Honeywell Metropolis Works
Safety Demonstration Report for USNRC Source Materials License SUB-526

Docket Number 40-3392

Table of Contents

Acronyms/Abbreviations

ALARA	As Low As Is Reasonably Achievable
ALI	Annual Limit on Intake
ANSI	American National Standards Institute
B.S.	Bachelor of Science
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
Cfs	Cubic feet per second
Cpm	Counts per minute
DAC	Derived Air Concentration
DDE	Deep Dose Equivalent
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
Dpm	Disintegrations per minute
EPDM	Ethylene-Propylene Diene Monomer
EPA	U.S. Environmental Protection Agency
EPF	Environmental Protection Facility
FMB	Feed Materials Building
HF	Hydrofluoric acid
HP	Health Physics
HS&E	Health, Safety, and Environmental
IPC	Internal Proportional Counter
KOH	Potassium Hydroxide
KPA	Kinetic Phosphorescence Analyzer
Mrem	Millirem
MOC	Management of Change
MTW	Metropolis Works or Metropolis Plant
NFPA	National Fire Protection Association
NIOSH	National Institutes of Occupational Safety and Health

Acronyms/Abbreviations

NRC	U.S. Nuclear Regulatory Commission
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	U.S. Occupational Safety and Health Administration
PHA	Process Hazards Assessment
PSI	Process Safety Information
PSIG	Pounds per square inch (gauge)
PSM	Process Safety Management
QA	Quality Assurance
SCFH	Standard cubic feet per hour
TEDE	Total Effective Dose Equivalent
UF_4	Uranium Tetrafluoride
UF_6	Uranium Hexafluoride

Preface

The Safety Demonstration Report contains information that demonstrates Honeywell's adherence to the conditions established in the Source Materials License Renewal Application. The organization of the Safety Demonstration Report generally corresponds to the organization suggested for Chapters 8 through 14 of license applications as presented in Regulatory Guide 3.55, "Standard Format and Content for the Health and Safety Sections of License Renewal Applications for Uranium Hexafluoride Production."

The Safety Demonstration Report is a living document that will be updated as necessary to reflect changes to the facility or procedures. Honeywell uses its Management of Change (MOC) and procedure control processes to ensure that changes to specified procedures, processes, and equipment are reflected in this document. These processes are implemented to ensure that, prior to implementation, a proposed change is reviewed and approved by management and/or supervisory personnel representing a range of plant disciplines. These processes ensure that specific questions are raised on whether process modifications affect the Source Materials License or the Safety Demonstration Report. Information of Honeywell's MOC and procedure control processes are provided in Section 1 of this document.

1. Overview of Operation

1.1. Corporate Information

The Metropolis uranium hexafluoride (UF_6) conversion plant is owned and operated by units of Honeywell International Inc. Corporate headquarters are located in Morristown, New Jersey. The top-ranking member of management at the plant site is the Plant Manager, who reports directly to executive level personnel in Honeywell's corporate offices.

1.2. Financial Qualification

Honeywell International Inc. is a large, financially secure organization with annual worldwide sales exceeding 24 billion dollars. The assets of the corporation are more than adequate to provide financial support for the operation and decommissioning of the Metropolis Plant. The Honeywell International, Inc. Year 2004 Annual Report (enclosed) provides evidence of Honeywell's financial capability for plant operation and decommissioning.

1.3. Summary of Operating Objective and Process

Honeywell International Inc. operates a privately-owned uranium hexafluoride conversion facility near Metropolis, Illinois. The Metropolis Works chemically converts natural uranium ore concentrates into high purity UF_6. The UF_6 product from the facility is shipped to uranium enrichment plants. Following enrichment, the uranium is typically converted into fuel for use in nuclear power reactors.

The present plant is a multi-product chemical manufacturing facility producing sulfur hexafluoride, iodine and antimony pentafluoride, and uranium hexafluoride. The production of uranium hexafluoride is the only operation requiring licensing by USNRC pursuant to the provisions of 10 CFR 40 (Ref. 1). The licensed facility is designed to produce in excess of 14,000 short tons per year of uranium as UF_6 from uranium ore concentrates. The plant feed usually assays about 75% uranium and the final UF_6 product contains less than 300 parts per million impurities. In the Honeywell process, the ore concentrates feed is carried through the successive steps of feed preparation, reduction, hydrofluorination, fluorination and distillation. Chemical reactions are carried out in fluid bed reactors. The process is sometimes referred to as the "fluoride volatility process."

Since the last license renewal Honeywell has made the following changes to the facility:

- Expanded ore storage pads;
- Increased the capacity of the calciner feed hopper;
- Installed a scalper screener in the Ore Preparation section;
- Installed a Prepared Feed Drumming and Dumping station;
- Replaced the Wet Process Ion Exchange system with a potassium removal process;
- Installed a new agglomeration solution system;
- Installed HF Mitigation systems on major HF vessels;

- Installed scrubbers on hydrofluorination dust collector blower discharges;
- Installed emergency relief control vessel on hydrofluorination relief valve discharges;
- Added fluorination filters and cold traps;
- Installed redesigned fluorinators;
- Retrofitted refrigeration system to environmentally-friendly refrigerants; and
- Upgraded controls and instrumentation technology.

1.4. Site Description

1.4.1. Geographical

The Honeywell Metropolis Plant is located on approximately 1000 acres of land in Massac County at the southern tip of Illinois. The primary site perimeter is formed by U.S. Highway 45 to the north, the Ohio River to the south, an industrial coal blending plant to the west and privately-owned, developed land to the east. Plant operations are conducted in a fenced restricted area covering approximately 59 acres in the north-central portion of the site. Honeywell also owns approximately 100 acres of land directly across U.S. Highway 45, N-NE of the plant.

The plant site is located in gently rolling hills, typical of Southern Illinois, and is bounded on the south by the Ohio River flood plain. The surface water drainage of the site is to the south into the Ohio River.

Approximately 25% of the site consists of idle agricultural fields which are returning to their natural state, approximately 10% is used for agriculture (soybeans or corn), and the remaining property is heavily wooded, second-growth timber.

1.4.2. Demographical

The plant site is located in a predominantly agricultural area. Within a two mile radius of the plant, approximately 68% of the land is undeveloped (e.g., cropland, forest, or wetland) and the remainder is developed.

Table 1-1 provides the populations and population densities of Massac County, IL, neighboring McCracken County, KY and the surrounding 50-mile radius. Table 1-2 provides a summary of cities in the surrounding area.

The population distribution within a 50-mile radius of the Metropolis plant is presented in Figures 1.1 and 1.2. Within a one-mile radius of the facility, the total population is 558 persons; most of these are concentrated in the E to ESE sectors near the city of Metropolis. The nearest residence sampling device is currently located between the two nearest residences, approximately 1850 feet NNE of the Feed Materials Building. There are no facilities that would present significant evacuation problems within the immediate vicinity of the site. In addition, the Protective Action Recommendations provided in the Emergency Response Plan are limited to shelter-in-place only; no provisions are required for evacuation of the near-site public.

1.4.3. Meteorological

Due to the location of the site at the southern tip of Illinois, the climate is more characteristic of Kentucky than of Illinois. Because of a slight modifying influence of the Ohio River, the absolute temperature range is smaller than that found in much of Illinois.

The region has two predominant weather patterns that define the winter and summer circulation regimes. Winter is characterized by evenly distributed precipitation events and moderate diurnal changes in temperature. During the summer, frontal and pressure systems generally pass north of the region, resulting in a more tranquil weather pattern over the area.

The following meteorological data is taken from the National Weather Service at Paducah, KY, located 6.8 miles south of the Metropolis site. The Paducah data is expected to be typical of conditions at the Honeywell site.

The average annual temperature from 1997 through 2004 was 58.2 degrees Fahrenheit, with the warmest month being July (79.1 degrees) and the coolest being January (35.4 degrees). The minimum and maximum temperatures during this period were –8 degrees and 101 degrees Fahrenheit, respectively.

The average precipitation for the 1997 through 2004 period was 48.6 inches. Snowfall during this period averaged 4.3 inches per year. The average annual depth of freeze penetration in the soil is about five inches. During much of the average winter, the ground remains unfrozen.

Recent data indicate that the seven county area averages 70 thunderstorm days per year. The seven county area has a fifty-five year tornado frequency rate of 1.08 tornado days annually per 10,000 square miles. The maximum wind gust recorded during the 1997 through 2004 period was 61 knots.

The predominant winds are from the south-southwest, and southwest about 36% of the time. The average speed is approximately 5.5 knots. Wind speed and direction from other directions are reasonably uniformly distributed. Figure 1.3 provides a wind rose for the Paducah, KY area for the period from 1997 through 2004.

1.4.4. Hydrological

1.4.4.1 Groundwater

Within the site area, deposits of Alluvium and Loess do not yield enough water for domestic use. When saturated by precipitation, these formations transmit water to the underlying aquifers of the Pleistocene and Pliocene series. The mixed gravel, sand and clay of the Pleistocene and Pliocene series is the principal aquifer for domestic use. Domestic wells may be bored to a depth of 120 feet before encountering the Porter's Creek Clay formation. The Porter's Creek Clay is not an aquifer but does retard groundwater movement between the Pliocene gravel and the sand in the McNairy formation. The McNairy and Tuscaloosa formations may yield enough water for domestic use but the high iron content and

fine-grained matrix make these formations generally unattractive. The shallowest aquifer adequate for most industrial needs is the Mississippian limestone, which occurs at a depth of 300 to 500 feet. The yield of an industrial well penetrating the Mississippian limestone exceeds one thousand gallons per minute, but usually the water is hard.

The Metropolis Plant water supply is pumped from wells bored into the Mississippian limestone. Process wells 1, 2 and 3 are drilled to depths of 455 feet, 520 feet and 500 feet, respectively. The plant sanitary well is 412 feet deep. The total capacity of these four wells is in excess of 4500 gpm and significantly greater than normal operating requirements. Wells 1 and 3 and the sanitary well have been in use since 1958. Well 2 was drilled in 1971. After placing automatic recorders on the other three wells, a seventy-two hour pumping test was performed on the Well 2 in October 1971. The drawdown was measured in all four wells during the test. During the pumping test of Well 2, a drawdown of 1.5 feet was observed in the sanitary well and two feet in Well 1 with no apparent drawdown experienced in Well 3. It was concluded that significant hydrologic connection exists between the sanitary well and Wells 1 and 2, but this system has no apparent interconnection with Well 3.

The Illinois Department of Public Health administers the drinking water regulations of the U.S. Environmental Protection Agency. The analyses required and frequencies of testing are determined by the Department of Public Health based on the results obtained from previous analyses. The results of the most recent testing for lead, copper, volatile organic chemicals, herbicides/pesticides, and inorganics/ metals indicate that the water meets current EPA standards.

There are no other private water users within the boundaries of the site. Public water use is obtained from the Massac County Water District (county residents) and the City of Metropolis. Both of these sources withdraw their water from wells in the Mississippian limestone aquifer.

The Plant's routine RCRA groundwater monitoring network consists of ten wells - two upgradient and seven downgradient; the tenth well is used for groundwater surface elevation determination only. The nine monitoring wells are sampled and analyzed quarterly for pH, specific conductance, turbidity, fluoride, gross alpha and gross beta. The quarterly results from each well are statistically compared to historical upgradient groundwater quality. Results are reported to Illinois EPA.

Other groundwater monitoring wells are installed and sampled as necessary to satisfy additional monitoring requirements established by the Illinois EPA.

1.4.4.2 Surface Water

There are no surface streams within the boundaries of the site; however, there are several natural water drainage concourses that carry rainwater run-off toward the Ohio River.

Most surface streams outside the site boundary are used for recreation and for watering livestock. Numerous farm ponds and lakes are found throughout the area. The Ohio River, which bounds the site on the south, is used for barge transportation, commercial and sport fishing and as a source of water supply for Paducah, Kentucky, eleven miles upstream of the site. The river is approximately 3000 feet wide with a normal pool elevation of 290 feet above mean sea level. River flow is regulated by flood control structures, the nearest being lock and dam No. 52 at Brookport, Illinois, about seven miles upstream from the site.

Stage-discharge records have been maintained at Metropolis, Illinois (Illinois Central Railroad Bridge) since 1928. The maximum discharge was 1,780,000 cubic feet per second (cfs) on February 1, 1937 and the minimum discharge of 15,000 cfs occurred on July 30, 1930. Average discharge is 265,000 cfs. The 7-day, 10-year low flow recorded is 43,600 cfs.

Although flooding is an annual event, the plant site has never been reached by flood waters. While the 1937 flood reached an elevation of 342 feet, the probable elevation of a 100-year flood (1 in 100 chance of occurring in a given year) in the area is 337 feet. The plant site elevation is approximately 375 feet and is considerably above the most extreme flood level projected.

1.4.5. Seismological

The site area is in the northern part of the Mississippi Embayment, which has had a long history of seismic activity. The only major earthquakes in historic times were the New Madrid earthquakes of 1811-1812, centered about 60 miles southwest of the site. This earthquake was one of the strongest on record in this country. Major faults, trending toward New Madrid, are found approximately twenty-five to thirty miles east and west of the site. These faults, which occurred millions of years ago, have not been active in geologically recent time.

Seismologists are unable to accurately predict the recurrence rates for destructive earthquakes such as those of 1811-1812 because of their infrequent occurrences. Nevertheless, experience indicates that major earthquakes originating along the New Madrid fault zone are capable of causing extensive damage in the Metropolis area. One such estimate concluded that a recurrence of an earthquake of the New Madrid intensity had a maximum likelihood of occurring once in 100-300 years in the entire seismic region.

The soil structure in the plant area may have a viscous or visco-elastic response to earthquake loading and may be susceptible to ground wave motion from distant earthquakes; however, severe ground motion tends to be reduced due to the soil structure present.

1.4.6. Geological

The Metropolis Plant site is located in the northern part of the Mississippian Embayment. This geological area of Southern Illinois and Western Kentucky is

characterized by Quaternary surface materials and subsurface layers of Tertiary and Cretaceous which lie on Mississippian undifferentiated carbonate rocks. The chief geologic resources within the area are sand, gravel, and groundwater.

Gently rolling hills are the predominant surface feature of the site area. Drainage is directly or indirectly through secondary watersheds into the Ohio River. Bottomland and light colored terrace soils are found along the Ohio River, which forms the south boundary of the site. These soils were developed primarily from outwash or alluvium under forest vegetation. Soils in the remainder of the area are light colored silt loams, with moderately slow to slowly permeable subsoils developed primarily under forest vegetation from loess.

The Quaternary surficial materials, consisting of clayey silt, silty clay, sand silt, and loess, are found throughout the area at depths of from 0-60 feet. The Continental and Porter's Creek clay deposits are principally brown sand, gravel, and clay. The McNairy and Clayton formations consist primarily of sand, clay and silt and extend from approximately 135 feet to greater than 225 feet beneath the surface. The McNairy and Clayton formations rest upon Paleozoic rock.

1.5 Location of Buildings on Site

The location of buildings on the site for the manufacture of fluorine chemicals (SF_6, IF_5, SbF_5, and F_2), UF_6 conversion, and support services are shown on Drawing MTW-4781 (Enclosure 1).

Most of the uranium processing equipment is housed in a seven-story (six above ground) structure termed the Feed Materials Building (FMB) where essentially all of the steps in the UF_6 manufacturing process are conducted. Other areas and buildings in which operations are conducted involving the handling or processing of significant quantities of source material include the following:

- A Sampling Plant, which receives and samples ore concentrates for uranium assay and moisture content.
- The Wet Process and Uranium Recovery Facilities, which are housed in buildings where ore concentrates are treated to remove various impurities, and where recycled materials are processed to recover contained uranium.
- The KOH muds facility, which processes uranium-bearing muds and liquors generated in the fluorination scrubber system. The potassium diuranate is then processed through Wet Process. The liquors are regenerated at EPF.
- The Calcining Facility, which dries the incoming feed material and recovered uranium.
- The Pond Mud Calciner Drier, which processes hard/wet ore concentrates and KOH Muds prior to packaging for blending with additional ore concentrates at the FMB for conversion to UF_6.
- The Laboratory Building, which houses facilities for conducting process control, product, and radiological control analyses.

- The Cylinder Wash Building, where UF_6 product cylinders are periodically washed and hydrostatically tested prior to reuse.
- Outdoor and indoor pads for storage of drums of ore concentrates and other uranium bearing materials, as well as UF_6 product cylinders.

Additional plant facilities that are involved directly in the UF_6 manufacturing process, but do not involve the handling of any significant quantities of source material, include a fluorine manufacturing building, a fluoride waste treatment facility, a powerhouse, a reductor off-gas incinerator, and two small uranium settling ponds to collect any uranium spills.

1.6 Maps and Plot Plans

A plot plan of the plant is shown in Drawing MTW-4781. This drawing also shows the location of the restricted area fence and distance and direction of public facilities of interest. Figure 1.4 indicates the location of the site relative to Southern Illinois and Western Kentucky.

1.7 License History

The Metropolis Plant was built at its present location to supply UF_6 to the U.S. Atomic Energy Commission under a five-year contract (1959-1964). The plant currently supplies conversion services for the commercial nuclear power industry as part of the nuclear fuel cycle. A brief licensing history of the plant is as follows:

License Number	Issue Date	Renewal Date	Comments
C-4493	12/17/58		Original License
C-4493		December 1959	
C-4493		December 1960	
C-4493		January 1962	Changed to SUB-526
SUB-526	January 1962	February 1965	
SUB-526		February 1968	
SUB-526		August 1977	
SUB-526		May 1985	
SUB-526		June 1995	

1.8 Changes in Procedures, Facilities, and Equipment

1.8.1 Assurance of Safety Review

Honeywell implements a Process Safety Management (PSM) Program consistent with the requirements of 29 CFR 1910.119 (Ref. 3). Honeywell's Process Safety Management Program addresses the following elements:

- Employee participation
- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Employee Training
- Contractors
- Pre-Startup Safety Review
- Mechanical integrity
- Hot Work Permits
- Management of Change
- Incident investigations
- Emergency planning and response
- Compliance audits
- Trade secrets

This program provides an integrated approach to safety and has been developed to be consistent with Honeywell's approach to ensuring compliance with applicable NRC license requirements.

The Management of Change (MOC) Process, as part of the PSM Program, is implemented to assure proper review and approval of changes to specified procedures, equipment or processes that could be detrimental to employee health and safety, environmental quality, or the equipment integrity. Types of changes subject to the MOC process include:

- Changes to a process parameter.
- Changes to environmental equipment, procedures, types and/or quantities of pollutants, types and/or quantities of hazardous waste, etc.
- Changes to plant-related Occupational Health and Health Physics equipment, procedures, and exposures to radiological, toxic and occupational hazards, etc.
- Changes to raw material specifications, in the handling of hazardous raw materials and treating agents, to the materials of construction for process equipment, etc.
- Changes to finished product quality, safety, handling, etc.
- Addition of new process equipment and the retirement or deletion of existing process equipment.
- Any change that requires additional training for Production, Maintenance, or Environmental/Regulatory Affairs personnel.

- Any change that may be detrimental to employee health and safety or the integrity of process equipment and the infrastructure of Honeywell.
- Revision of an approved operating procedure.
- Purchase of raw or non-like kind chemical.

1.8.2 Responsibility for Requesting Safety Analysis

Honeywell's MOC and procedure development processes establish requirements for requesting process change reviews. For operating procedure revisions, the individual developing the revision is typically responsible for submitting the revision for review and approval. For changes to plant processes and equipment, the Process Engineer, Plant Engineer, or Process Specialist who oversees development of the change, or his supervisor, would typically be responsible for submitting the change for review and approval. For other changes, including changes affecting the Regulatory Affairs or HSE Programs, the responsible supervisor or manager would typically be responsible for submitting the change for review and approval.

1.8.3 Analysis

Recommendations for changes are reviewed through a checklist that includes, at a minimum:

- Pre-startup Safety Review requirements.
- Process Hazard Analysis requirements.
- Potential for off-site report (e.g., noise, odor)
- Amended procedure requirements.
- Training requirements.
- PFD & P&ID change requirements.
- Product quality impact.
- Raw material or additive requirements.
- Product contamination possibilities.
- Site safety impact (e.g., impacts on lighting, security, traffic flow, road conditions, explosive or combustible hazards, ergonomics, noise, radiological conditions, or toxic/hazardous chemical exposure).
- Standby power requirements
- Ventilation requirements.
- Special monitoring.
- MSDS.
- Warning labels and handling instructions.

- Hazardous or toxic chemical inventory changes.
- Hazardous waste generation and disposal.
- Waste generation rate change (air, water, solid, hazardous)
- Concentration of pollutants.
- Discharge or release of toxic/hazardous material.
- Permit application or modification requirements.
- Spill or release prevention/containment procedure requirements.
- New point/fugitive emission source.

1.8.4 Review and Approval

Prior to implementation, the proposed change is reviewed and approved by management and/or supervisory personnel representing a wide range of plant disciplines, including at a minimum, HSE, Regulatory Affairs, Engineering, and Maintenance. The Plant Manager reviews and approves revisions to operating procedures.

Final authority to grant operational status is provided by the responsible manager or his/her designee.

1.8.5 Verification

The Honeywell MOC process includes provisions for conducting a Pre-Startup Safety Review when required to ensure the safety and operability of a changed process. Responsibility for conduct of the Pre-Startup Safety Review will be assigned as part of the MOC process.

Honeywell's procedure development process includes requirements for procedure review and verification.

1.8.6 Records

Honeywell's MOC and procedure development processes include requirements for development of detailed records associated with evaluation and implementation of process modifications and procedures changes. Records associated with changes typically include:

- Results of the analyses conducted as outlined in Section 1.8.3, including any corrective or mitigating actions;
- Records of any training associated with the change;
- Records of equipment or component tests;
- Records of engineering analyses;
- Records of reviewer comments and actions taken to respond to those comments;

- Records of workplace and/or environmental monitoring performed to ensure the safety of the change;
- Records of the Pre-Startup Safety review, when required; and
- Records of any associated audits and inspections.

1.9 References

1. Title 10, Code of Federal Regulations, Part 40, *Domestic Licensing of Source Material*, USNRC, as amended
2. Year 2000 Census Data, U.S. Census Bureau, www.census.gov
3. Title 29, Code of Federal Regulations, Part 1910.119, *Process safety management of highly hazardous chemicals*, U.S. Department of Labor, Occupational Safety and Health Administration, as amended

Table 1-1 – Populations and Population Densities (Ref. 2)		
Area	**2000 Population**	**2000 Population Density (People per square mile)**
Massac County, IL	15,161	63
McCracken County, KY	65,514	245
50 Mile Radius	516,825	66

Table 1-2: Cities In Vicinity Of MTW Facility				
City	**County/State**	**Distance & Direction from site (miles)**	**Direction from MTW Facility**	**Population (Ref. 2)**
Metropolis	Massac, IL	1.0	ESE	6,482
Joppa	Massac, IL	5.5	WNW	409
Brookport	Massac,IL	7.5	ESE	1,054
Kevil	McCracken, KY	9.2	SW	574
Paducah	McCracken, KY	10	SE	26,307
*Massac	McCracken, KY	10.2	SSE	3,888
*Hendron	McCracken, KY	11	SE	4,239
*Woodlawn-Oakdale	McCracken, KY	13.5	SE	4,937
*Ledbetter	McCracken, KY	16	ESE	1,700
*Reidland	McCracken, KY	17	SE	4,353

