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Toxic Air Pollutants Notice of Construction Multi-Function Waste Tank Facility

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Toxic Air Pollutants Notice of Construction Multi-Function Waste Tank Facility

Environmental Services
Westinghouse Hanford Company

Date Published
August 1994



United States
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TOXIC AIR POLLUTANTS NOTICE OF CONSTRUCTION
MULTI-FUNCTION WASTE TANK FACILITY

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LIST OF TERMS

1		
2		
3		
4	ASIL	acceptable source impact level
5	HEPA	high-efficiency particulate air
6	MBK	2-Hexanone
7	MIBK	4-Methyl-2-Pentanone
8	MWTF	Multi-Function Waste Tank Facility
9	SQE	small quantity emission
10	TAP	toxic air pollutant
11	TBP	tributyl phosphate
12	T-BACT	best available control technology for toxics
13		

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1 TOXIC AIR POLLUTANTS NOTICE OF CONSTRUCTION
2 MULTI-FUNCTION WASTE TANK FACILITY
3
4
5

6 1.0 INTRODUCTION
7
8

9 The Multi-Function Waste Tank Facility (MWTF) mission is to (1) provide
10 storage capacity to support retrieval operations from those tanks with safety
11 issues, (2) provide space for related retrieval demonstrations, and (3)
12 support the long-term cleanup mission at the Hanford Site. To accomplish
13 this, up to six 1,000,000-gallon (gal) [3,800,000-liter (L)] double-shell
14 high-level waste underground storage tanks and associated facilities are
15 proposed to be constructed. As many as four tanks may be constructed in the
16 Hanford Site 200 East Area and up to two tanks may be constructed in the
17 200 West Area, along with their respective associated facilities. The tank
18 farm located in the 200 East Area will be identified as the 241-HN Tank Farm
19 and the 200 West Area tank farm will be identified as the 241-SN Tank Farm.
20 Figure 1 shows the typical MWTF tank. Weather enclosures will cover each tank
21 farm and each farm will have its own support facility that will house the
22 ventilation systems, tank sampling systems, and a control room. A diesel
23 generator will supply emergency backup power to each tank farm and the 241-HN
24 Tank Farm will include an administrative building. This document serves as a
25 Notice of Construction pursuant to the requirements of Washington
26 Administrative Codes 173-400 and 173-460. This application addresses the
27 maximum number of tanks proposed to be constructed.

2.0 PROCESS INFORMATION

2.1 OVERVIEW

The MWTF will provide safe, environmentally acceptable storage capacity to receive and store waste from single-shell tanks (SST) and double-shell tanks (DST) in support of Tank Waste Remediation System activities. The MWTF will consist of two separate sites with similar design. The 241-HN Tank Farm will contain four 1,000,000-gal (3,800,000-L) (nominal) tanks and the 241-SN Tank Farm will contain two 1,000,000-gal (3,800,000-L) tanks. Figures 2 and 3 show the approximate location of each tank farm. Each tank farm will contain underground carbon steel tanks and associated equipment housed in two main buildings. One building is a support facility that houses the ventilation systems, liquid sampling systems, and control room. The second is a weather enclosure that covers the waste tanks and associated equipment. There will be an administration building for offices, locker rooms, and a lunchroom at the 241-HN Tank Farm only.

Each waste storage tank system will have a ventilation system. The ventilation system for each tank system will be divided into two subsystems: (1) the primary tank ventilation system and (2) the annulus ventilation system. The primary tank ventilation system will maintain the primary tank at a negative pressure to control contamination, remove a portion of the heat, and sweep potentially combustible gases out of the tank. The annulus ventilation system will circulate air around the annular space between the primary and secondary tanks to remove a portion of the mechanically induced heat (i.e., mixing pump operation) and radioactive decay heat. The ventilation air will be treated before release (see Section 3.0). The support facilities will also be ventilated and all ventilation systems will be combined for release at the each facility's stack. The primary ventilation system is the only system that will normally discharge toxic air pollutants (TAP) to the environment.

The tanks are primarily a storage system, and only minor in-tank processing activities to support pretreatment facilities have been proposed at this time. Section 2.2 describes the process operations of the MWTF.

2.2 OPERATIONAL MODES

The MWTF will have five operational modes:

- Operation - In this mode, the waste will be stored and transfers to or from the tank will be authorized and may occur.
- Warm standby - In this mode, waste will be stored, but transfers to or from the tank will not be authorized.

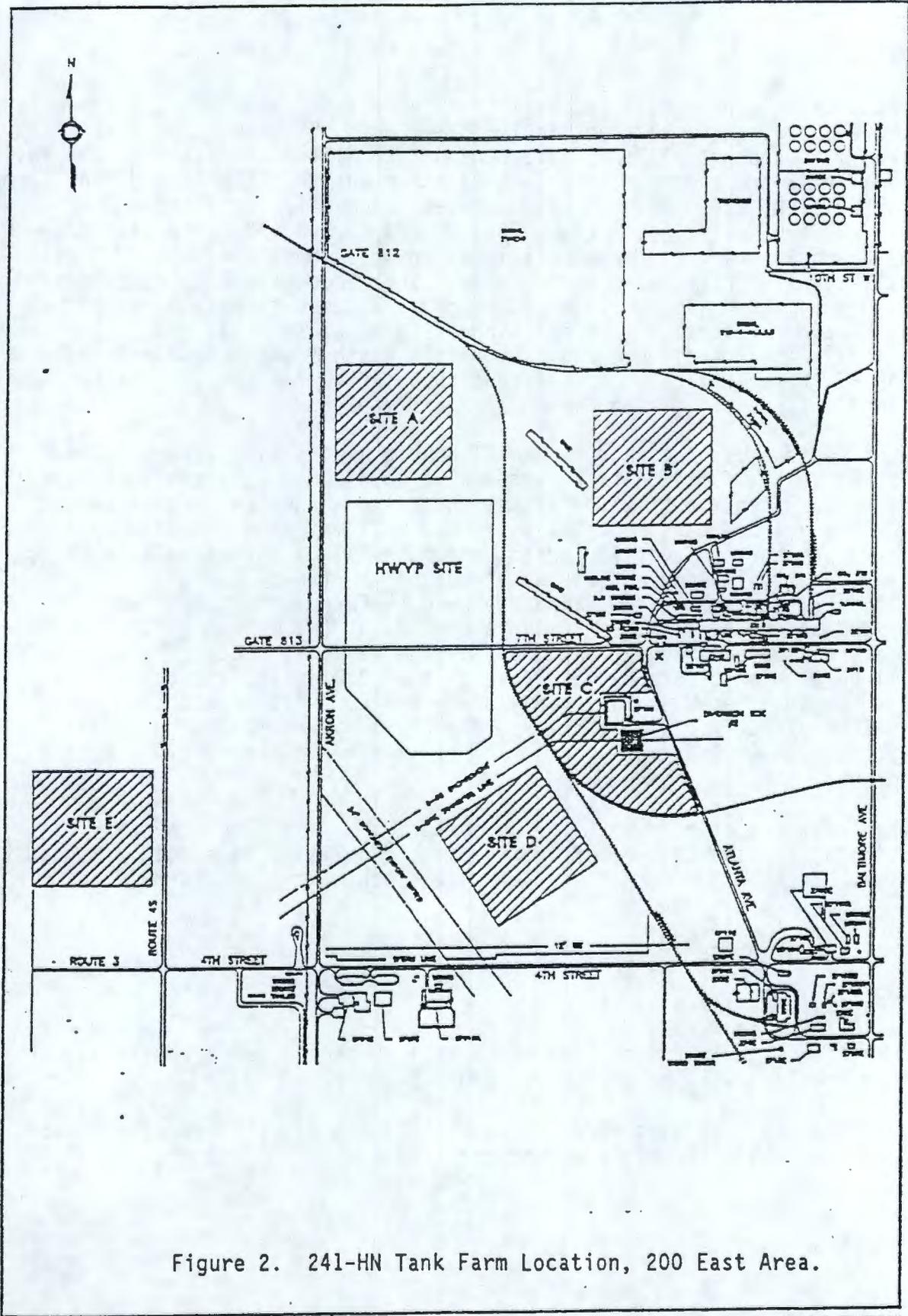


Figure 2. 241-HN Tank Farm Location, 200 East Area.

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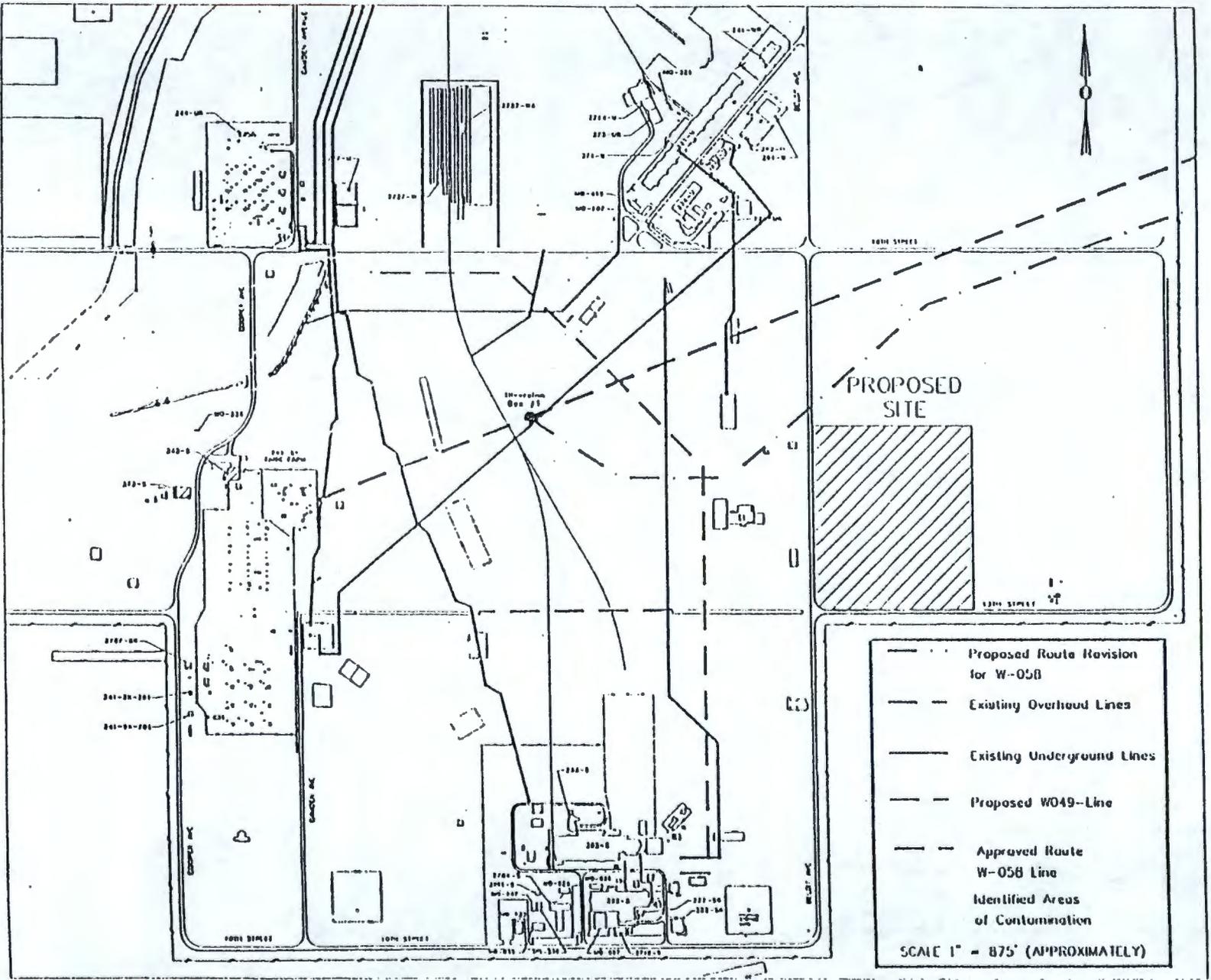


Figure 3. 241-SN Tank Farm Location, 200 West Area.

- 1 • Repair - In this mode, waste will be stored while maintenance or repairs
2 are done. Opening the confinement barriers to the environment will be
3 authorized in the repair mode, but transfers to or from the tank will not
4 be possible and will not be authorized.
5
- 6 • Empty - In this mode, the tank may be completely empty, if it has never
7 been used, or may contain a minimum heel of liquid (either water or
8 waste) below the retrieval capability of the transfer pumps (less
9 than 2%).
10
- 11 • Restricted - This mode is considered an abnormal condition where only
12 certain restricted activities may be performed. Transfers to or from the
13 tank will not be authorized in the restricted mode, except as allowed by
14 an approved recovery plan or as necessary to maintain the MWTF in a
15 stable and safe condition.

3.0 CONTROL EQUIPMENT INFORMATION

3.1 PARTICULATE EMISSION CONTROL

Particulate emissions will be controlled with high-efficiency metal filters and high-efficiency particulate air (HEPA) filters, which are being installed primarily to control radioactive particulates. Each of the high-efficiency filters are rated to remove at least 99.97% of the particles that are 0.3 μm and larger. Therefore, particulate emissions from this activity will not be a concern.

3.2 NONPARTICULATE EMISSION CONTROL

Appendix A contains a discussion of the best available control technology for toxics (T-BACT). The recommendation of the T-BACT assessment is to use carbon adsorption to control volatile organic compounds with vapor condensation/condensate removal to improve the overall efficiency of the system.

3.3 VENTILATION SYSTEM

The ventilation system consists of two portions. The cell treatment system consists of a chilled water condenser (to reduce the temperature of the stream to 40 °F), high-efficiency mist eliminator filter, an electric heater (to raise the temperature of the stream to 52 °F, thereby reducing the relative humidity), and a high-efficiency metal filter. To provide standby capacity, three cell treatment systems will be built for every two tanks. Consequently, there will be six cell treatment systems in the 241-HN Tank Farm and three cell treatment systems in the 241-SN Tank Farm. However, only one cell treatment system will be in operation at a time for each tank. The second portion of the ventilation system follows the cell treatment system and will combine the exhaust for all of the tanks in each tank farm. The combined exhaust will flow through a filter bank consisting of two stages of HEPA filters with a high-efficiency gas adsorption filter between each stage. The final filtration stage will also have a redundant system for backup. Monitoring for TAPs will occur following the final filtration stage, before combining the tank exhaust with the support facility exhaust and discharging to the stack.

4.0 PHYSICAL INFORMATION

The stack will be approximately 150 feet (ft) [46 meters (m)] high, 6 ft (2 m) in diameter. The average stack temperatures will be approximately 80 °F (27 °C). The 241-HN and the 241-SN Tank Farms will have separate stacks. Chapter 6.0 contains vapor composition information.

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5.0 PROCESS FLOW INFORMATION

5.1 EXHAUSTER DESIGN

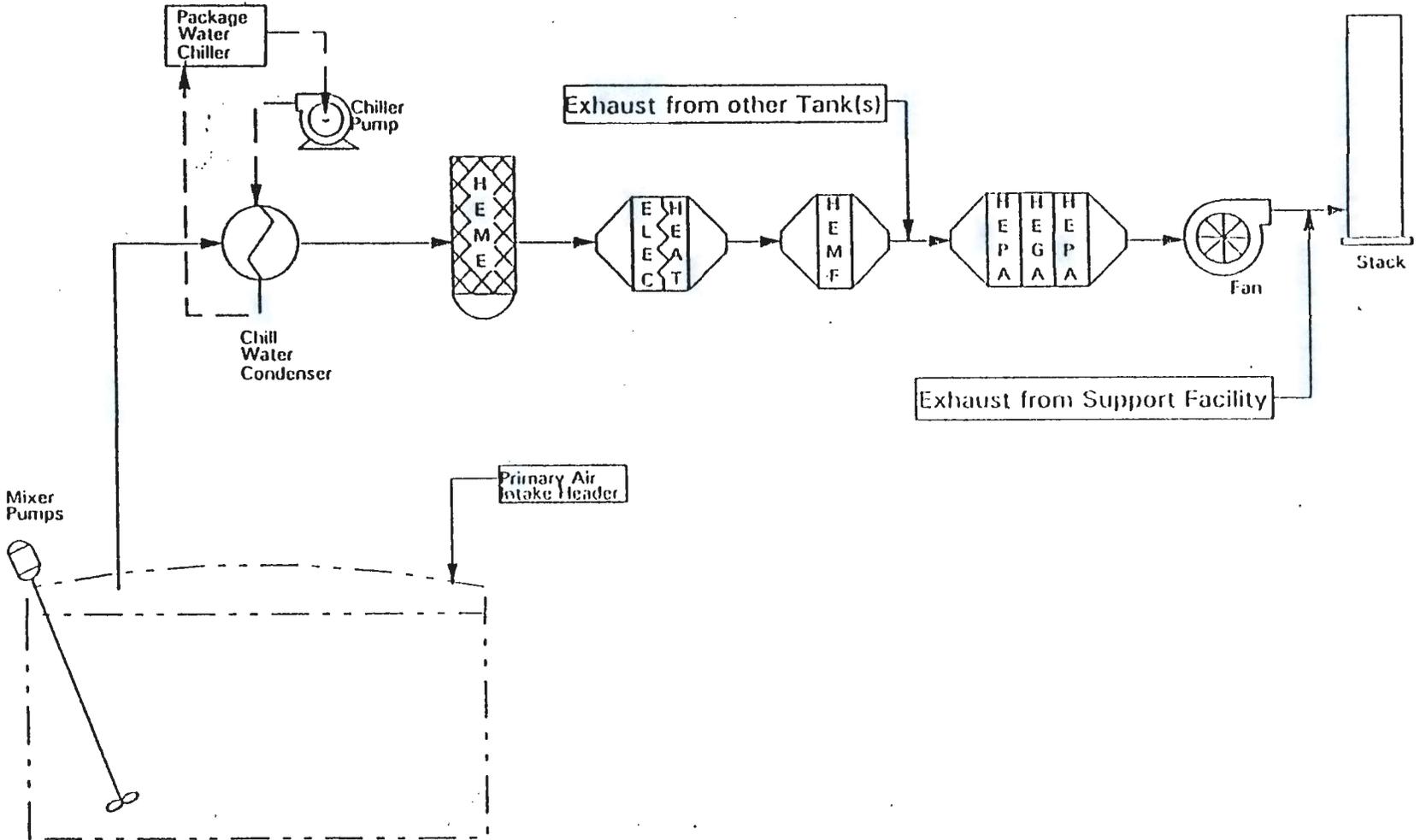
The conceptual design of the ventilation system (i.e., control equipment, fan, and stack) is shown in Figure 4. Chapter 3.0 discusses the system in greater detail.

5.2 METHOD OF OPERATION

The ventilation systems will operate 24 hours a day, 365 days a year. Both nominal and extreme operating scenarios were developed for the MWTF. For the nominal case, a heat load of approximately 32 kilowatts (kW) [110,000 British thermal units per hour (BTU/h)] per tank is assumed. For the extreme case, one tank is assumed to have a heat load of approximately 200 kW (700,000 BTU/h), while the other tanks are operating as in the nominal case.

Additionally, a 508-kilovolt ampere (kVa) stand-by power supply will be associated with each tank farm. These power supplies will be tested for approximately 30 minutes each month and will be fueled by No. 2 fuel oil. All other operation of the power supplies will occur only if there is loss of normal power to the tank farms. Approximate emissions from the power supplies are provided in Chapter 6.0.

Figure 4. Process Flow Diagram.



6.0 EMISSIONS ESTIMATION

6.1 PRIMARY VENTILATION SYSTEM EMISSIONS ESTIMATION

A number of TAPs are expected to be emitted from the proposed tank farms. Tables 1 and 2 list those TAPs, as well as the corresponding acceptable source impact level (ASIL) and small quantity emission (SQE) rate. The SQE rates are listed in English units in the regulations (WAC 173-460) and are not converted to metric units in this document in order to more easily demonstrate compliance.

Table 1. Class A Toxic Air Pollutants.

Toxic air pollutant	ASIL ($\mu\text{g}/\text{m}^3$)	Averaging time	SQE (lb/yr)
Benzene	1.20E-01	Annual	2.00E+01
Carbon tetrachloride	6.70E-02	Annual	2.00E+01
Arsenic and inorganic arsenic compounds	2.30E-04	Annual	Too small
Lead compounds	5.00E-01	24 hour	Wrong type

ASIL = acceptable source impact level.

SQE = small quantity emission.

Table 2. Class B Toxic Air Pollutants.

Toxic air pollutant	ASIL ($\mu\text{g}/\text{m}^3$)	SQE (lb/h)
Acetone	5.90E+03	5.00E+00
1-Butanol	5.00E+02	5.00E+00
2-Hexanone	6.70E+01	1.20E+00
4-Methyl-2-Pentanone	6.80E+02	5.00E+00
Tributyl phosphate	7.30E+00	2.00E-02
Ammonia	1.00E+02	2.00E+00
Silver, soluble compounds	3.30E-02	2.00E-02
Barium, soluble compounds	1.70E+00	2.00E-02
Calcium hydroxide	1.70E+01	2.00E-01
Copper, dusts and mists as copper	3.30E+00	2.00E-02
Magnesium oxide fumes	3.30E+01	6.00E-01
Antimony and compounds, as antimony	1.70E+00	2.00E-02
Selenium compounds, as selenium	6.70E-01	2.00E-02
Fluorides, as fluoride	8.30E+00	2.00E-02
Iron salts, soluble as iron	3.30E+00	2.00E-02
Chromium (II), (III), or metal compounds as chromium	1.70E+00	2.00E-02
Aluminum, as aluminum soluble salts	6.70E+00	2.00E-02
Sodium hydroxide	6.70E+00	2.00E-02

ASIL = acceptable source impact level.

SQE = small quantity emission.

TAP = toxic air pollutant.

Unabated emissions calculations were based on the heat load of the tank waste and the conditions of the vapor space above the tank waste. The emissions are based on a number of assumptions and may be found in the *Tank Primary Ventilation System Process Flow Diagram Descriptions* (ICF KH 1994). Emissions from a single tank in both nominal and extreme conditions are included in Tables 3 and 4.

Table 3. Unabated Class A Toxic Air Pollutant Emissions from One Tank.

Toxic air pollutant	Unabated (one extreme tank)			Unabated (one nominal tank)		
	lb/min	g/min	lb/yr	lb/min	g/min	lb/yr
Benzene	7.02E-06	3.18E-03	3.69E+00	--	--	--
Carbon tetrachloride	5.34E-08	2.42E-05	2.81E-02	--	--	--
Arsenic	2.20E-06	9.98E-04	1.16E+00	2.20E-06	9.98E-04	1.16E+00
Lead compounds	4.31E-08	1.95E-05	2.26E-02	4.31E-08	1.45E-05	2.26E-02

Table 4. Unabated Class B Toxic Air Pollutant Emissions From One Tank.

Toxic air pollutant	Unabated (one extreme tank)			Unabated (one nominal tank)		
	lb/min	g/min	lb/h	lb/min	g/min	lb/h
Acetone	4.46E-03	2.02E+00	2.68E-01	8.93E-04	4.05E-01	5.36E-02
Butanol	1.22E-01	5.53E+01	7.32E+00	2.45E-02	1.11E+01	1.47E+00
2-Hexanone	1.79E-04	8.12E-02	1.07E-02	3.58E-05	1.62E-02	2.15E-03
4-Methyl-2-Pentanone	1.26E-02	5.72E+00	7.58E-01	2.52E-03	1.14E+00	1.51E-01
Tributyl phosphate	6.12E-03	2.78E+00	3.67E-01	1.22E-03	5.53E-01	7.32E-02
Ammonia	2.60E-03	1.18E+00	1.56E-01	1.35E-03	6.12E-01	8.10E-02
Silver, soluble compounds	3.30E-08	1.50E-05	1.98E-06	3.30E-08	1.50E-05	1.98E-06
Barium, soluble compounds	1.10E-08	4.99E-06	6.60E-07	1.10E-08	4.99E-06	6.60E-07
Calcium hydroxide	1.02E-07	4.61E-05	6.10E-06	1.02E-07	4.61E-05	6.10E-06
Copper, dusts and mists, as copper	1.20E-08	5.44E-06	7.20E-07	1.20E-08	5.44E-06	7.20E-07
Magnesium oxide fumes	1.82E-08	8.27E-06	1.09E-06	1.82E-08	8.27E-06	1.09E-06
Antimony and compounds, as antimony	5.00E-08	2.27E-05	3.00E-06	5.00E-08	2.27E-05	3.00E-06
Selenium compounds, as selenium	4.40E-08	2.00E-05	2.64E-06	4.40E-08	2.00E-05	2.64E-06
Fluorides, as fluoride	1.20E-05	5.44E-03	7.20E-04	1.20E-05	5.44E-03	7.20E-04
Iron salts, soluble as iron	2.00E-05	9.07E-03	1.20E-03	2.00E-05	9.07E-03	1.20E-03
Chromium (II), (III), or metal compounds as chromium	4.10E-06	1.86E-03	2.46E-04	4.10E-06	1.86E-03	2.46E-04
Aluminum, as soluble aluminum salts	1.50E-04	6.80E-02	9.00E-03	1.50E-04	6.80E-02	9.00E-03
Sodium hydroxide	6.79E-04	3.08E-01	4.07E-02	6.79E-04	3.08E-01	4.07E-02

1
2 Table 5 includes the decontamination factor provided by each piece of
3 control equipment in the ventilation system for each TAP expected. Because
4 this table will not be compared directly to values provided in the
5 regulations, this table is not separated by Class A and Class B TAPs.
6

7 Table 5. Decontamination Factors for Each Toxic Air Pollutant.

8 Toxic air pollutant	Condenser	HEME	HEMF	HEPA/HEGA
9 Benzene	1.5	1.25	1	5
10 Carbon tetrachloride	1.5	1.25	1	5
11 Arsenic and inorganic arsenic compounds	4	15	3,000	100,000
12 Lead compounds	3	15	3,000	100,000
13 Acetone	1.5	4*	1	5
14 Butanol	1.5	18*	1	5
15 2-Hexanone	1.5	1.25	1	5
16 4-Methyl-2-Pentanone	1.5	1.25	1	5
17 Tributyl phosphate	3	15	3000	100,000
18 Ammonia	3	2	1	1
19 Silver, soluble compounds	4	15	3000	100,000
20 Barium, soluble compounds	4	15	3000	100,000
21 Calcium hydroxide	3	15	3,000	100,000
22 Copper, dusts and mists as copper	3	15	3,000	100,000
23 Magnesium oxide fumes	3	15	3,000	100,000
24 Antimony and compounds, as antimony	3	15	3,000	100,000
25 Selenium compounds, as selenium	4	15	3,000	100,000
26 Fluorides, as fluoride	4	15	3,000	100,000
27 Iron salts, soluble as iron	4	15	3,000	100,000
28 Chromium (II), (III), or metal compounds as 29 chromium	3	15	3,000	100,000
30 Aluminum, as aluminum soluble salts	4	15	3,000	100,000
31 Sodium hydroxide	4	15	3,000	100,000

32 HEGA = high-efficiency gas adsorption.

33 HEME = high-efficiency mist eliminator.

34 HEMF = high-efficiency metal filter.

35 HEPA = high-efficiency particulate air.

36 Acetone and Butanol reach phase equilibrium in the HEME. These DFs are the maximum expected and
37 the concentrations listed in the abated emission tables, following, are based on a
38 thermodynamic model.

39
40
41
42 Based on the decontamination factors provided in Table 5 and the unabated
43 emissions provided in Tables 3 and 4, abated emissions can be determined for
44 both the nominal and extreme cases for both the 241-HN and the 241-SN Tank

1 Farms. Abated emissions are calculated by dividing the unabated emissions by
 2 each decontamination factor. Tables 6 through 13 provide the abated emissions
 3 and a comparison of the emissions with the SQE rates. For two of the
 4 Class A TAPs, no SQE rates exist. Consequently, the concentration of the
 5 emissions before mixing with the support facility exhaust is compared directly
 6 with the ASIL.

