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United States Environmental Protection Agency

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Seattle WA 98101

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EPA

March 24, 1992

Reply To
Attn Of: HW-124

Paul R. Stasch
Compliance Specialist
Washington Department of Ecology
PV-11
Olympia, Washington 98504

Re: Hanford Federal Facility Research, Development and Demonstration Permit Application

Dear Mr. Stasch:

The U.S. Environmental Protection Agency (EPA) Region 10 recently held discussions, on March 19, 1992, with the Department of Energy-Richland Operations Office (Energy) regarding the Hanford Federal Facility Research, Development and Demonstration (RD&D) Permit Application. As a result of this meeting, a conference call has been scheduled for April 1, 1992 from 9:00 am to 12:00 pm to discuss their response to EPA's and Ecology's Notice of Deficiency.

At our March 19, 1992 meeting, Energy provided the enclosed revised sections, specifically Chapter 3.0 "Waste Characteristics" and Chapter 4.0 "Process Information", of the RD&D Permit for review. Your cooperation in reviewing and submitting any comments prior to this next scheduled conference call is greatly appreciated.

I am looking forward to working with you throughout the review and approval of this RD&D Permit application. If any additional information is required, please contact me at (206) 553-6693/FTS 399-6693.

Sincerely,

Daniel L. Duncan
Daniel L. Duncan
Hanford RCRA Program Manager

cc: w/o encl
Cliff Clark, DOE-RL
Paul Day, EPA
Cathy Massimino, EPA
David Jansen, Ecology

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APPENDIX

TABLES

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3.0 WASTE CHARACTERISTICS

This section presents a general description of the types of waste water that will be tested in the waste water pilot plant and the types of contaminants that will be encountered. A description of the chemical spikes that will be added to the waste during testing also is presented. An operating envelope has been defined to limit the type of waste that will be accepted in the waste water pilot plant. This section also includes a description of the waste analysis plan that will be used to ensure that the composition of the waste to be tested is within the parameters specified in the operating envelope of the waste water pilot plant.

3.1 WASTE WATER PILOT PLANT WASTE STREAMS FOR TESTING

The following sections include a description of the waste water streams received at the waste water pilot plant, a discussion of the waste composition, and dangerous waste designation.

3.1.1 Description of Waste Water Stream

One waste water effluent stream is planned to be tested in the waste water pilot plant. This stream is the 242-A Evaporator process condensate stream. No offsite waste will be received at the waste water pilot plant.

The 242-A Evaporator concentrates liquid waste generated at various waste management units on the Hanford Facility. The liquid waste is stored in underground double-shell tanks (DSTs) until disposal. The liquid waste in the DSTs is piped to the 242-A Evaporator, concentrated through evaporation, and returned to the DSTs for storage until final disposal. The condensate derived from this evaporation process, called '242-A Evaporator process condensate', is the waste water that will be tested at the waste water pilot plant. The 242-A Evaporator process condensate will be stored at the LERF until the 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility is operational.

3.1.2 Waste Stream Composition and Designation

A variety of constituents are contained in the 242-A Evaporator process condensate. Constituents can be classified as suspended solids, organics, and dissolved solids. Suspended solids include colloids, grit, and organic debris (e.g., algae). Organics include compounds such as acetone, butanol, methyl isobutyl ketone, methylene chloride, and tributyl phosphate. Dissolved solids include inorganics and radionuclides. The exact composition of the 242-A Evaporator process condensate is somewhat variable, depending on the source of DST waste that is treated at the 242-A Evaporator. In general, the amount of contaminants in the process condensate is less than 100 parts per million (i.e., less than 0.01 percent).

The results of 34 samples collected from the 242-A Evaporator process condensate are summarized in Table 3-1. The samples were collected between August 1985 and March 1989. It has not been possible to collect a 242-A Evaporator process condensate sample since April 1990, when the 242-A Evaporator was taken out of service. The table shows the range of constituents that might be encountered in the waste streams. It should be emphasized that no one waste water stream contains all of the constituents listed in the table nor does any one waste water contain the maximum concentration of all of these constituents on a regular basis. Detailed information on the process condensate sampling is presented in the stream specific report (WHC 1990).

The 242-A Evaporator process condensate is designated a dangerous waste as defined by WAC 173-303. The waste is designated dangerous because the process condensate is 'derived from a listed waste' and a toxic dangerous waste (WT02).

