U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

ENVIRONMENTAL ASSESSMENT RELATED TO THE CONSTRUCTION AND OPERATION OF THE AlChemIE FACILITY 1 CPDF

DOCKET NO. 50-603
ALL CHEMICAL ISOTOPE ENRICHMENT, INC.

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1.0 INTRODUCTION, SUMMARY, AND CONCLUSIONS

1.1 Introduction

The All Chemical Isotope Enrichment Company (AlChemIE) filed with the U.S. Nuclear Regulatory Commission (NRC) an application, dated November 17, 1987, for a license to construct and operate the AlChemIE Facility-1 CPDF. AlChemIE intends to use the facility to enrich stable isotopes. In order to enrich stable isotopes, AlChemIE is purchasing centrifuge machines from the Department of Energy (DOE).[1] The centrifuge machines were originally designed and manufactured to enrich uranium, but AlChemIE will not use them for that purpose.

Although the enriching of stable isotopes is not ordinarily within the regulatory authority of the Commission, any equipment or device capable of enriching uranium, if intended for commercial use, must be licensed by the Commission. Since the centrifuge machines AlChemIE will obtain from the Department of Energy are capable of enriching uranium, their possession and use must be licensed. The Commission rule which governs the licensing of production facilities is 10 CFR Part 50.

AlChemIE Facility-1 CPDF was previously used by the Department of Energy as a Centrifuge Plant Demonstration Facility (hence, CPDF) located at the site

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[1] On April 7, 1986 the Department of Energy published a notice in the Federal Register (51 FR 11811) requesting expressions of interest for participation in the Department's uranium enrichment program. AlChemIE responded to the notice, expressing an interest to use the centrifuge machines for commercial purposes, not involving the enriching of uranium, as further described herein and in their application. On December 5, 1986, AlChemIE submitted a proposal in response to the Department's announcement in the Commerce Business Daily requesting such proposals. On December 27, 1986, the Department notified AlChemIE that a minimum of 250 machines were reserved at the Portmouth, Ohio, Gaseous Centrifuge Enrichment Plant. Contract negotiations between AlChemIE and the Department have proceeded from that time, in one particular for lease arrangements for the Centrifuge Plant Demonstration Facility, located at the K-25 complex on the Federal reservation at Oak Ridge, Tennessee.

of the Oak Ridge Gaseous Diffusion Plant. Therefore, the facility has been completely constructed and operated. In fact, in addition to tests conducted with uranium (as the hexafluoride), the machines have been used to enrich some stable isotopes. As a result of the tests conducted by the Department of Energy, the centrifuge machines and associated piping have been slightly contaminated with uranium. Because the purpose of the tests, in part, was to demonstrate enrichment, some of the uranium contamination is enriched in the uranium-235 isotope. Although some building modifications are necessary, the construction period is expected to be very short.

The NRC has prepared this environmental assessment which reviews the local environment, briefly describes the proposed project including features of the facility and process, and evaluates the expected environmental impacts.

This document does not address the topic of safeguards. Readers interested in that topic should refer to the safety evaluation report soon to be issued by the NRC staff.

1.2 Summary

The local environment is a well characterized, industrialized area with an established buffer zone. The industrialized area has utilities and waste management services to support the major facility needs for steam, sanitary water, and electric power.

The exterior of the CPDF facility will be modified only slightly to meet AlChemIE's requirements. Existing centrifuge equipment will be used to process various chemical compounds, some of which are considered toxic or hazardous.

AlChemIE has filed for an air emissions permit with the Tennessee Department of Health and Environment (TDHE). Whil he feed material and processing rate information is not completely defined, the NRC used available information to perform a conservative analysis wh n indicates that material releases due to normal operations are expected to be environmentally acceptable.

AlChemIE waste water (primarily sanitary water) will be discharged through the existing Oak Ridge Gaseous Diffusion Plant waste water treatment plant, which is currently covered by an NPDES permit. The NPDES limits will not have to be modified to accommodate the AlChemIE waste water. AlChemIE's non-hazardous and hazardous/toxic solid and liquid wastes will be transferred to appropriate existing DOE, municipal, and commercial waste management operations which already have the necessary permits.

An analysis of potential accidental releases of material from the process indicates that the off-site concentrations of toxic materials will be less than the time-weighted average threshold limit values (TWA-TLV) which have been established by the American Conference of Governmental Industrial Hygienists (ACGIH). Exposure of the population to toxic material emissions in concentrations below these limits will not result in any adverse health and safety effects.

The NRC assessed the potential consequences of using the contaminated equipment and concluded that even under the unexpected conditions where the uranium would be released to the environment, the consequences would be minimal with a 50-year whole body equivalent dose commitment to an individual of less than 1.4E-5 mrem.

1.3 Conclusions

On the basis of the staff's evaluation of the applicant's environmental report and further independent analysis of environmental impacts of the proposed action, the staff concludes that the actions proposed will not result in any significant environmental impacts.

2.0 DESCRIPTION OF THE PROPOSED FACILITY AND OPERATIONS

AlChemIE is planning to modify a surplus DOE facility for operation as a stable isotope enrichment production plant. AlChemIE intends to utilize the Centrifuge Plant Demonstration Facility, which is owned by the U.S. Department of Energy and is located on the federally owned Oak Ridge Gaseous Diffusion Plant (ORGDP) site. The facility, the basics of the isotope enrichment process, the utility requirements, and the discharges from the proposed facility are described in this section.

2.1 FACILITY

OVERVIEW

The proposed AlChemIE facility at the CPDF site (Facility 1) will utilize a portion of the K-1220 building located in the southeast sector of the ORGDP site. This building, referred to as the Centrifuge Plant Demonstration Facility (CPDF), was originally designed, constructed, and operated as a development and demonstration plant for the gas centrifuge enrichment of uranium isotopes. The CPDF has feed and withdrawal areas, process areas, maintenance areas, and a control room. The total facility has over 78,000 square feet of floor space, of which AlChemIE will use only a portion. The AlChemIE project will utilize the cascade room where 120 centrifuges are located (18,000 square feet) and may use what were the feed and withdrawal areas for storage. Minimum modifications are required to convert the plant into a facility for enriching stable isotopes. The primary changes are the modification of the piping to produce several small cascades involving a few machines (5-10) rather than one 120 machine cascade and the establishment of new feed and withdrawal systems.

Figure 2.1 presents an external view of the CPDF and identifies the various portions of the facility. The centrifuges, which are the major pieces of process equipment, are located in the CPDF bay. AlChemIE will also use this area for feed and withdrawal. The uranium feed area located to the north of the cascade area and the withdrawal area to the south of the cascade area may be utilized as storage areas.

