistant materials, and strict control of flammable liquids and combustible materials. Procedures are followed for design review of plant and equipment changes for fire and explosion hazards, and routine inspections and audits are conducted to check for fire hazards. The combined safeguards for both prevention and control make the probability of an explosion or a major fire remote.

Criticality

Since the quantity of U-235 onsite is greater than a minimum critical mass, it is necessary to consider the possibility of a criticality incident. While such an accident is theoretically possible, programs of engineered safeguards, design review, operational controls, and audits are in place to prevent criticality accidents. Consequently the probability of an accident of this type is extremely low. In the history of the fuel fabrication industry, there has never been a criticality accident associated with fuel preparation or fabrication. The few criticality accidents that have occurred involved wet chemical processing in highly enriched scrap recovery operations. It should be noted that much larger quantities of the low enriched uranium handled at the Hematite plant would be required for a criticality accident than have been involved in these accidents with highly enriched uranium.

Criticality incidents that have occurred have had no significant environmental impact. Radiation injuries were limited to the individuals directly involved and fission products were mostly confined to the processing building in which the event happened. Based on this accident experience, it can be stated that significant environmental impact from a criticality accident is highly improbable.

Postulated Criticality Accident - The maximum number of fissions likely to occur, based on past accident experience, is 10^{19} fissions. The following assumptions were used in calculating the amount of radioactivity that would be released to the atmosphere.

1) The release results from 10^{19} fissions in 8 hours.
2) 25 percent of the iodine and 100 percent of the noble gases are released to the ventilated room atmosphere.

These assumptions are consistent with those presented in Regulatory Guide 3.34, "Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Criticality in a Uranium Fuel Fabrication Plant". No credit was taken for a stack because of its low elevation relative to the building roof.

An exposed individual would receive exposure from both internal and external sources of radiation. Radiation doses would be received from submersion in a semi-infinite cloud of beta and gamma emitters and from inhalation of fission products. The inhalation dose calculated would result from the inhalation of radioiodines during cloud passage.

Analysis shows that a criticality accident of an eight hour duration would result in moderate public exposure. Calculated doses to the nearest resident were:

	Rem
Whole Body Gamma Dose	0.27
Whole Body Beta Dose	0.15
Thyroid Dose	1.7

Dosage action levels recommended in EPA's "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents" suggest that protective actions should be considered when the individual whole-body-gamma dose and thyroid dose are between 1-5 rems and 5-25 rems respectively. Comparing the estimated dosages that the nearest resident would receive during the criticality against those specified by EPA, it does not appear that protective actions such as sheltering for the nearest residents would be necessary if an eight hour criticality occurred.

Class 5 Accidents

In this category are accidents that could occur offsite and subsequently release radioactivity offsite. An accident falling into this classification is a radioactive materials shipping accident.

Transportation of radioactive materials takes place both to and from the Hematite plant site. The uranium shipped to the Hematite site is principally UF_6 in Model 30B shipping containers. Shipments from the Hematite site are principally

UO_2 powder and pellets. Fuel shipments from the Hematite site are made using exclusive use trucks.

All such radioactive material shipments are regulated by the U.S. Department of Transportation and the Nuclear Regulatory Commission, and are in full accordance with state and federal regulations governing the safe shipment of hazardous materials.

Shipments to the Hematite Site

The majority of radioactive material shipped to the Hematite site will consist of uranium hexafluoride (UF_6). Some discrepant uranium oxide (UO_2) powder and pellets are also received for recycle.

The low enriched UF_6 is received in Model 30B cylinders 30-inches in diameter, containing up to 5000 pounds of UF_6. These cylinders are contained in Model OR-30 protective shipping packages. Approximately 45 shipments are received annually.

Discrepant UO_2 powder and pellets are received in Type "B" steel drums meeting all DOT specifications and NRC regulations.

Shipments, on receipt, are completely surveyed for damage and radioactive contamination and the truck is surveyed before it is allowed to leave the plant site.

Shipments From the Hematite Site

Radioactive material shipped from the Hematite plant site largely consists of finished UO_2 fuel pellets and UO_2 powder, and is shipped in specially designed and tested shipping containers. Most shipments are made in Model CE-250-2 and UNC 2901 shipping containers, but other approved models may be used. These containers are shipped in exclusive-use trucks, and approximately 45 shipments are made annually.

In addition to product shipments, small quantities of radioactive materials are also shipped in the form of contaminated paper, rags and other solid wastes. Approximately 2 such truckloads of waste materials are removed from the Hematite site and shipped to a licensed burial site each year. These shipments are made using steel drums or plastic lined wooden boxes on exclusive-use trucks.

All containers and the transport vehicles are surveyed for proper loading, absence of defects that could effect container integrity, and for levels of radioactive contamination before off-plant shipment.

Environmental Impact of Shipments

All shipments of radioactive material to and from the C-E Hematite plant site are made in accordance with the stringent regulations of the DOT and NRC. These regulations specify container integrity under severe conditions. The containers are designed, manufactured, and maintained to provide containment of their contents and remain subcritical when subjected to the following hypothetical accident conditions:

1) A 30' drop onto an unyielding surface in the most damaging orientation, followed by

2) A 40" drop onto a 6" diameter steel rod, striking in the most vulnerable spot on the container, followed by

3) A 30-minute fire at 1475°F, followed by

4) Submersion in water to a depth of 3' for 8 hours.

In addition to the stringent performance standards for shipping containers, C-E imposes administrative control over the exclusive-use truck transport vehicles. The number, type, and contents of the containers loaded on each truck will be controlled to ensure that all vehicles will remain nuclear-safe under normal transport and severe accident conditions.

No transportation accident resulting in a criticality has ever occurred. In addition, container performance standards and vehicle loading controls are provided to ensure that a vehicle will remain nuclear-safe even during hypothetical accident conditions. For this reason it is extremely unlikely that a nuclear criticality could result from shipments to or from the Hematite site. Should a shipping package be breached, the impact on the environment would be low as the nuclear materials are in solid, insoluble form and not readily dispersible. Due to the low specific activity and low radiation levels of the uranium involved, the radiological impact on the environment from a transportation accident would not be significant.

Class 6 Accidents

Accidents of this type are naturally occurring events such as flooding, wind damage, and earthquakes.

Flooding

Floods which might occur at the site will produce different flood levels depending upon the flow rate of Joachim Creek. While the historical records (maximum observed level of 431 feet msl) as well as the analysis by U.S. Corps of Engineers (100-year flood level at 434.7 ft. mls) show that a site flood is not likely it still is considered remotely possible. If a flood of larger magnitude (greater than 435 feet msl) were to occur, water at the plant site would rise but there is not expected to be any significant water velocity associated with the flooding. The reason for the minimal water velocity is that the railroad track, which is located between Joachim Creek and the plant, would serve to isolate the plant area from the main stream flow. Water would enter and exit this isolated area via a culvert 900 feet south of the plant boundary and a second one about 1200 feet northeast of the plant, both of which pass under the railroad tracks. This postulated flood would be expected to result in only minimal water velocities (less than 0.1 ft/sec). These velocities are not expected to be able to tip material storage cannisters within the buildings or transport any spilled material. Experimental results for a water-sand system show that for particles of UO_2 size water velocities of greater than 0.6 ft/sec are required to move the material. Given the increased density of UO_2 relative to sand (a factor of about 4), it does not seem likely that a credible flood would spill or transport spilled UO_2 particles.

Wind Damage

The average wind speed for the area, as recorded by the St. Louis U.S. Weather Bureau, is about 9.5 miles per hour. Elevated wind speeds often occur as storm fronts move through the area, particularly in the Spring and Summer. However, no wind damage has been experienced in the 25-year history of the plant.

The probability of a tornado striking the Hematite plant is extremely low.

The U.S. Department of Commerce reports a mean annual frequency of about 8 tornadoes in the 34 year period of 1919-1950. The probability of a tornado striking a particular location is computed as 7.51×10^{-4} and the recurrence interval as 1,331 years (Union Electric Company, Callaway Plant PSAR).

A tornado could cause considerable dispersement of contaminated items and require a major cleanup effort. Extensive dispersement of nuclear material would not be expected offsite, since nearly all uranium on the site is contained in UF_6 cylinders, sealed metal cans, pellet bundles, or silos with sound structural characteristics. Therefore, very little uranium would become airborne.

