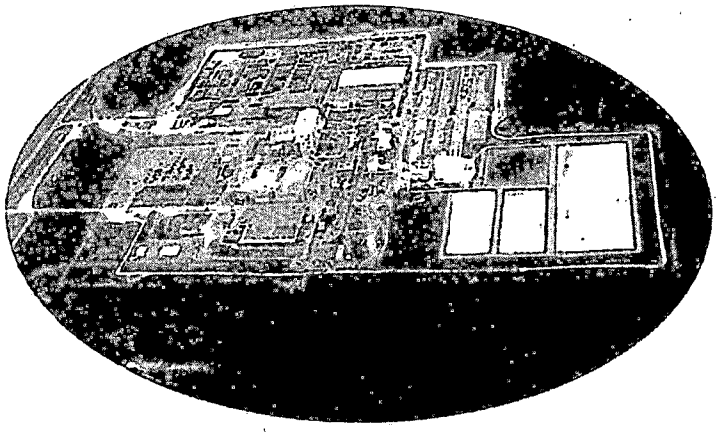
ENERCON

Decommissioning Cost Estimate



Prepared for:

Honeywell Metropolis Works
2768 North U.S. State Route 45
Metropolis, IL 62960

Honeywell

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EXECUTIVE SUMMARY

Enercon Services, Inc. (ENERCON) prepared this report to document the triennial update of the independent Decommissioning Cost Estimate (DCE) required for financial assurance purposes for the Honeywell Metropolis Works Plant (MTW) located in Metropolis, Illinois. As required by 10 Code of Federal Regulations (CFR) 40.36(d)(2) and License Condition 25, Honeywell must update the DCE at intervals not to exceed three years. To prepare this DCE, an onsite evaluation was made of the MTW building by building, area by area, and system by system. Current industry standards for demolition and waste disposal rates available to Honeywell were applied to this evaluation to reflect 2018 costs. This update accounts for changes in costs and for the events identified in 10 CFR 40.36(d)(2). The following is a chronological history of the previous DCEs prepared for the Honeywell MTW:

- *Site Reclamation Cost Estimate for Plant Located in Metropolis, Illinois, Revision 0* dated May 2006 (2006 Site Reclamation Cost Estimate Report)
- *Decommissioning Cost Estimate for Honeywell Metropolis Works, Revision 1* dated July 27, 2010
- *Decommissioning Cost Estimate for Honeywell Metropolis Works, Revision 0* dated August 15, 2012
- *Decommissioning Cost Estimate for Honeywell Metropolis Works, Revision 1* dated April 20, 2016.

Data and information were obtained from the Honeywell plant radiation protection department for this update to evaluate the events identified in 10 CFR 40.36(d)(2) that might affect the level of contamination.

There have been two releases of radioactive material to soils since the 2015 update to the DCE that have not been fully remediated. On May 25, 2017, contamination was discovered outside the research trailer located north of BD-2. Approximately 27 cubic feet (ft^3) of contaminated soil and gravel was excavated from the location to remove the contamination. This information has been considered in the preparation of the DCE.

On July 11, 2018, contamination was found on the wheels of a waste rail car east of the Feed Material Building (FMB) (BD-29). Further investigation found contamination by direct measurement in the aggregate material between the tracks and on the ground in this area which remains. It is estimated that 200 ft^3 of the aggregate material is contaminated. This DCE includes removal of the concrete pad and subsurface soils for the FMB (BD-29) and other structures surrounding it. This contamination is within the footprint of this area.

The resulting volumes of material from these inadvertent releases to subsurface soils from plant operations are included in the updated volumes of soil for this DCE.

A significant portion of the overall decommissioning costs is attributed to the processing, transportation, and disposal/burial of radioactive waste. The disposal rate used for most of the material in this estimate is based on shipping a large volume of low-level radioactive waste to US Ecology of Idaho as unimportant quantities of source material (less than 500 parts per million [ppm] or 0.05 percent by weight) based on the current rates available to Honeywell. The balance of the material requiring disposal will be sent to Energy*Solutions* of Utah based on their current rates provided to Honeywell. Remediation of the Landfill and Kickback area and disposal of the associated materials have also been included in this DCE. A portion of the materials to be disposed will include radiologically contaminated asbestos. This material will be evaluated to ensure that it meets the waste acceptance criteria guidelines for each of the disposal facilities. The fee for removal of asbestos as the initiating event to demolition has been incorporated into the DCE as a line item.

This DCE includes itemized costs for manpower and equipment resources, radioactive waste packaging, shipping and burial activities, and the performance of final status surveys for buildings and structures and land areas. The estimated decommissioning cost is approximately $192,463,202 in 2018 dollars.

1.0 INTRODUCTION

1.1 Purpose

Enercon Services, Inc. (ENERCON) is providing this report to document the triennial update of the independent Decommissioning Cost Estimate (DCE) required for financial assurance purposes for the Honeywell Metropolis Works Plant (MTW) located in Metropolis, Illinois as required by 10 Code of Federal Regulations (CFR) 40.36(d)(2) and License Condition 25.

This DCE is a triennial *Decommissioning Cost Estimate for Honeywell Metropolis Works, Revision 0* dated 2018. Data and information were obtained from the Honeywell plant radiation protection department for this update to evaluate the events identified in 10 CFR 40.36(d)(2) that might affect the level of contamination. This update to the DCE accounts for current costs and facility status as of August 2018 incorporating data from the Honeywell MTW *Radiological Characterization Report for Site Soils, Revision 0* (2009 Radiological Characterization Report). The results of the *Historical Site Assessment, Revision 0* dated April 2009 are included in the 2009 Radiological Characterization Report.

1.2 Background

The volumes of materials and/or building rubble to be sent to disposal have been estimated for each structure and the anticipated pathway for disposal considered to determine the cost for disposal.

A radiological characterization survey of surface and subsurface soils was performed as documented in the 2009 Radiological Characterization Report to determine the horizontal and vertical extent of radionuclide concentrations in soil. The data from this characterization report were used as the basis for determining the volume of surface and subsurface soils to be removed and the pathway for disposal of soils.

During the summer of 2018, an evaluation was undertaken of each of the open areas such as the employee parking lot, Ore Storage Pads, roadways, and the Uranium Hexafluoride (UF_6) Cylinder Storage Area to determine the means for ensuring they meet the decommissioning criteria and the expected volume of material to be disposed, if required.

Finally, this evaluation includes costs for characterization, a remediation pathway, and the volumes of materials in the Landfill and Kickback area and closure.

1.3 Changes Since the 2015 Update

Facility changes that have occurred which impact this update to the decommissioning costs are as follows:

- The SF6 Building (BD-12) and its contents have been removed.
- The calcium fluoride ponds—B, C, D, and E—are being removed.
- To support the removal of the calcium fluoride ponds, a new rail spur and security impoundment are being installed.
- The newly installed septic system has been upgraded with a chlorination system and is fully operational.

1.4 Scope

The scope of this report is to present the triennial update for site decommissioning costs of the Honeywell MTW. The specific areas covered by this estimate include:

- Feeds Material Building (BD-29)
- Fluorine Plant (BD-3, BD-4, BD-5)
- Ion Exchange Building (BD-37)
- Liquid Fluorine (BD-14) and Nitrogen Facilities (BD-83)
- Sodium Removal Building (BD-17)
- Potassium Hydroxide (KOH) Muds Building (BD-20)
- Calcium Fluoride Building (BD-11)
- Uranium Recovery Building (BD-19)
- Surface Treatment Facility (BD-42)
- FMB Pads
- Administrative Areas (BD-1)
- Sampling Plant (BD-23)
- Sanitary Wastewater Treatment Plant (U-1041)
- Ore Storage Pads
- Ore Storage Building (BD-18)
- Drum Storage Pad
- Bed Materials and Filter Fines Building (BD-33)
- Waste Storage Pad
- Pond Muds Filter Calciner Building (BD-16)
- Drains and Sewers
- Cylinder Wash Building (BD-15)
- Outdoor Areas
- Drum Crusher Building (BD-24 and BD-41)
- Discharge Ditch to River
- The open areas both inside and outside the Security Fence
- The Landfill and Kickback Area

Decommissioning costs are directly related to the degree of remediation required and the amount of radioactive waste generated. The extent of remediation is based on radiological data, application of proven decontamination processes, and data from similar projects.

1.5 Assumptions and Bases

The following are assumptions and bases utilized in creating this DCE:

- The estimate includes only activities and cost factors necessary to reduce residual radioactivity to levels that will permit unrestricted release of the associated structures, buildings, and grounds.
- Decommissioning activities will be completed sequentially building by building and area by area.
- Costs associated with the demolition and removal of non-contaminated equipment or structures are not included in this cost estimate unless such activities are required to support decommissioning. An actual date to perform the site decommissioning has not been selected. Therefore, the cost estimate provided herein is in 2018 dollars.
- The older, more contaminated structures will be removed completely. Structures with minimal or no contamination will remain in place after decommissioning. These structures will be decontaminated as required and free released. No building refurbishment is included.
- Uncontaminated processing equipment may have intrinsic value. No credit was taken for any salvage value. Contaminated equipment will be sent directly to an authorized waste disposal site.
- Molyflush cylinders will be shipped off-site for processing.
- Waste meeting the definition of unimportant quantities will be sent to US Ecology.
- Wastes not meeting the waste acceptance criteria of US Ecology qualify for disposal at Energy*Solutions* under their current license and waste acceptance criteria. No Class B or C radioactive wastes are present on-site.
- Removal and packaging of asbestos will be done by an independent contractor licensed to perform this work in the State of Illinois.
- For disposal of asbestos, the applicable waste acceptance criteria require the material to be double bagged.

- The costs for disposal for both Energy*Solutions* and US Ecology are based on pounds per rail car. This results in volumes of waste not being a factor of cost. Where volumes of material have been developed, this has been converted to pounds for each material considered.

- The independent third-party site remediation contractor will provide the demolition equipment and survey instrumentation at prevailing rates.

- Non-local contractors will be utilized for all aspects of the decommissioning process. Travel and living expenses are included for all project management, supervisors, and craft support.

- The data developed in the 2009 Radiological Characterization Report have been incorporated in this DCE.

- The site-specific release criterion used as the basis in this report is 110 picocuries per gram (pCi/g) which would support achieving the unrestricted release criterion of 25 millirems per year (mrem/yr). This value is consistent with the site-specific release criteria approved by the U.S. Nuclear Regulatory Commission (NRC) at the closed Sequoyah Fuels Corporation (Sequoyah Fuels) UF_6 conversion plant.

- Of the materials excavated from the 11-acre radiological portion of the Landfill and Kickback area, 10 percent will be radioactive waste to be shipped to US Ecology.

- To account for the volume contributed by miscellaneous items such as office equipment and supplies, forklifts, golf carts, tools, and other unspecified materials anticipated to be present at the beginning of decommissioning, 10 percent of the gross weight of waste for that structure was added to the total. This weight was added to the metals waste volumes when present. If no metals were present, the percentage was added to the soil weights.

- As a method to account for items such as booties, gloves, disposable coveralls, filters, blades, empty lockdown containers, and similar items to be disposed of as dry active waste, an additional 50 pounds was added to estimated waste for various structures.

- For the cost of NRC oversight, the NRC billing rate of $275 per hour was applied. For review of the Decommissioning Plan, the estimate is 400 hours or $110,000. For quarterly inspection by two inspectors for five days, the estimate is $88,000 per year for 12 years or $1,056,000 for a total of $1,166,000.