The 242-A Evaporator process condensate has been designated a dangerous waste because the process condensate is derived from DST waste. The DST waste has been designated dangerous due to presence of nonhalogenated spent solvents, namely acetone and methyl isobutyl ketone (F003) and methyl ethyl ketone (F005).

Acetone was detected in all 34 samples of 242-A Evaporator process condensate samples with an average concentration of 980 parts per billion. The acetone was used in laboratories to dry glassware and could have been discarded through drains to the DSTs.

Methyl isobutyl ketone (hexone) was detected in 10 of 34 samples at an average concentration of 11 parts per billion. Methyl isobutyl ketone was used in the solvent extraction process at the Hanford Site and was discarded to single-shell tanks as a spent solvent.

Methyl ethyl ketone (2-butanone) was detected in 25 of 34 samples at an average concentration of 51 parts per billion. Methyl ethyl ketone was used in past chemical processing operations [reduction-oxidation (REDOX) process] and has been determined to be a spent solvent.

Acetone, methyl isobutyl ketone, and methyl ethyl ketone in the 242-A Evaporator process condensate are not known to be 'discarded chemical products' as defined by WAC 173-303-081.

Two other 'listed' constituents are present in the 242-A Evaporator samples. Butyl alcohol was detected in 30 of 34 samples at an average concentration of 9,800 parts per billion. Butyl alcohol is an impurity and degradation product from tributyl phosphate used at the PUREX Plant. Pyridine was detected in 1 of 34 samples at a concentration of 550 parts per billion. Pyridine was not used in Hanford Site chemical processing. Neither butyl alcohol or pyridine are known to be discarded chemical products or spent solvents as defined in WAC 173-303-081 and -082.

The 242-A Evaporator process condensate also is designated a toxic dangerous waste (WT02) by the equivalent concentration method as described in WAC 173-303-084(5) and -101. Ammonia is the largest contributor to the equivalent concentration total; therefore, the waste is considered to be designated toxic because of ammonia concentration. Because the equivalent concentration method of determining toxicity is not included in 40 CFR 261, the waste is considered to be a 'state only' dangerous waste for ammonia.

The 242-A Evaporator process condensate is not a persistent dangerous waste because the concentrations of halogenated hydrocarbons or polycyclic aromatic hydrocarbons were below 0.01 and 1.0 percent, respectively (WAC 173-303-102).

Three constituents potentially present in the 242-A Evaporator process condensate were determined to be carcinogenic substances [cadmium chloride, nickel (II) hydroxide, and n-nitrosodiumethylamine]. Because none of the compounds exceeded 0.01 percent and the sum was less than 1.0 percent of the waste quantity, the waste is not a carcinogenic dangerous waste per WAC 173-303-084(7) and -103(2).

The waste is not ignitable because, as a dilute aqueous waste, the concentration of oxidizer (e.g., nitrate) and the sum of concentrations of potentially ignitable contributors are too low to be an ignitable waste. Flash point testing was not performed on the process condensate. The nitrate in the waste is so dilute (averaging 2.8 parts per million) that it is not expected to support the combustion of organic matter. Nitric acid is given an oxidizer hazard class when the concentration exceeds 40 weight percent (400,000 parts per million). The ignitability index was calculated for pure substances having a flash point of less than 140 °F. The ignitability index calculated from these constituents is between 0.0002 and.008 percent. Using best professional judgement, samples with an ignitablity index of less than 1 percent were not considered ignitable (DOE-RL 1991a).

Measured pH for the 242-A Evaporator process condensate ranged from 7.8 to 11.3 standard units, therefore the process condensate is not considered to be a corrosive waste per WAC 173-303-090(6).

The process condensate is a dilute aqueous waste and clearly does not meet the criteria contained in WAC 173-303-090(7) for reactive waste.

The total analyte concentrations for the 34 samples of 242-A Evaporator process condensate did not exceed the toxicity characteristics leaching procedure (TCLP) limits set in WAC 173-303-090(8)(c). Only four analytes from the TCLP list were detected in the waste (barium, cadmium, mercury and methyl ethyl ketone). None of the constituents exceeded the TCLP limits. Therefore, the 242-A Evaporator process condensate is not a toxicity characteristic dangerous waste.

3.2 CHEMICAL SPIKES

Most testing at the waste water pilot plant will be conducted using synthetic waste. Synthetic waste will be mixed and tested at elevated concentration levels of selected chemical constituents during the synthetic testing program. Limited testing will be performed on actual mixed waste (242-A Evaporator process condensate) to confirm the results observed during synthetic testing.