Earthquakes

The east-central Missouri general area is relatively active seismically and also contains a portion of the New Madrid Fault that caused the "great earthquakes" of 1811 and 1812. There were three quakes of Epicentral Intensity XII Modified Mercalli scale (M.M.) which took place on December 6, 1811 and January 23 and February 7, 1812, near New Madrid. During recent years, there have been two quakes recorded in the New Madrid area. In 1962 a quake measuring V (M.M.) was recorded and one with a magnitude of 4-1/2 was recorded in 1963. A quake reported as "the strongest in years" occurred near Caruthersville, Missouri, 150 miles southeast of Hematite, on December 3, 1980.

Essentially no nuclear material would be released offsite as the result of an earthquake. Because of the form and containment discussed above, there would be very little becoming airborne. The maximum release would probably be less than the routine annual release. (Additional information concerning Missouri seismic activity may be found in the Union Electric Company Callaway Plant PSAR).

Thus, the plant could sustain very severe damage from either a tornado or an earthquake without causing a radiological impact in excess of applicable limits to offsite individuals. The major concern would be clean-up activities, largely limited to the plant and its immediate environs on-site.

3.2 Classification Scheme

Section 3.1 of this plan evaluates the consequences of all credible accidents. In all cases examined, the probability of a major accident was found to be extremely low. This low probability is derived from the fact that: 1) all process equipment is designed to incorporate permanently engineered safeguards; 2) strict administrative control of production processes is maintained; 3) adherence to the double contingency principle in the preparation of safety evaluations; and 4) the inclusion of generous safety factors in all facility limits.

A classification system has been employed, however, which covers the entire spectrum of possible emergency situations, regardless of the probability of occurrence.

This section of the emergency plan describes how the spectrum of postulated accidents are encompassed within the emergency characterization classes. Each class defined is associated with a particular set of immediate actions to be taken to cope with the situation.

It should be noted that various classes of accidents require a graded scale of responses, which form the basis for the classification system. Also a small problem, such as a fire, may increase in severity and therefore move up from one class of accident to another.

Personnel Emergency

This class involves accidents and occurrences on-site in which emergency treatment of one or more individuals is required. It includes those situations that have no potential for escalation to more severe emergency conditions. There may be no effect on the facility, and immediate operator action to alter facility status is not necessarily required. A Personnel Emergency does not activate the entire emergency organization, but may activate teams such as the first aid team. It may also require special local services such as ambulance and medical. Emergencies in this class can reasonably be expected to occur during the life of the plant.

Recognition of this class of emergency is primarily a judgment matter for facility supervisory or management personnel. Its importance as part of the classification scheme rests to some extent on its "negative" information content, vis, that the incident giving rise to the emergency is restricted in its scope of involvement.

Examples of personnel emergencies are:

- Injuries requiring first aid treatment by trained plant personnel only.
- Injuries requiring transportation to offsite medical facilities for treatment.
- Actual or possible internal exposure to radioactive materials requiring health physics evaluation and follow-up.
- External contamination requiring decontamination and assessment by Nuclear and Industrial Safety (Health Physics)

Personnel Emergency Action

This class of emergency is declared by the affected individual or nearby personnel. (It does not involve sounding of an alarm). An assessment of the situation is made by a representative of the Nuclear and Industrial Safety group to determine whether medical treatment and/or personnel decontamination is necessary. When applicable, corrective actions will be promptly taken to preclude further injury to the individual involved or nearby personnel. These correction actions may include:

Shutting off electrical power to faulty equipment.
Isolation and containment of minor process leaks.
Restricting personnel access to areas of possible high concentrations of airborne radioactive material.
Any other action necessary to correct or mitigate the situation at or near the source of the problem.

Normally protective action, other than the possible use of respiratory protection in the immediate area, is not required for a personnel emergency.

Use of respiratory protection is determined by a trained member of the Nuclear and Industrial Safety group. Personnel decontamination will be performed by or under the supervision of a trained NIS representative. Notification of and transportation to offsite medical facilities, if necessary, is also made by the Nuclear and Industrial Safety group. An NIS representative will accompany the victim to any offsite treatment facility.

A licensed medical doctor is retained to provide medical treatment locally (Crystal City) when hospitalization is not required.

Emergency Alert

This class involves specific situations that can be recognized as creating a hazard potential that was previously nonexistent or latent. The situation may not yet have caused damage to the facility or harm to personnel and does not necessarily require an immediate change in facility operating status. Inherently, however, this is a situation in which time is available to take precautionary and constructive steps to prevent an accident and to mitigate the consequences should it occur. An Emergency Alert situation may be the result of either man-made or natural phenomena and can reasonably be expected to occur during the life of the plant.

Emergency Alert conditions imply a rapid transition to a state of readiness by the facility personnel and possibly by off-site emergency support organizations, the possible cessation of certain routine functions or activities within the facility that are not immediately essential, and possible precautionary actions that a specific situation may require.

Example of situations which fall in the emergency alert classification are:

- Bomb threats
- Civil disturbances
- Tornado warning or sighting
- Earthquake tremor or warning of seismic activity
- Forest fire
- Release of toxic or noxious gas nearby which could affect the site

The Emergency Director is responsible for determining when an emergency alert condition exists. Note that no situation associated with in-plant events involving radioactive materials has been identified as belonging in the emergency alert classification.

Emergency Alert Action

The responsibility for delcaring an emergency alert rests with the Emergency Director. The general criteria for declaring an emergency alert are as follows:

1. Bomb threats
2. Actual or warning of impending civil disturbance
3. Tornado warning or sighting
4. Earthquake tremor or warning of seismic activity
5. Forest fire warning or sighting
6. Sighting or report of release of toxic or noxious gas nearby which could affect the site

The Emergency Director then assesses the situation and makes a decision as to whether to evacuate to the designated assembly area by manually activating the non-nuclear alarm, or to instruct personnel to remain inside plant buildings by telephone and direct voice contact. At this time the plant will be secured, processes and equipment shut down and utilities shut off as deemed necessary by the Emergency Director. Contact would be made with offsite agencies as necessary.

The emergency alert is terminated by the Emergency Director when the threatening situation has passed.

Plant Emergency

This class includes accidents within the plant requiring staff emergency organization response. The initial assessment of situations in this class should indicate that it is unlikely that an offsite hazard will be created. However, substantial modification of plant operating status is a highly probable corrective action if it has not already taken place by automatic protective systems. This class is normally associated with a judgment that the emergency situation can be corrected and controlled by the facility staff.

Protective evacuations or isolation of certain plant areas may be necessary. This class of emergency can also reasonably be expected to occur during the life of the plant.

Accidents which fall into this class are those accidents analyzed in the Environmental Impact Information as events that are predicted to have insufficient consequences outside the plant to warrant taking protective measures.

Criteria for declaring Plant Emergencies should be based on (1) the recognition of an immediate need to implement in-plant emergency measures to protect or provide aid to affected persons in the facility or to mitigate the consequences of damage to plant equipment; (2) a positive observation that radiation monitors do not indicate the possibility of a criticality; (3) the recognition by personnel in the area involved that the situation is beyond their capability to resolve.

The non-nuclear alarm may be sounded by any person cognizant of the situation. Declaring and classifying the emergency is the responsibility of the Emergency Director.

Plant Emergency (continued)

Examples of plant emergencies are:

- Major process leak or spill (toxic or radioactive)
- Fire (not controllable by personnel in the immediate vicinity)
- Explosion contained within building

The Emergency Director may request that offsite agencies which may be required to respond to a particular emergency assume an alert condition until the emergency is terminated. For example, the Hematite Fire Department would be requested to stand by in case of a fire that is not easily extinguishable.

Notification of C-E management and appropriate offsite agencies to alert them to the nature and extent of a plant emergency is to be made in accordance with directions contained in the Hematite Emergency Procedures Manual.

Plant Emergency Action

A plant emergency is declared by manual activation of the non-nuclear alarm by any personnel cognizant of the emergency situation.

Plant emergency situations include:

Major process leak in UF_6 to UO_2 conversion line

Fire not easily extinguishable by personnel in the immediate vicinity

Break in combustible gas line

Explosion contained within building

Any other situation which results in immediate danger to plant personnel

Upon sounding of the alarm, personnel other than production area monitors immediately evacuate to the designated non-nuclear emergency assembly area. Production area monitors monitor or shut down process equipment and evacuate their area when secured or otherwise instructed. The following onsite emergency teams are then called upon as appropriate by the Emergency Director.