2.0 MTW LOCATION, HISTORY, AND CURRENT STATUS

2.1 MTW Location and Description

MTW is the holder of NRC License No. SUB-526. The plant address listed on the license is as follows:

Honeywell
2768 N U.S Route 45
Metropolis, IL 62960-6700

The plant is located on U.S. Highway 45, approximately 1.8 miles northwest of downtown Metropolis, Illinois. MTW is located on approximately 1,000 acres of land in Massac County at the southern tip of Illinois (Figure 1). 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. MTW also owns approximately 100 acres of land directly across U.S. Highway 45, north-northeast of the plant.

2.2 MTW History

Initial construction of the facility was completed in 1958, and the first UF_6 was produced in 1959 as part of a five-year contract for conversion services with the former Atomic Energy Commission (AEC). The AEC conversion contract expired in 1964 and the conversion process was placed in an idle state. Continued increase in demand for conversion services resulted in rehabilitation of the UF_6 facility in 1967, and commercial conversion started in 1968. In 1968-1969, capacity for the facility was expanded to 9,000 metric tons. Capacity was increased to 11,500 metric tons and 12,700 metric tons in 1975 and 1995, respectively. Re-engineering in 2001 increased capacity to approximately 14,000 metric tons. Additional re-engineering in 2007 further increased the capacity to approximately 15,000 metric tons. To date, the highest production has been approximately 13,000 metric tons.

2.3 MTW Physical Description

Figure 3 (Drawing No. MTW-2800) shows the approximate location of the following areas on the MTW site.

2.3.1 Main Production and Plant Operations Buildings

Main production buildings include the following: FMB (BD-29), Ion Exchange Building (BD-37), Sodium Removal Building (BD-17), KOH Muds Building (BD-20), Uranium Recovery Building (BD-19),

Sampling Plant (BD-23), Fluoride Production Facility (BD-3, BD-4, BD-5, and BD-35), Waste Treatment Plant, and UF_6 Cylinder Storage Area. The plant operations buildings include the Administration Building (BD-1), Laboratory and HP Building (BD-2), Maintenance Shop/Store/Office Building (BD-6), and Powerhouse (BD-7).

2.3.2 Miscellaneous Production Buildings

The miscellaneous production buildings include the Ore Storage Building (BD-18), Bed Materials and Filter Fines Building (BD-33), Pond Muds Filter Calciner Building (BD-16), Cylinder Wash Building (BD-15), Drum Crusher Building (BD-41), Liquid Fluorine Facility (BD-14), and Calcium Fluoride Building (BD-11).

2.3.3 Drum Storage Pads and Uranium Settling Ponds

The Drum Storage Pads and Uranium Settling Ponds are in the (plant) eastern portion of the restricted area and include the five Ore Storage Pads, the Drum Storage Pads, the Waste Storage Area, and Uranium Settling Pond Nos. 3 and 4.

2.3.4 Outdoor Areas, Drains, and Sewers

The outdoor areas, drains, and sewers include the employee parking lot, paved roads on-site, Railroad Spur Nos. 1 through 5, the land between two parallel property exclusion fences, site drains/sewers/underground process lines, and MTW land outside the fenced operations area.

2.3.5 Calcium Fluoride Ponds

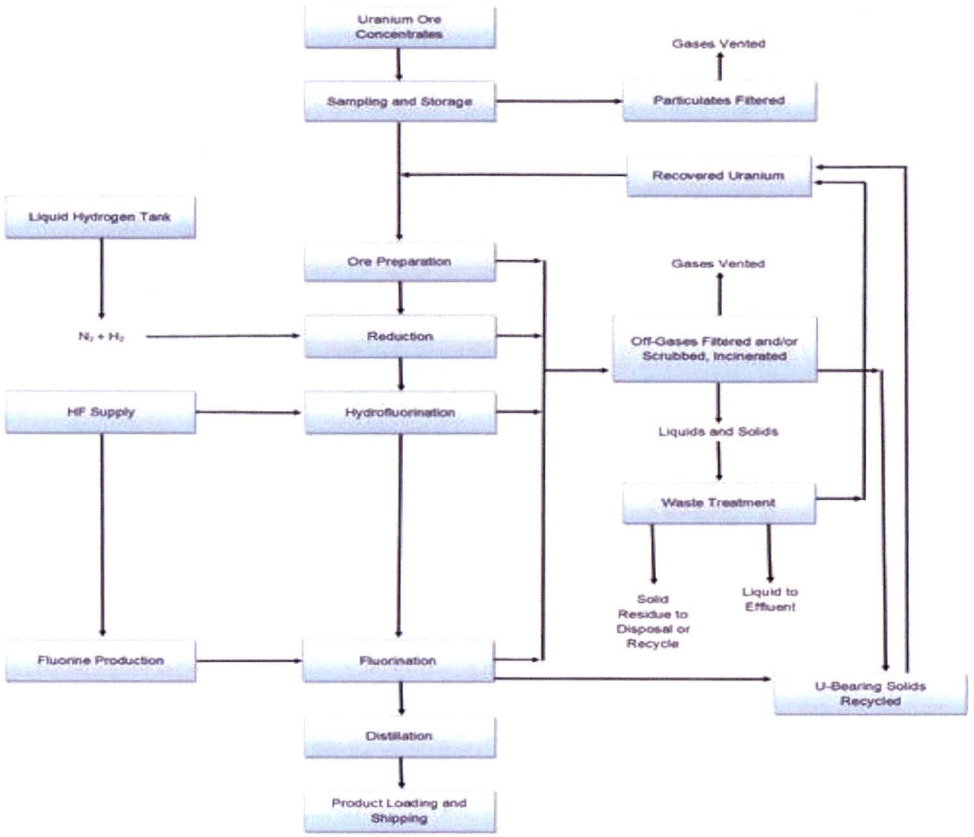
There are currently four calcium fluoride ponds located at the site designated Ponds B, C, D, and E. Pond A (which was located north of Pond B) was removed and the Surface Treatment Facility was constructed in the area previously occupied by Pond A. Historically, calcium hydroxide was used to precipitate fluorides as insoluble calcium fluoride into these ponds. The Surface Treatment Facility is currently used to treat fluoride materials prior to a permitted discharge; therefore, fluoride materials are no longer added to the calcium fluoride ponds. Preparations for removal of these ponds were underway during the summer of 2018. The materials in these ponds and their removal are not included in this DCE. The final status survey of the area during decommissioning is included in this DCE as part of Land Areas P-21, P-22, P-23 and P-24. No additional soils are expected to be encountered.

2.4 MTW Process Operations

MTW was designed to convert uranium ore concentrates into UF_6, which is then shipped to U.S. and foreign plants for enrichment of the Uranium-235 (U-235) isotope. The facility, which uses the fluoride volatility process, has the capacity to convert approximately 15,000 metric tons of uranium per year from ore concentrates into UF_6. Assays of the uranium ore concentrates show approximately 75 percent uranium. The distilled UF_6 product contains less than 300 parts per million (ppm) impurities. A process flow diagram of the conversion process is provided, and each significant step of the conversion process is described in the following sections of this report.

2.4.1 Uranium Hexafluoride Conversion Process Flow Diagram

The UF_6 conversion process flow diagram for the plant operations is as follows.



The plant receives uranium ore concentrates in 55-gallon drums. Each drum of ore concentrate is weighed and then stored on storage pads until accountability procedures and the uranium and impurity analyses are completed.

2.4.2 Pretreatment and Ore Concentration Preparation

Uranium compounds from the uranium recovery processes contain contaminants that must be minimized before the concentrates are converted to UF_6. The method of pretreatment used is a two-stage sulfuric acid leach followed by aqueous ammonia precipitation. After precipitation, the uranium-bearing solids are settled and filtered into a calciner prior to introduction into the ore preparation process.

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

Incoming ore concentrates are charged into the system through a drum dumping station and then a calciner. Following the calciner, the ore concentrates are blended, agglomerated, dried, crushed, and sized for uniformity. In the agglomeration step, water, sulfuric acid, magnesium hydroxide, and/or sodium hydroxide are used depending on the concentrate characteristics. Dusts and fumes from this process are controlled by use of dust collectors.

2.4.3 Uranium Reduction

The sized uranium concentrates enter one of two fluid-bed reactors (reductors). In the reductor, the mixed uranium oxides (U_3O_8) are reduced to a uranium dioxide (UO_2) form utilizing hydrogen. A liquid hydrogen system is used as a source of hydrogen. This system, located within a gated enclosure south of the Maintenance Building (BD-6), consists of a cryogenic storage tank and vaporizers. This system is owned and maintained by the vendor. Outside the liquid hydrogen system's fence, a nitrogen/hydrogen mixing station provides the appropriate fluidizing and reactive gas mixtures to the Green Salt reductors. 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 to burn the excess hydrogen.

2.4.4 Uranium Hydrofluorination

The UO_2 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 hydrogen fluoride (HF) fluidizing gas, supplied from on-site rail cars, converts the UO_2 into uranium tetrafluoride (UF_4). 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 product.

2.4.5 Uranium Fluorination

The UF_4 is fed into a fluid-bed fluorinator that also contains 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 contaminants prohibits 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.

2.4.6 Cold Traps and Off-Gas Cleanup

The bulk of the UF_6 is desublimated in a series of primary cold traps which are operated at approximately -20 degrees Fahrenheit to 0 degrees Fahrenheit. The secondary and tertiary traps 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. 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 fluorine, air, HF, nitrogen, 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 (BD-10) where it is regenerated and subsequently reused.

The potassium diuranate is further treated and the uranium is then re-introduced into the ore preparation process.

2.4.7 Uranium Hexafluoride Distillation

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 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.

2.4.8 Uranium Recovery

Different types of uranium-bearing liquors are processed in wet process/uranium recovery to recover as much uranium as possible. These include FMB (BD-29) and cylinder wash liquors, rainwater from certain storage pads, and fluorination scrubber liquors. Regardless of the origin of the uranium-bearing liquors, the uranium is precipitated from solution by pH adjustment, separated from the solution using rotary drum vacuum filtration at the Pond Muds Calciner and drummed for future use in ore preparation. The liquors in each case are treated in the Environmental Protection Facility (BD-10) to remove fluorides and then discharged into the plant effluent. Fluorination scrubbing liquors, which contain potassium diuranate solids, may also be shipped to a mill for toll reprocessing.

2.4.9 Uranium Hexafluoride Cylinder Cleaning

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 American National Standards Institute N14.1, "Packaging of Uranium Hexafluoride for Transport. 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.

2.4.10 Fluorine Production

Fluorine, which is one of the raw materials required for the UF_6 process, is produced on-site by electrolysis using HF as the source.

2.4.11 Plant and Non-Plant Area Delineation

In 2009, ENERCON assessed the plant and non-plant areas at MTW as part of the Historical Site Assessment, Revision 0 dated April 2009. The plant area was divided into 29 separate areas or systems of interest. Non-plant areas were divided into 5 separate areas or systems. Table 2-1 provides a list of the 34 areas of interest (Figures 1 and 2).