Figure 1.1 – Population 0 – 5 Miles From Honeywell Metropolis Works

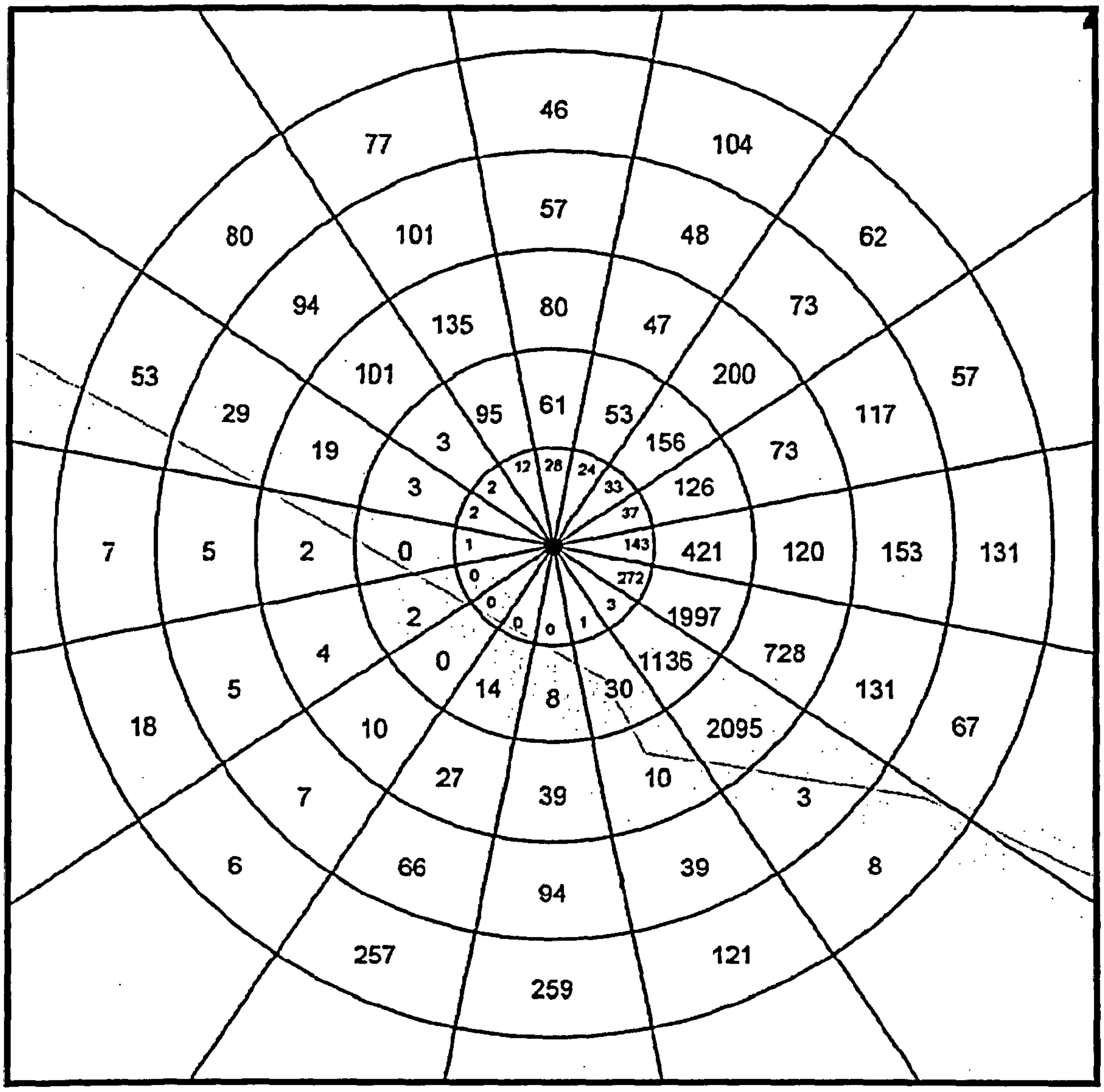


Figure 1.2 – Population 10 – 50 Miles From Honeywell Metropolis Works

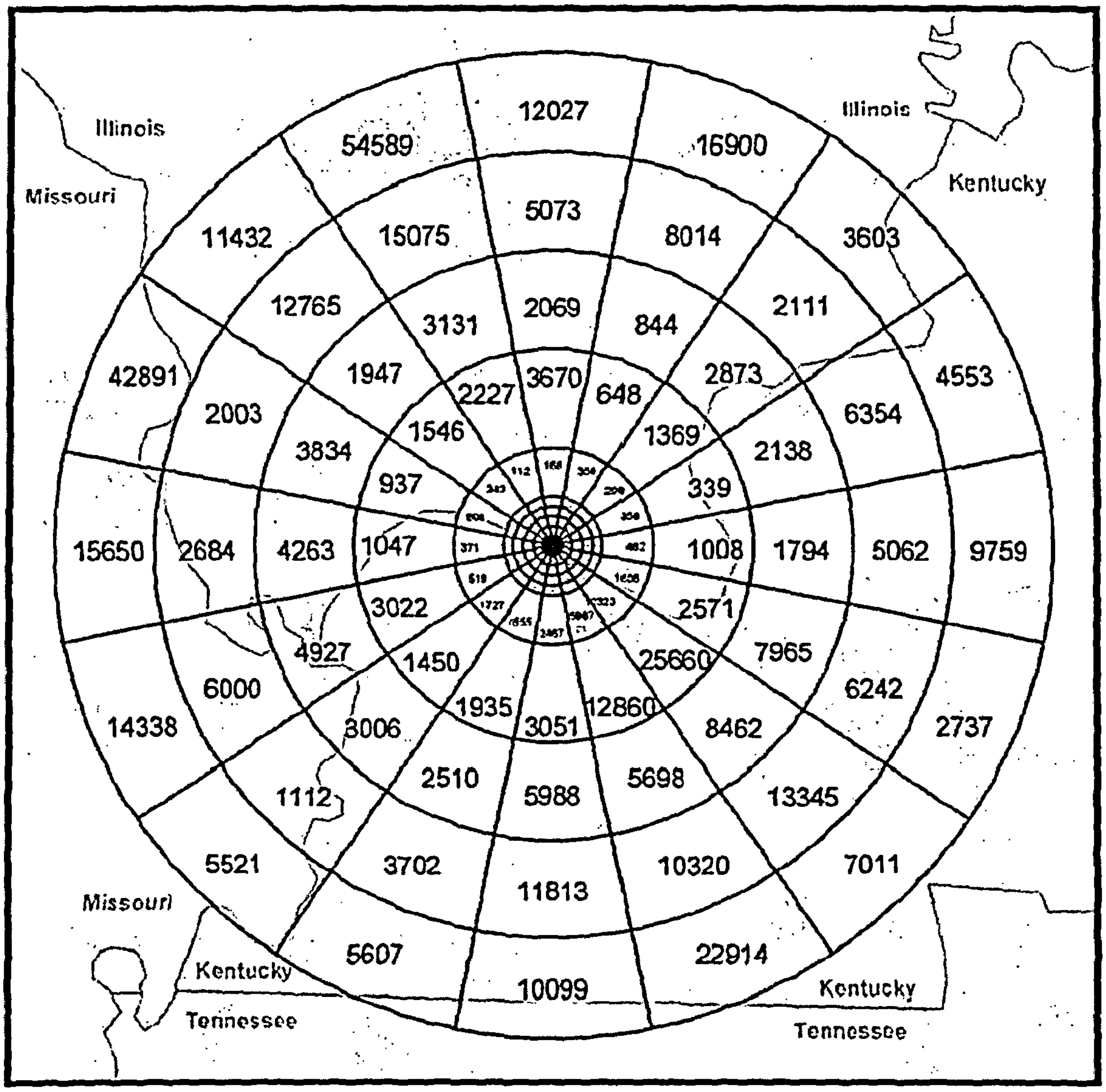
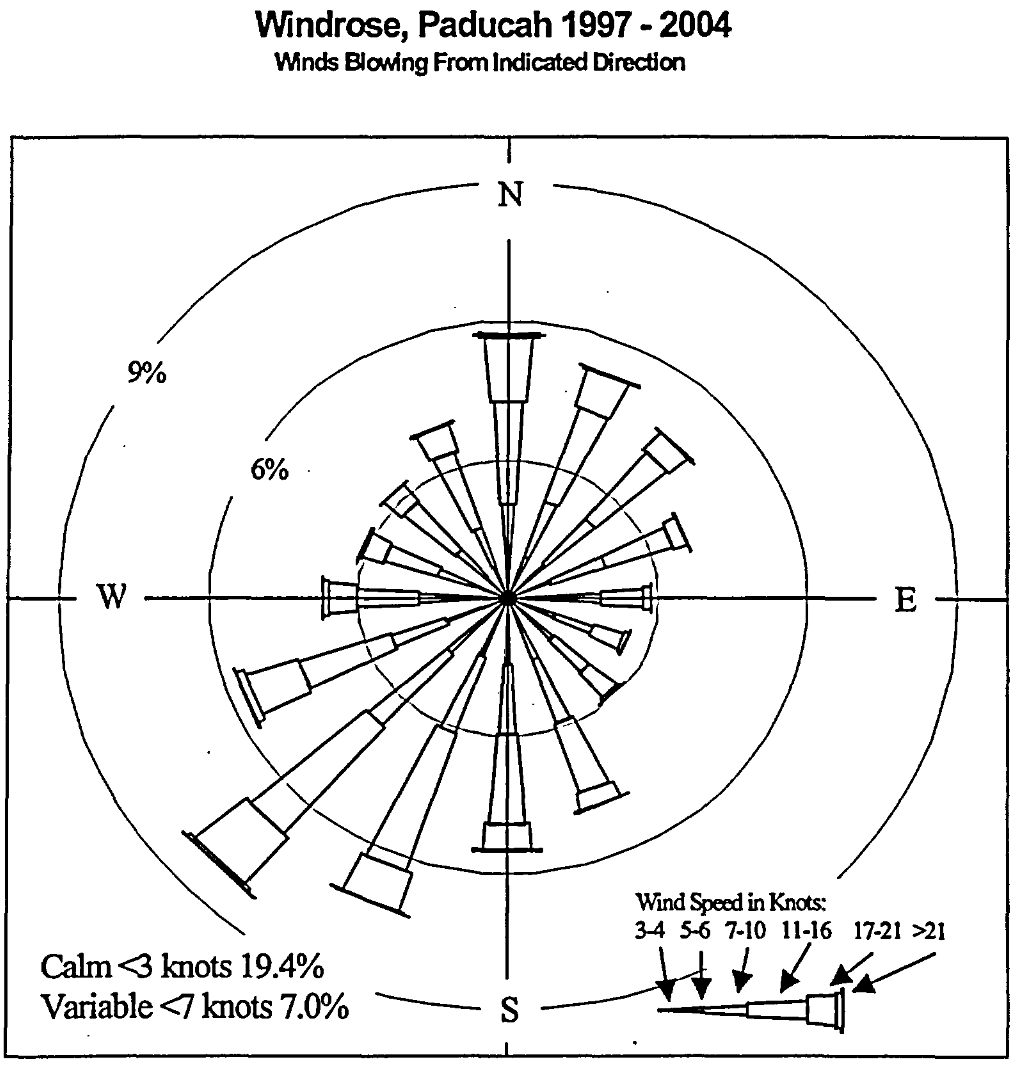
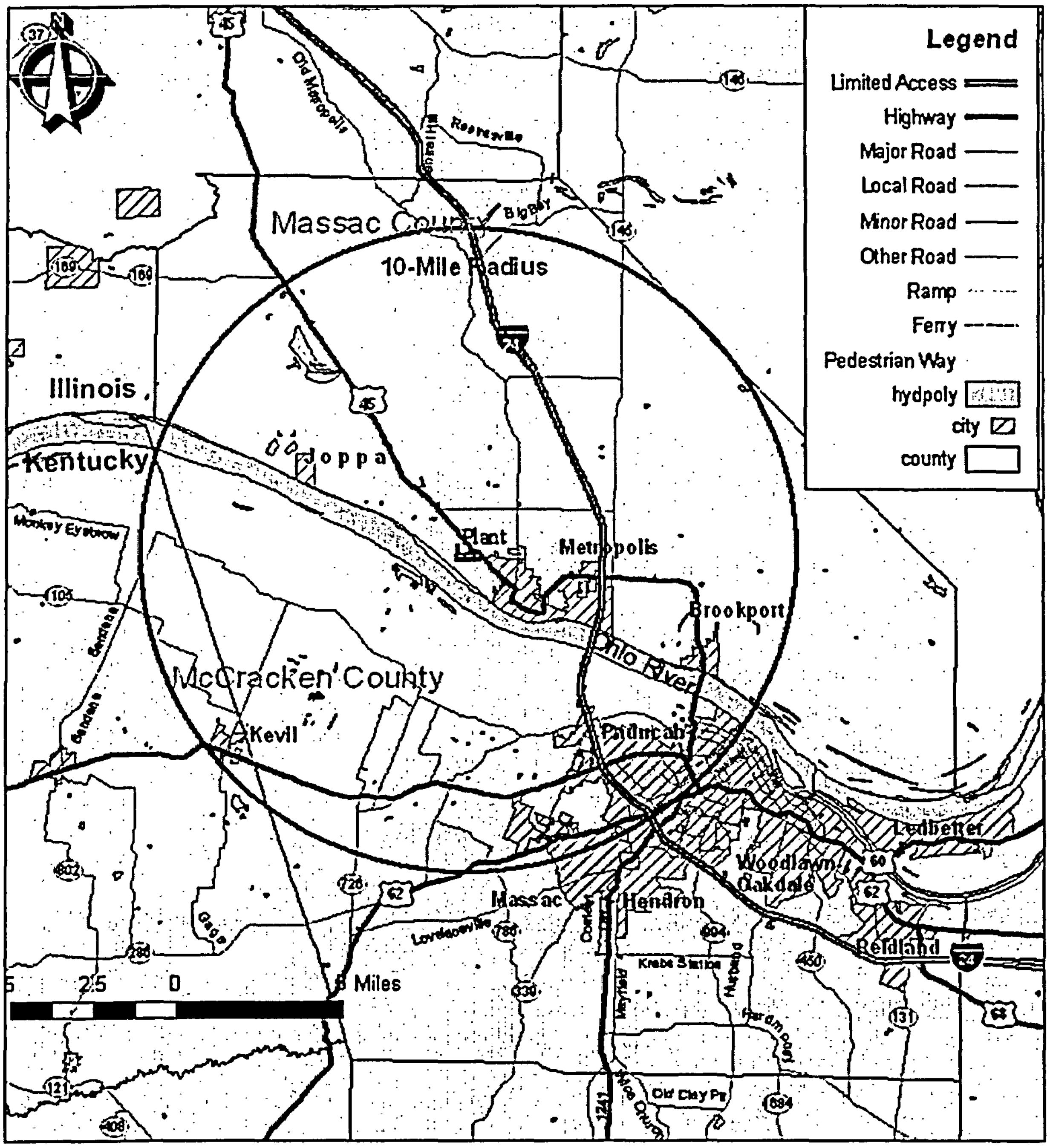


Figure 1.3 – Paducah, KY Wind Rose 1997 - 2004



Percentages Are Percentages Of All Wind Data; Winds With Direction Defined Total 83.6%.

Figure 1.4 – Location of Honeywell Metropolis Works Site



2. Facility Description

2.1. Plant Layout

A flowsheet depicting the UF_6 conversion process is shown in Figure 2.1. The layout of the plant is shown in Drawing MTW-4781 (Enclosure 1). The process description and associated flowsheets are provided in Section 6 and in the enclosed drawings (Enclosure 1).

2.2. Utilities and Support Systems

2.2.1. Electric Power

The plant production processes and supporting activities require a large amount of electrical power to operate. The electrical power is provided by Ameren through a 69,000 volt substation within the restricted area fence. Because the chemical processes contain hazardous materials at elevated temperatures and pressures, these processes operate using many electrically- and/or pneumatically-operated safety features. In addition, some of the processes contain chemicals that must be kept warm.

Standby utilities are maintained in order to facilitate a safe and orderly shutdown of the process units during a complete power failure. Standby electrical power is provided from an electrical generator located in the Powerhouse Building. The standby electrical generator is diesel powered and delivers 480 volts AC. In the event that electrical power is interrupted, the standby generator automatically starts and comes to a standby mode. The standby power is then distributed, as required, to the following:

- Emergency exit lighting in process buildings.
- The Administration Building and the Laboratory Building for standby lighting in the Dispensary, Lab, and Health Physics areas.
- One deep well pump providing for operation of the process boilers and providing seal liquor for the fixed air monitoring system pump.
- All three process boiler instrument panels and all boiler support equipment which, along with the emergency water supply, allows the production of steam for space heating and for critical process equipment, including the Health Physics air sampling pump.
- Pre-designated instrumentation and equipment, including a selected fluorination scrubbing train, providing operating personnel the capability to monitor the in-process UF_6 and to evacuate piping or vessels as needed to maintain the process in a safe condition.

The H_2S incinerator is provided with a dedicated standby power generator.

2.2.2. Compressed Air, Breathing Air and Liquid Nitrogen Systems

Three different compressed air systems are provided for plant operation. Each is designed to supply the quantity and quality of compressed air necessary for the end use.

2.2.2.1 Fluidizing Air

The fluidizing air system provides is capable of delivering the high quality (low dewpoint) air. Fluidizing air is delivered to the plant extremely dry and free of contaminants because it is used in the Fluorination and Distillation areas where it comes in contact with fluorine and UF_6.

2.2.2.2 Instrument Air

The instrument air system provides dry, contaminant-free air to the pneumatic instrumentation in the plant.

2.2.2.3 Plant Air

The plant air system provides dry, contaminant-free air for general usage in the plant.

Each of the three compressed air systems obtains air as follows. Atmospheric air is drawn through a screen into the intake of the compressor from just above the Powerhouse roof. The air is compressed in one or two stages to 80-105 psig and about 200°F. The compressed air is cooled to about 80°F and condensed moisture is removed from the compressed air through a float trap. The air is then passed through a receiver to disengage and drop out any residual moisture. The air then passes through a desiccant dryer, a filter to remove desiccant particles, a surge receiver, and then to the plant consumers.

2.2.2.4 Breathing Air

Certified breathing air for use in masks and protective suits is obtained in cylinders from an outside vendor.

2.2.2.5 Liquid Nitrogen System

A pressurized nitrogen system is used to provide backup nitrogen pressure for pneumatic instrumentation and to provide an inert gas for purging process piping and vessels. Normally open (power to close) solenoid valves are located on tie lines between the nitrogen header and the plant air and inert gas headers. During a loss of air pressure, these valves automatically open thereby supplying nitrogen pressure for critical pneumatic instrumentation and purging of equipment.

Nitrogen is also used as an inert gas for selected pressure-testing and processing operations.

2.2.3. Water

There are three primary water systems in the plant: 1) the Process Water System; 2) the Sanitary Water System; 3) the Fire Water System. Process Water is supplied from three (3) deep wells, each greater than 400 feet in depth. Sanitary Water is supplied from a fourth well which is also greater than 400 feet deep. All wells are drilled into the Mississippian limestone aquifer and are located within the restricted area. The Fire Water System is considered a "closed" system in that it does not normally need fresh water makeup. Firefighting water is supplied from the fire water storage tank, which

may be replenished as needed from the Process Water System. Each of these systems has a specific function, but interconnections are provided to ensure adequate water supply during emergencies or for deep well pump repairs.

The four plant deep well pumps are all electrically-powered centrifugal pumps and are designed for continuous operation. The #1, #2, and #3 deep well pumps supply the Process Water System while the #4 (Sanitary) deep well pump supplies the Sanitary Water System. The original design capacity of the three process pumps was about 4500 GPM. The sanitary well pump is rated at greater than 200 GPM.

The liquid effluent from the entire plant is normally about 3,000 GPM, thus adequate excess capacity exists for emergency use.

2.2.4. Steam

Some chemical processes at the plant require steam in order to produce the final products. The primary use of steam is for:

- Steam tracing both indoors (mostly UF_6 lines) and outdoors for freeze protection.
- The UF_6 Distillation process for vaporizing and reboiling the UF_6.
- The gaseous fluorine plants to keep the cell electrolyte in liquid form during periods of downtime.

Steam is produced at approximately 90 psig by three steam boilers located in the Powerhouse, along with other supporting equipment needed to produce the steam. The boilers are two-drum, water-tube types that are rated at 200 psig. Each boiler is equipped to burn either natural gas or LPG. Each boiler is equipped with extensive safety controls to assure a safe combustion process. Each boiler is also equipped with dual relief valves to relieve steam pressure in the boiler if it should ever rise above 130 psig. The highest pressure required by the process is about 70 psig.

2.2.5. Refrigeration

UF_6 vapor produced in the fluorinators passes through a set of refrigerated cold traps to desublime the UF_6, then through a caustic scrubbing system.

The cold trap system consists of primary, secondary, and tertiary cold traps. The gas flows through each type of cold trap in series. Cooling and heating for the primary cold traps is accomplished in two steps to minimize thermal stress. Initial cooling for the primary cold traps is provided by a 90°F - 110°F glycol solution (intermediate system) which is heated or cooled as needed by steam or well water respectively. Cooling below the 90°F - 110°F range is accomplished with a cold glycol solution which is chilled by a refrigeration system. Initial heating to 90°F - 110°F also comes from the intermediate system. Heating above the 90°F - 110°F range is supplied via a hot glycol solution, which is heated by steam. The secondary and tertiary cold traps are chilled with a refrigerant and heated with steam. Cooling for the refrigeration system's condenser is provided by second refrigeration system.

2.3. Ventilation Systems

Uranium processing areas that produce dusts, mists, or fumes containing uranium or other toxic materials are provided with dust collectors and/or scrubbers to reduce employee or environmental exposure to levels that are as low as is reasonably achievable (ALARA). The design efficiency of the fabric filter baghouses is greater than 95% efficiency each. Providing two, and sometimes three gaseous cleanup systems in series allows a decontamination factor of greater than 10^4. (Note: The Wet Process dust collector consists of a single stage). Table 2-1 provides the rated efficiency of each gaseous cleanup system.

The gas exiting the tertiary cold traps flows through a caustic scrubbing system. In the caustic scrubbing system, the residual gas stream is contacted, in several vessels, with a potassium hydroxide (KOH) solution. The KOH solution removes essentially all of the remaining fluoride-bearing components of the gas stream. The remaining air is then vented to the atmosphere through a stack. The stack is continuously monitored to measure the quantity of uranium discharged to the atmosphere.

Reduction off-gases consist of H_2S, hydrogen, nitrogen and metallic sulfides. These are processed through a gas-fired incinerator to burn off the excess hydrogen and convert H_2S and other sulfides to SO_2, which exits the incinerator stack. Hydrofluorinator off-gases are twice scrubbed with water and then scrubbed with KOH to remove fluorides. The weak acidic HF liquors and spent KOH are transferred to the EPF for treatment.

The general ventilation system used in the UF_6 process area consists of a series of fresh-air intake units and a series of window and roof exhaust fans. The system is designed to provide a complete air changeout approximately once every five minutes. In addition, the distillation section is provided with containment walls to prevent the spread of UF_6 vapors in the event of a release, and exit stairwells are enclosed to provide contamination-free egress from the building.

The FMB Control Room has a separate air conditioning system that maintains the room under a slight positive pressure. This system is equipped with dual fresh air intakes located outside each end of the FMB.

Laboratory hoods that are routinely used to handle unencapsulated uranium are checked monthly and adjusted to assure adequate face velocity.

Workroom air concentrations of uranium are continuously monitored in process areas to assure the ventilation systems are adequately controlling employee exposures.

Each individual uranium emission source is continuously monitored. This emission data is computerized to provide emission data on a daily, monthly or annual basis. Appendix A, provides a graph of stack emissions from 2000 through 2004. Operational and administrative controls are utilized to shut down equipment when the concentration of uranium in the exit stack exceeds the established administrative limit for the stack.

Essentially all stack emissions of uranium are of mixed solubility (Class D, W, and Y) due to the variety of milling processes used to produce ore concentrates; however, in the fluorination and distillation sections the emissions are primarily highly soluble UO_2F_2 from UF_6 decomposition.

In addition to analysis of the stack samples, operating personnel monitor the pressure drop across the dust collectors to assure proper operation. Samples are also analyzed from the off-gas scrubbers as required to control emissions. Additional samples, visual observation, and precautions are taken as necessary to ensure effective performance of the pollution abatement equipment.

Stacks that contain non-radiological emissions are required to have an approved operating permit from the Illinois Environmental Protection Agency (IEPA). Each emission source is operated in accordance with the IEPA Air Permit.

2.4. Radioactive Waste Handling

2.4.1. Liquid Wastes

All liquid wastes from the facility are discharged via natural drainage into the Ohio River. Figure 2.2 depicts the current wastewater disposition scheme. The main plant effluent is continuously sampled and the composite sample is analyzed daily for uranium. In the event of a spill that could significantly increase effluent water concentrations of uranium or other chemicals, controls such as diking or neutralization are utilized to minimize contamination of the liquid effluent. Suspended solids, pH, temperature, flow, biochemical oxygen demand, and fluoride are monitored in accordance with the NPDES permit. The daily samples of the main effluent are composited into a monthly sample that is analyzed for numerous impurities. Typical analyses of effluent concentrations are shown in Table 2-2.

An Environmental Protection Facility (EPF) is utilized to remove chemical pollutants (primarily fluoride) from the main plant effluent stream. The facility process uses calcium hydroxide to precipitate fluorides as insoluble calcium fluoride. The "synthetic" calcium fluoride solids are precipitated and may be recovered and recycled to any commercial organization which can use synthetic CaF_2 as a substitute for naturally occurring CaF_2 (fluorspar).

The effluent from the EPF plant typically has a pH of approximately 11 and is automatically adjusted to a pH range of 6-9 using H_2SO_4. This stream is combined with other treated wastewater, which is then mixed with uncontaminated cooling water, stormwater, and the effluent from the uranium settling ponds and monitored before being discharged into the Ohio River.

Wastewater that is known to contain uranium, and does not contain significant quantities of fluoride, is routed through the #3 and #4 uranium settling ponds.

The HF water scrubber liquors are routed directly to the EPF for HF neutralization. The uranium content of this stream averages less than 10 ppm uranium.

The pH of the uranium settling ponds (Ponds No. 3 & 4) is maintained slightly basic to minimize dissolved uranium loss. Experience indicates that approximately 80 - 90% of the uranium loss from these ponds is soluble uranium. As the effluent leaves the second uranium pond, the level is measured to determine flow rate and a proportional sample is taken for a 24-hour composite sample. The pH and uranium

content of the composite sample are analyzed daily. The average flow from these two ponds is approximately 25 gpm. The effluent from the uranium settling ponds is then mixed with the remainder of the facility effluent before discharging into the Ohio River.

The solids level in the ponds is measured periodically; an individual pond is removed from service when the available "freeboard" is reduced to approximately 2 feet. The solids removed from No. 3 and 4 ponds during a cleanout may be transferred into the pond muds calciner for drying and are packaged into drums for onsite or offsite recycling. The settling ponds solids are processed for recovery of the contained uranium.

These settling ponds are predominately an above grade system. Only about two feet of each pond is below grade. Each time a pond is emptied and cleaned, a thorough examination is made of the lining. The lining is 60 mil Ethylene-Propylene Diene Monomer (EPDM) rubber installed over previously-used asphalt and burlap liners. The material in the ponds is alkaline and the EPDM rubber liner has excellent resistance to alkaline solutions. In the event a pond liner should develop a leak, seepage drains are installed under each pond which discharge into the main effluent which is continuously sampled. In addition, groundwater monitoring wells are provided downgradient of these ponds.

Mixed waste currently (First quarter, 2005) stored at the plant consists of:

- 600 gallons of used lubricating oils from various maintenance activities.
- 305 gallons of sludge from several drums from which the liquid was decanted prior to shipment for disposal.
- 116 gallons of waste acetone from laboratory analytical activities.
- 100 gallons of TBP, TEHP and CFC-113 extraction solvent from laboratory analytical activities.
- 110 gallons of sandblast fines.
- 360 gallons of fluorine trench muds

All of the mixed waste listed above is stored on a covered, concrete storage pad that is permitted by the plant's Resource Conservation and Recovery Act (RCRA) permit issued by the Illinois Environmental Protection Agency. These waste streams are characterized and awaiting shipment for disposal.

2.4.2. Solid Wastes

Radioactive solid wastes are generated from routine operation of the uranium processes. The routine wastes generated consist primarily of contaminated filters, paper, wood, plastic, cloth, rubber, and scrap metal. These materials are normally shipped to a licensed disposal site or processor.

These materials are collected in marked containers, segregated by radioactivity monitoring to reduce volume, and then containerized. The containerized material

may then be compacted on site, then shipped to a licensed processor or disposal site. Solid waste volumes shipped for the period from 2000-2004 have been 8,000 to 20,000 cubic feet per year.

Contaminated pieces of process equipment and other scrap metal being discarded are decontaminated where feasible to recover uranium, volume reduced as appropriate, then shipped to a licensed processor or disposal site. Non-contaminated scrap metal may be sold to various scrap metal dealers or disposed of as non-radioactive waste. Radiological monitoring is performed to assure that the residual radioactivity level is below release criteria as stated in Section 2.5 of Regulatory Guide 8.30. Other recyclable materials may be released if residual radioactivity levels are less than these same levels.

2.5. Shipping and Receiving

Honeywell receives uranium ore concentrates via common carrier from uranium mills throughout the world. Each shipment is unloaded at the Sampling Plant. Upon completion of unloading, each trailer is monitored for residual radioactivity in accordance with appropriate DOT or NRC standards before the trailer is released from the plant. If a trailer is found to be contaminated at levels exceeding the controlling regulatory requirements, appropriate decontamination measures are taken or the trailer is controlled as radioactive material.

Outgoing shipments of UF_6 product cylinders, low-level waste, or off-grade residues to be recycled are monitored in accordance with Section 2.8 of Regulatory Guide 8.30 to assure compliance with regulatory standards. A shipment is not allowed to leave the site until all requirements are satisfied.

2.6. Chemical Systems

The major chemicals used in the UF_6 manufacturing process and the plant's present storage capacity are shown in Table 2-3. The following sections describe the storage and distribution of these chemicals.

2.6.1. Ammonia

Ammonia is stored in two horizontal, standard ASME dished-head tanks. The storage tanks are constructed of mild steel and insulated with polyurethane coating. Pressurized NH_3 vapor (via a compressor) is the driving force for filling the storage tanks. Steam is then used to increase vapor pressure to transfer NH_3 to process areas.

Potential contact with NH_3 requires the proper protective gear. Relief valves protect the storage tanks from overpressurization. Any release is discharged to the atmosphere through tall vertical pipes, elevated more than 20 feet above the top of the tank.

2.6.2. Hydrofluoric Acid

Anhydrous HF is stored in three (3) horizontal, ASME dished-head tanks. The storage tanks are constructed of mild steel. AHF is transferred both to the storage tanks and from the storage tanks to process areas by inert gas pressure.

Potential contact with HF requires the proper protective gear. The integrity of the tanks is preserved with rupture discs and relief valves. An inadvertent release from a storage tank discharges into a Dump Tank of equivalent design. The Dump Tank in turn relieves into a water scrubber that discharges to the plant wastewater treatment facility. Remote operated valves are employed to isolate transport vehicles (tank cars, etc.) and storages in an emergency.

2.6.3. Potassium Hydroxide

Potassium hydroxide (KOH) is stored in a horizontal, standard ASME dished-head tank. The tank is constructed of mild steel.

Potassium Hydroxide is transferred to storage and process areas by a pump. Potential contact with KOH requires proper safety gear. Environmental releases are minimized by providing containment diking beneath discharge piping, pumps, and rail cars. Additionally, the tank is equipped with an overflow that discharges into the containment area.

2.6.4. Sulfuric Acid

Sulfuric acid is stored in a horizontal, standard ASME dished-head tank. The storage tank is constructed of mild steel. Sulfuric acid is unloaded and transferred by air pressure as the driving force.

Potential contact with sulfuric acid requires proper safety gear. Tank integrity is protected by an overflow line containing a rupture disc. Any release to the environment is controlled by diked containment.

2.7. Fire Protection

2.7.1. System Design

There is no available record of the name of the person or firm that designed the plant system (circa 1956). Honeywell headquarters personnel provide guidance and professional expertise on proper selection and design of fire protection equipment and system design. In addition, industrial risk insurance carriers provide expertise and recommendations during their annual audits of the fire protection program.

The standards to which the Honeywell fire protection system was designed and constructed were those codes and standards in effect at the time of construction in 1956. The plant fire protection system is appropriate for the plant areas protected and utilizes the guidance provided in various NFPA standards. In addition, modifications may be made based upon audit recommendation by the industrial risk insurance carriers.

2.7.2. Fire Control Systems

2.7.2.1 Water Supply

A 250,000 gallon above-ground reservoir dedicated to the fire protection system provides water supply for fire fighting/HF mitigation. The tank level is automatically maintained. The tank is heated in winter. Fire pump suction can also be taken directly from the process water system through appropriate valving.