First Aid Team
Fire Brigade
Radiological Survey Monitoring
Guard Force
Utilities and Emergency Repair

The Emergency Director in accordance with procedures contained in the Emergency Procedures Manual issues directions for care of any injured personnel, combating the specific problem and preventing unauthorized entry to the affected area. He then determines the need for additional assistance from offsite support groups and initiates call-in (e.g. fire department) by telephone. Back up communication for calling in outside assistance consists of an independent telephone in the Emergency Control Center and a citizens' band radio.

Use of respiratory protection is determined by a trained member of the Nuclear and Industrial Safety group. Personnel decontamination will be performed by or under the supervision of a trained NIS representative. Notification of and transportation to offsite medical facilities, if necessary, is also made by the Nuclear and Industrial Safety group. An NIS representative will accompany the victim to any offsite treatment facility.

The non-nuclear emergency procedure will contain instructions for the specific emergency teams action during the emergency. When the emergency has been controlled, NIS will survey the affected area and release for clean-up or return to normal operations.

Site Emergency

Emergency situations more severe than plant emergencies are not expected to occur during the life of a plant because of design features and other measures taken to guard against their occurrence.

Nevertheless, it is necessary and prudent to make provisions for a class that involves an uncontrolled release of radioactive materials or chemicals into the site environs, outside the fenced manufacturing area. Notification of offsite emergency organizations will be made as necessary. Protective actions include evacuation of all facility areas other than the emergency control center. Associated assessment actions include appropriate provisions for monitoring the environment.

A site emergency is declared by (1) automatic sounding of the nuclear (criticality) alarm or (2) sounding of the non-nuclear alarm. The non-nuclear alarm may be sounded by any person cognizant of the situation. Declaring and classifying the emergency is the responsibility of the Emergency Director.

Examples of site emergencies are:

- Criticality accident
- Substantial UF_6 release
- Major fire or explosion
- Major anhydrous ammonia release
- Substantial release of airborne radioactive particulates (a substantial release is defined as the release of 300 microcuries within a 24-hour period).

Site Emergency Action

The Site Emergency can be implemented in several ways:

Sounding of the nuclear alarm (intermittent horn).

Sounding of the non-nuclear alarm (loud, continuously ringing bell).

By any personnel cognizant of an actual or impending emergency which affects the C-E Hematite Site.

Examples of site emergencies are:

Criticality accident

Major UF_6 release

Major fire or explosion

Major anhydrous ammonia release

The non-nuclear alarm is usually sounded to designate a plant emergency. At the discretion of the Emergency Director, a site emergency may be declared in accordance with the criteria discussed in Section 4.4. At this time personnel are instructed to further evacuate to either the parking lot or the Emergency Assembly Area in the tile barn. The emergency actions are then directed and any necessary offsite notifications made from the Emergency Control Center.

In the case of the sounding of the nuclear alarm, all personnel evacuate immediately to the Emergency Assembly Area in the tile barn. Upon assembly at the barn, supervisors determine that all personnel under their cognizance have been evacuated and are accounted for, including their visitors and outside contractors.

Those present in the assembly area are questioned to determine if any unusual occurrences were observed and a survey team, consisting of at least two persons knowledgeable in the use of instruments, are instructed to prepare for re-entry. The emergency procedures contain appropriate instructions to minimize the possibility of a second criticality excursion.

Site Emergency Action (continued)

First aid is provided for any individuals injured during the evacuation and all identification badges are checked for indium foil activation.

When the report of the re-entry team is received, the incident is considered confirmed if radiation levels in excess of 5 mr/hr are encountered.

At this point, a NIS representative is dispatched to the site boundary downwind of the plant to monitor the exposure rate. The maximum offsite thyroid dose is estimated from these readings as specified in the detailed procedures.

The Emergency Director assures that the following preplanned actions are initiated:

- Arrange for treatment of injured or exposed personnel.
- Arrange for decontamination of personnel.
- Determine radiation level in assembly area. Decide need to relocate.
- Collect film badges and record indium foil readings.
- Instruct health physics to initiate sampling of airborne contamination.
- Start action to obtain assistance:
  - Ambulance, Company Physician
  - Hillsboro Sheriff
  - Barnes Hospital (radiation exposure)
  - C-E Management list. Request first individual contacted to inform the NRC and other persons on management notification list.
- Direct survey team to establish 100 mr/hr boundary line.

Site Emergency Action (continued)

Based on information from survey team, initiate action to shut down the plant.

Obtain other assistance and make notifications of other offsite agencies as required.

Exposures during subsequent re-entry operations will be limited. Specific instructions, based on actual equipment or process involved will be issued to minimize the possibility of causing additional criticality excursions.

Allowed exposure during re-entry for any person shall not exceed 12.5 rems. Under unusual circumstances (e.g., lifesaving) exposures may be permitted to a maximum of 25 rems.

Time-of-stay during re-entry shall be limited. Such time-of-stay will commence upon penetrating beyond the 100 mr/hr boundary and terminate upon recrossing it while exiting.

No personnel are allowed to re-enter the affected plant areas unless authorized by the Emergency Director.

Prior to startup after a site emergency, the plant will be returned to a safe condition. Spills will be cleaned up and no excessive radiation or contamination levels will be present. Radiation levels will not be in excess of normal operating levels as specified in the SNM-33 license.

Radiological and non-radiological monitoring will be conducted as appropriate in case of a non-criticality site emergency.

General Emergency

Accidents that have the potential for serious radiological consequences to the public health and safety have been analyzed previously and were found not to be credible for the C-E Hematite facility (NRC Environmental Impact Appraisal, March 1977).

3.3 Range of Postulated Accidents
Spectrum of Postulated Accidents

Offsite impact of the spectrum of accidents analyzed in the Environmental Impact Appraisal is shown in the following table:

Accident	Classification	Offsite Impact
Injured employee	personnel emergency	none
Contaminated employee	personnel emergency	none
Train derailment	emergency alert	none (from plant)
Process leak or spill	plant emergency	none
Fire	plant emergency	none
Substantial UF_6 release	site emergency	Site boundary concentration: 30% of 8-hr. TLV 4% of single exposure TLV
Criticality	site emergency	Site boundary dose: whole body - 0.5 Rem thyroid - 1.5 Rem
Substantial release of airborne particate uranium	site emergency	Unrestricted Area MPC

4.0 ORGANIZATION FOR CONTROL OF RADIOLOGICAL CONTINGENCIES

The formal organization of C-E Hematite contains support groups which, in addition to normal functions during routine operations, can provide support to any or all facilities at Hematite during an emergency.

4.1 Normal Plant Organization

Each operation at C-E Hematite is staffed with experienced operating personnel. These personnel are well qualified to recognize conditions that may result in an accident and are capable of instituting remedial procedures. If these remedial actions would be insufficient to deal with a situation, the employees have been trained to make emergency notifications and to perform those emergency functions that provide the maximum immediate control over most situations. These staffs are also trained to evacuate the facility involved, if necessary.

The Production Superintendent has been delegated Emergency Director by the Plant Manager. The shift foremen act as alternates in his absence. A list is maintained of trained Fire Brigade Members and First Aid Team Members for the Emergency Director to call upon as necessary. A Health Physics Technician is present onsite for each production shift. A call-in list is used by the security guard to obtain emergency organization personnel when they are not present on site. A security guard is on duty at all times. This list also shows the line of succession for the major emergency functions.

The responsibility and authority of the Emergency Director and other members of the emergency organization are specified in the Emergency Procedures Manual. If management personnel are recalled to the site during an emergency, the highest ranking person assumes control of his emergency function.

4.2 Onsite Radiological Co. ingency Response Organization

At such time as the Hematite Emergency Plan is put into effect, all aspects of the emergency situation will be coordinated within the scope of the Hematite emergency organization (see Figure 4.1, which illustrates the emergency functions. An individual may perform more than one function, depending upon his training and the nature of the emergency).

Responsibilities of each position or function are shown below:

Emergency Director (Production Superintendent, Alternate: Shift Foreman).

a. Activate Emergency Control Center in the tile barn emergency room, or establish an alternate control point from which activities can be directed.

b. Determine status and necessity for shutdown of plant systems.

c. Direct, coordinate, and evaluate actions to be taken by functioning emergency teams.

d. Assure that off-site agencies are notified.