Table 2-1: Listing of Plant and Non-Plant Areas

Area Designation	Description
P-1	Administration Building and Parking Lot

Area Designation	Description
P-2	Laboratory Building and Adjacent Storage Area
P-3	Former Cold Trash Storage Area
P-4	Fluorination Preparation
P-5	Ore Staging Area/Drum Dumping Area/Sodium Removal Building/KOH Muds Building/Wet Process Building/Calciner
P-6	FMB and South Pad
P-7	Powerhouse, Nitrogen Generation, Laundry, Flammable Storage Building, and Storage Area
P-8	Liquid Fluorine Facility, Sulfur Hexafluoride Plant, Antimony Pentafluoride, Iodine Pentafluoride Plant, and the Loading Docks
P-9	Ore Sampling Area
P-10	Ore Storage Building
P-11	Ore Storage Pads
P-12	Tank Farm, Pond Muds Filter Calciner, and Fuel Oil Storage
P-13	Cylinder Wash Area
P-14	Uranium Settling Ponds
P-15	Bed Materials and Filter Fines Building
P-16	Drum Storage Pad
P-17	Waste Storage Area
P-18	UF_6 Cylinder Storage Area
P-19	Drum Crushing Facility
P-20	Environmental Protection Facility
P-21	Calcium Fluoride Ponds
P-22	Maintenance Storage Area/Trash Compactor/Switchyard/Fuel Depot
P-23	Maintenance Shop/Stores/Loading Dock
P-24	Liquid Propane Gas Area
P-25	Roadways and Ground Surface
P-26	Plant Exclusion Area
P-27	Sanitary Drain Lines
P-28	Process Drain Lines
P-29	Storm Water Drain Lines
NP-1	Non-Plant Area 1 – NPDES Outfalls
NP-2	Non-Plant Area 2 – Surface Drainage Pathways to the Ohio River
NP-3	Non-Plant Area 3 – On-Site Landfill and Kickback Area
NP-4	Non-Plant Area 4 – River Road
NP-5	Non-Plant Area 5 – Remainder of the Property

The 2009 site characterization activities evaluated the site soils in 26 (P-1 through P-26) of the 29 designated plant areas and 5 (NP-1 through NP-5) designated non-plant areas. Plant Areas P-27, P-28, and P-29 were not characterized due to the inability to access the various subsurface lines due to ongoing plant operations. Details are provided in the *Historical Site Assessment, Revision 0* and the 2009 Radiological Characterization Report.

3.0 ASSESSMENT OF PLANT RADIOLOGICAL CONDITIONS

3.1 Radiological Criteria for License Termination

The overall objective of MTW decommissioning is to remediate the site to an unrestricted use condition that corresponds to a calculated dose to the public that is less than 25 mrem/yr from applicable dose pathways. The site can then be used without any radiological restrictions. The 25 mrem/yr dose limit is codified at 10 CFR 20.1402, Radiological Criteria for Unrestricted Use.

The Derived Concentration Guideline Level (DCGL) is defined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) as the radionuclide-specific concentration within a survey unit corresponding to the release criterion. The DCGL is dependent upon several factors, including the radionuclides of concern (ROCs), applicable dose pathways, area occupancy, and the future use of the facility. The DCGL assumes a uniform level of residual radioactivity across the survey unit. For the Honeywell MTW, it was assumed that site-specific release criteria would be developed. The 2009 Radiological Characterization Report cited as an example the release criterion of 110 pCi/g for the Sequoyah Fuels facility. The Sequoyah Fuels facility was a uranium conversion plant similar to MTW that closed in the 1990s. ENERCON believes that 110 pCi/g is a reasonable DCGL for planning purposes.

The NRC criteria for acceptable surface contamination levels historically were 5,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) average for natural uranium (U-nat) and 1,000 dpm/100 cm^2 removable for U-nat as stated in Policy and Guidance Directive FC 83-23, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Materials Licenses." These acceptable levels are presented in Table 3-1. The current NRC guidance for acceptable activity levels for specific radionuclides is presented in NUREG-1757, Volume 1, Appendix B, Table B.1. The NRC declined to provide specific guidance for alpha emitting radionuclides, including U-nat. ENERCON expects that MTW will apply for site-specific release criteria using the guidance in NUREG-1757, Volume 2, Appendix I and the As Low As Reasonably Achievable (ALARA) analysis guidance in NUREG-1757, Volume 2, Appendix N.

Table 3-1: Acceptable Surface Contamination Levels

Nuclides[a]	Average[b,c,f] (dpm/100 cm²)	Maximum[b,d,f] (dpm/100 cm²)	Removable[b,e,f] (dpm/100 cm²)
U-nat, U-235, U-238, and associated decay products	5,000 (α)	15,000 (α)	1,000 (α)
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 (βγ)	15,000 (βγ)	1,000 (βγ)

[a]Where surface contamination by both alpha- and beta-gamma emitting nuclides exists, the limits established for alpha- and beta-gamma emitting nuclides should apply independently.

[b]As used in this table, dpm means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such subject.

[d]The maximum contamination level applies to an area not more than 100 cm².

[e]The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per cm² of total absorber.

3.2 Prior Assessment of Plant Radiological Conditions

Based on a review of NRC criteria, the following conclusions regarding potential release criteria for MTW are provided:

- NRC criterion for residual depleted uranium (DU) in soil was formerly 35 pCi/g.
- NRC guidance for acceptable license termination screening values for specific radionuclides was available in NUREG-1757, Volume 1, Appendix B, Table B.2.
- Honeywell will apply for site-specific release criteria using the guidance in NUREG-1757, Volume 2, Appendix I and the ALARA analysis guidance in NUREG1757, Volume 2,

Appendix N. The outcome of this effort would be a release criterion for residual DU in soil in excess of 35 pCi/g.

Other sites have performed evaluations and obtained site-specific release criteria using a DCGL for soil in excess of 35 pCi/g. For example, the DCGL for uranium at the Sequoyah Fuels site was 110 pCi/g for a release criterion of 25 mrem/yr. A corresponding ALARA evaluation indicated an ALARA action level of 4,780 pCi/g uranium, thus demonstrating that the 110 pCi/g value was ALARA. Therefore, it is assumed that a site-specific release level of 110 pCi/g or greater for soils could be established using the release criteria for surface contamination levels discussed in the following sections.

3.3 Identification of Potential Radionuclides of Concern

A list of potential ROCs has been developed.

The ROCs in incoming ore concentrate and the plant-specific waste streams were assessed. Evaluating the various forms of uranium found in the incoming ore concentrate and the plant waste streams, the following was concluded:

- Dose exposure from the incoming ore concentrate is primarily (more than 90 percent) driven by the presence of Radionuclides Uranium-234 (U-234), U-235, and Uranium-238 (U-238).
- Dose exposure based on on-site and off-site environmental air monitoring data is primarily driven (more than 90 percent) by the presence of Radionuclides U-234, U-235, and U-238.
- Dose exposure based on uranium recovery solid wastes is primarily driven by the presence of Radionuclides Radium-226 (Ra-226), Thorium-230 (Th-230), and Thorium-232 (Th-232).
- Dose exposure based on water effluent monitoring data is primarily driven by the presence of Radionuclides Ra-226, U-234, and U-238.

Radionuclides U-234, U-235, and U-238 were identified as the base ROC group. Radionuclides Ra-226, Th-230, and Th-232 were designated as modified ROC Group 1. Radionuclides Ra-226, U-234, and U-238 were designated as modified ROC Group 2.

Within the plant operational processes, the uranium recovery process occurs in the following locations:

- FMB (BD-29) (P-6)
- Cylinder Wash Area (BD-15) (P-13)
- Bed Materials and Filter Fines Building (BD-33) (P-15)

- Waste Storage Area (BD-80) (P-17).

Thus, 4 of the 29 plant areas were assessed using the base ROC group and modified ROC Group 1. The remaining plant operational areas (25 of the 29 plant areas) were assessed using the base ROC group.

The water effluent location is the National Pollutant Discharge Elimination System (NPDES) outfall (NP-1), and this area was assessed using the modified ROC Group 2. All remaining non-plant areas (NP-2 through NP-5) were assessed using the base ROC group.

3.4 Characterization Data for Prior Assessments of Radiological Conditions

Available data and previous experience were used to estimate the extent of remediation that will be required during decommissioning. The characterization data used to estimate the decommissioning costs in the *Site Reclamation Cost Estimate for Plant Located in Metropolis, Illinois, Revision 0* dated May 2006 (2006 Site Reclamation Cost Estimate Report) included removable activity survey data and environmental sampling data.

The removable activity survey data were utilized to help determine which buildings and indoor areas required remediation. Fixed activity data were not available. The average and maximum activity levels measured for each building were provided in the 2006 Site Reclamation Cost Estimate Report. The limit used for removable activity for U-nat was 1,000 dpm/100 cm^2. No additional data from buildings and indoor areas were collected during this evaluation.

This report uses data collected during the 2009 Radiological Characterization Report site characterization assuming a site-specific soil release level of 110 pCi/g.

3.4.1 Main Production Buildings

Survey data included in the 2006 Site Reclamation Cost Estimate Report for the main production buildings indicated that (in general) these buildings were contaminated and would require remediation. Specifically, the FMB (BD-29), Uranium Recovery Building (BD-19), KOH Muds Building (BD-20), and Sampling Plant (BD-23) exceeded the release level assumed for the 2006 Site Reclamation Cost Estimate Report. This DCE assumes no change in the radiological status of these buildings.

3.4.2 Miscellaneous Production Buildings

Survey data included in the 2006 Site Reclamation Cost Estimate Report for the miscellaneous production buildings indicated that (in general) these buildings were not contaminated and would not require extensive remediation.

Based on prior history, the Pond Muds Filter Calciner Building (BD-16) is assumed to require remediation in the 2006 Site Reclamation Cost Estimate Report. This DCE assumes no change in the radiological status of these buildings.

3.4.3 Drum Storage Pads and Ponds

The Drum Storage Pad, the former KOH Muds Storage Pad (which now serves as a Drum Storage Pad), the Waste Storage Pad, and the Ore Storage Pads were assumed in the 2006 Site Reclamation Cost Estimate Report to require remediation. Uranium Settling Pond Nos. 3 and 4 were assumed in the 2006 Site Reclamation Cost Estimate Report to require remediation based upon data from Uranium Settling Pond Nos. 1 and 2 that required remediation at closure. This DCE assumes no change in the radiological status of these areas.

3.4.4 Outdoor Areas, Drains, and Sewers

Prior to the 2009 site characterization, there were limited data available for surface and subsurface soils in the plant and non-plant areas. The site characterization completed in 2009 focused on plant and non-plant surface and subsurface soils. Characterization activities excluded subsurface piping systems to eliminate disruptions to plant operations. Assumptions were made to estimate the potential impacts to subsurface piping systems. A significant volume of impacted soil was identified beyond the volume estimated in the 2006 Site Reclamation Cost Estimate Report.

The volume of impacted soil in Plant Areas P-1 through P-25 estimated during the 2009 characterization is as follows:

- Plant area soil impacted to a depth of approximately 1 foot below grade was identified in an estimated footprint area of 489,435 square feet (ft^2). Therefore, an additional 489,435 ft^3 of impacted soil was added to the 2009 DCE.

- Plant area soil impacted to a depth of approximately 3 feet below grade was identified in an estimated footprint area of 69,609 ft^2. Therefore, an additional 139,218 ft^3 (69,609 ft^2 by 2 feet) of impacted subsurface soil was added to the 2009 DCE.

- Plant area soil impacted to a depth of approximately 6 feet below grade was identified in an estimated footprint area of 30,013 ft^2. Therefore, an additional 90,039 ft^3 (30,013 ft^2 by 3 feet) of impacted subsurface soil was added to the 2009 DCE.

The volume of impacted soil in the non-plant areas (NP-1 through NP-5 and P-26) estimated during the 2009 characterization is as follows:

- NP-1 – Impact of 7,649 ft^3 of soil was estimated based on the 2009 characterization.
- NP-2 – No additional impacts were discovered based on the 2009 characterization.
- NP-3 – Impact of 16,020 ft^3 of soil was estimated based on the 2009 characterization.
- NP-4 – Impact of 37,500 ft^3 of soil was estimated based on the 2009 characterization.
- P-26 and NP-5 – Impact of 49,025 ft^3 of soil was estimated based on the 2009 characterization.

In summary, the volume of impacted soil adjacent in the non-plant areas (NP-1 through NP-5 and P-26) was estimated during the 2009 characterization to be approximately 110,194 ft^3.