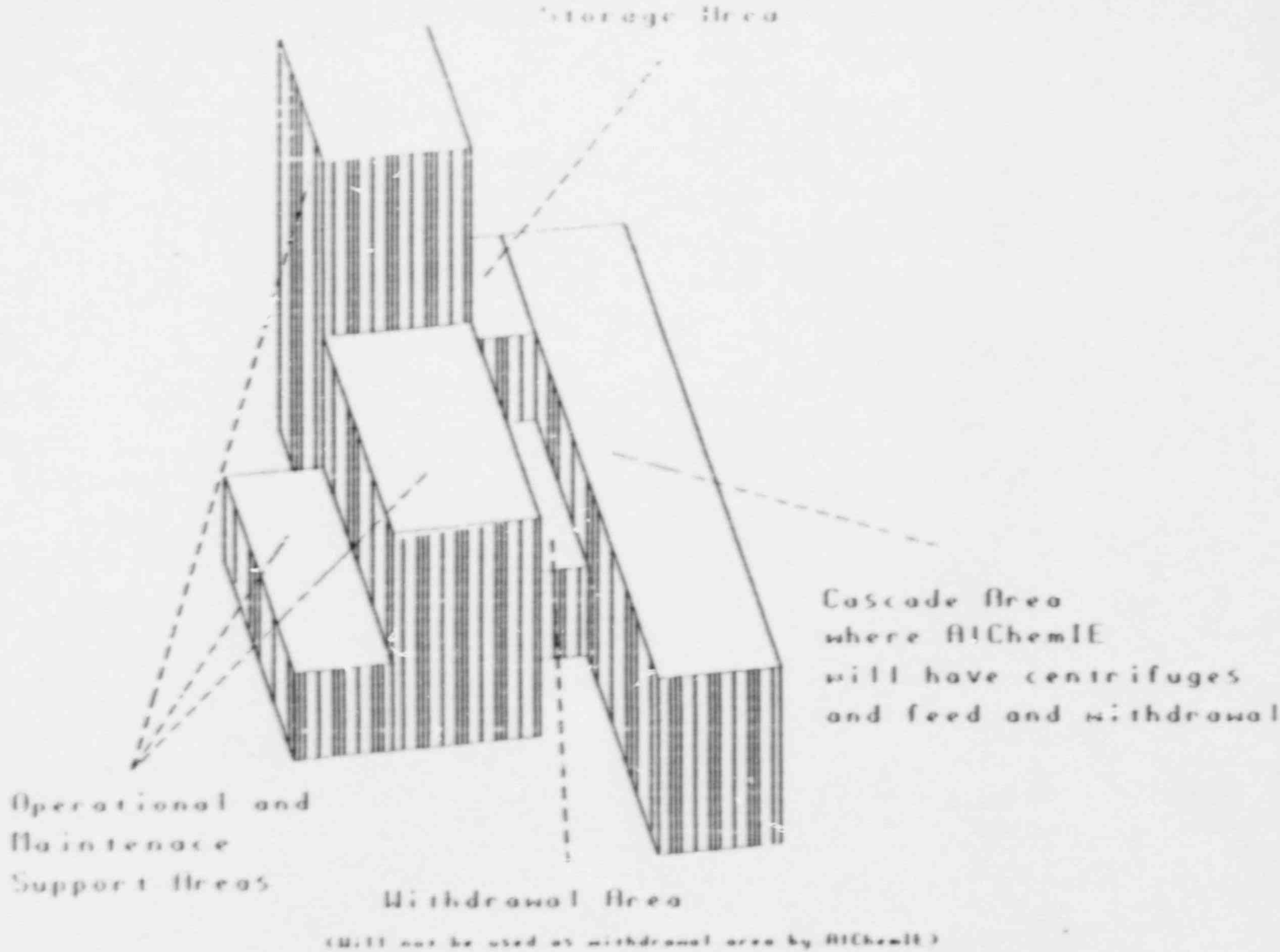

Figure 2.1 CPM which will be utilized by AlChemIE

Because of the value of the product material and its toxicity in several instances, the applicant will take several precautions to confine it.

The two avenues for any process material to enter the environment are through the ventilation system and the water drainage system from the building. These two potential outlets are described in the following paragraphs.

CASCADE AREA VENTILATION SYSTEM

The ventilation system in the cascade area maintains a vertical temperature gradient for the cascade in order to improve process efficiency. This ventilation system recirculates air, heating and discharging it as necessary through twelve roof-mounted ventilators. The ventilators are operated by an automatic control system to maintain the desired temperature profile in the cascade area. The maximum exhaust rate is 129,000 cfm, but the ventilators are expected to operate at significantly lower levels, particularly during the winter months when heat will be required to maintain the desired temperature gradient. The building operators have the ability to shut down the exhaust system, if necessary. The system maintains the cascade area at a pressure slightly above atmospheric (0.1 in. of water pressure).

BUILDING DRAIN SYSTEM

The building has a drain connected under each centrifuge in the cascade area. AlChemIE will remove these connections and seal all the floor drains in the operating and maintenance areas to prevent potential leaks from escaping from the facility through this drain system.

2.2 PROCESS

CENTRIFUGES

The gas centrifuge isotope enrichment process involves the rotation of a long, thin vertical cylinder about its vertical axis in an evacuated casing. The rotation at high speeds subjects the contained gases to centrifugal acceleration thousands of times greater than gravity. As a result, the heavier isotopes collect at the outer radius of the cylinder.

In the machines being used in the AlChemIE facility, the feed is introduced at the center of the rotating cylinder and two streams are produced. The first stream contains the concentrated light elements and is removed from the top of the centrifuge near the center of the rotating cylinder. The second stream contains the concentrated heavy elements and is removed from the bottom of the centrifuge near the outer radius of the rotating cylinder. Both streams are products.

Some of these machines have already been used for uranium separation purposes and contain residual amounts of uranium contamination in them. The extent of uranium contamination within the 120 machines of the CPDF has been estimated by DOE to be 11.4 kg of uranium with an average enrichment of 0.8 % U-235. This corresponds to an average of 95 grams of uranium per machine. DOE has estimated the amount of uranium in the process piping at 9.9 kg, also with an associated average enrichment of 0.8 % U-235. This is only slightly higher than the U-235 concentration that is found in naturally occurring uranium which has 0.71 % U-235. The chemical form of the uranium is UO_2F_2 and is permanently fixed on the machines and piping. Processing of materials other than uranium at the CPDF has indicated that the residual uranium is not transferred to the process gas stream. This uranium is expected to remain fixed to the piping and centrifuges during AlChemIE's operation of the facility.

FEED AND REMOVAL SYSTEMS

The centrifuges can only operate with a gaseous feed material. The feed material for the centrifuge cascade is either already in the gaseous form at normal temperatures and pressures or it is converted to a gas by the application of heat from either a hot water bath or a forced hot air system.

AlChemIE will utilize portable feed carts for feed cylinders. These feed carts, while not designed at the present time, may provide secondary confinement for feed cylinders. Feeds such as the noble gases (Ar, Kr, Ne, etc.), which are already a gas and are non-toxic, will not require feed carts.