Water for fire protection in the Administration Building, Laboratory and Sampling Plant is provided from the process water system. These buildings are not connected to the primary plant fire system.

2.7.2.2 Fire Water Pressure

A 1000 GPM pump provides pressure (approx. 100 psig) for the fire mains. The pump is provided with both a diesel engine and electric motor. Both the motor and engine start on pressure drop controllers with the electric motor being energized first due to a decreased pressure in the main. If the electric motor fails, the diesel engine starts. The diesel engine is also provided with redundant manual starting controls if the automatic controller fails.

Automatic operation of the pump activates an alarm in the Powerhouse. If both the electrical and diesel motors fail, process water will pressurize the system through a check valve arrangement at a pressure of approximately 65 psig.

A jockey pump maintains the static pressure in the fire mains and compensates for minor pressure variations due to leaks in the system.

The fire pump is operated weekly when drain tests are conducted on the sprinkler systems. The electric motor and the diesel engine are operated to perform this test. The pump also receives routine preventive maintenance.

The pump is flow tested annually by an insurance carrier. Both the electric motor and diesel engine are used for the test.

2.7.2.3 Fire Water Distribution

Primary fire water piping is eight inches in diameter with six inch distribution pipes to the various areas. Supply to these areas is controlled by post indicator valves. Fire main installation meets the standards of NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances" (Ref. 1) in effect at the time of installation.

2.7.2.4 Sprinklered Areas

A pre-action wet sprinkler system provides protection for the maintenance shop and stores area. The system was engineered by the Grinnell Company, presumably in 1956, with revisions in 1977. Sprinkler drain tests are conducted monthly.

2.7.2.5 Deluge System

The main rectifiers for the gaseous fluorine plants that are located in close proximity are provided with a water deluge system unless the oil is of a non-combustible type. The fire deluge system is a dry system with flow controlled by Quartzoid detectors (or equivalent) which operate a Grinnell multi-matic valve on rate of rise. This system is flow tested annually by activating a detector with heat application. This test is witnessed by an insurance carrier representative annually.

Four Liquefied Petroleum Gas (propane) tanks are provided with deluge protection by two 500 gpm deck guns, or water cannons. The deck guns are flow tested quarterly.

2.7.2.6 Hose Houses

Metropolis Works currently has seven hose houses. Five were installed in 1956 according to NFPA standards. A sixth at the Sampling Plant was installed in 1968. The seventh was installed on the south pad in 1999. Each house is equipped with a minimum of 300 feet of fire hose and appropriate accessories. The fire hose is hydrostatically tested and re-racked annually.

Six houses have a fire water hydrant in close proximity. Hydrants are visually inspected monthly and flushed annually at the time of hydrostatic testing of the hoses. Hoses are tested by a fire equipment service contractor.

2.7.2.7 Standpipes

Standpipes are located in various areas of the plant as follows:

Feed Materials Building:

Three hose reels are located on each floor. Fifty feet of hose with variable pattern shutoff nozzle is provided on each reel. The minimum pressure is 75 psig. These standpipes are part of the main fire water distribution system.

Administration Building:

Two standpipes with hose cabinets are located on the second floor, and five standpipes with hose cabinets on the first floor. Each cabinet contains fifty feet of hose with a variable pattern shutoff nozzle. Minimum pressure is 65 psig. These standpipes are pressurized from the process water system.

Laboratory:

Two standpipes with hose cabinets are located in the main hallway. Each cabinet contains fifty feet of hose with a variable pattern shutoff nozzle. The minimum pressure is 65 psig. These standpipes are pressurized from the process water system.

Shop/Stores:

Four standpipes with hose are provided in the shop/stores building. Each reel and rack contains 50 feet of hose with a variable pattern shutoff nozzle. This system is pressurized from the fire main.

2.7.2.8 Fire Extinguishers

Honeywell maintains appropriate supplies of portable fire extinguishers. These are distributed and maintained in accordance with NFPA 10 "Portable Fire Extinguishers." Fire extinguisher hydrostatic testing is performed by a fire equipment service contractor.

2.7.3. Emergency Response Team

Honeywell maintains Emergency Response Teams (ERTs) whose responsibilities include fire protection. The MTW Emergency Response Plan establishes requirements for ERT Training.

A letter of assistance has also been signed with the Massac County Fire Department stating that, if an emergency exceeds the facility capabilities, they may be contacted for assistance.

2.7.4. Personal Protective Equipment

Two hose houses contain six (6) sets of personal protective equipment designed to protect the Emergency Response Team. This equipment consists of helmets, face shields, coats, pants, gloves, boots and SCBAs.

2.7.5. Combustible Storage

Most of Honeywell's raw materials and products are non-combustible. Many combustibles are incidental to the operation and are generated as refuse. The uncontaminated refuse is deposited in metal drums and disposed of in accordance with local industrial waste disposal practices.

2.7.6. Fire Reporting

Few areas are protected by automatic fire alarms. Persons observing a fire are instructed to dial the public address system on the plant phone system and announce the location of the fire. The Emergency Response Team will respond to fight the fire. The Massac County Fire Department would be contacted for assistance if the emergency exceeded the capability of the Emergency Response Team.

2.7.7. Tests and Inspections

Routine testing and inspection of the plant fire apparatus and accessories are conducted under the supervision of the Safety Supervisor or his designee. In addition, Honeywell's insurance carrier conducts routine detailed inspections of the

plant fire protection program. Written inspection reports are reviewed and appropriate action taken for deficiencies or recommendations.

2.7.8. Fire Hazard Analysis

An initial fire hazard analysis was performed in December 1994 and updated in May 1998. These reports indicate that the fire hazards are low at this facility due to non-combustible construction.

2.7.9. Fire Protection Action Plan

The plant maintains a "Fire Preplanning Guide" in accordance OSHA 29 CFR 1910.38 (Ref. 3). This facility also has a mutual aid agreement with the Massac County Fire Department. An open invitation is provided to this agency for plant orientation and familiarization of the facility.

2.8. References

1. NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, National Fire Protection Association, various revisions
2. NFPA 10, *Portable Fire Extinguishers*, National Fire Protection Association, 2002
3. Title 29, Code of Federal Regulations, Part 1910.38, *Emergency action plans*, U.S. Department of Labor, Occupational Safety and Health Administration, as amended

Table 2-1 – Gaseous Cleanup Systems (Rated efficiency in parentheses)					
Description	**Stack #**	**Contaminant Removed**	**Primary Control**	**Secondary Control**	**Tertiary Control**
Wet Oxide Dust Collector	1-1	Particulates	Baghouse (95)	Baghouse (95)	
Dry Oxide Dust Collector	1-2	Particulates	Baghouse (95)	Baghouse (95)	
Drum Cleaner Dust Collector	1-3	Particulates	Baghouse (95)	Baghouse (95)	
Oxide Vacuum Cleaner	1-4	Particulates	Cyclone (95.0)	Baghouse (95)	Baghouse (95)
UF4 Vacuum Cleaner	1-7	Particulates	Cyclone (80.0)	Baghouse (95)	Baghouse (95)
"B" UF4 Dust Collector	1-10	Particulates	Baghouse (95)	Baghouse (95)	
Dry Oxide Dust Collector	1-11	Particulates	Baghouse (95)	Baghouse (95)	
Ash Vacuum Cleaner	1-12	Particulates	Cyclone (80.0)	Baghouse (95)	
Ash Dust Collector	1-12	Particulates	Baghouse (95)	Baghouse (95)	
"A" Fluorinator Filters	1-13	Particulates	Metal Filters (>95)	Metal Filters (>95)	
"A" Fluorinator Scrubbers	1-13	F_2, HF, UF_6	Spray Tower (80.0)	Packed Tower (99.0)	Coke Box (99.0)
"B" Fluorinator Filters	1-14	Particulates	Metal Filters (>95)	Metal filters (>95)	
"B" Fluorinator Scrubbers	1-14	F_2, HF, UF_6	Spray Tower (80.0)	Packed Tower (99.0)	Coke Box (99.0)
"C" Fluorinator Filters	System identical to 1-13, may use "A" or "B" fluorinator scrubber system				
"A" Top Hydrofluorinator Filter	1-23	Particulates	Carbon Filters (>95)	Carbon Filters (>95)	
"A" Top Hydrofluorinator Scrubber	1-23	HF	H2O Venturi (88.0)	KOH Venturi Jets (85.0)	KOH Packed Tower (99.0)
"B" Top Hydrofluorinator Filter	1-24	Particulates	Carbon Filters (>95)	Carbon Filters (>95)	

Table 2-1 – Gaseous Cleanup Systems (Rated efficiency in parentheses)

Description	Stack #	Contaminant Removed	Primary Control	Secondary Control	Tertiary Control
"B" Top Hydrofluorinator Scrubber	1-24	HF	H2O Venturi (88.0)	KOH Venturi Jets (85.0)	KOH Packed Tower (99.0)
"A" UF4 Dust Collector	1-46	Particulates	Baghouse (95)	Baghouse (95)	
H2S Incinerator Stack	1-48	H_2S, S	Sulfur Condenser Incinerator (99.0)		
Drum Inverter Dust Collector	1-54	Particulates	Baghouse (95)	Baghouse (95)	
Uranium Recovery Dust Collector	3-2	Particulates	Baghouse (95)		
Pond Mud Calciner	4-2	Particulates HF, SO_2	Baghouse (95)	Spray Tower (95.0)	
Sampling Plant Dust Collector	17-1	Particulates	Baghouse (95)	Baghouse (95)	
Sampling Plant Vacuum Cleaner	17-2	Particulates	Baghouse (95)	Baghouse (95)	

Table 2-2 - Liquid Effluent Contaminants (Annual Average)

Contaminant in mg/L	2000	2001	2002	2003	2004
Chromium	0.005	0.005	0.004	0.005	0.003
Iron	0.125	0	0	0	0.005
Molybdenum	0.077	0.046	0.059	0.028	0.021
Niclel	0.018	0.006	0.007	0.003	0.005
Phosphate as "P"	0.047	0.08	0.038	0.052	0.046
Total Solids	784	652	666	632	577
Uranium	0.262	0.155	0.101	0.098	0.094
Uranium (Range of Values)	0.13 - 0.55	0.07 - 0.211	0.04 - 0.21	0.04 - 0.15	0.04 - 0.318
Vanadium	0.001	0.004	0.003	0.002	0.003
Gross Radioactivity in pCi/ml					
Radioactivity, Alpha	0.102	0.05	0.039	0.034	0.021
Radioactivity, Alpha (Range of Values)	0.0 - 0.2	0.01 - 0.12	0.02 - 0.06	0.01 - 0.08	0.01 - 0.04
Radioactivity, Beta	0.179	0.201	0.17	0.186	0.158
Radioactivity, Beta (Range of Values)	0.0 - 0.34	0.04 - 0.74	0.03 - 0.27	0.0 - 0.39	0.0 - 0.35

Table 2-3 – Major Chemical Storage Systems		
Chemical	**Max. Quantity Stored (lbs.)**	**Where Used**
Anhydrous Ammonia	120,000 plus one (1) 80 ton railroad car	Reduction of Uranium ore contrates to UO_2
Anhydrous Hydrofluoric Acid	424,000 plus up to four (4) 80 ton railroad cars	Conversion of UO_2 to UF_4
Potassium Hydroxide	102,400	Scrubbing exit gases for environmental protection
Sulfuric Acid	256,000	Digestion of high sodium ore concentrates (Sodium Removal Process)

Figure 2.1 – UF_6 Conversion Flowsheet

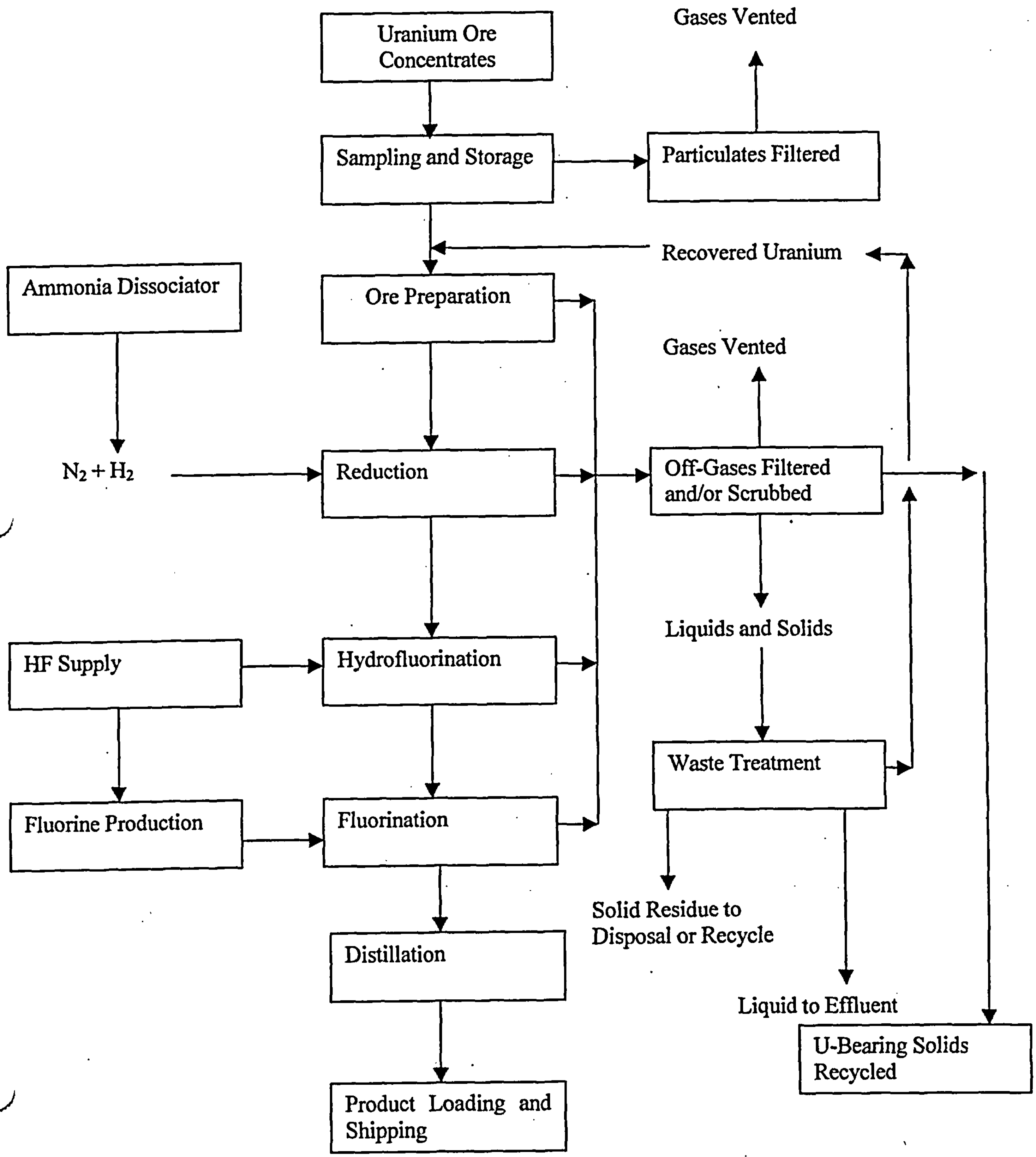
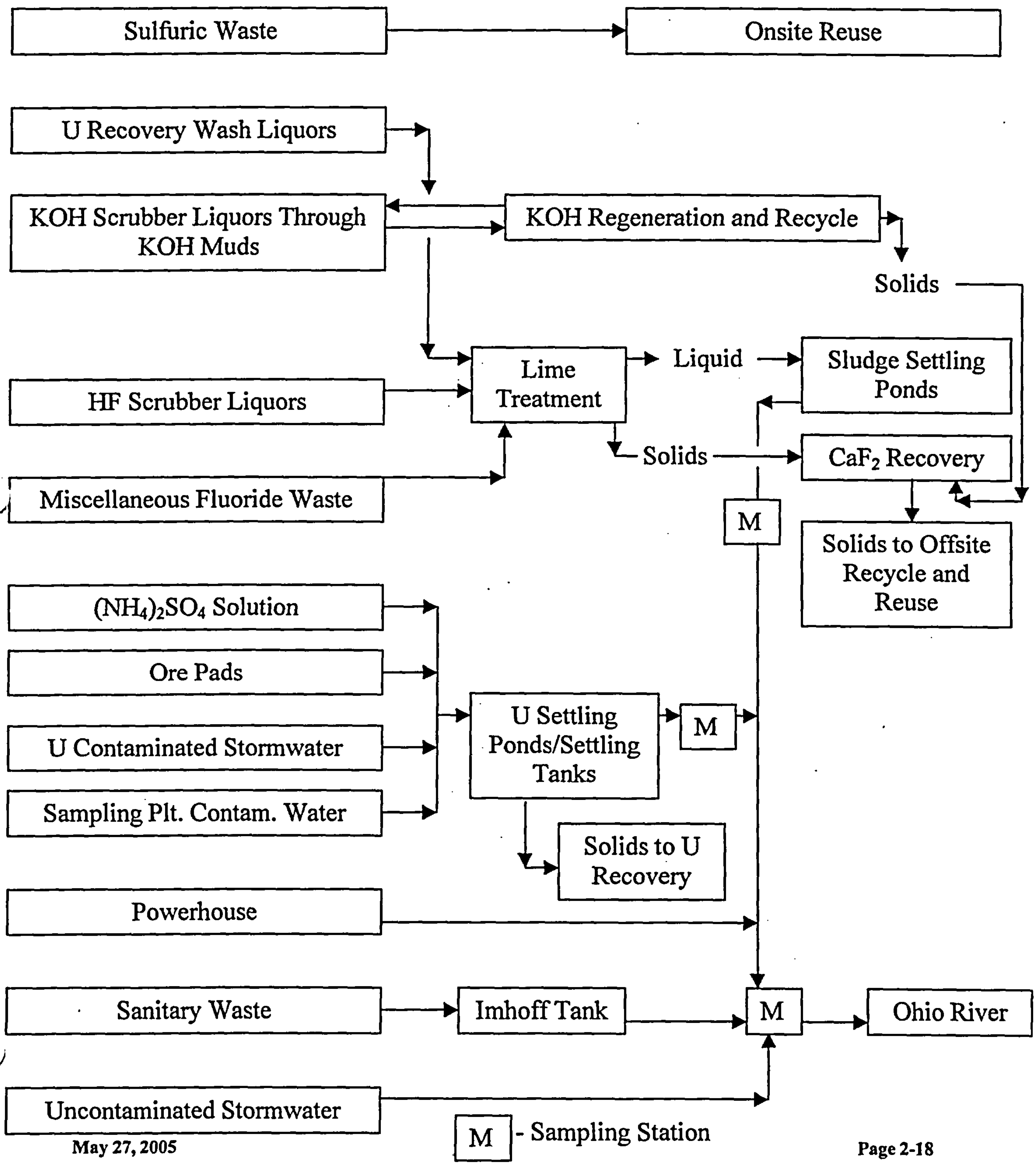


Figure 2.2 – Wastewater Disposition



3. Organization and Personnel

3.1. Organizational Responsibilities

The Metropolis UF_6 conversion plant is owned and operated by Honeywell International, Inc. Corporate Headquarters are located in Morristown, New Jersey. The top-ranking member of management at the plant site is the Plant Manager. MTW is a component of Honeywell's Specialty Chemicals business unit; the MTW Plant Manager reports to Specialty Chemicals business unit executives in Honeywell's corporate offices.

All personnel permanently assigned to the site report through a chain of command to the Plant Manager. The plant organization provides for independent lines of authority for production/maintenance functions and for safety/auditing/regulatory affairs functions. Primary responsibility for development of plant safety programs, including programs for industrial, chemical, and environmental safety, is assigned to the HSE Manager. Primary responsibility for auditing and inspection functions is assigned to the QA Manager. Primary responsibility for regulatory affairs and health physics functions is assigned to the Regulatory Affairs Manager. Primary responsibility for plant engineering, production, and maintenance functions is assigned to the Engineering, Production, and Maintenance Managers, respectively.

3.2. Organization Charts

The sections below describe the organization of the Honeywell staff and safety committees as related to safety-related responsibilities. A current organization chart has been provided as Figure 3.1.

3.3. Operating Procedures

Honeywell has established written procedures governing the development and implementation of plant technical procedures.

Technical Procedures as defined at the Honeywell facility are procedures that provide directions for and allow manipulation, maintenance, or operation of a system, component or piece of equipment. A technical procedure is classified as Standard Operating Procedure (SOP), Maintenance Procedure (MP), Abnormal Operating Procedure (AOP), Emergency Operating Procedure (EOP), and Alarm Response Procedure (ARP). While the Honeywell procedure recommends a format for maintenance procedures, all existing maintenance procedures and practices remain valid until an implementation plan to convert them into a new format is approved. Presently, the Honeywell procedure development process is concentrating on the development of operating procedures that include those technical documents which are used to direct the arrangement, manipulation or alignment of components, equipment, and systems necessary to the completion of the operations process for licensed material.

Steps in the Honeywell Technical Procedure Development Process include the following:

- Application of procedure development guidelines and determination of basis for the procedure.
- Information gathering

- Determination of procedure use classification and applicable format
- Initial review and comment
- Procedure verification
- Procedure validation
- Final Review
- Procedure Approval
- Entering approved procedure in Document Control System
- Conducting necessary training prior to implementation

The Honeywell procedure for development and implementation of technical procedures also addresses the use of temporary procedures, procedure revision and periodic review. Plant technical procedures subject to the Honeywell procedure are reviewed annually.

3.4. Functions of Key Personnel

The Source Material License Renewal Application identifies the functions, responsibilities, and authorities of key personnel.

In the event of absence, incapacitation, or other emergencies, sufficient redundancy is provided to allow for continued plant operation, including discharge of emergency response responsibilities. In the absence of the Plant Manager, one of the subordinate managers (typically the Nuclear Services Leader) will assume the Plant Manager's responsibilities. In the absence of one of the subordinate managers, the affected responsibilities will be assumed by another qualified individual, typically another manager or a subordinate supervisor.

3.5. Education and Experience of Key Personnel

Appendix B provides a summary of the qualifications of key personnel filling safety-related positions.

3.6. Training

Honeywell implements a training program that ensures unescorted personnel working on site possess the requisite knowledge to work safely and take appropriate actions in an emergency. The training is provided using a graded approach that ensures each individual receives training commensurate with the nature of the work performed and the hazards encountered.

3.6.1. Employee Initial Training and Refresher Training

Honeywell provides appropriate training to new employees before beginning work.

Training for new employees includes the following, at a minimum:

- An indoctrination in plant safety procedures, including issuance and demonstrations of proper use of personal safety equipment;
- Radiation safety training in accordance with 10 CFR 19.12 including, to the extent appropriate to the hazards, information from Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure," and Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure."
- Environmental safety training, including waste handling and disposal.

All experienced employees will be re-instructed in safety hazards and proper radiation protection procedures at "B" Council meetings. Typical radiation safety topics used in employee training include: radiological emergency planning, ALARA, air activity measurements, surface contamination, waste disposal, external dose control, dose units and limits, uranium deposition and toxicity, biological effects of radiation, respiratory protection, and employee rights and responsibilities.

3.6.2. Emergency Response Team Training

Emergency Response Team members will be trained, and receive refresher training, in accordance with the MTW Emergency Response Plan.

3.6.3. Plant Operator Training

3.6.3.1 Initial Training

Plant operators (specifically, "Chemical Operators," individuals who routinely monitor plant parameters and manipulate controls associated with licensed material processing) will be initially trained and qualified, and receive continuing training, in accordance with established plant policies and procedures. Chemical Operator Training and Qualification requirements will be specified in an appropriate qualification description document.

Chemical operators will receive specific knowledge and skills training in all areas to which they are assigned. This training typically includes the following, as appropriate to the individual's responsibilities and previous education, training, and experience:

- Basic chemical concepts and plant industrial functions
- Disciplined Operating concepts (e.g., Conduct of Operations)
- Systems Overview
- Process/Unit skills training (e.g., On-the-Job Training)
- Process Operations Procedures (e.g., startup, normal operations, and shutdown)

- Procedural process (including review, verification, validation, approval and revision)
- Temporary and emergency operations
- Alarm response and abnormal conditions
- Operating limits and safety features
- Safety and Health Hazards related to assigned work area(s)
- Emergency Response and Shutdown
- Chemical and Radiological Safe Work Practices

3.6.3.2 Chemical Operator Continuing Training

Continuing training is provided to maintain and enhance the ability of Chemical Operators to perform job assignments and to ensure facility safety and reliability.

Continuing training includes, but is not limited to:

- Fixed regulatory refresher requirements
- Items identified as requiring continuing training as a result of job/task analysis
- Changes to procedures and governing documents
- Facility/process modifications
- Industry operating experience and correction of performance problems
- Regulatory/requirements changes
- Management directives.

3.6.4. Other Training

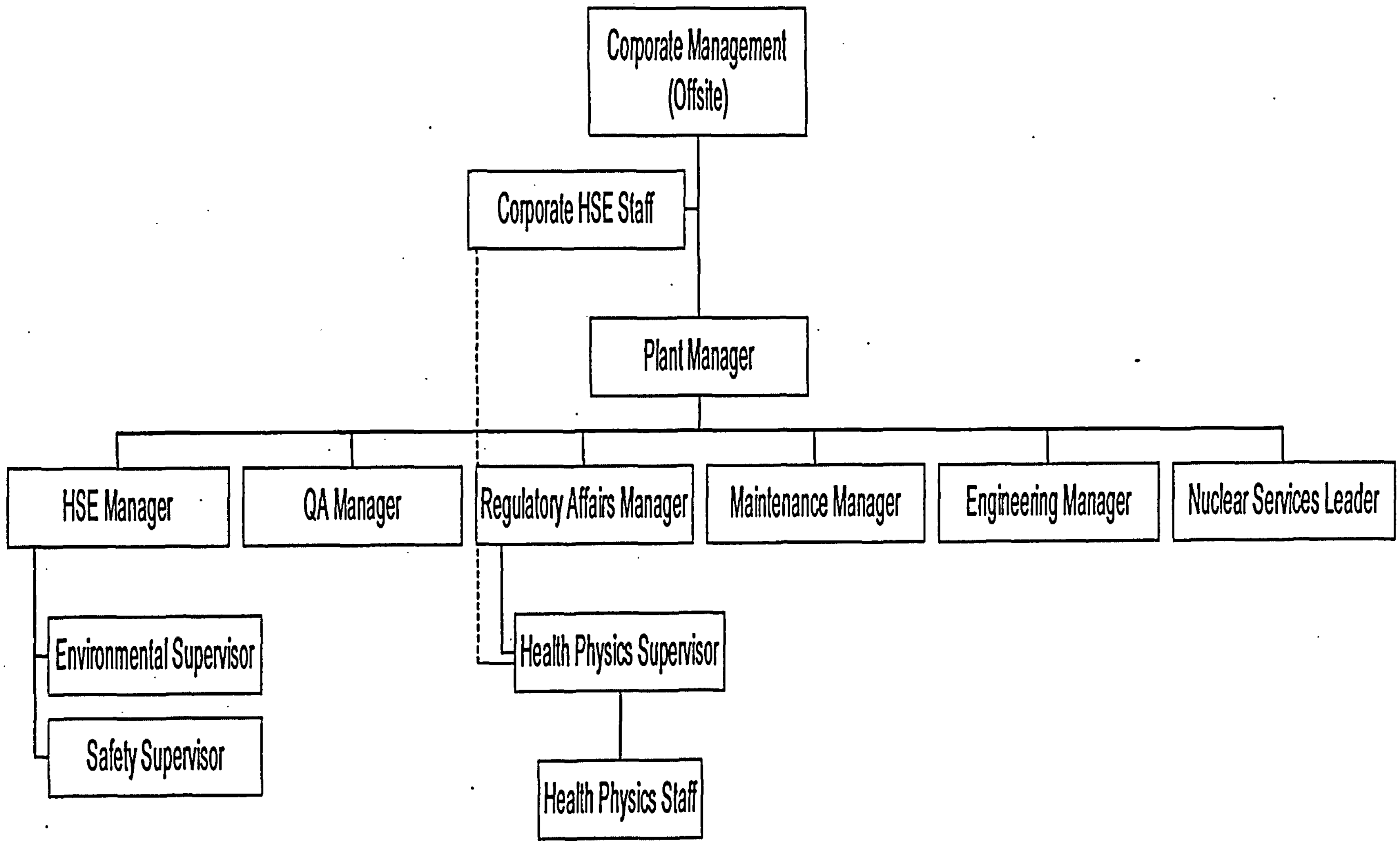
Temporary contract workers will receive the following training, to the extent appropriate to the areas entered and hazards encountered, prior to being authorized unescorted access to the restricted area:

- Radiological hazard training as required by 10 CFR 19.12 (Ref. 1);
- Chemical and industrial safety training in accordance with applicable sections of 29 CFR 1910 (Ref. 2);
- Emergency response training in accordance with the Emergency Response Plan.