Chemical spikes will be used in order to determine efficiency of the test equipment at constituent concentrations ranging up to several orders of magnitude greater than expected in the actual waste. Chemical spikes are the chemical constituents added to the actual waste.

To test all the potential contaminants of regulatory concern in the waste water feed is impractical. Instead, the approach used was to systematically select a number of analyzable chemicals that accurately represent all of the contaminants of legitimate regulatory concern and include these constituents on a 'spike list'.

Development of an edited spike list with 238 constituents was accomplished through the application of selection criteria to a comprehensive list of 452 chemical constituents. The origin of the comprehensive list and rationale for eliminating chemicals to develop an edited spike list is presented in Sections 3.2.1 and 3.2.2, respectively.

The 238 constituents in the edited list were reduced further to 43 constituents by grouping the constituents into classes of chemicals. The selected chemical is judged to be representative of its class. Representativeness is evaluated in terms of evaporator carry over potential (e.g., volatility and solubility) and process efficiency [e.g., susceptibility to ultraviolet oxidation (uv/ox) breakdown].

One additional criteria was applied to the spike list. The chemical could not be a Class A or B1 carcinogen, chlorinated dioxin or furan, herbicide, pesticide or polychlorinated biphenyl (PCB). This ensures that unconfirmed compounds that have a potential for significant health effects are not introduced into the waste water pilot plant.

The final spike list of 43 chemicals consists of 18 inorganic and 25 organic species. The basis for the spike concentrations is the larger value of 10 times the minimum practical detection limit or 10 times the maximum concentration in Table 3-1 (except ammonia, 1-butanol, tributyl phosphate, and carbonate for which the maximum concentration value was used). These levels were chosen to ensure that process removal efficiencies up to 90 percent can be detected. At the same time, concentrations are low enough that the spiked feed is not designated a dangerous waste per WAC 173-303 regulations.

The final spike list of 43 chemicals shown in Table 3-2 is believed to accurately represent the contaminants potentially present in the waste water feed. Any waste water treatment plant that can successfully treat feed with

this wide range of chemicals will have demonstrated a high degree of capability and robustness.

3.2.1 Comprehensive Regulatory List

The starting point for determining the chemical constituents of the spike list is the "comprehensive regulatory list". The comprehensive regulatory list is made up of 452 chemical constituents of regulatory concern including the following three groups:

- The three constituents that led to the initial determination that the 242-A Evaporator process condensate was an F003 and F005 listed waste, (i.e., acetone, methyl ethyl ketone, methyl isobutyl ketone); although not believed to be spent solvents, pyridine and n-butanol are included on the list

- The 409 chemicals specified in Appendix VIII of 40 CFR 261; these chemicals represent all of the specific chemicals that the EPA regulates under the RCRA program

- The 40 chemicals on the list of Priority Pollutants specified under 40 CFR Part 136 that are not included in the first two subgroups.

3.2.2 Edited Regulatory List

The comprehensive regulatory list of 452 chemicals contains many entries for which there are no logical basis to anticipate their presence in the waste water stream. In addition, the list contains many chemicals for which appropriate analytical procedures are not available. An 'edited regulatory list' of 238 chemicals was derived by deleting certain chemicals from the comprehensive regulatory list.

A total of 30 chemicals on the Appendix VIII list (40 CFR 261) were eliminated because of their limited or specific use or occurrence. The chemicals fall into very narrow categories that include experimental drugs, previously used therapeutic agents, anticancer agents, chemical warfare agents, natural products, microbial products, and other similar chemicals. There is no logical basis to believe that these chemicals would be present in the waste streams planned for testing in the waste water pilot plant.

A total of 18 organic chemicals and 12 inorganic elements on Appendix VIII (40 CFR 261) with the designation "not otherwise specified" (N.O.S.) were eliminated. This designation is used to describe generic classes of inorganic compounds (e.g., lead compounds N.O.S.) or organic compounds (e.g., chlorinated benzenes, N.O.S.). The intention of this designation is to include the general class of all isomers or forms of a general chemical group as hazardous waste chemicals. Organic chemicals designated as N.O.S. can be legitimately eliminated from the comprehensive list because the specific isomers of concern within the group (such as o- or m-dichlorobenzene) already are individually listed on the comprehensive list.

Inorganic chemicals designated N.O.S. can be eliminated because the parent metal (such as lead) or the individual compound (such as lead acetate) also is included on the list. Eliminating these chemicals from the comprehensive list also is supported by the fact that the EPA-approved analysis methods are not available for generic classes of chemicals designated as N.O.S.