After the material has passed through the centrifuge cascade, it is placed in product cylinders. This is accomplished by condensation, possibly with the aid of a compressor if the physical properties of the material being processed through the cascade require one. The condensation will occur in portable withdrawal carts. The carts are still being designed, but they will be similar to the portable feed carts in providing confinement capability. The material being withdrawn from the cascade will be condensed using either dry ice in isopropyl alcohol or liquid nitrogen.

PROCESS OFF-GAS SYSTEMS

Each cascade will have four process off-gas systems. These areas are the evacuation and purge systems for: (1) the cascade, (2) the feed system, (3) the product withdrawal system, and (4) the tails withdrawal system.

The cascade evacuation and purge system will establish and maintain a low pressure in the centrifuge casing. The evacuation system is used to reduce the centrifuge casing pressure from atmospheric pressure down to a level where the purge pump operates. At this point, the evacuation system is shut off and the purge system is used to further reduce and maintain the vacuum used in the process.

The evacuation and purge systems for the feed and withdrawal systems are used in combination with each other in a similar manner as the feed and withdrawal systems. The feed evacuation and purge system is used to remove air from the lines between the feed cylinder and the centrifuge before the feed is introduced into the cascade. This system is only used prior to start-up of the cascade.

The product and tails withdrawal evacuation and purge system is used to initially evacuate the cascade and the withdrawal piping. The purge system may remain operational during cascade operation to remove any non-condensables that collect in the product or tail cylinders.

The discharges from all four of these evacuation and purge systems will be connected to a common discharge header for each cascade. In all the cascades, except those processing xenon and krypton, the gases in this header will be treated to remove the process material. The specific method of gas treatment of the various potential process materials has not been selected at the present time, but AlChemIE has stated that it will use cold trapping, chemical trapping, or mechanical trapping depending on the physical and chemical properties of the process material.

PROCESS MATERIALS

There is a wide range of feeds that AlChemIE is planning or considering for processing in its Facility 1. A list of the potential materials to be processed as well as the feed form is presented in Table 2.1. The various forms have been identified based on their vapor pressure. Some of these materials or their reaction products are toxic. For these toxic materials in particular, AlChemIE states in their environmental report that they will use material safety data sheets and other data supplied by the manufacturers of their feed chemicals to develop handling, operating, and safety procedures. These are normal industrial precautions to protect workers and the environment when handling the material.

Additional materials will be utilized in the AlChemIE enrichment process. These materials have been identified in the AlChemIE waste management plan and are: (1) absorbents for the process off-gas treatment system, (2) vacuum pump oil, (3) freon TP-35, (4) centrifuge oils, (5) nitrogen, dry ice, and isopropyl alcohol which are used for product and tails condensing.

2.3 UTILITIES

There are four utilities which will be used in the AlChemIE facility: electricity, water, steam, and compressed air. The demand for each of these utilities and the capability of existing systems to provide these utilities is reviewed in this section.

Electricity is needed to drive the centrifuges, the vacuum pumps, and the compressors. It will also be used to generate the small amount of heat required to raise the temperature of some of the feed cylinders. The maximum demand for

TABLE 2.1 POTENTIAL AlChemIE FEEDS

Element Being Separated	Element or Compound	Toxic or Hazardous Properties for the Material or its Reaction Products
Ar	Ar	
B	$B(CH_3)_2I$	yes
B	BF_2I	yes
Br	CF_3Br	
C	CF_4	
C	C_3H_8	
C	$C_2H_xF_{(6-x)}$	
Cd	$Cd(CH_3)_2$	yes
Cl	CF_3Cl	
Cr	CrO_2F_2	yes
Fe	$Fe(CO)_5$	yes
Ga	$Ga(CH_3)_3$	yes
Ge	$GeF_4(l)$	yes
Ge	$GeF_4(g)$	yes
Ir	$Ir(CH_3)_3$	yes
Ir	IrF_6	yes
Kr	Kr	
Mo	MoF_6	yes
N	N_2	
Ne	Ne	
Ni	$Ni(CO)_4$	yes
O	PF_3O	
O	CO_2	
Pb	$Pb(CH_3)_4$	yes
Pt	$Pt(PCH_3)_3$	yes
Re	ReF_6	yes
Ru	$Ru(CO)_4$	yes
S	SO_3	
S	SF_6	
Sb	SbH_3	yes
Se	SeF_6	yes
Si	SiF_4	yes
Sn	SnH_4	yes
Ta	TaF_5	yes
Te	TeF_5	yes
Ti	$TiCl_4$	yes
Tl	$Tl(CH_3)_3$	yes
W	WF_6	yes
Xe	Xe	
Zn	$Zn(CH_3)_2$	yes

electricity has been estimated by AlChemIE to be 400 kw. The existing power system is capable of delivering millions of kw to the site. This capacity was established for the support of the ORGDP which required over 2000 Mw of power. Since the ORGDP is now shut down with no plans to restart, excess electrical capacity exists at the site.

The primary use of water at the AlChemIE facility will be for sanitary purposes and some small amount (100 gallons per year) for make-up of the cooling water blowdown. The maximum demand for water for the AlChemIE facility is estimated to be 5000 gallons per day (gpd). At the present time the usage of sanitary water at the ORGDP site is about 300,000 gpd which is down from the 600,000 gpd used when the gaseous diffusion plant was in full scale operation. The site sanitary water facilities are fully capable of handling the small additional amount of sanitary water that will result from the operation of the AlChemIE facility.

Steam is used for space heating in the CPDF. The maximum rate of steam usage is estimated to be 10,000 lbs per hour. The capacity of the ORGDP steam supply system is 320,000 lbs per hour.

Compressed air is used for process instrumentation and control. The present ORGDP capacities are adequate for the small estimated needs of AlChemIE.

The liquid nitrogen will be a new utility for the CPDF. AlChemIE will utilize either dry ice (solid CO_2) in isopropyl alcohol or liquid nitrogen to condense the product and tail gases after they have been removed from the cascade.

A summary of the consumption of these utilities and their planned usage relative to past consumption at the site and at the CPDF are presented in Table 2.2.

2.4 DISCHARGES

The operation of the AlChemIE facility will result in some gaseous and liquid discharges to the environment as well as some solid waste which must be

TABLE 2.2 UTILITIES AND MATERIALS REQUIRED FOR AlChemIE FACILITY 1

Utility	Peak Facility Demand
Electric (kw)	400
Water (gal/day)	5000
Compressed Air (scfm)	150
Steam (lb/hr)	10,000
Liquid Nitrogen (lb/day)	450
Dry Ice, CO_2 (lb/day)	240

managed. This section describes the estimated discharges and the estimated solid waste.

GASEOUS DISCHARGES

Some very small gaseous discharges are expected from both the building ventilation system as well as the evacuation and purge systems for the cascade. The extent of these emissions has not been estimated by AlChemIE, but the Staff believes that it will be small because the cascades operate under vacuum and because DOE experience with such facilities has demonstrated that releases are small. Furthermore, AlChemIE has stated that they will install systems to treat the discharges from the evacuation and purge systems for all cascades except those processing xenon and krypton. These systems will utilize cold trapping, chemical trapping or mechanical trapping systems depending on the physical and chemical characteristics of the material involved. In addition to these releases of process materials, there will be some releases of N_2 and CO_2 from the cooling of product cylinders. The maximum release rate of these two inert gases is 450 lb/day for N_2 and 240 lb/day for CO_2.