For any contractor performing long-term or repetitive work in the restricted area, the indoctrination will be refreshed each year.

For unescorted railroad crews at least one employee in each switching crew will be required to have a current modified contractor's indoctrination to cover the plant hazards next to the railroad tracks.

Figure 3.1 – Honeywell Metropolis Works Organization



4. Radiation Protection

4.1. Program

Honeywell management and staff are committed to maintaining employee and environmental radiation exposures As Low As Is Reasonably Achievable (ALARA). Honeywell commits sufficient manpower, resources, and equipment to assure an effective radiation protection program. Honeywell uses NRC Regulatory Guides to identify program elements that are appropriate for a uranium conversion plant radiation protection program. The Radiation Protection Program has been developed using the following Regulatory Guides to the extent appropriate to site hazards and activities:

- 8.7 - Instructions for Recording and Reporting Occupational Radiation Exposure Data (Ref. 1)
- 8.9 - Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program (Ref. 2)
- 8.10 - Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable (Ref. 3)
- 8.11 - Applications of Bioassay for Uranium (Ref. 4)
- 8.13 - Instruction Concerning Prenatal Radiation Exposure (Ref. 5)
- 8.15 - Acceptable Programs for Respiratory Protection (Ref. 6)
- 8.25 - Air Sampling in the Workplace (Ref. 7)
- 8.29 - Instruction Concerning Risks from Occupational Radiation Exposure (Ref. 8)
- 8.30 - Health Physics Surveys in Uranium Recovery Facilities (Ref. 9)
- 8.31 - Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable (Ref. 10)
- 8.34 - Monitoring Criteria and Methods To Calculate Occupational Radiation Doses (Ref. 11)
- 8.37 - ALARA Levels for Effluents from Materials Facilities (Ref. 12)

Sections 4.2 through 4.14 provide a description of the MTW Radiation Protection Program.

4.2. Posting and Labeling

Upon consideration of the requirements of 10 CFR 20 (Ref. 13) and the guidance provided in Regulatory Guide 8.30, Honeywell has determined that its current posting practices for radiation areas and radioactive material areas are consistent with the applicable requirements and guidance. Therefore, continuation of the previous exemption from the requirements of 10 CFR 20.1902(a) and (e) is not necessary. Due to the nature, quantity, and continuous movement of licensed material processed at MTW, the affected areas consist of major portions of the restricted area. Therefore, Honeywell established a fenced restricted area and established appropriate postings for Radioactive Material Areas within the restricted area. Honeywell has not posted individual rooms or areas as radioactive material areas. The practice of posting individual rooms and areas as radioactive material

areas arising from the presence of containers of radioactive material would not be practical, nor would it provide any significant improvement in the state of radiation safety. Adequate warning regarding the hazards associated with these containers is provided by both the primary posting of Radioactive Material Area warning signs (see Section 4.2.3), which meet the requirements of 10 CFR 20.1902(e) and the guidance provided in Section 7 of Regulatory Guide 8.30, and the radiation safety training program. Therefore, Honeywell will continue its previous practice for posting of radioactive material areas, but does not believe that an exemption is necessary to ensure compliance.

4.2.1. Restricted Area

The restricted area is enclosed within a cyclone fence. Access to the restricted area is limited by the fence and Security force monitoring of the entrance points.

4.2.2. Radiation Areas

Honeywell has established conspicuous Radiation Area postings in all areas where an individual may receive a deep dose equivalent exceeding 5 mrem in any one hour. In addition, for any process equipment that emits radiation such that an individual could receive a deep dose equivalent exceeding 5 millirem in one hour at a distance of 30 centimeters from the source, Honeywell will:

- Post the process equipment "Caution - Radiation Area," and
- Establish yellow and magenta floor markings around the equipment.

Although almost any area within the restricted area may become a radiation area due to the movement of radioactive material containers, radiation monitoring efforts indicate that certain areas of the facility may have more significant external radiation hazards due to the nature of material stored or processed in that area. Honeywell believes that additional precautions are warranted to inform individuals of the hazards associated with higher radiation levels, consistent with the ALARA process. Therefore, in any area where an individual could receive a deep dose equivalent exceeding 50 millirem in one hour at a distance of 30 centimeters from the surface, Honeywell will establish additional warning devices or barriers and postings to provide a clear warning of the elevated radiation levels. Additional warning devices may include, as appropriate for the size and configuration of the area, flashing lights or audible alarms. Barriers and postings may include rope, ribbon, cable, chain, or fencing to establish the affected boundaries, accompanied by supplemental radiation area postings consistent with 10 CFR 20.1902(a).

4.2.3. Radioactive Material Areas

Honeywell's existing practice is to post the Radioactive Material Area entrances with signs bearing the radiation symbol and the words:

CAUTION

RADIOACTIVE MATERIALS

Any area or container in this plant (or "beyond this point")

may contain radioactive materials.

This practice is consistent with the guidance provided in Section 7 of Regulatory Guide 8.30.

4.2.4. Airborne Radioactivity Areas

Airborne radioactivity areas are posted as required by 10 CFR 20.1902(d). In the FMB, airborne radioactivity area postings are augmented by an installed system of flashing red lights that alert personnel to the hazard and the need to wear respirators.

4.2.5. Labeling of Radioactive Material Containers

Honeywell has requested continuation of its existing exemption from the radioactive material labeling requirements of 10 CFR 20.1904(a) as those requirements would apply to drums of natural uranium and the resulting intermediates and byproducts of uranium processing operations. Maintenance of radioactive material labels on individual containers as required by 10 CFR 20.1904(a) would not be practical due to the large quantity (thousands) of drums and the need to stack the drums close together, rendering the labels inaccessible for both observation and maintenance.

In addition, labeling of these drums would not provide any significant improvement in the state of radiation safety due to the limited radiological hazards of the radioactive material processed at MTW and the administrative controls implemented to ensure adequate employee protection.

All individuals who enter the restricted area unescorted receive appropriate radiation safety information via the area posting, the radiation safety training program, and supplemental radiological postings and warnings and are therefore informed of the presence of and hazards associated with the radioactive material present in their work areas. In the presence of these controls, labeling of individual containers would be redundant, providing no information that is not already readily accessible to affected individuals. Therefore, Honeywell believes that continuation of its exemption from the requirements of 10 CFR 20.1904(a) is justified and is consistent with the ALARA process.

4.2.6. High Radiation Areas

High radiation areas will be posted in accordance with 10 CFR 20.1902(b) and controlled in accordance with 10 CFR 20.1602.

4.3. External Radiation – Personnel Monitoring

4.3.1. External Radiation Monitoring Protocols

Each individual working in a uranium processing area within the restricted area is issued and required to wear an individual monitoring device; thermoluminescent dosimeters (TLDs) are currently used. The capabilities of the current TLDs are as follow:

- TLD Type: TLD-760 (Li-F)
- Minimum Reportable Dose: 10 mrem
- Lower Limit of Detection: 6 mrem
- Useful dose Range: 10 mrem to 1000 RAD
- Energy response: 0.766 MeV to 5 MeV Beta, 5 KeV to 6 MeV photon

A commercial service holding National Voluntary Laboratory Accreditation Program (NVLAP) accreditation provides analysis services. The vendor supplies new TLDs on a quarterly basis for salaried employees and monthly for hourly employees and contractors. The vendor is instructed to notify Health Physics of any whole body exposure exceeding 125 millirem during the month or 375 millirem during the quarter. An investigation is conducted to determine the source of the exposure.

4.3.2. Use of Results for Operational Planning

The nature of the work performed at the plant involves an essentially continuous process involving low-hazard radioactive material, negating the need for complex entry control and access tracking systems. The results of worker dosimeter processing tend to be relatively stable over long periods of time. As a result, external dosimetry results have limited utility with regard to operational planning. However, external dosimetry results may be correlated to an individual's primary work function, and in some instances locations, and provide insight into those processes and areas having the greatest impact of external radiation doses. This information is reviewed by the ALARA Committee and provides a useful input into planning processes.

4.4. Radiation Surveys

Honeywell will conduct routine gamma radiation surveys consistent with the guidance provided in Section 2.4 of Regulatory Guide 8.30, e.g., quarterly within known radiation areas and semi-annually in other areas where radioactive materials are used, processed, or stored. The results of these surveys will be used to identify areas requiring posting, changes in radiological conditions, and areas where personnel dosimeters may be required. Radiation survey results will also be used as an input to the ALARA Program.

Honeywell conducts investigative beta-gamma instrument surveys when a process or procedural change is made that could result in a significant increase in employee exposure. Exposure rates and occupancy factors are appropriately utilized to determine if additional

precautions are needed. Additionally, each time a radioactive material vessel is entered for inspection or repairs (confined space entry), a radiation survey is conducted by Health Physics and appropriate employee protection is specified utilizing time, distance and shielding considerations. Airborne radioactivity surveys are also periodically performed in radioactive material vessels (primarily baghouses) to assure the specified respiratory protection is adequate for worker protection. Section 4.13 provides additional information on the airborne radioactivity monitoring program. Section 4.14 provides additional information on the surface contamination monitoring program.

4.5. Reports and Records

4.5.1. Radiation Exposure Records

Records related directly to radiation exposure of employees or members of the public are retained until NRC authorizes disposition. These records include:

- Personnel and environmental TLD dosimetry results
- Bioassay results (urinalysis and whole body counts)
- Environmental measurements (air, soil, vegetation and water)
- Unusual events reportable to NRC (overexposures, excessive concentrations, etc.)

4.5.2. Records Supporting Exposure Records

Records that relate indirectly to employee or environmental exposure are maintained a minimum of five (5) years; a summary report is prepared prior to disposal. These records include:

- Contamination survey results
- Daily workroom air activity measurements
- Daily gaseous and liquid effluent measurements
- Fence line air sampling data
- Health Physics incident reports

4.5.3. Other Records and Reports

The following reports and records are maintained a minimum of five (5) years:

- NRC Inspection Reports
- ALARA Meeting Minutes
- Quarterly Health Physics Audit Reports
- Semi-annual Radiological Environmental Report
- Health Physics Instrument Calibrations
- Employee Training Records

- Management Assurance Program Documentation
- Investigations of unusual events

4.6. Instruments

4.6.1. Health Physics Instruments

The natural uranium processed in the plant is primarily an alpha emitter; however, the uranium and uranium daughters emit sufficient beta-gamma radiation to provide an alternate method for measuring contamination. Radiological monitoring instruments for external radiation, surface contamination, and monitoring of effluents have been selected to be appropriate for the type, range, and energies of the emitted radiations.

Alpha counting is the primary method utilized for analyzing airborne radioactivity, removable contamination, and daily stack filter control samples. Beta-gamma measurements are used for direct surface contamination measurements and smear measurements of transport vehicles and packages. Beta-gamma Geiger counters are typically used for equipment surveys and confined space entry surveys. Thin window beta-gamma survey meters are utilized for personnel monitoring to assure maximum sensitivity measurement on personnel exiting the plant. Both gross alpha and gross beta counts are performed on liquid effluent samples.

Kinetic Phosphorescence Analyzer (KPA) analysis for uranium is a very sensitive analytical method and may be used to confirm the alpha counting methods utilized in the plant. Sufficient instrumentation and back-ups are maintained to assure an effective Health Physics monitoring capability. Instruments routinely used in radiological monitoring activities are shown in Table 4-1.

The thin window, scintillation, and IPC counters are calibrated using a certified U_3O_8 source. Exposure rate meters are calibrated using a Cs^{137} sealed source. Appropriate check sources are also available to monitor instrument response during use. In the event measurements are required which are beyond the capabilities of plant instrumentation, an outside vendor is utilized to perform the analysis.

Health Physics instrumentation is stored primarily in the plant Health Physics facility. Instrument calibration is performed by trained Health Physics technicians.

4.6.2. Health Physics Facilities

The Health Physics facilities include:

- Office space for HP supervisors and technicians;
- Dedicated laboratory space and fume hoods as needed for preparation and radiological analyses of samples, including smears, bioassay samples and air samples;
- Space for performance of quantitative respirator fit testing;

- Space for performance of instrument calibration, sealed radioactive source storage, and instrument storage.

4.7. Protective Clothing

Protective clothing available for personnel performing routine work in the restricted area includes lab coats, shoe covers, coveralls, and gloves. Honeywell requires the use of this clothing in designated areas. This clothing is manufactured consistent with conventional industrial clothing practice and provides sufficient protection against routine exposure to dry particulate contamination.

Additional protective clothing and equipment is required for maintenance operations that could potentially expose the employee to hazardous chemicals during line breaking or other potentially hazardous activities. Equipment required for each job is specified in the Supervisor's Safety Manual, Job Safety Analysis sheet, or on the Work Permit authorizing the activity. The equipment utilized meets the requirements of the NIOSH "Certified Personal Protective Equipment List."

Protective equipment utilized under accident conditions also meets the requirements of the "Certified Personal Protective Equipment List." In addition, appropriate personnel are trained in the use of specific emergency equipment that may be utilized by the plant Emergency Response Team or in responding to a major UF_6 release as outlined in the Emergency Response Plan.

4.8. Administrative Control Levels, Including Effluent Control

4.8.1. Airborne Effluent Monitoring Program

A comprehensive environmental air monitoring program is conducted to demonstrate compliance with applicable environmental air quality standards. The environmental air monitoring program consists of taking continuous air samples (low volume) at four points along the restricted area fence line (Stations No. 9, 10, 12, and 13). Two samplers are located near the site boundary in the prevailing wind direction (Stations No. 8 and 11). One sampler is located off-site approximately one mile downwind of the FMB (Station No. 6). An additional continuous air sampler is located at the location of the nearest downwind residence (Station NR-7). See Drawing No. MTW-4781 (Enclosure 1).

Each low volume (No. 6, 8, 9, 10, 11, 12, and 13) sample filter is changed weekly and analyzed for uranium and fluoride content. Results are reported as µCi/ml uranium and $\mu g/m^3$ fluoride. Additionally, a quarterly composite of the 13 weekly samples is sent to a vendor analytical laboratory for Ra^{226} and Th^{230} analysis. Weekly samples obtained at the nearest resident (NR-7) sample station are analyzed for uranium (µCi/ml). In addition, quarterly composites of the weekly (NR-7) samples are analyzed by a vendor laboratory for Ra^{226} and Th^{230}.

Quarterly simulated lung fluid solubility tests are also run on the NR-7 sample to determine the biological half-life of uranium collected during the quarter. The site-

specific data collected from Station NR-7 are used to calculate compliance with 40 CFR 190 requirements.

The lower limit of detection using these methods is <1E^{-16} μCi/ml for uranium, <3E^{-9} μCi/ml for Ra^{226} and <5E^{-9} for Th^{230}.

4.8.2. Liquid Effluent Monitoring Program

Compliance with applicable effluent release limits and water quality criteria is determined by sampling the plant effluent discharge and the Ohio River (discussed in Chapter 5), which is the receiving stream for plant effluents.

The main plant effluent is continuously sampled and a daily composite is analyzed for uranium content. The daily samples are composited into a monthly composite sample, which is analyzed for uranium and several non-radiological constituents. Quarterly composites of the monthly samples are analyzed by a vendor laboratory for Ra^{226} and Th^{230}. Effluent water samples are also collected in accordance with conditions prescribed in the plant NPDES permit.

The lower limits of detection for water samples is <0.001 ppm for uranium and <2E^{-10} μCi/ml for Ra^{226} and Th^{230}, respectively.

Results from the Radiological Environmental Monitoring Program (air and water) are reviewed weekly by Health Physics. The environmental information is utilized to perform trend analysis. Undesirable trends are reported to Plant Management via ALARA meetings, quarterly Health Physics audits, or immediately depending on the severity of the condition. Appropriate information from the monitoring program is also utilized to prepare the Semi-Annual Effluent Report required by NRC regulations.

4.8.3. Compliance Methods for 40CFR Part 190

The site-specific analytical data collected at the nearest residence sampling station (NR-7) is used to calculate the nearest resident radiation dose in conjunction with dose conversion factors provided in Federal Guidance Report No. 11 (Ref. 14). The dose factors assume a particle size of 1 AMAD and vary by solubility, in accordance with the Federal Guidance Report.

For dose calculation purposes, 100% occupancy is assumed for the nearest resident. $Radium^{226}$ is taken to be class "W" solubility in accordance with ICRP-30 and $Thorium^{230}$ is assumed to be class "Y" solubility.

The quarterly dose to the nearest resident is derived by combining air concentration and solubility with dose factors from Federal Guidance Report No. 11 as follows:

Dose (mrem/qtr.) = Air Concentration (μCi/cc) (Note 1)
X Annual Breathing Rate (Note 2)
X Solubility Fraction (Note 3)
X Dose Conversion Factor
X 1000 (mrem/Rem)
X 0.25 (¼ of year)

Note (1): Natural uranium concentration is factored by

Isotopic composition:

U^{234} - 0.48877

U^{238} - 0.48877

U^{235} - 0.02245

Note (2): The annual breathing rate is taken to be 8.32 E^9cc, based upon 16 hours non-occupational @ 9600 L/8 hrs. and 8 hrs. resting @ 3600 L/8 hrs.

Note (3): The solubility fraction found from simulated lung fluid testing, "D", "W", or "Y".

Repetitive calculations are performed for each significant isotope according to the solubility and air concentration measured. The 50-year dose commitments calculated from plant gaseous emissions are shown in Chapter 5. In addition, the EPA computer program "COMPLY" is used to model stack emissions for calculation of the nearest resident dose.

4.9. Respiratory Protection

Individuals are required to carry emergency-use respirators (half-face respirators) when entering certain buildings. Experience indicates that extended periods of respirator usage are unlikely. Airborne radioactivity areas may be created during maintenance activities and following process equipment breakdowns that result in area contamination. An in-plant administrative level of 30% of the applicable Derived Air Concentration (DAC) (averaged over any four samples on the floor) or any single sample exceeding 1 DAC is used as the air activity level at which respirators are required (for other than incidental entry). Airborne radioactivity areas may also be posted as a precaution during activities having the potential to release airborne contamination. Flashing red lights, area posting, and written instructions are used to ensure employees wear respirators in airborne radioactivity areas until such time that air sampling indicates the air activity in the area has been reduced below the administrative level.

The Respiratory Protection Program is implemented in accordance with 10 CFR 20 and Regulatory Guide 8.15. Each potentially-exposed employee is given an annual quantitative respirator fit test. The employee is informed which mask size and model provides the greatest protection factor. Only NIOSH-certified respiratory equipment is utilized. Each new employee is fitted and instructed in the proper fitting of respirators and in positive/negative pressure field tests for respirator function immediately prior to use. These instructions and fitting procedures are repeated annually for all potentially-exposed employees.

When conditions indicate that the protection provided by a half-face respirator may be inadequate, respiratory equipment is used which will provide the individual greater protection factors, such as a full-face canister, airline mask, or self-contained breathing apparatus, as appropriate. This respiratory protective equipment is available at strategic locations throughout the plant for immediate use. For purposes of computing individual exposures to airborne radioactivity, respiratory protection factors used are in accordance with the recommendations contained in NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials," (Ref. 15) and Regulatory Guide 8.15.

At the end of each shift, used respirators are deposited in a designated receptacle, collected, disassembled, and cleaned. Each cartridge is checked for radioactivity using a beta-gamma probe to detect low levels of activity. All parts of the used respirator except the cartridges are then washed, disinfected, rinsed, dried, and packaged prior to re-issue. Respirator facepieces are surveyed to ensure removable alpha contamination levels are less than 100 $dpm/100cm^2$, consistent with Section 2.10 of Regulatory Guide 8.30.

4.10. Occupational Exposure Analysis

4.10.1. External Dosimetry Historical Results

Historical data and plant operating experience indicate employees are unlikely to receive an annual total effective dose equivalent of more than 500 mrem. Employees working in the ore concentrate sampling plant, or other jobs where close contact with uranium or its daughter products occur, are most likely to receive higher than average exposures.

Table 4-2 shows the occupational doses recorded during the most recent 10-year period (1995-2004). Three hundred eighty one (381) exposures of more than 500 mrem have been measured during the last 5 years of plant operation. The percentage of employees at background radiation level has varied from approximately 30% to 75% of the plant population.

Table 4-3 provides an analysis of historical occupational doses (TEDE) segregated by dose range. Table 4-4 provides a similar analysis for deep dose equivalents.

4.10.2. Internal Exposure

Results from the routine urinary uranium sampling program for the five year period from 2000 through 2004 are shown in Table 4-5. Special urinary uranium samples are also obtained following exposure to a UF_6 release or other work in uranium-

bearing vessels. The data from these samples are presented in Table 4-6. As might be expected, exposures from specific incidents are somewhat higher. Each of these incidents was investigated and documented.

4.11. Measures Taken to Implement ALARA

4.11.1. ALARA Commitment

MTW's ALARA Program consists of multiple features and activities and is consistent with the guidance provided in Regulatory Guide 8.10. Features of the ALARA Program include:

- Management commitment, demonstrated through a written policy statement, procedures, and other directives.
- Formal program audits, conducted on at least an annual basis.
- Well-supervised and defined radiation protection capability, including appropriate supervisors and technicians. All personnel on site have the authority to stop work as needed to ensure appropriate safety precautions are observed.
- Appropriate training for the workforce, including training consistent with the requirements of 10 CFR 19.12 and incorporating appropriate portions of the guidance provided in Regulatory Guides 8.13 and 8.29.
- Appropriate authority vested in HP personnel, including stop work authority and authority for HP Supervisors to communicate with corporate-level HSE personnel as needed.
- Consideration of the need for plant modifications as warranted to reduce personnel doses at reasonable costs.

4.11.2. ALARA Committee

The MTW ALARA Committee consists of key members of plant management, supervision, and the workforce and meets at least once each calendar quarter. Membership of the ALARA Committee includes:

- The Plant Manager;
- Selected Department Managers;
- The Regulatory Affairs Manager;
- The Health Physics Supervisor; and
- Selected supervisors and hourly personnel.

The scope of the ALARA Committee's activities include:

- Reviewing site radiological operating performance on a quarterly basis;
- Reviewing operations and exposure records to determine where exposures may be reduced;
- Reviewing employee training, and methods for utilizing information on-the-job to keep exposure ALARA; and
- Reviewing potential modifications of procedures and equipment when changes will reduce exposure at reasonable cost.

The ALARA Committee uses the guidance provided in Regulatory Guides 8.10 and 8.37 for formulating plant operating philosophy in reducing exposures.

4.11.3. Results of ALARA Program Implementation

Examples of ALARA trend charts utilized by the committee are shown in Appendix A. Undesirable trends are corrected to assure an NRC reportable incident does not result. Appendix A also discusses examples of ALARA Committee initiatives.

4.12. Bioassay Program

The plant bioassay program consists of routine and special urinary uranium sampling for evaluation of employee exposure to the natural uranium compounds processed in the plant. The program utilizes guidance provided in Regulatory Guides 8.9 and 8.11. Intakes are calculated using the methodology provided in NUREG/CR-4884, "Interpretation of Bioassay Measurements," (Ref. 16), in conjunction with the computer program "INDOS" developed by Skrable Enterprises Inc.

Hourly employees are required to leave a routine urine sample twice monthly following a 24-96 hour absence from work. Salaried personnel who routinely work inside uranium processing areas are sampled monthly. Contractor personnel are sampled based on an evaluation of their work activities. The routine sampling schedule is appropriately adjusted to allow for vacations, illnesses, etc.

Special urinary uranium samples are collected following confined space entries, (e.g., baghouses), where the air concentrations may exceed DAC; and following a UF_6 release, if employees have been exposed. In addition, employees are encouraged to submit urine samples at the end of a work shift following a suspected exposure to airborne uranium to determine if an exposure has actually occurred. Follow-up special samples are obtained if results exceed the evaluation level.

The Kinetic Phosphorescence Analyzer (KPA) is used for analysis of urinary uranium. The urinary uranium evaluation level is 15 µg/L; employees whose urinary excretion rate exceeds the evaluation level are re-sampled for confirmation. The urinary uranium investigation level is 60 µg/L; if an employee's urinary excretion rate exceeds the investigation level, the intake is investigated and daily urinary uranium samples are normally obtained until the results are less than the evaluation level. Work restrictions are considered if the bioassay data indicate the intake exceeds 30% of the annual limit on

intake (ALI) for mixed solubility material ("Y", "W", and "D"). Work restrictions are imposed if results indicate the weekly intake limit (10 mg) for class "D" uranium or the ALI has been exceeded.

Employees exposed to highly soluble UF_6 as a result of unplanned workplace releases are required to submit two (2) special urine samples within the first 24 hours following exposure, usually at 3-6 hours post-exposure, and 16-20 hours post-exposure. The action level for these samples is 200 µg/L and work restrictions are imposed if it appears the 10 mg weekly limit for soluble uranium may be exceeded. Daily sampling is continued until the concentration is less than 15 µg/L.

Whole body counting will be performed by an outside contractor if, based on urinalysis results, a Class "Y" intake could result in a committed effective dose equivalent exceeding 5 Rem. Work restrictions and whole body counting are considered if bioassay data indicate the intake could exceed 30% of the appropriate ALI for the material of exposure.

Results from the four most recent years of bioassay sampling are provided in Section 4.10, "Occupational Exposure Analysis."

The bioassay evaluation level of 15 µg/L and investigation level of 60 µg/L correspond to 2% and 10%, respectively, of the ALI (annual limit on intake) as defined in 10 CFR 20. If the chemical compound to which the employee was exposed is known, the corresponding evaluation level may be used; however, if the exposure compound is not known, UF_4 will be used as the compound of choice in accordance with the ALARA concept. The urinary uranium concentrations are rounded to correspond with previously established plant databases. Exposure to UF_6 is limited by chemical toxicity to the kidney rather than annual radiation dose (10 CFR 20.1202(e)). The value of 35 µg/L represents the urinary uranium concentration that would be expected in urine at 14 days after an unknown intake of 10 mg of uranium, which is the weekly intake limit. It is extremely unlikely an unknown exposure to UF_6 could occur in the plant due to the highly visible "smoke" produced by a small quantity of UF_6. Special bioassay samples are required following a UF_6 release.

Routine whole body counting does not appear to be a useful method for measuring exposures to the more soluble natural uranium compounds to which employees may be exposed. Whole body counting does appear useful as an additional investigative method for employees exposed to Class "Y" natural uranium. Acute exposures are readily detected from excretion of the Class "D" component in conjunction with incident investigation of air activity, and employee interviews to determine the solubility of the intake material.

4.13. Air Sampling and Internal Exposure Program

The primary control utilized in the plant for maintaining internal exposures ALARA is confinement of source material within process vessels. Extensive air sampling provides an indication of degradation in the confinement systems and during these occasions respiratory protection is utilized by employees working in the affected area.

There are currently fifty-six (fixed) continuous work area samplers in the FMB (eight on each floor), three in the Sodium Removal facility, two in the drum dumping area, and ten in the Sampling Plant. Each fixed breathing zone sampler is located approximately five feet

above the floor and consists of: a 25 mm open-face filter holder; fiberglass or membrane particulate filter; flow meter; and associated fittings for connection to a central sample vacuum system. The sampling rate used is 40 SCFH, which is approximately equal to "standard man" respiration rate. Employee lapel samples are taken at least once per year to ensure the fixed air sample results provide a reliable indication of actual workplace conditions and may also be used in specific exposure evaluations.