Fact Finding Committee

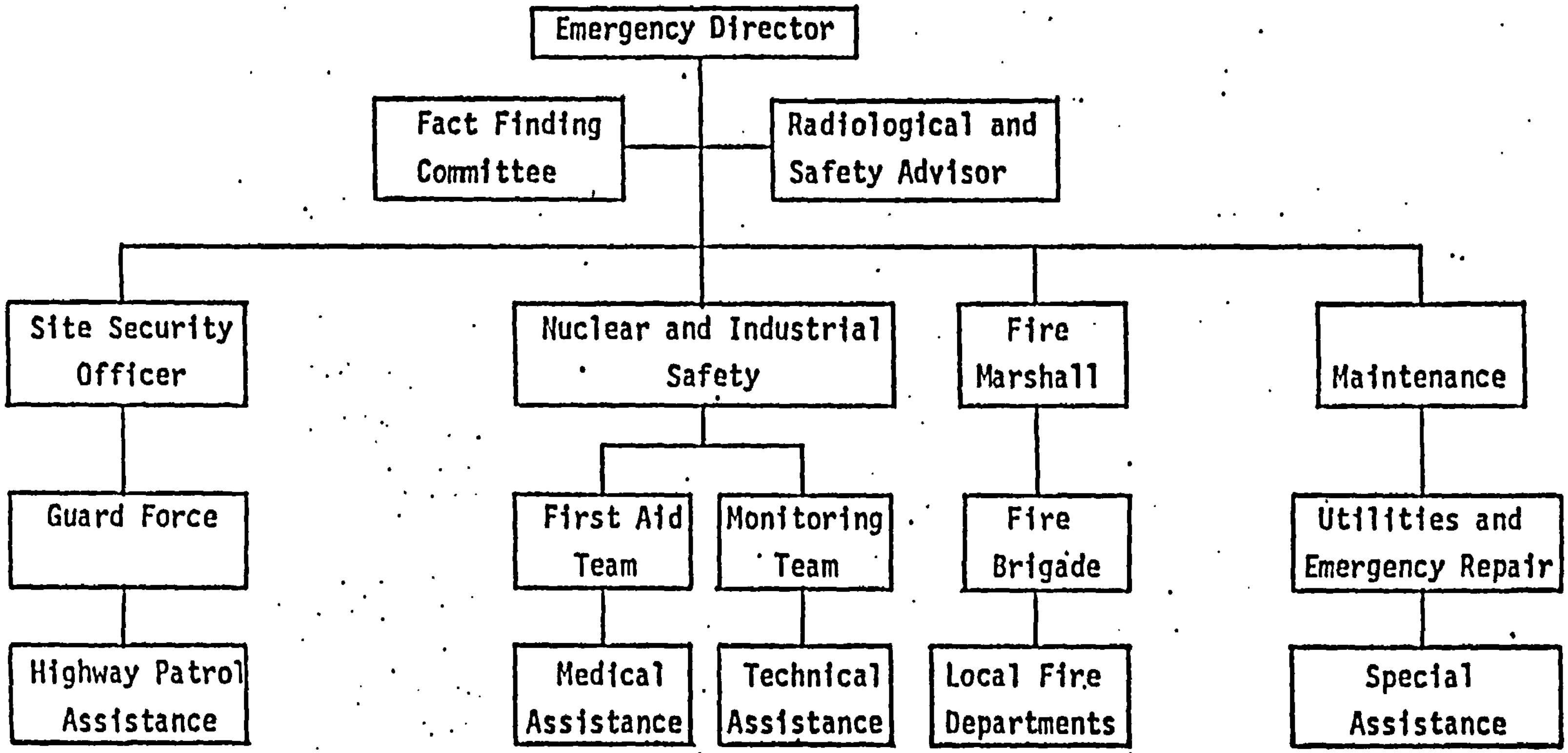
Members to serve on this committee will be selected by the Director depending on the nature of the emergency. The Chairman of the committee shall be an individual who is not a member of the immediate response teams.

a. Communicate with the Emergency Director and others to obtain facts for determining the cause and effect of the emergency.

b. Interview personnel who witnessed the incident or those who can contribute information leading to cause and effect.

c. Review and examine all evidences (photographs, recoverable materials, etc.) that may be considered pertinent and informative for evaluation purposes.

d. Keep records and prepare a written report for the Plant Manager.



EMERGENCY ORGANIZATION CHART
Figure 4-1

4.2 Onsite Radiological Contingency Response Organization (continued)

Radiological and Safety Advisor (Supervisor, Nuclear Licensing, Safety and Accountability, Alternate: Quality Control Manager).

a. Accumulate and evaluate known data to determine the extent of the emergency.

b. Establish a liaison between the Director and a direct source of available information.

c. Establish policies with Emergency Director regarding the emergency plan of action for controlling the incident.

d. Shall be responsible for collecting and disseminating information pertaining to the emergency to outside agencies.

e. Normally be the sole contact with news media.

f. Maintain a close liaison with the Emergency Director and the Plant Manager regarding emergency activity progress.

g. Inform and consult with the Fact Finding Committee.

h. Review public releases and notices and obtain approval of of Windsor Public Relations or their designate for such releases.

Supervisors

a. Each supervisor is responsible for proper implementation of the Emergency Plan in his areas.

b. Shall assure himself that personnel under his supervision are familiar with the location and use of emergency equipment.

c. Shall assure personnel familiarization with the Emergency Plan and procedures.

d. Shall account for their personnel during an emergency, including visitors and contractor personnel in their area.

4.2 Onsite Radiological Contingency Response Organization (continued)

Nuclear and Industrial Safety

a. Shall assess and delineate an emergency radiation or toxic fume, vapor or mist condition, including radiological survey monitoring.

b. Provide personnel monitoring, decontamination, recovery accident dosimetry for analysis and collect health physics or industrial hygiene samples for analysis.

c. Conduct environmental monitoring.

d. Assist with first aid and emergency rescue.

e. Procure, store and issue protective clothing and equipment for recovery operations.

f. Prepare necessary records and reports.

Site Security Officer (Production and Materials Control Supervisor, Alternate: Shift Security Guard).

a. Direct and coordinate Security Guard activities.

b. Restrict access to the site to authorized personnel and outside supporting services.

c.. Coordinate activities with state and local police.

Fire Marshal (NIS Technician, Alternates: Shift Foreman)

a. Coordinate the fire-fighting activities of site fire brigades with local fire departments.

b. Organize site fire brigades.

c. Assure that both onsite and offsite personnel have been trained in fire-fighting techniques involving radioactive materials, including precautions to be taken in criticality control areas.

4.2 Onsite Radiological Contingency Response Organization (continued)

Security Guards

a. Provide traffic control and communication with outside supporting services.

b. Be familiar with Special Guard Orders for all emergency occurrences, which includes maintaining plant security and access control.

Maintenance

a. Maintain or discontinue as necessary utility services during the emergency.

b. Provide, fabricate or modify equipment needed for recovery operations.

c. Provide equipment and personnel for recovery and salvage operations.

d. Obtain special assistance as necessary.

4.3 Offsite Assistance to Facility

Windsor Support

Technical support and consultation in the areas of nuclear criticality safety, radiological safety and industrial hygiene is provided by the Nuclear Licensing and Safety Supervisor, Windsor, upon request.

Local Services Support

Agreements have been reached with various private and civil organizations to provide assistance as required.

Barnes Hospital

Barnes Hospital has agreed to accept victims of accidents having injuries possibly complicated by radioactive contamination. Barnes Hospital has a procedure for handling patients who are contaminated with radioactive materials.

Joachim-Plattin Ambulance District

Joachim-Plattin Ambulance District has agreed to transport victims of accidents having injuries possibly complicated by radioactive contamination to Barnes Hospital.

Jefferson County Sheriff Department

The Jefferson County Sheriff Department has agreed to provide assistance to C-E Hematite in an emergency. This assistance includes coordination with other civil authorities as necessary, traffic control, and control of civil disturbances.

4.3 Offsite Assistance to Facility (continued)

Hematite and Festus Fire Departments

The Hematite and Festus fire departments respond to emergency calls at C-E Hematite. If the response is for a fire involving radioactive material, Nuclear and Industrial Safety technicians provide monitoring as necessary to protect fire department personnel.

Protective equipment (e.g., protective clothing, respirators) is available for the protection of Fire Department personnel while fighting fires.

4.4 Coordination with Participating Government Agencies

As previously stated, analysis of the postulated C-E Hematite accident spectrum shows that there is no credible accident with significant offsite consequences.