A total of 26 inorganic salts on the Appendix VIII list (40 CFR 261) were deleted because the metallic cations are already on the comprehensive list of chemicals of concern. These chemicals are included in the analysis for the parent metal and deletion will not result in the significant loss of information.

A total of 28 non-Priority Pollutant pesticides and herbicides were removed from the comprehensive list. The basis for this is that no pesticides or herbicides have been identified in either the Hanford Site inventory document (Klem 1990) or in any of the historical data for waste water streams.

A total of 100 chemicals on the Appendix VIII list (40 CFR 261) not already removed were deleted based on the fact that there currently is no recommended SW-846 analysis method. Because SW-846 analytical procedures form the basis of the data collection requirements, there are no regulatory acceptable methods for analyzing for these chemicals. Two chemicals without SW-846 method potentially are present in waste waters planned for treatment in the waste water pilot plant. Hydrazine and n-butanol are retained on the edited regulatory list.

3.3 OPERATING ENVELOPE

The purpose of the operating envelope is to preclude waste water pilot plant conditions that would be potentially unsafe to people or damaging to the environment. The operating envelope includes two components. The first component addresses the composition of the waste water to be tested in the waste water pilot plant. The second component addresses the operating parameters that are in place to ensure the safety of personnel and the prevention of releases.

3.3.1 Waste Water Composition

The composition of the waste feed (Table 3-1) to the waste water pilot plant has been characterized by analyses of 34 samples of 242-A Evaporator process condensate collected over a period of almost 4 years. Because some variability is expected in waste composition, a sampling program will be implemented to ensure that the waste composition will be within the operational capabilities of the waste water pilot plant.

The constituents to be analyzed include 8 metals and 8 volatile organic compounds as well as pH. The 8 metals include the toxic metals found in the 242-A Evaporator process condensate. The volatile organics include 8 of the 13 volatile organic compounds found in the process condensate for which SW-846 analytical methods exist.

The operational envelope for waste composition consists of the maximum values (limits) for the waste transferred to the waste water pilot plant (Table 3-3). The constituent concentrations are raised one or two orders of magnitude (10 or 100 times) to derive the limits shown in Table 3-3. The basis for the limits is the reduction of personnel exposure/environmental contamination risk to as low as reasonably achievable.

The limited waste analysis program is justified for the following reasons.

- The toxicity of the waste is low.
- After pilot plant testing, the waste will be transferred to the unit that normally stores or disposes of the waste, i.e., the LERF.
- The potential release of volatile organics to the atmosphere will be controlled at the 1706-KE Building by the use of two stages of carbon adsorbers, in series. The use of an interstage organic vapor analyzer provides continuous on-line monitoring with alarm to indicate "breakthrough" (saturation, or full loading) of the first stage adsorber.

After introduction into the waste water pilot plant, the waste composition will be modified by the addition of chemical spikes described in Table 3-2. Spiked waste composition will be controlled through administrative measures given in individual test procedures.

An additional limitation is placed on the shipment of waste water via the tank trailers, i.e., the waste water must be low specific activity (LSA) with respect to the radionuclide content to meet U.S. Department of Transportation requirements.

3.3.2 Operating Parameters

Operating parameter limitations are required only for 'critical parameters'. A critical parameter is defined as an operating parameter for which loss of control of the parameter can affect safety of Hanford Site personnel or the general public or result in the contamination of the 1706-KE Building, LERF, or the general environment.

On this basis, the critical parameters for the waste water pilot plant include:

- High pressure
- High vacuum
- Ultraviolet light
- Corrosion
- Tank overflow
- Leakage
- Corrosivity
- High temperature

- Radiation
- Differential pressure
- Low vessel vent vacuum.

The critical parameters are discussed in detail in Section 4.0 where descriptions of the pilot plant processes and equipment are presented. The critical parameters, their limitations, and how the parameters are monitored and controlled are shown in Table 4-3.

3.4 WASTE ANALYSIS PLAN

The waste analysis plan will provide data to establish that the 242-A Evaporator process condensate stored at the LERF is within the operating envelope of the waste water pilot plant. This will be accomplished through sampling and analysis of the process condensate before unloading at the 1706-KE Building.

The concentrations of the constituents added during spiking will be administratively controlled through the use of test plans and test procedures.

3.4.1 Sampling and Preservation

To determine if the waste is within the operating envelope limits, a composite sample of the LERF waste water will be collected during the filling of the tank trailer. This will be accomplished using a sample port on the tank trailer fill line.