The sampling filters from all air sampling points are changed, counted for alpha-emitting radionuclides, and reported daily. However, during periods of abnormal operating conditions (visible spills or leaks), the sample filters in the affected area are changed after the upset is corrected and the area decontaminated of visible contamination. Respirators are required for potentially-exposed employees during this period. The sample filters are then changed at two-hour intervals until analytical results indicate the air activity is less than 30% of the DAC. Respirator requirements are then removed. In addition, employees are encouraged to submit urine samples at the end of a work shift following a suspected exposure to airborne uranium to determine if an exposure has actually occurred.

The respirator action level of 30% of DAC is calculated to be $5.0E^{-11}$ μCi/ml by assuming the exposure is to UF_4 (32% D, 68% Y). This is a conservative action level because most exposures are to uranium ore concentrates or UF_6, which would produce a higher calculated action level. If the average activity on any floor in the FMB is greater than 30% of DAC, or any four (4) of eight individual air samples exceeds 30% of DAC, the entire floor is posted for precautionary use of respirators and an informal investigation is conducted by the Production Foreperson and Health Physics department to correct the problem. If any single air sample is greater than DAC ($1.7E^{-10}$ μCi/ml for UF_4), an investigation is initiated by the Production Foreperson with support from Health Physics.

Employee urinary uranium results (See Sec. 4.12, Bioassay Program) are periodically compared to air sampling data. Reasonable agreement is obtained during normal operations.

4.14. Surface Contamination

4.14.1. Area Designations

For purposes of contamination monitoring and control, areas within the restricted area are designated as follows:

Controlled Areas: Plant areas in which uranium is processed and could be present in unencapsulated form.

Intermediate Areas: Production areas for non-radioactive fluorine based chemicals, and plant support facilities.

Uncontrolled Areas: Plant areas where food may be consumed, locker rooms, and entrance/exit areas from the plant.

Surface contamination will be identified by a combination of routine visual observation (not normally documented unless related to a specific unplanned event) and swipe surveys. Table 4-7 provides the area designations, action levels, and

swipe survey frequencies. Section 4..6 provides information addressing surface contamination survey instruments.

4.14.2. Actions Upon Discovery of Contamination Exceeding Action Levels

If any area is found to have removable contamination levels exceeding the removable contamination action level specified in Table 4-7, the Shift Foreman is notified so that decontamination efforts can be completed.

Follow-up surveys are conducted following area decontamination.

4.15. References

1. Regulatory Guide 8.7, Revision 1, *Instructions for Recording and Reporting Occupational Radiation Exposure Data*, USNRC, June 1992
2. Regulatory Guide 8.9, Rewvision 1, *Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program,* USNRC, July 1993
3. Regulatory Guide 8.10, Revision 1R, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable,* USNRC, May 1977
4. Regulatory Guide 8.11, *Applications of Bioassay for Uranium,* USNRC, June 1974
5. Regulatory Guide 8.13, Revision 3, *Instruction Concerning Prenatal Radiation Exposure,* USNRC, June 1999
6. Regulatory Guide 8.15, Revision 1, *Acceptable Programs for Respiratory Protection,* USNRC, October 1999
7. Regulatory Guide 8.25, Revision 1, *Air Sampling in the Workplace,* USNRC, June 1992
8. Regulatory Guide 8.29, Revision 1, *Instruction Concerning Risks from Occupational Radiation Exposure,* USNRC, February 1996
9. Regulatory Guide 8.30, Revision 1, *Health Physics Surveys in Uranium Recovery Facilities*, USNRC, May 2002
10. Regulatory Guide 8.31, Revision 1, *Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable,* USNRC, May 2002
11. Regulatory Guide 8.34, *Monitoring Criteria and Methods To Calculate Occupational Radiation Doses,* USNRC, July 1992
12. Regulatory Guide 8.37, *ALARA Levels for Effluents from Materials Facilities,* USNRC, July 1993
13. Title 10, Code of Federal Regulations, Part 20, *Standards for protection against radiation,* USNRC, as amended

14. Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, USEPA, September 1988

15. NUREG/CR-4884, *Interpretation of Bioassay Measurements*, USNRC, June 1987

16. NUREG-0041, *Manual of Respiratory Protection Against Airborne Radioactive Materials,* USNRC

Table 4-1 – Radiological Monitoring Instruments

Type (Minimum Number)	Use	Sensitivity	Range	Calibration Frequency
Geiger Mueller Count Rate Meter (5)	Personnel and material exit monitoring	Beta/Gamma > 40 KeV	0-50,000 CPM	Quarterly
Exposure Rate Meters (3)	Exposure Rates	Beta/Gamma	0-5 rem/hr	Quarterly
Scintillation Alpha Counter (1)	Surface Contamination, Air Filters	Alpha	0 - 1E6 CPM	Monthly
Internal Proportional Counter (1)	Air Filters, Surface Contamination	Alpha/Beta	0 - 1E6 CPM	Quarterly
Kinetic Phosphorescence Analyzer (KPA) (1)	Uranium analysis	Uranium	1 ppb (upper range determined by analytical techniques)	As needed (based on performance monitoring)
Portable air samplers (2)	Grab air sampling	NA	NA	Monthly
Lapel Air samplers/monitors (3)	Breathing zone air sampling	NA	NA	Before use

Table 4-2 – Collective Dose History – 1995 - 2004			
	DDE rem	CEDE rem	TEDE rem
1995	42.04	143.43	185.47
1996	45.65	189.8	235.45
1997	47.95	172.08	220.031
1998	54.504	143.972	198.476
1999	39.513	20.732	60.245
2000	50.809	19.013	69.822
2001	50.791	73.521	124.312
2002	41.36	118.19	159.55
2003	34.454	85.307	119.761
2004	44.0	99.8	143.8

Table 4-3 – Total Effective Dose Equivalent Distribution 2000 - 2004					
DOSE RANGE * (REMS)	2000**	2001	2002	2003	2004
NO MEASURABLE EXPOSURE	31	13	7	9	17
< 0.100	131	61	8	46	82
0.100 - 0.250	87	95	62	110	174
0.250 - 0.500	59	97	139	129	156
0.500 - 0.750	20	49	57	38	44
0.750 - 1.000	14	21	36	21	19
1.000 - 2.000	3	17	24	12	6
2.000 – 2500	0	0	0	0	0
TOTALS	345	353	333	365	498

Table 4-4 – External Dose Monitoring Results					
DOSE RANGE * (REMS)	**2000**	**2001**	**2002**	**2003**	**2004**
NO MEASURABLE EXPOSURE	63	68	70	121	116
< 0.100	151	158	152	137	258
0.100 - 0.250	58	49	48	62	71
0.250 - 0.500	48	51	44	35	46
0.500 - 0.750	17	18	16	8	6
0.750 - 1.000	7	7	3	2	1
1.000 - 2.000	1	2	0	0	0
TOTALS	345	353	333	365	498

Table 4-5						
ROUTINE URINARY URANIUM DATA						
		Number and Percent of Samples				
Ug/L U		2000	2001	2002	2003	2004
<5.0	Number of Samples	6328	5594	5177	5597	6555
	% Samples	98%	89%	83%	89%	91%
5.0 --15.0	Number of Samples	122	679	940	642	565
	% Samples	2%	11%	15%	10%	8%
15.0 – 60.0	Number of Samples	12	32	82	27	68
	% Samples	0.2%	0.5%	1.3%	0.4%	0.9%
>60.0	Number of Samples	1	2	2	0	1
	% Samples	0.02%	0.03%	0.03%	0	0.01%
Total Routine		6463	6307	6201	6266	7189

Table 4-6						
SPECIAL URINARY URANIUM DATA						
		Number and Percent of Samples				
Ug/L U		2000	2001	2002	2003	2004
<5.0	Number of Samples	105	182	98	158	260
	% Samples	88.2%	73%	43%	49%	66%
5.0 --15.0	Number of Samples	11	33	102	125	107
	% Samples	9.2%	13%	44%	39%	27%
15.0 -- 60.0	Number of Samples	3	22	25	33	28
	% Samples	2.5%	9%	11%	10%	7%
>60.0	Number of Samples	0	13	5	4	1
	% Samples	0.0	5%	2%	1.3%	0.3%
Total Special		119	250	230	320	396

Table 4-7 –Surface Contamination Control		
Uncontrolled Areas	**Intermediate Areas**	**Controlled Areas**
Removable Contamination Action Level: 200 dpm/100 cm^2 (alpha)	Removable Contamination Action Level: 200 dpm/100 cm^2 (alpha)	Removable Contamination Action Level: 5,000 dpm/100 cm^2 (alpha)
Survey Frequency: Weekly	Survey Frequency: Quarterly	Survey Frequency: Monthly
Admin Building 1st Floor	Laboratory	Feed Materials Building
Construction Gate Building	Maintenance Shop	U Recovery and NaR Building
	Fluorine Plants	KOH Muds Building
Lab Library	SF6 Building	Sampling Plant
Main Lunchroom	Power House	Cylinder Wash Building
Sampling Plant Lunchroom	CFx Building	Ore Storage Building
Storehouse Office Area	Storehouse	Drum Dumper Building
Locker Rooms	Admin Building 2nd Floor	Drum Crusher Building
FMB Control Room	Safety/Laundry	
U Rec. and NaR Cont. Room	EPF Area	
KOH Muds Bldg. Cont. Room	HP Offices	
Maintenance Offices		
Production Offices Building		
Capital Engr/CLC Offices		
Maintenance Engr. Offices		
HP Building		
Fluorine Plant Control Room		
Purchasing Offices		
Admin Bldg. Laundry		
Sampling Plant TQ Room		
SF6 Control Room		
CFx Control Room		
Powerhouse Control Room		
Fluorine Plant Office Trailer		
The Dispensary is considered to be an uncontrolled area and shall be surveyed daily on normal workdays (Monday-Friday).		

5. Environmental Safety – Radiological and Non-Radiological

5.1. Nearest Resident Inhalation Dose

Analytical data collected at the nearest residence sampling station (NR-7) during the most recent four years of operation (2000 - 2003) are shown in Table 5-1. These site-specific data are used to calculate the nearest resident inhalation dose in conjunction with dose conversion factors provided from the COMPLY computer code. A one (1) micron particle size is assumed and dose conversion factors from Federal Guidance Report No. 11 are used to calculate the Committed Effective Dose Equivalent (CEDE) from one year of intake for the nearest residence. The doses calculated for the nearest resident are provided in Table 5-2.

5.2. Stack Emissions

MTW's stack emissions from the plant during the four year period have been modeled using EPA's COMPLY computer code to predict the inhalation and ingestion dose at the location of the nearest resident. The highest committed effective dose equivalent calculated using the COMPLY program was 2.2 mrem in 2002. The COMPLY computer program assumes that 100% of the food source is locally grown.

5.3. Direct Radiation Monitoring

Direct radiation is continuously monitored using environmental TLDs. An environmental TLD is located on or adjacent to the restricted area fence on each side of the plant, one badge is located at the nearest property boundary, one is located at the Metropolis Airport approximately one mile NE of the facility and two are located at the nearest residence (see Drawing No. MTW-4781 (Enclosure 1). The badges are exchanged quarterly for analysis by a vendor laboratory.

The environmental TLD monitoring results for the years 2000 through 2003 are shown in Tables 5-3, 5-4, 5-5, and 5-6. The maximum annual average gamma radiation dose occurred at the east and south restricted area fences, due to ore concentrate and waste storage areas immediately adjacent to the monitoring locations. The maximum annual dose for the four-year period was 495 mrem at the East Fence location and 412 mrem at the South Fence location. Background radiation levels at the airport averaged 93 mrem/year during the four-year period. Measurements taken at the nearest residence averaged 91 mrem/year during the four-year period. It appears that dose measured at the nearest residence is not significantly different from that at the airport, and is within the expected range of natural background radiation.

5.4. Environmental Air Monitoring

The environmental air monitoring program consists of taking continuous air samples (low volume) at four points along the restricted area fence line (Stations No. 9, 10, 12, and 13). Two samplers are located near the site boundary in the prevailing wind direction (Stations No. 8 and 11). One sampler is located off-site approximately one mile downwind of the FMB (Station No. 6). An additional continuous air sampler is located at the nearest residence (NR-7).

The concentrations of uranium found in environmental air samples during the years 2000 – 2003 are shown in Table 5-7. The maximum annual average concentration measured at the fence line during the four year period (Stations 9, 10, 12, and 13) was $3.94E^{-14}$ µCi/ml at Station 13 during 2001.

The quarterly air sample concentrations of Ra^{226} and Th^{230} are shown in Table 5-8. The maximum annual average concentration at the restricted area fence line was $8.48E^{-17}$ µCi/cc for Ra^{226} during 2000 and $2.98E^{-16}$ µCi/cc for Th^{230} during 2003.

Environmental air sample results for fluoride (µg/m^3) are presented in Table 5-9. During the most recent four years of plant operation, the average concentration at the fence line was .227 µgF$^-$/m^3. The maximum annual concentration near the site boundary was 0.838 µg/m^3 during 2002 at Station No. 10.

5.5. Wastewater Monitoring

Compliance with applicable effluent release limits and water quality criteria is determined by sampling the plant effluent discharge and the Ohio River, which is the receiving stream for plant effluents.

The analytical data provided in Table 5-10 indicates the maximum annual gross alpha activity occurred in 2000 and was 0.102 pCi/ml. The maximum annual beta concentration was 0.201 pCi/ml in 2001. Experience indicates the majority of the beta activity results from the presence of Th^{234} in the effluent. The maximum annual average uranium concentration was 0.262 ppm in 2000.

In 2004, the average discharge rate for the plant effluent was approximately 3.42 million gallons per day. The effluent discharges into a natural watercourse, which also carries run-off during periods of heavy precipitation. The effluent travels about 2,000 feet across Honeywell property before it enters the Ohio River. The quantity of effluent discharged is insignificant compared to the annual mean flow of the Ohio River, which has ranged from 118,900 to 465,500 cubic feet per second. Under these conditions, the contaminants discharged would not be expected to be detectable after mixing with the river and should have no significant environmental impact.

5.6. Environmental Water and Mud Sampling

Environmental water and mud samples are taken semi-annually from four locations on the Ohio River and at three area lakes and ponds. These samples are analyzed for uranium and fluoride content to determine any potential impact of plant operation. Refer to Figure 5.1 for location of water, mud, soil, and vegetation sampling locations.

Environmental water samples collected from the Ohio River during the most recent four year period of plant operation are shown in Table 5-11. During the most recent four-year period, the river concentration of uranium and fluoride upstream of the plant discharge (Brookport Dam) averaged 0.865 ppm fluoride and 0.004 ppm uranium. Downstream concentrations at Joppa, Illinois averaged 0.816 ppm F^- and 0.019 ppm uranium. Joppa is the nearest downstream municipality that could (but does not) use river water for drinking purposes. The State of Kentucky, which owns the Ohio River, limits fluoride in drinking

water (401 KAR 5:031), at the point of withdrawal, to 1 ppm F^-. Thus, the plant effluent is not providing a significant contribution to background concentrations of these contaminants in the Ohio River, and downstream concentrations are less than drinking water standards.

Analysis of mud samples (bottom sediment) for uranium and fluoride (see Table 5-12) indicate there is some deposition of both uranium and fluoride in river sediment at the point of effluent discharge into the river. With the exception of the area around the plant effluent discharge point, results for uranium appear uniform for all sampling stations. Fluoride concentrations in sediment are generally higher downstream compared to upstream. There are no established standards for uranium or fluoride in stream sediments; however, the off-site concentrations fall within the concentration range of many naturally occurring materials, e.g., Florida phosphate rock contains up to 200 ppm U, and some United States soils contain up to 300 ppm F^- to plow depth (6").

Sediment samples are also collected semi-annually from the effluent ditch at points 700 feet and 1400 feet downstream of the plant effluent sampling station. These samples have been analyzed for uranium and fluoride content since 1985. 'Analytical results from the most recent four-year period are shown in Table 5-13.

5.7. Environmental Soil and Vegetation Samples

Additional environmental soil and vegetation samples are also collected semi-annually. Six sample stations are located on-site at the same location of the low volume air samplers. Seven additional stations are located off-site in the surrounding areas of Illinois and Kentucky covering a radius of about eight miles from the plant. Refer to Figures 5.1 and 5.2, respectively, for location of on-site and off-site stations. Each sample is analyzed for uranium and fluoride content.

Table 5-14 shows the results for uranium and fluoride in soil during the years 2000 - 2003. The four-year off-site average concentration of uranium in soil is 1.77 ppm. On-site uranium in soil concentrations averaged 20.97 ppm during the four-year period.

Off-site fluoride in soil concentrations averaged 10.03 ppm and on-site averaged 12.86 ppm during the four-year period. These concentrations are not considered significant because many agricultural soils contain greater concentrations of fluoride due to annual application of super phosphate fertilizer which contains about 1-3% fluoride. About 90% of the applied fluoride in fertilizer may accumulate in the soil. Fluorides in soil often are, or rapidly become, relatively insoluble forms that are not readily available to plants grown on the soil. Fluoride accumulation in forage plants is thus more indicative of environmental impact than soil concentration.

Table 5-15 provides concentrations of fluoride and uranium in vegetation for the years 2000 - 2003. The off-site concentrations averaged 24 ppm "F", and 2.92 ppm "U" during the four-year period. The on-site concentrations are significantly higher than off-site; however, these areas are inside the MTW property boundary and under licensee control. The on-site concentration of fluoride in vegetation (68.6 ppm) may be compared to the State of Kentucky limit (401 KAR 53:010) which allows a 40 ppm average during a 6-

month growing season, 60 ppm as a 2-month average, or 80 ppm as a 1 month average. Although the plant species collected for fluoride analysis could be considered cattle forage, the plant does not allow cattle grazing on the property.

5.8. Summary

Table 5-16 provides a summary of the effluent and environmental monitoring programs.

Table 5-1 – Nearest Residence Air Sampling Data							
YEAR	CONCENTRATION			PART. SIZE	SOLUBILITY FRACTION		
	U(NAT)μCi/cc	Ra^{226} μCi/cc	Th^{230} μCi/cc	AMAD	"D"	"W"	"Y"
1st Qtr. 2000	$2.09E^{-14}$	$2.75E^{-16}$	$1.62E^{-17}$	1	0.716	0.284	
2nd Qtr. 2000	$2.84E^{-14}$	$1.65E^{-17}$	$3.96E^{-16}$	1	0.752	0.248	
3rd Qtr. 2000	$1.04E^{-14}$	$1.62E^{-17}$	$1.62E^{-17}$	1	0.608	0.392	
4th Qtr. 2000	$9.50E^{-15}$	$1.88E^{-17}$	$1.88E^{-17}$	1	0.434	0.569	
1st Qtr. 2001	$1.24E^{-14}$	$2.80E^{-16}$	$6.65E^{-16}$	1	0.530	0.470	
2nd Qtr. 2001	$3.72E^{-14}$	$1.49E^{-16}$	$5.61E^{-16}$	1	0.591	0.407	
3rd Qtr. 2001	$1.33E^{-14}$	$1.81E^{-17}$	$1.27E^{-16}$	1	0.515	0.488	
4th Qtr. 2001	$1.13E^{-14}$	$4.00E^{-17}$	$2.00E^{-17}$	1	0.644	0.356	
1st Qtr. 2002	$8.82E^{-15}$	$1.62E^{-17}$	$5.36E^{-16}$	1	0.731		0.269
2nd Qtr. 2002	$6.26E^{-15}$	$1.63E^{-17}$	$1.63E^{-17}$	1	0.956	0.044	
3rd Qtr. 2002	$5.46E^{-15}$	$2.59E^{-16}$	$7.93E^{-16}$	1	0.287	0.713	
4th Qtr. 2002	$7.68E^{-15}$	$1.66E^{-17}$	$1.66E^{-17}$	1	0.646	0.354	
1st Qtr. 2003	$9.34E^{-15}$	$1.62E^{-17}$	$1.20E^{-15}$	1	0.619	0.381	
2nd Qtr. 2003	$1.05E^{-14}$	$3.34E^{-17}$	$4.34E^{-16}$	1	0.588	0.412	
3rd Qtr. 2003	$5.48E^{-15}$	$1.63E^{-17}$	$9.05E^{-15}$	1	0.704	0.296	
4th Qtr. 2003	$8.22E^{-14}$	$1.07E^{-16}$	$6.29E^{-15}$	1	0.879		0.121

Table 5-2 - Nearest Residence Dose - 2000-2003

YEAR	COMPLY EDE mRem(1)
2000	0.70
2001	0.70
2002	2.20
2003	1.60

(1) Effective Dose Equivalent (Inhalation + Ingestion)

Table 5-3 - ENVIRONMENTAL GAMMA DOSE MEASUREMENTS
ANNUAL DOSE (mRem) - 2000

Location	TLD #	Detection	Annual Dose (mRem)* 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average mRem
Control		ENV TLD	96	96	96	72	90
North Fence	9001	ENV TLD	168	172	168	156	166
East Fence	9002	ENV TLD	756	652	684	740	708
South Fence	9003	ENV TLD	236	216	204	196	213
West Fence	9004	ENV TLD	120	112	124	100	114
North Boundary	9005	ENV TLD	124	112	124	112	118
Airport	9006	ENV TLD	108	84	92	80	91
NR-7 A NORTH	9007	ENV TLD	92	92	100	84	92
NR-7 SOUTH	9008	ENV TLD	100	84	92	80	89

*Annual Dose in mRem determined from vendor's mRem/quarter X 4 quarters

Table 5-4 - ENVIRONMENTAL GAMMA DOSE MEASUREMENTS ANNUAL DOSE (mRem) - 2001							
Location	TLD #	Detection	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average mRem
Control		ENV TLD	84	84	92	76	84
North Fence	9001	ENV TLD	160	160	164	148	158
East Fence	9002	ENV TLD	684	656	544	528	603
South Fence	9003	ENV TLD	200	260	412	468	335
West Fence	9004	ENV TLD	112	108	108	100	107
North Boundary	9005	ENV TLD	112	116	116	112	114
Airport	9006	ENV TLD	96	88	88	92	91
NR-7 A NORTH	9007	ENV TLD	92	88	84	80	86
NR-7 SOUTH	9008	ENV TLD	96	84	84	84	87

*Annual Dose in mRem determined from vendor's mRem/quarter X 4 quarters

No control exposures have been subtracted, and only element, reader and fade corrections have been made.

Table 5-5 - ENVIRONMENTAL GAMMA DOSE MEASUREMENTS ANNUAL DOSE (mRem) - 2002							
Location	TLD #	Detection	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average mRem
Control		ENV TLD	88	136	92	88	101
North Fence	9001	ENV TLD	200	164	180	184	182
East Fence	9002	ENV TLD	496	352	328	324	375
South Fence	9003	ENV TLD	568	496	520	536	530
West Fence	9004	ENV TLD	128	116	120	116	120
North Boundary	9005	ENV TLD	144	124	128	128	131
Airport	9006	ENV TLD	108	92	92	96	97
NR-7 A NORTH	9007	ENV TLD	116	80	96	96	97
NR-7 SOUTH	9008	ENV TLD	108	84	84	100	94
*Annual Dose in mRem determined from vendor's mRem/quarter X 4 quarters							
No control exposures have been subtracted, and only element, reader and fade corrections have been made.							

Table 5-6 - ENVIRONMENTAL GAMMA DOSE MEASUREMENTS
ANNUAL DOSE (mRem) - 2003

Location	TLD #	Detection	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average mRem
Control		ENV TLD	84	92	92	76	86
North Fence	9001	ENV TLD	180	168	180	168	174
East Fence	9002	ENV TLD	304	264	312	296	294
South Fence	9003	ENV TLD	584	552	560	576	568
West Fence	9004	ENV TLD	124	112	116	100	113
North Boundary	9005	ENV TLD	128	124	128	124	126
Airport	9006	ENV TLD	100	88	96	88	93
NR-7 A NORTH	9007	ENV TLD	104	96	92	80	93
NR-7 SOUTH	9008	ENV TLD	92	96	88	76	88

*Annual Dose in mRem determined from vendor's mRem/quarter X 4 quarters

No control exposures have been subtracted, and only element, reader and fade corrections have been made.

Table 5-7 - ENVIRONMENTAL AIR MONITORING
Uranium (μCi/cc) Annual Average

	SAMPLE STATION NUMBER						
YEAR ANNUAL AVERAGE	6	8	9	10	11	12	13
2000	1.89 E^{-15}	2.29 E^{-14}	1.32 E^{-14}	2.45 E^{-14}	1.93 E^{-14}	1.59 E^{-14}	4.21 E^{-15}
2001	2.23 E^{-15}	2.06 E^{-14}	1.83 E^{-14}	2.50 E^{-14}	2.30 E^{-14}	1.33 E^{-14}	3.94 E^{-14}
2002	1.40 E^{-15}	1.12 E^{-14}	9.13 E^{-15}	1.99 E^{-14}	1.01 E^{-14}	8.59 E^{-15}	2.05 E^{-15}
2003	5.73 E^{-15}	1.41 E^{-14}	6.51 E^{-15}	9.77 E^{-15}	1.65 E^{-14}	1.40 E^{-14}	3.05 E^{-14}

Sample Locations:

• No. 6	5300 Ft. NNE (Metropolis Airport)	• No. 11	1250 Ft. N of UF_6 Bldg.
• No. 8	1035 Ft. NE of UF_6 Bldg.	• No 12	655 Ft. SSE of UF_6 Bldg.
• No. 9	775 Ft. NNW of UF_6 Bldg.	• No 13	755 Ft. NE of UF_6 Bldg.
• No. 10	950 Ft. SW of UF_6 Bldg.		

Table 5-8 - ENVIRONMENTAL AIR MONITORING
Ra^{226} and Th^{230} (μCi/cc) Annual Average

	SAMPLE STATION NUMBER													
YEAR	6		8		9		10		11		12		13	
	Ra^{226}	Th^{230}	Ra^{226}	Th^{230}	Ra^{226}	Th^{230}	Ra^{226}	Th^{230}	Ra^{226}	Th^{230}	Ra^{226}	Th^{230}	Ra^{226}	Th^{230}
2000	$3.83E^{-18}$	$9.22E^{-18}$	$8.48E^{-17}$	$2.08E^{-17}$	$3.82E^{-18}$	$4.17E^{-17}$	$1.24E^{-17}$	$1.07E^{-16}$	$6.69E^{-18}$	$3.12E^{-17}$	$7.64E^{-18}$	$7.81E^{-17}$	$5.74E^{-18}$	$7.72E^{-17}$
2001	$1.72E^{-17}$	$6.69E^{-18}$	$9.54E^{-18}$	$8.58E^{-17}$	$7.64E^{-18}$	$2.29E^{-17}$	$8.59E^{-18}$	$5.44E^{-17}$	$1.05E^{-17}$	$3.15E^{-17}$	$1.34E^{-17}$	$1.35E^{-17}$	$7.65E^{-18}$	$5.74E^{-17}$
2002	$3.82E^{-18}$	$1.72E^{-17}$	$3.82E^{-18}$	$1.43E^{-17}$	$3.82E^{-18}$	$2.29E^{-17}$	$1.25E^{-17}$	$8.72E^{-17}$	$3.81E^{-18}$	$2.38E^{-17}$	$7.73E^{-18}$	$1.63E^{-17}$	$3.81E^{-18}$	$3.60E^{-17}$
2003	$6.19E^{-17}$	5.95^{-17}	$8.87E^{-18}$	$2.98E^{-16}$	$5.57E^{-18}$	$2.35E^{-16}$	$8.60E^{-18}$	$1.52E^{-16}$	$7.68E^{-17}$	$2.94E^{-16}$	$8.80E^{-18}$	$2.79E^{-16}$	$4.68E^{-18}$	$2.93E^{-16}$

Sample Locations:

• No. 6	5300 Ft. NNE (Metropolis Airport)	• No. 11	1250 Ft. N of UF_6 Bldg.
• No. 8	1035 Ft. NE of UF_6 Bldg.	• No 12	655 Ft. SSE of UF_6 Bldg.
• No. 9	775 Ft. NNW of UF_6 Bldg.	• No 13	755 Ft. NE of UF_6 Bldg.
• No. 10	950 Ft. SW of UF_6 Bldg.		