A list of cognizant government agencies and current telephone numbers is maintained, however, and they will be contacted should an emergency arise involving a consideration within their jurisdiction. The contact would normally be in the form of notification although a request for emergency assitance would be made as needed. These agencies include:

U.S. Nuclear Regulatory Commission, Region III - Glen Ellyn, Illinois
Missouri Department of Public Safety, Disaster Planning and Operations Office - Jefferson City
Missouri Division of Health, Bureau of Radiological Health - Jefferson City
Missouri Department of Natural Resources - Jefferson City, St. Louis
U.S. Environmental Protection Agency, Region 7 - Kansas City
Missouri Highway Patrol - Creve Coeur
U.S. Federal Bureau of Investigation - St. Louis
U.S. Department of Energy Radiological Assistance Team - Oak Ridge

The above agencies are listed, with their area of interest, in the Emergency Procedures Manual. In the event of a plant emergency, only local agencies would be contacted (as discussed in Section 5.3). In the event of any site emergency, all the agencies would be contacted.

The State of Missouri is currently preparing a Radiological Emergency Plan. The plan for off-site assistance will be coordinated with the State Plan.

5.0 RADIOLOGICAL CONTINGENCY MEASURES

5.1 Activation of Radiological Contingency Response Organization

5.1.1 Reporting the Emergency

Any person cognizant of an emergency situation should initiate assistance by:

1) Use of the nearest telephone; Dial 0 - - - Pause - - - and listen for a response from the Guard Station.

   NOTE: In an emergency requiring evacuation, the telephone in the Emergency Control Center (Tile Barn) may be used to obtain assistance.

2) Report the emergency, speaking slowly and clearly, stating:
   a) Name
   b) Nature of the emergency (Fire, Explosion, etc.)
   c) Location (Area and Building #)
   d) Request any services or personnel needed
   e) Repeat information

5.1.2 Personnel Emergency

An emergency which involves treatment of one or more individuals, has no effect on the facility, and no potential for escalation to more severe emergency conditions. (It does not involve sounding of an alarm).

Examples: Any serious injury, contamination, or radiation exposure.

Initiated By: The affected individual or nearby supervisory personnel.

Action:

1) Report the incident to the foreman or supervisor immediately.
2) The foreman will call Ext. 49 (Health Physics) for first aid assistance and/or any emergencies involving radioactive materials.
3) For emergencies involving radioactive materials, Health Physics personnel will take over and direct any decontamination or assessment procedures.
4) a. During off-hours (4:30 PM -.7:30 AM, weekdays), First aid assistance is available at Est. 49 (Health Physics). The foreman shall call Ext. 0 and request an ambulance or company vehicle to transport injured personnel to Jefferson Memorial Hospital for additional medical assistance, if required.
   b. Weekends and Holidays Call Ext. 0 and request assistance; the guard will obtain off-site medical assistance or initiate site call-in list if necessary.

5.1.3 Emergency Alert

Examples: Bomb threats, civil disturbances, tornado or seismic warning, forest fire.

Initiated By: Anyone can report an emergency alert condition, but the Emergency Director is responsible for classifying and declaring the emergency alert.

Action:

1) Call 0 and describe the situation.
2) The guard then activates the emergency plan, explains the emergency situation, and requests the Emergency Director.
3) The Emergency Director then decides:
   a) To evacuate personnel to the Emergency Assembly Areas or the Emergency Control Center (Tile Barn) for protection by manually activating the non-nuclear alarm or
   b) To instruct personnel to remain inside plant buildings by telephone communication and security guard assistance.
   c) To contact off-site agencies as necessary, i.e., (local police, Missouri Disaster Planning and Operations Office, etc.).
4) The Emergency Alert is terminated by the Emergency Director when the threatening situation has passed or is reclassified into a plant or site emergency.

NOTE: Specific Procedures for Bomb Threats and Civil Disobedience and Disorder are included in the Emergency Plan.

5.1.4 Plant Emergency

An emergency which has no effect on the Hematite site environs outside of the fenced manufacturing area.

Examples: Fire not controllable by personnel in the immediate vicinity; Explosion contained within the building; Major process leak or spill (toxic or radioactive) contained within the building.

Initiated by: Manual activation of the non-nuclear alarm: Continuously ringing bell. Alarm buttons are strategically located throughout the plant and office areas.

Action:

1) All personnel except for production area monitors must evacuate to Emergency Assembly Area promptly. (Driveway by site water tank).
2) The Emergency Director will then request medical assistance, fire brigade, and/or site security as needed.
3) All personnel will assemble with their immediate supervisor and inform him of any information pertaining to the emergency. Escorts are responsible for their visitors.
4) The Supervisors will account for all of their personnel and report to the Emergency Director. All personnel who are unaccounted for are assumed to be in the affected area.
5) Site Security guards will prevent unauthorized entry into the fenced area.
6) The Emergency Director determines final classification of the emergency (plant or site), the need for additional assistance, and initiates the call in of appropriate off-site agencies as needed, (i.e., Hematite Fire Department, Joachim-Plattin Ambulance District, etc.
7) The Emergency Director assures that C-E management is notified of the emergency.

5.1.5 Site Emergency

An emergency having the potential for off-site impact.

Examples: Criticality accident, major fire or explosion, major UF_6 release, major anhydrous ammonia release.

Initiated by:

1) Automatic sounding of the nuclear criticality alarm (radiation levels of 10 mr/hr or greater at any area radiation monitor) or
2) Sounding of the non-nuclear alarm initiated by any person cognizant of the emergency situation. (Alarm buttons are strategically located throughout the plant and office areas).
3) A release of 300 μCi of airborne radioactive particulates averaged over a 24-hour period to the Hematite site environs.

NUCLEAR ALARM

Action:

1) All personnel must evacuate to Emergency Assembly Area in the Emergency Control Center promptly (Tile Barn).
   DO NOT ATTEMPT RECOVERY OPERATIONS
2) The Emergency Director will request medical assistance, fire brigade, and/or site security as needed.
3) All personnel will assemble with their immediate supervisor and inform him of any information pertaining to the emergency. Escorts are responsible for their visitors.
4) Supervisors will account for all of their personnel and report to the Emergency Director. All personnel who are unaccounted for are assumed to be in the affected area.
5) Site Security Guards will prevent unauthorized entry into the fenced area.
6) The Emergency Director instructs the re-entry team to confirm criticality accident.

If criticality is confirmed

a) A Site Emergency is declared by the Emergency Director and he initiates assessment procedures.

b) The Emergency Director then begins notification of off-site agencies with information regarding the emergency and requests assistance as required.

7) If criticality is not confirmed:

a) The Emergency Director notifies the guard that this was a false alarm and terminates the emergency.

b) A follow-up investigation is then conducted under the direction of the Emergency Director.

NON-NUCLEAR ALARM

Action:

(1-5) Evacuation is initiated and steps 1-5 from the Nuclear Alarm Procedures above are followed.

(6) The Emergency Director classifies the emergency, initiates appropriate assessment procedures, and begins notification of off-site agencies with information regarding the emergency and requests assistance as required.

RADIOACTIVE PARTICULATE RELEASE

Action

1) For any major spill or dispersal of radioactive particulates, Health Physics is to be notified.

2) The Health Physics Technician then pulls the stack filter samples and determines the magnitude of the release.

3) If the activity is 300 μCi or greater averaged over a 24-hour period, the Emergency Director will be notified and a Site Emergency will be declared.

4) The Emergency Director then notifies personnel to remain within their buildings via the telephone system and assistance from the site security guard.

5) Appropriate off-site agencies listed are then notified and the need for assistance is determined.

5.2 Assessment Actions

See Paragraph 5.1.

5.3 Corrective Actions

See Paragraph 5.1.

5.4 Protective Actions

5.4.1 Personnel Evacuation from Site and Accountability

All personnel are responsible for knowing WHAT TO DO and WHERE TO GO during any emergency situation. Therefore, the response to alarms should be clearly understood by all persons working at C-E Hematite.

The sounding of the nuclear alarm is activated by a general radiation level of 10 mr/hr or greater. The non-nuclear alarm is activated manually by pushing the alarm buttons located at various locations throughout the plant and office areas. The non-nuclear alarm may be activated if conditions necessitate the evacuation of the plant. When the nuclear or non-nuclear alarms sound, the following procedures apply:

1) All personnel evacuate immediately to the designated Emergency Assembly Areas. (Driveway by site water tank for the non-nuclear alarm and The Emergency Control Center for the nuclear alarm). DO NOT ATTEMPT RECOVERY OPERATIONS

2) Escorts are responsible for their visitors. The Security Guard will also bring the visitors log to the Emergency Assembly Area to aid in the accounting of any visitors.