7
 8 As presented in these tables, all TAPs either meet the applicable SQE
 9 rate or the emissions in the ventilation system are below the ASILs before
 10 mixing with the support facility exhaust.

11
 12 Table 6. Nominal Abated Emissions of Class A Toxic Air Pollutants from the
 13 241-HN Tank Farm.

Class A toxic air pollutant	Nominal abated emissions					
	lb/min	g/min	lb/yr	SQE	$\mu\text{g}/\text{m}^3$	ASIL
Benzene	--	--	--	Meets	--	--
Carbon tetrachloride	--	--	--	Meets	--	--
Arsenic and inorganic arsenic compounds	4.80E-16	2.18E-13	2.52E-10	--	3.90E-09	Meets
Lead compounds	1.28E-17	5.81E-15	6.73E-12	--	1.04E-10	Meets

22 ASIL = acceptable source impact level.
 23 SQE = small quantity emission.

24
 25
 26
 27 Table 7. Extreme Abated Emissions of Class A Toxic Air Pollutants from
 28 the 241-HN Tank Farm.

Class A toxic air pollutant	Extreme abated emissions					
	lb/min	g/min	lb/yr	SQE	$\mu\text{g}/\text{m}^3$	ASIL
Benzene	3.00E-06	1.36E-03	1.57E 00	Meets	--	--
Carbon tetrachloride	2.79E-08	1.03E-05	1.20E-02	Meets	--	--
Arsenic and inorganic arsenic compounds	4.80E-16	2.18E-13	2.52E-10	--	3.90E-09	Meets
Lead compounds	1.28E-17	5.81E-15	6.73E-12	--	1.04E-10	Meets

36 ASIL = acceptable source impact level.
 37 SQE = small quantity emission.

1 Table 8. Nominal Abated Emissions of Class A Toxic Air Pollutants from
 2 the 241-SN Tank Farm.

Class A toxic air pollutant	Nominal abated emissions					
	lb/min	g/min	lb/yr	SQE	$\mu\text{g}/\text{m}^3$	ASIL
Benzene	--	--	--	Meets	--	--
Carbon tetrachloride	--	--	--	Meets	--	--
Arsenic and inorganic arsenic compounds	2.40E-16	1.09E-13	1.26E-10	--	3.90E-09	Meets
Lead compounds	6.29E-18	2.85E-15	3.30E-12	--	1.02E-10	Meets

10 ASIL = acceptable source impact level.
 11 SQE = small quantity emission.

12
 13
 14
 15 Table 9. Extreme Abated Emissions of Class A Toxic Air Pollutants
 16 from the 241-SN Tank Farm.

Class A toxic air pollutant	Extreme abated emissions					
	lb/min	g/min	lb/yr	SQE	$\mu\text{g}/\text{m}^3$	ASIL
Benzene	1.50E-06	6.79E-04	7.87E-01	Meets	--	--
Carbon tetrachloride	1.14E-08	5.17E-06	5.99E-03	Meets	--	--
Arsenic and inorganic arsenic compounds	2.40E-16	1.09E-13	1.26E-10	--	3.90E-09	Meets
Lead compounds	6.29E-18	2.85E-15	3.30E-12	--	1.02E-10	Meets

24 ASIL = acceptable source impact level.
 25 SQE = small quantity emission.

1 Table 10. Nominal Abated Emissions of Class B Toxic Air Pollutants
 2 from the 241-HN Tank Farm.

Class B toxic air pollutant	Nominal abated emissions			
	lb/min	g/min	lb/hr	SQE
Acetone	5.79E-04	2.63E-01	3.47E-02	Meets
Butanol	3.60E-03	1.63E+00	2.16E-01	Meets
2-Hexanone	1.53E-05	6.94E-03	9.18E-04	Meets
4-Methyl-2-Pentanone	1.08E-03	4.90E-01	6.48E-02	Meets
Tributyl phosphate	3.63E-13	1.65E-10	2.18E-11	Meets
Ammonia	9.03E-04	4.10E-01	5.42E-02	Meets
Silver, soluble compounds	7.30E-18	3.31E-15	4.38E-16	Meets
Barium, soluble compounds	2.40E-18	1.09E-15	1.44E-16	Meets
Calcium hydroxide	2.96E-17	1.34E-15	1.77E-16	Meets
Copper, dusts and mists as copper	3.60E-18	1.63E-15	2.16E-16	Meets
Magnesium oxide fumes	5.14E-18	2.33E-15	3.08E-16	Meets
Antimony and compounds, as antimony	1.50E-17	6.80E-15	9.00E-16	Meets
Selenium compounds, as selenium	9.70E-18	4.40E-15	5.82E-16	Meets
Fluorides, as fluoride	2.60E-15	1.18E-12	1.56E-13	Meets
Iron salts, soluble as iron	4.40E-15	2.00E-12	2.64E-13	Meets
Chromium (II), (III), or metal compounds as chromium	1.20E-15	5.44E-13	7.20E-14	Meets
Aluminum, as aluminum soluble salts	3.20E-14	1.45E-11	1.92E-12	Meets
Sodium hydroxide	1.51E-13	6.87E-11	9.08E-12	Meets

27 SQE = small quantity emission.

Table 11. Extreme Abated Emissions of Class B Toxic Air Pollutants
from the 241-HN Tank Farm.

Class B toxic air pollutant	Extreme abated emissions			
	lb/min	g/min	lb/h	SQE
Acetone	5.79E-04	2.63E-01	3.47E-02	Meets
Butanol	3.60E-03	1.63E+00	2.16E-01	Meets
2-Hexanone	3.05E-05	1.38E-02	1.83E-03	Meets
4-Methyl-2-Pentanone	2.15E-03	9.75E-01	1.29E-01	Meets
Tributyl phosphate	7.25E-13	3.29E-10	4.35E-11	Meets
Ammonia	1.10E-03	4.99E-01	6.60E-02	Meets
Silver, soluble compounds	7.30E-18	3.31E-15	4.38E-16	Meets
Barium, soluble compounds	2.40E-18	1.09E-15	1.44E-16M	Meets
Calcium hydroxide	2.96E-17	1.34E-14	1.77E-15	Meets
Copper, dusts and mists as copper	3.60E-18	1.63E-15	2.16E-16	Meets
Magnesium oxide fumes	5.14E-18	2.33E-15	3.08E-16	Meets
Antimony and compounds, as antimony	1.50E-17	6.80E-15	9.00E-16	Meets
Selenium compounds, as selenium	9.70E-18	4.40E-15	5.82E-16	Meets
Fluorides, as fluoride	2.60E-15	1.18E-12	1.56E-13	Meets
Iron salts, soluble as iron	4.40E-15	2.00E-12	2.64E-13	Meets
Chromium (II), (III), or metal compounds as chromium	1.20E-15	5.44E-13	7.20E-14	Meets
Aluminum, as aluminum soluble salts	3.20E-14	1.45E-11	1.92E-12	Meets
Sodium hydroxide	1.51E-13	6.87E-11	9.08E-12	Meets

SQE = small quantity emission.

1 Table 12. Nominal Abated Emissions of Class B Toxic Air Pollutants
 2 from the 241-SN Tank Farm.

Class B toxic air pollutant	Nominal abated emissions			
	lb/min	g/min	lb/h	SQE
Acetone	2.89E-04	1.31E-01	1.74E-02	Meets
Butanol	1.80E-03	8.16E-01	1.08E-01	Meets
2-Hexanone	7.65E-06	3.47E-03	4.59E-04	Meets
4-Methyl-2-Pentanone	5.40E-04	2.45E-01	3.24E-02	Meets
Tributyl phosphate	1.81E-13	8.21E-11	1.09E-11	Meets
Ammonia	4.51E-04	2.05E-01	2.71E-02	Meets
Silver, soluble compounds	3.70E-18	1.68E-15	2.22E-16	Meets
Barium compounds	1.20E-18	5.44E-16	7.20E-17	Meets
Calcium hydroxide	1.50E-17	6.79E-15	8.99E-16	Meets
Copper, dust and mists as copper	1.80E-18	8.16E-16	1.08E-16	Meets
Magnesium oxide fumes	2.65E-18	1.20E-15	1.59E-16	Meets
Antimony and compounds, as antimony	7.40E-18	3.36E-15	4.44E-16	Meets
Selenium compounds, as selenium	4.80E-18	2.18E-15	2.88E-16	Meets
Fluorides, as fluoride	1.30E-15	5.90E-13	7.80E-14	Meets
Iron salts, soluble as iron	2.20E-15	9.98E-13	1.32E-13	Meets
Chromium (II), (III), or metal compounds as chromium	6.10E-16	2.77E-13	3.66E-14	Meets
Aluminum, as aluminum soluble salts	1.60E-14	7.26E-12	9.60E-13	Meets
Sodium hydroxide	7.48E-14	3.39E-11	4.49E-12	meets

25 SQE = small quantity emission.

Table 13. Extreme Abated Emissions of Class B Toxic Air Pollutants
from the 241-SW Tank Farm.

Class B toxic air pollutant	Extreme abated emissions			
	lb/min	g/min	lb/h	SQE
Acetone	2.89E-04	1.31E-01	1.74E-02	Meets
Butanol	1.80E-03	8.16E-01	1.08E-01	Meets
2-Hexanone	2.30E-05	1.04E-02	1.38E-03	Meets
4-Methyl-2-Pentanone	1.62E-03	7.35E-01	9.72E-02	Meets
Tributyl phosphate	5.44E-13	2.47E-10	3.26E-11	Meets
Ammonia	6.50E-04	2.95E-01	3.90E-02	Meets
Silver, soluble compounds	3.70E-18	1.68E-15	2.22E-16	Meets
Barium, soluble compounds	1.20E-18	5.44E-16	7.20E-17	Meets
Calcium hydroxide	1.50E-17	6.79E-15	8.99E-16	Meets
Copper, dusts and mists as copper	1.80E-18	8.16E-16	1.08E-16	Meets
Magnesium oxide fumes	2.65E-18	1.20E-15	1.59E-16	Meets
Antimony and compounds, as antimony	7.40E-18	3.36E-15	4.44E-16	Meets
Selenium compounds, as selenium	4.80E-18	2.18E-15	2.88E-16	Meets
Fluorides, as fluoride	1.30E-15	5.90E-13	7.80E-14	Meets
Iron salts, soluble as iron	2.20E-15	9.98E-13	1.32E-13	Meets
Chromium (II), (III), or metal compounds as chromium	6.10E-16	2.77E-13	3.66E-14	Meets
Aluminum, as aluminum soluble salts	1.60E-14	7.26E-12	9.60E-13	Meets
Sodium hydroxide	7.48E-14	3.39E-11	4.49E-12	Meets

SQE = small quantity emission.

6.2 STAND-BY POWER SUPPLY ESTIMATED EMISSIONS

The stand-by power supply emissions are listed in Table 14. The emissions are based on information from the supplier. Also included in Table 14 is the significance level for each pollutant, as defined in 40 *Code of Federal Regulations* (CFR) 52.21.

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Table 14. Criteria Pollutant Emissions from Each
Stand-by Generator

Criteria Pollutant	lb/h	ton/yr	Significance level tons/yr
Volatile Organic Compounds	2.33	6.99E-03	40
Carbon Monoxide	0.48	1.44E-03	100
Sulfur Dioxide	0.75	2.25E-03	40
Oxides of Nitrogen	0.62	1.86E-03	40
Particulate Matter (less than 10 microns)	12.90	3.87E-02	15

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7.0 COMPLIANCE WITH REQUIREMENTS

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Appendix A includes a T-BACT Assessment, which recommends the use of carbon adsorption to control volatile organic compounds with vapor condensation/condensate removal to improve the overall efficiency of the system.

All emissions resulting from the MWTF are in compliance with the ASILs. For the Class B TAPs as well as benzene and carbon tetrachloride, this has been demonstrated by meeting the SQE rates. For arsenic and lead compounds, the concentration in the ventilation system prior to the addition of the emissions from the support facility are in compliance with the ASIL. It should be noted that the ASIL is an offsite concentration standard and it is not a requirement that the concentration in the ventilation system meet this standard.

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8.0 REFERENCES

- 1
- 2
- 3
- 4 40 CFR 52.21, "Prevention of Significant Deterioration of Air Quality," *Code*
- 5 *of Federal Regulations*, as amended.
- 6
- 7 ICF KH, 1994, *Tank Primary Ventilation Process Flow Diagram Descriptions*,
- 8 W236A-T2-TR-18, ICF Kaiser Hanford Company, Richland, Washington.
- 9
- 10 WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," Washington
- 11 Administrative Code (as amended).

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APPENDIX A

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BEST AVAILABLE CONTROL TECHNOLOGY FOR TOXICS

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**Project W-236A
Multi-Function Waste Tank Facility Operations
Best Available Control Technology
for Toxics Assessment**

Submitted To:

**Westinghouse Hanford Company
Purchase Order No. MJK-SVV-296951, Task No. 16**

Prepared By:

CH2M HILL/IT CORPORATION

July 1994

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1.0 Executive Summary

This document has been prepared to report the determinations of best available control technology for toxics (T-BACT), as defined by Chapter 173-460 of the Washington Administrative Code, for Project W-236A, Multi-Function Waste Tank Facility (MWTF) at the U.S. Department of Energy's (DOE) Hanford Site. The conclusions in this report are based on a "top-down" evaluation of control technologies.

DOE's Hanford Site is located approximately 20 miles (32 kilometers) northwest of Richland, Washington. The MWTF will be located near the center of the Hanford Site and comprises six 1-million gallon (nominal) underground waste storage tanks and two separate support systems in the 200 East and 200 West Areas. Two of the tanks will be installed in the 200 West Area, and four in the 200 East Area. The tanks will be designed to contain radioactive mixed wastes which have been generated by various production processes at the Site.

The Hanford Site is currently working to resolve major tank waste safety and environmental issues. A major priority of the MWTF is to allow environmentally safe transfer and storage of waste from specific double shell tanks (DST) designated as "watchlist" tanks. The MWTF will be utilized in conjunction with other planned waste handling activities by the Tank Waste Retrieval System (TWRS) organization.

The nature of the waste to be stored in the MWTF is such that air pollutant emissions are expected, including various radionuclide, organic, and inorganic compounds. The exhaust stream from the tank is anticipated to be a mixture of solid and liquid particulate matter (aerosol) and vapors. Emission estimates have been developed for the MWTF based upon characterizations of waste which could potentially be stored in the MWTF.

Toxic air pollutants assumed to be generated during MWTF operations include ammonia, volatile organic compounds (VOC), and iodine. VOCs emitted from the MWTF will potentially include acetone, benzene, 1-butanol, carbon tetrachloride, 2-hexanone (methyl butyl ketone), 4-methyl-2-pentanone (methyl isobutyl ketone), and normal paraffin hydrocarbons (NPH). The estimated uncontrolled emissions of ammonia are 3,500 pounds per year (lb/yr) for the 200 East MWTF and 2080 lb/yr for the 200 West MWTF. Uncontrolled VOC emissions from the 200 East MWTF will be approximately 29,000 lb/yr, while for the 200 West MWTF, uncontrolled

VOC emission levels are expected to be 16,000 lb/yr. Uncontrolled iodine levels are expected to be less than 0.15 lb/yr for both the 200 East and 200 West MWTFs.

Particulate toxic air pollutants are not anticipated to be substantially different from radionuclide particulates emitted from the MWTF. The complete analysis for radioactive constituents, including particulates, is contained in a separate document, *Project W-236A, MWTF Multi-Functional Waste Tank Facility, Best Available Radionuclide Control Technology Assessment* (WHC, 1994). That analysis concluded that a complex emissions control system utilizing various levels of particulate matter control was required to meet Hanford Site derived concentration guidelines (DCG) for radionuclide emissions. The particulate matter emissions control system is considered to satisfy the T-BACT requirement for any toxic particulate matter.

Two technically feasible control systems were identified for ammonia: a packed bed acid scrubber and impregnated carbon adsorption. The T-BACT analysis for ammonia indicates that neither of these control devices are cost-effective and cannot be justified for control of ammonia in the MWTF exhaust; therefore, T-BACT for ammonia is no control.

VOCs are emitted at reasonably high levels from the MWTF. The T-BACT analysis revealed a cost effectiveness of \$3,271 per ton of VOC removed for the 200 East MWTF and \$3,855 per ton of VOC removed for the 200 West MWTF for carbon adsorption. The costs do not represent an adverse economic impact for toxics and, thus carbon adsorption is selected as T-BACT for VOC control.

As a result of carbon adsorption technology being selected as T-BACT for VOCs, no additional energy, environmental, or economic impacts would be incurred for control of iodine. Carbon adsorption will be T-BACT for iodine.

2.0 Introduction

2.1 Purpose

The objective of this document is to report the determinations of best available control technology for toxics (T-BACT) for Project W-236A, Multi-Function Waste Tank Facility (MWTF) at the U.S. Department of Energy's (DOE) Hanford Site. The Washington Department of Ecology's (Ecology) New Source Review program requires that controls for new sources of toxic air pollutants (TAP) comply with Ecology regulations concerning T-BACT as defined in Chapter 173-460 of the Washington Administrative Code (WAC). The conclusions reached in this report are based on a "top-down" evaluation of air toxics emission control technologies, using the procedures in Chapter B of the U.S. Environmental Protection Agency (EPA) draft guidance document, *New Source Review Workshop Manual: Prevention of Significant Deterioration and Non-Attainment Area Permitting* (EPA, 1990a). Ecology has indicated that proposals for T-BACT should be based on EPA's top-down methodology.

2.2 Background

DOE's Hanford Site covers approximately 560 square miles of semi-arid land in southeastern Washington, northwest of Richland. The MWTF will be located in the 200 East Area and 200 West Area near the center of the Hanford site. Figure 2-1 shows the geographical location of the Hanford Site and identifies the 200 East and 200 West Areas within the Hanford Site boundary. The MWTF will be utilized for storage of waste from tanks which the Tank Waste Removal System (TWRS) is attempting to remove from service.

2.3 Scope of the T-BACT Analysis

The determination of T-BACT for the MWTF included the five steps of EPA's top-down approach:

- (1) **Identify All Control Options:** Identify all available control technologies with practical potential for application to the source and the regulated TAPs under evaluation.
- (2) **Eliminate Technically Infeasible Options:** From the results of the literature search, identify candidate technologies that are technically feasible for installation and successful operation. Eliminate from further analysis those technologies which are not technically feasible.

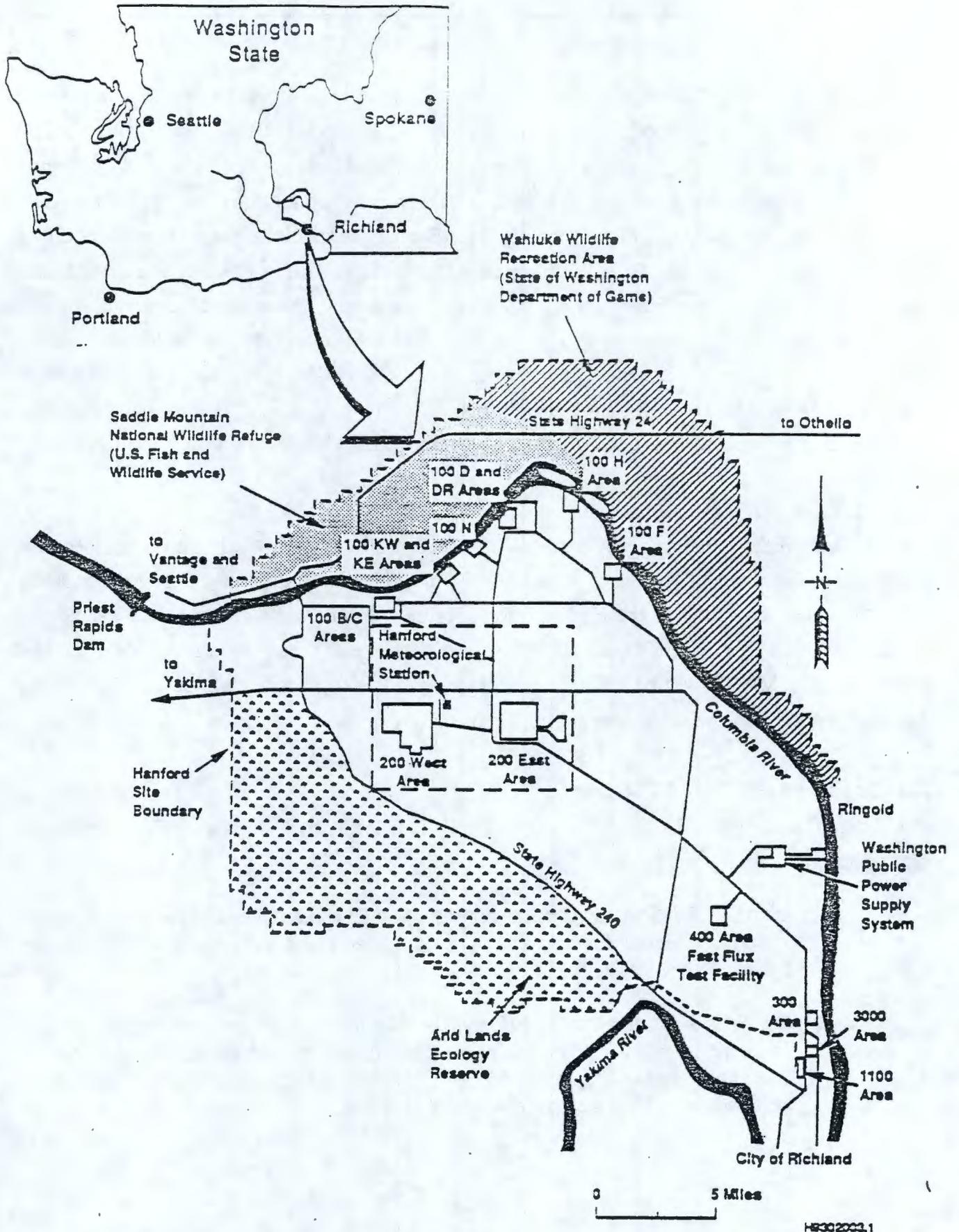


Figure 2-1. Location of the Hanford Site and the 200 Area

- (3) **Rank Remaining Control Technologies:** Rank each of the technically feasible technologies in decreasing order of the expected percentage of pollutant removed.
- (4) **Evaluate Environmental, Economic, and Energy Impacts:** For each of the control options, provide a more detailed analysis of the environmental, economic, and energy impacts, as well as other impacts which are specific to the emissions source.
- (5) **Select T-BACT:** T-BACT is determined to be the control option which achieves the highest degree of removal for the TAP considered, and which exhibits no significant adverse impacts on the areas considered in Step 4.

Using this approach, T-BACT was determined for the TAPs that are likely to be present in emissions from the MWTF.

3.0 Description of the Multi-Function Waste Tank Facility

3.1 General Facility Description and Layout

The MWTF comprises the 200 East and 200 West Areas as shown in Figure 3-1. The facility will be used to store radioactive mixed waste from other tanks used by TWRS.

Each underground tank is to consist of two concentric structures. The outer structure will consist of steel-lined reinforced concrete, and is referred to as the secondary confinement structure. The reinforced concrete is to be designed to sustain all soil loadings, dead loads, live loads, seismic loads, and loads caused by temperature gradients between the radioactive wastes confined within the primary storage tank and the outside soil.

The secondary liner is carbon steel extending along the bottom, sides, and upper haunch of the reinforced concrete just beyond the upper knuckle of the primary storage tank. The inner, completely enclosed, carbon steel primary storage tank will be located within the secondary confinement structure and be separated from the secondary confinement structure by an annular space.

The primary storage tank will be designed to confine the radioactive mixed waste while the secondary confinement structure will safely confine any leakage from the primary storage tank.

3.1.1 Primary Storage Tank

The primary storage tanks are to be designed and constructed per the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, and shall comply with all applicable Federal and State Codes and Hanford Plant Standards.

Provisions will be made for inspection and corrosion monitoring to assess primary storage tank integrity during the design life of the tank, and for flushing, decontaminating, and cleaning of the tanks, as required, to avoid mixing of different waste contents. In addition, the design will enable pumpout of the primary storage tank to within 2 percent of the nominal tank capacity (maximum tank heel). To minimize the buildup of solids at the tank bottom and to enhance heat transfer, the primary storage tanks are designed to accept a waste-mixing system.

A device to measure concentration of ignitable and hazardous gases in the vapor space within each tank shall be provided. The device shall be able to detect the presence of and continuously measure hydrogen, carbon monoxide, hydrogen sulfide, carbon disulfide, nitrous oxide, ammonia and organic gases which might be generated by the waste stored in the tank.

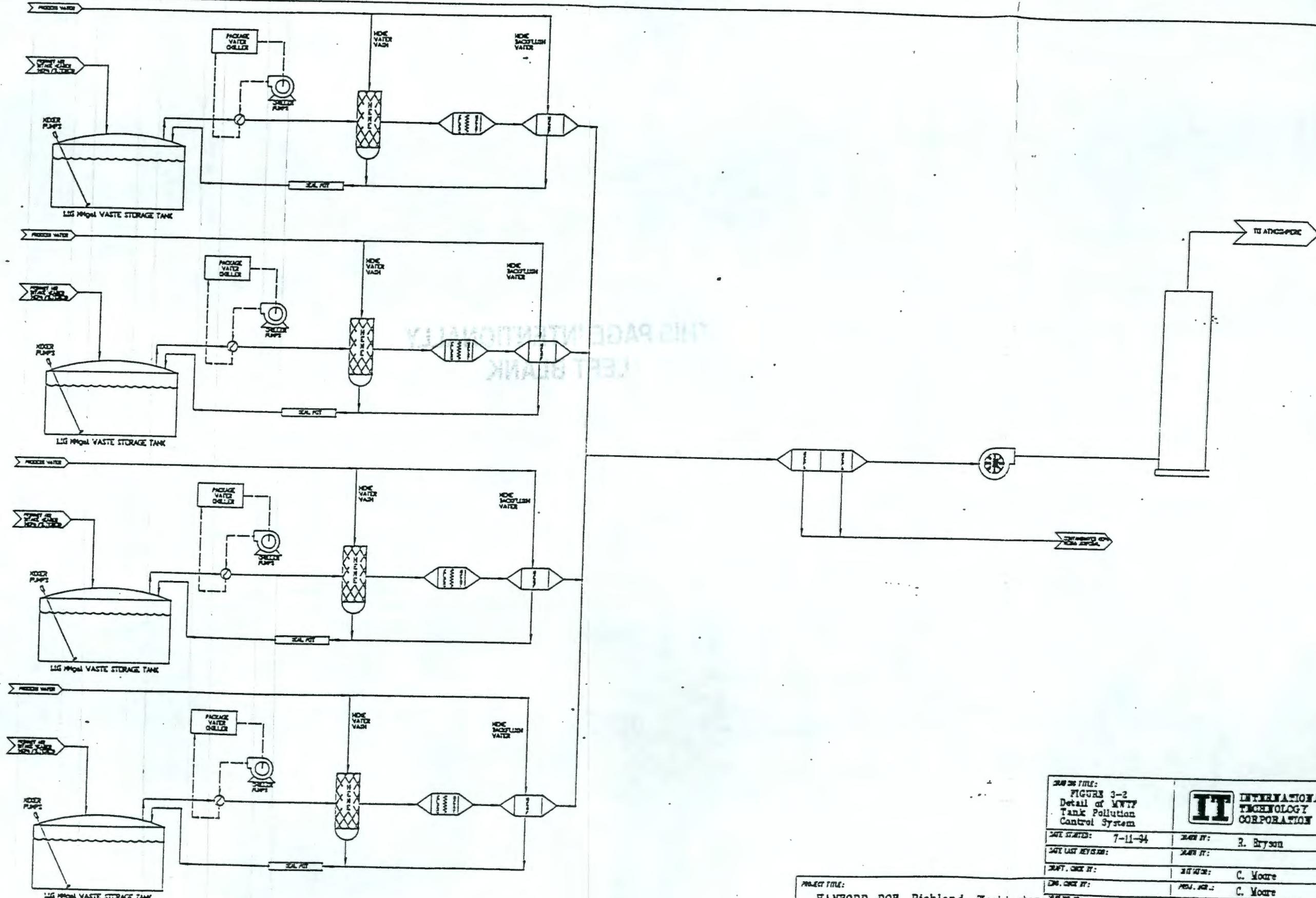
3.2 Primary Ventilation and Heat Removal System

Preliminary design considerations for the MWTF included the development of a multistage emission control system specifically for particulate radionuclides. Each waste storage tank shall be provided with a primary ventilation and heat removal system. To provide for operational flexibility and separation of dissimilar waste forms, each primary ventilation system shall be designed so that vapor condensate can be returned to its tank of origin. The primary ventilation system equipment shall be contained in a building (Support Facility) and be connected via encased underground stainless steel ductwork to dedicated risers on the primary storage tanks.