Samples will be collected and preserved in accordance with Table 4.1 of the QAPP (Appendix 2A).

3.4.2 Analyses and Analytical Methods

The LERF waste water samples will be analyzed for pH, ammonia, metals (cations), and volatile organic compounds. The analytical methods to be used are listed in Table 3-3. These analyses will be performed at QA Level II in accordance with the QAPP (Appendix 2A). The data will be used to confirm that the limits of the operating envelope are not exceeded before unloading the waste water into the pilot plant.

A more detailed list of analytical methods to be used at the waste water pilot plant, including extraction methods, is shown in Table 3-4.

The LERF waste water analysis will include determining concentrations of a number of radionuclide constituents, as well as total alpha and combined total beta/gamma radiation. A description of the radionuclide analytical methods are given in Appendix 3A. Because the radionuclides are not subject to regulation under WAC 173-303, the radionuclide analytical methods are provided for information only. The radionuclide data will be used to confirm

that the LSA limits have not been exceeded before shipment of the waste to the pilot plant.

3.5 SECONDARY WASTE

After testing at the waste water pilot plant, the liquid portion of the waste will be returned to the LERF.

Additional types of secondary waste will be generated in relatively small quantities at the waste water pilot plant. This waste will include items such as rags, gloves, failed equipment, used filters, and recovered solids (e.g., ammonium sulfate). The mixed waste (rags and other solids) will be transferred to the Hanford Central Waste Complex for storage and disposal according to applicable regulations and DOE Orders. Nonradioactive dangerous waste will be transferred to the 616 Nonradioactive Dangerous Waste Storage Facility for storage and eventual offsite disposal at permitted TSD facilities in accordance with applicable federal and state regulations.

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Table 3-1. 242-A Evaporator Effluent Characterization Data.
(sheet 1 of 2)

Parameter	Units[a]	Average	90% CI	Maximum
Conductivity	µS	304		590
pH	SU	7.8	10	11.3
Total dissolved solids (TDS)	ppb			2,700
Aluminum	ppb	1,295	1,330	4,992
Ammonium	ppb	482,511	511,344	9,350,000
Barium	ppb	6.8	7.2	8
Boron	ppb	65	97	151
Cadmium	ppb	5		
Calcium	ppb	2,600	2,800	8,300
Carbonate	ppb	98,000	104,347	750,000
Chloride	ppb	1,000	1,200	2,300
Chromium	ppb	52	66	156
Copper	ppb	60	67	127
Fluoride	ppb	874	971	12,273
Iron	ppb	112	131	503
Magnesium	ppb	122	153	3,670
Manganese	ppb	5		
Mercury	ppb	0.3	0.31	0.69
Phosphorus	ppb	1,177	1,336	6,195
Nickel	ppb	14	15	17
Nitrate	ppb	2,800	2,292	5,000
Potassium	ppb	5,944	6,495	19,238
Silicon	ppb	15,616	24,252	985,819
Sodium	ppb	3,586	4,469	51,497
Sulfate	ppb	2,600	2,800	13,000
Sulfide	ppb	36,000	66,000	66,000
Vanadium	ppb	6.3	6.7	7
Total organic carbon (TOC)	ppb	42,024	218,415	4,920,000
Acetone	ppb	980	1,000	5,100
Benzyl alcohol	ppb	13	14	18
Benzaldehyde	ppb	23		
2-Butoxyethanol	ppb	380	400	920
1-Butanol	ppb	9,800	11,000	88,000
2-Butanone	ppb	51	53	120
Butoxyglycol	ppb	280	290	810
Butoxydiglycol	ppb	19	44	27
Butoxytriethyleneglycol	ppb	35		
Butraldehyde	ppb	56	62	230
Chloroform	ppb	14	14	27
Caproic acid	ppb	70		
3,5-Dimethylpyridine	ppb	21	23	24
Dimethylnitrosamine	ppb	57		
Dodecane	ppb	43	52	46

Table 3-1. 242-A Evaporator Effluent Characterization Data.
(sheet 2 of 2)