3) Each Supervisor will verify evacuation of their respective personnel. It will be assumed that any personnel unaccounted for are injured or trapped in the affected area.

4) Any information pertaining to the emergency and/or missing personnel is then reported to the Emergency Director, who will direct any recovery or rescue operations which are necessary.

5.4.2 Use of Protective Equipment and Supplies

The Respiratory Protection Program is designed to provide guidance that will assist all prospective respiratory users with the required knowledge to effectively wear respiratory protection. Through the use of face masks or supplied air type respiratory protection devices, individual internal exposures will be kept as low as possible during any emergency situation.

5.4.3 Contamination Control Measures

1) Any emergency response personnel or equipment entering contaminated areas will be monitored when leaving the affected area by members of the survey team.

2) The Emergency Director assigns a member of the survey team to check personnel badges for indium foil activation:
Place the probe of a GM Survey Instrument close to the surface of the badge. The badge contains an Indium foil which, upon exposure to neutrons, becomes activated and will cause a response from a GM Survey Instrument. A GM Survey Probe placed approximately one-half inch from a foil approximately 1/2 inch square and 0.005 thick will cause a response of at least 100 c/m for each rad of neutron dose (10 rem of neutron exposure). It is important that this survey be carried out within 15 minutes of evacuation. Record each response in excess of 100 c/m.

3) Exposure to neutrons can also be immediately identified by a GM Survey of gold foils or rings. The gold, although less sensitive than the indium has a long half-life (65 hours) permitting the identification of highly exposed personnel for several days following exposure. It is important to remember that a variety of metals that are commonly carried or worn by people (cigarette lighters, rings, jewelry, belt buckles, etc.) become activated upon exposure to neutrons and would be extremely valuable for:
   a) Confirming that a nuclear accident has occurred.
   b) Determination of personnel exposure to neutrons.

4) All film badges of personnel in or near the affected area shall be collected, identified, and sent for emergency processing.

5.5 Exposure Control in Radiological Contingencies

5.5.1 Emergency Exposure Control Program

5.5.1.1 Exposure Guidelines

Nuclear Alarm Procedure

1) Re-entry into the building will be made by a minimum of two persons designated by the Emergency Director.

2) Equipment Required:

   a) New film badge
   b) Pocket Dosimeter
   c) High level and low level Survey Meters.

3) Re-entry Team Instructions:

   a) Be sure meters are functioning properly (use check source).
   b) Approach plant cautiously
   c) One member of the re-entry team shall closely watch readings on the low level meter while the other observes the surrounding area.
   d) Proceed in northwest entrance of Building 240 or main entrance of new office building to the nuclear alarm control panel. Determine which area has alarmed.

NOTE: Report back to the Emergency Director immediately if general radiation levels of 5 mr/hr are found.

   e) Approach the alarmed area carefully, noting closely the survey meter readings and any abnormalities in suspected areas.
   f) Report all information to the Emergency Director.

Rescue

1) When personnel are not accounted for, it is assumed they are still in the building and rescue operations are initiated.

2) RESTRICTIONS:

   a) In extreme life-saving situations, permissible dose to the whole body shall not exceed 100 rems. For emergency actions requiring less urgent response, the permissible whole body dose shall not exceed 12.5 rems. Under unusual circumstances, 25 rems may be permitted.

2) RESTRICTIONS (continued)

b) Prompt evacuation is required if the radiation level seems to fluctuate or suddenly rises without apparent reason. Avoid unnecessary exposure.

c) Do not enter a radiation field in excess of 200 R/Hr.

3) Permissible Exposure

a) Re-entry into areas greater than 100 mr/hr must be authorized by the Emergency Director for the purpose of rescue of individuals, prevention of exposure to a large number of individuals, or saving of a valuable installation.

b) Time-of-stay limits in the following table are based upon the highest dose rate to which the re-entry team will be exposed and will limit their exposure to the recommended 12.5 rems.

Emergency Rescue Time-of-Stay

Max. Radiation Level	Permitted Minutes in Area
200 R/hr	4
150 R/hr	5
100 R/hr	7.5
75 R/hr	10
50 R/hr	15
30 R/hr	25
15 R/hr	50

4) Protective Equipment available for rescue operations

Coveralls
Shoe Covers
Film Badge and Pocket Dosimeter
Gloves
Scott Air Packs

5) Following the table for permissible time in area, try to locate and remove all victims in high radiation areas to areas less than 5 mr/hr where possible and to locations where first aid assistance may be rendered.

5.5.1.2 Radiation Protection Program

See 5.5.1.1

5.5.1.3 Monitoring

1) Any emergency response personnel or equipment entering contaminated areas will be monotored when leaving the affected area by members of the survey team.

5.5.2 Decontamination of Personnel

Handling of Contaminated Victims (Personnel Decontamination)

1) The Emergency Director will designate one of the survey team members to monitor personnel that were in or near the affected area for contamination.
2) The survey team member has both portable alpha and Gm Survey meters available in the Emergency Control Center.
3) Contamination will be removed under the direction of Health Physics personnel utilizing the decontamination supplies in the emergency supply cabinets.
4) Showers are available in Building 240 change area.

Injuries Complicated by Radioactive Contamination:

1) Do not attempt decontamination on personnel with any serious injury to avoid complicating the injury.
2) Dial 0 and request site security to obtain ambulance to transport the injured.
3) The injured should be wrapped in blankets to provide maximum degree of contamination control during movement.
4) The Emergency Director is responsible for notifying Jefferson County or Barnes Hospital that there is a contaminated victim enroute and relaying any information available on the condition of the patient.
5) A Health Physics staff member, equipped with both alpha and GM survey meters, will accompany the contaminated victim.
6) If Health Physics personnel are not available, initiate the site call-in list and a member of the Health Physics staff will meet the injured at the hospital.
7) The Emergency Director will assure all personnel and equipment involved in the handling of radioactively contaminated individuals, are monitored for contamination before leaving the area.

5.6 Medical Transportation

See 5.5.2

5.7 Medical Treatment

Care of patients upon arrival at Barnes Hospital:

1. Monitor the individuals for radioactive contamination (Note: Monitor the personnel who accompanied patients before allowing them to enter the Hospital). The Radiation Safety Representative will assist the Health Physicists who are accompanying the patients from the site of the accident. They will monitor the individuals for radioactive contamination. This should be done in the vehicles transporting the patients before they are brought into the hospital. Individuals found NOT contaminated will enter through the Wohl Clinic Entrance north of the E.R. entrance and those found to be contaminated will enter through the E.R. entrance. The contaminated individuals will then be directed to an appropriate place in the "Red Area". Injured individuals will be placed in Examination Room #2,3, or 4. Once contaminated individuals enter the "Red Area", ALL hospital personnel entering this area will wear the protective clothing (from Barnes O.R.). This protective apparel will be removed upon leaving the "Red Area" and deposited in the plastic bags for disposal by Radiation Safety. The number of personnel entering the "Red Area" shall be kept at an absolute minimum. ALL personnel shall be monitored by the Radiation Safety Representative as they exit from the "Red Area".

2. Utilize the Autopsy Room located on the first floor of the Wet Building to decontaminate and care for extremely contaminated individuals. A Radiation Safety Representative MUST accompany anyone transferred to that facility. Extreme care SHALL be taken so as not to spread any contamination enroute.

5.7 Medical Treatment (continued)

3. Decontamination of Individuals: It is anticipated that the patients arriving in the E.R. will have been fairly well decontaminated at the site of the accident. If significant contamination remains then further decontamination should be carried out. The following procedure is recommended.

   A. Contaminated Clothing: Remove clothing and place in a plastic bag. Affix a radiation tag which shall include the nature of the contamination, date and time, patient's name. This container will then be handled only by the Radiation Safety Representative. NOTE: Valuables should be inventoried by two persons, placed in a plastic bag and sealed.

   B. Skin Contamination: If skin surfaces are found to be contaminated scrub these areas with gauze sponges soaked in RADCON or Phisohex for two or three minutes and then remove with a damp clean sponge. (Contaminated sponges shall be placed in plastic bags for later disposal). Re-monitor the contaminated area and if still significantly contaminated, scrub with a Soft brush using RADCON or Phisohex. AVOID ABRASION of the skin. Re-monitor and repeat if necessary. The area between the fingers, under the fingernails, and in skin folds are the most difficult to decontaminate. If it is possible to hold the contaminated part of the body over the large sinks during decontamination this is much more preferable as large quantities of water is very helpful. AVOID use of any organic solvents on skin or wounds as they often increase the permeability of the skin.