Recirculation of the exhaust stream for cooling purposes has not been included in the MWTF exhaust system design. Heat loading estimates for the tanks have shown that appropriate cooling levels can be maintained by the normal operation of the ventilation system and inlet air flow system.

Considering the potential emissions from the MWTF and the nature of the exhaust stream, a combination of particulate matter controls were selected for emissions control system. The system will consist of a vapor condensing system, high-efficiency mist eliminator (HEME), high-efficiency metal filter (HEMF), and high-efficiency particulate air (HEPA) filtration. A set of exhaust fans will be provided to discharge filtered air to the ventilation stack. Each waste storage tank system shall also be provided with an air intake system equipped with HEPA filters to provide adequate supply of air into the tank vapor areas for operation of the primary ventilation system within the range or tank pressure specified. All heaters, condensers, moisture eliminator equipment, HEPA filters, and exhaust fans will be located in concrete shells or enclosures for confinement of radioactivity and for shielding. Schematics of the base case control system are shown in Figures 3-2 and 3-3 for the 200 East and 200 West MWTF.

Each tank in the MWTF will initially be exhausted through a "treatment cell" consisting of the condenser, HEME, heater, and HEMF. A condenser cooling system will be utilized to cool and remove vapors from the ventilation air stream. Vapors in the ventilation stream are condensed on the shell side of the condenser by a chilled water system. The condenser system will reduce the exhaust stream temperature of 200°F to 40°F. The chiller units will be designed to remove

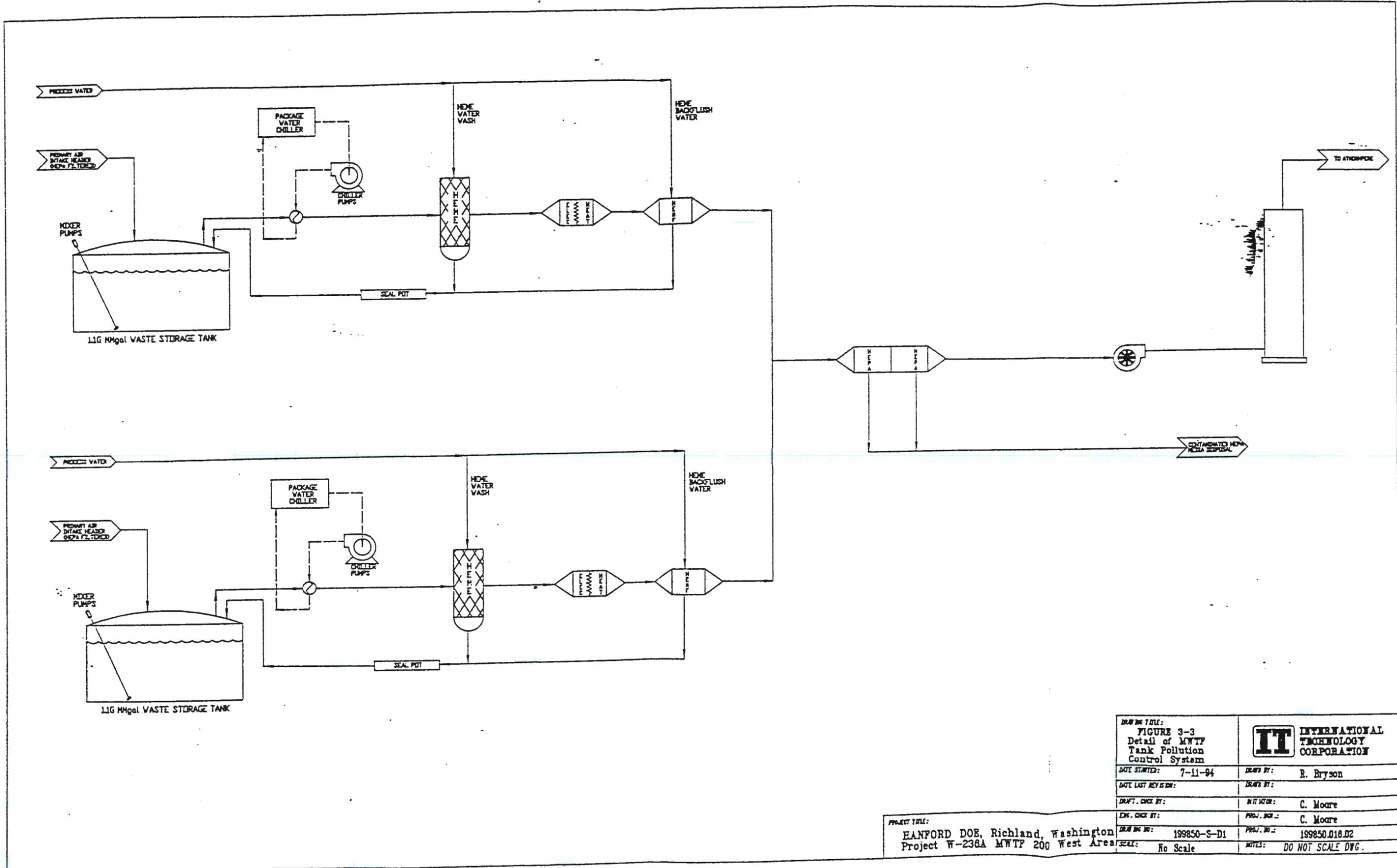


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DRAWING TITLE: FIGURE 3-2 Detail of WWTP Tank Pollution Control System		INTERNATIONAL TECHNOLOGY CORPORATION
DATE ISSUED: 7-11-94	DRAWN BY: R. Bryson	
DATE LAST REVISION:	DATE BY:	
DRAWN BY:	CHECKED BY: C. Moore	
DATE BY:	PROJECT NO.: 199850.018.02	
SCALE: No Scale	NOTES: DO NOT SCALE DWG.	

PROJECT TITLE:
 HANFORD DOE, Richland, Washington;
 Project W-238A WWTP 200 East Area

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DRAWING TITLE: FIGURE 3-3 Detail of WWTP Tank Pollution Control System		INTERNATIONAL TECHNOLOGY CORPORATION
DATE STARTED: 7-11-94	DRAWN BY: R. Bryson	
DATE LAST REVISION:	DRAWN BY:	
DRAFT, CHECK BY:	IN IT VECTOR: C. Moore	
ENG. CHECK BY:	PROJ. NO.: C. Moore	
PROJECT TITLE: HANFORD DOE, Richland, Washington Project W-236A WWTP 200 West Area	DRAWING NO.: 199850-S-D1	PROJ. NO.: 199850.016.02
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0.5 million British thermal units per hour per tank (MBtu/hr/tank) at a ventilation flow rate of 500 cubic feet per minute (ft³/min). The chilled water system design will allow operation at a pressure higher than the pressure in the primary tank ventilation system to prevent contamination of the cooling water system in the event of a leak in the condenser.

Following the condenser, the HEME will be installed to provide complete fog removal. A cleaning water spray will operate as needed to maintain the removal efficiency of the HEME. The air downstream of the HEME is to be heated to prevent moisture accumulation on the HEPAs in the air filter train. The heater will be designed to increase the temperature from 40°F to 52°F.

The HEMF filters shall be installed to remove radioactive and other particulate contaminants and to minimize contaminant buildup on the HEPA filters. The HEMFs shall be provided with a remotely operated backwash system to prevent plugging and for decontamination.

Before passing through the HEPA filtration system, the individual tank exhaust will be combined; thus, in the 200 East MWTF, four tanks will be combined into one exhaust stream, while in the 200 West MWTF, two tanks will be combined prior to final filtration. Each waste storage tank will include a primary ventilation and heat removal system.

4.0 Uncontrolled Toxic Air Pollutant Release Rates

Estimates of the components, concentrations, and flow rates of the uncontrolled exhaust stream have been developed separately (Meisinger, 1994a,b). Emission estimates are based on a number of assumptions related to the potential wastes to be processed in the MWTF. Emission estimates have been developed for two cases: extreme and nominal. The estimated uncontrolled emission rates and the assumptions used to develop them are described in the following section.

4.1 Extreme and Nominal Cases

Within the storage tanks, the combination of sludge, waste liquid, and heat result in a moisture-laden headspace; thus, exhaust from the waste tanks will be in the form of an aerosol, which is defined as a dispersion of microscopic solid and liquid particles in a gas phase (Wark and Warner, 1981). The exhaust stream characteristics differ significantly for the extreme and nominal case. Table 4-1 is a comparison of exhaust stream characteristics. As shown, the heat load for the extreme case is approximately seven times greater than the nominal case. Subsequently, the extreme case exhaust has a much higher humidity and temperature.

Organic vapor constituents have been determined by assuming similar compositions as Tank 103-C, which is generally considered a "worst case" tank for organic vapors. The organics in Tank 103-C are primarily a mixture of normal paraffin hydrocarbons (NPH) and tributyl phosphate (TBP).

NPH was used in the plutonium uranium extraction (PUREX) process as a diluent for TBP in the extraction of uranyl and plutonium nitrate from an aqueous solution containing nitric acid. NPH used in this process contained straight chain hydrocarbons from C-10 to C-15. NPH and TBP have been sent to the tank farms with stripping losses; additionally, process errors have resulted in larger quantities of NPH and TBP reaching the waste tanks. To determine the vapor space concentration of NPH and TBP, the mutual solubility of NPH and TBP in an aqueous solution was utilized (Groth, 1993). TBP has a high boiling point (543°F) and has negligible potential to be emitted in a gaseous form. It was assumed for the calculations that TBP will exist entirely as an aerosol (Meisinger, 1994a,b).

Other organics are introduced into the tank in smaller quantities or are degradation products of the introduced organics. Other organics expected to be in the MWTF tanks include acetone,

Table 4-1

Comparison of Exhaust Stream Characteristics for Extreme and Nominal Case Emissions

Tank Characteristic	Extreme Case	Nominal Case
Heat Load (BTU/hr)	7.0 E+05	1.1 E+05
Vapor Space Temperature (°F)	177	106
Vapor Space Humidity (lb/lb dry air)	0.211	0.021
Waste Vapor Pressure (inches of mercury)	0.93	N/A

benzene, 1-butanol, carbon tetrachloride, 2-hexanone (methyl butyl ketone [MBK]), 4-methyl-2-pentanone (methyl isobutyl ketone [MIBK]) (Groth, 1993). MIBK was used in the S-Plant process operations which were shutdown in 1966. 1-Butanol is created by the radiolytic degradation of TBP and is typically found in evaporator condensate samples. Acetone originated in lab wastes, decontamination facilities, and radiolysis of MBK and MIBK. The other organic constituents entered the waste system through other pathways.

The only significant inorganic vapor constituent is expected to be ammonia. Ammonia is present in most waste tanks on the Hanford Site and, thus, should be present in the MWTF.

Other toxic particulate matter, in addition to TBP, expected to present as uncontrolled aerosol emissions from the MWTF, and that are defined as TAPs include:

Aluminum	Antimony	Arsenic	Barium
Calcium	Cesium	Chloride	Chromium
Copper	Fluoride	Iron	Lead
Magnesium	Nickel	Plutonium	Selenium
Silver	Sodium	Strontium	Tin
Uranium	Yttrium		

As part of the permitting process for the MWTF operations, an analysis for best available radionuclide control technology (BARCT) has been prepared in addition to the T-BACT analysis. Particulate toxic air pollutants are not anticipated to be substantially different in form or treatability from radionuclide particulates emitted by the MWTF. Therefore, an independent assessment of particulate matter is not included here, and the particulate matter control selected as BARCT is presumed to satisfy T-BACT. The complete analysis for radioactive constituents is contained in a separate document, *Project W-236A, Multi-Function Waste Tank Facility, Best Available Radionuclide Control Technology Assessment* (WHC, 1994).

4.2 200 East and 200 West MWTF Uncontrolled Toxic Air Pollutant Emissions

The MWTF will include two tanks in the 200 West Area and four tanks in the 200 East Area. For the emission estimates, it was assumed that all six tanks will process similar types of waste. To provide an accurate estimate of the emissions for each area while maintaining conservatism, it was assumed that each MWTF area would contain one tank representing the extreme case and the other tanks representing nominal conditions. Thus, in the 200 East Area, one tank will represent the extreme case, while three tanks will be nominal, and, in the 200 West Area, one tank will be extreme and one tank will be nominal. Under normal conditions, the tank vent stream flowrate is estimated at 500 standard cubic feet per minute (scfm).

As a result of the particulate radionuclide emissions control system, small quantities of the TAPs will be removed. Specifically, the condenser and HEME will reduce the concentrations of ammonia and the high boiling point organics. For the purposes of T-BACT evaluation, uncontrolled emissions will be considered as those TAP emissions after the exhaust stream passes through the condenser and the HEME. These control elements are necessary for the particulate radionuclide control system and, thus, would be present regardless of TAP emissions. Estimated uncontrolled TAP emission rates are presented in Tables 4-2 and 4-3 for the 200 East and 200 West MWTF areas, respectively.

In the 200 East Area, NPH has the highest uncontrolled emission rate of 666 pounds per hour (lb/hr) with a cumulative uncontrolled emission rate of $5.83 \text{ E}+06 \text{ lb/yr}^*$. Emissions of 1-butanol are expected to be 11 lb/hr and $1.03 \text{ E}+05 \text{ lb/yr}$. Ammonia emissions are estimated at 0.4 lb/hr and $3.5 \text{ E}+03 \text{ lb/yr}$.

Emission estimates for the 200 West MWTF are slightly lower than 200 East. NPH emissions are 499 lb/hr and $4.37 \text{ E}+06 \text{ lb/yr}^*$, while 1-butanol is emitted at a rate of 9 lb/hr and $7.7 \text{ E}+04 \text{ lb/yr}$. Ammonia emissions are estimated to be 0.2 lb/hr and $2.08 \text{ E}+03 \text{ lb/yr}$.

For comparison, the Washington State Small Quantity Emission Rates (SQER) for these toxics are shown. The SQER is the amount under which a TAP that is emitted as a result of a minor process change does not require a notice of construction or dispersion modeling if all TAPs are below their respective SQERs. As shown in the Tables 4-2 and 4-3, the SQER is exceeded for 1-butanol and NPH in both the 200 East and West MWTF.

Note: The maximum inventory of NPH for any tank is expected to be about 5500 gallons, or approximately $3.4 \text{ E}+04$ pounds.

Table 4-2

200 East MWTF Uncontrolled Hazardous Air Pollutant Emissions

Hazardous Air Pollutant	Expected Annual Uncontrolled Emissions (lb/yr)	Small Quantity Emission Rate (lb/yr)
Acetone	3.75 E+03	4.37 E+04
Benzene	3.69 E+00	2.00 E+01
1-Butanol	1.03 E+05	4.37 E+04
Carbon Tetrachloride	2.81 E-02	2.00 E+01
2-Hexanone (MEK)	1.51 E+02	1.05 E+04
4-Methyl-2-Pentanone (MIBK)	1.06 E+04	4.37E+04
Normal Paraffin Hydrocarbons (NPH)	5.83 E+06	4.37 E+04
Ammonia	3.50 E+03	1.75 E+04
Iodine	1.25 E-01	1.75 E+02

Table 4-3

200 West MWTF Uncontrolled Hazardous Air Pollutant Emissions

Hazardous Air Pollutant	Expected Annual Uncontrolled Emissions (lb/yr)	Small Quantity Emission Rate (lb/yr)
Acetone	2.81 E+03	4.37 E+04
Benzene	3.69 E+00	2.00 E+01
1-Butanol	7.70 E+04	4.37 E+04
Carbon Tetrachloride	2.81 E-02	2.00 E+01
2-Hexanone (MBK)	1.13 E+02	1.05 E+04
4-Methyl-2-Pentanone (MIBK)	7.95 E+03	4.37E+04
Normal Paraffin Hydrocarbons (NPH)	4.37 E+06	4.37 E+04
Ammonia	2.08 E+03	1.75 E+04
Iodine	8.36 E-02	1.75 E+02

5.0 Review of Feasible Control Alternatives

Applying EPA's top-down approach, the first step in the T-BACT analysis is to identify all available control technologies with a practical potential for application to the source and the regulated pollutant under evaluation. The control options for ammonia, volatile organic compounds (VOC), and iodine were selected by searching for technologies used to reduce emissions of these chemicals in any gas streams.

From the available controls group, the technologies which are technically feasible for installation and successful operation are selected. Feasible technologies are those control measures which are available and which have demonstrated the ability to achieve reductions in emission rates for the pollutant being evaluated. In order to be technically feasible, it must be clearly demonstrated that a technology will be effective at the expected process conditions, such as flow rates, temperatures, concentrations, and levels of other components in the process stream. While successful operation in industry is not the only criteria for demonstrating technical feasibility, it is a strong indicator. The control technology selected as a result of the T-BACT analysis should not be the pilot demonstration for this application, and should also represent an alternative that may have a guaranteed performance.

Each of the candidate technologies for ammonia, VOCs, and iodine control were reviewed for technical feasibility.

5.1 Ammonia

Ammonia is the primary inorganic toxic air pollutant expected to be released from operation of the MWTF.

5.1.1 Literature Search

A search was conducted of EPA's best available control technology (BACT)/lowest achievable emission rate (LAER) Clearinghouse database for all cases in which a permit included control of ammonia. Twenty-nine cases were identified. The majority of the processes were power generation, in which an ammonia limit was included in the permit, but for which no controls were listed. Four companies listed information under the Control Equipment field; these cases are summarized in Table 5-1.

Table 5-1

Results of BACT/LAER Clearinghouse Database Search for Ammonia

Permit Date	State	Company Name	Process	Primary Emissions	Control Equipment	Percent Efficiency	Basis
5/90	Texas	Laport Chemical Corporation	Refrigerator unit	0.01 ton/yr	Ammonia scrubber	99.9	BACT
4/91	Arizona	Apache Nitrogen Products, Inc.	Ammonium nitrate mfg vessel; neutralizer	10 lb/hr (43.8 ton/yr)	Wet scrubber	91.94	BACT (not required)
6/91	Nevada	Saguaro Power Company	Combustion turbine generator	4.4 lb/hr (43.6 ton/yr)	Combustion process control; selective catalytic reduction for NO _x	NA	NA
4/92	Virginia	Hudson Power 14	Coal boilers	7.1 lb/hr 25 ppm	Combustion process control; selective catalytic reduction for NO _x	NA	BACT

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For Laport Chemical Corporation, an ammonia scrubber was listed as BACT. The second company also listed a wet scrubber as BACT, and noted that BACT was not required to meet the permit limit, but was applied to achieve 92 percent removal. The remaining two listings were for power companies; in these cases, no control equipment was installed for a reduction in ammonia emissions. Both of these entries are combustion processes in which selective catalytic reduction (SCR) is employed to reduce nitrogen oxide (NO_x) emissions. In SCR, ammonia is injected into the combustion effluent in order to chemically reduce the oxidated NO_x components. Control in these cases refers to optimizing the combustion process to reduce the NO_x , so that ammonia emissions are minimized.

The lack of control technologies represented in the Clearinghouse database is partially attributable to the fact that ammonia is not on the Priority Pollutant List (PPL). Without this regulatory emphasis, there has not been a high demand for innovative technologies. When ammonia emissions are controlled, an acid scrubber is usually employed and it is usually one component of an overall odor control system.

To identify alternative technologies for ammonia control, technical journals for societies such as the American Institute of Chemical Engineers and the Air and Waste Management Association were searched. Vendors dealing with odor control or suppliers of wet scrubbers and other absorption technologies were consulted. The resulting technologies available for ammonia emissions reduction are described in the following section.

5.1.2 Descriptions of Control Technologies

Packed Bed Scrubber. Wet scrubbing is the most frequently applied control technology for ammonia emissions. It is based on absorption technology, in which ammonia in the vapor phase is transferred into, or absorbed by, an aqueous solution. The liquid is delivered into the top of a column and flows downward through a solid packing, which provides surface area for the ammonia exchange. The gas stream may flow current or cocurrent to the liquid, but countercurrent flow provides the highest removal efficiencies. Although the gas stream makes a single pass through the column, the water is recycled to reduce water usage rates.

The scrubbing solution for ammonia removal is water with varying amounts of acid added, usually sulfuric acid. Ammonia reacts with the acid to produce ammonium sulfate. Absorption with a wet scrubber is an extremely flexible technology. Removal efficiencies are dependent

on the acid strength; although ammonia may be removed by water alone, the efficiency drops off sharply at a pH of 7 or above. The volume of liquid waste produced is controlled by acid solution strength and the packing volume, affecting liquid residence time.

Removal efficiencies up to 99.99 percent are achievable. Other advantages of this process are the ability to handle a wide range of concentrations and gas flow rates, and the flexibility of operating parameters. For lower flow rates (less than 4,000 scfm), packed bed scrubbers are more cost-effective than mist scrubbers. The technology is well-understood, and usage is widespread enough that off-the-shelf models are available. Disadvantages include relatively high pressure drops and the production of a waste ammonium sulfate solution. In effluent streams containing a high amount of particulates, the potential for fouling exists (McInnes, 1992).

Mist Scrubber. Removal of chemicals using a mist scrubber is another absorption technology. In this application, the liquid is sprayed through a nozzle into a hollow chamber through which the gas stream is flowing. This mist, or fog, increases the surface area for mass transfer and/or reaction by several orders of magnitude greater than the packed bed scrubber. With more available surface area, comparable efficiencies can be achieved without recycling the scrubbing liquid, allowing a clean scrubbing fluid to be used.

A primary application of the mist scrubber is to remove low-solubility compounds, where a chemical reaction between the scrubbing liquid and the adsorbate is required. Mist scrubbers are designed for large-scale processes, in which flow rates are greater than 4,000 scfm and concentrations are in the percent range. Currently, small-scale units are not available. For large applications, the mist scrubber is more cost-effective than a packed bed scrubber, due to low pressure drop and highly efficient mass transfer eliminating the liquid recycle. Disadvantages are high equipment cost, the production of a liquid waste stream, and lack of availability of small-scale systems (Rosalini, 1993). Appendix A contains records of personal communication.

Carbon Adsorption. Carbon adsorption is a technology which is widely used for removing organic contaminants from gas streams, especially when concentrations of the adsorbate are low. Adsorbers typically consist of a fixed bed or vessel packed with granulated carbon. The gas is passed through the bed and physically adsorbed to the carbon. When the available adsorption sites are filled, the adsorbate will pass through the bed; at this operational point, called

"breakthrough," the carbon is replaced. Since the adsorption capacity of the carbon decreases over time, adsorption systems often are equipped with two parallel units.

Activated carbon is produced from charcoal which is heated in a steam atmosphere to drive off all noncarbon matter. The resulting carbon structure has a large surface area which serves as adsorption sites. To enhance removal of inorganic contaminants, carbon is impregnated with a material which reacts with the adsorbate, chemically bonding it to the carbon. For ammonia adsorption, the impregnate is phosphoric acid, which traps the ammonia as ammonium phosphate.

Advantages of activated carbon adsorption include an extremely low operating cost, simple design, and a high removal efficiency, as much as 99.9 percent; however, the efficiency is dependent on operating conditions such as ammonia concentration, gas flow rates, humidity, temperature, and the specific brand of carbon. Removal efficiencies of 99 percent have been achieved in pilot tests at concentrations in the same range as those estimated for the MWTF operations. There are a number of commercially available carbons for ammonia removal, and a large number of units in full-scale use, although there is a lack of published results. Another disadvantage of this technology is the production of a solid waste (Bayati, 1993; Jarnecke, 1993).

DeAmine Injection. This technology is available from a vendor who provides equipment for odor removal. The process consists of a contact chamber through which the odor-containing gas flows. A proprietary chemical reactant mist is injected crossflow or coflow with the air stream and is carried up into fixed media packings, where the odor compounds are neutralized. Advantages of the system are low equipment and operational costs, low pressure drop, and suitability for low flow rates and odor compound concentrations.

This process is available from a single vendor, who was unable to estimate a removal efficiency for ammonia. According to the vendor, there are currently no applications of this process to ammonia removal, and the upper limit for removal of odor compounds is 30 parts per million (ppm) (McQueen, 1993).

5.1.3 Evaluation of Technical Feasibility

Table 5-2 summarizes each of the four ammonia technologies, the service experience, advantages and disadvantages, and states whether or not the control is technically feasible for removal of ammonia from the MWTF emissions stream, based on prior discussions.

Table 5-2

Summary of Ammonia Control Technologies

Control Technology	Service Experience	Advantages	Disadvantages	Technically Feasible
Acid/Water Scrubber	<ul style="list-style-type: none"> Extensive use in chemical processing industry 	<ul style="list-style-type: none"> 99+ percent removal efficiency May be operated in batch or continuous mode Ability to handle wide range of concentrations and flow rates Off-the-shelf units available 	<ul style="list-style-type: none"> Produces liquid ammonium sulfate waste Older technology less cost effective for large (>4,000 scfm) operations 	Yes
Mist Scrubber	<ul style="list-style-type: none"> Newer removal technology for chemical processing industry 	<ul style="list-style-type: none"> More cost-effective for flow rates >4,000 scfm Lower operating cost No recycle stream required 	<ul style="list-style-type: none"> Solid waste stream High equipment cost 	No
Carbon Adsorption	<ul style="list-style-type: none"> Commercially available 	<ul style="list-style-type: none"> Up to 99 percent removal efficiency Simple design and operation 	<ul style="list-style-type: none"> Solid waste stream Newer technology 	Yes
DeAmine Injection	<ul style="list-style-type: none"> New product for odor control 	<ul style="list-style-type: none"> Suitable for odor compound concentrations below 30 ppm Low pressure drop Low capital cost and operating equipment 	<ul style="list-style-type: none"> No experience for ammonia control Vendor unable to provide an efficiency 	No

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Acid scrubbing in a packed bed tower is technically feasible, and is retained for further evaluation. This technology is considered BACT as reported in the EPA Clearinghouse database, and has been proven for removal of ammonia from similar gas streams at the concentrations expected from the MWTF.

Mist scrubbing is not feasible for treatment of the MWTF emissions, and is rejected from further consideration. The technology is applied to large-scale process, with flow rates greater than 4,000 scfm, and units are not available for treating only 500 scfm. The primary application of the mist scrubber is for removal of low solubility compounds, where chemical reaction is required.

Carbon adsorption is technically feasible for ammonia control from the MWTF operations. It is commercially available and there are carbons which are impregnated specifically for ammonia removal at the MWTF ammonia concentrations. Field experience at these levels has not been confirmed, but the technology will be considered in more detail in this analysis.

DeAmine injection is not technically feasible for ammonia removal and will not be evaluated further. This technology has never been applied to ammonia emissions, and the vendor reported an upper limit for treatment of other odor compounds of 30 ppm; the MWTF ammonia emissions are estimated at 32 ppm.

5.1.4 Ammonia Control Technology Hierarchy

Technically feasible control technologies are ranked in order of effectiveness for ammonia in Table 5-3.

5.2 Volatile Organic Compounds

VOC emissions from the MWTF are expected to consist of the following toxic air pollutants: acetone, benzene, 1-butanol, carbon tetrachloride, 2-hexanone (MBK), 4-methyl-2-pentanone (MIBK), and NPH. The maximum flow rate of the MWTF ventilation system is estimated at 500 scfm from each tank.