Parameter	Units[a]	Average	90% CI	Maximum
Ethoxytriethyleneglycol	ppb	99	120	150
Ethyl alcohol	ppb	2		
Hexadecane	ppb	17		
Heptadecane	ppb	18		
Methoxydiglycol	ppb	40	52	52
Methoxytriglycol	ppb	220	370	370
Methylene chloride	ppb	120	140	180
Methyl n-propyl ketone	ppb	9.3	9.7	12
Methyl n-butyl ketone	ppb	13	14	79
MIBK (Hexone)	ppb	11	14	68
2-Methylnonane	ppb	16	17	17
Pentadecane	ppb	20		
Phenol	ppb	33		
2-Propanol	ppb	22		
Pyridine	ppb	550		
Tetradecane	ppb	76	83	440
Tetrahydrofuran	ppb	37	39	170
Tributyl phosphate	ppb	3,900	4,100	21,000
1,1,1-Trichloroethane	ppb	5		
Tridecane	ppb	70	77	350
Triglyme	ppb	90		
Alpha	pCi/L	160	350	750
Beta	pCi/L	4,600	6,000	74,000
Strontium-90[b]	pCi/L	5,200	7,600	81,000
Ruthenium-106	pCi/L	10,500	11,080	17,800
Cesium-137[b]	pCi/L	4,400	5,400	26,000
Promethium-147	pCi/L	1,300	1,600	4,100
Uranium (gross)	pCi/L	20	33	140
Tritium	pCi/L	5,600,000	6,300,000	24,000,000
Plutonium-239	pCi/L	0.00037	0.00068	0.0024
Tin-113	pCi/L	540	770	2,500
Europium-155	pCi/L	1,400	na	1,400

[a] Units: μS = microsiemen
SU = standard pH units
ppb = parts per billion
pCi/L = picocuries per liter

[b] Cesium-137 and strontium-90 values have been multiplied by 10 to account for the removal of the existing ion exchange system in the 242-A Evaporator.

Abbreviations: CI = confidence interval
na = not applicable

NOTE: Radionuclide data presented for information only.

Table 3-2. Chemical Spikes for the C-018H Pilot Plant.
(sheet 1 of 2)

Desired analyte (a)	CASN (b)	Maximum concentration (ppm)	Spike reagent (c)	Maximum concentration (ppm)
Acetone	67-64-1	51	Acetone	51
Acetonitrile	75-05-8	2	Acetonitrile	2
Ammonia	7664-41-7	10,000	Ammonia hydroxide (ammonia sulfate)	25,582 (77,592)
Anthracene	120-12-7	1	Anthracene	1
Barium	7440-39-3	0.5	Barium chloride	0.8
Benzyl alcohol	100-51-6	1	Benzyl alcohol	1
Bis(2-ethylhexyl) phthalate	117-18-7	2	Bis(2-3thylhexyl) phthalate	2
n-Butanol	71-36-3	100	n-Butanol	100
Cadmium	7440-43-9	0.5	Cadmium chloride	0.9
Carbon disulfide	75-15-0	10	Carbon disulfide	10
Carbon tetrachloride	56-23-5	0.5	Carbon tetrachloride	0.5
Chloride		10	Sodium chloride (d)	13
Chloroform	67-66-3	0.5	Chloroform	0.5
Chromium	7440-47-3	1.5	Sodium chromate (IV)	4
Copper	7440-50-8	1.5	Copper chloride	4
Cyanide	57-12-5	1	Sodium cyanide	2
m-Dichlorobenzene	541-73-1	1	m-Dichlorobenzene	1
Dichloroisopropyl ether	108-60-1	1	Dichloroisopropyl ether	1
Ethylene glycol monomethyl ether	110-80-5	1	Ethylene glycol monomethyl ether	1
Ethylmethacrylate	97-63-2	2	Ethylmethacrylate	2
Fluoride	16984-48-8	120	Sodium fluoride	265
Formaldehyde	50-00-0	10	Formaldehyde	10
Formic acid	64-18-6	10	Formic acid	10
Iron	7439-89-6	5	Iron(III) chloride	15
Manganese	7439-96-5	0.5	Manganese(II) chloride	1.2
Mercury	7439-97-6	0.1	Mercury(II) chloride	0.2
Methyl butyl ether	591-78-6	1	Methyl butyl ether	1
Methyl ethyl ketone	78-93-3	1	Methyl ethyl ketone	1
Methyl isobutyl ketone	108-10-1	1	Methyl isobutyl ketone	1
Methylene chloride	75-09-2	2	Methylene chloride	2
Naphthalene	91-20-3	1	Naphthalene	1
Nickel	7440-02-0	1	Nickel chloride	2.2

Table 3-2. Chemical Spikes for the C-018H Pilot Plant.
(sheet 2 of 2)