WATER DISCHARGES

The sanitary waste water from the facility will be discharged through the existing ORGDP waste water treatment facility. The estimated quantity of sanitary water discharged from the AlChemIE facility is 5000 gallons per day. This will be released to existing waste water treatment systems which are part of the ORGDP.

OILS, SOLVENTS AND SOLID WASTES

In addition to these air and water discharges, there will be some oils, solvents, and solid waste generated at the facility. The oils and solvents (both water and organic solvents) will be generated as a result of operations and maintenance activities. These wastes will be handled and packaged on site as required for safe shipment to off-site waste treatment or disposal facilities.

Solid waste will al be generated at the facility as a result of failed equipment (primarily centrifuges), but also vacuum and gas handling equipment. The failed centrifuges will contain uranium and may contain toxic or hazardous material contamination as well. In the event they are contaminated with toxic or hazardous material, they will be decontaminated. The decontaminated failed centrifuges will then be sent to DOE for classified burial; the toxic or hazardous material removed from the equipment will be packaged for shipment to a licensed waste management contractor. All solid wastes will be transferred to existing waste management organizations which are licensed to handle the various kinds of waste generated.

Table 2.3 presents a summary of the estimates of liquid and solid waste that will be generated by the AlChemIE facility. The table also identifies the amount of material expected to be sent to each type of treatment or disposal site.

2.5 ADMINISTRATIVE CONTROLS

The AlChemIE operations will conduct isotope separation operations according to the needs of customers in the medical, industrial, and research communities. As such, the exact determination of what and when isotope separations will be conducted will depend on the status of the commercial market. To help assure that operator and public health and safety are considered during processing, AlChemIE will prepare detailed handling, operating, and safety procedures for each of the materials before actual processing is undertaken.

TABLE 2.3 AlChemIE FACILITY DISCHARGES

	Projected Discharge	Destination
WATER (gallons/day)	5000	sewer system
SOLID WASTE (lbs/yr)	825	commercial garbage
	1375	ChemWaste
	14,000	DOE/ORGDP
	540	scrap metal
	15	TOSCA or RCRA facility
Subtotal	16,755	
OILS AND SOLVENTS (gal/yr)	50	commercial disposal
	150	ChemWaste
	10	TOSCA or RCRA facility
Subtotal	210	

3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

The environment around the proposed AlChemIE facility at the CPDF has been well characterized as a result of studies and investigations by DOE and their contractors. Detailed discussions of land use, geology, surface and ground-water hydrology, meteorology, ecology, cultural and historical resources, socioeconomic and demography, and aesthetic characteristics can be found in Loar, et al., 1980 (reference 1); MMES, 1985 (reference 2); and Union Carbide, 1979 (reference 3). An environmental report which discusses the proposed action as it affects the environment has been prepared by the EDGe Group, 1987 (reference 4).

This section briefly summarizes each aspect of the environment around the proposed AlChemIE facility. More detailed information can be obtained from the references listed above.

LAND USE

The proposed facility will be located in the existing buildings of the CPDF. The CPDF is located in the ORGDP within the 15,000 hectare (37,300 acre) DOE Oak Ridge Reservation (ORR) (Fig 3.1). The ORGDP site is already dedicated to industrial uses. The lands surrounding the ORR are rural farmlands with associated low density housing. The proposed AlChemIE facility is approximately 3 km from both the north and west boundary of the ORR. Immediately beyond the north boundary are a few rural homesites. More rural homesites are located across the Clinch River to the west of the ORR.

GEOLOGY

The site lies in the Valley and Ridge Physiographic province of East Tennessee. This province is characterized by alternating ridges and valleys aligned southwest to northeast. The ridge and valley topography is an expression of the different erosion rates of the folded and faulted Paleozoic sedimentary formations which underlie the province. The proposed AlChemIE site lies in a valley underlain by shales and limestones of the Conasauga and Chickamauga Formations. Ridges to the northwest and southeast of the site are underlain by the more resistant Knox group and Rome formations.