5.2.1 Literature Search

A search was conducted of EPA's BACT/LAER Clearinghouse database for all cases in which a permit included control of common VOCs. The database search was performed by keying on pollution control device. The search was further made more specific by also adding VOC to

Table 5-3

Ammonia Control Technology Hierarchy for MWTF Operations

Control Alternative	Control Device Efficiency
Wet acid scrubber	99 percent
Carbon adsorption	Up to 99 percent

the criteria of the query. Many cases were identified for each VOC control device. A summary of the BACT/LAER Clearinghouse search is presented in Table 5-4.

5.2.2 Descriptions of Control Technologies

Carbon Adsorption. Carbon adsorption is a technology which is widely used for removing organic contaminants from gas streams, especially when concentrations of the adsorbate are low. Adsorbers typically consist of a fixed bed or vessel packed with granulated carbon. The gas is passed through the bed and physically adsorbed to the carbon. When the available adsorption sites are filled, the adsorbate will pass through the bed; at this operational point, called "breakthrough," the carbon is replaced. Since the adsorption capacity of the carbon decreases over time, adsorption systems often are equipped with two or more parallel units.

Activated carbon produced from charcoal which is heated in a steam atmosphere to drive off all noncarbon matter. The resulting carbon structure has a large surface area which serves as adsorption sites. Advantages of activated carbon adsorption include an extremely low operating cost, simple design, and a high removal efficiency, as much as 99.9 percent; however, the efficiency is dependent on operating conditions such as VOC concentration, gas flow rates, humidity, temperature, and specific brands of carbon.

There are some advantages of the carbon adsorption technology for VOC control. Variable flow rates and VOC concentrations are not disruptive to carbon adsorbers. Also, carbon adsorption systems are flexible and inexpensive to operate (installation costs are often lower than those of other systems). One disadvantage of this technology is that removal efficiencies decrease with decreasing inlet concentrations of adsorbate. At low inlet concentrations, the molecule effectively passes through the large pores in the carbon, bypassing adsorption sites. Another disadvantage of this technology is the production of solid waste (Bayati, 1993; Jarnecke, 1993).

Thermal Oxidation. Thermal oxidation systems, also known as fume incinerators, are no longer simple flares or afterburners. The modern thermal oxidizer is designed to accomplish from 95 to 99 plus percent destruction of virtually all VOCs. These systems can be designed to handle a capacity of 1,000 to 500,000 cubic feet per minute (cfm) and VOC concentration ranges from 100 to 2,000 ppm. Thermal oxidation systems combust VOCs at temperatures from 1,300 to 1,800°F. Actual operating temperature is a function of the type and concentration of materials in the vent stream and the desired destruction/removal efficiency

Table 5-4

Results of BACT/LAER Clearinghouse Search for VOC Control Devices

Permit Date	State	Company Name	Process	Primary Emission	Control Equipment	Percent Efficiency	Basis
05-90	Michigan	C.S. OHM Manufacturing Company	Spray Booth	VOC	Carbon Adsorption	99.0	BACT
07-89	North Carolina	Globe Manufacturing Company	Extruding Line	VOC	Carbon Adsorption	90.0	BACT
04-90	Connecticut	BYK-CHEMIE, USA	Material Transfer Mixing Tank	VOC	Condenser	95.0	BACT
04-92	Michigan	Chrysler Corporation	Dryer, Paint Sludge	VOC	Thermal Oxidizer	98.0	BACT
05-91	Tennessee	Screen Arts	Printer Screen	VOC	Catalytic Incinerator	90.0	BACT
01-93	Alabama	Daikin America Inc	Incinerator	VOC	Scrubber	99.99	BACT

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(DRE). Compounds that are difficult to combust or that are present at low inlet concentrations will require greater input (greater fuel costs) and retention time in the combustion zone to ensure that the desired DRE is accomplished.

Catalytic Oxidation. Catalytic oxidation systems directly combust VOCs in a manner similar to thermal oxidizers. The major difference is that the catalytic system operates at a lower temperature, typically about 700 to 900°F. This is made possible by the use of catalysts that reduce the combustion energy requirements.

Catalytic systems can be designed to handle a capacity of 1,000 to 100,000 cfm and VOC concentration ranges from 100 to 2,000 ppm. The catalytic system is well suited to low concentration operations or those that operate in a cyclic manner. They are often used for vent controls where flow rates and VOC content are variable. Destruction efficiencies in excess of 90 percent are common with a maximum DRE of 95 percent. Catalytic systems, like thermal oxidizers, can produce secondary combustion wastes. Halogens and sulfur compounds are converted to acidic species by the catalytic combustion process; these are treated by using acid-gas scrubbers. Also, the spent catalyst materials can require disposal as a hazardous waste if they are not recyclable.

Condensation. The driving force for condensation is oversaturation, which is achieved by chilling or pressurization (or both) of the waste gas stream. Condensation is most efficient for VOCs with boiling points above 100°F at relatively high concentrations (greater than 5,000 ppm). Low boiling VOCs can require extensive cooling pressurization, which sharply increases operating costs. Condensation processes are best suited to monosolvent systems, which is a disadvantage of this technology for the MWTf operation.

Biofiltration. Biofiltration is the removal and oxidation of organic gases (VOCs) from contaminated air by beds of compost or soil. Biofilters are beds of soil or compost, under which lies a distribution system of perforated pipe. Soil and compost are extensive networks of fine pores and have large surface areas. As contaminated air flows upward through the bed, VOCs sorb onto the organic surfaces of the soil or compost. The sorbed gases are then oxidized by microorganisms to carbon dioxide (CO₂). The removal and oxidation rates depend on the biodegradability and reactivity of the gases. Biofiltration technology is best applied to vapor streams of concentrations in the range of 20 to 5000 ppm; however, there are many exceptions. Almost all the costs of biofiltration are for capital equipment. When properly designed, operation and maintenance costs are minimal. Combining biofiltration with

condensers, particulate filters, or activated carbon filters can increase the range of operation beyond the normal scope of biofiltration alone. Biofilters, unlike scrubbers, are able to control odors as well as VOCs in an air stream. The enforcement of the Clean Air Act (CAA) amendments has forced many industries, who at one time only needed to control odors, to now also control volatile organic emissions.

Biofiltration combines the sorption of activated carbon, the washing effect of water, and oxidation. It removes 80 percent to greater than 99 percent of a very wide range of VOCs, depending on their chemical and biological reactivity.

Packed-Bed Scrubber (Absorption Tower). Adsorption is used to remove VOCs from gas streams by contacting the contaminated air with a liquid solvent. This takes place in an absorber tower designed to provide the liquid-vapor contact area necessary to facilitate mass transfer.

Absorption systems can be designed to handle a capacity of 2,000 to 100,000 cfm and VOC concentration ranges from 500 to 5,000 ppm. Absorbers can achieve VOC removal efficiencies in the high- ninety percent range.

5.2.3 Evaluation of Technical Feasibility

Table 5-5 summarizes each of the five VOC control technologies considered for BACT. No cases of biofiltration were found in the BACT/LAER database. The control technologies are evaluated from most to least efficient as found in the BACT/LAER database.

Packed-bed scrubber (Absorption Tower) is technically feasible, and is retained for further evaluation. This technology is considered BACT as reported in the EPA Clearinghouse database (Daikin America Inc.). This technology is widely used in the commercial sector with excellent removal efficiencies.

Carbon adsorption technology is considered as T-BACT for the MWTF operation. It has been widely used to capture VOCs from emission sources, and is commercially available and quite suitable for the mixed VOC vapors expected from the waste storage tanks (MWTF). This technology is also a very economically sound solution to control the low concentrations of VOCs (less than 1,000 ppm) present in the MWTF off gas.

Table 5-5

Summary of VOC Control Technologies

Control Technology	Service Experience	Advantages	Disadvantages	Technically Feasible
Carbon Adsorption	<ul style="list-style-type: none"> Commercially available 	<ul style="list-style-type: none"> 99+ percent removal efficiency Simple design and operation 	<ul style="list-style-type: none"> Produces solid waste stream Newer technology 	Yes
Thermal Oxidation	<ul style="list-style-type: none"> Extensive use in chemical industry 	<ul style="list-style-type: none"> Up to 99+ percent removal efficiency Simple design 	<ul style="list-style-type: none"> Not recommended for low VOC concentrations High operating and equipment cost 	No
Catalytic Oxidation	<ul style="list-style-type: none"> Extensive use in chemical industry 	<ul style="list-style-type: none"> Up to 99 percent removal efficiency Simple design and operation 	<ul style="list-style-type: none"> Catalysts can become fouled by impurities and/or halogenated VOCs 	No
Condensation	<ul style="list-style-type: none"> Commercially available 	<ul style="list-style-type: none"> Simple design 	<ul style="list-style-type: none"> Used for high concentrations (>5,000 ppm) Not recommended for mixed VOC off-gas streams 	Yes
Biofiltration	<ul style="list-style-type: none"> Fairly new and used in conjunction with other technologies for odor control 	<ul style="list-style-type: none"> Very low operating cost 	<ul style="list-style-type: none"> Aromatic VOCs are very difficult to biodegrade 	No
Packed Bed Scrubber	<ul style="list-style-type: none"> Extensive use in chemical industry 	<ul style="list-style-type: none"> 90+ percent removal efficiency Simple design 	<ul style="list-style-type: none"> Requires additional chemical solvent Significant liquid waste stream 	Yes

Thermal oxidization technology is not technically feasible, and is rejected from further evaluation. Due to the low heat content of the air stream from the tanks, large quantities of burner fuel would be necessary for incineration. With the potential presence of hydrogen in the gas stream, this technology would not be considered inherently safe. Additionally, the incineration system would be required to be placed a minimum distance from the tanks for safety considerations, and any additional systems required to place the incinerator further from the tanks would increase costs and potential of personnel exposure.

Condensation as a means of VOC control will be retained for further consideration. This technology is ideal for high concentrations (greater than 5,000 ppm) of VOCs and single constituent, high boiling (above 100°F) compounds. The MWTF could potentially produce high concentrations of VOCs and will have multiple constituents with boiling points above the 100°F level.

Catalytic incineration is not technically feasible for this application, and is rejected from further consideration. It is commercially available, has a simple design, and operates in a similar manner to thermal oxidation. However, masking and fouling of the catalyst may occur due to the mixed wastes (i.e., halogenated VOCs), which will degrade the capability of the catalyst.

Biofiltration technology is not technically feasible, and is rejected from further consideration as a stand-alone VOC control technology. This technology is fairly new and usually applied in conjunction with other control devices. This technology may be considered for application as a final control for odor removal during a later phase of this project.

5.2.4 VOC Control Technology Hierarchy

Carbon adsorption, condensation, and the packed bed scrubber (absorption tower) are technically feasible and will be evaluated for potential implementation as BARCT. Table 5-6 ranks the hierarchy of the potential VOC control technologies.

5.3 Iodine

Although the expected emissions of iodine from the MWTF are minimal, potential control technologies will be discussed.

5.3.1 Literature Search

A review was conducted of EPA's BACT/LAER Clearinghouse database to collect information on pollution control equipment for iodine. All source types were included, but no control

Table 5-6

VOC Control Technology Hierarchy for MWTF Operations

Control Alternative	Control Device Efficiency
Carbon Adsorption	99 percent
Packed Bed Scrubber (Absorption)	< 95 percent
Condensation	< 90 percent

technologies for iodine were identified. Additional searches were then conducted using a variety of sources, including chemical engineering, pollution control, and waste management journals; previously published technical reports; nuclear industry conference proceedings; and discussions with iodine control equipment vendors. Results includes the identification of seven technologies for gas phase iodine control. Each control technology is discussed in the following section.

5.3.2 Descriptions of Control Technologies

The identified iodine control technologies are discussed in the following paragraphs.

Caustic Scrubber. Caustic scrubbing is one of the earliest methods used for primary cleanup of iodine. In this system, a caustic scrubbing solution, usually potassium hydroxide or sodium hydroxide, is used in a packed column or bubble plate column. The caustic solution flows downward through the column countercurrent to the gas stream. Mixing between the gas and scrubbing liquid takes place, and mass transfer across the gas-liquid interfaces results in the removal of iodine from the gas stream. Other acid compounds, such as carbon dioxide and nitrogen oxides, will also be removed. A typical caustic concentration is 5 percent by weight.

When employed for primary cleanup, caustic scrubbing can provide up to 99 percent removal of elemental iodine. This control technology is usually applied prior to a secondary removal control, such as solid adsorbents. This technology has limited application for removing small concentrations of iodine. A further limitation of this technology is that organic compounds of iodine will not be removed. A liquid waste stream will be produced which would contain a mixture of caustic and iodine compounds. Pressure drop across the scrubber is relatively high (Battelle, 1984; NCRP, 1983; Ebasco, 1992).

Iodox Process. The Iodox process is an experimental liquid scrubbing technology similar to caustic scrubbing; it differs mainly in the attempt to utilize a high efficiency scrubbing solution that is recovered and recycled. The Iodox process uses a scrubbing solution of 20 to 22 molar nitric acid (hyperazeotropic acid), which oxidizes all iodine species to the plus 5 oxidation state. The resulting solution is concentrated in an evaporator; a stream is bled off to further evaporate and precipitate the iodine as iodic acid, a solid waste which is packaged for final disposal. The acid solution is distilled with magnesium nitrate to recover the nitric acid, which is reused.

Bench tests show that the Iodex process is capable of high efficiencies, such as 99.99 percent, but these efficiencies have not been achieved even in pilot testing. There are no full-scale applications of this process. Additional disadvantages include the need for additional unit operations such as evaporator and acid concentrator, high energy usage and operating costs, corrosivity, and the requirement for special materials of construction (Battelle, 1984; NCRP, 1983; Ebasco, 1992).

Mercurex Process. The Mercurex process utilizes the ability of the mercuric ion to form strong polyanionic complexes with the iodide ion. The technology is similar to the Iodex process, employing a high efficiency liquid scrub solution in a packed column or bubble-cap tray column. A mercuric nitrate/nitric acid solution flows countercurrent to the gas stream, and iodine complexes with mercury to form $HgI_2^{(2-x)}$ and $Hg(IO_3)_2$. The solution is recirculated to minimize the volume of waste produced.

In pilot-testing, iodine removal efficiencies of up to 99.8 percent have been achieved. In order to remove organic iodine, a 10 molar nitric acid solution has been used. This process has not been proven on a full scale. Although the Mercurex process has been studied extensively, there has been no full scale demonstration, and there is currently no effective means of treating the toxic/radioactive mercuric liquid waste which is produced. Other disadvantages include the toxicity and high cost of mercury and a decreasing removal efficiency over time (Battelle, 1984; NCRP, 1983; Ebasco, 1992).

Activated Carbon Adsorption. This technology is widely used in the nuclear industry for removing radioactive iodine from gas streams. Adsorbers typically consist of a fixed bed or vessel packed with granulated carbon. The iodine gas is passed through the bed and physically adsorbed to the carbon. When the available adsorption sites are filled, iodine will pass through the bed; at this operational point, called "breakthrough," the carbon is replaced. Because the adsorption capacity of the carbon decreases over time, adsorption systems often are equipped with two parallel units.

Activated carbon is produced from charcoal which is heated in a steam atmosphere to drive off all noncarbon matter. The resulting carbon structure has a large surface area which serves as adsorption sites. Elemental iodine gas is effectively removed using carbon adsorption. To enhance the removal of organic iodine, the carbon is usually impregnated with either KI, KI-I₂, KOH-I₂, or ethylenediamine. The iodine is chemically bonded to the carbon, and the more permanent bond is not easily reversed.

Advantages of activated carbon adsorption include low cost, simple design, and a high removal efficiency, as much as 99.9 percent; however, the efficiency is dependent on operating conditions such as iodine concentration, gas flow rates, humidity, temperature, and the specific brand of carbon. Removal efficiencies decrease with decreasing inlet concentrations. At low iodine concentrations, the molecule effectively passes through the large pores in the carbon, bypassing adsorption sites.

Silver Zeolite Adsorption. This adsorption technology is used for iodine removal in the waste management and fuel processing sectors of the nuclear industry. It is similar to carbon adsorption, except that the adsorbents are silver zeolites (either silver mordenite [designated AgZ] or silver faujasite [AgX]). The beds are operated at elevated temperatures (between 150 and 200°C), and the zeolite used is in pellet or granular form. Iodine is held on the zeolite material in the form of AgI, AgIO₃, and less stable complexes. Capture efficiencies of up to 99.9 percent are achievable in some applications. Since silver zeolites have the ability to remove low levels of iodine, they are attractive for low flow rates and cleanup of trace iodine following other sorption processes. Both elemental iodine and methyl iodide are removed.

Silver zeolites are produced by treating the zeolite minerals (or synthetic analogs) with a silver nitrate solution to replace sodium sites with silver ions. Advantages of silver zeolites include the ability to retain iodine removal efficiencies in the presence of humidity and NO_x, at elevated temperatures, and at low flow rates and low iodine concentrations. Unlike activated carbon, there are no concerns of flammability. Disadvantages include an extremely high material cost due to the silver, the requirement for heat addition and temperature control in the presence of humidity, and deactivation by acid gases. If fluoride or chloride are present, they will compete for adsorption sites. AgCl is more thermodynamically stable than AgI, so the chloride will be preferentially removed, and inhibit iodine removal.

Although theoretically silver zeolites may be capable of removing such low concentrations, this ability has not been demonstrated at full scale. The single manufacturer of vent systems with AgZ in the United States has no installations in this country. It would be difficult to determine breakthrough times in the field (Ebasco 1992; NCRP 1983; Emmonds 1993; Boron, 1993).

Silver-Loaded Silica Gel Adsorber. This iodine adsorbent technology is identical to the silver zeolite adsorber, except that a silver nitrate-impregnated amorphous silicic acid (AgSi) is the adsorbent. Operating conditions are identical to those for silver zeolites and high removal

efficiencies are achievable, but AgSi is less effective for removal of low levels of iodine. This technology is used for iodine control in German nuclear operations.

Advantages of AgSi include high removal efficiencies up to 200°C, no adverse effects from low levels of NO_x, and adsorbing ability in the presence of humidity if the temperature is kept above 150°C. Disadvantages are a lack of use of the material in the United States, deactivation in the presence of acids, and the need for elevated temperatures. The capacity for removal of iodine is inhibited by the presence of other halogens.

Silver silica gel technology has not been applied or tested at low concentrations. It has only demonstrated the ability to remove iodine at concentrations down to approximately 0.1 ppm. Its use in the United States is limited to developmental work (DOE, 1992; Ebasco, 1992; NCRP, 1983).

Silver Nitrate Scrubber. This removal technology is known as the "silver reactor." Although the name "scrubber" suggests a wet removal technology, the reactor unit is dry. The system consists of a vessel which contains a ceramic packing coated with silver nitrate. The gas stream is passed through the packing at a temperature of 190°C, and iodine is trapped by the dried packing as AgI and AgIO₃. The use of silver nitrate solution is applied after the vessel is off-line, when the packing is recharged by flushing with a concentrated silver nitrate solution.

The purpose of the silver nitrate reactor is to hold up the radionuclide iodine-131 long enough to permit decay. This process is less suitable for removal of iodine-129, due to the long half-life and production of a silver nitrate solution containing iodine. The reactor requires frequent regeneration. The other disadvantages are the same as for other silver technologies: the need for elevated temperature control, deactivation by acids, and inhibition by other halogens.

The only installation of this technology is at the Hanford Site; it is not commercially available. The lowest outlet concentration encountered at Hanford is 8 parts per billion (ppb). (NCRP 1983; Ebasco, 1992; Sowa, 1993).

5.3.3 Evaluation of Technical Feasibility

The seven iodine control technologies are summarized in Table 5-7, which lists each technology, the service experience, advantages, disadvantages, and technical feasibility for application to Project W-236A.

Table 5-7

Summary of Iodine Control Technologies

(Page 1 of 2)

Control Technology	Service Experience	Advantages	Disadvantages	Technically Feasible
Carbon Adsorption	<ul style="list-style-type: none"> Commercially available 	<ul style="list-style-type: none"> 99+ percent removal efficiency Simple design and operation Low cost 	<ul style="list-style-type: none"> Produces solid waste stream Newer technology Difficult recycle of carbon Decreased efficiency with decreased concentrations 	Yes
Caustic Scrubber	<ul style="list-style-type: none"> Existing proven technology 	<ul style="list-style-type: none"> Up to 99+ percent removal efficiency Simple design Simultaneous removal of acid compounds 	<ul style="list-style-type: none"> Not recommended for low concentrations of iodine Applied as first part of multi-stage control system Organic compounds of iodine not removed Produces liquid waste stream 	No
Iodox Process	<ul style="list-style-type: none"> Proven pilot scale technology 	<ul style="list-style-type: none"> Up to 99.99 percent removal efficiency Similar technology as Caustic Scrubber 	<ul style="list-style-type: none"> Unproven in full scale operations Need for additional control equipment from special metals Produces solid waste stream 	No
Mercurax Process	<ul style="list-style-type: none"> Proven pilot scale technology 	<ul style="list-style-type: none"> Up to 99+ percent removal efficiency 	<ul style="list-style-type: none"> Unproven in full scale operations No means available to treat toxic/radioactive waste stream High cost and toxicity of mercury used 	No
Silver Loaded Silica Gel	<ul style="list-style-type: none"> Currently used in nuclear industry 	<ul style="list-style-type: none"> Ability to retain efficiencies in presence of NO_x and humidity Maintains efficiency in low flow rates, high temperatures and mid-level concentrations No concerns of flammability 	<ul style="list-style-type: none"> Not effective for low-level concentrations of iodine High material cost Requires heat addition and temperature control system Deactivation by acid gases Adsorption fouling by chlorides and fluorides 	No

Table 5-7

(Page 2 of 2)

Control Technology	Service Experience	Advantages	Disadvantages	Technically Feasible
Silver Zeolite Adsorption	<ul style="list-style-type: none">• Currently used in nuclear industry	<ul style="list-style-type: none">• Ability to retain efficiencies in presence of NO_x and humidity• Maintains efficiency in low flow rates and low concentrations• No concerns of flammability	<ul style="list-style-type: none">• High material cost• Requires heat addition and temperature control system• Deactivation by acid gases• Adsorption fouling by chlorides and fluorides	No
Silver Nitrate Scrubber	<ul style="list-style-type: none">• Experimental technology	<ul style="list-style-type: none">• Holds Iodine-131 long enough to permit decay	<ul style="list-style-type: none">• Less suitable to Iodine-129• Reactor requires frequent regeneration• Need for elevated temperature control, deactivation by acids and inhibition by halogens	No

Of the potential iodine control technologies, only carbon adsorption is considered technically feasible for the low levels of iodine which are estimated to be emitted from the MWTF. Process-specific determinations of technical infeasibility for the remaining processes are discussed below.

Caustic scrubbing is typically applied as a primary treatment, followed by one of the adsorption technologies for secondary removal. It is not suitable for the MWTF concentrations. In addition, scrubbing will not remove organic compounds of iodine.

Neither the Iodox nor the Mercurex process has been demonstrated for full-scale applications; they are dismissed as feasible technologies. In addition, there is no adequate method of final treatment and disposal of the mercury-contaminated waste from the Mercurex process.

The silver loaded silica gel adsorber's capacity for removal of iodine is inhibited by the presence of other halogens. It has not been applied or tested at low concentrations and has only demonstrated the ability to remove iodine at concentrations down to approximately 0.1 ppm. Its use in the United States is limited to developmental work; therefore, this technology is not considered feasible for consideration as T-BACT (DOE, 1992; Ebasco, 1992; NCRP, 1983).

The lack of demonstration of silver zeolite adsorption technology at full scale and the uncertainty of its performance at the low iodine levels eliminate this technology from consideration. The silica gel adsorber has not successfully removed iodine at the levels demonstrated by the silver zeolite technology and, therefore, is not technically feasible.

The silver nitrate scrubber is not available commercially and, again, has been operated minimally at the low iodine concentrations emitted from the MWTF. The scrubber is not considered to be technically feasible.

5.3.4 Iodine Control Technology Hierarchy

No hierarchy ranking table was included as carbon adsorption was the only technically feasible control technologies for iodine removal.

5.4 Particulate Matter

As described in Section 4.2.1, the control of particulate matter is addressed in detail in the BARCT analysis for the W-236A project. Any potentially toxic particulate matter emissions

will be subject to the rigorous control requirements of radionuclide emissions. No further discussion of particulate matter control will be addressed in this report.

6.0 Analysis of Environmental, Energy, and Economic Impacts

To determine T-BACT for the MWTF project, an analysis of the energy, environmental, and economics was completed. The technologies were evaluated in the order determined by control technology hierarchies established in Chapter 5.0. If the impact on any of the three evaluation criteria was determined to be substantial, then that technology was rejected. The remaining technologies were considered until one was found to meet all criteria; that technology is proposed as T-BACT.

Environmental impacts addressed included the generation of solid and/or liquid waste from use of the technology, construction and maintenance hazards, and other health and safety issues. Energy impacts focused on direct energy impacts from the addition of emissions control technology such as the cost of the energy required to overcome the pressure drop of a particular control device.

For the economic analysis, each potential technology was evaluated by considering the total capital investment required and the annual operating cost for the control technology. The estimates provided are rough order of magnitude costs based on vendor-supplied quotes, engineering judgment, and cost estimation methodologies presented in the *Office of Air Quality Planning and Standards (OAQPS) Control Cost Manual* (EPA, 1990b) and in *Plant Design and Economics for Chemical Engineers* (Peters and Timmerhaus, 1980). These costs should be considered "budgetary" (plus or minus 30 percent).

Cost effectiveness represents the total dollars required for a certain percentage reduction in the pollutant and is equal to the annualized cost of the control technology divided by the difference between the uncontrolled emissions and the controlled emissions. Annualized cost is equal to the total capital investment multiplied by a Capital Recovery Factor (CRF) plus the annual operating cost of the control system. The CRF is calculated using an assumed interest rate and project life. The design life of the MWTF is approximately 30 years; therefore, annual amortized equipment costs for all emissions control configuration schemes were determined assuming a 30-year useful life for the installed equipment. The interest rate was assumed to be 10 percent.

6.1 Ammonia Controls

Environmental, energy, and economic impacts are discussed for the packed bed scrubber, carbon adsorption, and no control options.

6.1.1 Packed Bed Scrubber

Environmental Impacts. The design for the scrubber incorporates the Hanford Site criteria for minimizing waste produced and minimizing the need for operators to enter the tank farm area and perform maintenance on the equipment. To these ends, the scrubber will be operated in batch mode, requiring minimal field attention. A pH probe will be used to monitor the scrubbing fluid and indicate when replacement is necessary. The fluid is estimated to require replacement approximately twice a year.

The waste produced by the system is estimated at 160 gallons of 21 percent ammonium sulfate solution per change, or a total of 122 gallons of solution a year. Liquid waste will be recycled into the liquid waste recirculation system and eventually into the waste tanks; thus, the cost of waste disposal has not been included in the operating cost. Neither the waste produced nor the operation and maintenance required for the packed bed scrubber present adverse environmental impacts.

Energy Impacts. The predominant energy requirement for the scrubber is the electricity required to operate the liquid recirculation pump. The 10 horsepower (hp) pump would require 65,350 kilowatt-hour per year (kWh/yr) of electricity, which is not considered to be an adverse energy impact.

Economic Impacts. The economic impacts of the packed bed scrubber for the 200 East and 200 West MWTF areas are summarized in Tables 6-1 and 6-2.* The total capital investment for the scrubber option is estimated at \$165,600 for 200 East and \$82,800 for 200 West, with annual operating cost of \$60,624 and \$30,312, respectively. Appendix B contains actual vendor quotes for capital equipment. The annual amortized cost was determined to be \$78,178 for 200 East and \$39,089 for 200 West.

In the 200 East MWTF, the amount of ammonia removed is estimated to be 99 percent of the annual emissions of 3,500 lb/year or 3,460 lb/year (1.73 ton/yr). Therefore, the cost-effectiveness of the ammonia removal for the 200 East MWTF is \$45,190 per ton of ammonia removed.