The volume of impacted soil adjacent to subsurface piping was estimated during the 2009 characterization to be approximately 129,622 ft^3.The additional impacted soil volume for plant areas (P-1 through P-25), non-plant areas (P-26 and NP-1 through NP-5), and impacted soil adjacent to subsurface piping identified in the 2009 DCE was estimated to be 718,692 ft^3, 110,194 ft^3, and 129,622 ft^3, respectively. Routine characterization surveys performed since 2009 do not indicate that the amount of impacted surface and subsurface soil material needs to be revised.

3.4.5 Administrative Areas

The Administration Building (BD-1), the Laboratory and HP Building (BD-2), the Maintenance Shop/Store/Office Building (BD-6), and the Power House (BD-7) were previously identified as not contaminated. Because radioactive materials were used in the Laboratory and HP Building (BD-2), some remediation in this area would be required. This DCE assumes the Laboratory and HP Building (BD-2) in its entirety will be demolished and the resulting debris will be sent for disposal. At the same time, the roof above the laundry in the Administration Building (BD-1) will be removed if found to be contaminated.

3.4.6 Calcium Fluoride Ponds B, C, D, and E

Ponds B, C, D, and E are Resource Conservation and Recovery Act (RCRA)-regulated surface impoundments. Characterization of the ponds was completed by Honeywell in 2009. Pond closure requirements are currently being undertaken. RCRA financial assurance for the calcium fluoride pond closures is accounted for separately and is not part of this DCE.

3.4.7 Roads

Based on the 2009 characterization data, the subgrade material under the roads (P-25) inside the restricted area was characterized as having little or no radiological impact. Therefore, no adjustment to the impacted volume of soil was made.

In 2012, Honeywell replaced most of the asphalt roads inside the restricted area with concrete. The project required removal of approximately 6 inches of asphalt and subgrade material so that the concrete roadway could be constructed.

Prior to the removal of the asphalt paving material, a walkover survey was performed. The walkover survey results showed little to no radiological impact to the asphalt paving material. Therefore, the material which was removed was managed as non-impacted material. Subsequently, Honeywell used the asphalt and subgrade material as fill within the plant.

3.4.8 Aisle No. 5 of the Uranium Hexafluoride Pad

In August 2011, ENERCON performed a radiological survey of Aisle No. 5 of the UF_6 pad. The details of this survey are provided in *Radiological Characterization Report of the UF_6 Pad* (prepared by ENERCON). This survey was performed because the existing concrete in Aisle No. 5 was scheduled to be removed so that the areas could be repaved. The results of the survey showed some elevated activity in the concrete and no impacts to the aggregate beneath the existing concrete pad. The clean concrete in Aisle No. 5 was removed, crushed, and utilized as fill in the Waste Storage Area.

3.4.9 Support Trailers

In 2011, Honeywell installed a 12-wide trailer (BD-69) and an additional training trailer (BD-58) in the old Liquid Petroleum Gas Area (northwestern corner of the restricted area) to provide office space to support ongoing site operations. The administrative activities being conducted in the trailers are not expected to

result in any impacts to building surfaces or soil. Therefore, no adjustments were made to the DCE due to the installation of these trailers.

3.4.10 RCRA KOH Muds Drums Storage Building

In 2009, Honeywell installed the RCRA KOH Muds Storage Building (BD-26) (an opened wall structure) in the southern portion of the Ore Storage Pad area. The location of BD-26 is depicted in Figure 3 (Drawing No. MTW-2800, Rev AF). The original concrete pad is still in place and was only cut at the footer/foundation locations for the building column installation. The Ore Storage Pads are considered impacted, and the volume of impacted concrete was not adjusted for this update. The building is comprised of steel columns, trusses, and a sheet metal roof. It is assumed for this DCE that the building will be demolished.

3.4.11 Sheet Metal Buildings

In 2012, Honeywell installed two sheet metal buildings. The Waste Sorting Building (BD-92) was installed west of the Surface Treatment Facility. The Capital Fabrication Building (BD-93) was installed south of the Sampling Plant (BD-23). It has a poured concrete floor with industrial coating to prevent migration of contamination into the concrete. Based on historical knowledge of the activities that occur in these buildings and contamination control measures, it is assumed that there will be no radiological impacts.

3.4.12 Calcium Fluoride Pond Removal Rail Spur

In preparation for load out of the calcium fluoride ponds, a new rail spur was installed parallel to and outside the western fence line from the main rail line to a point west of Ponds C and E. When completed, the section of rail spur directly west of the ponds will have a fenced security impoundment. Rail cars will be pulled into this impoundment, loaded with materials from the calcium fluoride ponds, undergo the necessary radiological and security evaluations, and then be released to be transported for disposal.

Prior to the work commencing on the land area, ENERCON performed a radiological evaluation documented in the *Preconstruction Radiological Survey Report Surface Impoundment Closure* dated January 25, 2018. This evaluation identified one location approximately 1 meter in diameter near NPDES Outfall 005 which was subsequently removed by Honeywell.

4.0 DECOMMISSIONING COST ESTIMATION METHODS

This section of the DCE report documents the considerations and factors used to prepare this DCE.

The estimated cost to decommission the Honeywell MTW is approximately $192,463,202. Appendix A-2 provides a summary of the costs for each area of the facility.

4.1 Cost Escalation Factor

The cost escalation methodology specified in NUREG-1307, Revision 15, was not utilized.

4.2 Summary of Decommissioning Costs

The summary of decommissioning costs is shown in Table 4-1.

Table 4-1: Decommissioning Cost Summary – Honeywell Facility

Operation	Man-hours	Labor Plus Travel & Living	Waste Disposal	Equipment, Supplies & Subcontracts	Total Cost
Main Production Buildings	41,639	$2,613,279	$51,880,942	$540,319	$55,034,540
Misc. Production Buildings	31,744	$2,089,565	$4,202,990	$299,892	$6,592,446
Drum Storage Pads and Ponds	4,880	$298,634	$482,333	$39,364	$820,330
Outdoor Areas, Drains, & Sewers	8,948	$599,898	$26,261,254	$195,762	$27,056,913
Administrative Areas	4,592	$315,613	$249,760	$24,850	$590,223
Additional Soil Plant Areas P1-P25	28,228	$1,837,131	$14,874,688	$472,089	$17,183,907
Decommissioning Planning	736	$91,555	$0	$0	$91,555
Planning, Training & Mobilization	24,572	$1,648,611	$0	$0	$1,648,611
Oversight, Reporting & Licensing	93,392	$19,498,013	$0	$18,364,770	$37,862,783
NRC Fees	-----	-----	-----	$1,166,000	$1,166,000
Asbestos Removal and Disposal	-----	-----	$1,602,000	$1,084,560	$2,686,560
Totals	238,731	$28,992,297	$99,553,966	$22,187,606	$150,733,869
			25% CONTINGENCY		$37,683,467
			ILLINOIS RAD WASTE FEE ($3/ft^3)		$4,045,866
			GRAND TOTAL		$192,463,202

4.3 Radioactive Waste Disposal Cost

This report reflects the current estimated waste on-site and whether it is going to the Energy*Solutions* disposal facility or to the US Ecology disposal facility. The following sections describe the costs provided to Honeywell for the various disposal pathways.

For purposes of the DCE, the following were applied for terms of disposal:

- Lidded high-sided gondola rail cars for disposal to Energy*Solutions* at $220,000 each at 150,000 pounds per gondola car or $1.47 per pound.
- Lidded low-sided gondola cars for disposal at US Ecology at $17,500 per gondola car at 75,000 pounds per gondola car, including asbestos at $0.24 per pound.

Appendix A-2 provides a summary of the disposal costs and Appendix A-3 provides a summary of the labor unit cost information.

4.4 Remediation Methods

Remediation methods considered contamination levels, degree of penetration of contamination into substrate material, equipment cost, support equipment costs, material and chemical costs, the generation of secondary waste volumes (waste in addition to the removed contaminated material), processing rates, labor requirements, and applicability to various tasks. The process consists of removing all components and equipment with unimportant quantities of contamination from each structure or area and placing them in rail cars for disposal primarily at US Ecology facilities.

This is followed by survey of the remaining structures and areas in a manner that the surveys will meet the requirement for final status survey. For the main production buildings, the process is the same except that the structures will also be demolished along with the components placed in rail cars. These structures and components will be treated as having contamination exceeding levels that would qualify as unimportant quantities and will be disposed at Energy*Solutions*. All the remaining pads throughout the site will be scabbled to remove residual surface contamination, and the resulting material is anticipated to meet the definition of unimportant quantities and will be disposed at US Ecology.

Productivity loss factors (Table 4-2) have been applied to demolition tasks to adjust for the various constraints to efficiency because of working with radioactive materials.

Table 4-2: Productivity Loss Factors

	Height	Resp. Protection	Rad/ ALARA	Subtotal	Protective Clothing	Subtotal	Breaks	TOTAL PLF
	15.00%	38.00%	15.00%		23.00%		8.00%	
All factors	0.15	0.38	0.15	0.68	0.23	2.07	0.08	2.23
All except Height		0.38	0.15	0.53	0.23	1.88	0.08	2.03
Protective Clothing, Radiological Work, and Respirator Only		0.38	0.15	0.53	0.23	1.88		1.88
All factors except Respirator	0.15		0.15	0.30	0.23	1.60	0.08	1.73
Height, Protective Clothing, and Radiological Work only	0.15		0.15	0.30	0.23	1.60		1.60
Protective Clothing, Radiological Work, and Breaks			0.15	0.15	0.23	1.41	0.08	1.53
Protective Clothing and Rad only			0.15	0.15	0.23	1.41		1.41
Height and Breaks only	0.15			0.15		1.15	0.08	1.24
Height only	0.15			0.15		1.15		1.15
Breaks only				0.00		1.00	0.08	1.08

Source: AIF/NESP-036

The productivity loss factor of 2.23 was applied to the summary tables for each of the buildings listed below:

- Laboratory and HP Building (BD-2)
- Cylinder Wash Building (BD-15)
- Pond Muds Filter Calciner Building (BD-16)
- Sodium Removal Building (BD-17)
- Uranium Recovery Building (BD-19)
- KOH Muds Building (BD-20)
- Drum Dumping Area and Sampling Plant (BD-21)
- Sampling Plant (BD-23)
- RCRA KOH Muds Storage Building (BD-26)
- Safety Building (BD-28)
- FMB (BD-29)
- Bed Materials and Filter Fines Building (BD-33)
- Drum Crusher Building (BD-34)
- Ion Exchange Building (BD-37)
- Sand Blast Building (BD-39)
- Drum Crusher Building (BD-41)
- Drum Wash Building (BD-79)
- H2S Incinerators Control (BD-89)
- Tank Yard

4.5 Unit Costs

Select 2018 unit cost rates are shown in Table 4-3. Rates listed in Table 4-3 are prevailing rates.

Table 4-3: Decommissioning Estimate Selected Unit Cost Factors

Unit Cost Factor	2018 Unit Cost Rate	Units
Radioactive Soil and Rubble Disposal at Energy*Solutions* of Utah	$220,000.00	150,000 lb. Rail Car
Waste Transportation to US Ecology includes Asbestos	$17,500.00	75,000 lb. Rail Car
Waste Transportation to Energy*Solutions* of Utah	$4.30	mile
Management and Supervision	$160.00	hour
Engineer	$120.00	hour
Radiation Protection Supervisor	$110.00	hour
Laborer Foreman	$92.60	hour
Administrative Assistant	$60.00	hour
Equipment Operator	$81.05	hour
Instrument Technician	$85.00	hour
Radiation Protection Technician	$85.00	hour
Laborer	$60.70	hour

4.6 Final Status Surveys

This report assumes that a post-remediation survey of each structure or area is completed. These post-remediation surveys are to be performed in such a manner that if no contamination is found, the results may be used as final status survey data or to augment final survey data.