5.7 Medical Treatment (continued)

3. C. Open Wounds: If the wound is found to be contaminated with radioactive material the following procedure is recommended; First, rinse the wound with running tap water for several minutes and then use the procedures in paragraph B for decontaminating the surrounding skin. Necrotic tissue should be surgically removed. If the wound still contains significant contamination then a block resection may be the procedure of choice. Any tissue removed should be saved for analysis.

   D. Contamination of the Eyes, Nose and Mouth: These areas should be irrigated with copious amounts of normal saline using a bulb syringe or standard I.V. bottle and tubing.

   E. Contamination of the Hair: Hair should be shampooed with Phisohex and rinsed with large amounts of water. If, after repeated shampooing, it is still contaminated it may be necessary to remove the hair with a clipper. (The clipper will then be contaminated).

Further E.R. Examination and Care:

1. Blood Tests:
   A. WBC, RBC, Differential, Hemoglobin, Hematocrit, Platelet Count, and Reticulocyte Count.
   B. 20 cc of oxylated or heparnized blood for Sodium-24 activitation analysis.
   C. SMA 6 and SMA 12
2. Urine:
   A. Routine urinalysis
   B. Hold all urine for analysis (refrigerate)
3. Feces, Vomitus - Save and refrigerate for isotopic analysis.

6.0 EQUIPMENT AND FACILITIES

This section identifies, describes briefly, and gives locations of items to be maintained for emergency use at C-E Hematite.

6.1 Control Point

The emergency control center is located within the tile barn west of the fenced manufacturing area. This direction is normally upwind from the manufacturing area. Although an alternate offsite location is not considered necessary, emergency equipment is portable and can easily be moved to an alternate location. Alternate emergency control locations are specified in the Emergency Procedures Manual.

6.2 Communications Equipment

Communications during an emergency may be by the following methods:

- Normal plant telephone system
- Separate emergency telephone line in Emergency Control Center
- 2-way radios for plant re-entry (battery operated)
- Voice and hand signals (effective in many cases due to small size of plant)

All the above communication methods may be used at the Emergency Control Center.

6.3 Facilities for Assessment Teams

The following monitoring systems are used to initiate emergency measures as well as those used for continuing assessment:

6.3.1 Onsite Systems and Equipment

Windspeed and direction - remote readout is in NIS office, but estimate may be obtained visually from emergency control center.

6.3.1 Onsite Systems and Equipment (continued)

Radiation monitors and alarms - Radiation monitors are installed in various areas of plant manufacturing and storage areas so that all Special Nuclear Material located in or about the facility is observed by a detector.

The radiation intensity is shown on a meter mounted on the front panel of the monitor. There is an alarm which serves as a local and general audible radiation evacuation alarm. A visual alarm for each of the above units is also located near the NIS office and at the guard station.

An externally mounted light and control panel buzzer serve as a power failure indicator.

Loss of power indicators are also provided at the readout location for each detector. These monitors are connected to the emergency power system.

Portable monitors - several portable air samplers, radiation survey instrumentation, and radiation dosimeters - located in NIS office and/or Emergency Control Center.

Process monitors - normal chemical process control monitors are not related to emergency conditions or situations.

6.3.2 Facilities and Equipment for Offsite Monitoring

Portable battery-operated air samplers
Fixed air samplers outside of fenced manufacturing area
Portable radiation survey instruments
Containers, etc. for sampling soil, water and vegetation
Mobile proportional counter for alpha and beta analyses of samples - located in NIS Laboratory
Standard industrial hygiene equipment for measuring ammonia concentrations.

6.4 First Aid and Medical Facilities

Standard first aid supplies are available in 3 locations at the C-E Hematite site:

1) Health Physics Office
2) Shift Foreman's Office
3) Tile Barn (Emergency Control Center)

6.5 Emergency Monitoring

The emergency assembly area in the tile barn, located west of the fenced manufacturing area, is of adequate size to accommodate the entire plant staff. It is not in the prevailing wind direction and its distance and construction provide sufficient shielding in the event of a criticality accident.

Located in the emergency control and assembly area are emergency equipment and supplies, including

- Radiation survey instruments
- Respirators
- Protective Clothing
- Personnel dosimeters
- First Aid Supplies
- 2-way Radios
- Decontamination supplies
- Environmental Sampling Supplies

For plant emergencies of a localized nature, there are three other emergency supply stations strategically located in the manufacturing areas. The supplies located in the tile barn would be relied upon in the event of a site emergency.

EMERGENCY EQUIPMENT

Following is a typical listing of emergency equipment in the various plant areas and the Emergency Control Center, and a facility layout map designating the locations of the emergency equipment stations.

Station #1 (Pellet Plant)

Scott Air Pack
Fire Extinguishers
Stretcher
All Service Gas Mask
Emergency Medical Oxygen Bottles
First Aid Kit

Station #2 (Building 240 Hallway)

Scott Air Pack
Fire Extinguishers
Inflatable Splints
All Service Gas Mask
Emergency Medical Oxygen Bottles
First Aid Kit

Station #3 (Pellet Plant Break Area)

Resuscitator

Station #4 (Well House)

Scott Air Pack

Station #5 (Oxide Control Room)

Scott Air Pack
Emergency Repair Kit for 30-B (UF_6/Chlorine) Cylinders

Station #6 (Warehouse)

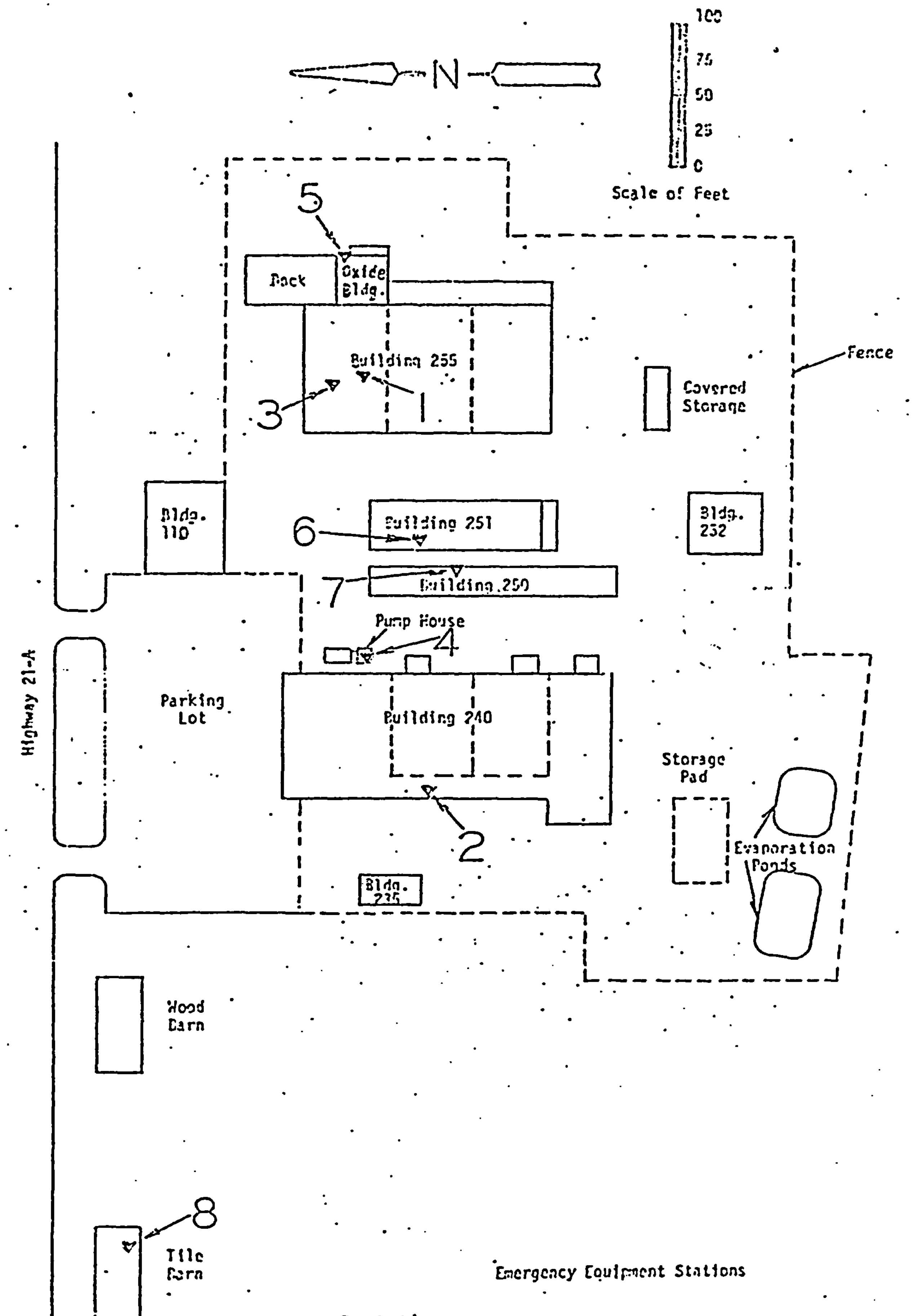
Fire Extinguisher - 125 lb. Wheeled Unit