Table 6-1

**200 East MWTF Ammonia Emission Control System - Acid Scrubber
Capital and Operating Cost Estimate for Project W-236A**

CAPITAL INVESTMENT COSTS	COST
Purchased Equipment	
Scrubber Unit (4 Units @ \$13,800 each)	\$55,200
Total Equipment Cost	\$55,200
Installation (50 % of Total Equipment Cost)	\$27,600
Piping (30 % of Total Equipment Cost)	\$16,560
Instrumentation & Controls (30 % of Total Equipment Cost)	\$16,560
Engineering & Supervision (30 % of Total Equipment Cost)	\$16,560
Sub-total Equipment & Installation Cost	\$132,480
Contingency (15 % of Equipment & Installation Cost)	\$19,872
Start-up (10 % of Equipment & Installation Cost)	\$13,248
Total Capital Investment	\$165,600
DIRECT ANNUAL OPERATING & MAINTENANCE COSTS	
Replacement of Scrubber Solution (\$85/ton)	\$320
Operating Labor (365 Hours @ \$20/hr/unit for 4 units)	\$29,200
Supervision of Operating Labor (15% of Operating Labor)	\$4,380
Maintenance & Repairs (20% of Total Equipment Cost)	\$11,040
Electricity (@ \$.06/kW-hr)	\$15,684
Total Annual Direct Operating & Maintenance Cost	\$60,624
INDIRECT ANNUAL COST^a	
Capital Recovery (% of Total Capital Investment = 10.6) ^b	\$17,554
Total Annual Indirect Cost	\$17,554
TOTAL ANNUALIZED COST	\$78,178

^aAll labor overhead costs are included in operating labor above; no incremental cost for administrative labor is included.

^bCapital recovery factor based on 30 year project life; 10% interest rate; no salvage value.

Table 6-2

**200 West MWTF Ammonia Emission Control System - Acid Scrubber
Capital and Operating Cost Estimate for Project W-236A**

CAPITAL INVESTMENT COSTS	COST
Purchased Equipment	
Scrubber Unit (2 Units @ \$13,800 each)	\$27,600
Total Equipment Cost	\$27,600
Installation (50 % of Total Equipment Cost)	\$13,800
Piping (30 % of Total Equipment Cost)	\$8,280
Instrumentation & Controls (30 % of Total Equipment Cost)	\$8,280
Engineering & Supervision (30 % of Total Equipment Cost)	\$8,280
Sub-total Equipment and Installation Cost	\$66,240
Contingency (15 % of Equipment & Installation Cost)	\$9,936
Start-up (10 % of Equipment & Installation Cost)	\$6,624
Total Capital Investment	\$82,800
DIRECT ANNUAL OPERATING AND MAINTENANCE COSTS	
Replacement of Scrubber Solution (\$85/ton)	\$160
Operating Labor (365 Hours @ \$20/hr/unit for 4 units)	\$14,600
Supervision of Operating Labor (15% of Operating Labor)	\$2,190
Maintenance & Repairs (20% of Total Equipment Cost)	\$5,520
Electricity (@ \$.06/kW-hr)	\$7,842
Total Annual Direct Operating & Maintenance Cost	\$30,312
INDIRECT ANNUAL COST^a	
Capital Recovery (% of Total Capital Investment = 10.6) ^b	\$8,777
Total Annual Indirect Cost	\$8,777
TOTAL ANNUALIZED COST	\$39,089

^aAll labor overhead costs are included in operating labor above; no incremental cost for administrative labor is included.

^bCapital recovery factor based on 30 year project life; 10% interest rate; no salvage value.

For the 200 West MWTF, 2,060 lb/year (1.03 ton/yr) would be removed by the scrubber. The cost effectiveness for the 200 West MWTF is \$37,950 per ton of ammonia removed.

There are currently no available guidelines for acceptable costs of ammonia removal; however, costs for removal of other air pollutants which are considered may be applied for comparison. Results of prior BACT analyses indicate that criteria pollutant emission control costs greater than \$10,000 per ton removed are considered cost prohibitive. These significant costs, coupled with the low potential emissions, and no adverse ambient air impacts expected support the conclusion that the option of ammonia removal using the packed bed scrubber is considered adverse; thus this option is rejected.

6.1.2 Impregnated Carbon Adsorption

Environmental Impacts. The environmental impacts from the application of impregnated carbon adsorption are related to disposal of the spent carbon. The amount of spent carbon that would be generated annually is estimated to be equal to 3 carbon canisters per tank or 12 total for 200 East and 6 total for 200 West, each containing 1,000 pounds of carbon. The spent carbon will be disposed of in accordance with applicable regulations and would cost approximately \$7,192 for the 200 East MWTF and \$3,596 for the 200 West MWTF. Disposal does not present a significant adverse impact.

Energy Impacts. Energy in the form of electricity will be required to provide the suction for drawing the emissions air stream through the carbon canister. The system pressure drop is estimated to be 10 inches of water, this corresponds to energy requirements of 31,629 kWh/yr for 200 East and 15,815 kWh/yr for 200 West, neither of which are adverse energy impacts.

Economic Impacts. The economic impacts of carbon adsorption are summarized in Tables 6-3 and 6-4 for the 200 East and 200 West MWTFs, respectively. The total capital investment for the carbon option is estimated at \$68,820 for 200 East and \$34,410 for 200 West, with annual operating costs of \$116,076 and \$58,038 for 200 East and 200 West, respectively. The annual amortized cost for 200 East was determined to be \$123,371; for 200 West, the annual amortized cost was \$61,685.

In the 200 East MWTF, the amount of ammonia removed is estimated to be 98 percent of the annual emissions of 3,500 lb/year or 3,440 lb/yr (1.72 ton/yr). Therefore, the cost-effectiveness of the ammonia removal for the 200 East MWTF is \$71,727 per ton of ammonia removed. For

Table 6-3

**200 East MWTF Ammonia Emission Control System - Carbon Adsorption
Capital and Operating Cost Estimate for Project W-236A**

CAPITAL INVESTMENT COSTS	COST
Purchased Equipment	
Carbon Adsorption Unit (4 Units @ 5,735/unit)	\$22,940
Total Equipment Cost	\$22,940
Installation (50 % of Total Equipment Cost)	\$11,470
Piping (30 % of Total Equipment Cost)	\$6,882
Instrumentation & Controls (30 % of Total Equipment Cost)	\$6,882
Engineering & Supervision (30 % of Total Equipment Cost)	\$6,882
Sub-total Equipment & Installation Cost	\$55,056
Contingency (15 % of Equipment & Installation Cost)	\$8,258
Start-up (10 % of Equipment & Installation Cost)	\$5,506
Total Capital Investment	\$68,820
DIRECT ANNUAL OPERATING & MAINTENANCE COSTS	
Replacement of Adsorption Units (@ \$5,735/unit)	\$68,820
Disposal of Used Adsorbers (@ \$299.65/cf)	\$7,192
Operating Labor (365 Hours @ \$20/hr)	\$29,200
Supervision of Operating Labor (15% of Operating Labor)	\$4,380
Maintenance & Repairs (20% of Total Equipment Cost)	\$4,588
Electricity (@ \$.06/kW-hr)	\$1,896
Total Annual Direct Operating & Maintenance Cost	\$116,076
INDIRECT ANNUAL COST^a	
Capital Recovery (% of Total Capital Investment = 10.6) ^b	\$7,295
Total Annual Indirect Cost	\$7,295
TOTAL ANNUALIZED COST	\$123,371

^aAll labor overhead costs are included in operating labor above; no incremental cost for administrative labor is included.

^bCapital recovery factor based on 30 year project life; 10% interest rate; no salvage value.

Table 6-4

**200 West MWTF Ammonia Emission Control System - Carbon Adsorption
Capital and Operating Cost Estimate for Project W-236A**

CAPITAL INVESTMENT COSTS	COST
Purchased Equipment	
Carbon Adsorption Unit (2 Units @ \$5,735/unit)	\$11,470
Total Equipment Cost	\$11,470
Installation (50 % of Total Equipment Cost)	\$5,735
Piping (30 % of Total Equipment Cost)	\$3,441
Instrumentation & Controls (30 % of Total Equipment Cost)	\$3,441
Engineering & Supervision (30 % of Total Equipment Cost)	\$3,441
Sub-total Equipment & Installation Cost	\$27,528
Contingency (15 % of Equipment & Installation Cost)	\$4,129
Start-up (10 % of Equipment & Installation Cost)	\$2,753
Total Capital Investment	\$34,410
DIRECT ANNUAL OPERATING & MAINTENANCE COSTS	
Replacement of Adsorption Units (@ \$5,735/unit)	\$34,410
Disposal of Used Adsorbers (@ \$299.65/cf)	\$3,596
Operating Labor (365 Hours/unit @ \$20/hr)	\$14,600
Supervision of Operating Labor (15% of Operating Labor)	\$2,190
Maintenance & Repairs (20% of Total Equipment Cost)	\$2,294
Electricity (@ \$.06/kW-hr)	\$948
Total Annual Direct Operating & Maintenance Cost	\$58,038
INDIRECT ANNUAL COST^a	
Capital Recovery (% of Total Capital Investment = 10.6) ^b	\$3,647
Total Annual Indirect Cost	\$3,647
TOTAL ANNUALIZED COST	\$60,475

^aAll labor overhead costs are included in operating labor above; no incremental cost for administrative labor is included.

^bCapital recovery factor based on 30 year project life; 10% interest rate; no salvage value.

the 200 West MWTF, 2,040 lb/yr (1.02 ton/yr) would be removed by the adsorption system. The cost effectiveness for the 200 West MWTF is \$60,475 per ton of ammonia removed.

As previously stated, there are currently no available guidelines for acceptable costs for ammonia removal. Criteria pollutant emission control costs greater than \$1,000 to \$10,000 per ton removed are considered cost prohibitive. Therefore, the economic impact ammonia removal using impregnated carbon adsorption is considered adverse, and this option is rejected.

6.1.3 No Controls

Neither of the technically feasible controls are acceptable as T-BACT due to the unacceptably high cost-effectiveness. Therefore, no controls are considered T-BACT for ammonia. Furthermore, it should be noted that uncontrolled ammonia emissions are not expected to pose adverse environmental effects. The SQER for ammonia is 17,500 lb/yr. The estimated annual release rate for uncontrolled ammonia emissions are 3,500 lb/yr for 200 East and 2,080 lb/yr for 200 West. The T-BACT analysis for ammonia control is summarized in Table 6-5 for the 200 East MWTF and Table 6-6 for the 200 West MWTF.

6.2 VOC Controls

Environmental, energy, and economic impacts are discussed for VOC control options considered technically feasible.

6.2.1 Carbon Adsorption

Environmental Impacts. Potential environmental impacts from the application of carbon adsorption are related to disposal of the spent carbon. The amount of spent carbon that would be generated annually is estimated to be equal to four carbon canisters for the 200 East MWTF and two for the 200 West MWTF, each containing 1,000 pounds of carbon. The spent carbon will be disposed of in accordance with applicable regulations and would cost approximately \$2,397 for the 200 East MWTF and \$1,199 for the 200 West MWTF. Disposal does not present a adverse impact.

Energy Impacts. Energy in the form of electricity will be required to provide the suction for drawing the emissions air stream through the carbon canister. The system pressure drop is estimated to be 5 inches of water; this converts to energy requirements of 15,815 kWh/yr for 200 East and 7,907 kWh/yr for 200 West, neither of which are adverse energy impacts.

Table 6-5

Summary of T-BACT Analysis for Ammonia Emissions
for the W-236A 200 East Multi-Function Waste Tank Facility

Control Alternative	Uncontrolled Emissions (lb/yr)	Emissions Reduction ^a (lb/yr)	Economic Impacts				Adverse Environmental Impact (Yes/No)	Adverse Energy Impact (Yes/No)
			Total Capital Investment ^b (\$)	Total Annualized Cost ^c (\$/yr)	Cost Effectiveness ^d (\$/ton)	Adverse Economic Impact (Yes/No)		
Acid Scrubber	3.50E+03	3.46E+03	165,600	78,178	45,190	Yes	No	No
Carbon Adsorption	3.50E+03	3.44E+03	68,820	123,371	71,727	Yes	No	No
Baseline	3.50E+03		--	--	--	--	--	--

^aEmissions reduction over baseline level.

^bInstalled capital cost relative to baseline

^cIncludes capital and operating costs. The capital recovery factor was used based on a 30 year equipment life and a 10% annual interest rate.

^dAverage Cost Effectiveness is total annualized cost for the control option divided by the emissions reductions resulting from the option.

9413297.0556

Table 6-6

**Summary of T-BACT Analysis for Ammonia Emissions
for the W-236A 200 West Multi-Function Waste Tank Facility**

Control Alternative	Uncontrolled Emissions (lb/yr)	Emissions Reduction ^a (lb/yr)	Economic Impacts				Adverse Environmental Impact (Yes/No)	Adverse Energy Impact (Yes/No)
			Total Capital Investment ^b (\$)	Total Annualized Cost ^c (\$/yr)	Cost Effectiveness ^d (\$/ton)	Adverse Economic Impact (Yes/No)		
Acid Scrubber	2.08E+03	2.06E+03	82,800	39,089	37,950	Yes	No	No
Carbon Adsorption	2.08E+03	2.04E+03	34,410	61,685	60,475	Yes	No	No
Baseline	2.08E+03	--	--	--	--	--	--	--

^aEmissions reduction over baseline level.

^bInstalled capital cost relative to baseline.

^cIncludes capital and operating costs. The capital recovery factor was used based on a 30 year equipment life and a 10% annual interest rate.

^dAverage Cost Effectiveness is total annualized cost for the control option divided by the emissions reductions resulting from the option.

Economic Impacts. The economic impacts of carbon adsorption are summarized in Tables 6-7 and 6-8 for the 200 East and 200 West MWTFs respectively. The total capital investment for the carbon adsorption unit is estimated at \$17,400 for both the 200 East and 200 West MWTFs, with annual operating costs of \$36,101 and \$22,828 for 200 East and 200 West, respectively. The capital cost of the VOC carbon adsorption unit is slightly higher than that of the ammonia carbon adsorption unit as a result of the carbon formulation required for VOC removal. The annual amortized cost for 200 East was determined to be \$37,947; for 200 West, the annual amortized cost was \$24,674.

In the 200 East MWTF, VOC removal is estimated to be 80 percent of the annual emissions of 29,000 lb/yr or 23,200 lb/yr (11.6 ton/yr). Therefore, the cost-effectiveness of the VOC removal for the 200 East MWTF is \$3,271 per ton of VOC removed. For the 200 West MWTF, 12,800 lb/yr (6.38 ton/yr) would be removed by the adsorption system. The cost effectiveness for the 200 West MWTF is \$3,855 per ton of VOCs removed. These cost effectiveness values are not considered to be adverse; thus, carbon adsorption is selected as T-BACT for VOCs. Summaries of the T-BACT analysis are given in Tables 6-9 and 6-10 for the 200 East and 200 West MWTFs, respectively.

6.3 Iodine Controls

Although three technically feasible control technologies were identified in Chapter 5.0 of this report, the result of the VOC evaluation which establishes carbon adsorption as T-BACT for VOC control implies that no additional energy, environmental, or economic impacts would be incurred from utilizing carbon adsorption as T-BACT for iodine control. In addition, carbon adsorption represented the most efficient of the potential alternatives for iodine control. Based on these conclusions, carbon adsorption will be considered as T-BACT for iodine.

Table 6-7

**200 East MWTF VOC Emission Control System - Carbon Adsorption
Capital and Operating Cost Estimate for Project W-236A**

CAPITAL INVESTMENT COSTS	COST
Purchased Equipment	
Carbon Adsorption Unit (1 Unit @ \$5,800)	\$5,800
Total Equipment Cost	\$5,800
Installation (50 % of Total Equipment Cost)	\$2,900
Piping (30 % of Total Equipment Cost)	\$1,740
Instrumentation & Controls (30 % of Total Equipment Cost)	\$1,740
Engineering & Supervision (30 % of Total Equipment Cost)	\$1,740
Sub-total Equipment & Installation Cost	\$13,920
Contingency (15 % of Equipment & Installation Cost)	\$2,088
Start-up (10 % of Equipment & Installation Cost)	\$1,392
Total Capital Investment	\$17,400
DIRECT ANNUAL OPERATING & MAINTENANCE COSTS	
Replacement of Adsorption Units (@ \$5,800/unit)	\$23,200
Disposal of Used Adsorbers (@ \$299.65/cf)	\$2,397
Operating Labor (365 Hours/unit @ \$20/hr)	\$7,300
Supervision of Operating Labor (15% of Operating Labor)	\$1,095
Maintenance & Repairs (20% of Total Equipment Cost)	\$1,160
Electricity (@ \$.06/kW-hr)	\$949
Total Annual Direct Operating & Maintenance Cost	\$36,101
INDIRECT ANNUAL COST^a	
Capital Recovery (% of Total Capital Investment = 10.6) ^b	\$1,844
Total Annual Indirect Cost	\$1,844
TOTAL ANNUALIZED COST	\$37,945

^aAll labor overhead costs are included in operating labor above; no incremental cost for administrative labor is included.

^bCapital recovery factor based on 30 year project life; 10% interest rate; no salvage value.

Table 6-8

200 West MWTF VOC Emission Control System - Carbon Adsorption
Capital and Operating Cost Estimate for Project W-236A

CAPITAL INVESTMENT COSTS	COST
Purchased Equipment	
Carbon Adsorption Unit (1 Unit @ 5,800/unit)	\$5,800
Total Equipment Cost	\$5,800
Installation (50 % of Total Equipment Cost)	\$2,900
Piping (30 % of Total Equipment Cost)	\$1,740
Instrumentation & Controls (30 % of Total Equipment Cost)	\$1,740
Engineering & Supervision (30 % of Total Equipment Cost)	\$1,740
Sub-total Equipment & Installation Cost	\$13,920
Contingency (15 % of Equipment & Installation Cost)	\$2,088
Start-up (10 % of Equipment & Installation Cost)	\$1,392
Total Capital Investment	\$17,400
DIRECT ANNUAL OPERATING & MAINTENANCE COSTS	
Replacement of Adsorption Units (@ \$5,735/unit)	\$11,600
Disposal of Used Adsorbers (@ \$299.65/cf)	\$1,199
Operating Labor (365 Hours/unit @ \$20/hr)	\$7,300
Supervision of Operating Labor (15% of Operating Labor)	\$1,095
Maintenance & Repairs (20% of Total Equipment Cost)	\$1,160
Electricity (@ \$.06/kW-hr)	\$474
Total Annual Direct Operating & Maintenance Cost	\$22,828
INDIRECT ANNUAL COST*	
Capital Recovery (% of Total Capital Investment = 10.6) ^b	\$1,844
Total Annual Indirect Cost	\$1,844
TOTAL ANNUALIZED COST	\$24,672

*All labor overhead costs are included in operating labor above; no incremental cost for administrative labor is included.

^bCapital recovery factor based on 30 year project life; 10% interest rate; no salvage value.

Table 6-9

Summary of T-BACT Analysis for VOC Emissions
for the W-236A 200 East Multi-Function Waste Tank Facility

Control Alternative	Uncontrolled Emissions (lb/yr)	Emissions Reduction ^a (lb/yr)	Economic Impacts				Adverse Environmental Impact (Yes/No)	Adverse Energy Impact (Yes/No)
			Total Capital Investment ^b (\$)	Total Annualized Cost ^c (\$/yr)	Cost Effectiveness ^d (\$/ton)	Adverse Economic Impact (Yes/No)		
Carbon Adsorption	2.90E+04	2.32E+04	17,400	37,945	3,271	No	No	No
Baseline	2.90E+04	--	--	--	--	--	--	--

^aEmissions reduction over baseline level.

^bInstalled capital cost relative to baseline.

^cIncludes capital and operating costs. The capital recovery factor was used based on a 30 year equipment life and a 10% annual interest rate.

^dAverage Cost Effectiveness is total annualized cost for the control option divided by the emissions reductions resulting from the option.

Table 6-10

Summary of T-BACT Analysis for VOC Emissions
for the W-236A 200 West Multi-Function Waste Tank Facility

Control Alternative	Uncontrolled Emissions (lb/yr)	Emissions Reduction ^a (lb/yr)	Economic Impacts				Adverse Environmental Impact (Yes/No)	Adverse Energy Impact (Yes/No)
			Total Capital Investment ^b (\$)	Total Annualized Cost ^c (\$/yr)	Cost Effectiveness ^d (\$/ton)	Adverse Economic Impact (Yes/No)		
Carbon Adsorption	1.59E+04	1.28E+04	17,400	24,672	3,855	No	No	No
Baseline	1.59E+04		--	--	--	--	--	

^aEmissions reduction over baseline level.

^bInstalled capital cost relative to baseline.

^cIncludes capital and operating costs. The capital recovery factor was used based on a 30 year equipment life and a 10% annual interest rate.

^dAverage Cost Effectiveness is total annualized cost for the control option divided by the emissions reductions resulting from the option.

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7.0 Air Quality Analysis

Chapter 173-460 of the WAC establishes SQER and acceptable source impact levels (ASIL) for toxic air pollutants. To determine the impact of the controlled toxic air pollutant emissions, specifically VOCs from Project W-236A, comparison of the controlled emission rates to SQERs is given in Tables 7-1 and 7-2 for 200 East and 200 West MWTFs. Controlled emissions for VOCs are based on the T-BACT recommendation. As shown in the tables, the controlled emissions are below the respective SQERs. Appendix C contains the WAC tables of SQERs and ASILs.

Table 7-1

200 East MWTF Controlled Hazardous Air Pollutant Emissions

Hazardous Air Pollutant	Uncontrolled Annual Emissions (lb/yr)	Controlled Emission Rate (lb/yr)	Small Quantity Emission Rate (lb/yr)	Controlled Stack Emission Concentration ($\mu\text{g}/\text{m}^3$)
Acetone	3.75 E+03	3.05 E+02	4.37 E+04	4.65 E+03
Benzene	3.69 E+00	3.94 E-01	2.00 E+01	6.01 E+00
1-Butanol	1.03 E+05	1.89 E+03	4.37 E+04	2.89 E+04
Carbon Tetrachloride	2.81 E-02	3.00 E-03	2.00 E+01	5.00 E-02
2-Hexanone (MBK)	1.51 E+02	1.61 E+01	1.05 E+04	2.45 E+02
4-Methyl-2-Pentanone (MIBK)	1.06 E+04	1.14 E+03	4.37 E+04	1.73 E+04
NPH (Kerosene)	5.83 E+06	2.45 E+03	4.37 E+04	3.73 E+04
Total VOCs	2.90 E+04	5.80 E+03		

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Table 7-2

200 West MWTF Controlled Hazardous Air Pollutant Emissions

Hazardous Air Pollutant	Uncontrolled Annual Emissions (lb/yr)	Controlled Emission Rate (lb/yr)	Small Quantity Emission Rate (lb/yr)	Controlled Stack Emission Concentration (µg/m ³)
Acetone	2.81 E+03	1.52 E+02	4.37 E+04	4.65 E+03
Benzene	4.00 E+00	3.94 E-01	2.00 E+01	1.20 E+01
1-Butanol	7.70 E+04	9.45 E+02	4.37 E+04	2.88 E+04
Carbon Tetrachloride	2.81 E-02	3.00 E-03	2.00 E+01	9.00 E-02
2-Hexanone (MBK)	1.13 E+02	1.21 E+01	1.05 E+04	3.69 E+02
4-Methyl-2-Pentanone (MIBK)	7.95 E+03	8.48 E+02	4.37 E+04	2.59 E+04
NPH (Kerosene)	4.37 E+06	1.23 E+03	4.37 E+04	3.75 E+04
Total VOCs	1.59 E+04	3.19 E+03		

8.0 References

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APPENDIX A
RECORD OF PERSONAL COMMUNICATIONS

CH2M HILL Telephone Conversation Record

CALL TO Larry Rosalini
DATE 12/3/93
PHONE NUMBER 708-564-5070
SUBJECT Ammonia mist scrubber

They sell mist scrubbers. Usually, these used for gas streams at 4000 cfm or higher, and for removal of ammonia at higher concentrations than we have. Cost starts at \$125,000. Have an air compressor, control panel, lots of instrumentation. Are large units - won't be efficient for small applications.

Mist scrubber is hollow chamber where mist is sprayed in. Get much greater surface area for exchange. Suitable for high concentrations, flowrates. Very low pressure drop.

CH2M HILL Telephone Conversation Record

CALL TO Catherine Sowa, Westinghouse Hanford Company

DATE 12/8/93

PHONE NUMBER 509-376-2780

SUBJECT Iodine gas removal processes at Hanford

The only case where Hanford has controls for iodine gas is the silver zeolite reactor at the Purex plant. The conditions at the inlet were 1.55 ppm at 278 scfm, and 30°C. They achieved a DF of 1 to 1000, depending on filter conditions. The outlet concentration was 8.6×10^{-3} ppm. I-129 was about 1/10 of the iodine stream; the rest was I-131.

CH2M HILL Telephone Conversation Record

CALL TO Dana Emmonds, SAIC-Radeco, San Diego, CA

DATE 12/6/93

PHONE NUMBER 800-962-1632

SUBJECT Iodine removal with silver zeolite

They work with sampling. Provide \$35 cartridges with the silver zeolite - only 1" by 2". Would need someone who could provide a larger system with baffles for longer residence time. Probably zeolite would be cost prohibitive. Didn't think they could help us.

They buy zeolite to use for sampling, from Doug Pourri at Ionex. Suggested calling Doug P.

CH2M HILL Telephone Conversation Record

CALL TO Chuck Jarnecke, Cameron Yakima, Inc., Yakima, WA

DATE 12/13/93

PHONE NUMBER 509-452-6605

SUBJECT Carbon adsorption for ammonia removal

If they were to pick up used canister and bring new one, costs as below.

Need a completed spent carbon profile form. \$100/waste stream. If material is classified as hazardous, need hazardous manifest fee of \$50 per manifest. Not including the freight to Cameron and back to site.

Costs are initial, plus \$1500 per service, plus \$250 for disposal. Don't know if radioactivity is a problem.

CH2M HILL Telephone Conversation Record

CALL TO Chuck Jarnecke, Cameron Yakima, Inc., Yakima, WA

DATE 12/8/93

PHONE NUMBER 509-452-6605

SUBJECT Carbon adsorption for ammonia removal

Impregnated carbon has phosphoric acid. Neutralizes the ammonia, producing ammonium phosphate.

If space is not a problem, "tub-scrub" would last a long time, and not need frequent service. Used 24 hours a day at 360 scfm at 32 ppm ammonia. 98% + removal efficiency, 1/10 second contact time. Carbon usage would be to saturation, use 0.218 lb/hr. Breakthrough will occur sometime before this.

Only hands-on required is when change unit.

CH2M HILL Telephone Conversation Record

CALL TO Brian Kimmer, Duall Division, MetPro Corporation,
Owosso, MI

DATE 12/9/93

PHONE NUMBER 517-725-8184

SUBJECT Ammonia removal with acid scrubber

Acid carryover from the scrubber should not be a problem, as the outlet has a mist eliminator.

CH2M HILL Telephone Conversation Record

CALL TO Dale McQueen, NuTech Northwest

DATE 12/3/93

PHONE NUMBER 708-564-5070

SUBJECT Ammonia vapor removal

DeAmine injection in QCID - quick contact chamber - suitable for removal of up to about 30 ppm. Have not done for ammonia removal even benchtop. Don't know the removal efficiency for ammonia.

CH2M HILL Telephone Conversation Record

CALL TO Doug Pourri, Ionex, Denver, CO

DATE 12/10/93

PHONE NUMBER 303-666-4400

SUBJECT Iodine adsorption on carbon or zeolite

They provide silver zeolite to various customers. The test concentration is 1.3×10^{-2} mg/m³. Certification done by EE + T, Dr. Ludwick, 946-7002 in Richland, WA (who said this is 100,000 times as large as our concentration - I calc 10,000). That's the lowest concentration which Ionex deals with. They sell zeolite and customers do their own thing, not necessarily reporting back on conditions. this is the only company in the US who supplies this (not true, according to Hi-Q; maybe he means as a vent system?). They sell to air samplers such as SAIC-Radeco. Also sell a lot to Japan.