Table 5-9 - ENVIRONMENTAL AIR MONITORING Fluoride (μg/m³) Annual Average							
	SAMPLE STATION NUMBER						
YEAR ANNUAL AVERAGE	6	8	9	10	11	12	13
2000	0.014	0.072	0.262	0.526	0.179	0.131	0.119
2001	0.021	0.110	0.591	0.661	0.299	0.134	0.172
2002	0.022	0.125	0.651	0.838	0.341	0.109	0.197
2003	0.005	0.090	0.131	0.228	0.084	0.068	0.187

Table 5-10 - Liquid Effluent Contaminants (Annual Average)					
Contaminant in mg/L	**2000**	**2001**	**2002**	**2003**	**2004**
Chromium	0.005	0.005	0.004	0.005	0.003
Iron	0.125	0	0	0	0.005
Molybdenum	0.077	0.046	0.059	0.028	0.021
Nickel	0.018	0.006	0.007	0.003	0.005
Phosphate as "P"	0.047	0.08	0.038	0.052	0.046
Total Solids	784	652	666	632	577
Uranium	0.262	0.155	0.101	0.098	0.094
Uranium (Range of Values)	0.13 - 0.55	0.07 - 0.211	0.04 - 0.21	0.04 - 0.15	0.04 - 0.318
Vanadium	0.001	0.004	0.003	0.002	0.003
Gross Radioactivity in pCi/ml	**2000**	**2001**	**2002**	**2003**	**2004**
Radioactivity, Alpha	0.102	0.05	0.039	0.034	0.021
Radioactivity, Alpha (Range of Values)	0.0 - 0.2	0.01 - 0.12	0.02 - 0.06	0.01 - 0.08	0.01 - 0.04
Radioactivity, Beta	0.179	0.201	0.17	0.186	0.158
Radioactivity, Beta (Range of Values)	0.0 - 0.34	0.04 - 0.74	0.03 - 0.27	0.0 - 0.39	0.0 - 0.35

Table 5-11 - ENVIRONMENTAL SURFACE WATER SAMPLES
Uranium & Fluoride (ppm) Annual Average

	SAMPLE STATION NUMBER													
YEAR	(A) Lamb Farm*		(B) TVA (1)		(C) Plant Site Outflow (2)		(D) Brookport Dam (3)		(E) Joppa Power Plant (4)		(F) Lindsay Lake		(G) Oak Glenn Lake	
	U	F	U	F	U	F	U	F	U	F	U	F	U	F
2000	0.005	0.89	0.007	0.64	0.145	4.95	0.011	0.66	0.013	0.59	0.016	0.63	0.008	0.71
2001	0.060	0.62	0.011	0.55	0.031	0.770	0.004	0.60	0.057	0.565	0.005	0.535	0.005	0.505
2002	0.006	0.93	0.001	0.90	0.040	1.57	0.001	0.950	0.003	0.950	0.004	1.02	0.001	0.830
2003	0.001	1.9	0.001	1.4	0.012	2.18	0.001	1.25	0.002	1.16	0.001	1.13	0.0005	1.08

*Lamb farm pond filled in Fall 1989. Sample collected in another pond ~ ¼ mile from Lamb farm.

Sample Locations	
No. (1)	Ohio River opposite plant outflow
No. (2)	Ohio River at plant flow
No. (3)	Ohio River, 7 miles upstream, at Lock and Dam No. 52
No. (4)	Ohio River, 5 miles downstream at Joppa, Illinois

Table 5-12 - ENVIRONMENTAL MUD SAMPLES
Uranium & Fluoride (ppm) Annual Average

YEAR	SAMPLE STATION NUMBER													
	(A) Lamb Farm*		(B) TVA (1)		(C) Plant Site Outflow (2)		(D) Brookport Dam (3)		(E) Joppa Power Plant (4)		(F) Lindsay Lake		(G) Oak Glenn Lake	
	U	F	U	F	U	F	U	F	U	F	U	F	U	F
2000	1.99	5.85	1.07	16.83	4.30	81.34	0.73	21.13	0.88	23.0	1.79	7.65	0.93	15.16
2001	4.03	6.25	3.38	12.91	5.4	21.31	2.78	13.20	1.27	16.99	1.84	6.11	8.85	5.82
2002	1.60	15.55	0.80	20.87	4.53	54.87	0.54	21.36	0.51	19.89	0.78	9.73	1.04	13.01
2003	0.72	4.49	0.24	6.57	0.65	15.24	0.18	7.44	0.25	8.15	0.61	4.05	1.35	3.72

Sample Locations:	
No. (1)	Ohio River opposite plant outflow
No. (2)	Ohio River at plant flow
No. (3)	Ohio River, 7 miles upstream, at Lock and Dam No. 52
No. (4)	Ohio River, 5 miles downstream at Joppa, Illinois

Table 5-13 - ENVIRONMENTAL MUD SAMPLES EFFLUENT DITCH
Uranium & Fluoride (ppm)

	YEAR ANNUAL AVERAGE									
LOCATION	2000		2001		2002		2003		4 YEAR AVERAGE	
	U	F	U	F	U	F	U	F	U	F
700 Ft.	3.88	75.78	19.17	235.06	8.09	72.34	4.26	24.95	8.85	102.03
1400 Ft.	192.5	2276.9	112.79	9229.62	173.43	11899.81	200.42	9083.05	169.79	8122.35

Table 5-14 – ENVIRONMENTAL SOIL SAMPLES
Uranium & Fluoride (ppm)

	YEAR ANNUAL AVERAGE									
LOCATION	2000		2001		2002		2003		4 Year Average	
	U	F	U	F	U	F	U	F	U	F
(A) Lamb Farm*	1.94	12.56	1.52	6.1	2.36	27.92	1.38	4.41	1.8	12.75
(B) Brubaker Farm	1.65	8.34	2.61	4.55	3.08	13.40	0.66	3.74	2.0	7.51
(C) Texaco Station	1.82	26.39	2.42	4.76	2.24	11.28	0.65	3.44	1.78	11.47
(D) IL Power Equip Station	1.56	8.67	1.77	4.90	4.53	25.43	1.17	3.83	2.26	10.71
(E) Reiniking Property	1.81	28.43	1.43	5.21	1.19	10.82	0.90	3.42	1.33	11.97
(F) Metropolis Airport	3.42	16.02	1.33	4.78	3.61	10.26	0.90	3.03	2.31	8.52
(G) Maple Grove School	1.06	11.15	1.23	4.77	0.80	10.38	0.49	2.91	0.90	7.30
#8 NE Feed Mat'l. Bldg.	17.79	18.92	16.78	11.44	14.45	11.74	11.22	3.65	15.06	11.44
#9 W Feed Mat'l. Bldg.	15.55	17.46	12.1	7.76	14.45	12.30	5.05	4.42	11.79	10.49
#10 S Feed Mat'l. Bldg.	14.80	39.12	10.11	11.32	40.64	14.41	3.23	3.95	17.20	17.20
#11 N Feed Mat'l. Bldg.	24.83	12.63	30.01	7.1	12.06	13.33	12.56	3.94	19.87	9.25
#12 E Feed Mat'l. Bldg.	4.77	14.01	13.20	15.89	12.38	10.72	3.75	3.84	8.53	11.12
#13 NE Feed Mat'l. Bldg.	74.91	30.69	86.46	15.58	18.86	17.32	33.29	7.15	53.38	17.69
(A) – (G) Offsite Avg.	1.89	15.94	1.76	5.01	2.54	15.64	0.88	3.54	1.77	10.03
(8) – (13) On Site Avg.	25.44	22.14	28.11	11.52	18.81	13.30	11.52	4.49	20.97	12.86

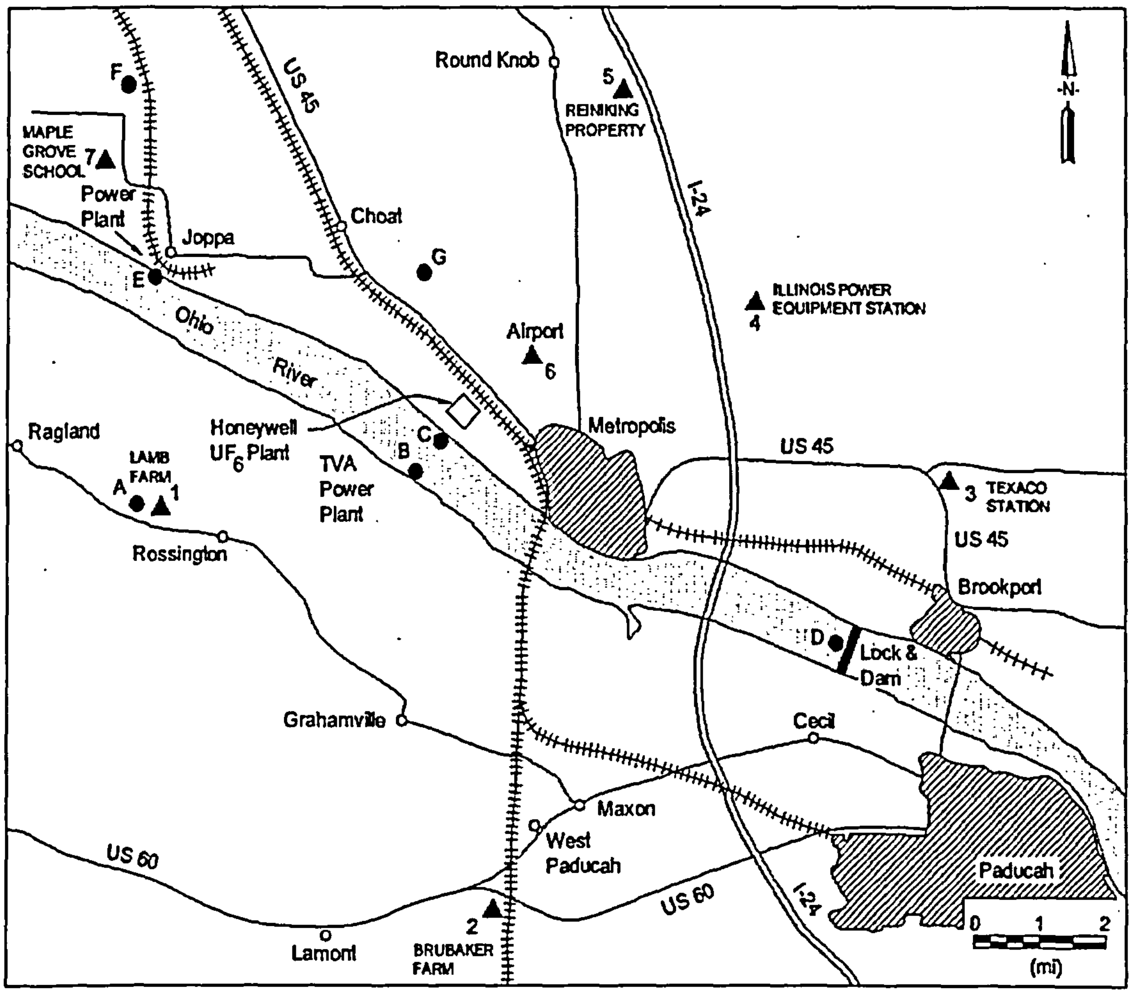
Table 5-15 - ENVIRONMENTAL VEGETATION SAMPLES
Uranium & Fluoride (ppm) Annual Average

	YEAR ANNUAL AVGERAGE									
LOCATION	2000		2001		2002		2003		4 Year Average	
	U	F	U	F	U	F	U	F	U	F
(A) Lamb Farm*	6.31	23	10.60	22.87	1.66	35.84	1.24	26.69	4.95	27.1
(B) Brubaker Farm	6.75	10.8	14.69	22.33	1.61	31.26	0.63	23.67	5.92	22.02
(C) Texaco Station	3.22	10.45	1.63	22.65	2.11	35.26	1.86	21.96	2.21	22.58
(D) IL Power Equip Station	2.22	8.45	5.91	22.46	2.06	28.36	0.75	19.92	2.74	19.80
(E) Reiniking Property	1.75	24.65	7.98	40.79	1.06	33.5	0.83	22	2.91	30.24
(F) Metropolis Airport	1.25	13.55	0.80	20.67	1.09	42.88	0.58	20.60	0.93	24.43
(G) Maple Grove School	0.93	14.85	0.58	22.34	0.73	28.79	1.01	21.39	0.81	21.84
#8 NE Feed Mat'l. Bldg.	2.13	20.9	4.76	60.02	3.26	157.79	2.09	29.23	3.06	66.99
#9 W Feed Mat'l. Bldg.	2.54	30	2.97	54.49	5.47	53.22	0.90	27.79	2.97	41.38
#10 S Feed Mat'l. Bldg.	6.18	124.3	8.83	152.82	14.56	92.39	1.17	41.18	7.69	102.67
#11 N Feed Mat'l. Bldg.	8.69	34.15	11.02	48.70	1.94	111.5	1.33	29.71	5.75	56.02
#12 E Feed Mat'l. Bldg.	4.59	24.05	5.78	32.72	4.91	45.24	3.58	28.10	4.72	32.53
#13 NE Feed Mat'l. Bldg.	15.95	62.65	7.23	106.14	2.52	234.2	3.47	45.06	7.29	112.01
(A) – (G) Offsite Avg.	3.20	15.11	6.03	24.87	1.47	33.70	0.99	22.32	2.92	24
(8) – (13) On Site Avg.	6.68	49.34	6.77	75.82	5.44	115.72	2.09	33.51	5.25	68.60

Table 5-16 - Summary Of Effluent And Environmental Monitoring Programs[a]

Sample Medium	Number of Stations	Analytical Frequency	Sample Type	Type of Analysis[b]
Onsite				
Air	6	Quarterly	Continuous	Uranium, Ra-226, Th-230, Fluoride
Soil	6	Semiannually	Grab	Uranium, fluoride
Vegetation	6	Semiannually	Grab	Uranium, fluoride
Ambient Radiation	4	Quarterly	Continuous	Gamma
Surface water	1	Monthly Monthly	Continuous Continuous	Uranium, gross alpha, gross beta Suspended solids, dissolved solids, pH, fluorides, other chemicals (see Table 2.12)
Sediment	2	Semiannually	Grab	Uranium, fluoride
Offsite				
Air	2	Weekly	Continuous	Uranium,Ra-226, Th-230, fluoride
Soil	7	Semiannually	Grab	Uranium, fluoride
Vegetation	7	Semiannually	Grab	Uranium, fluoride
Ambient radiation	2	Quarterly	Continuous	Gamma
Surface water	7	Semiannually	Grab	Uranium, fluoride
Sediment	7	Semiannually	Grab	Uranium, fluoride

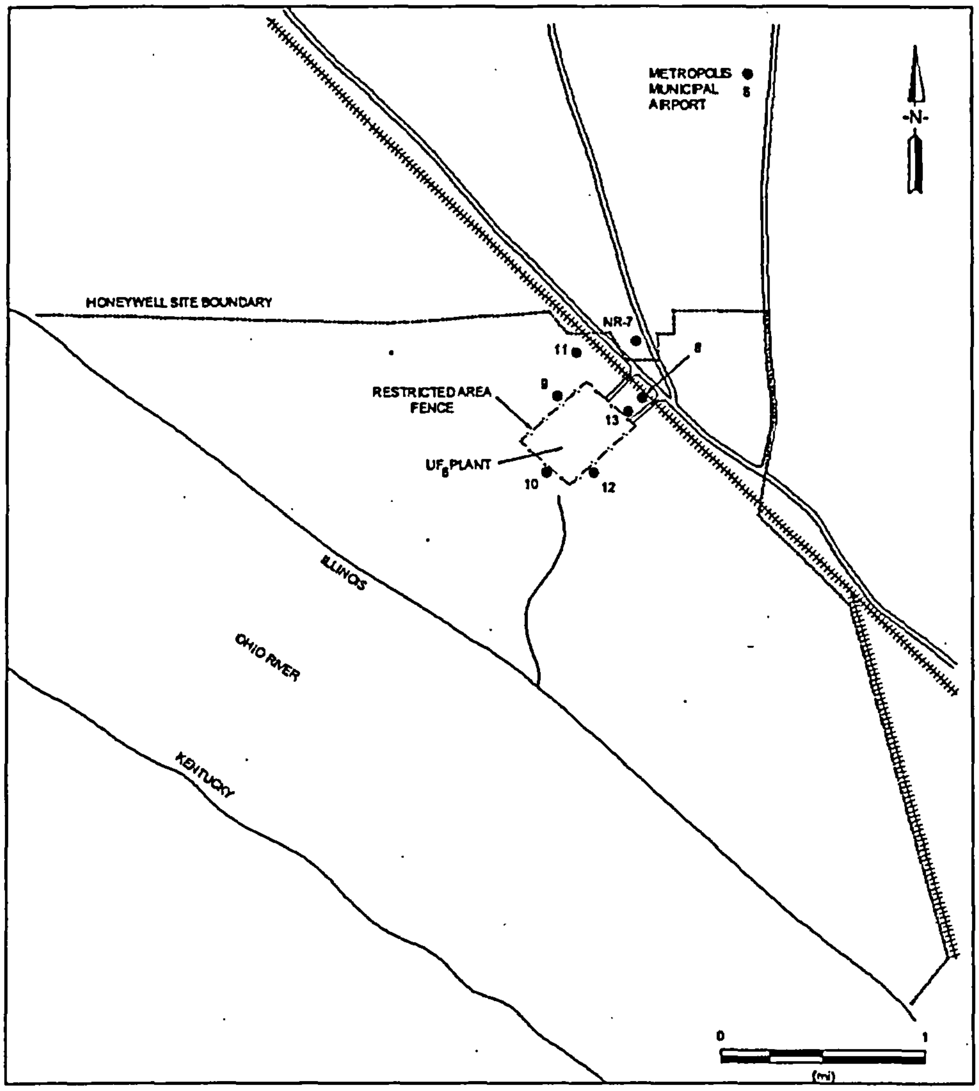
Figure 5.1 – Off-Site Sample Points



● Surface Water and Sediment (Mud) Samples ▲ Soil and Vegitation Samples

A	Lamb Farm	1	Lamb Farm
B	TVA	2	Brubaker Farm
C	Plant Site Outflow	3	Texaco Station
D	Bookport Dam	4	Illinois Power Equipment Station
E	Joppa Power Plant	5	Reiniking Property
F	Lindsay Lake	6	Metropolis Airport
G	Oak Glenn Lake	7	Maple Grove School

Figure 5.2 – Environmental Air Sampling Stations



6. Process Description and Safety Analyses

6.1. Process Steps and Flowsheets

Most of the uranium processing equipment is housed in the seven-story (six floors above ground) FMB where essentially all of the steps in the UF_6 conversion process are conducted. Process Flow Diagrams for the major processes are provided in Enclosure 1, including the following:

MTW-A2307 – Sodium Removal Flow Diagram for IEPA Air Permit

MTW A4868 – Sampling Plant Auger System Equipment Layout

MTW 3401 - Ore Preparation Process Flow Diagram

MTW 3393 –Process Flow Diagram – Green Salt

MTW 3392 – Fluorination Flow Diagram

MTW 3010 - Piping and Instrumentation Diagram – UF6 Distillation

MTW 3438 – Process Flow Diagram – EPF Acid Neutralization and Base Regeneration Units

MTW 3341 - CaF2 Recovery Process Flow Diagram

All major plant equipment is of standard chemical plant design and construction. The major UF_6 conversion vessels are fabricated in accordance with ASME codes, ANSI Standards, and chemical industry practices.

6.1.1. Sampling and Storage

The plant receives uranium ore concentrates (in 55-gallon drums) from uranium mills via rail car or common carrier (truck). The uranium ore concentrates are sampled in the Sampling Plant (except hard or wet ore) to obtain statistically-significant analytical samples in accordance with ASTM standards. Each lot of concentrates is weighed, and stored on storage pads until accountability procedures and the uranium and impurity analyses are completed.

6.1.2. Pre-treatment Facility

Some ore concentrates and uranium compounds from the uranium recovery processes contain undesirable contaminants that must be minimized before the concentrates are converted into UF_6. The method of pretreatment used is a two-stage sulfuric acid leach followed by ammonia precipitation. After precipitation, the uranium bearing solids are settled and filtered into the calciner of the Ore Preparation section.

The pretreatment facility is also equipped to process ore concentrates which have absorbed moisture or become hard. These drums cannot be processed through the normal drum dumping station.

6.1.3. Ore Concentrate Preparation

Incoming ore concentrates are charged into the system through a drum dumping station. The concentrates go directly to the Ore Preparation section via the calciner or through the pre-treatment facility and then to the calciner. Following the calciner, the ore concentrates are blended, agglomerated, dried, crushed and sized to a uniform particle size distribution. In the agglomeration step, water, sulfuric acid, magnesium hydroxide, and/or sodium hydroxide is used depending on the concentrate characteristics. Dusts and fumes from this process are controlled by use of dust collectors.

6.1.4. Reduction

The sized uranium concentrates enter one or both of two available fluid-bed reactors (reductors). In the reductor, the uranium is reduced from trioxide to dioxide form utilizing hydrogen from dissociated ammonia; the nitrogen serves as a fluidizing gas. Ammonia is stored as a liquid at the facility's tank farm. Steam is used to vaporize the ammonia to be fed to the dissociators which uses high temperatures and a catalyst to break the ammonia into its elemental components. The reductor off-gas (principally nitrogen, water vapor, hydrogen and hydrogen sulfide) is passed through filters to remove particulate uranium, and the residual gas is then incinerated to convert the hydrogen sulfide into sulfur dioxide and water and burn the excess hydrogen.

6.1.5. Hydrofluorination

The uranium dioxide from the reductor is fed into one of two fluid-bed hydrofluorinators operated in series; two trains are available for operation. A counter-current flow of anhydrous HF fluidizing gas converts the uranium dioxide into uranium tetrafluoride (UF_4). Anhydrous HF is stored on site as a liquid. Through a system of vaporizers and heat exchangers the HF is changed to a gaseous form and brought to the proper reaction temperature before being introduced into the fluid-bed reactors.

The off-gas is filtered to remove particulate uranium and scrubbed with water and a potassium hydroxide solution to remove HF before being vented to the atmosphere. The HF scrubber liquors are pH-adjusted and treated to remove fluoride. This waste fluoride is subsequently converted into a recyclable synthetic calcium fluoride (CaF_2) product.

6.1.6. Fluorination

The UF_4 is fed into one of three available fluid-bed fluorinators that also contain inert bed material. Elemental fluorine is used as the fluidizing gas to convert solid UF_4 to gaseous UF_6 which is volatilized from the fluorinator. A cobalt catalyst may be used to enhance the reactivity and improve the fluorine yields. The cobalt is added during Ore Preparation. Some residual uranium, non-volatile impurities and uranium daughter products remain in the bed material, which is recycled and reused until the buildup of contaminates prohibit further use. The bed material is then

retired for radioactive decay and subsequently shipped to a contractor for reprocessing of the uranium. The volatilized gas containing UF_6 excess fluorine, and HF is passed through a series of filters for particulate removal, and through a series of cold traps for UF_6 desublimation.

6.1.7. Cold Traps and Off-Gas Cleanup

The bulk of the UF_6 is desublimed in a series of primary cold traps which are operated at approximately -20°F to 0°F. The secondary and tertiary trap operate at lower temperatures and remove essentially all of the remaining UF_6. The secondary and tertiary cold traps are not essential for the process. One or both could be bypassed without adversely affecting the operation. A green salt absorber could also be used in lieu of these traps. Crude UF_6 is removed from the cold traps intermittently following liquefaction by heating, and then transferred to still feed tanks to await purification by fractional distillation.

Uncondensed gas from the cold traps, consisting of F_2, air, HF, and traces of UF_6, is routed into scrubbers where contact with potassium hydroxide solution removes fluorides and traces of uranium prior to release to the atmosphere. The spent scrubbing solutions are routed through Wet Process, where the potassium diuranate is precipitated and filtered. The filtrate (spent KOH) is sent to the Environmental Protection Facility where it is regenerated and subsequently reused.

The potassium diuranate is further treated and the uranium is then re-introduced into the Feeds Material Process.

6.1.8. Distillation and Product Packaging

Crude UF_6 from the still feed tanks is fed into a low boiler distillation column. The UF_6 that has been stripped of low- boiling impurities is then fed into a high boiler distillation column where high boiling impurities are eliminated. The product, which meets or exceeds DOE purity requirements, is condensed and packaged into approved product cylinders. Gaseous effluents from this process are fed back to Fluorination and are treated along with the fluorination off gas.

6.1.9. Uranium Recovery

Fluorination solid residues that contain economically recoverable quantities of uranium are recycled to a licensed uranium mill for recovery of the uranium through a toll milling agreement.

The average concentration of significant isotopes in the recycled residue is about 0.03 µCi/gm as listed in Table 6-1 below. When recovery of the uranium is no longer economically feasible, the material will be disposed of at a licensed radioactive waste disposal site.

Table 6-1 - Isotopic Content of Uranium Recovery Residue		
Isotope	**Source**	**Radioactivity μCi/gram**
Uranium (Natural)	Unrecoverable	1.0E-2
Radium-226	Long-lived daughter not removed in milling process	1.5E-3
Thorium-230	Long-lived daughter not removed in milling process	1.4E-2
Thorium (Natural)	Natural Thorium not removed in milling process	2.0E-3
Total		**2.8E-2**

The plant uranium recovery process does, however, process liquors from other plant operations containing recoverable quantities of uranium. These liquors are primarily solutions from which the uranium is precipitated using KOH and NH_3. The precipitated diuranate is recovered and the liquors are filtered before final treatment at the Environmental Protection Facility.

6.1.10. Cylinder Wash Facility

Periodically, UF_6 Product cylinders must be washed and pressure tested to assure that there has been no significant degradation of design integrity and to comply with the recertification requirements of ANSI N14.1. The cylinders are washed with sodium carbonate or sodium hydroxide solution to recover uranium. The leach liquors are then filtered and the uranium bearing liquid transferred to the uranium recovery facility. The filter residue, which contains daughter products of uranium, principally ^{234}Th and ^{234}Pa, is stored on-site and eventually disposed of at a licensed waste disposal facility.

6.2. UF6 Cylinder Safety Limits

6.2.1. Safety Controls for Cylinder Filling and Handling

Honeywell's UF6 cylinder filling system uses the following features to isolate potential leaks and minimize the amount of UF6 that would be released in the event of a pigtail failure:

- A remote-controlled shut-off valve in the liquid UF_6 filling manifold may be closed immediately to prevent further cylinder filling if a UF_6 leak occurs in the pigtail piping.
- A remote-controlled drive motor on the product cylinder valve may be closed immediately to prevent back flow of UF_6 from the cylinder

These two controls may be simultaneously activated from several locations.

Plant administrative fill limits for UF6 cylinders have been established at least 100 pounds less than those listed in the American National Standards Institute (ANSI) Standard N14.1, as applicable at the manufacture date of the UF_6 cylinder.

Cylinder filling operations are not conducted unless at least two independent methods exist for determining the amount of UF_6 filled into the cylinder. Cylinder weight is determined by independent methods as follows:

During UF6 cylinder filling operations, the cylinder is placed on dual (independent) element load cells. The load cell weights are continuously indicated and recorded in the FMB Control Room and also indicated at the filling area.

A separate UF_6 product flow totalizer is utilized to measure the amount of UF_6 transferred into a cylinder.[1] If the weights indicated by the dual-element load cells and the flow totalizer differ by more than 300 pounds during cylinder filling, the highest reading device is used as the cylinder fill indicator.[2]

A calculation of flow rate versus time is used to predict when the cylinder will be filled to the plant administrative limit.

After filling, the UF6 cylinder is lifted using a crane equipped with a built-in digital scale, which provides an additional verification that the cylinder weight is at or below the permitted maximum.

The UF6 cylinder is then placed on a beam scale buggy for final product weight determination. If the weight determined by the beam scale differs from the weight previously indicated by the dual-element load cells by more than 300 pounds for 48 inch cylinders or 100 pounds for 30 inch cylinders, the responsible Foreman is notified immediately.

6.2.2. Safety Controls for Heating or Sampling of UF6 Cylinders

Under normal operating conditions, the UF_6 continuous sampling system is used to obtain a UF_6 sample between the high boiler column and the product take-off control valve, thus reducing the need for UF_6 cylinder sampling. .

When a UF_6 cylinder must be sampled instead of, or in addition to, using the continuous sampling system, the following controls are used to minimize hot cylinder movement and to assure a product cylinder is not overfilled.