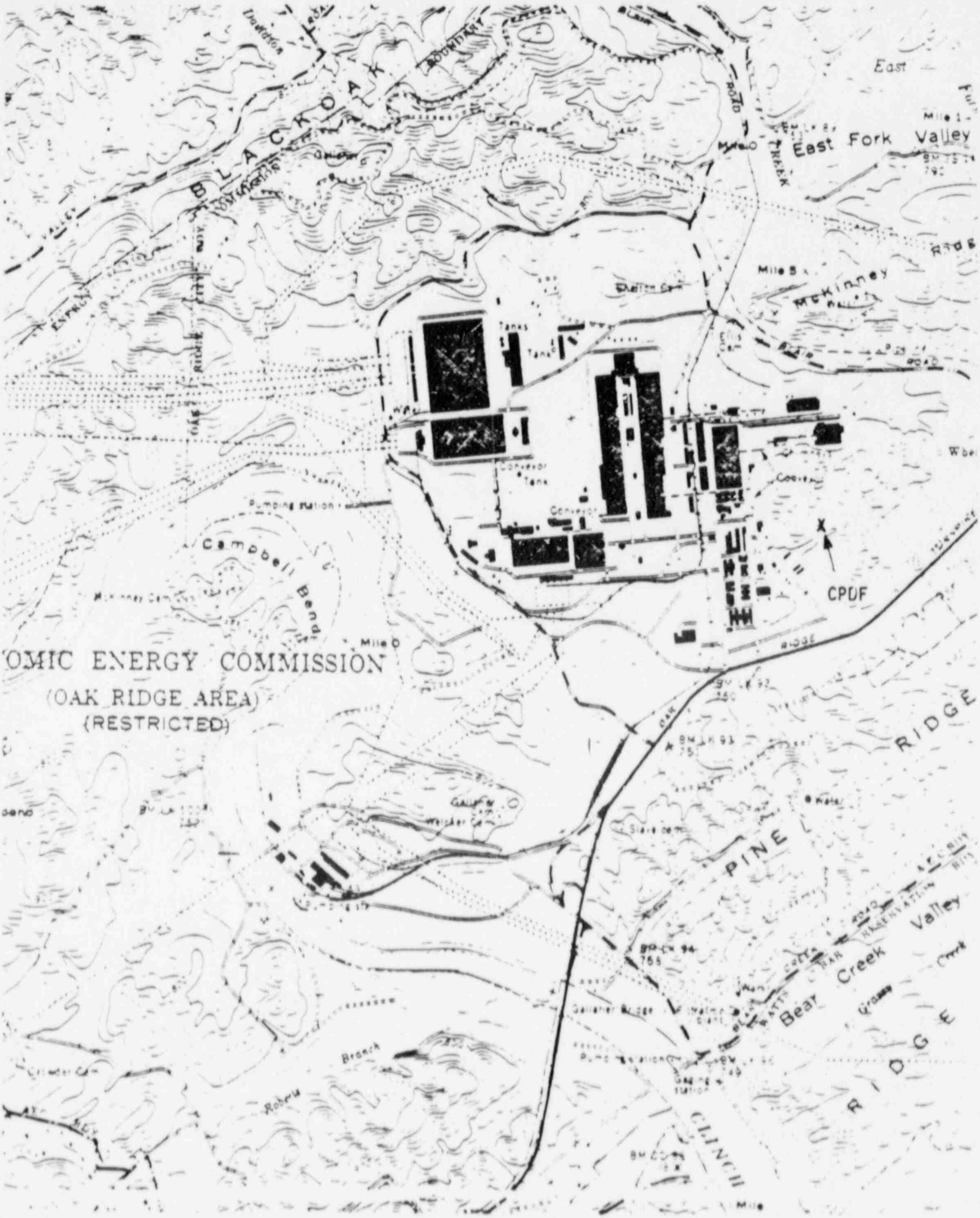

Figure 3.1
CPDF Location at the ORGDP Site

CULTURAL AND HISTORICAL RESOURCES

There are 23 sites in the five county area surrounding the ORGDP which are on the National Register of Historic Places. No historic structures or sites requiring preservation are located near the proposed AlChemIE facility. Only four of the 23 listed historic sites are within 10 km of the facility. Archaeological surveys have identified remnant cemeteries and prehistoric sites, but none are located near the proposed facility.

DEMOGRAPHY AND SOCIOECONOMICS

The proposed facility is surrounded by five counties (Anderson, Knox, Loudon, Morgan and Roane) which had a combined 1980 population of 480,622. The largest population centers are Knoxville, 40 km to the east, and Oak Ridge 10 km to the northeast, with 1980 populations of 183,139 and 27,662, respectively. The area immediately surrounding the west end of the ORR where the proposed facility is located is rural farmland with low population density.

Currently, the DOE and its contractors are the dominant force in the local economy. DOE accounts for 77 percent of the local employment in Oak Ridge and owns 63 percent of the total land area within the city limits. DOE owns 10 percent of the land in Roane county where the proposed facility is located. This area includes many of the prime industrial sites on TVA's Melton Hill and Watts Bar Lakes. Government ownership of such a high percentage of the local land substantially reduces the size of the potential tax bases for Anderson and Roane counties.

ECOLOGY

The ecology of the ORR has been studied and assessed by numerous scientists. Comprehensive discussions of terrestrial and aquatic communities can be found in the references identified at the beginning of this section.

Two threatened or endangered species occur near the proposed facility. The black snakeroot (Cimicifuga rubifolia), a Tennessee state threatened species, and the Federally endangered pink mucket pearly mussel (Lampsilis orbiculata) occur near the site. The black snakeroot occurs within 3000 meters of the site in mesic calcareous soils where minimal disturbance has occurred. The Clinch River and its tributaries contained several endemic aquatic species prior to impoundment by the TVA lakes. These species are now confined to the unaltered regions above Norris Reservoir. Approximately 30 endemic mollusks have been reported above the reservoir while none have recently been recorded below it. The mollusk Lampsilis orbiculata, an attached filter feeder, was reported in the Clinch River in 1982. This mollusk requires clear silt-free water. No other record of its occurrence has been reported in the area.

HYDROLOGY

Poplar Creek, a tributary of the Clinch River, is the major surface drainage in the valley where the ORGDP is located. The confluence of Poplar Creek and the Clinch River is approximately 2 km east of the proposed facility. A water pumping and filtration facility located on the Clinch River at CRK (Clinch River Kilometer) 23.2, immediately adjacent to the ORGDP, supplies water to the ORGDP and the Clinch River Industrial Park. Discharges from the proposed facility would originate from outfall K-1203 into Poplar Creek. Runoff from around the facility would also flow to Poplar Creek. The surface waters of the watershed are a calcium-magnesium/bicarbonate type. Hardness is generally moderate with total dissolved solids concentration usually ranging between 100 and 250 mg/l.

According to the MMES 1986 report (reference 2) ambient concentrations of some chemical species exceed Tennessee Stream Standards at sampling locations within the Poplar Creek watershed upstream from ORGDP and downstream in the Clinch River. The species are lead, mercury, and zinc. The source of these species is unknown. Zinc and lead are potential products of the AlChemIE Facility, but, as discussed under water quality below, no release of these species to the environment is expected.

Generally, ground-water flow in the area occurs under water table conditions but local and transient semi-confined conditions have been observed during periods of high water levels, especially in low areas. Water levels are highest in January and February and decrease to minimum levels in October and November. Depth to the water table is generally 10 meters or less except in areas of high relief. The Knox and the Chickamauga are the primary aquifers in the vicinity of the ORGDP. Permeabilities in these units are quite high near the surface where dissolution has enlarged fractures in the dolomites and limestones. Data indicates that permeabilities decrease with depth so that ground-water movement is restricted to the upper more weathered zones of bedrock.

Because of the abundant surface water resources, no industrial or public drinking water supplies are withdrawn from local ground-water sources by ORGDP or other institutions. Residential and single-family wells are common in rural areas not served by public water supplies. Most of the residential wells in the area are south of the Clinch River.

METEOROLOGY

The meteorology of the Oak Ridge area is largely influenced by its topography. The prevailing winds follow the topographic trend of the ridges: daytime up-valley winds come from the southwest; nighttime down-valley winds come from the northeast. The wind rose (Figure 3.2), based on data collected at 60 meters above ground surface at ORGDP during 1987, shows the bimodal nature of the winds at the site. Annual X/Q values were calculated using the 1987 ORGDP data and EPA-approved air quality dispersion models. This analysis shows that maximum annual average X/Q values are predicted for the SSW to WSW direction at distances of 1 to 1.2 km and in the NE to ENE direction at distances of 0.5 to 0.6 km. The value of X/Q ranges from 3.2E-8 to 3.8E-8 sec/m^3.