At Hanford, sold some silver zeolite, but not as a vent system. Don't know what was used for.

CH2M HILL Telephone Conversation Record

CALL TO Dr. George Boron, Hi-Q Environmental, La Jolla, CA

DATE 12/6/93

PHONE NUMBER 619-549-9657

SUBJECT Iodine gas removal with silver zeolite

Costs \$225/lb

Used in sampling in the nuclear industry. Can differentiate between iodine and noble gases. Carbon will collect all of them. Therefore, they make zeolite for sampling purposes after an accident, when need to see whether I was present, and for analysis of Iodine.

Suggests talking to Alltech - make - or SAIC

Elemental iodine will condense on anything - particles, vent system, carbon. Will stay until conditions change. On impregnated carbon, chelates, so won't resublime. But adsorption on carbon will be negatively affected by humidity, other species present, temperature.

Methyl iodide - gas at room temperature - the tricky one because doesn't condense. AgZ will remove it.

We are the only mfrs of silver zeolite material anywhere (Note by me: not true, according to Ionex)

I₂ is a solid which sublimates. If use plain carbon, then can also desorb if temperature up, for instance. Also, other things will adsorb on carbon - water, for instance. Impregnated holds as a chemical bond - covalent and Van der Waals, not just adsorb/desorb equilibrium.

APPENDIX B
VENDOR QUOTES



Duall Division

MAIN OFFICE AND
MANUFACTURING HEADQUARTERS
1550 INDUSTRIAL DRIVE
OWOSSO MI 48867
(517) 725-8184
FAX (517) 725-8168

THANK YOU FOR YOUR INQUIRY. WE ARE PLEASED TO SUBMIT THE FOLLOWING PROPOSAL.

TO CH2M Hill Bellevue Office P. O. Box 91500 Bellevue, Wa 98009-2050 Phone: 206 - 453-5000 Fax: 206 - 462-5957		PROPOSAL NO. 060-1693-005-I-006-B
		DATE OF PROPOSAL December 10, 1993
ATTENTION OF Sarah Richards	END USER Hanford Site, WA	YOUR REFERENCE NO.

SHIPPING SCHEDULE 6-8 wks after receipt of PO & approval of prints, if any	TERMS Progressive - see below	F.O.B. Owosso, Michigan Freight not Included
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BUDGET PROPOSAL

Basis of Design

- Batch Operation - Estimated removal efficiency of 99% on ammonia (NH₃)
- Initial solution required: 159 gal. of 35% H₂SO₄
 - Estimated solution life: 4000 hours of operation
 - Waste generated: 159 gal. every 4000 hours of 21-1/2% ammonium sulfate solution.
 - Acid carryover into airstream should not occur
 - Total static pressure: 4" w.c.

1. 1 - Duall Division Ejector/Tower Scrubber fabricated of PVC material and equipped with eductor, pack tower, internal recirculation tank and recirculation pump.

BUDGET PRICE.....\$13,800.00

NET PRICE

Items not Included

Frigh to jobsite, field service testing, interconnecting ductwork, control panel, motor starters, chemicals and external piping and fittings.

TERMS: 10% upon issue of order
 40% before release for shipment
 50% Net 30 Days from date of shipment
 Subject to credit approval

Duall Division's standard terms and conditions apply to all transactions, a copy of which is included with each proposal. Full payment is due Net 30 days from date of shipment. Payment retainage and/or liquidated damages will not be accepted by Duall Division.

Our representative in your area:

Mr. George Todd Phone: 206/885-2805
Axium Composites
Redmond, WA 98073

To insure proper processing, a purchase order resulting from this proposal should be issued to:

MET-PRO CORPORATION DUALL DIVISION
1550 Industrial Drive
Owosso, MI 48867
Attn: Sales Secretary

BY

Brian Kibler
Brian Kibler

MET-PRO CORPORATION, DUALL DIVISION

ACCEPTANCE OF THIS OFFER IS LIMITED TO ITS TERMS INCLUDING ALL OF THE TERMS AND CONDITIONS ON ITS

MET-PRO CORPORATION DUALL DIVISION

MODEL ET SCRUBBERS

Duall scrubbers are manufactured from Type II Grade I PVC - conforming to ASTM D1784 and containing no plasticizers, or from polypropylene - conforming to ASTM P2146. All vessels are of hot-gas welded construction and are hydrostatically tested at the factory by filling to the air inlet nozzle. They are made in flanged sections for assembly on site by the Contractor. Flange sealant and hardware are provided by Duall. The hardware is 316 stainless steel. The flange sealant is silicone rubber or 3" x 3/8" neoprene gaskets.

Structural Design

The structural design is based on operation at a maximum temperature of 120°F, with a 100 mph wind load, and in seismic zone 3. A load safety factor of three (3) is applied to the design. Tie downs, guy wires, anchor bolts, and foundation are not provided by Duall. The polypropylene packing support system will have a maximum deflection of 1/2".

Ejector

An ejector provides the motive force for inducing air flow and overcoming static pressure losses in the system. Therefore, a fan is not required for most applications. Scrubbing solution is recirculated through a spray nozzle in the ejector. This flow entrains air, creating a draft.

Recycle/Separator Tank

Both ejector and packed tower are mounted on top of a tank which serves as a sump to contain the scrubbing solution and to separate the bulk of the motive fluid from the air stream.

Packing

We provide high-efficiency polypropylene packing supported on polypropylene or FRP grating.

Demister

Scrubbers have an integral mist eliminator. This will be 12" of polypropylene packing supported on polypropylene or FRP grating. It is located above the spray nozzles in the tower section. The mist eliminator will remove 99% of droplets 10 microns and larger.

Access

Two access ports with clear PVC covers are provided. They are located for inspection of spray nozzles, and at the sump for liquid level inspection. Sealant and hardware are provided by Duall. All hardware is 316 stainless steel. Silicone rubber sealant or 3" x 3/8" neoprene gaskets are provided.

Liquid Distribution

The liquid distributor consists of spray nozzles in a header arrangement. The entire assembly is constructed from Schedule 80 PVC pipe with PVC nozzles. It is installed at the factory. Hayward full-union PVC ball valves are provided

TERMS AND CONDITIONS

By Acceptance of this Offer the Buyer Expressly Agrees:

1. **AGREEMENT** - Subject to Paragraph 2 hereof, this Offer may only be accepted on, and is expressly limited to acceptance of, the exact terms and conditions contained herein and any acceptance by Buyer shall be deemed an acceptance of all the said terms and conditions, and this Offer contains a final, complete and exclusive statement of the terms and conditions of the contract between Mac-Pro Corporation Duall Division and Buyer relative to the sale of the products, materials and/or workmanship described or referenced to on the front side hereof and there have been no written or verbal understandings or agreements relative thereto other than those herein stated.
2. **MODIFICATION** - No waiver or modification of or addition to the terms and conditions contained herein shall be valid unless in writing and signed by a duly authorized representative of Mac-Pro Corporation Duall Division.
3. **TERMS** - Unless otherwise stated in our proposal, the standard payment terms are 10% with purchase order, 40% prior to shipment and 50% net 30 days subject to credit approval. Prices are quoted F.O.B. Owasso, Michigan. Buyer's financial responsibility is at all times subject to approval of Mac-Pro Corporation Duall Division, and Mac-Pro Corporation Duall Division may at any time require payment in advance or satisfactory security or guarantee that invoices will be promptly paid when due. If Buyer fails to comply with any terms of payment or requirements to secure payment, Mac-Pro Corporation Duall Division reserves the right to withhold further deliveries or terminate the Agreement and any unpaid amount shall thereupon become immediately due.
4. **CONTINGENCIES** - Mac-Pro Corporation Duall Division shall not be held liable or deemed in default if prevented from performing any of the obligations of the Agreement due to causes beyond its reasonable control such as fire, flood, drought, acts of God, war, riot, strikes, differences with workmen, lockouts, epidemics, quarantines, delays in transportation, shortage of cars, fuel, labor or materials, embargo or governmental orders or actions which in any way interfere with the purchase or manufacture or flow of the necessary materials, products or labor required to manufacture or fabricate the products, materials or workmanship described or referred to on the front side hereof.
5. **TAXES** - To the extent legally permissible all present and future taxes imposed by any federal, state, foreign or local authority which Mac-Pro Corporation Duall Division may be required to pay or collect upon or with reference to the sale, purchase transportation, delivery, storage, use or consumption of the products, materials and/or workmanship described or referred to on the front side hereof (except income taxes) shall be added to the purchase price of such product and shall be promptly paid by Buyer to Mac-Pro Corporation Duall Division upon demand.

6. **DELIVERY AND SHIPMENT** - Upon delivery of the products and/or materials described or referred to on the front side hereof, F.O.B. carrier, all risk of loss, damage and other incidents of ownership shall immediately pass to Buyer, but title to such products will be retained by Met-Pro Corporation Duall Division as security for Buyer's performance until payment in full is received.
7. **WARRANTY** - Met-Pro Corporation Duall Division warrants to Buyer that, subject to Paragraph 8 hereof, the products, materials and/or workmanship described or referred to on the front side hereof shall reasonably conform to that said description and/or reference, including any specifications specifically incorporated therein. Buyer's exclusive remedy for breach of said warranty shall be as follows: If, and only if Met-Pro Corporation Duall Division is notified in writing within (365) days from the date of shipment or completion of any such defect in the said products, materials and/or workmanship, and Met-Pro Corporation Duall Division, upon examination of any such defects shall find the same to be within the terms and covered by any warranty running from Met-Pro Corporation Duall Division to Buyer, Met-Pro Corporation Duall Division will, at its option, as soon as reasonably possible, replace or repair any such product, material and/or workmanship, without charge to Buyer; no such product, material and/or workmanship shall be returned to Met-Pro Corporation Duall Division without its consent, in no event, shall Met-Pro Corporation Duall Division be liable for consequential or incidental damages for breach of said warranty.
- The foregoing warranty and any other warranties included in the front side hereof ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY (INCLUDING BUT NOT LIMITED TO THE WARRANTY OF MERCHANTABILITY), WHICH OTHER WARRANTIES ARE EXCLUDED HEREBY, and of any other obligations and liabilities on the part of Met-Pro Corporation Duall Division and Met-Pro Corporation Duall Division neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the said products, materials and/or workmanship.
8. **PERMISSIBLE VARIATIONS** - Unless otherwise specified and agreed upon, all products, materials and/or workmanship shall be furnished subject to Met-Pro Corporation Duall Division's standard practices, tolerances and variations. Met-Pro Corporation Duall Division reserves the privilege of shipping overages or underages of weight, length, size and/or quantity in accordance with such of Met-Pro Corporation Duall Division's standard practices as may be applicable to the products, materials, and/or workmanship to be furnished upon acceptance of this Offer.
9. **DAMAGES** - Met-Pro Corporation Duall Division shall in no event be liable for incidental or consequential damages resulting from its breach of any of the terms of the Agreement, nor for special damages, nor for improper selection of any product described or referred to on the front side hereof for a particular application. No action for breach of any of the provisions of this Agreement may be maintained by Buyer against Met-Pro Corporation Duall Division unless commenced within one year of the date such cause of action shall have accrued.

10. **WAIVER** - The waiver by Met-Pro Corporation Duall Division of any term, provision, or condition hereof shall not be construed to be a waiver of any other term, condition or provisions hereof, nor shall such waiver be deemed a waiver of a subsequent breach of the same condition or provision. In the event Buyer shall default in its obligations under this Agreement, Buyer shall be liable for Met-Pro Corporation Duall Division's costs of collection, including reasonable attorneys' fees.
11. **ACCEPTANCE** - This Offer shall expire and terminate at midnight on the thirtieth day after the date shown on the front side hereof, unless it is sooner revoked by oral or written notice from Met-Pro Corporation Duall Division or is accepted by Buyer. No acceptance shall be deemed to be effective unless it is in writing signed by a duly authorized representative of Buyer and is actually received by Met-Pro Corporation Duall Division.
12. **PERMITS** - Buyer is responsible for obtaining any and all local permits in any instance where Met-Pro Corporation Duall Division is responsible for any installation or other performance beyond shipping the products, materials and or workmanship described on the front side hereof.
13. **SECURITY INTEREST** - Upon acceptance of the proposal and in addition to the other terms and conditions, Buyer grants seller a security interest in all products described in this proposal.
14. **CANCELLATION** - All orders upon acceptance by Duall cannot be cancelled without Duall's written consent, and then only upon payment to Duall of reasonable and proper cancellation charges.
15. **RETURNS** - No goods may be returned unless authorization in writing has been received from Duall's home Office. After authorization is received, all goods must be returned, freight prepaid, to our home office in Owosso, Michigan. No returned goods will be accepted without a "Return Goods Authorization" tag issued by the company.
16. **SHIPMENTS** - Scheduled shipping dates are approximate. Duall will make every effort to ship within scheduled shipping dates but will not be liable for delay that is beyond its control or caused by accident disabling our plant or equipment; riots or insurrection; national emergency; material or fuel shortages; labor disputes of any kind; embargoes; nondelivery by suppliers; delays of carriers or postal authorities; or government restrictions or prohibition. Title to and risk of loss for the material shall pass to the buyer upon delivery thereof by Duall to the carrier or delivery service.

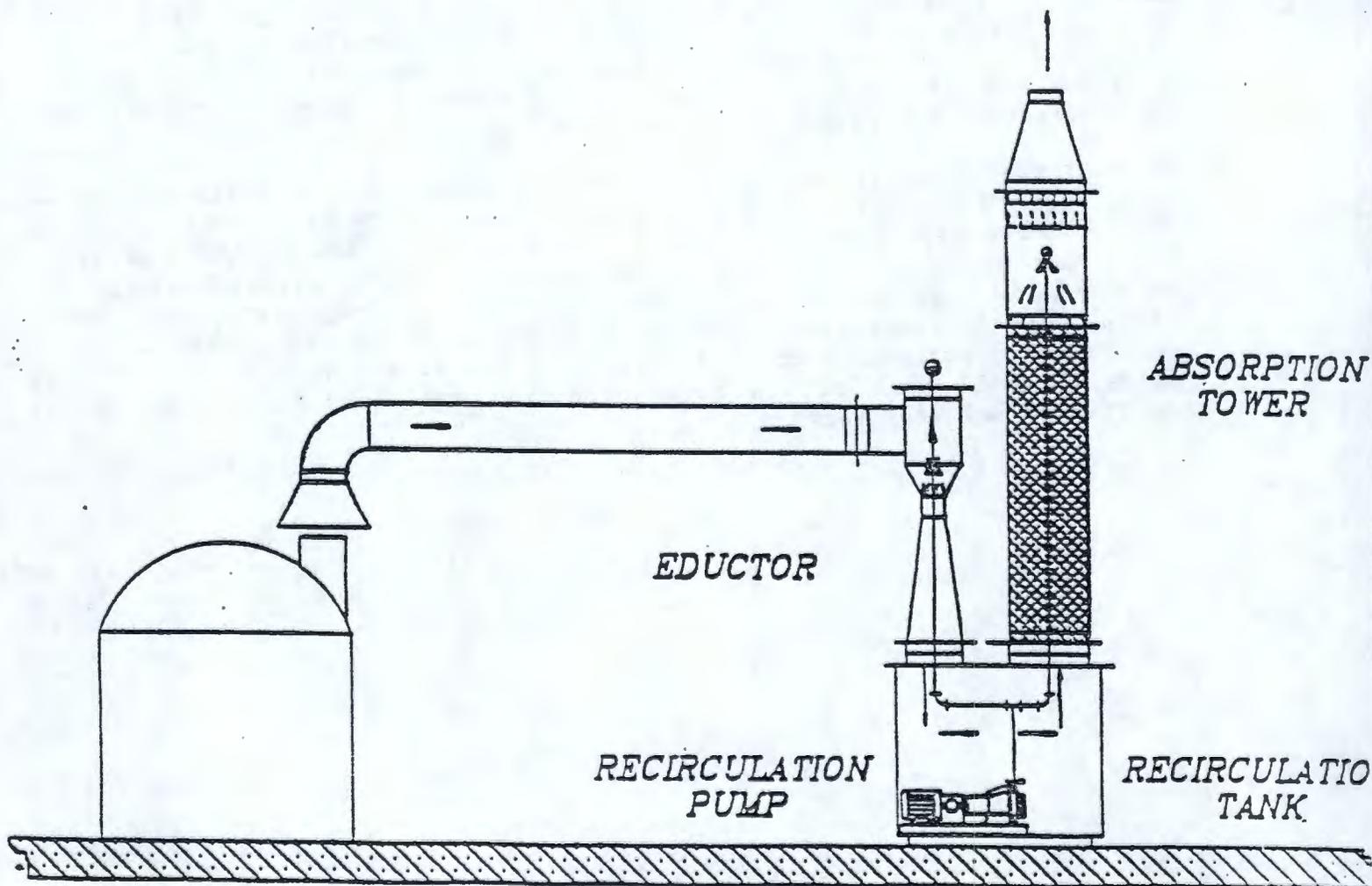
DUALL DIVISION—PRODUCT APPLICATIONS
STORAGE TANK VENTING

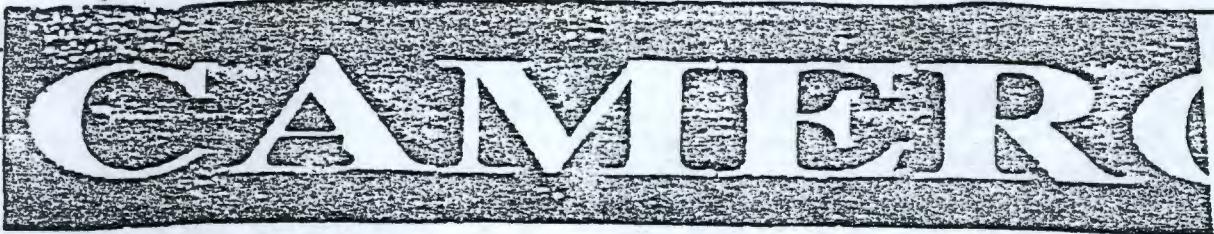
Current regulations require the scrubbing of toxic and noxious acid gases vented to atmosphere during storage tank filling operations. For this application, Duall recommends the "ET" series, "JET EJECTOR". This eductor/tower combination is a relatively low cost, but highly efficient scrubber system.

In the ejector, high pressure water is pumped through a nozzle. The venturi utilizes the energy in the water creating a draft. The air enters the venturi where it is accelerated by the water droplets. Particles are captured by impingement. Gases are absorbed by the water. The air stream is cooled by the evaporation of water. Most of the water droplets are separated from the air stream by the deflector and fall into the recirculation tank.

In the absorption tower contaminated air moves upward through the packed section. Water is pumped to the top of the packing and cascades down the column. The packing surface provides intimate contact surface for mass transfer of soluble gases into the liquid. The useful life of the recirculation water is dependent on equilibrium between gases and liquid, dissolved solids content and particulate loading. Efficiency depends on the nature of the contaminants, residence time, liquid loading and neutralizing.

No fan is required as the gases are drawn through the venturi by the water jet. Some gases will require nitrogen purge, others special cleaning features or separate tower pump. All Duall Division scrubbers can be supplied with control panel complete with pump motor starter, disconnect switch, and relay to interlock activation of scrubber with start of filling operation. Draft hood and ducting also available from Duall Division.





Carbon Adsorption
Quote

Yakima, Inc.

Since 1944

1414 South
Yakima
(509) 452-6

ACTIVATED CARBON SALES & SERVICE

***** Facsimile Transmission *****

TO : CH2M HILL
 ATTN : RACHEL CONTORER
 FAX : 206/462-5957
 FROM : CHUCK JARNECKE DATE: 12/08/93 TOTAL # OF PAGES : 6

DEAR RACHEL,

Persuant to our telcon earlier today, please find several options for the removal of ammonia fumes.

Given 32 ppm Ammonia @ 360 CFM, you will use 7.92 pounds of CY-NH per 24 hour day. This amounts to approx. 240 pounds per month. Below you will find pricing on several options for equipment. To see how long the equipment will last before requiring service, divide the total amount of carbon in the unit by 240. This will tell you how many months that unit will last before requiring service provided the concentration levels, and all other variables stay constant.

- 1 TSU/1000P POLY WITH CY-NH \$ 4,000.00
- 1 TSU/1000S WITH CY-NH \$ 5,735.00
- 1 TSU/200 WITH CY-NH \$ 2,450.00
- 1 TSU/270HP WITH CY-NH \$ 4,630.00

Please notice that the 270HP is an FRP vessel which you indicated may be required. Lead time required is 1 week.

Also, I noticed that we don't currently show you as having an open account with us. Do you bill through one of your other offices or can I fax you a credit application?

Best Regards,

Chuck Jarnecke
Sales

CAMERON

Yakima, Inc.

Since 1944

1414 South First Street • P.O. Box 1554
Yakima, Washington 98907
(509) 452-6605 • FAX (509) 453-9912

ACTIVATED CARBON SALES & SERVICE

CY - NH

IMPREGNATED FOR AMMONIA REMOVAL

"CY-NH" is high activity, specially treated activated carbon for use in vapor-phase ammonia (NH_3) removal applications.

PROPERTIES:

Base Material:

Apparent density (lbs/cu. ft)	30
Hardness number, minimum	95
Carbon tetrachloride activity number, minimum	60

Finished Product:

Apparent density (lb/cu. ft)	44 Average
NH_3 removal capacity, minimum (% w/w)	16% *

* (This equals 30% of the weight of the base activated carbon before treatment)

Peyster L. Morgan Jr. P.E.
George B. Bishop P.E.
Neil D. Kirk
William C. McConnell



Manufacturers' Representatives
P.O. Box 10648 Knoxville, TN 37923-0648
(615) 524-1100 FAX (615) 525-2305

PROPOSAL

see below
7-13-94

To: IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TN. 37923

6-13-1994 FAX
6-13-94

Date: DECEMBER 1, 1993

Quotation No.: DOE HANFORD, WA
Reference: W-320 TANK 241-C-106
WASTE REMOVAL

ATTN: CHRISTOPHER MOORE

We are pleased to submit the following proposal:

FLANDERS FILTERS:

360 SCFM MAXIMUM

- 1 EA. E-8 BAG-IN/BAG-OUT HOUSING
SIZE 1 H X 1 W; 304 SST
TEST/HEPA/TEST/HEPA
WITH: 99.97% OCP FILTERS

BUDGET-----\$7,100.00

REVISION
7-12-94
2000 CFM
SIZE 1X2

\$ 11,000⁰⁰

Budget

OPTION:

- 1 EA. E-8C BAG-IN/BAG-OUT HOUSING
SIZE 1 H X 1 W; 304 SST
WITH: CARBON AND ADSORBERS

BUDGET-----\$3,400.00

SIZE 1X2

\$ 5,200⁰⁰ BUDGET

Shipment: 6 WEEKS A.R.O.
F.O.B.: WASHINGTON, N.C.
Terms: NET 30

Submitted for:

FLANDERS FILTERS, INC.
C/O ROGERS & MORGAN, INC.

Prices do not include Excise, Sale or Use Taxes.
Proposal valid for 30 days unless otherwise noted.

By:

GEORGE B. BISHOP

Peyton L. Morgan Jr. P.E.
George B. Bishop P.E.
Neil D. Kirk
William C. McConnell



Manufacturers' Representatives
P.O. Box 10846 Knoxville, TN 37809-0846
(615) 224-1100 FAX (615) 523-2303

PROPOSAL

To: IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TN. 37923

ATTN: CHRISTOPHER MOORE

Date: DECEMBER 1, 1993
Quotation No.:
Reference: DOE HANFORD, WA
K-320 TANK 241-C-106
WASTE REMOVAL

We are pleased to submit the following proposal:

HARTZELL CENTRIFUGAL FAN: K1-1
230 SCFM
MODEL 052-12-MH13
1-1/2 HP MOTOR, TEFC

BUDGET-----\$1,500.00

HARTZELL CENTRIFUGAL FAN: K2-1
830 SCFM
MODEL 052-12-MHK3
3 HP MOTOR, TEFC

BUDGET-----\$1,750.00

300 of 1
7-13-94
2/16/93
800 400T
\$ 2,000

NOTES:

1. WITH: WEATHER COVER, DRAIN, V-BELT
2. VARIABLE FREQUENCY DRIVE BY OTHERS

Shipment: 6 WEEKS A.R.O.
PIQUA, OHIO

F. O. B.: NET 30

Terms:

Submitted for: HARTZELL FAN, INC.
C/O ROGERS & MORGAN, INC.

By:
GEORGE B. BISHOP

Prices do not include Excise, Sale or Use Taxes.
Proposal valid for 30 days unless otherwise noted.

APPENDIX C

TABLES OF ACCEPTABLE IMPACT LEVELS (ASIL) AND SMALL QUANTITY EMISSION - RATES

January 14, 1994

James A. Medina

Director

AMENDATORY SECTION (Amending WSR 93-20-079, filed 10/6/93)

WAC 326-30-041 Annual goals. The annual overall goals for participation by certified firms in the public works, other contracting, and procurement of each state agency and educational institution, subject to this chapter, shall be as follows:

July 1, ~~1993~~ 1993, through June 30, ~~1994~~ 1994

Construction/Public Works	10% MBE	6% WBE
Architecture/Engineering	10% MBE	6% WBE
Purchased Goods and Services	8% MBE	4% WBE
Other Consultants	10% MBE	4% WBE

Reviser's notes: The typographical errors in the above section occurred in the copy filed by the agency and appear in the Register pursuant to the requirements of RCW 34.05.040.

BEST AVAILABLE COPY

WSR 94-03-072
PERMANENT RULES
DEPARTMENT OF ECOLOGY
 (Order 93-19—Filed January 14, 1994, 2:56 p.m.)

Date of Adoption: January 12, 1994.

Purpose: Revise definitions, typographical errors and ASILs; add 42 toxic pollutants, consistent with PCAA Act.

Citation of Existing Rules Affected by this Order:
 Amending WAC 173-460-020, 173-460-030, 173-460-040, 173-460-050, 173-460-060, 173-460-080, 173-460-090, 173-460-100, 173-460-110, 173-460-150, and 173-460-160.

Statutory Authority for Adoption: Clean Air Act of Washington, chapter 70.94 RCW.

Pursuant to notice filed as WSR 93-22-102 on November 3, 1993.

Changes Other than Editing from Proposed to Adopted Versions:

ATTACHMENT
Chapter 173-460 WAC

Differences Between the Text of the Rule as Proposed and as Adopted

A redline (~~example~~ or ~~example~~) indicates language that has been added and a strikeout (~~example~~) indicates language that has been deleted. Following each of the changes or groups of changes is an explanation of Ecology's reasons for making the change.

Section 173-460-020 ((~~Wacstep 77-11~~)) ~~PO Box 47600~~, Olympia, WA 98504-((~~8711~~))7600.

Section 173-460-020(8) (~~Revised 1940 Code Part 5 Appendix A ((49012-13-0272 as amended by Supplement 3 (September 1999))~~)

Section 173-460-020(12) "Inhalation Reference Concentration

Section 173-460-020(14) "Modification" means any physical change in, or change in the method of operation of, a stationary source that increases the amount of any ((~~toxic~~)) air contaminant emitted by such source or that results in the emission of any ((~~toxic~~)) air contaminant not previously emitted. The term modification shall be construed consistent with the definition of modification in Section 7411, Title 42, United States Code, and with rules implementing that section. For purposes of this chapter, the term "air contaminant" shall mean "toxic air contaminant" or "toxic air pollutant" as defined in WAC 173-460-020(20).

Section 173-460-020(20) "Toxic air pollutant (TAP)" ~~or toxic air contaminant~~ means any Class A or Class B toxic air pollutant listed in WAC 173-460-150 and WAC 173-460-160. . . .