5.0 DESCRIPTION OF THE DECOMMISSIONING PROCESS

Decommissioning of the Honeywell facility will require that residual radioactive materials be removed or remediated to meet the unrestricted release criteria to allow removal of the decommissioned facilities from the site's radioactive materials license. The unrestricted release means no restrictions are imposed upon the site after license termination. Numerous structures will remain after license termination. These structures will not have had their structural soundness compromised by decommissioning activities.

5.1 Asbestos Removal

The initiating event for decommissioning is to remediate all the asbestos sitewide utilizing the services of an asbestos abatement contractor licensed to perform work in the State of Illinois. After a structure has been remediated or identified as asbestos free, the radiological decommissioning tasks can begin. All waste generated during the asbestos remediation is anticipated to go to US Ecology for disposal.

5.2 Wipe Down and Application of Fixative

After the asbestos removal has been completed for a structure or area, a crew will wipe down all the interior surfaces of the buildings and equipment in each of the structures. For the structures designated for demolition, a fixative will be applied to all accessible surfaces of the buildings and equipment.

5.3 Lead Survey

After the wipe down and fixative application has been completed, an equipment and structure evaluation will take place to determine if there is any lead-based paint present.

5.4 Characterization Surveys

Areas of the facility that are not anticipated to be demolished and have a history of radioactive materials use or storage will have radiological surveys conducted. Survey results will determine the extent of remediation, if any, required to achieve release of these areas for unrestricted use. Characterization surveys are normally performed in such a manner that if no contamination is found, the results may be used as final status survey data or to augment final survey data.

5.5 Remediation

The general remediation approach assumes that source material and waste will be removed from process areas and that no remediation is required in administrative areas except for the Laboratory and HP Building (BD-2).

Further discussion of the individual remediation tasks follows.

5.5.1 Main Production Buildings

The entire FMB (BD-29) structure, concrete slab, building pads, and all the equipment are considered to be contaminated. The building and associated encased equipment will be demolished and removed from the site for processing or disposal at an authorized waste disposal facility.

The Ion Exchange Building (BD-37), Sodium Removal Building (BD-17), KOH Muds Building (BD-20), Uranium Recovery Building (BD-19), Drum Dumping Area and Sampling Plant (BD-21), the Production Offices on the eastern side of SGF2/Anode Prep Building (BD-3), the Safety Building (BD-28), FMB South Pad, and H2S Incinerators Control (BD-89) will be demolished. The structures and all the equipment housed within are considered to be contaminated and will be demolished and removed from the site for disposal at an authorized waste disposal facility.

After all the buildings are removed to the concrete slab, the slabs and the basement of the FMB (BD-29) will be removed along with the subsurface soil to a depth of 3 feet. It is anticipated that these materials will go to US Ecology.

5.5.2 Production Support Buildings

The Ore Storage Building (BD-18), Bed Materials and Filter Fines Building (BD-33), Pond Muds Filter Calciner Building (BD-16), Cylinder Wash Building (BD-15), and Drum Crusher Building (BD-34) are considered to be contaminated. The Pond Muds Filter Calciner Building (BD-16) and associated equipment will be demolished and removed from the site for processing or disposal at an authorized waste disposal facility. Building concrete slabs will be left in place after being decontaminated using surface removal methods.

The South GF2 Plant Building (BD-3), GF2 Plant (BD-4), Liquid Fluorine Facility (BD-14), Surface Treatment Facility (BD-42), and Calcium Fluoride Building (BD-25) are not anticipated to require remediation. The duct work associated with the heating, ventilation, and air conditioning (HVAC) system

for these buildings will be surveyed and, if contaminated, will be removed and disposed of at the appropriate waste site.

5.5.3 Miscellaneous Building and Structures to be Demolished

In the footprint of the Environmental Protection Facility Building (BD-10), three tanks (801, 804, and 915) will be demolished based on their use during operation and disposed at an authorized waste disposal facility.

The Drum Wash Building (BD-79), Break Room Shed (BD-80), Bed Materials and Filter Fines Building (BD-33), Drum Crusher Building (BD-34), Ion Exchange Building (BD-37), and Drum Crusher Building (BD-41) all will be demolished, and their debris treated as radioactive waste.

5.5.4 Drum Storage Pads and Uranium Settling Ponds

The Ore Storage Pads, the former KOH Muds Storage Pad (which now serves as a Drum Storage Pad), Drum Storage Pad, and Waste Storage Pad are considered to be contaminated. The concrete slabs will be left in place after surface contamination is mechanically removed.

Uranium Settling Pond Nos. 3 and 4 are contaminated and will be remediated by removing the pond sediments, pond liner, and contaminated soil under the ponds for disposal at an authorized waste disposal facility.

The balance of miscellaneous equipment, piping, and tanks associated with Uranium Settling Pond Nos. 3 and 4 is assumed to be contaminated and will be demolished and disposed at Energy*Solutions*.

5.5.5 Outdoor Areas, Drains, and Sewers

The sanitary system is assumed to be impacted; therefore, it will require demolition.

The entire process system and portions of the storm water system were assumed to be impacted.

No characterization was performed near subsurface piping systems during the 2009 site characterization due to ongoing production at the site. The determining factor for the storm water system was based on whether or not the piping was located downgradient of an area that had impacts to surface and subsurface soils. If a subsurface piping system was assumed to be impacted, remediation was assumed to consist of removing the piping and associated backfill. A typical cross section (3 feet wide by 5 feet deep) was used to estimate the removal volume. The disposition of the impacted piping and backfill was assumed to be disposal at an authorized waste disposal facility.

The drainage swale from Outfall 002 (formerly referred to as "The Discharge Ditch to River" in the 2006 Site Reclamation Cost Estimate Report) is contaminated and will be remediated by removing the ditch sediments and surrounding impacted soil for disposal at an authorized waste disposal facility. The typical cross section assumed was a 2-foot-deep trapezoidal-shaped channel with a 3-foot bottom and 2 horizontal to 1 vertical side slopes. The total length was estimated to be approximately 2,770 feet. No changes were made to these assumptions in this update of the DCE.

The other four notable impacts to areas outside the restricted area include east of the Ore Storage Pads, along River Road, the road to the inactive landfill, and the landfill. The impacts along River Road were detected approximately 25 feet on either side of the center of River Road over approximately 750 feet. The impacts east of the Ore Storage Pads were in a drainage swale located east of the Ore Storage Pads. The typical cross section assumed a 1-foot-deep rectangular-shaped channel with a 3-foot-wide bottom. Approximately 675 feet of drainage swale was assumed to be impacted. The impacts along the road to the inactive landfill were isolated. Due to limited sampling, which did not allow for extensive delineation, an area that was assumed to be impacted was used.

The 38-acre area on the eastern perimeter west of the eastern rail spur along the Honeywell property line is known as the Landfill and Kickback area. This location was known to be used by a previous owner for creosote processing. Additionally, Honeywell used this space as a subsurface disposal area from the late 1950s through to the mid-1980s.

The process to remediate this area is as follows:

- All known files and historical documents in the public and private domain concerning this area are to be reviewed.
- A ground penetrating radar survey will be performed to determine the approximate boundaries of the area in question and to determine the nature of the near-surface materials.
- An electromagnetic survey of the area will be conducted to determine materials that appear to be below the range of the ground penetrating radar. This technique will allow for evaluation to a depth of 30 feet if needed. The results of the electromagnetic survey will also be used to assist in the determination of the nature of landfill materials.
- After an understanding of the boundaries, depth, and subsurface materials present are established, the next evolution is to begin the excavation of the identified area and to load the materials into

suitable containers for transport and disposal. The containers will be staged for sampling and analysis.

- Sampling will occur for each 25 cubic yards of excavated materials. After the sample results are received, the containers can be loaded in suitable transport for disposal.

5.5.6 Final Status Surveys

Final status surveys will be performed using the guidance provided in NUREG-1575, MARSSIM. The surveys will be performed in accordance with specifically developed plans and procedures.

5.5.7 Survey Instrumentation

Selection and use of instrumentation will ensure sensitivities are sufficient to detect the identified nuclides at the minimum detection requirements. A list of typical final status survey instrumentation, radiation detected, and calibration sources is provided in Table 5-1.

Table 5-1: Typical Final Status Survey Instrumentation

Instrument/Detector	Detector Type	Radiation Detected	Calibration Source	Use
Ludlum Model 2350 with 4368, 43-98, 43-94 or 43-106 detector	Gas-flow proportional (126 cm^2)	Alpha or beta	99Tc (β) 230Th (α)	Direct alpha and direct beta surveys; Beta scans on solid surfaces.
Ludlum Model 2350/ SP-1133m or SP-175-3m	GM Pipe Detector	Alpha or beta	99Tc (β) 230Th (α)	Direct beta pipe survey.
Ludlum Model 2350 with 44-40 detector	Shielded GM (15.5 cm^2)	Beta	99Tc (β)	Direct beta surveys; Beta scans on solid surfaces.
Ludlum Model 2350 with 44-2 or 44-10 detector	NaI (Tl) Scintillator	Gamma	137Cs	Gamma exposure rate and gamma scans.
Eberline Teletector Model 6112B	Ion Chamber	Gamma	60Co (γ)	Gamma exposure rate
Eberline SAC-4 Scaler Counter	ZnS scintillator	Alpha	230Th (α)	Smear counting
Eberline BC-4 Scaler Counter	Shielded GM	Beta	99Tc (β)	Smear counting
Tennelec/Planchette Counter or Equal	Shielded Gas-flow proportional	Alpha and Beta	99Tc (β), 230Th (α)	Smear counting
EG&G NOMAD Gamma Spectrometer or Equal	HPGe	Gamma energy and intensity	Mixed gamma	Nuclide identification and quantification of soil and sand samples.

6.0 REFERENCES

American National Standards Institute, 2012, "Packaging of Uranium Hexafluoride for Transport," ANSI N14.1.

Code of Federal Regulations, 10 CFR 20.1402, Radiological Criteria for Unrestricted Use.

Code of Federal Regulations, 10 CFR 30, Rules of General Applicability to Domestic Licensing of Byproduct Material.

Code of Federal Regulations, 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste.

Enercon Services, Inc., 2006, *Site Reclamation Cost Estimate for Plant Located in Metropolis, Illinois, Revision 0*, May 2006.

Enercon Services, Inc., 2009, *Historical Site Assessment, Revision 0.*

Enercon Services, Inc., 2010, *Radiological Characterization Report for Site Soils, Revision 0*, January 11, 2010.

Enercon Services, Inc., 2010, Modified DCGLs for the Honeywell Metropolis Works (draft), April 29, 2010.

Enercon Services, Inc., 2010, *Decommissioning Cost Estimate for Honeywell Metropolis Works, Revision 1*, July 27, 2010.

Enercon Services, Inc., 2011, *Radiological Characterization Report of the UF_6 Pad* for the Honeywell Metropolis Works (UF6PAD-RPT-001), Revision 0, October 31, 2011.

Enercon Services, Inc., 2012, *Decommissioning Cost Estimate for Honeywell Metropolis Works, Revision 0*, August 15, 2012.

Enercon Services, Inc., 2016, *Decommissioning Cost Estimate for Honeywell Metropolis Works, Revision 1*, April 20, 2016.

Enercon Services, Inc., 2018, *Preconstruction Radiological Survey Report Surface Impoundment Closure*, January 25, 2018.

NUREG-1307, 2013, *Report on Waste Burial Charges*, Revision 15, January 2013.

NUREG-1575, 2000, Rev. 1, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), August 2000.

NUREG-1757, Vol. 1, Rev. 1, Consolidated Decommissioning Guidance Decommissioning Process for Materials Licensees, Table B.1, Acceptable License Termination Screening Values of Common Radionuclides for Building-Surface Contamination.