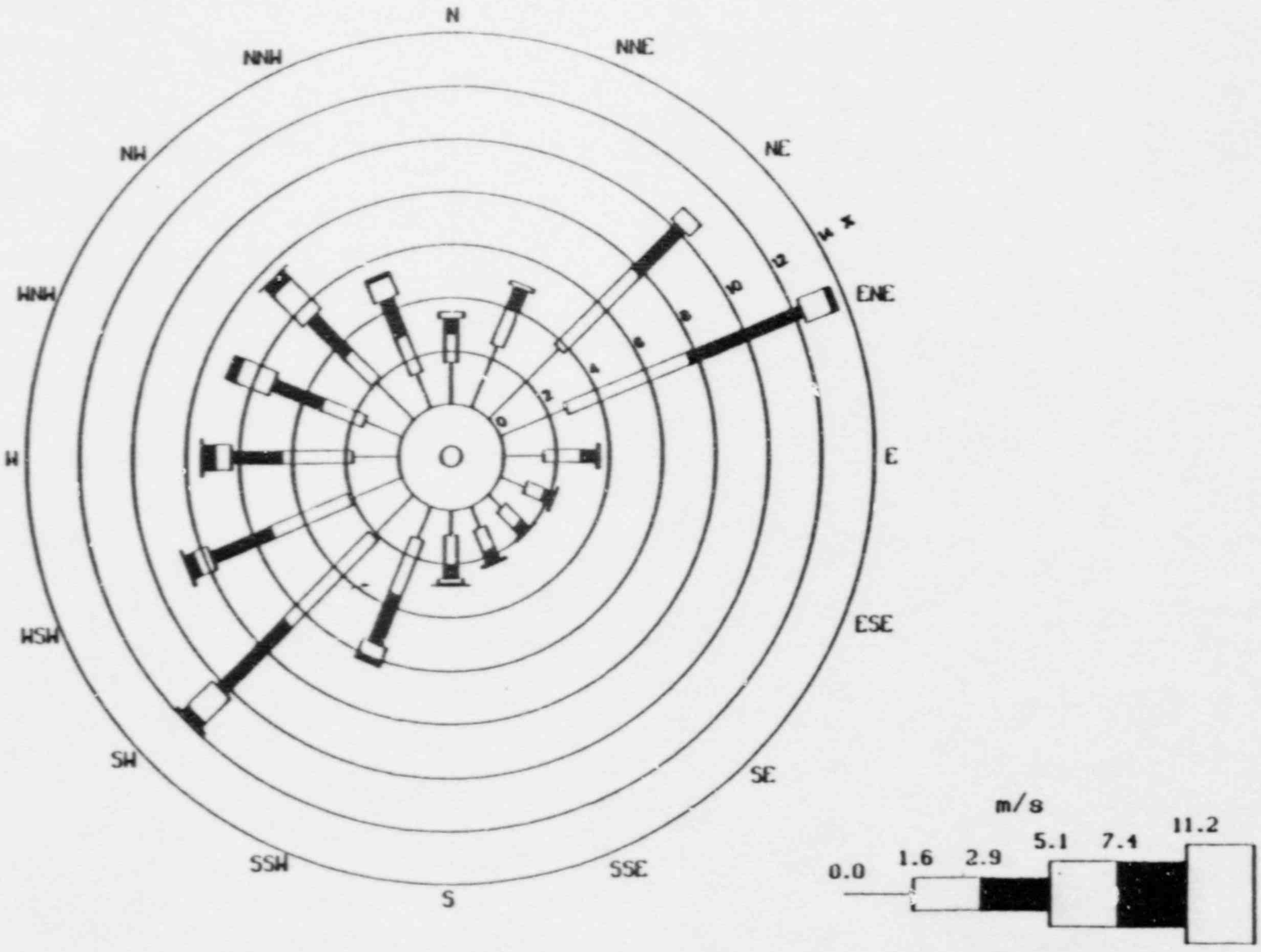

Figure 3.2
Wind Rose for the Oak Ridge Gaseous Diffusion Plant Site (Data taken at 60m during 1987)

4.0 ALTERNATIVES TO THE PROPOSED ACTION

There are three general alternatives to the proposed action that have been identified and are discussed in this section. These alternatives are the no action alternative, the different site alternative, and the different technology alternative. The evaluation of these alternatives is presented in Section 5.

4.1 NO ACTION

The no action alternative would result in the unused DOE facility remaining vacant. There would be no changes in discharges to the environment since the facility would not be operating.

4.2 DIFFERENT SITE

The different site alternative would involve the construction of the AlChemIE facility at another site. This could involve the adaptation of an existing building or the construction of a new building.

4.3 DIFFERENT TECHNOLOGY

The different technology alternative could involve the use of a different enrichment technology. The specific alternate enrichment technologies which might be used are the Calutron or the gaseous diffusion methods.

5.0 THE CONSEQUENCES OF THE PROPOSED ACTION AND THE ALTERNATIVES

This proposed action as well as some of the alternative will have impacts on the environment. This section presents estimates of these impacts.

5.1 CONSEQUENCES OF THE PROPOSED ALTERNATIVE

5.1.1 Nonradiological Consequences

The conversion of the CPDF into a facility for enrichment of stable isotopes and its subsequent operation is expected to have a potential for impact only in a few areas. No impact is expected on land use, geology, subsurface water, cultural resources, aesthetic characteristics, or demography; because the modification of the CPDF will be internal to the existing structure, and no new land will be utilized or developed as a part of the proposed action.

Socioeconomic

The operation of the AlChemIE Facility 1 will create about 50 jobs for management and skilled labor personnel. The net effect of this is expected to be a positive benefit for the local area and will offset some of the recent layoffs at the DOE site. The modest size of the work force required by operation of the CPDF would not be expected to add any significant burden on local communities insofar as requiring additional services such as new schools, roads, or utilities.

Air Quality

AlChemIE is planning to operate their Facility 1 in such a manner that there will be no degradation of the local air quality. AlChemIE projects no emissions from the facility other than ventilation air and some krypton and xenon when these materials are being processed. AlChemIE has applied to the Tennessee Department of Health and Environment (TDHE) for an air permit. The TDHE will issue permits with any restrictions deemed necessary to assure that the AlChemIE facility complies with the Clean Air Act requirements and does not impact the local air quality.

While no specific estimates of air emissions from the AlChemIE Facility 1 were provided in the AlChemIE submittal, the staff performed a preliminary evaluation of the normal releases that might be expected from the facility in order to estimate the consequences of normal operation. The release fraction from the CPDF (mass out/mass in) was conservatively estimated based on reported information for gas centrifuge plants. DOE reports on the assessment of various uranium enrichment technologies indicated a release fraction of 6E-5 and 5E-6 for gas centrifuge plants (references 5, 6).

The release fraction for the AlChemIE operation of the CPDF may be higher because: (1) some of the process materials have higher vapor pressures than UF_6, and (2) the frequency of cylinder connections are likely to be greater because of the smaller sizes of the cylinder and the number of cascades in operation at one time.

The annual production of individual compounds at the AlChemIE facility is expected to range from a gram per year for some of the materials required for research to possibly a metric ton per year for a few isotopes for which there is large application. When comparing the ratio of expected maximum annual production to the American Conference of Governmental Industrial Hygienists (ACGIH) established Time Weighted Average Threshold Limit Value (TWA-TLV), the material which has the highest ratio is dimethylcadmium. The release of this material was examined in what was considered to be a bounding analysis of the consequences of normal releases to the atmosphere.