After filling, the cylinder is lifted approximately four inches using a crane equipped with a built-in digital scale, providing verification of the calculated weight and the

---

[1] Honeywell expects to eliminate the flow totalizer during the 2005-2006 time frame. The flow totalizer will be replaced by a system that automatically monitors for inconsistencies between the two independent element load cells.

[2] If the indicated weights are within 300 pounds then a designated load cell is used as the default weight indicator as specified in operating procedures.

weight indicated by the load cells. If the re-confirmed weight is within established fill limits, the cylinder is then lowered and rotated from the 12 o'clock position to the 9 o'clock position, heated in a steam chest and sampled.

If the weight of UF_6 in a 30 or 48 inch diameter cylinder exceeds by more than 100 pounds or 500 pounds, respectively, the maximum fill limits specified in the applicable revision of ANSI N14.1, heating of the cylinder is not be allowed without specific written procedures approved by the Plant Manager. Also, Honeywell provides notification to the Nuclear Regulatory Commission (NRC) of any cylinder filled in excess of these weights and of planned remedial actions prior to cylinder heating.

6.2.3. Hydrocarbon Controls

The following controls are utilized to address hydrocarbon contamination of UF_6 cold trap systems and UF_6 product cylinders:

- UF_6 is produced, distilled and packaged in a closed system to reduce the likelihood of hydrocarbon contamination during normal operations.
- The possibility of hydrocarbon contamination does exist during equipment and piping maintenance, particularly from replacement equipment or piping. These sources are controlled via extensive degreasing processes. Administrative controls, in the form of increased supervision, are utilized during maintenance of UF_6-bearing equipment and piping.
- Cylinder sampling and line evacuations are performed using an oil-filled vacuum pump. The vacuum system is engineered with safeguards that provide an oil trapping capacity in excess of 20 times the volume of oil contained in the vacuum pump. Additionally, one trap contains activated alumina to prevent oil mist carryover. A check valve in this system prevents oil contamination due to back flow. The system also contains a "fail safe" slam valve that closes automatically upon loss of power to the vacuum pump motor. Similar safeguards have been engineered into the laboratory UF_6 sub-sampling system.
- The plant establishes administrative provisions requiring that incoming cylinders that contain "heels" be sealed with tamper-evident seals in accordance with ANSI N14.1 as applicable at the date of manufacture of the UF_6 cylinder.
- New cylinders manufactured for Honeywell are inspected at the manufacturing site during the production process. Newly manufactured cylinders are degreased in accordance with the current ANSI N14.1. The cylinders are inspected by Honeywell personnel prior to valve and plug installation. Upon installation, valves and plugs are sealed in a manner consistent with the provisions of ANSI N14.1 for full or empty UF_6 cylinders.
- When cleaned cylinders (that are not owned by Honeywell) are to be received, the owner shall certify as to the absence of hydrocarbons in the cylinders.

Additionally, these cylinders shall be sealed in a manner consistent with the provisions of ANSI N14.1 applicable at the date of manufacture. Alternatively, cylinders that do not meet these specifications shall be subject to an internal inspection by Honeywell personnel prior to filling or shall be returned.

- All cylinders received at Honeywell undergo an external receiving inspection. An integral part of this inspection is an evaluation of the tamper-evident seals. Violation of the seals would be readily apparent. Evidence of a broken seal will be investigated and appropriate action will be taken.
- Once received, cylinders are secured within the restricted area. These cylinders are subject to the same scrutiny as other sensitive areas within the plant property.
- Cylinders that receive five-year re-certification, or are washed and/or hydrostatically tested for other reasons, are internally inspected prior to reuse. Water and air systems are engineered to preclude any contamination of the cylinders with oil.

6.2.4. Glycol Contamination Controls

The following controls shall be utilized to detect and minimize the potential of contaminating UF6 with ethylene glycol during routine operation of primary cold traps:

- A weight and temperature indicator/alarm is provided on the UF_6 Surge Tank and UF_6 Dump Tank to alert the process operator of an unusual weight or temperature increase.
- The temperature and weight of the UF_6 Surge Tank is recorded before and after a primary cold trap is heated in preparation for draining. An excessive gain in temperature or weight of the UF_6 Surge Tank or Dump Tank requires notification to the responsible Foreperson.

Each cold trap that is returned to service after washing or internal repairs shall have the tare weight determined before and after completion of one (1) heating and cooling cycle. An excessive gain in weight during this cycle requires notification to the responsible Foreperson.

6.3. Safety Analysis of Each Step

6.3.1. Specific Chemical Safety Systems

Honeywell utilizes the following safety measures for the specific chemicals associated with uranium processing:

UF_6:

- Smoke detectors and cameras in distillation areas
- Automatic shut-of valves at cylinder fill spots
- Dump and surge tanks for containment of pressure relief
- Automatic sampling system
- Standby power system for critical equipment

Anhydrous Hydrofluoric Acid:

- Dump tank and emergency scrubber for relief valves on HF storage
- HF Mitigation Spray Tower System with three control stations
- Automatic shut-offs on HF tank car unloading valves
- HF storage Nuclear level indicators close automatic valves
- Foundation improvements to improve earthquake resistance at HF storage
- Risk assessment by outside expert
- Use of improved training and checklists for HF storage
- Fence-line halide monitors and alarms

6.3.2. Safety Analysis and Safety Features

Table 6-2 provides a summary of the hazards and safety features associated with each step of the uranium conversion process.

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
6.3.3. Sampling and Storage	
Internal radiation exposure from handling unencapsulated uranium. External radiation exposure from handling encapsulated drums of uranium ore concentrate. Physical stress, and pinch points in handling drums weighing 600 - 800 pounds each. Potential impact from process stack emissions.	A vacuum cleaner system with primary and secondary baghouses is used for ventilation, and building and equipment decontamination. Vacuum connections are provided throughout the building. Powered equipment is provided at each drum weighing or sampling station. Powered conveyors and elevators are used to move drums as needed through the process.
6.3.4. Pre-treatment Facility	
Acid or caustic burns to employees working in process area. Corrosion of equipment could cause leaks, resulting in area surface contamination, and potential airborne contamination.	Ore concentrates are mixed into a slurry to prevent dusting, and for transport to the sulfuric acid digestion system. Level and flow controllers are used to control slurry makeup. Alarms and interlock sequences are also provided to assist the operator in maintaining process control. Rubber-lined vessels and equipment are provided in the leach and precipitation steps to eliminate corrosion. Due to the large amount of heat released in the precipitation step, a water cooled reactor is used. Process piping, filters, settlers and liquor storage vessels are constructed of corrosion-resistant materials. pH control systems with alarms are used to control the flow of leach and precipitation materials to the reactors. Various high level, high pressure and low flow alarms are located in a centralized control room. Pressurized filtration systems are designed to ASME codes.
6.3.5. Ore Concentrates Preparation	
Internal radiation exposure from leaks or spills of the dry uranium compounds processed.	Each section of the Ore Preparation unit is provided with a primary and backup dust collector system to maintain slight negative pressure on equipment. Electrical interlocks are provided to allow proper start-up of equipment and to prevent damage to other pieces of equipment

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
Physical stress and pinch points in handling drums at the drum dumper. Potential impact from process stack emissions.	when a particular piece of equipment fails. Level indicators, load cells, alarms and remote valve operators are centrally located in the control room. This allows the operator to monitor and control operation of the process from this location. Powered equipment is provided in the drum dumping area to prevent personal injury when loading and dumping ore concentrate drums. A hooded enclosure with series dust collectors are provided for the drum dumper operation. A drum washer is also provided to decontaminate ore concentrate containers before release from the drum dumper area. A vacuum cleaner system is provided with outlets located throughout the Ore Preparation process for cleanup and decontamination of uranium spills. Temperature controls and automatic shut off valves are provided for all furnaces on the calciner and dryer. During dust collector rebagging operations, additional ventilation is provided to control employee internal exposure. A specialized procedure is used for entering and rebagging of uranium bearing dust collectors. A manifolded air line is provided to each dust collector so as to minimize employee's movement of air bottles and enhance the protection provided by respiratory protective equipment.
6.3.6. Reduction	
Process consumes hydrogen, which is flammable. Very low potential for internal exposure to insoluble UO_2 (Class "Y" material). Potential impact from process stack emissions.	The reductor system and various equipment associated with the reductor have a continuous on-line analyzer system to detect the presence of hydrogen. Whenever any one of these samplers detect an appreciable increase in hydrogen concentration (20% of the lower explosive limit), the hydrogen feed system is shut down. Process gases from the reductor are filtered to remove particulate uranium and incinerated to eliminate hydrogen and hydrogen sulfide. All process equipment, excluding the fluid-bed reactors, is enclosed and ventilated to dust collector bag houses to prevent personnel exposure to uranium. The reductors are constructed of special alloys to reduce corrosion during the reaction process. The ammonia storage tanks, ammonia vaporizers, ammonia dissociators and reductors have rupture discs and relief valves to prevent overpressurization of these vessels in accordance with ASME standards. Electrical interlocks are provided on all mechanical equipment in the Reduction Section to allow proper start-up, and to prevent damage to other pieces of equipment when a particular piece of equipment fails.

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
	The incinerator system is interlocked with the raw material feeds to the reductor. In the event of incinerator malfunction, all raw material feeds are shut down. The incinerator system also has its own standby generator that will maintain the incinerator operation during an electrical power outage. Level indicators, load cells, alarms, controllers, differential pressure measurements, and remote valve operators are centrally located in the control room. This allows the operator to monitor and control operation of the process from this location. The operator is provided with an emergency shut off button in the control room which will shut off all raw material feed to the reductor. The reductors are provided with cooling and heating systems to maintain control of the chemical reaction in the vessel. Automatic shut off valves are provided for gas supply to the furnaces if a malfunction of the furnace occurs. Automatic temperature overrides and shutdowns are provided on all heated equipment in the reductor section to prevent overheating.
6.3.7. Hydrofluorination	
The process consumes hydrofluoric acid (HF), which is corrosive to equipment, and may cause serious burns from skin contact or inhalation. Possible internal radiation exposure to mixed solubility uranium compounds ("D", "W", and "Y"). Potential impact from stack emissions.	All process equipment, excluding the fluid-bed reactors, is enclosed and ventilated to dust collector baghouses to prevent personnel exposure to uranium. The fluid-bed reactors and vessels used in the vaporization of hydrofluoric acid (HF) use relief valves and rupture discs to prevent overpressurization of vessels. Discharge from these relief valves are vented to scrubbers, dust collectors, or the relief tank to reduce impact on the environment and exposure to operating personnel. Process gases from the fluid-bed reactors are filtered to remove particulate uranium. The gases are scrubbed with water, and then with potassium hydroxide to reduce fluoride emissions to acceptable levels. Scrubbing liquors are then sent to the Environmental Protection Facility for neutralization and fluoride removal before discharge to the plant effluent. Level indicators, load cells, alarms, controllers, differential pressure measurement, and remote valve operators are centrally located in the second floor control room of the FMB. This allows the operator to monitor and control operation of the process from this location. The operator is provided with an emergency shut off button in the control room which will shut off all raw material feed to the Hydrofluorination System. The hydrofluorinators are provided with cooling and heating systems to maintain control of the chemical reaction in the vessels. Automatic shutoff valves are provided for gas supply to furnaces if a malfunction of the furnace occurs. Automatic temperature overrides and shut downs are provided on all heated equipment in the hydrofluorination unit to

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
	prevent overheat. All vessels are constructed of special alloys to reduce corrosion during the reaction process. Vessel designs for pressure vessels are per ASME specifications. Electrical interlocks are provided on all mechanical equipment in the reduction section to allow proper start-up, and to prevent damage to other pieces of equipment when a particular piece of equipment fails. A vacuum cleaner system is provided for cleanup of uranium spills and for decontamination of equipment in preparation for maintenance repairs. Specialized equipment and procedures (e.g., line breaking) are provided to protect employees from HF exposure.
6.3.8. Fluorination	
The process consumes fluorine (F_2), an extremely strong oxidizing agent which is corrosive to equipment and causes skin burns upon contact. Contact of oil with F_2 or UF_6 may initiate an uncontrolled reaction. Uranium daughter products accumulate in the fluorinator bed material (CaF_2). This produces external radiation levels which are higher than other process areas. Fluorine leaks from process equipment may produce a significant safety hazard. Possible internal exposure to highly soluble UF_6 which could produce HF burns and chemical toxicity. Potential impact from stack emissions.	Spar movement into and out of the reactor is automated. Dust collection for this equipment is provided by primary and backup dust collectors. This automated movement reduces risk of inhalation to operating personnel. Oil contamination in UF6 can cause vigorous reactions. In order to eliminate this potential problem, all vessels used in fluorine and UF6 service are degreased prior to being put in service. To eliminate problems with fluorine leaks, the process operates at a pressure below atmospheric. Thus, any leaks that do occur will cause air in-leakage into the system rather than F2 leaks. The fluid-bed reactors, filters and piping are constructed of special alloys to reduce corrosion during the reaction process. Vessel designs for pressure vessels are per ASME specifications. Electrical interlocks are provided on all mechanical equipment in the fluorination process to allow proper start-up, and to prevent damage to other pieces of equipment when a particular piece of equipment fails. Level indicators, temperature recorders, alarms, controllers, differential pressure measurements, and remote valve operators are centrally located in the second floor control room of the FMB. This allows the operator to monitor and control the operation of the process from this location. The fluorinators are provided with cooling and heating systems to maintain control of the chemical reaction in the vessels. Automatic shutoff valves are provided for gas supply to furnaces if a malfunction of the furnace occurs. Automatic temperature overrides and shutdowns are provided on the fluorinators to prevent overheat. A vacuum cleaner system is provided for cleanup of spar spills, and for decontamination of equipment in preparation for maintenance repairs.

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
	Specific procedures are provided to control external radiation exposure to uranium daughters. Specialized equipment and procedures are provided to control employee exposure to F2, HF and UF6.
6.3.9. Cold Traps and Off-Gas Cleanup	
Heating of cold traps containing excessive amounts of UF_6 could produce overpressurization. Hydrocarbon or glycol contamination of UF_6 can cause vigorous reactions. Fluorine leaks may create a significant safety hazard. Possible internal exposure to highly soluble UF_6 which could cause skin burns and chemical toxicity.	Cold traps are heated and cooled on a regular basis. Overfills of traps and subsequent heating can cause structural damage to the cold trap. Administrative controls are in place to prevent traps from being overfilled. The cold traps are also provided with relief valves, so that if an overpressurization occurs, the pressure will be relieved to a surge tank designed to hold the trap's contents, thus eliminating exposure to operating personnel and the environment. Oil contamination of UF6 can cause vigorous reactions. In order to eliminate this potential problem, all vessels used in fluorine and UF6 service are degreased prior to being used. Ethylene glycol contamination of UF6 may cause vigorous reactions. The following controls are utilized to detect glycol contamination in the primary cold traps and to reduce the potential of contaminating UF6 in the Distillation area: A weight and temperature indicator/alarm on the Surge Tank will be used to alert the process operator of a weight or temperature gain. A weight and temperature indicator/alarm on the Dump Tank will be used to alert the process operator of a weight or temperature gain. Each primary cold trap has a relief valve which relieves to the Surge Tank. The Surge Tank has a weight indicator/alarm and a temperature indicator/alarm in the UF6 Control Room. A Production Operator will record the temperature and weight of the Surge Tank before and after a Cold Trap is heated in preparation for draining. A comparison of these indicators will be made before the trap is drained to the Distillation unit. An excessive gain in temperature or weight will cause notification of the responsible supervisory and technical personnel and an evaluation of the conditions will then be made to determine the course of action. Pressure and temperature monitoring are provided to detect potential glycol leaks. Once a cold trap has been returned to service after washing or internal repairs, the trap tare weight will be obtained before and after the trap has been put through one heating/cooling cycle. An excessive increase in weight could indicate a leak of the coils and will cause notification of the responsible supervisory and technical personnel and an evaluation of the conditions will then be made to determine the course of action. Each major piece of distillation equipment has a relief valve that relieves to the Dump Tank. The Dump Tank has a weight indicator/alarm and a temperature indicator/alarm in the UF6 Control Room. Once an excessive gain in weight

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
	or temperature in the Dump Tank is detected, the responsible supervisory and technical personnel will be notified of the situation and an evaluation of the conditions will then be made to determine the course of action. To eliminate problems with fluorine leaks, the Cold Trap system is designed to operate at a pressure below atmospheric. Thus, any leaks that do occur are actually in-leakage into the system. Cold trap operation is maintained by refrigeration equipment to provide the temperature requirements necessary for trapping the gaseous UF6. Failure of the refrigeration systems does not create a potential for UF6 release. The UF6 will remain as a solid at ambient temperatures, and the vapor pressure created by these ambient temperatures is less than the design rating of the cold traps. Cold traps and piping are constructed of special alloys to reduce corrosion during operation. Vessel designs for pressure vessels are per ASME specifications. All relief valves are constructed of special alloys to reduce corrosion during operation. All designs are per ASME specifications. Load cells, temperature recorders, alarms and differential pressure measurements are centrally located in the control room. This allows the operator to monitor and control the operation of the process from this location. Special procedures are in place to ensure notification of plant management if overfill of a trap occurs. Special monitoring and control procedures are implemented to alleviate the situation. TV monitoring equipment is continuously utilized to visually detect a UF6 release. Specialized equipment and procedures are provided to control employee exposure to F2, HF and UF6.
6.3.10. Distillation and Product Packaging[2]	
Heating of vessels and cylinders containing excessive amounts of UF_6 could cause overpressurization. Increased potential for UF_6 release because the UF_6 is processed as a liquid and a gas under pressure. Hydrocarbon contamination of UF_6 can cause vigorous reactions.	Safety controls utilized for filling and handling UF6 product cylinders are described in Section 1.5.1 and 1.5.2 of this application. Procedures for hydrocarbon control (oil) are described in Section 1.5.3. To prevent overpressurization of any vessel, relief valves are installed on each vessel. If an overpressurization does occur, the pressure is relieved to a vessel designed to hold the contents of the release. Redundancy is built into the system at this point, if a release can't be contained in the first tank, it can be relieved through a relief valve to another hold tank. All UF6 Product cylinders and valves are manufactured and inspected in accordance with ANSI N14.1. Each cylinder is inspected for visible defects when received, prior to filling, after filling and prior to shipment in accordance with the Quality Assurance Program.

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
Possible internal exposure to highly soluble UF_6 could cause skin burns and chemical toxicity.	Vessels used in the Distillation Process are constructed of special alloys to reduce corrosion during operation. Vessel designs for pressure vessels are per ASME specifications. All relief valves are constructed of special alloys to reduce corrosion during operation. All designs are per ASME specifications. Load cells, temperature recorders, alarms, flow controllers, differential pressure measurements, and remotely operated valves are centrally located in the control room. This allows the operator to monitor and control the operation of the process from this location. An emergency shutdown button is located in the control room to allow the operator to shut off UF6 flow into and out of the process. Automatic steam shutoff valves are located on all vessels in the Distillation Process which vaporize UF6. If UF6 pressure is greater than 90 psig (60 psig below the relief valve rating), the steam is automatically shut off to stop pressurization of the system. Portable CO2 fire extinguishers are located on each floor of the FMB to provide an emergency method for stopping small UF6 releases. In addition, a permanent CO2 dispensing unit is located on the first floor of the Distillation Process. Prior to filling each UF6 product cylinder, the cylinder line "pigtail" is thoroughly inspected, new gaskets installed, and the "pigtail" leak tested before proceeding with filling the cylinder. A remotely operated shut off for the UF6 cylinder being filled, and the fill line to that cylinder, is incorporated into the system to mitigate the amount of UF6 which could be released in the event of a "pigtail" failure. The remotely operated valves can be operated from three different locations in the Distillation Area. Normal operation of the Distillation crane is from a hand held controller versus cab operation in the crane. In the event of a release in the fill area, the crane operator would not be trapped in an elevated area without means of egress. The strongback used for lifting cylinders is provided with an attached scale. Each full cylinder is weighed before heating as an additional assurance that the amount of UF6 in the cylinder is less than the plant administrative fill limit. This crane scale also reduces the amount of hot cylinder movement by eliminating the need to relocate the cylinder to the beam scale for verification of weight before heating.
6.3.11. Uranium Recovery	
Small potential for internal exposure to airborne radioactivity.	Expanded metal walking surfaces are provided to minimize personal contamination

Table 6-2 - Safety Analysis and Safety Features

Hazards	Safety Features[1]
Possible surface contamination from leaks and spills of uranium bearing liquors. Possible employee exposure to corrosive alkaline chemicals used in the process.	Routine surface contamination monitoring. Specific procedures and equipment are provided when employees may be exposed to alkaline solutions.
<u>6.3.12. Cylinder Wash Facility</u>	
Possible external radiation exposure from concentrated uranium daughter products. Possible surface contamination from spills or leaks of leach liquors.	Filters used to remove particulate material containing the uranium daughter products are enclosed in lead shielding. Used filters are stored in an isolated, shielded area to allow radioactive decay before disposal. Dikes and sumps are provided to contain liquid leaks. Routine surface contamination monitoring.

1 The safety features discussed in this section are in addition to those radiation safety and environmental protection controls discussed throughout this application.

2 These safety features are supplemented by the UF_6 cylinder filling and handling safety features discussed in Section 1.6 of Honeywell's license renewal application.

7. Accident Analyses

7.1. Introduction

A spectrum of plant accident scenarios involving radioactive materials were analyzed to determine potential off-site impact. These accidents range from realistic (small powder and minor UF_6 releases) to large releases of UF_6. Using computerized dispersion modeling, it was concluded that the only plant accident involving radioactive materials that could produce a significant off-site impact, is a significant release of uranium hexafluoride (UF_6). A specific Emergency Response Plan has been developed to minimize the potential impact of significant site release scenarios.

The UF_6 conversion process consumes relatively large quantities of corrosive raw materials, in particular anhydrous hydrogen fluoride (HF). Plant accidents that release substantial amounts of HF could produce short-term off-site environmental effects.

The U.S. Environmental Protection Agency's SCREEN computer model has been used to evaluate the potential impact of an accidental release of HF. The model computes short-term concentrations downwind from a point source at specified distances. Average meteorology at Evansville, Indiana was used as input to the computer program. Stability Class "D" and an average wind speed of 3.0 meters per second was used to determine downwind concentrations for a given release rate. A "Rural" dispersion environment was assumed for the modeling analyses.

7.2. Hydrogen Fluoride (HF) Accident Analysis:

For the analysis of atmospheric releases of HF, it has been assumed that the release persists for one hour, that it occurs at ground level, and that it occurs in the open so that there is no attenuation by filtration or scrubbing.

Four criteria have been selected to gauge the environmental effects of accidental releases:

1. Air concentrations of HF not exceeding 0.25 mg/m^3 (0.3 ppm), which is in the range where exposures of the order of one hour can cause damage to vegetation.
2. Concentrations up to 2.5 mg/m^3, which is the TLV ceiling concentration which should not be exceeded during an eight-hour work day as recommended by the American Conference of Governmental Hygienists.
3. Concentrations up to 7 mg/m^3, which is the emergency exposure limit for 60 minutes recommended by the National Academy of Sciences.
4. Concentrations not exceeding 40 mg/m^3, which is extremely dangerous for even very short exposures.

Experimental data and occupational experience indicate that man is susceptible to irritation from gaseous HF. At 10 mg/m^3 the mucosa become irritated. At a concentration of 26 mg/m^3 for 3 minutes, one becomes uncomfortable and able to taste the gas. At 50 mg/m^3, the severity of the irritation increases. At 100 mg/m^3, a stinging sensation of the skin is added along with other irritations so severe as to make exposure for more than one minute intolerable. For this reason, it is unlikely that persons able to escape would remain in the toxic cloud for any length of time.

The calculated release rates required to produce each of the exposure criteria concentrations at the nearest site boundary (330 meters) are shown in Table 7-1. For each release rate the downwind distance to all concentration criteria listed above are also provided. Additionally, the area of influence for each concentration criteria analyzed are provided in Table 7-2.

The results from the dispersion calculations indicate a HF release of 6.03 pounds per hour would not produce any off-site effects. A release of more than 169 pounds per hour is required to exceed the 60 minute emergency exposure limit (7 mg/m^3 of HF) to any member of the public, if the prevailing wind is toward the nearest site boundary. A release of this size could produce short-term varying degrees of damage to vegetation over an off-site area of about 114 acres if the release occurs during a south to southwest wind.

There have been two significant releases of HF in the 31-year operating history of the plant. The first involved the leakage of 95 pounds of UF_6 which, fully hydrolyzed, is equivalent to about 22 pounds of HF. The leak occurred in the UF_6 building as a result of a valve failure in the distillation section. Elevated fluoride concentrations were not detected off-site because of the effectiveness of emergency control procedures.

In the second incident, a leak was detected in a HF tank car awaiting delivery to the plant. It was estimated that a total of about 250 pounds of HF was lost over a period of more than one hour; emergency procedures were instituted to prevent the spread of the material, and no off-site impact was observed.

It is concluded that accidents of this magnitude are possible, but are not likely and do not represent a significant environmental or health hazard to the surrounding population.

7.3. Maximum Hypothetical HF Release:

Due to the recognized safety hazards of handling HF, the plant has made, and continues to make, significant improvements in the HF storage and transfer system. Recently installed safety features include redesigned relief valves, and a remotely controlled automatic valve closure device to eliminate significant spills which might occur while unloading tank cars under pressure. In addition, future plans include the installation of load cells on HF storage tanks, a new Venturi vent gas scrubbing system, and a new HF dump tank that will allow the entire contents of a storage tank to be drained to the dump tank in the event of a storage tank leak.

These additional safety features significantly reduce the potential impact that might result from a HF handling accident. The maximum hypothetical spill of HF under these safety features is expected to be about 287 gallons of anhydrous HF. The following possible scenario is hypothesized which could result in a spill of this magnitude:

1. A HF tank car at 75° F is being unloaded at 47 PSI through the 1½ inch transfer line.
2. A total failure of the transfer line occurs. The operator, who is always in attendance during unloading operations, consumes one (1) minute in reaching and activating the emergency valve closure device that stops HF flow from the tank car.

3. Under these hypothetical conditions, approximately 287 gallons (2,289 pounds) of HF would be released. Almost 3 percent of this release will be in the form of flashed gas with roughly an equal percentage of suspended aerosol droplets. The remaining 270 gallons of HF is assumed to form a pool 1-centimeter deep with an effective diameter of 37 feet.

4. HF volatilization from this shallow pool surface will decrease with time due to the drop in temperature associated with evaporative cooling. The average HF release rate from the pool during the first 10 minutes following the spill will be 48.4 pounds per minute. Combining these evaporative emissions with the vapor and aerosol released during the first minute gives a 10-minute average emission rate of 61.7 pounds per minute. The 1-hour average HF emission rate is 33.7 pounds per minute.

The HGSYSTEMS dispersion model was used to calculate distances to criteria concentrations for this hypothetical release. Ten-minute average concentrations exceeding 40 mg/m^3 could reach 749 meters from the release point. The corresponding distance to the 7 mg/m^3-one-hour average concentration endpoint would be 1,043 meters. Short-term temporary vegetation damage would be expected in an area north and east of the highway. Honeywell, however, currently owns a large portion of this property.

It is anticipated that immediate plant emergency response to such an incident would reduce the duration of the release and mitigate any off-site impact.

Table 7-1 – Hydrogen Fluoride Criteria Distances

Table 14.0A. Hydrogen Fluoride Criteria Distances				
Emission Rate (lb/hr)	Distance (meters)			
	0.25 mg/m^3	2.5 mg/m^3	7 mg/m^3	40 mg/m^3
6.03	330	-	-	-
60.26	1300	330	200	-
168.71	2500	600	330	200
964.07	800	1800	1000	330

Table 7-2 – Hydrogen Fluoride Criteria Isopleths

Table 14.0B Hydrogen Fluoride Criteria Isopleths				
Emission Rate (lb/hr)	Area (acres)			
	0.25 mg/m^3	2.5 mg/m^3	7 mg/m^3	40 mg/m^3
6.03	2.51	-	-	-
60.26	32.5	2.51	0.61	-
168.71	113.9	7.39	2.51	0.37
964.07	1008	57.95	17.13	2.51

Honeywell Metropolis Works

Application for Renewal of Source Material License SUB-526

Appendix A –Occupational Exposure and Trend Analysis

May 27, 2005

Appendix A – Occupational Exposure and Trend Analysis

This Appendix provides graphs that trend specified critical parameters and discusses initiatives undertaken to improve radiological protection performance. In general, the charts indicate that plant operations, doses, and emissions are relatively stable, as might be expected of a mature (i.e., > 45 years in operation) process and facility.