Section 173-460-040(2)(b) minor process change((~~+~~)) that does

Section 173-460-040(9) construction approval((+)); prior

Section 173-460-050(3) be used ((~~prior~~)) to demonstrate compliance with WAC 173-460-090.

Section 173-460-050(4)(a)(1) and performing modeling for the total TAP emissions and compar((~~+~~))ing ~~results~~

Section 173-460-060(5)(d)(1) be allowed to ((~~fully~~)) drain fully;

Section 173-460-080(2)(c) can be obtained through NTIS (703) 487-4650 or can be downloaded from the CAQPS Technology Transfer Network electronic bulletin board system).

Section 173-460-150 Table 1 Class A TAPs

53-96-3	2-Acetylaminofluorene	
((56-55-3))	Benzo(a)anthracene	
56-55-3	Benzo(a)anthracene	
3547-04-4	DDE (p,p'-((Dichlorodiphenyl ether)))	<u>Dichlorodiphenyl dichloromethane</u>
((58-83-3))	Indene	

PERMANENT

- 129-15-7 2-Methyl-1-nitroanthraquinone
(~~(71856-13-3) Methyl azoxymethanol-3,3-glucosiduronic acid~~)
- 592-62-1 Methyl azoxymethan(~~ene~~)yl acetate
- 139-91-3 5-(Morpholinomethyl)-2-(((4)5-nitrofurfurylidene(+)amino)-2-oxasolidinone (furaltudone)
- C7440-02-0 Nickel and compounds (as nickel subsulfide or nickel refinery dust)
- (~~921-16-3 N-Nitrosodi-n-butylamine~~)
- 531-82-8 N-(4-(5-((Nitro))Nitro-2-Furyl)-2-thiazolyl)acetamide
(~~(759-73-3 N-Nitroso-n-butylamine~~)
- ~~621-64-7 N-Nitrosodi-n-propylamine~~
- ~~10595-95-6 N-Nitrosomethylmethylamine~~
- ~~59-89-2 N-Nitrosomorpholine~~
- ~~86-30-6 N-Nitrosodiphenylamine~~
- ~~55-18-5 N-Nitrosodimethylamine (dimethylnitrosoamine) (DMN)~~
- ~~62-75-9 N-Nitrosodimethylamine~~)
- 924-16-3 N-Nitrosodi-n-butylamine
- 759-73-9 N-Nitroso-N-ethylurea (NEU)
- 615-53-2 N-Nitroso-(n)N-methylurethane
- 621-64-7 N-Nitrosodi-n-propylamine
- 10595-95-6 N-Nitrosomethylmethylamine
- 59-89-2 N-Nitrosomorpholine
- 86-30-6 N-Nitrosodiphenylamine
- 55-18-5 N-Nitrosodimethylamine (dimethylnitrosoamine) (DMN)
- 62-75-9 N-Nitrosodimethylamine

Section 173-460-150 Table II Class A TAPs

- 108-43-0 ((Chlorophenols))Chlorophenols 0.1800000
- 764-41-0 1,4-Dichloro-2-butane 3.0003300
- 106-93-4 Ethylene dibromide (dibromethane) 0.0045000
- C7440-02-0 Nickel and compounds (as nickel subsulfide or nickel refinery dust) 0.0021000
- 1746-01-6 2,3,7,8-Tetrachlorodibenz(±)g-p-dioxin (2,3,7,8-TCDD) 0.00000003

Section 173-460-150 Table III Class A TAPs

- 126-99-8 ((3))2-Chloropropane 120 24 hour
- (~~(58-89-7 Lindane 100 24 hours)~~)
- 101-77-9 4,4-Methylene dianiline 2.7 24 hour

Section 173-460-160 Class B TAPs

- (~~(73-06-1 Merylanide 3-13)~~)
- 7773-06-0 Ammonium ((sulfamase))sulfamate 33
- (~~(56-53-3 Benzocyclohexene~~)
- (~~(75-25-2 Bromoform 17)~~)
- 106-97-8 Butane ((---))500000
- 109-79-5 n-Butyl mercaptan 6.0
- 109-73-9 n-Butylamine 50.
- (~~(5712-63-3) 55720-79-3~~) Chlorinated diphenyl oxide (hexachlorophenyl ether) 1.7
- (~~(51-50-3)~~)

REPLACEMENT

51-79-5	Cyanides, as CN	17	
95-50-1	<u>o-Dichlorobenzene (1,2-Dichlorobenzene)</u>	1000	
((106-6-7))	p-Dichlorobenzene	1500	
((25221-1-1))	Dinitrotoluenes (mixed)	---	
121-14-2	2,4-Dinitrotoluenes	500	
((106-39-3))	Trichloroethylene	---	
51-79-5	Ethyl carb((o))anate	---	
-	F((o))ibrous glass dust	33	
1309-37-1	Iron oxide fume, ((Fe2O3))Fe ₂ O ₃ , as Fe	((1-7))17	
26952-21-6	((Isocetyl)) <u>Isocetyl</u> alcohol	890	
3687-31-8	Lead arsenate, as Pb((PbAsO4)), (A.O.)	0.50	
150-76-5	4-Methoxyphenol	((1-7))17	
71-55-6	Methyl chloroform (<u>1,1,1-Trichloroethane</u>)	((6700))6400	
21087-64-9	Metribuzin	((1-7))17	
C7439-98-7	Molybdenum, as Mo soluble cpds	((1-7))17	
88-72-2	Nitrotoluene	((3-7))37	
8012-95-1	Oil mist, mineral	((1-7))17	
((87-26-5))	Pentachlorophenol	---	
106-50-3	p-Phenylene(a-diamine)ediamine	0.33	
626-17-5	m-Phthalodinitrile	((1-7))17	
142-64-3	Piperazine dihydrochloride	((1-7))17	
71-23-8	n-Propyl alcohol	1600	
((75-36-3))	Propylene oxide	---	
83-79-4	Rocenone	((1-7))17	
7803-62-5	((silicon)) <u>Silicon</u> tetrahydride	22	
C7440-22-4	Silver, soluble compounds as Ag	0.033	
7631-90-5	Sodium bisulfite	((1-7))17	
C7440-25-7	Tantalum, metal & oxide dusts	((1-7))17	
7722-88-5	Tetrasodium pyrophosphate	((1-7))17	
C7440-28-0	Thallium, soluble compounds, ((Tl)) <u>Tl</u>	0:33	
((6)) 7440-31-5	Tin, Metal	6.7	
7440-31-5	Tin, oxide & inorganic except Sn((Sn))H ₄	6.7	
((71-55-5))	1,1,1-Trichloroethane	6000	
1321-65-9	Trichloronaphthalene	((1-7))17	
603-34-9	Triphenyl amine	((1-7))17	
C7440-33-7	Tungsten, insoluble compounds	((1-7))17	
1314-62-1	Vanadium, as ((V2O5)) <u>V₂O₅</u>	0.17	
-	Welding fumes	((1-7))17	
1314-13-2	Zinc oxide, fume	((1-7))17	
C7440-67-7	Zirconium compounds, as Zr	((1-7))17	

PERMANENT

Effective Date of Rule: Thirty-one days after filing.
 January 12, 1994
 Mary Riveland
 Director

AMENDATORY SECTION (Amending Order 90-62 filed 9/18/91, effective 9/18/91)

WAC 173-60-020 Definitions. The definitions of terms contained in chapter 173-00 WAC are incorporated into this chapter by reference. In the event of a conflict between the definitions provided in chapter 173-00 WAC and the definitions provided in this section, the definitions in this section shall govern. Unless a different meaning is clearly required by context, the following words and phrases

as used in this chapter shall have the following meanings. Note: For copies of the above mentioned rule and any other rule cited in this chapter, contact the Department of Ecology, Records Section, (Mailstop 21144) P.O. Box 7600, Olympia, WA 98504, (360) 760.

(1) "Acceptable source impact analysis" means a procedure for demonstrating compliance with WAC 173-60-020 and 173-60-030, that compares maximum incremental ambient air impacts with applicable acceptable source impact levels (ASIL).

(2) "Acceptable source impact level (ASIL)" means a concentration of a toxic air pollutant in the outdoor atmosphere in any area which does not have restricted or controlled public access that is used to evaluate the air quality impacts of a single source. There are three types of accept-

source impact levels: Risk-based, threshold-based, and special. Concentrations for these three types of ASILs are determined as provided in WAC 173-60-110. ASILs are listed in WAC 173-60-150 and 173-60-160.

3. "Authority" means an air pollution control authority activated pursuant to chapter 70.94 RCW that has jurisdiction over the subject source. Ecology is the authority if an air pollution control authority has not been activated or if ecology has jurisdiction over the source pursuant to RCW 70.94.395.

(4) "Best available control technology for toxics (T-BACT)" applies to each toxic air pollutant (TAP) discharged or mixture of TAPs, taking in account the potency quantity and toxicity of each toxic air pollutant or mixture of TAPs discharged in addition to the meaning given in WAC 173-400-030(10).

(5) "Carcinogenic potency factor" means the upper 95th percentile confidence limit of the slope of the dose-response curve and is expressed in units of (mg/kg-day)⁻¹.

(6) "Class A toxic air pollutant (Class A TAP)" means a substance or group of substances listed in WAC 173-60-150.

(7) "Class B toxic air pollutant (Class B TAP)" means any substance that is not a simple asphyxiant or nuisance particulate and that is listed in WAC 173-60-160.

(8) "EPA's Dispersion Modeling Guidelines" means the United States Environmental Protection Agency Guideline on Air Quality Models, EPA ((40 CFR Part 51 Appendix V)) (Revised) 40 CFR Part 51 Appendix V, and is hereby incorporated by reference.

(9) "EPA's Risk Assessment Guidelines" means the United States Environmental Protection Agency's Guidelines for Carcinogenic Risk Assessment 51 FR 33992 (September 24, 1986) and is hereby incorporated by reference.

(10) "Increased cancer risk of one in one hundred thousand" means the 95th percent upper bound on the estimated risk of one additional cancer above the background cancer rate per one hundred thousand individuals continuously exposed to a Class A toxic air pollutant at a given average dose for a specified time.

(11) "Increased cancer risk of one in one million" means the 95th percent upper bound on the estimated risk of one additional cancer above the background cancer rate per one million individuals continuously exposed to a Class A toxic air pollutant at a given average dose for a specified time.

(12) "Inhalation Reference ((Dose)) Concentration (Inhalation ((RfC)) RfC)" means a reference ((dose)) concentration published in the United States Environmental Protection Agency Integrated Risk Information System (IRIS).

(13) "Mixture" means a combination of two or more substances mixed in arbitrary proportions.

(14) "Modification" means any physical change in, or change in the method of operation of, a stationary source that increases the amount of any air contaminant emitted by such source or that results in the emission of any air contaminant not previously emitted. The term modification shall be construed consistent with the definition of modification in Section 7411, Title 42, United States Code, and with rules implementing that section. For purposes of this chapter, the term "air contaminant" shall mean "toxic air contaminant" or

"toxic air pollutant" as defined in subsection (20) of this section.

(15) "New toxic air pollutant source" means the source or emission unit which may emit toxic air pollutants and which commenced construction after the effective date of this chapter, in addition to enlargement, modification, replacement or alteration of any process at an pollutant source which may increase emissions of ambient air concentrations of any regulated air pollutant, including toxic air pollutants, shall be construed as construction or installation or establishment of a new toxic source.

(15) "Second Tier Analysis" applies to each toxic air pollutant or mixture of TAPs, taking in account the potency quantity and toxicity of each toxic air pollutant or mixture of TAPs discharged in addition to the meaning given in WAC 173-400-030(10).

(a) The construction or modification of a stationary source that increases the amount of any toxic air pollutant emitted by such source or that results in the emission of any toxic air pollutant not previously emitted; and

(b) Any other project that constitutes a new source under section 112 of the Federal Clean Air Act.

(16) "Second Tier Analysis" means an optional procedure used after T-BACT and acceptable source impact analysis for demonstrating compliance with WAC 173-60-070. The second tier analysis uses a health impact assessment as provided in WAC 173-60-090, instead of an acceptable source impact level.

(17) "Simple asphyxiant" means a physiologically inert gas or vapor that acts primarily by diluting atmospheric oxygen below the level required to maintain proper levels of oxygen in the blood. Examples of simple asphyxiants are given in Appendix X of the TLV Booklet referred to in subsection (19) of this section and incorporated by reference.

(18) "Threshold limit value-time weighted average TLV-TWA" means a concentration limit recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for a normal eight-hour workday and forty-hour workweek.

(19) "TLV Booklet" means "TLVs, Threshold Limit Values and Biological Exposure Indices for ((40 CFR Part 51)) 1991-92," published by the American Conference of Governmental Industrial Hygienists and is hereby incorporated by reference.

(20) "Toxic air pollutant (TAP)" or "toxic air contaminant" means any Class A or Class B toxic air pollutant listed in WAC 173-60-150 and 173-60-160. The term toxic air pollutant may include particulate matter and volatile organic compounds if an individual substance or a group of substances within either of these classes is listed in WAC 173-60-150 and/or 173-60-160. The term toxic air pollutant does not include particulate matter and volatile organic compounds as generic classes of compounds.

(21) "Upper bound unit risk factor" means the 95 percent upper confidence limit of an estimate of the extra risk of cancer associated with a continuous 70 year exposure to 1 ug/m3 of a Class A toxic air pollutant.

AMENDATORY SECTION (Amending Order 90-62, filed 6/18/91, effective 9/18/91)

WAC 173-460-030 Requirements, applicability and exemptions. (1) Applicability.

(a) The provisions of this chapter shall apply state-wide. The authority shall enforce WAC 173-460-010, 173-460-020, 173-460-030, 173-460-040, 173-460-050, 173-460-060, 173-460-070, 173-460-080, 173-460-130, 173-460-140, 173-460-150, and 173-460-160.

(b) Except as provided in this chapter, any new toxic air pollutant source listed in (b)(i), (ii), or (iii) of this subsection that may emit a Class A or Class B TAP into the ambient air is subject to these regulations:

(i) Standard industrial classifications:

(A) Major group 10-Metal mining.

(B) Major group 12-Bituminous coal and lignite mining.

(C) Major group 13-Oil and gas extraction.

(D) Manufacturing industries major groups 20-39.

(E) Major group 49-Electric, gas, and sanitary services except 4971 irrigation systems.

(F) Dry cleaning plants, 7216.

(G) General medical surgical hospitals, 8062.

(H) Specialty hospitals, 8069.

(I) National security, 9711.

(ii) Any source or source category listed in WAC 173-400-100, 173-400-115(2), or 173-490-030(1) except WAC 173-490-030 (1)(e) gasoline dispensing facilities.

(iii) Any of the following sources:

(A) Landfills.

(B) Sites subject to chapter 173-340 WAC Model Toxics Control Act—Cleanup regulation.

(2) Exempt sources.

(a) Containers such as tanks, barrels, drums, cans, and buckets are exempt from the requirements of this chapter unless equipped with a vent other than those required solely as safety pressure release devices.

(b) Nonprocess fugitive emissions of toxic air pollutants from stationary sources, such as construction sites, unpaved roads, coal piles, waste piles, and fuel and ash handling operations are exempt from WAC 173-460-060.

(c) The following sources are generally exempt from the requirements of WAC 173-460-050, 173-460-070, 173-460-080, and 173-460-090. However, the authority may on a case-by-case basis, require compliance with these sections if the authority determines that the amount of emissions, nature of pollutant, or source location indicate that the ambient impact should be evaluated.

(i) Perchloroethylene dry cleaners

(ii) Petroleum solvent dry cleaning systems

(iii) Solvent metal cleaners

(iv) ~~(Spray coating operations)~~ Chromic acid plating and anodizing

(v) Abrasive blasting

(d) Demolition and renovation projects involving asbestos removal and disposal are exempt from the requirements of this chapter.

(e) Process vents subject to 4) C.F.R. Parts 264 and 265, Subpart AA are exempt from the requirements of this chapter.

AMENDATORY SECTION (Amending Order 90-62, filed 6/18/91, effective 9/18/91)

WAC 173-460-040 New source review. (1) Applicability. This chapter supplements the new source review requirements of WAC 173-400-110 by adding additional new source review requirements for toxic air pollutant sources. If a notice of construction is required under both chapter 173-400 WAC and this chapter, the written applications shall be combined. A notice of construction is a written application to permit construction of a new source.

(a) The owner or operator of a new toxic air pollutant source listed in WAC 173-460-030 ~~((2))~~ (1) shall notify the authority prior to the construction, installation, or establishment of a new toxic air pollutant source and shall file a notice of construction application with the authority for the proposed emission unit(s). Notification and notice of construction are not required if the source is an exempt source listed in WAC 173-460-030 ~~((2))~~ (2) or subsection (2) of this section.

(b) The notice of construction and new source review applies only to the affected emission unit(s) and the contaminants emitted from the emission unit(s).

(c) New source review of a modification ~~((2))~~ shall be limited to the emission unit or units proposed to be modified and the ~~(emission unit or units whose emissions of TAPs may)~~ toxic air contaminants whose emissions would increase as a result of the modification.

(2) The owner or operator of a new toxic air pollutant source listed in WAC 173-460-030 ~~((2))~~ (1) is not required to notify or file a notice of construction with the authority if any of the following conditions are met:

(a) Routine maintenance or repair requires equivalent replacement of air pollution control equipment; or

(b) The new source is a minor process change ~~((2))~~ that does not increase capacity and total toxic air pollutant emissions do not exceed the emission rates specified in small quantity emission rate tables in WAC 173-460-080; or

(c) The new source is the result of minor changes in raw material composition and the total toxic air pollutant emissions do not exceed the emission rates specified in the small quantity emission rate tables in WAC 173-460-080.

(3) Additional information. Within thirty days of receipt of a notice of construction, the authority may require the submission of additional plans, specifications, and other information necessary for the review of the proposed new or modified source.

(4) Requirements for new toxic air pollutant sources. The authority shall review notice(s) of construction, plans, specifications, and other associated information to determine that:

(a) The source will be in accord with applicable federal, state, and authority air pollution control rules and regulations;

(b) The source will use T-BACT for emissions control for the toxic air pollutants which are likely to increase; and

(c) ~~((The source will use T-BACT for emissions control for the toxic air pollutants which are likely to remain the same or decrease and~~

~~((Sources required to use T-BACT for emission control must demonstrate compliance with WAC 173-460-030~~

failing that, demonstrates compliance, by using the additional procedures in WAC 173-460-090 and/or 173-460-100.

~~((4))~~ (5) Preliminary determination. Within thirty days after receipt of all information required, the authority shall:

(a) Make preliminary determinations on the matters set forth in this section; and

(b) Initiate compliance with the provisions of WAC 173-400-171 relating to public notice and public comment, as applicable.

~~((5))~~ (6) Final determination. If, after review of all information received including public comment, the authority finds that all the conditions in this section are satisfied, the authority shall issue a regulatory order to approve the notice of construction for the proposed new source or modification. If the authority finds that the conditions in this section are not satisfied, the authority shall issue an order for the prevention of construction, installation, or establishment of the toxic air pollution source(s). Where ecology has jurisdiction, it will endeavor to make final determinations as promptly as possible.

~~((6))~~ (7) Appeal of decision. A final notice of construction decision may be appealed to the pollution control hearings board pursuant to chapter 43.21B RCW.

~~((7))~~ (8) Commencement of construction. The owner(s) or operator(s) of the new source shall not commence construction until the applicable notice of construction has been approved.

~~((8))~~ (9) Operation and maintenance plan. As a condition of notice of construction approval, prior to start up, the authority may require a plan for the operation and maintenance of all equipment and procedures to assure continuous compliance with this chapter.

(a) A copy of the plan shall be filed with the authority upon request.

(b) The plan shall reflect good industrial practice and may include operating parameters and maintenance procedures, and shall be updated to reflect any changes in good industrial practice.

(c) Submittal of all plans should coincide with the authorities reporting requirements where applicable.

~~((9))~~ (10) Jurisdiction. Emission of toxic air pollutants that exceed the acceptable source impact levels listed in WAC 173-460-150 and 173-460-160 requires ecology and, if applicable, authority approval as specified in WAC 173-460-090 and 173-460-100.

AMENDATORY SECTION (Amending Order 90-62, filed 6/18/91, effective 9/18/91)

WAC 173-460-050 Requirement to quantify emissions. (1) New sources.

(a) When applying for a notice of construction, an owner or operator of a new toxic air pollution source shall quantify those emissions of each TAP or combination of TAPs that:

(i) Will be used for the modeling procedures in WAC 173-460-080; and

(ii) That may be discharged after applying required control technology. The information shall be submitted to the authority.

(b) Emissions shall be quantified in sufficient detail to determine whether the source complies with the requirements of this chapter.

(2) Small quantity sources.

Sources that choose to use small quantity emission rate tables instead of using dispersion modeling shall quantify emissions as required under WAC 173-460-050, in sufficient detail to demonstrate to the satisfaction of the authority that the emissions are less than the applicable emission rates listed in WAC 173-460-080.

(3) Level of detail.

An acceptable source impact level analysis under WAC 173-460-050, may be based on a conservative estimate of emissions that represents good engineering judgment. If compliance with WAC 173-460-070 and 173-460-080 cannot be demonstrated, more precise emission estimates shall be used ~~((prior))~~ to demonstrate compliance with WAC 173-460-090.

(4) Mixtures of toxic air pollutants.

(a) An owner or operator of a source that may discharge more than one toxic air pollutant may demonstrate compliance with WAC 173-460-070 and 173-460-080 by:

(i) Quantifying emissions and performing modeling for each TAP individually; or

(ii) ~~((Calculate))~~ Calculating the sum of all TAP emissions and ~~((perform))~~ performing modeling for the total TAP emissions and ~~((compare))~~ comparing maximum ambient levels to the smallest ASIL; or

(iii) Equivalent procedures may be used if approved by ecology.

(b) Dioxin and furan emissions shall be considered together as one TAP and expressed as an equivalent emission of 2,3,7,8 TCDD based on the relative potency of the isomers in accordance with United States Environmental Protection Agency (EPA) guidelines.

Note: Copies of EPA *Interim procedures for estimating toxic exposures to mixtures of chlorinated dibenzodioxins and dibenzofurans (CDDs and CDFs)*, 1989 *Update* are available by requesting EPA 625/3-89/016, March 1989 from ORD Publications (513) 68-7562.

(c) Polyaromatic hydrocarbon (PAH) emissions. The owner or operator of a source that may emit a mixture of polyaromatic hydrocarbon emissions shall quantify the following PAHs and shall consider them together as one TAP equivalent in potency to benzo(a)pyrene: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(a)pyrene. The acceptable source impact analysis shall be conducted using the polyaromatic hydrocarbon emission ASIL contained in WAC 173-460-150(3).

(d) Uncontrolled roof vent emissions from primary aluminum smelters. The owner or operator of a primary aluminum smelter that may emit a mixture of polyaromatic hydrocarbons from uncontrolled roof vents shall quantify PAH emissions using either of the following methods:

(i) Quantify PAH emissions using the procedures in (c) of this subsection; or

(ii) Multiply the total particulate emission mass from the uncontrolled roof vents by the percent of the particulate that is extractable organic matter. The percent extractable organic matter shall be considered one percent of total particulate matter unless ecology determines that -----

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Compelling scientific data which demonstrates that the use of this value is inappropriate. The acceptable source impact analysis shall be conducted using the primary aluminum smelter uncontrolled roof vent PAH emission ASTL contained in WAC 173-60-150(3). Note: For example, 100 grams of particulate air emission mass times one percent yields one gram of PAH emissions.

AMENDATORY SECTION (Amending Order 90-62, filed 5/13/91, effective 9/13/91)

WAC 173-60-060 Control technology requirements.

Except as provided for in WAC 173-60-040, a person shall not establish, operate, or cause to be established or operated any new toxic air pollutant source which is likely to increase TAP emissions without installing and operating T-BACT. Satisfaction of the performance requirements listed below fulfill the T-BACT requirement for those particular sources. Local air pollution authorities may develop and require performance requirements in lieu of T-BACT provided that ecology approves the performance requirements as equivalent to T-BACT.

(1) Perchloroethylene dry cleaners. The entire dryer exhaust shall be vented through a control device which will reduce VOC emissions to 5 kg or less per 100 kg dry weight of cleaned articles.

(a) The control device shall meet one of the following conditions:

(i) The exhaust from a carbon adsorber shall contain less than 100 ppm perchloroethylene as measured over a period of one minute before dilution; or

(ii) The air temperature at the outlet of a refrigerated condenser shall reach seven degrees celsius or less during the cool-down period. A temperature gauge with a minimum range from negative thirty-two to seventy-five degrees celsius shall be installed and maintained on the condenser outlet duct; or

(iii) The demonstrated control efficiency for any other control device shall be ninety percent or greater by weight, prior to the discharge to the atmosphere measured over a complete control cycle.

(b) The operation of any perchloroethylene dry cleaner shall meet all of the following conditions:

(i) All leaking components shall be repaired immediately; and

(ii) All filtration cartridges shall be drained in the filter housing or other enclosed container before discarding the cartridges.

(2) Petroleum solvent dry cleaning systems. A petroleum solvent dry cleaning system shall include the following:

(a) All cleaned articles are dried in a solvent recovery dryer or the entire dryer exhaust is vented through a properly functioning control device which will reduce emissions to no more than 3.5 kg of VOC per 100 kg dry weight of cleaned articles; and

(b) All cartridge filtration systems are drained in their sealed housing or other enclosed container before discarding the cartridges; and

(c) All leaking components shall be repaired immediately.

(3) Chromic acid plating and anodizing. The facility-

plating or anodizing tanks shall be reduced by at least ninety-five percent using either of the following control techniques:

(a) An antimist additive or other equally effective control method approved by ecology or authority; or

(b) The tank is equipped with:

(i) A ~~(electro)~~ capture system which represents good engineering practice and which shall be in place and in operation at all times electrical current is applied to the tank; and

(ii) An emission control system which limits hexavalent chromium emissions to no more than 0.15 milligrams per ampere-hour of electrical charge applied to the tank or uncontrolled emissions shall be reduced by ninety-five percent.

(4) Chromic acid ~~(electro)~~ plating and anodizing (greater than 1 kilogram). If the facility-wide hexavalent chromium emissions from chromic acid plating and anodizing are greater than 1 kilogram per year after the application of control techniques required by subsection (3) of this section, the facility-wide hexavalent chromium emissions shall be reduced by at least ninety-nine percent using either of the following control techniques:

(a) An antimist additive or other equally effective control method approved by ecology or authority; or

(b) The tank is equipped with:

(i) A ~~(electro)~~ capture system which represents good engineering practice and which shall be in place and in operation at all times electrical current is applied to the tank; and

(ii) An emissions control system which limits hexavalent chromium emissions to no more than 0.03 milligrams per ampere-hour of electrical charge applied to the tank or uncontrolled emissions shall be reduced by ninety-nine percent.

(5) Solvent metal cleaners.

(a) Any solvent metal cleaner shall include all of the following equipment:

(i) A cover for the solvent tank which shall be closed at all times except when processing work in the degreaser. However, the cover shall be closed to the maximum extent possible when parts are being degreased;

(ii) A facility for draining cleaned parts such that the drained solvent is returned to the solvent tank;

(iii) For cold solvent cleaners, a freeboard ratio greater than or equal to 0.75;

(iv) Vapor degreasers shall have:

A) A high vapor cutoff thermostat with manual reset; and

B) For degreasers with spray devices, a vapor-up thermostat which will allow spray operation only after the vapor zone has risen to the design level; and

C) Either a freeboard ratio greater than or equal to ~~0.75~~ 1.00 or a refrigerated freeboard chiller; and

(v) ConveyORIZED vapor degreasers shall have:

A) A drying tunnel or a rotating basket sufficient to prevent cleaned parts from carrying liquid solvent out of the degreaser; and

B) A high vapor cutoff thermostat with manual reset; and

(C) A vapor-up thermostat which will allow conveyor movement only after the vapor zone has risen to the design vapor level.