The maximum annual production of dimethylcadmium was estimated to be less than 5E+4 gm/yr. An assumption considered to be conservative was that the AlChemIE facility would release one part in a thousand to the atmosphere. Using this assumption, the maximum amount of dimethylcadmium released to the atmosphere in a year would be 50 grams (this corresponds to 40 grams of cadmium). To make the analysis more conservative, it was assumed that this material was processed, and therefore released, over a 3-month period. This would correspond to an average release rate of about 5E-6 gm/sec. The maximum X/Q is 3.8E-8 sec/m^3 which means that the maximum cadmium concentration in the air at ground level will be 2E-13 g/m^3 which is many orders of magnitude below the ACGIH

TWA-TLV for cadmium of 0.C5 mg/m^3. On the basis of this anulysis, the staff concludes that normal atmospheric emissions for the AlChemIE facility are expected to be of no environmental consequence.

Potential accidental releases that could result in releases to the atmosphere were also considered. For accidents, the material in storage as well as the material in process was considered. Because the cascade operates at very low pressure (on the order of a torr) the cascade will contain only a few gram-moles of material. The cylinders which are used for feed, withdrawal, and storage can contain hundreds or thousands of gram-moles of material. The potential accidents of greatest concern are considered to be those which involve the release of material from a cylinder.

The amount of material in the various cylinders which AlChemIE expects to use is tentatively identified in the Environmental Report (reference 4). This information, together with time-weighted average threshold limit values (TWA-TLV) established by the ACGIH, was used to evaluate the level of hazard associated with the various cylinders of material. The hazard index for the various cylinders was estimated by dividing the mass of material in the cylinder by the TWA-TLV. On this basis, the material that presents the greatest potential hazard to the environment is dimethylcadmium ($Cd(CH_3)_2$). Table 5.1 presents the listing of these various hazardous materials.

Dimethylcadmium has a melting point of -4°C and a boiling point of 106°C. This means that as long as the cylinder is not heated above its boiling point, the pressure in the cylinder will be subatmospheric. In the case of the AlChemIE process, the feed cylinder is expected to be at room temperature with a cylinder pressure estimated to be about 11 psia. In an accident situation where the piping leading from the cylinder to the cascade failed, air would enter the process piping and the opening would allow the dimethylcadmium to diffuse out. Only gaseous cadmium would be released initially although the liquid material could vaporize and be released with time. In this specific analysis, it was assumed that the cylinder was primarily filled with vapor which was completely released at the time of the accident. The amount of cadmium in the vapor state of the cylinder is estimated to be 0.35 lbs (0.43 lbs of dimethylcadmium).

TABLE 5.1 HAZARD POTENTIAL FOR AlChemIE CYLINDERS

Element Being Separated	Element or Compounds	Feed Cylinder (lbs)	Feed Cylinder (gms)	ACGIH TWA TLVs (mg/m^3)	Cylinder Risk Index
Cd	$Cd(CH_3)_2$	104	4.72E+04	0.05	9.44E+05
Tl	$Tl(CH_3)_3$	97	4.40E+04	0.1	4.40E+05
Sn	SnH_4	90	4.09E+04	0.1	4.09E+05
Te	TeF_6	176	7.99E+04	0.2	4.00E+05
Se	SeF_6	141	6.40E+04	0.2	3.20E+05
Ni	$Ni(CO)_4$	142	6.45E+04	0.35	1.84E+05
Fe	$Fe(CO)_5$	156	7.08E+04	0.8	8.85E+04
Sb	SbH_3	91	4.13E+04	0.5	8.26E+04
Ta	TaF_5	512	2.32E+05	5	4.65E+04
W	WF_6	218	9.90E+04	5	1.98E+04
Mo	MoF_6	275	1.25E+05	10	1.25E+04
S	SF_6	107	4.86E+04	6000	8.10E+00
O	CO_2	32	1.45E+04	9000	1.61E+00

The volume of the room containing the centrifuges is 4.25E+4 m^3 (1.5E+6 ft^3) and assuming uniform dispersion of the material in the process room, the concentration of cadmium in the building air would be 3.74 mg/m^3. This is greater than the ACGIH TWA-TLV of 0.05 mg/m^3. (The TWA-TLV is a concentration at or below which a worker exposed for 8 hours per day for 40 hours a week should experience no ill effects.) In actuality, the concentration of the cadmium in the room will not be uniform since the gas has a density that is almost five times that of air. There will be a tendency for the cadmium vapor to concentrate in the lower levels of the room.

In the cadmium release scenario, the release of cadmium from the process building is calculated to occur with the building ventilation fans operating at their maximum rate of 61 m^3/sec (130,000 cfm). The associated release rate of cadmium is 0.28 g/sec. This will be dispersed by the local winds. The maximum concentration is expected to occur at a distance of about 1 km. At this location, the X/Q is 3.8E-8 sec/m^3 and the predicted concentration is 0.01 $\mu g/m^3$. This is below the ACGIH TWA-TLV of 0.05 mg/m^3. The X/Q at the nearest residence is estimated to be about 1.4E-8 sec/m^3 and the predicted concentration at this location is estimated to be 0.004 $\mu g/m^3$, which is also well below the ACGIH TWA-TLV.

An accidental release of tin hydride (SnH_4) was also calculated. Tin hydride was selected because, while it has a lower toxicity than cadmium, the material has a much higher vapor pressure (the boiling point is -52°C) and so the material will be completely released to the building atmosphere. The feed cylinders of tin hydride are estimated to contain 41,000 grams of tin hydride or 40,000 grams of tin. If this entire amount is released to the process room, the concentration of tin in the room atmosphere would be 0.9 g/m^3. This is significantly greater than estimated TWA-TLV of 0.1 mg/m^3. (The value of 0.1 was used because ACGIH does not provide a TWA-TLV for tin hydride but it does identify a TWA-TLV for organic tin compounds of 0.1 mg/m^3. Toxicology sources state that SnH_4 is more toxic than AsH_3 which has a TWA-TLV of 0.2 mg/m^3). Again, the density of this material is over four times that of air and so the tin hydride will concentrate in the lower elevations of the process building.

Assuming that the building exhaust fans are operating at the maximum rate of 61 m^3/sec (130,000 cfm), this material would be released to the environment at the rate of 55 g/sec. The maximum concentration is expected to occur at a distance of about 1 km. At this location, the X/Q is 3.8E-8 sec/m^3 and the predicted concentration is 0.002 μg/m^3. This is well below the estimated TWA-TLV of 0.1 mg/m^3. The X/Q at the nearest residence is estimated to be about 1.4E-8 sec/m^3, and the predicted concentration at this location is estimated to be 0.0008 mg/m^3 which is also well below the estimated TWA-TLV.

This accident analysis indicated that for the materials AlChemIE expects to process, no major off-site impacts will result even in the event of a failure of equipment that results in the release of material from a cylinder.

Irrespective of the preceding analysis, the applicant is currently discussing with the State of Tennessee its obligations, if any, related to the small inventories of toxic chemicals it may possess and Title III - Emergency Planning and Community Right-to-Know of the Superfund Amendments and Reauthorization Act of 1986.