Desired analyte (a)	CASN (b)	Maximum concentration (ppm)	Spike reagent (c)	Maximum concentration (ppm)
Nitrate		50	Sodium nitrate	69
Phenol	108-95-2	2	Phenol	2
Pyridine	110-86-1	5	Pyridine	5
Sulfate		130	Sodium sulfate	192
Sulfide	18496-25-8	660	Sodium sulfide	1,606
Toluene	108-88-3	1	Toluene	1
Tributylphosphate	126-73-8	21	Tributylphosphate	21
1,1,1-Trichloroethane	71-55-6	0.5	1,1,1-Trichloroethane	0.5
Trichloroethylene	79-01-6	0.5	Trichloroethylene	0.5
Vanadium	7440-62-2	0.5	Vanadium pentoxide	0.9
Zinc	7440-66-6	0.5	Zinc chloride	1.1

(a) Inorganic analytes are ions.

(b) Chemical Abstract Service Number

(c) Spike formulation is for anhydrous compounds diluted by actual waste.

(d) Sodium chloride increases total chloride for all salts to 10,000 ppb.

ppm = parts per million.

Table 3-3. Operating Envelope.

Parameter	Limit(s)	Derivation of limit[1]	Analytical method[2]
pH	2<pH<12	NA	SW-846-9040
Metals (ppm)			
Chromium	≤1.5	10 x	SW-846-6010
Copper	≤1.5	10 x	SW-846-6010
Barium	≤0.8	100 x	SW-846-6010
Cadmium	≤0.5	100 x	SW-846-6010
Manganese	≤0.5	100 x	SW-846-6010
Mercury	≤0.1	100 x	SW-846-7470
Nickel	≤2.0	100 x	SW-846-6010
Vanadium	≤1.0	100 x	SW-846-6010
Volatile organic compounds (ppm)			
Acetone	≤50	10 x	SW-846-8260
Chloroform	≤0.3	10 x	SW-846-8010
Methylene chloride	≤1.8	10 x	SW-846-8010
Methyl n-butyl ketone	≤0.8	10 x	SW-846-8260
MEK (2-butanone)	≤1.2	10 x	SW-846-8015
MIBK (Hexone)	≤0.7	10 x	SW-846-8015
Ethyl alcohol	≤0.2	100 x	SW-846-8015
1,1,1-trichloroethane	≤0.5	100 x	SW-846-8010

[1]Factor times the maximum amount detected in the 242-A Evaporator process condensate (Table 3-1).

[2]SW-846-8015 will be used in lieu of SW-846-8260 if proven viable. SW-846-8021 may be used in lieu of SW-846-8010.

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Table 3-4. Waste Water Analytical Methods.
(sheet 1 of 2)

Parameter	Technique	Method number
pH	Glass electrode	SW-846-9040
Conductivity	Conductivity meter	ASTM D1125-82
Total organic carbon	Carbonaceous analyzer	SW-846-9060
Inorganics		
Ammonia	Ion-selective electrode	ASTM D1426
Anions	Ion chromatography	SW-846-300.0
Metals	Inductively coupled plasma atomic emission spectroscopy (ICP)	SW-846-6010
Antimony	Graphite furnace atomic absorption spectroscopy	SW-846-7041
Arsenic		SW-846-7060
Selenium		SW-846-7740
Mercury	Cold vapor atomic absorption spectroscopy	SW-846-7470
Organics	Gas chromatography/mass spectroscopy (GC/MS):	
	Gas chromatography - general	SW-846-8000
Sample preparation	Organic extraction	SW-846-3500
	Separatory funnel liquid - liquid extraction	SW-846-3510
	Continuous liquid - liquid extraction	SW-846-3520
	Hexadecane extraction and screening of purgeable organics	SW-846-3820
	Sample preparation using purge and trap	SW-846-5030
Volatiles	Halogenated volatile organics	SW-846-8010
	Non-halogenated volatile organics	SW-846-8015
	Halogenated and aromatic volatile organics	SW-846-8021
	Capillary column GC/MS	SW-846-8260
Semivolatiles	Chlorinated	SW-846-8120

Table 3-4. Waste Water Analytical Methods.
(sheet 2 of 2)

Parameter	Technique	Method number
	Capillary column GC/MS	SW-846-8270
Phenols	Gas chromatography	SW-846-8040
Nitrosoamines	Gas chromatography	SW-846-8070
Radionuclides		
Cesium-137	Gamma energy analysis using a hyperpure germanium detector	Onsite method
Strontium-89/90	Separation using carbonate precipitation; beta counting	Onsite method
Tritium	Liquid scintillation counting	Onsite method
Americium-241	Separation using ion exchange; alpha counting	Onsite method
Total plutonium	Separation using ion exchange; alpha counting	Onsite method
Total uranium	Laser fluorometry	Onsite method
Total alpha	Gas flow proportional counting	Onsite method
Total beta	Gas flow proportional counting	Onsite method
Total gamma	Gamma energy analysis using a hyperpure germanium detector	Onsite method

Note: Radionuclide test methods are presented for information only. A description of onsite radionuclide test methods is included in Appendix 3A.