(b) The operation of any solvent metal cleaner shall meet the following requirements:

(i) Solvent shall not leak from any portion of the degreasing equipment;

(ii) Solvent, including waste solvent, shall be stored in closed containers and shall be disposed of in such a manner as to prevent its evaporation into the atmosphere;

(iii) For cold cleaners, cleaned parts shall be drained until dripping ceases; and

(iv) Degreasers shall be constructed to allow liquid solvent from cleaned parts to drain into a trough or equivalent device and return to the solvent tank.

(c) For open-top vapor degreasers, solvent drag-out shall be minimized by the following measures:

(i) Racked parts shall be allowed to ~~((fully))~~ drain fully;

(ii) The work load shall be degreased in the vapor zone until condensation ceases;

(iii) Spraying operations shall be done within the vapor layer;

(iv) When using a powered hoist, the vertical speed of parts in and out of the vapor zone shall be less than three meters per minute (ten feet per minute);

(v) When the cover is open, the lip of the degreaser shall not be exposed to steady drafts greater than 15.3 meters per minute (fifty feet per minute); and

(vi) When equipped with a lip exhaust, the fan shall be turned off when the cover is closed.

(d) For conveyORIZED vapor degreasers, solvent drag-out shall be minimized by the following measures:

(i) Racked parts shall be allowed to ~~((fully))~~ drain fully; and

(ii) Vertical conveyor speed shall be maintained at less than three meters per minute (ten feet per minute).

(6) Abrasive blasting.

(a) Abrasive blasting ~~((shall))~~ shall be performed inside a booth or hangar designed to capture the blast gun or overspray.

(b) Outdoor blasting of structures or items too large to be reasonably handled indoors ~~((shall))~~ shall employ control measures such as curtailment during windy periods and enclosure of the area being blasted with tarps.

(c) Outdoor blasting ~~((shall))~~ shall be performed with either steel shot or an abrasive containing less than one percent (by mass) which would pass through a No. 200 sieve.

(d) All abrasive blasting with sand shall be performed inside a blasting booth or cabinet.

(a) Carcinogenic effects. The owner or operator shall use dispersion modeling to estimate the maximum incremental ambient impact of each Class A TAP from the source and compare the estimated incremental ambient values to the Class A acceptable source impact levels in WAC 173-60-150. If applicable, the source may use the small quantity emission rate tables in (e) of this subsection.

(b) Other toxic effects. The owner or operator shall use dispersion modeling to estimate the maximum incremental ambient impact of each Class B TAP from the source and compare the estimated ambient values to the Class B acceptable source impact levels in WAC 173-60-160. If applicable, the source may use the small quantity emission rate tables in (e) of this subsection.

(c) Dispersion modeling. The owner or operator shall use dispersion modeling techniques in accordance with EPA guidelines. If concentrations predicted by dispersion screening models exceed applicable acceptable source impact levels, more refined modeling and/or emission estimation techniques shall be used. Refined modeling techniques shall be approved by ecology and the authority. (Note: EPA's Guideline on Air Quality Models, EPA ~~((402-2-2-77))~~ 450/2-78-027R, can be obtained through NTIS (703, 497-4650 or can be downloaded from the OAOPS Technology Transfer Network electronic bulletin board system).

(d) Averaging times. The owner or operator shall use the averaging times in (d)(i), (ii), (iii) of this subsection unless alternate averaging times are approved by ecology. Ecology may allow the use of an alternate averaging time if it determines that the operating procedures of the source may cause a high concentration of a TAP for a short period and that consideration of potential health effects due to peak exposures may be warranted for the TAP.

(i) An annual average shall be used for Class A TAPs listed in WAC 173-60-150(2).

(ii) The averaging times specified in WAC 173-60-150(3) shall be used for Class A TAPs listed in WAC 173-60-150(3).

(iii) A twenty-four-hour averaging time shall be used for Class B TAPs listed in WAC 173-60-160.

(e) Small quantity emission rates. Instead of using dispersion modeling to show compliance with ambient impact demonstration requirements in WAC 173-60-080 and 173-60-090, a source may use the small quantity emission rate tables for all toxic air pollutants with acceptable source impact levels equal to or greater than 0.001 ug/m3. A source must first meet control technology and emission quantification requirements of WAC 173-60-050 and 173-60-060, then demonstrate that the source emission rate does not exceed the rates specified in the appropriate table below.

SMALL QUANTITY EMISSION RATES
CLASS A TOXIC AIR POLLUTANTS

Acceptable Source Impact Level (Annual avg.)	TAP Emissions Pounds per Year (10 meter stack and downwash)
0.001 to 0.0099	3.5
0.01 to 0.06	10
0.07 to 0.12	20
0.13 to 0.99	50
1.0 to 12	100

AMENDATORY SECTION (Amending Order 90-62, filed 6/13/91, effective 9/13/91)

WAC 173-60-080 Demonstrating ambient impact compliance. (1) When applying for a notice of construction under WAC 173-60-040, the owner or operator of a new toxic air pollutant source which is likely to increase TAP emissions shall complete an acceptable source impact level analysis for Class A and Class B TAPs. The authority may complete this analysis.

(2) Acceptable source impact analysis.

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SMALL QUANTITY EMISSION RATES
CLASS B TOXIC AIR POLLUTANTS

The manner shall be returned to the authority if ecology finds the conditions for a second tier analysis evaluation have not been met.

(2) Jurisdiction.

(a) Any second tier analysis application submitted by a source wishing to emit toxic air pollutants at levels greater than the acceptable source impact level contained in WAC 173-60-150 or 173-60-160 shall be approved or rejected by ecology.

(b) Any new emission limits approved by ecology as a result of the second tier analysis evaluation shall be enforced by the authority provided the authority approves the new emission limits.

(3) Approval criteria.

(a) Based on the second tier analysis, ecology may approve the emissions of TAPs from a source where ambient concentrations exceed acceptable source impact levels only if it determines that emission controls represent at least T-BACT and the source demonstrates that emissions of Class A TAPs are not likely to result in an increased cancer risk of more than one in one hundred thousand. The emission of Class A TAPs at levels likely to result in an increased cancer risk of more than one in one hundred thousand requires the approval of the director after complying with WAC 173-60-100.

(b) Ecology shall consider the second tier analysis and other information submitted by the applicant as well as department of health comments.

(i) Comments from other agencies and universities with appropriate expertise may also be considered in the decision to approve emissions that exceed acceptable source impact levels.

(ii) Public comments shall be considered if the source applies for a risk management decision under WAC 173-60-100.

(4) Contents of the second tier analysis.

(a) The second tier analysis consists of a health impact assessment. The applicant shall complete and submit a health impact assessment to ecology which includes the following information. Ecology may approve the submittal of less information if it determines that such information is sufficient to perform the second tier analysis evaluation. The health impact assessment shall be prepared in accordance with EPA's risk assessment guidelines as defined in WAC 173-60-100(1-2)(b)(2).

(i) Demographics such as population size, growth, and sensitive subgroups;

(ii) Toxicological profiles of all toxic air pollutants that exceed the ASIL;

(iii) Characterization of existing pathways and total daily intake for toxic air pollutants that exceed the ASIL;

(iv) Contribution of the proposed source toward total daily intake for toxic air pollutants that exceed the ASIL;

(v) Using existing data, characterization of risk from current exposure to the toxic air pollutants that exceed the ASIL. This includes existing TAP sources in the area, and anticipated risk from the new source;

(vi) Additive cancer risk for all Class A toxic air pollutants which may be emitted by the source;

(vii) Other information requested by ecology and pertinent to ecology's decision to approve the second tier

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Acceptable Source Impact Level (24 hour average)	TAP Emissions	
	Pounds per Year	Pounds per Hour
less than 1	175	0.02
1 to 9.9	175	0.02
10 to 29.9	1,750	0.20
30 to 59.9	5,250	0.60
60 to 99.9	10,500	1.20
100 to 129.9	17,500	2.0
130 to 250	22,750	2.6
greater than 250	43,748	5.0

(3) Criteria for compliance. Compliance with WAC 173-60-070 is demonstrated if the authority determines that on the basis of the acceptable source impact analysis, the source's maximum incremental ambient air impact levels do not exceed the Class A or Class B acceptable source impact levels in WAC 173-60-150 and 173-60-160; or, if applicable, the source TAP emission rates do not exceed the rates specified in subsection (2)(c) of this section.

MANDATORY SECTION (Amending Order 90-62, filed 1/3/91, effective 9/18/91)

WAC 173-60-090 Second tier analysis. (1) Applicability.

(a) The owner or operator who cannot demonstrate class A or class B TAP source compliance with WAC 173-60-070 and 173-60-080 using an acceptable source impact level analysis as provided in WAC 173-60-080(2), may submit a petition requesting ecology perform a second tier analysis evaluation to determine a means of compliance with WAC 173-60-070 and 173-60-080 by establishing allowable emissions for the source. Petitions for second tier analysis evaluation shall be submitted to the local authority or ecology if ecology has jurisdiction over the source. Petitions received by local authorities shall be submitted to ecology within ten days of receipt. A second tier analysis evaluation may be requested when a source wishes to more accurately characterize risks, to justify risks greater than acceptable source impact levels, or to otherwise modify assumptions to more accurately represent risks. Risks may be more accurately characterized by utilizing updated EPA risk factors, inhalation reference (~~concentration~~) concentrations, or other EPA recognized or approved methods. Ecology shall specify the maximum allowable emissions of class A or class B TAP sources based on ecology's second tier analysis evaluation.

(b) Ecology shall evaluate a source's second tier analysis only if:

- (i) The authority has advised ecology that other conditions for processing the notice of construction have been met and
 - (ii) Emission controls contained in the conditional notice of construction represent at least T-BACT; and
 - (iii) Ambient concentrations exceed acceptable source impact levels after using more refined emission estimation and air dispersion modeling techniques.
- (c) Ecology shall determine whether the conditions in (b), (ii), and (iii) of this subsection for a second tier analysis have been satisfied within ten working days of receipt of all information needed to make the determination.

(2) Threshold-based acceptable source impact levels for Class B TAPs. Threshold-based acceptable source impact levels in WAC 173-460-160 shall be determined as follows:

(a) If a Class B TAP has an Environmental Protection Agency Inhalation Reference ((~~State~~) Concentration, the inhalation reference ((~~state~~) concentration and specified averaging time shall be used.

(b) Other Class B TAP acceptable source impact levels shall be determined by dividing the TLV-TWA by three hundred to calculate a twenty-four hour TWA acceptable source impact level.

(3) Special acceptable source impact levels.

(a) Ecology may establish special acceptable source impact levels for TAPs for which upper bound risk factors or TLVs have not been established, or for mixtures of compounds if it determines that the above acceptable source impact level methods are not appropriate, do not adequately protect human health or are overly stringent.

(b) The averaging times for special ASILs are listed in WAC 173-460-150(3).

AMENDATORY SECTION (Amending Order 90-62, filed 6/18/91, effective 9/18/91)

WAC 173-460-150 Class A toxic air pollutants: Known, probable and potential human carcinogens and acceptable source impact levels.

(1) TABLE 1 CLASS A TOXIC AIR POLLUTANTS Known and Probable Carcinogens

Table with 2 columns: CAS # and SUBSTANCE. Lists various chemical compounds such as Acetaldehyde, Acetaminofluorene, Acrylamide, Aldrin, Aluminum smelter particulate, etc.

Table with 2 columns: CAS # and SUBSTANCE. Lists various chemical compounds such as Calcium and compounds, Carbon tetrachloride, Chloroacetylene, Chlorobenzene, Chloroform, etc.

Table 6-5

Summary of T-BACT Analysis for Ammonia Emissions
for the W-236A 200 East Multi-Function Waste Tank Facility

Control Alternative	Uncontrolled Emissions (lb/yr)	Emissions Reduction ^a (lb/yr)	Economic Impacts				Adverse Environmental Impact (Yes/No)	Adverse Energy Impact (Yes/No)
			Total Capital Investment ^b (\$)	Total Annualized Cost ^c (\$/yr)	Cost Effectiveness ^d (\$/ton)	Adverse Economic Impact (Yes/No)		
Acid Scrubber	3.50E+03	3.46E+03	165,600	70,178	45,190	Yes	No	No
Carbon Adsorption	3.50E+03	3.44E+03	60,820	123,371	71,727	Yes	No	No
Baseline	3.50E+03		--	--	--	--	--	--

^aEmissions reduction over baseline level.

^bInstalled capital cost relative to baseline.

^cIncludes capital and operating costs. The capital recovery factor was used based on a 30 year equipment life and a 10% annual interest rate.

^dAverage Cost Effectiveness is total annualized cost for the control option divided by the emissions reductions resulting from the option.

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(C) TABLE II CLASS A TOXIC AIR POLLUTANTS WITH ESTABLISHED ACCEPTABLE SOURCE IMPACT LEVELS

101-77-9	(4,4-Methylenedianiline) 4,4-Methylene dianiline
13352-44-8	4,4-Methylenedianiline dihydrochloride
4091-91-4	4-Methylmorpholine-N-oxide (N-methyl-1-piperazine)
(---)	Martex
2365-85-5	5-Morpholinobenzyl-3-(4-morpholinophenyl)amine
139-91-3	(6-oxo-1,2-dioxane) Hexachlorocyclohexane (foraldehyde)
102-117-7	Methylamine (secondary)
134-32-7	N-Naphthylamine
67440-02-0	Nickel and compounds (as nickel subsulfide or nickel refinery dust)
531-82-8	N-(4-S-(phenylthio)-2-furyl)-2-thiazylacetamide
(---)	N-Nitrosodimethylamine
(---)	N-Nitrosodipropylamine
(---)	N-Nitrosodimethylmethanamine
(---)	N-Nitrosodimethylamine
602-87-9	S-Nitrosopyrrolidine
1836-75-5	Nitrobenzene
(---)	Nitrobenzene (nitrobenzene)
59-57-3	Nitrofurantoin
554-34-9	1-(5-Nitrofurfuryl)amino-2-imidazolidinone
129-85-5	Nitrogen mustard N-oxide
302-70-5	Nitrogen mustard N-oxide hydrochloride
79-46-9	2-Nitropropane
924-16-3	N-Nitrosodimethylamine
759-77-9	N-Nitroso-N-methylurea (NEMU)
615-53-2	N-Nitroso-(o) N-methylurea
421-44-1	N-Nitroso-o-propylamine
10595-95-6	N-Nitrosodimethylamine
59-39-1	N-Nitrosodimethylamine
36-30-6	N-Nitrosodimethylamine
55-18-5	N-Nitrosodimethylamine (dimethylnitrosamine) (DEN)
52-75-9	N-Nitrosodimethylamine
2546-17-5	Oil orange SS
794-93-4	Pantufur S (dihydroxymethylfurfural)
87-36-5	Pentachlorobenzol
127-18-4	Pentachlorobenzene (pentachlorobenzene)
55-92-3	Phenylbenzamide hydrochloride
(---)	N-Phenyl-2-naphthylamine
(---)	Polyaromatic hydrocarbons (PAH)
1326-36-3	Polychlorinated biphenyls (PCBs)
3761-53-3	Ponemex MX
(---)	Propylene glycol
1120-71-4	Propylene glycol
75-56-9	Propylene glycol
1740-21-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)
139-65-1	4,4'-Thiodianiline
1314-20-1	Thionin dihydrochloride
95-80-7	2,4-Toluene diamine
53-44-9	2,4-Toluene diisocyanate
95-53-4	o-Toluidine ((o)-aminotoluene)
636-21-5	o-Toluidine hydrochloride
8001-35-2	Taxapone
5573-54-0	Trans-2((Dimethylamino)ethyl)amine-5-(2-(5-methyl-2-furyl) vinyl)-1,2,4-oxadiazole
79-01-9	Trichloroethylene
(---)	Trichloroethylene
58-76-2	2,4,6-Trichlorobenzol ((---))
75-01-4	Vinyl chloride

CAS #	SUBSTANCE	10-6 RISK ASIL MICROGRAMS/ANNUAL AVERAGE
101-77-9	(4,4-Methylenedianiline) 4,4-Methylene dianiline	0.000001
13352-44-8	4,4-Methylenedianiline dihydrochloride	0.000001
4091-91-4	4-Methylmorpholine-N-oxide (N-methyl-1-piperazine)	0.000001
(---)	Martex	0.000001
2365-85-5	5-Morpholinobenzyl-3-(4-morpholinophenyl)amine	0.000001
139-91-3	(6-oxo-1,2-dioxane) Hexachlorocyclohexane (foraldehyde)	0.000001
102-117-7	Methylamine (secondary)	0.000001
134-32-7	N-Naphthylamine	0.000001
67440-02-0	Nickel and compounds (as nickel subsulfide or nickel refinery dust)	0.000001
531-82-8	N-(4-S-(phenylthio)-2-furyl)-2-thiazylacetamide	0.000001
(---)	N-Nitrosodimethylamine	0.000001
(---)	N-Nitrosodipropylamine	0.000001
(---)	N-Nitrosodimethylmethanamine	0.000001
(---)	N-Nitrosodimethylamine	0.000001
602-87-9	S-Nitrosopyrrolidine	0.000001
1836-75-5	Nitrobenzene	0.000001
(---)	Nitrobenzene (nitrobenzene)	0.000001
59-57-3	Nitrofurantoin	0.000001
554-34-9	1-(5-Nitrofurfuryl)amino-2-imidazolidinone	0.000001
129-85-5	Nitrogen mustard N-oxide	0.000001
302-70-5	Nitrogen mustard N-oxide hydrochloride	0.000001
79-46-9	2-Nitropropane	0.000001
924-16-3	N-Nitrosodimethylamine	0.000001
759-77-9	N-Nitroso-N-methylurea (NEMU)	0.000001
615-53-2	N-Nitroso-(o) N-methylurea	0.000001
421-44-1	N-Nitroso-o-propylamine	0.000001
10595-95-6	N-Nitrosodimethylamine	0.000001
59-39-1	N-Nitrosodimethylamine	0.000001
36-30-6	N-Nitrosodimethylamine	0.000001
55-18-5	N-Nitrosodimethylamine (dimethylnitrosamine) (DEN)	0.000001
52-75-9	N-Nitrosodimethylamine	0.000001
2546-17-5	Oil orange SS	0.000001
794-93-4	Pantufur S (dihydroxymethylfurfural)	0.000001
87-36-5	Pentachlorobenzol	0.000001
127-18-4	Pentachlorobenzene (pentachlorobenzene)	0.000001
55-92-3	Phenylbenzamide hydrochloride	0.000001
(---)	N-Phenyl-2-naphthylamine	0.000001
(---)	Polyaromatic hydrocarbons (PAH)	0.000001
1326-36-3	Polychlorinated biphenyls (PCBs)	0.000001
3761-53-3	Ponemex MX	0.000001
(---)	Propylene glycol	0.000001
1120-71-4	Propylene glycol	0.000001
75-56-9	Propylene glycol	0.000001
1740-21-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	0.000001
139-65-1	4,4'-Thiodianiline	0.000001
1314-20-1	Thionin dihydrochloride	0.000001
95-80-7	2,4-Toluene diamine	0.000001
53-44-9	2,4-Toluene diisocyanate	0.000001
95-53-4	o-Toluidine ((o)-aminotoluene)	0.0150000
636-21-5	o-Toluidine hydrochloride	0.0150000
8001-35-2	Taxapone	5.000000
5573-54-0	Trans-2((Dimethylamino)ethyl)amine-5-(2-(5-methyl-2-furyl) vinyl)-1,2,4-oxadiazole	0.000001
79-01-9	Trichloroethylene	0.000001
(---)	Trichloroethylene	0.000001
58-76-2	2,4,6-Trichlorobenzol ((---))	0.000001
75-01-4	Vinyl chloride	0.000001

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C740-16-6	Rhodium, insoluble compounds	118-96-7
C740-18-0	Rhodium, soluble compounds	76-30-4
399-22-7	Rennet	9009-02-9
57-74-4	Resorcinol	107-08-6
	Rubber solvent, Naphthalene	C740-33-7
C775-49-3	Selenium compounds, as Se	C740-33-7
733-76-1	Selenium hexafluoride, as Se	3008-01-2
136-38-7	Sesone	C740-34-1
7803-65-3	Siacopa (estradiol)	3082-32-4
740-02-4	Silver, Metal	110-62-3
C740-33-7	Silver, soluble compounds, as Ag	131-03-1
36623-22-8	Sodium azide	108775-4
7631-90-5	Sodium bisulfite	493-50-7
62-72-8	Sodium fluoride	106-47-6
1310-73-2	Sodium hydrosulfide	74-38-4
7681-57-4	Sodium metasilicate	35013-14-4
7803-52-3	Soline	31-21-0
37-24-9	Styrene	
100-42-9	Sulfene	147-35-0
46-9-3	Sulfene oxide	130-20-7
1395-31-7	Sulfonamides	300-77-8
3689-32-3	Sulfonates	C740-36-5
345-48-4	Sulfur hexafluoride	74-40-3
7002-8-3	Sulfur monochloride	74-40-3
371-22-7	Sulfur pentachloride	131-03-1
7783-90-0	Sulfur tetrafluoride	
7662-67-3	Sulfuric acid	
2499-79-3	Sulfuryl fluoride	
33-00-3	Sulfuric acid	
93-76-3	2,4,5-T	
107-08-6	2,4,6-T	
C740-25-7	Tantalum, metal & oxide dusts	
C1349-20-9	Tellurium & compounds, as Te	
7783-30-4	Tellurium hexafluoride, as Te	
3383-96-8	Tenax	
26140-80-3	Tenax	
76-12-0	1,1,2,2-Tetrafluoro-1,2-difluoroethane	14900
76-11-9	1,1,1,2-Tetrafluoro-2,2-difluoroethane	14900
76-14-5	1,1,2,2-Tetrafluoroethane	
1335-86-3	Tetrahydrofuran	
73-00-2	Tetrahydrofuran	
109-66-0	Tetrahydrofuran	
73-72-1	Tetrahydrofuran	
3333-83-6	Tetramethylammonium	
604-11-4	Tetramethylammonium	
73-72-1	Tetramethylammonium	
479-35-3	Tetramethylammonium	
C740-24-0	Titanium, soluble compounds, Ti	
96-49-3	2,4-Dichlorobiphenyl	
68-11-1	2,4-Dichlorobiphenyl	
7719-09-7	2,4-Dichlorobiphenyl	
137-26-3	Titanium	
7440-31-4	Titanium	
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7440-31-5	Tin, oxide & boronate except SnO ₂	
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108-10-1	m-Toluidine	
106-49-0	o-Toluidine	
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WSR 94-03-073
 PERMANENT RULES
 DEPARTMENT OF
 LABOR AND INDUSTRIES

(Filed January 17, 1994, 3:50 a.m., effective March 1, 1994)

Date of Adoption: January 17, 1994.

Purpose: To clarify the rules relating to the evaluation of respiratory impairment.

Citation of Existing Rules Affected by this Order: Amending WAC 296-20-370, 296-20-380, and 296-20-680; and creating WAC 296-20-385.

Statutory Authority for Adoption: RCW 51.04.020 & 51.04.030, and 51.52.080(2).

Pursuant to notice filed as WSR 93-21-074 on October 20, 1993.

Effective Date of Rule: March 1, 1994.

January 17, 1994
 Mark O. Brown
 Director

AMENDATORY SECTION (Amending Order 82-39, filed 11/29/82, effective 1/1/83)

WAC 296-20-370 Respiratory impairments. (1) Rules for evaluation of permanent respiratory impairments:

((1. All reports of physical examination of persons for respiratory impairment shall include: Date of examination, name, sex, address, birthdate, marital status, and occupation of the person being examined; height, weight, temperature, pulse rate, blood pressure and respiratory rate and physical findings as inspection, palpation, percussion, and auscultation; vital capacity tests including one second forced expiration, volume, forced vital capacity and maximum voluntary ventilation; all symptoms such as wheeze, cough, stridor, chest pain, paroxysmal nocturnal dyspnea, expectoration, hemoptysis as to date of onset, cause with description, duration, whether influenced by bodily activity, emotional stress, posture, allergens, immediate environmental factors.

Sections not affected by WSR 94-03-072

Chapter 173-460 WAC
CONTROLS FOR NEW SOURCES OF TOXIC AIR POLLUTANTS

173-460-010 PURPOSE
173-460-070 AMBIENT IMPACT REQUIREMENT.
173-460-120 SCIENTIFIC REVIEW AND AMENDMENT OF ACCEPTABLE SOURCE IMPACT LEVELS AND LISTS.
173-460-130 FEES.
173-460-140 REMEDIES.

WAC 173-460-010 PURPOSE. (1) Pursuant to chapter 70.94 RCW, Washington Clean Air Act, the purpose of this chapter is to establish the systematic control of new sources emitting toxic air pollutants (TAPs) in order to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality as will protect human health and safety. Toxic air pollutants include carcinogens and noncarcinogens listed in WAC 173-460-150 and 173-460-160.

(2) This chapter establishes three major requirements:
(a) Best available control technology for toxics;
(b) Toxic air pollutant emission quantification;
(c) Human health and safety protection demonstration.
(3) Policy. It is the policy of ecology to reduce, avoid, or eliminate toxic air pollutants prior to their generation whenever economically and technically practicable.

[Statutory Authority: RCW 70.94.331. (Order 90-62), 91-13-709, §173-460-010 Filed June 18, 1991.]

Date :06/18/1991

WAC 173-460-070 AMBIENT IMPACT REQUIREMENT. When applying for a notice of construction under WAC 173-460-040, the owner or operator of a new toxic air pollutant source which is likely to increase TAP emissions shall demonstrate that emissions from the source are sufficiently low to protect human health and safety from potential carcinogenic and/or other toxic effects. Compliance shall be demonstrated in any area which does not have restricted or controlled public access. The source shall demonstrate compliance by using procedures established in this chapter after complying with the control technology requirements in WAC 173-460-060.

[Statutory Authority: RCW 70.94.331. (Order 90-62), 91-13-709, §173-460-070 Filed June 18, 1991.]

Date :06/18/1991

WAC 173-460-120. SCIENTIFIC REVIEW AND AMENDMENT OF ACCEPTABLE SOURCE IMPACT LEVELS AND LISTS.

(1) Ongoing scientific review.
(a) To use the best available scientific information, ecology shall conduct an ongoing review of information concerning whether to add or delete toxic air pollutants to WAC 173-460-150 or 173-460-160, what acceptable source impact

levels should be used to review emissions of TAPs, source applicability and exemptions.

(b) A complete review shall be made at least once every three years at which time ecology shall consider scientific information developed by the E.P.A., Washington department of health, other states or other scientific organizations, scientific information provided by any person, and results of second tier analyses evaluations.

(2) Criteria for listing as Class A or Class B TAP.

(a) Ecology shall list a substance or group of substances as Class A or Class B TAPs if the department has reason to believe that the compound or group of compounds are likely to be emitted to the air from an air pollution source and the air emission of such compound or compounds could impact public health. The compounds shall be removed from the list if ecology determines that these conditions no longer exist.

(b) Ecology may list mixtures of compounds as Class A and/or Class B TAPs if ecology determines that the health impact of the emission mixture is likely to be different from the known individual chemical impacts.

(3) Acceptable source impact level (ASIL). Ecology may adopt an ASIL only if ecology determines that concentrations at that level will not unreasonably endanger human health.

[Statutory Authority: RCW 70.94.331. (Order 90-62), 91-13-709, §173-460-120 Filed June 18, 1991.]

Date :06/18/1991

WAC 173-460-130 FEES. (1) Pursuant to RCW 70.94.152, ecology or the authority may charge a fee for the review of notices of construction.

(2) The fee imposed under this section may not exceed the cost of reviewing plans, specifications, and other information and administering such notice.

[Statutory Authority: RCW 70.94.331. (Order 90-62), 91-13-709, §173-460-130 Filed June 18, 1991.]

Date :06/18/1991

WAC 173-460-140 REMEDIES. Violations of this chapter are subject to the penalty provisions and/or other remedies provided in chapter 70.94 RCW.

[Statutory Authority: RCW 70.94.331. (Order 90-62), 91-13-709, §173-460-140 Filed June 18, 1991.]

Date :06/18/1991

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