Water Quality

The AlChemIE facility will discharge primarily sanitary water. Waste water will be routed through existing ORGDP waste treatment systems including the K-1203 facility which currently processes about 1.1 million liters per day but has a capacity of 2.3 million liters per day. AlChemIE will not require its own NPDES permit to comply with the requirements of the Federal Water Pollution Control Act. The facility will be discharging to the existing ORGDP waste water treatment system which has an NPDES permit. The treated water is discharged to Poplar Creek after passing through extended aeration treatment.

The sanitary waste water from the AlChemIE facility is not expected to contain any radiological or toxic materials. Therefore the waste water treatment facility is expected to comply with existing NPDES limits. The NPDES permit for the K-1203 facility will be revised and submitted to the Tennessee Department of Health and Environment for approval.

Solid Waste and Hazardous/Toxic Wastes

The solid waste generated by the AlChemIE operations will be packaged as necessary and transported to approved disposal or treatment and disposal sites. This applies to the commercial trash, the hazardous and toxic waste, the uranium contaminated waste, and the scrap metal. There will be no waste disposal on the AlChemIE site.

Oils and solvents generated at the AlChemIE facility will also be sent to approved facilities for treatment or disposal. No oil or solvent disposal will occur on the AlChemIE site.

Transportation

There will be minimal transportation requirements for the AlChemIE operation at the CPDF. The maximum number of cylinders of gas processed per year is estimated to be less than 400, about 1 cylinder per day. Delivering the feed cylinders to the facility and removing the product cylinders from the facility is estimated to require on the average 1 truck trip per week or less.

5.1.2 Radiological Consequences

During normal operation, no releases of the uranium contaminating some of the centrifuges and piping is expected. This is based on previous DOE experience with uranium contamination. As a consequence, no radiological doses are projected for normal operations.

There is the unlikely event of the fixed uranium contamination (presumed to be UO_2F_2) being converted to a volatile form (possibly UF_6) and being released from the centrifuges and piping. A bounding accident involving radionuclides is the release of uranium from one contaminated centrifuge cascade over an 8-hour period. The amount of material involved is estimated as that from ten average contaminated centrifuges (950 grams of uranium at 0.8% U-235). The release rate is estimated at 0.033 grams/sec.

The greatest air concentrations from these releases are projected to occur at about 0.5 kilometer from the facility which is still within the general ORGDP site. The maximum concentrations are calculated to be 1.3E-9 g/m^3. The breathing rate for an adult who might be exposed to accidental release is 1.2 m^3/hr. Over an 8-hour period, an adult at this point of maximum concentration would breathe in 9.6 cubic meters of air containing 1.2E-8 grams of uranium. Since there is 3.2E-4 Bq of activity associated with this material, the dose commitment to the adult breathing this air would be 2E-5 mrem to the red marrow, 1E-5 mrem to the lung, 1.4E-4 mrem to the kidney, 3.2E-4 mrem to the bone surface and 1.4E-5 mrem whole body equivalent dose. This is over six orders of magnitude less than the naturally occurring annual dose and is an insignificant dose contribution.

The exposure of off-site personnel to this concentration for 8 hours would result in an exposure level of 6.2E-4 mg-min/m^3 which is at a level where no toxicological effects would be expected (reference 7).

In addition to examining the consequence as described above related to the fixed uranium contamination, the applicant analyzed the potential for enriching naturally occurring radioisotopes and a possible radiological safety consequence.

Our evaluation of the information provided in the applicant's report and our own independent analysis indicates that, even if very conservative assumptions are made, the radiation effects are negligible when compared with background radiation.

5.2 CONSEQUENCES OF THE NO ACTION ALTERNATIVE

If the AlChemIE project did not proceed, the CPDF would remain in its shutdown status. A small amount of sanitary water would continue to be discharged from DOE uses of the offices in the building. Run-off from the facility would continue during periods of heavy precipitation. The projected discharges to the atmosphere would not occur, and the generation of toxic and hazardous wastes expected by AlChemIE operations would also not take place. DOE would be required to dispose of the centrifuge machines, which could result in the disposal of significant amounts of classified waste. These amounts would be the same as for the AlChemIE proposed action, but the disposal would occur at a greater rate in the case of the no action alternative. The moderate socioeconomic benefits associated with the employment of about 50 personnel would not occur.

5.3 CONSEQUENCES OF ALTERNATE SITE SELECTION

No specific alternate sites were identified by AlChemIE for their centrifuge enrichment facility. The only other readily adaptable facility identified in this assessment was the centrifuge facility at the Portsmouth site, but this facility is not available. Any other sites or facilities are expected to require significant modification or improvement to accommodate the facility height and utility requirement for the cascade.

5.4 CONSEQUENCES OF ALTERNATE TECHNOLOGY SELECTION

There are other isotope enrichment technologies that might be used to enrich the stable isotopes AlChemIE is considering, but these alternate technologies are either too inefficient or cannot be put into operation by AlChemIE in a cost effective and timely manner.

6.0 LIST OF AGENCIES AND PERSONNEL CONTACTED

Roane County Executive	Kenneth E. Yager
Oak Ridge City Manager	Jeff Proughton
Oak Ridge Mayor	Roy F. Pruett
Anderson County Exec	David O. Bolling
Oliver Springs Town Administrator	Howard L. Elliott
Tennessee Department of Health and Environment Division of Air Pollution Control	V. N. Malichis
Tennessee Department of Health and Environment Division of Air Pollution Control	George R. Woods
Tennessee Department of Health and Environment Division of Water Pollution Control	Natalie Harris
Tennessee Department of Health and Environment Division of Solid Waste Management	Rick Brown

7.0 REFERENCES

1. Loar, J.M., et al., 1980, Environmental Analysis Report for the Oak Ridge Gaseous Diffusion Plant. ORNL/TM-6714. Oak Ridge National Laboratory, Oak Ridge, TN.

2. Martin Marietta Energy Systems, Inc., 1986, Environmental Surveillance of the Oak Ridge Reservation and Surrounding Environs During 1985. ORNL-6271. Oak Ridge National Laboratory, Oak Ridge, TN.

3. Union Carbide Corporation, 1979, Environmental Assessment of the Oak Ridge Gaseous Diffusion Plant Site. DOE/EA-0106. Oak Ridge National Laboratory, Oak Ridge, TN.

4. EDGe Group, 1987, All Chemical Isotope Enrichment, Inc., Facility 1 - CPDF. Environmental Report prepared by the EDGe Group, 725 Pellissippi Parkway, Knoxville, TN 37933-1010

5. U.S. Department of Energy, 1982, Technology Assessment Uranium Enrichment Technologies. DOE/TIC-11488.

6. U.S. Department of Energy, 1980, Technology Characterizations Environmental Information Handbook, DOE/EV-0072.

7. Just, R.A., 1984, Report on Toxicological Studies Concerning Exposures to UF_6 and UF_6 Hydrolysis Products. K/D-5573.