As discussed in Section 4, the nature of the work performed at the plant involves an essentially continuous process involving low-hazard radioactive material, negating the need for complex entry control and access tracking systems. The results of worker dosimeter processing tend to be relatively stable over long periods of time. As a result, external dosimetry results have limited utility with regard to operational planning. However, the ALARA Committee is able to analyze other data, such as individual internal and external dosimetry results and air monitoring data, to identify specific processes where more significant exposures are occurring and take action to control those exposures consistent with the ALARA process.

Figure A.1 provides a graph of occupational radiation doses received at Honeywell's Metropolis Plant from 1995 through 2004. This decade has included periods of significant production activities and also periods of significant shutdowns, particularly during 2004. No clearly evident trends are discernible. However, the ALARA Committee did note that certain personnel who worked primarily in the FMB Control Room were receiving higher than average deep dose equivalents. To correct this situation, the ALARA Committee sponsored a project to provide lead shielding between the major radiation sources and the individuals in the Control Room, thus reducing exposure rates in this area.

Figure A-2 provides a graph of the average airborne radioactivity concentrations in the Feed Materials Building from 2000 through 2004. Although there has been a slight downward trend over the 2002 to 2004 period, there is no discernible change in the average activity over the entire five year period. The chart indicates that the average airborne radioactivity concentration remains a small fraction of the Derived Air Concentration.

Figure A-3 provides a graph of the average airborne radioactivity concentrations in the Drum Dumper Area from 2000 through 2004. This graph revels a distinct downward trend in the airborne radioactivity concentration in this area. This downward trend is the result of specific actions taken as approved by the ALARA Committee, including improvements in engineering controls and work processes.

Figure A.4 provides a graph of stack emissions of uranium from 2000 through 2004. This graph indicates that, althought there are year to year change in the stack emissions, there is little change in the annual average.

Figure A.1 – Occupational Dose Analysis – 1995 - 2004

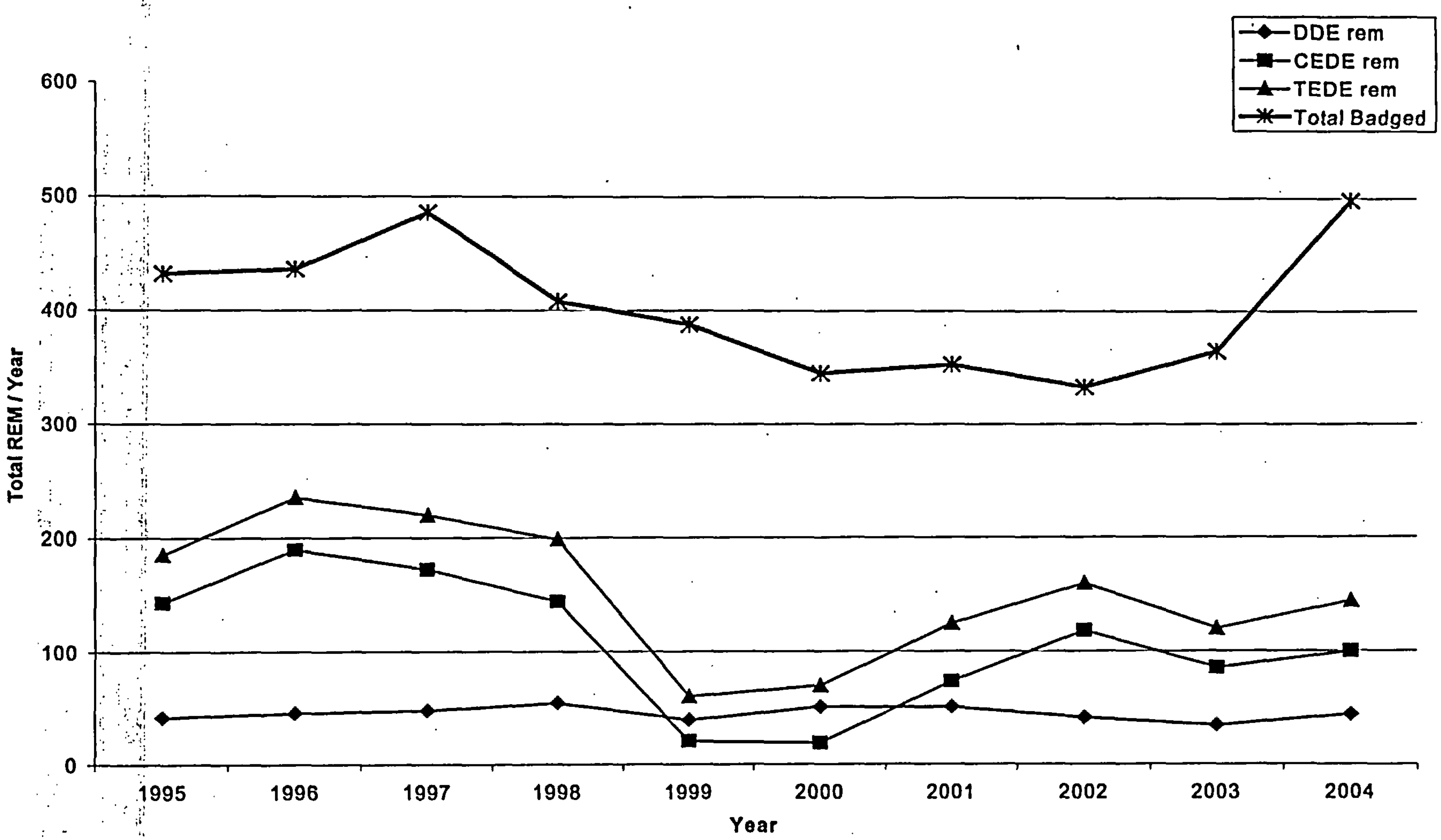


Figure A.2 – FMB Air Activity 2000 - 2004

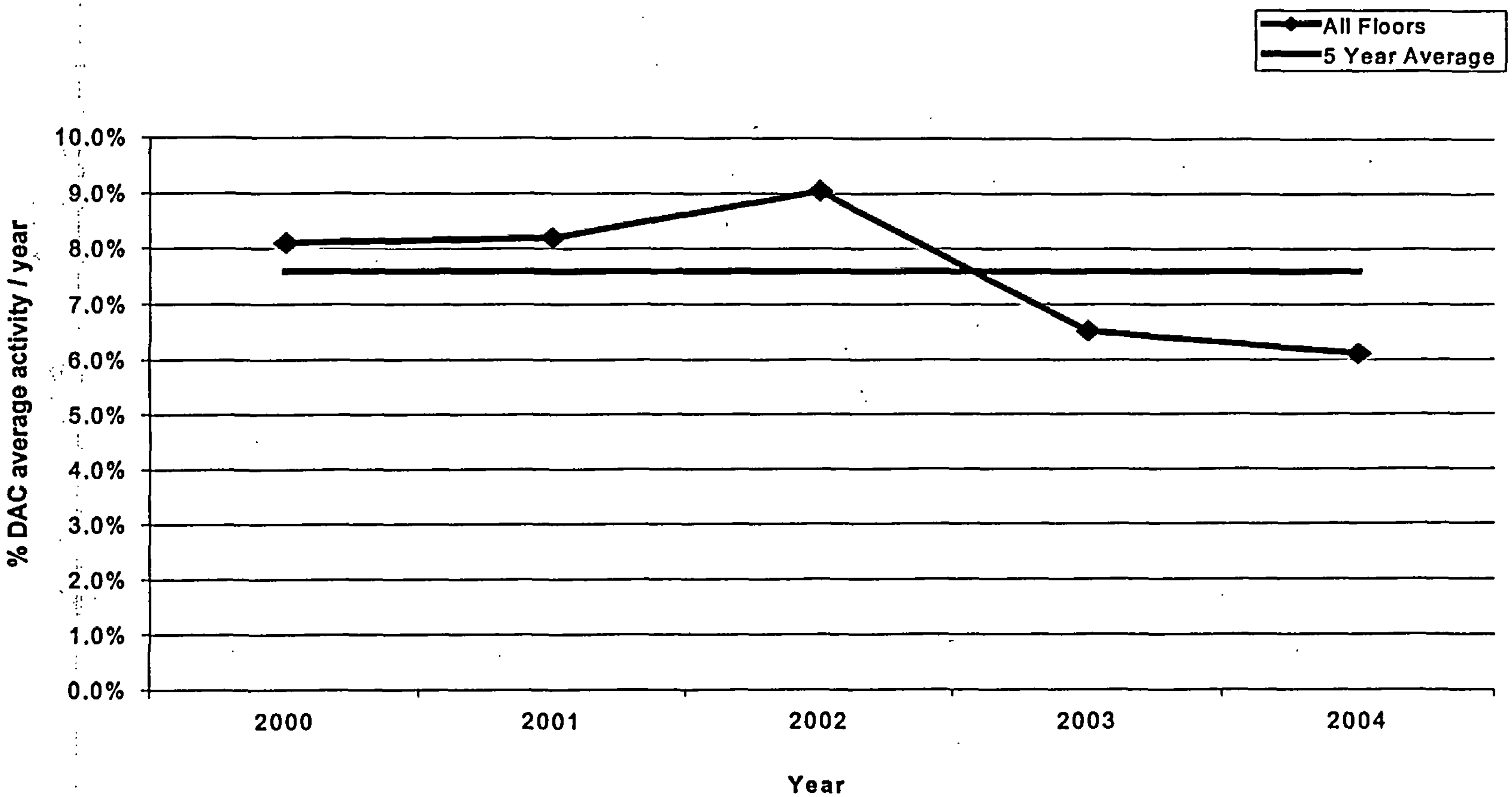


Figure A.3 – Drum Dumper Area Air Activity 2000 – 2004

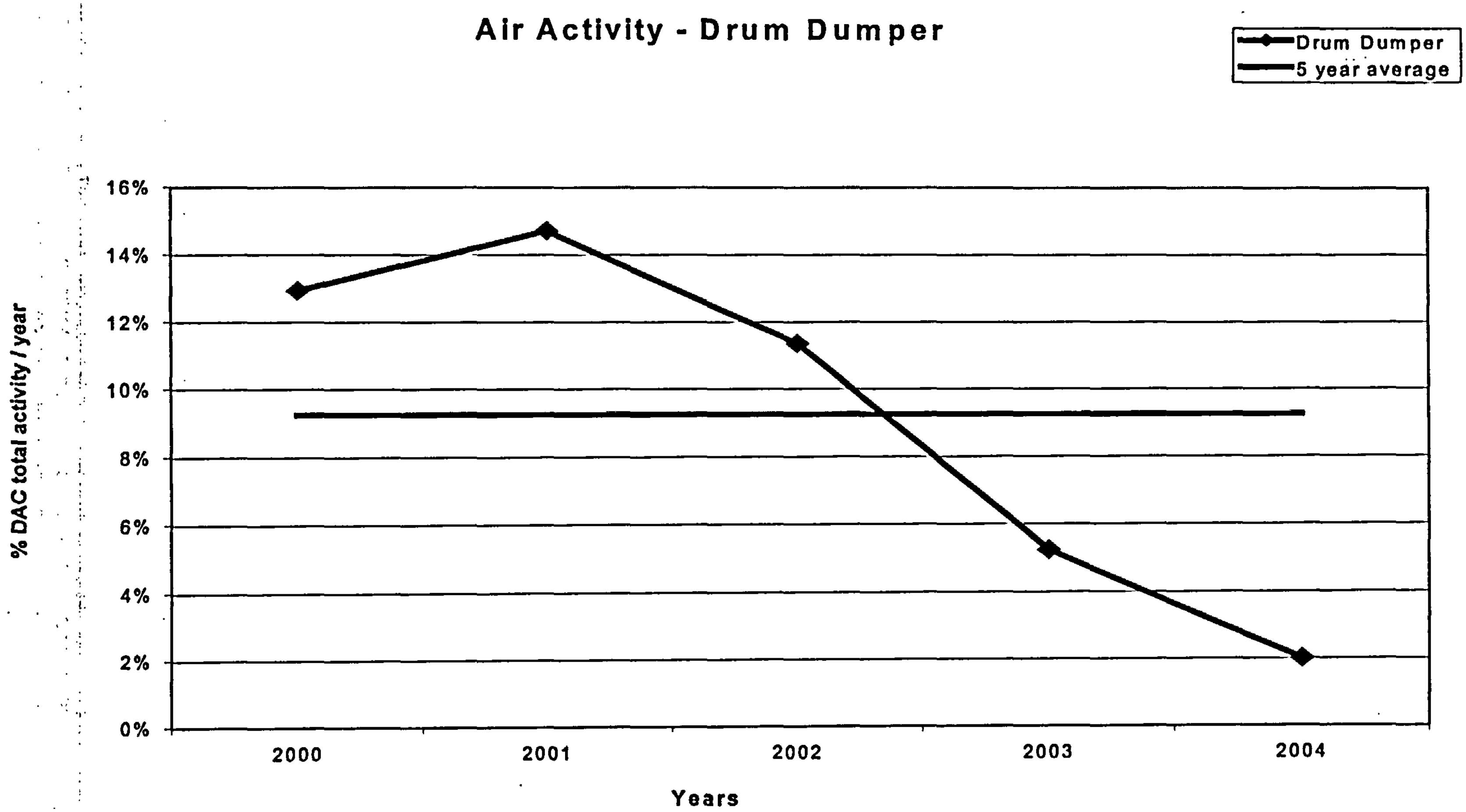
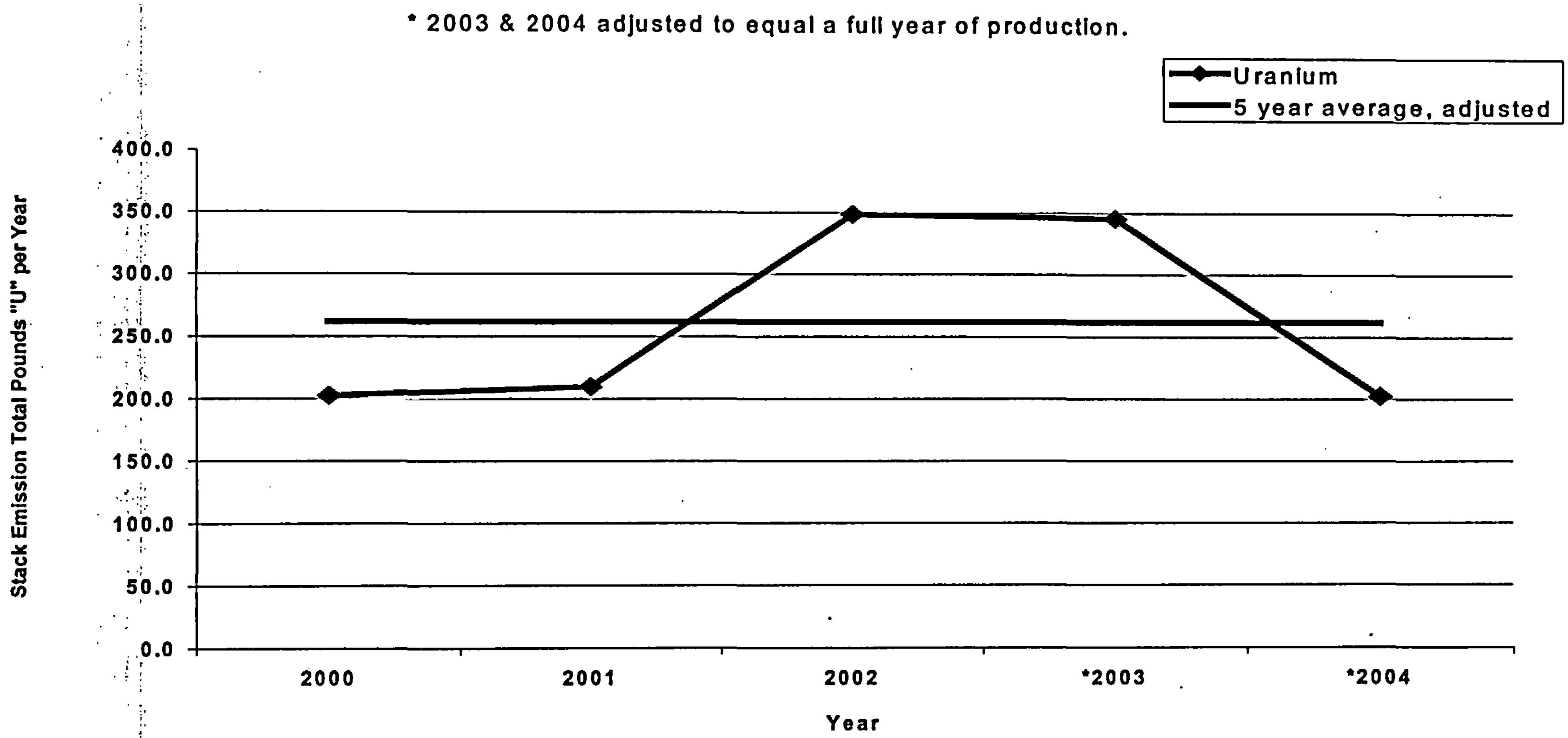


Figure A.4 – Stack Emissions – Pounds Uranium



Appendix B – Summary of Qualifications of Key Personnel

Appendix B – Summary of Qualifications of Key Personnel

Position: Plant Manager

Incumbent Name: Dave Edwards

Education: B.S., Chemical Engineering; M.S., Chemical Engineering

Years Related Experience: 30

Other Pertinent Training: Certified Professional Engineer

Years Experience at Metropolis Works: 3 months

Experience Summary:

Mr. Edwards has 30 years of varying experience in the chemical industry including process engineering, operations and project leadership roles. He has extensive experience in the leadership, management, and cultural development of chemical facilities.

Position: Health, Safety & Regulatory Affairs Manager

Incumbent Name: Darren E. Mays

Education: B.S., Business, Minor Chemistry; MBA; M.S., Safety, Environmental, and Industrial Hygiene

Other Pertinent Training: Occupational and Environmental Radiation Protection

Years Related Experience: 10

Years Experience at Metropolis Works: 3.5

Experience Summary:

Mr. Mays has 10 years experience in the chemical industry industrial health and safety field, including 8 years of supervisory/management experience. He has extensive experience in the management, development, implementation and oversight of programs related to Health, Safety, Environmental and Health Physics.

Position: Engineering Manager

Incumbent Name: Vacant

Position: Quality Assurance Manager

Incumbent Name: Bruce Vandermeulen

Education: B.S., Business Management

Years Related Experience: 3

Years Experience at Metropolis Works: 13 years

Other Pertinent Training:

Experience Summary:

Mr. Vandermeulen has thirteen years experience in the nuclear industry with 10 of those 13 years as Plant controller. During his tenure with Honeywell, Mr. Vandermeulen has served in the capacity of Supervisor and Manager of the finance department. He has extensive experience in the management and development of procedures related to Quality assurance and Supply Chain.

Position: Maintenance Manager

Incumbent Name: John Tennison

Education: B.S., Chemical Engineering

Years Related Experience: 20 years

Years Experience at Metropolis Works: 0.25

Experience Summary:

Mr. Tennison has 15 years of supervisory/management experience in the chemical industry. He has extensive experience in the management of programs related to SAP and preventative maintenance.

Position: Nuclear Services Leader

Incumbent Name: Vacant – Responsibilities being assumed by Plant Manager and Senior Production Supervisors

Position: Health Physics Supervisor

Incumbent Name: Michael Ginzel

Education: B.S., Environmental Health Science

Other Pertinent Training: Various Health Physics Systems Programs, NRRPT Certified

Years Related Experience: 18

Years Experience at Metropolis Works: 2.5

Experience Summary:

Mr. Ginzel has 18 years experience in the nuclear industry, including 10 years of supervisory experience. He has extensive experience in the development, implementation and oversight of health physics/radiation protection programs.

Position: Environmental Supervisor

Incumbent Name: Darrin Dodge

Education: B.S., Environmental Engineering Technology

Years Related Experience: 11 years

Years Experience at Metropolis Works: 5 years

Experience Summary:

Mr. Dodge has 11 years experience in the chemical industry environmental foeld, including over 4 years os supervisory/management experience. He has extensive experience in the development, implementation, and overisght of environmental compliance programs.

Position: Safety Supervisor

Incumbent Name: Joseph C. Johnson

Education: B.S., Business & Administration; M.S., Occupational Safety and Health

Other Pertinent Training: (technical schools, seminars, short courses, certifications, etc.)

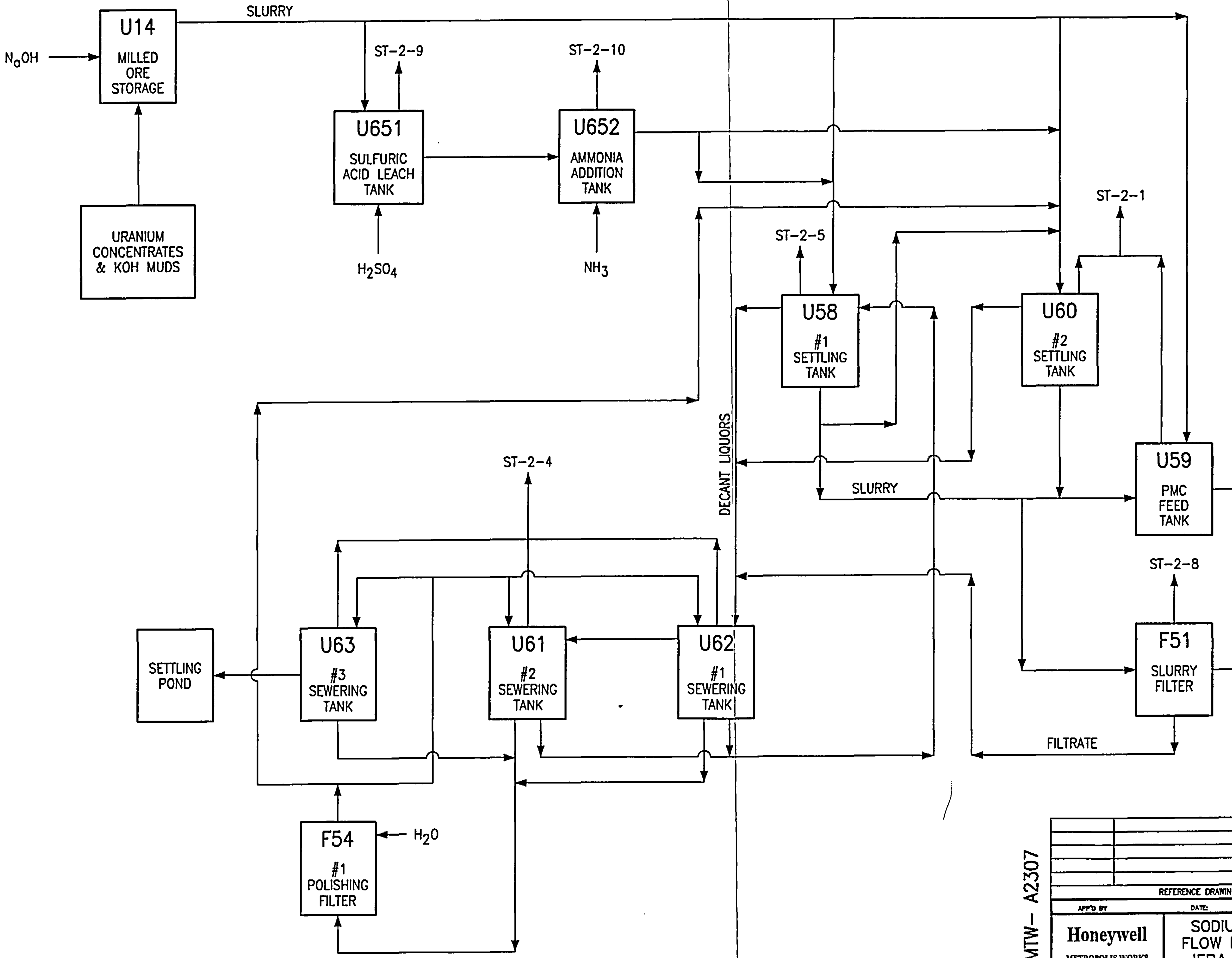
Confined Space Rescue	24-Hour HAZWOPER
8-Hour RCRA/TSD	Process Improvement
Advanced Incident Command	Fire Rescue
First Aid/CPR	Managing Safety

Years Related Experience: 12 years

Years Experience at Metropolis Works: 10 years

Experience Summary:

Mr. Johnson has 12 years experience in the chemical (or nuclear) industry (or industrial health and safety field), including 7 years of supervisory/management experience. He has extensive experience in the management (or development or oversight or implementation) of programs related to employee relations, chemical process oversight, and health and safety procedures.



LEGEND

F-51	SLURRY FILTER
F-54	#1 POLISHING FILTER
U-14	MILLED ORE STORAGE
U-58	#1 SETTLING TANK
U-59	PMC FEED TANK
U-60	#2 SETTLING TANK
U-61	#2 SEWERING TANK
U-62	#1 SEWERING TANK
U-63	#3 SEWERING TANK
U-651	SULFURIC ACID LEACH TANK
U-652	AMMONIA ADDITION TANK

MTW- A2307

REV.	DESCRIPTION	BY	DATE
A	ISSUED FOR IEPA AIR PERMIT	DPD	1/28/03

REFERENCE DRAWINGS

APP'D BY DATE: TITLE:

Honeywell
METROPOLIS WORKS

SODIUM REMOVAL FLOW DIAGRAM FOR IEPA AIR PERMIT

DATE: 1/27/03 SCALE: NONE
DRAWN BY: D DRISCOLL
DRAWING NO. A.R. REV
MTW- A2307 A

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO.: MTW - 3010,
"P & I DIAGRAM ~ UF 6 DISTILLATION",
ISSUE A

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. MTW - 3010

D-01

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: DRAWING NO.: MTW - 3392, "FLUORINATION FLOW DIAGRAM", REV. C

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. MTW - 3392

D-02

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: DRAWING NO.: MTW - 3393, "PROCESS FLOW DIAGRAM - GREEN SALT - (ONE TRAIN)", REV. T

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. MTW - 3393

D-03

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO.: MTW - 3396,
"PIPING & INSTRUMENTATION DIAGRAM - "U" RECOVERY",
REV. F

WITHIN THIS PACKAGE... OR,
BY SEARCHING USING THE DOCUMENT/REPORT
DRAWING NO. MTW - 3396

D-04

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO.: MTW - 3401,
"ORE PREPARATION PROCESS FLOW DIAGRAM",
REV. F

WITHIN THIS PACKAGE... OR,
BY SEARCHING USING THE DOCUMENT/REPORT
DRAWING NO. MTW - 3401

D-05

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO.: MTW - 4781, "METROPOLIS WORKS PLANT ENVIRONMENTAL SAMPLING STATIONS", REV. K

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. MTW - 4781

D-06

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO.: MTW - 513~~4~~8,
"METROPOLIS WORKS UNDERGROUND FIRE WATER PIPING",
REV. H

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. MTW - 5138

D-07

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO.: MTW - A4868,
"SAMPLING PLANT
AUGER SYSTEM
EQUIPMENT LAYOUT
1st FLOOR PLAN",
REV. C

WITHIN THIS PACKAGE... OR,
BY SEARCHING USING THE
DOCUMENT/REPORT
DRAWING NO. MTW - A4868

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: DRAWING NO.: MTW - 3438, "PROCESS FLOW DIAGRAM - EPF ACID NEUTRALIZATION & BASE REGENERATION UNITS", ISSUE C

WITHIN THIS PACKAGE... OR, BY SEARCHING USING THE DOCUMENT/REPORT DRAWING NO. MTW - 3438

D-09

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
DRAWING NO.: MTW - 3341,
"CaF2 RECOVERY PROCESS FLOW DIAGRAM",
ISSUE A

WITHIN THIS PACKAGE... OR,
BY SEARCHING USING THE DOCUMENT/REPORT
DRAWING NO. MTW - 3341