Station #7 (Outside Old Boiler Room)

Respirators
Acid Suits w/hoods
Rubber Suit w/hood
Harness w/Life-Line
Face Shield
Vinyl Rain Coat
Emergency Procedures Manual

Station #8 (Assembly Area, Tile Barn)

Radiation Survey Instruments
Dosimeters
Film Badges w/Film
Lab Coats
Urine Sample Bottles
Respirators
Chemox Breathing Apparatus
Flares
First Aid Kit
Disposable Litters
Disposable Splints
Blankets
Sheets
Surgical Caps
Surgical Gloves
Emergency Procedures Manual
Check Sources
Portable Radio Transceivers
Misc. Environmental Sample Containers
Misc. Forms and Instructions



Emergency Equipment Stations

7.0 MAINTENANCE OF RADIOLOGICAL CONTINGENCY PREPAREDNESS CAPABILITY

7.1 Written Procedures

An annual review of the emergency plan is performed by the Emergency Planning Coordinator and a Review Committee for the purpose of updating and improving procedures. Results of training and drills as well as changes on site or in the environs are incorporated into this review, which is documented.

All written agreements are reviewed and updated at least every two years.

7.2 Training

The purpose of the training program is to inform and instruct all employees in the policy and programs of the company as they relate to nuclear criticality safety, health physics and industrial safety, emergency procedures, and proper and safe performance of their assignments.

The indoctrination of new employees in the safety aspects of the facility is conducted by, or under the supervision of specialists in the various topics. The indoctrination topics include but are not limited to:

a. Fundamentals of nuclear criticality safety and controls.
b. Fundamentals of the health physics program and controls.
c. Emergency alarms and actions required.
d. A review of the facility operations.
e. On the job training, under direct line supervision and/or by experienced personnel.

After determining by testing that a new employee has attained sufficient knowledge in the above topics, adequate performance is monitored by the Foreman and NIS 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, industrial safety and accident prevention, emergency procedures and other safety topics are included. Foremen receive a formal course in radiation safety, criticality control emergency plans and procedures. Sufficient knowledge to enable them to carry out their training functions is determined by testing. Offsite fire fighting personnel are given an annual familiarization tour. All operating personnel receive a re-training course in criticality control, radiation safety and emergency procedures on an annual basis. Selected personnel are provided specialized training in Fire Fighting twice a year, and first aid every three years. All training is documented. The remainder of emergency team members receive training at least annually in connection with drills and exercises. The NLS&A Supervisor evaluates effectiveness of training, documentation, and revises the training program as appropriate.

7.3 Tests and Drills

Semi-annual site emergency evacuation drills and an annual emergency exercise are conducted to provide training and test promptness of response, familiarity with duties, adequacy of procedures, emergency equipment and the overall effectiveness of the emergency plan. At least one of the drills will involve participation by offsite agencies to test as a minimum the communication links and notification procedures.

All drills and exercises are documented and critiqued by the NLS&A Supervisor to evaluate the effectiveness of the plan and to correct weak areas through feedback with emphasis on practical training. The NLS&A Supervisor revises drills and exercises, if necessary, to increase their effectiveness.

7.4 Review and Up-Dating Plans and Procedures

See 7.1

7.5 Maintenance and Inventory of Radiological Emergency Equipment, Instrumentation and Supplies

Both the nuclear and non-nuclear alarm systems are tested weekly to insure their proper operation. Testing is documented.

Nuclear and Industrial Safety is responsible for routine inspection and testing of all equipment and supplies at all emergency stations and other reserve equipment, and for maintenance and servicing, or obtaining servicing, for all emergency equipment. NIS also procures or initiates procurement, of all supplies of emergency equipment and other miscellaneous supplies necessary to cope with foreseeable emergency situations. Inspections and testing are documented.

The minimum frequency for inspections and testing of all equipment and supplies is quarterly.

8.0 RECORDS AND REPORTS

8.1 Records of Incidents

All health physics records for the current calendar year, including training, and all reports required by the regulations of the USNRC and the C-E license will be retained by the NLS&A group. Reports and records for previous years will be made available to inspectors upon request. However, all reports and records over five years old may be stored on microfilm.

Records relating to health and safety shall be retained indefinitely. Such records shall include plant alterations or additions, abnormal, and off-normal occurrences and events associated with radioactivity releases, criticality analyses, audits and inspections, instrument calibration, ALARA findings, employee training and retraining, personnel exposures, routine radiation surveys, and environmental surveys.

8.2 Records of Preparedness Assurance

All employees shall attend a formal training session prior to working in restricted areas. This will cover principles of radiation safety (ALARA practices) nuclear criticality safety, industrial safety, emergency procedures, applicable state and federal regulations (i.e., 10 CFR Parts 19 and 20) additional information pertaining to their job. Specialized training for radiation protection and nuclear criticality safety shall be commensurate with the extent of the employee's contact with radioactive materials. All personnel who will be working with radioactive materials must complete a test to ascertain the effectiveness of the training. All trainees shall satisfactorily complete the test before being allowed to handle radioactive materials without direct supervision. All training will be conducted under the direction of the NLS&A Supervisor.

8.2 Records of Preparedness Assurance

Records of all formal training sessions shall be kept and will include the date held, subject matter covered, attendees, instructor, and the results of the method used to ascertain the effectiveness of the training.

All production personnel who work with radioactive materials shall attend formal annual safety training sessions. These training sessions will include as a minimum the topics covered in the initial training sessions. In addition, these sessions shall emphasize problem or potential problem areas, involving the topics covered, or any other safety related areas.

C-E Hematite also maintains a comprehensive system of operating procedures which include the appropriate safety precautions. Informal training (not documented with lesson plans, etc.) are conducted by production foremen on a continual basis as needed to assure that personnel are properly following the approved procedures. The ultimate responsibility to follow the operating procedure lies with the employee. Any change which alters the employee's responsibility or actions in regard to safety (criticality, radiation, and industrial) must be approved by the NLS&A Supervisor who will assure the appropriate training is conducted prior to implementation. This also includes changes to the emergency procedures which affect employee actions in an emergency situation. All maintenance personnel shall also attend formal training sessions annually. Contractors may work in the restricted area only with a trained escort.

The effectiveness of all retraining is determined by the instructor questioning the personnel to determine their understanding of each topic.

8.2 Records of Preparedness Assurance (continued)

Records of all formal training sessions shall be kept and will include the date held,subject matter covered, attendees, instructor, and the results of the method used to ascertain the effectiveness of the training.

8.3 Reporting Arrangements

See Paragraphs 3.2, 4.3 and 4.4.

9.0 RECOVERY

9.1 Re-Entry

Re-entry into the affected area will be in accordance with sections 5.0 and 6.0 of this plan.

9.2 Plant Restoration

The Emergency Director will assign such personnel as necessary to restore or have restored all equipment and/or services to a safe operating condition upon termination of the emergency. Any spills will be cleaned up and no excessive radiation levels will be present when operations are restarted. Radiation levels will not exceed normal operating levels as specified in the SNM-33 license.

Each member of the emergency organization will assure that safety related equipment, within his area of responsibility, is restored to normal as soon as practicable following an incident. Refer to Section 4.0 for specific responsibilities.

9.3 Resumption of Operations

Corrective actions for each type of incident included in this plan are discussed in Sections 4.0, 5.0 and 6.0. Normal operations will resume after the conditions specified in the above noted sections have been complied with. Deficiencies identified in the investigation of the incident shall be resolved prior to resumption of operations.

Reportable Events