NUREG-1757, Vol. 1, Rev. 1, Consolidated NMSS Decommissioning Guidance Decommissioning Process for Materials Licensees, Table B.2, Screening Values (pCi/g) of Common Radionuclides for Soil Surface Contamination Levels.

NUREG-1757, Vol. 2, Rev. 1, Consolidated Decommissioning Guidance Characterization, Survey, and Determination of Radiological Criteria, September 2006.

NUREG-1757, Vol. 3, Rev. 1, Consolidated Decommissioning Guidance, Financial Assurance, Recordkeeping, and Timeliness, PART II: Financial Assurance.

NUREG/CR-5512, Volume 2, Residual Radioactive Contamination From Decommissioning: User's Manual DandD Version 2.1," Decontamination and Decommissioning (DandD).

R.S. Means Company, Inc., 2006, *Means Building Construction Cost Data*, 64th Annual Edition.

R.S. Means Company, Inc., 2015, *Site Work & Landscape Cost Data*, 34th Annual Edition.

U.S. Nuclear Regulatory Commission, Federal Register, 1981, "Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations," Vol. 46, No. 205, Pages 52061-3, October 23, 1981

U.S. Nuclear Regulatory Commission, Policy and Guidance Directive FC 83-23, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Byproduct, Source, or Special Nuclear Material Licenses."

APPENDIX A-1
DURATION

Task Durations Summary

Project Name: **Honeywell MTW Decommissioning Cost Estimate**

WBS #		Task Identification	Duration (Days)
3.1.1		BD - 1 Administrative Building	45
3.1.10		BD - 10 FPF Area Building	30
3.1.101		BD - 101 Storage Tent	1
3.1.1040		U-1040 and U-1041 Sanitary Treatment System	10
3.1.1052		P-1052 Diesel Compressor Trailer South of the Power House	5
3.1.11		BD - 11 CAF2 Recovery Area Building	40
3.1.14		BD - 14 Liquid Flourine Facility	5
3.1.15	*	BD - 15 Cylinder Wash Building	23
3.1.16	*	BD - 16 Pond Muds Calciner Area & Uranium Ponds Equipment Area	34
3.1.17	*	BD - 17 Iodium Removal and BD-19 Uranium Recovery	34
3.1.18		BD - 18 Ore Storage Building	15
3.1.2	*	BD - 2 Laboratory Equipment Building	67
3.1.20	*	BD - 20 KOH Muds Building	12
3.1.21	*	BD - 21 Ore Drum Dumper, Washer & Crusher Building	23
3.1.22		BD - 22 Scale House Area BD - 36	10
3.1.23	*	BD - 23 (ORE) Sampling Plant	45
3.1.24		Ore Storage Pads	55
3.1.25		BD - 25 CFX Building	15
3.1.26	*	BD - 26 RCRA Large Drum Storage Area	12
3.1.27		BD - 27 Switch House Building	5
3.1.28	*	BD - 28 Safety Building	12
3.1.29	*	BD - 29 Feed Materials Building	357
3.1.3		BD - 3 GF2 South Cell Room and Production Offices	45
3.1.31		Drum Storage Pads	15
3.1.32		BD - 32 Supply Storage Building for BD - 69	5
3.1.33	*	BD - 33 Fines Storage Building	67
3.1.34	*	BD - 34 Drum Crusher Building	56
3.1.35		BD - 35 GF2 Cell Cond and Maintenance	65
3.1.37	*	BD - 37 Ion Exchange and Potassium Removal Building	23
3.1.39	*	BD - 39 Sand Blast Building	12
3.1.4		BD - 4 GF2 C Cell Room, ABC South Pad and A&B Rect	50
3.1.41	*	BD - 41 Drum Crusher Building	12
3.1.42		BD - 42 STF Area Building	25
3.1.43		BD - 43 and BD - 76 Contractor Security Entrance	15
3.1.44		BD - 44 KPA Bioassembly Lab Urine Analysis Trailer	5
3.1.48		BD - 48 UF6 Cylinder Storage	40
3.1.49		BD - 49 Storage Shed For Cylinder Hauler	5
3.1.5		BD - 5 GF2 North Cell Room, D&E Rect and D&E South Pad	35
3.1.50		BD - 50 Storage Building	5
3.1.52		BD - 52 Control Room Building for HF Railcar Off Loading	5
3.1.58		BD - 58 Learning Resource Center	10
3.1.6		BD - 6 Shop and Stores Building	20
3.1.601		Portable Steam Supply Trailer East of the Power House	10
3.1.69		BD - 69 Admin - Nuclear Compliance Trailer	5
3.1.7		BD - 7 Power House Building	70
3.1.79	*	BD - 79 Drum Wash Building	12
3.1.8		BD - 8 Paint Building	5
3.1.80		BD-80 Break Room and Shed	12

3.1.83		BD - 83 Liquid Nitrogen Building	5
3.1.84		BD - 84, BD-85, BD-86 and BD-100 Structures	5
3.1.87		BD - 87 Janitorial Storage Building	5
3.1.89	*	BD - 89 Feed Materials Building South Pad East Side	23
3.1.9		BD - 9 Dealkalization Building	5
3.1.92		BD - 92 Waste Sorting Building	10
3.1.94		Waste Storage Area	20
3.1.Sub-11		BD - Sub - 11 CIPS Sub Station	5
3.1.Tank Yard	*	Tank Yard	67
3.3.1		Parking Lot	10
3.3.24		FMB Post Demolition Concrete Pads Survey	35
3.3.25		Roadways and Ground Areas (P-25)	10
3.3.26		Security Exclusion Area (P-26)	10
3.3.27		2009 Subsurface Soils	120
3.3.28		Outfall 002	15
3.3.29		Non-Impacted Outside Plant Areas	205
3.3.30		Landfill and Kickback Area	275
3.3.31		P-23 Fuel Depot	5
3.3.32		Land Area P-21 and P-24	60
Prep		Preparatory Plans and Procedures	23
Lockdown		Lockdown	110
Mob		Mobilization	45
Demob		Demobilization	23
FSS		FSS Samples	40
Report		Final Project Report	70
PM		Project Management	2,560

APPENDIX A-2
COST SUMMARY

Cost Estimate Summary

Project Name: Honeywell MTW Decommissioning Cost Estimate

WBS #	Task Identification	Labor	Travel & Living	Equipment	Subcontracts	Waste Disposal	Total
3.1.1	BD - 1 Administrative Building	$ 122,266.40	$ -	$ 7,343.75	$ -	$ 6,348.00	$ 135,958.15
3.1.10	BD - 10 FPF Area Building	$ 117,494.40	$ -	$ 17,721.55	$ -	$ 84,756.00	$ 219,971.95
3.1.101	BD - 101 Storage Tent	$ 3,532.88	$ -	$ 3,531.56	$ -	$ 144.00	$ 7,208.44
3.1.1040	U-1040 and U-1041 Sanitary Treatment System	$ 41,812.80	$ -	$ 8,705.78	$ -	$ 25,692.00	$ 76,210.58
3.1.1052	P-1052 Diesel Compressor Trailer South of the Power House	$ 25,227.20	$ -	$ 5,902.45	$ -	$ 9,612.00	$ 40,741.65
3.1.11	BD - 11 CAF2 Recovery Area Building	$ 91,679.20	$ -	$ 7,043.53	$ -	$ 43,728.00	$ 142,450.73
3.1.14	BD - 14 Liquid Flourine Facility	$ 20,906.40	$ -	$ 4,352.89	$ -	$ 27,492.00	$ 52,751.29
3.1.15	BD - 15 Cylinder Wash Building	$ 48,084.72	$ -	$ 4,559.55	$ -	$ 10,723.68	$ 63,367.95
3.1.16	BD - 16 Pond Muds Calciner Area & Uranium Ponds Equipment Area	$ 101,787.84	$ -	$ 17,490.22	$ -	$ 2,421,163.50	$ 2,540,441.56
3.1.17	BD - 17 Iodium Removal and BD-19 Uranium Recovery	$ 142,163.52	$ -	$ 13,058.67	$ -	$ 521,976.42	$ 677,198.61
3.1.18	BD - 18 Ore Storage Building	$ 42,199.62	$ -	$ 6,491.78	$ -	$ 9,104.88	$ 57,796.28
3.1.2	BD - 2 Laboratory Equipment Building	$ 119,399.22	$ -	$ 8,480.38	$ -	$ 1,714,857.36	$ 1,842,736.96
3.1.20	BD - 20 KOH Muds Building	$ 100,350.72	$ -	$ 4,352.89	$ -	$ 126,611.10	$ 231,314.71
3.1.21	BD - 21 Ore Drum Dumper, Washer & Crusher Building	$ 96,169.44	$ -	$ 13,683.56	$ -	$ 113,384.04	$ 223,237.04
3.1.22	BD - 22 Scale House Area BD - 36	$ 39,649.60	$ -	$ 12,983.56	$ -	$ 7,388.52	$ 60,021.68
3.1.23	BD - 23 (ORE) Sampling Plant	$ 188,157.60	$ -	$ 34,192.92	$ -	$ 215,597.52	$ 437,948.04
3.1.24	Ore Storage Pads	$ 172,721.20	$ -	$ 27,252.00	$ -	$ 417,837.00	$ 617,810.20
3.1.25	BD - 25 CFX Building	$ 42,516.00	$ -	$ 4,662.88	$ -	$ 19,020.00	$ 66,198.88
3.1.26	BD - 26 RCRA Large Drum Storage Area	$ 50,175.36	$ -	$ 7,820.44	$ -	$ 36,812.16	$ 94,807.96
3.1.27	BD - 27 Switch House Building	$ 6,870.80	$ -	$ 103.33	$ -	$ 12.00	$ 6,986.13
3.1.28	BD - 28 Safety Building	$ 7,734.96	$ -	$ 103.33	$ -	$ 17,634.00	$ 25,472.29
3.1.29	BD - 29 Feed Materials Building	$ 1,449,377.16	$ -	$ 412,418.11	$ -	$ 45,702,480.81	$ 47,564,276.08
3.1.3	BD - 3 GF2 South Cell Room and Production Offices	$ 102,869.61	$ -	$ 25,541.09	$ -	$ 86,551.20	$ 214,961.90
3.1.31	Drum Storage Pads	$ 39,649.60	$ -	$ 3,028.00	$ -	$ 9,121.50	$ 51,799.10
3.1.32	BD - 32 Supply Storage Building for BD - 69	$ 6,870.80	$ -	$ 103.33	$ -	$ 12.00	$ 6,986.13
3.1.33	BD - 33 Fines Storage Building	$ 145,466.12	$ -	$ 13,119.78	$ -	$ 210,792.58	$ 369,378.48
3.1.34	BD - 34 Drum Crusher Building	$ 182,475.78	$ -	$ 28,317.34	$ -	$ 435,974.81	$ 646,767.92
3.1.35	BD - 35 GF2 Cell Cond and Maintenance	$ 121,712.25	$ -	$ 10,049.07	$ -	$ 58,188.96	$ 189,950.28
3.1.37	BD - 37 Ion Exchange and Potassium Removal Building	$ 96,169.44	$ -	$ 8,705.78	$ -	$ 630,972.51	$ 735,847.73
3.1.39	BD - 39 Sand Blast Building	$ 50,175.36	$ -	$ 7,820.44	$ -	$ 7,341.84	$ 65,337.64
3.1.4	BD - 4 GF2 C Cell Room, ABC South Pad and A&B Rect	$ 112,585.60	$ -	$ 14,091.97	$ -	$ 71,196.00	$ 197,873.57
3.1.41	BD - 41 Drum Crusher Building	$ 50,175.36	$ -	$ 7,820.44	$ -	$ 15,090.96	$ 73,086.76
3.1.42	BD - 42 STF Area Building	$ 62,719.20	$ -	$ 13,575.32	$ -	$ 85,548.00	$ 161,842.52
3.1.43	BD - 43 and BD - 76 Contractor Security Entrance	$ 29,245.60	$ -	$ 206.66	$ -	$ 12.00	$ 29,464.26
3.1.44	BD - 44 KPA Bioassembly Lab Urine Analysis Trailer	$ 6,870.80	$ -	$ 103.33	$ -	$ 12.00	$ 6,986.13
3.1.48	BD - 48 UF6 Cylinder Storage	$ 86,262.80	$ -	$ 9,084.00	$ -	$ 55,374.00	$ 150,720.80
3.1.49	BD - 49 Storage Shed For Cylinder Hauler	$ 20,906.40	$ -	$ 7,820.44	$ -	$ 1,590.00	$ 30,316.84
3.1.5	BD - 5 GF2 North Cell Room, D&E Rect and D&E South Pad	$ 104,238.00	$ -	$ 18,134.87	$ -	$ 128,580.00	$ 250,952.87
3.1.50	BD - 50 Storage Building	$ 6,870.80	$ -	$ 103.33	$ -	$ 12.00	$ 6,986.13
3.1.52	BD - 52 Control Room Building for HF Railcar Off Loading	$ 23,066.80	$ -	$ 4,456.22	$ -	$ 1,068.00	$ 28,591.02
3.1.58	BD - 58 Learning Resource Center	$ 13,741.60	$ -	$ 206.66	$ -	$ 12.00	$ 13,960.26
3.1.6	BD - 6 Shop and Stores Building	$ 68,505.60	$ -	$ 3,620.21	$ -	$ 240,012.00	$ 312,137.81

Cost Estimate Summary

Project Name: Honeywell MTW Decommissioning Cost Estimate

WBS #	Task Identification	Labor	Travel & Living	Equipment	Subcontracts	Waste Disposal	Total
3.1.601	Portable Steam Supply Trailer East of the Power House	$ 34,261.20	$ -	$ 4,456.22	$ -	$ 10,572.00	$ 49,289.42
3.1.69	BD - 69 Admin - Nuclear Compliance Trailer	$ 6,870.80	$ -	$ 103.33	$ -	$ 1,212.00	$ 8,186.13
3.1.7	BD - 7 Power House Building	$ 286,943.01	$ -	$ 52,648.00	$ -	$ 74,382.00	$ 413,973.01
3.1.79	BD - 79 Drum Wash Building	$ 11,304.96	$ -	$ 103.33	$ -	$ 788.16	$ 12,196.45
3.1.8	BD - 8 Paint Building	$ 6,870.80	$ -	$ 103.33	$ -	$ 12.00	$ 6,986.13
3.1.80	BD-80 Break Room and Shed	$ 50,448.00	$ -	$ 10,776.89	$ -	$ 1,876.18	$ 63,101.07
3.1.83	BD - 83 Liquid Nitrogen Building	$ 6,870.80	$ -	$ 103.33	$ -	$ 12.00	$ 6,986.13
3.1.84	BD - 84, BD-85, BD-86 and BD-100 Structures	$ 17,664.40	$ -	$ 3,310.22	$ -	$ 10,572.00	$ 31,546.62
3.1.87	BD - 87 Janitorial Storage Building	$ 17,664.40	$ -	$ 2,488.89	$ -	$ 276.00	$ 20,429.29
3.1.89	BD - 89 Feed Materials Building South Pad East Side	$ 96,169.44	$ -	$ 6,841.78	$ -	$ 143,374.98	$ 246,386.20
3.1.9	BD - 9 Dealkalization Building	$ 6,870.80	$ -	$ 103.33	$ -	$ 2.40	$ 6,976.53
3.1.92	BD - 92 Waste Sorting Building	$ 13,741.60	$ -	$ 206.66	$ -	$ 1,212.00	$ 15,160.26
3.1.94	Waste Storage Area	$ 52,214.00	$ -	$ -	$ -	$ 419,580.00	$ 471,794.00
3.1.Sub-11	BD - Sub - 11 CIPS Sub Station	$ 6,870.80	$ -	$ 103.33	$ -	$ 12.00	$ 6,986.13
3.1.Tank Yard	Tank Yard	$ 248,799.59	$ -	$ 17,067.75	$ -	$ 70,332.00	$ 336,199.34
3.3.1	Parking Lot	$ 13,741.60	$ -	$ -	$ -	$ -	$ 13,741.60
3.3.24	FMB Post Demolition Concrete Pads Survey	$ 134,483.60	$ -	$ 16,550.67	$ -	$ 2,537,664.00	$ 2,688,698.27
3.3.25	Roadways and Ground Areas (P-25)	$ 11,191.60	$ -	$ -	$ -	$ -	$ 11,191.60
3.3.26	Security Exclusion Area (P-26)	$ 39,662.20	$ -	$ 19,155.56	$ -	$ 871,689.60	$ 930,507.36
3.3.27	2009 Subsurface Soils	$ 544,343.17	$ -	$ 187,056.32	$ -	$ 26,235,561.60	$ 26,966,961.09
3.3.28	Outfall 002	$ 63,422.40	$ -	$ 19,155.56	$ -	$ 1,073,649.00	$ 1,156,226.96
3.3.29	Non-Impacted Outside Plant Areas	$ 458,855.60	$ -	$ -	$ -	$ -	$ 458,855.60
3.3.30	Landfill and Kickback Area	$ 1,174,678.40	$ -	$ 433,777.92	$ -	$ 12,929,337.00	$ 14,537,793.32
3.3.31	P-23 Fuel Depot	$ 6,870.80	$ -	$ -	$ -	$ -	$ 6,870.80
3.3.32	Land Area P-21 and P-24	$ 82,449.60	$ -	$ -	$ -	$ 12.00	$ 82,461.60
Prep	Preparatory Plans and Procedures	$ 91,554.72	$ -	$ -	$ -	$ -	$ 91,554.72
Lockdown	Lockdown	$ 1,377,927.76	$ -	$ -	$ -	$ -	$ 1,377,927.76
Mob	Mobilization	$ 179,128.80	$ -	$ -	$ -	$ -	$ 179,128.80
Demob	Demobilization	$ 91,554.72	$ -	$ -	$ -	$ -	$ 91,554.72
FSS	FSS Samples	$ 65,998.40	$ -	$ -	$ 364,770.00	$ -	$ 430,768.40
Report	Final Project Report	$ 278,644.80	$ -	$ -	$ -	$ -	$ 278,644.80
PM	Project Management	$ 10,465,853.44	$ 8,687,516.40	$ -	$ 1,084,559.73	$ 1,602,000.00	$ 21,839,929.57
		==========	==========	==========	==========	==========	==========
	Subtotal	**$ 20,304,781**	**$ 8,687,516**	**$ 1,572,276**	**$ 1,449,330**	**$ 99,553,966**	**$ 131,567,869**

TOTAL - BASE COST	$ 131,567,869
Regulatory Fees	$ 18,000,000
NRC Fees	$ 1,166,000
Illinois Rad Waste Fee ($3/ft^3)	$ 4,045,866
25% Contigency	$ 37,683,467
TOTAL ALL COSTS	**$192,463,202**

APPENDIX A-3
WASTE SUMMARY

ENERCON Waste Volume Summary
Project Name: Honeywell MTW Decommissioning Cost Estimate

WBS #	Task Identification	DAW (lb)	Installed Equipment / Metals (lb)	Asbestos Waste (lb)	Concrete Rubble/Building Rubble (lb)	Soil (lb)
3.1.1	BD - 1 Administrative Building	50	26,400	-	-	-
3.1.10	BD - 10 FPF Area Building	50	182,100	-	171,000	-
3.1.101	BD - 101 Storage Tent	-	600	-	-	-
3.1.1040	U-1040 and U-1041 Sanitary Treatment System	50	107,000	-	-	-
3.1.1052	P-1052 Diesel Compressor Trailer South of the Power House	50	40,000	-	-	-
3.1.11	BD - 11 CAF2 Recovery Area Building	50	182,150	-	-	-
3.1.14	BD - 14 Liquid Flourine Facility	50	114,500	-	-	-
3.1.15	BD - 15 Cylinder Wash Building	50	44,632	-	-	-
3.1.16	BD - 16 Pond Muds Calciner Area & Uranium Ponds Equipment Area	50	108,000	-	-	1,539,000
3.1.17	BD - 17 Iodium Removal and BD-19 Uranium Recovery	50	355,036	-	-	-
3.1.18	BD - 18 Ore Storage Building	25	3,537	-	34,375	-
3.1.2	BD - 2 Laboratory Equipment Building	50	685,925	-	6,459,264	-
3.1.20	BD - 20 KOH Muds Building	-	86,130	-	-	-
3.1.21	BD - 21 Ore Drum Dumper,Washer &Crusher Building	-	77,132	-	-	-
3.1.22	BD - 22 Scale House Area BD - 36	50	4,798	-	25,938	-
3.1.23	BD - 23 (ORE) Sampling Plant	50	158,261	-	740,012	-
3.1.24	Ore Storage Pads	50	15,000	-	1,725,938	-
3.1.25	BD - 25 CFX Building	50	79,200	-	-	-
3.1.26	BD - 26 RCRA Large Drum Storage Area	-	153,384	-	-	-
3.1.27	BD - 27 Switch House Building	50	-	-	-	-
3.1.28	BD - 28 Safety Building	50	-	-	73,425	-
3.1.29	BD - 29 Feed Materials Building	1,000	14,382,873	-	-	16,706,250
3.1.3	BD - 3 GF2 South Cell Room and Production Offices	50	360,580	-	-	-
3.1.31	Drum Storage Pads	38	-	-	37,969	-
3.1.32	BD - 32 Supply Storage Building for BD - 69	50	-	-	-	-
3.1.33	BD - 33 Fines Storage Building	40	90,036	-	53,320	-
3.1.34	BD - 34 Drum Crusher Building	50	223,469	-	73,063	-
3.1.35	BD - 35 GF2 Cell Cond and Maintenance	50	242,404	-	-	-
3.1.37	BD - 37 Ion Exchange and Potassium Removal Building	50	429,183	-	-	-
3.1.39	BD - 39 Sand Blast Building	50	30,541	-	-	-
3.1.4	BD - 4 GF2 C Cell Room, ABC South Pad and A&B Rect	50	296,600	-	-	-
3.1.41	BD - 41 Drum Crusher Building	25	62,854	-	-	-
3.1.42	BD - 42 STF Area Building	50	356,400	-	-	-
3.1.43	BD - 43 and BD - 76 Contractor Security Entrance	50	-	-	-	-
3.1.44	BD - 44 KPA Bioassembly Lab.Urine Analysis Trailer	50	-	-	-	-
3.1.48	BD - 48 UF6 Cylinder Storage	100	-	-	230,625	-
3.1.49	BD - 49 Storage Shed For Cylinder Hauler	25	6,600	-	-	-
3.1.5	BD - 5 GF2 North Cell Room, D&E Rect and D&E South Pad	50	535,700	-	-	-
3.1.50	BD - 50 Storage Building	50	-	-	-	-
3.1.52	BD - 52 Control Room Building for HF Railcar Off Loading	50	4,400	-	-	-
3.1.58	BD - 58 Learning Resource Center	50	-	-	-	-
3.1.6	BD - 6 Shop and Stores Building	50	1,000,000	-	-	-
3.1.601	Portable Steam Supply Trailer East of the Power House	50	44,000	-	-	-
3.1.69	BD - 69 Admin - Nuclear Compliance Trailer	50	5,000	-	-	-
3.1.7	BD - 7 Power House Building	50	309,875	-	-	-
3.1.79	BD - 79 Drum Wash Building	50	3,234	-	-	-
3.1.8	BD - 8 Paint Building	50	-	-	-	-
3.1.80	BD-80 Break Room and Shed	38	7,780	-	-	-
3.1.83	BD - 83 Liquid Nitrogen Building	50	-	-	-	-
3.1.84	BD - 84, BD-85, BD-86 and BD-100 Structures	50	44,000	-	-	-

3.1.87	BD - 87 Janitorial Storage Building	50	1,100	-	-	-
3.1.89	BD - 89 Feed Materials Building South Pad East Side	-	87,566	-	9,968	-
3.1.9	BD - 9 Dealkalization Building	10	-	-	-	-
3.1.92	BD - 92 Waste Sorting Building	50	5,000	-	-	-
3.1.94	Waste Storage Area	-	-	-	-	1,748,250
3.1.Sub-11	BD - Sub - 11 CIPS Sub Station	50	-	-	-	-
3.1.Tank Yard	Tank Yard	50	293,000	-	-	-
3.3.1	Parking Lot	-	-	-	-	-
3.3.24	FMB Post Demolition Concrete Pads Survey	100	-	-	2,593,500	7,980,000
3.3.25	Roadways and Ground Areas (P-25)	-	-	-	-	-
3.3.26	Security Exclusion Area (P-26)	40	-	-	-	3,632,000
3.3.27	2009 Subsurface Soils	40	-	-	-	109,314,800
3.3.28	Outfall 002	38	-	-	-	4,473,500
3.3.29	Non-Impacted Outside Plant Areas	-	-	-	-	-
3.3.30	Landfill and Kickback Area	38	-	-	-	53,872,200
3.3.31	P-23 Fuel Depot	-	-	-	-	-
3.3.32	Land Area P-21 and P-24	50	-	-	-	-
Prep	Pre-Mobilization	-	-	-	-	-
Lockdown	Lockdown	-	-	-	-	-
Mob	Mobilization	-	-	-	-	-
Demob	Demobilization	-	-	-	-	-
FSS	FSS Samples	-	-	-	-	-
Report	Final Project Report	-	-	-	-	-
PM	Project Management	-	-	6,675,000	-	-

TOTAL	**3,705**	**21,245,980**	**6,675,000**	**12,228,396**	**199,266,000**

APPENDIX A-4
LABOR SUMMARY

ENERCON Labor Summary (Hours)
Project Name: Honeywell MTW Decommissioning Cost Estimate

WBS #		Task Identification	Project Manager	Assistant Project Manager	RSO/CHP	EH&S Manager	QA/Waste Manager	Engineer	Cost & Schedule Controls	Adminsitrative Assistant	D&D Supervisor	HP Technician	Laborer (Semi-Skilled)	Equipment Operators	TOTAL
3.1.1		BD - 1 Administrative Building	-	-	-	-	-	-	-	-	360	800	320	80	1,560
3.1.10		BD - 10 FPF Area Building	-	-	-	-	-	-	-	-	200	440	800	400	1,840
3.1.101		BD - 101 Storage Tent	-	-	-	-	-	-	-	-	8	8	32	8	56
3.1.1040		U-1040 and U-1041 Sanitary Treatment System	-	-	-	-	-	-	-	-	80	80	320	160	640
3.1.1052		P-1052 Diesel Compressor Trailer South of the Power House	-	-	-	-	-	-	-	-	40	120	160	80	400
3.1.11		BD - 11 CAF2 Recovery Area Building	-	-	-	-	-	-	-	-	320	720	320	160	1,520
3.1.14		BD - 14 Liquid Flourine Facility	-	-	-	-	-	-	-	-	40	40	160	80	320
3.1.15	*	BD - 15 Cylinder Wash Building	-	-	-	-	-	-	-	-	92	92	368	184	736
3.1.16	*	BD - 16 Pond Muds Calciner Area & Uranium Ponds Equipment Area	-	-	-	-	-	-	-	-	272	544	544	272	1,632
3.1.17	*	BD - 17 Iodium Removal and BD-19 Uranium Recovery	-	-	-	-	-	-	-	-	272	272	1,088	544	2,176
3.1.18		BD - 18 Ore Storage Building	-	-	-	-	-	-	-	-	120	160	320	80	680
3.1.2	*	BD - 2 Laboratory Equipment Building	-	-	-	-	-	-	-	-	536	1,132	238	119	2,025
3.1.20	*	BD - 20 KOH Muds Building	-	-	-	-	-	-	-	-	192	192	768	384	1,536
3.1.21	*	BD - 21 Ore Drum Dumper,Washer &Crusher Building	-	-	-	-	-	-	-	-	184	184	736	368	1,472
3.1.22		BD - 22 Scale House Area BD - 36	-	-	-	-	-	-	-	-	80	160	320	80	640
3.1.23	*	BD - 23 (ORE) Sampling Plant	-	-	-	-	-	-	-	-	360	360	1,440	720	2,880
3.1.24		Ore Storage Pads	-	-	-	-	-	-	-	-	440	520	1,440	360	2,760
3.1.25		BD - 25 CFX Building	-	-	-	-	-	-	-	-	40	200	160	240	640
3.1.26	*	BD - 26 RCRA Large Drum Storage Area	-	-	-	-	-	-	-	-	96	96	384	192	768
3.1.27		BD - 27 Switch House Building	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.28	*	BD - 28 Safety Building	-	-	-	-	-	-	-	-	40	96	-	-	136
3.1.29	*	BD - 29 Feed Materials Building	-	-	-	-	-	-	-	-	2,856	2,856	10,710	5,712	22,134
3.1.3		BD - 3 GF2 South Cell Room and Production Offices	-	-	-	-	-	-	-	-	360	880	320	160	1,720
3.1.31		Drum Storage Pads	-	-	-	-	-	-	-	-	80	160	320	80	640
3.1.32		BD - 32 Supply Storage Building for BD - 69	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.33	*	BD - 33 Fines Storage Building	-	-	-	-	-	-	-	-	536	625	800	357	2,319
3.1.34	*	BD - 34 Drum Crusher Building	-	-	-	-	-	-	-	-	358	538	1,434	538	2,867
3.1.35		BD - 35 GF2 Cell Cond and Maintenance	-	-	-	-	-	-	-	-	520	1,040	320	160	2,040
3.1.37	*	BD - 37 Ion Exchange and Potassium Removal Building	-	-	-	-	-	-	-	-	184	184	736	368	1,472
3.1.39	*	BD - 39 Sand Blast Building	-	-	-	-	-	-	-	-	96	96	384	192	768
3.1.4		BD - 4 GF2 C Cell Room, ABC South Pad and A&B Rect	-	-	-	-	-	-	-	-	360	760	480	240	1,840
3.1.41	*	BD - 41 Drum Crusher Building	-	-	-	-	-	-	-	-	96	96	384	192	768
3.1.42		BD - 42 STF Area Building	-	-	-	-	-	-	-	-	120	120	480	240	960
3.1.43		BD - 43 and BD - 76 Contractor Security Entrance	-	-	-	-	-	-	-	-	120	160	160	40	480
3.1.44		BD - 44 KPA Bioassembly Lab Urine Analysis Trailer	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.48		BD - 48 UF6 Cylinder Storage	-	-	-	-	-	-	-	-	320	680	480	-	1,480
3.1.49		BD - 49 Storage Shed For Cylinder Hauler	-	-	-	-	-	-	-	-	40	40	160	80	320
3.1.5		BD - 5 GF2 North Cell Room, D&E Rect and D&E South Pad	-	-	-	-	-	-	-	-	280	400	640	320	1,640
3.1.50		BD - 50 Storage Building	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.52		BD - 52 Control Room Building for HF Railcar Off Loading	-	-	-	-	-	-	-	-	40	80	160	80	360
3.1.58		BD - 58 Learning Resource Center	-	-	-	-	-	-	-	-	80	160	-	-	240
3.1.6		BD - 6 Shop and Stores Building	-	-	-	-	-	-	-	-	160	360	480	120	1,120
3.1.601		Portable Steam Supply Trailer East of the Power House	-	-	-	-	-	-	-	-	80	120	160	160	520
3.1.69		BD - 69 Admin - Nuclear Compliance Trailer	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.7		BD - 7 Power House Building	-	-	-	-	-	-	-	-	560	933	1,920	1,040	4,453
3.1.79	*	BD - 79 Drum Wash Building	-	-	-	-	-	-	-	-	96	96	-	-	192
3.1.8		BD - 8 Paint Building	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.80		BD-80 Break Room and Shed	-	-	-	-	-	-	-	-	96	96	384	96	672
3.1.83		BD - 83 Liquid Nitrogen Building	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.84		BD - 84, BD-85, BD-86 and BD-100 Structures	-	-	-	-	-	-	-	-	40	40	160	40	280
3.1.87		BD - 87 Janitorial Storage Building	-	-	-	-	-	-	-	-	40	40	160	40	280
3.1.89	*	BD - 89 Feed Materials Building South Pad East Side	-	-	-	-	-	-	-	-	184	184	736	368	1,472
3.1.9		BD - 9 Dealkalization Building	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.92		BD - 92 Waste Sorting Building	-	-	-	-	-	-	-	-	80	160	-	-	240
3.1.94		Waste Storage Area	-	-	-	-	-	-	-	-	40	200	480	120	840
3.1.Sub-11		BD - Sub - 11 CIPS Sub Station	-	-	-	-	-	-	-	-	40	80	-	-	120
3.1.Tank Yard	*	Tank Yard	-	-	-	-	-	-	-	-	536	625	1,787	893	3,841
3.3.1		Parking Lot	-	-	-	-	-	-	-	-	80	160	-	-	240
3.3.24		FMB Post Demolition Concrete Pads Survey	-	-	-	-	-	-	-	-	280	360	800	600	2,040
3.3.25		Roadways and Ground Areas (P-25)	-	-	-	-	-	-	-	-	40	160	-	-	200
3.3.26		Security Exclusion Area (P-26)	-	-	-	-	-	-	-	-	80	220	160	160	620
3.3.27		2009 Subsurface Soils	-	-	-	-	-	-	-	-	960	668	3,680	2,760	8,068
3.3.28		Outfall 002	-	-	-	-	-	-	-	-	80	240	320	320	960
3.3.29		Non-Impacted Outside Plant Areas	-	-	-	-	-	-	-	-	1,640	6,560	-	-	8,200
3.3.30		Landfill and Kickback Area	-	-	848	-	-	-	-	-	2,200	2,920	5,360	5,360	16,688
3.3.31		P-23 Fuel Depot	-	-	-	-	-	-	-	-	40	80	-	-	120
3.3.32		Land Area P-21 and P-24	-	-	-	-	-	-	-	-	480	960	-	-	1,440
Prep		Pre-Mobilization	184	-	184	-	184	184	-	-	-	-	-	-	736
Lockdown		Lockdown	220	-	-	-	-	-	-	-	880	176	21,120	-	22,396
Mob		Mobilization	360	-	360	-	360	360	-	-	-	-	-	-	1,440
Demob		Demobilization	184	-	184	-	184	184	-	-	-	-	-	-	736
FSS		FSS Samples	80	-	-	-	-	-	-	-	320	640	-	-	1,040
Report		Final Project Report	560	-	560	-	560	560	-	-	-	-	-	-	2,240
PM		Project Management	20,480	10,240	20,480	10,240	10,240	10,240	4,096	4,096	-	-	-	-	90,112
		TOTAL	**22,068**	**10,240**	**22,616**	**10,240**	**11,528**	**11,528**	**4,096**	**4,096**	**19,570**	**31,809**	**65,592**	**25,347**	**238,731**

* A Productivity Loss Factor of 2.23 was applied to labor for this structure