* ASTM (ASTM 1989)
EPA-300 (EPA 1979)
SW-846 (EPA 1986b).

CONTENTS

APPENDICES

FIGURES

TABLES

4.0 PROCESS INFORMATION

Waste water pilot plant testing of treatment technologies using mixed and dangerous waste will be conducted primarily in the 1706-KE Building. Limited testing also will be performed at the LERF. The following sections provide information on the waste water pilot plant and testing equipment, testing performed at the LERF, loading and unloading of waste at the testing locations, and equipment decontamination.

4.1 PILOT PLANT TESTING AT THE 1706-KE BUILDING

This section provides a general discussion of the 1706-KE Building, waste water pilot plant containment, ventilation system, and operating capacity. The section also provides a more detailed discussion of the types of technologies to be used, equipment descriptions, and critical parameters related to potential safety concerns.

4.1.1 The 1706-KE Building

The 1706-KE Building is located adjacent to the decommissioned 100-KE reactor, and originally was designed to study the effects of water quality and decontamination solvents on reactor hardware and fuel element materials. With the startup of the N reactor in 1965, and the shutdown of the KE reactor in 1971, the 1706-KE Building was used to perform operational testing in support of N reactor. The testing programs included water quality control, corrosion, decontamination, procedure development, waste treatment systems development, ion exchange evaluations, and material testing. Testing is still being performed in support of N reactor shutdown and the 100 KE Area storage basins.

The 1706-KE Building is part of a complex of three buildings, namely 1706-KE, 1706-KEL, and 1706-KER. Portions of the three buildings form what is known as the Engineering and Environmental Demonstration Laboratory. As shown on Figure 1-3, the 1706-KEL Building is attached to the west side of the 1706-KE Building and the 1706-KER Building is located north of the 1706-KE and 1706-KEL Buildings. The 1706-KER Building is joined to the 1706-KE and 1706-KEL Buildings beneath ground level.

Waste water pilot plant activities will take place in the 1706-KEL and 1706-KE Buildings. As shown in Figure 4-1, the waste water pilot plant, storage area, and men's change room will be located in the 1706-KEL Building. The waste water pilot plant analytical lab, storage area, women's change room, and offices will be located in the 1706-KE Building. Unless otherwise specified, this permit application will use the term '1706-KE Building' to refer to the portions of 1706-KE and 1706-KEL Buildings used for waste water pilot plant activities.

The 1706-KE Building was chosen for the waste water pilot plant operation because of the available space, trained personnel, available utility

services, and existing ventilation system. Also, the 1706-KE Building will require minimal renovation, and is designated for radiological activities. The 1706-KE Building also contains adequate laboratory analytical space to perform the necessary analyses required for process information.

The 1706-KE Building is concrete block and reinforced concrete construction and is designed for a Safety Class 2 seismic loading (DOE-RL 1988). The area designated for waste water pilot plant testing is approximately 36 by 34 feet (11 by 10.4 meters) [1,200 square feet (111.5 square meters)] with an additional 900 square feet (84 square meters) available for support equipment and storage (Figure 4-1). Equipment access to this pilot plant area is limited by a 82 inch (208 centimeter) high by 58 inch (147 centimeter) wide double swinging metal door. The floor is 4½-inch (11-centimeter) reinforced concrete with a load capacity of 100 pounds per square foot (488 kilograms per square meter). Available utilities are raw water, electrical supply, sanitary water, demineralized water, and distribution lines for bottled gas (e.g., nitrogen, etc.).

4.1.2 Waste Water Pilot Plant Spill Prevention and Containment

A primary safety concern at the waste water pilot plant will be spill prevention and containment. A multi-tiered approach has been taken, the highest priority being the prevention of leaks or spills. This is followed by secondary containment at the potential points of leakage, and finally by use of the building as the final form of containment (tertiary).

To prevent the occurrence of leaks or spills, the following steps are planned:

- All process piping and equipment will be aboveground and easily accessible for daily visual inspections

- Process piping and equipment will be leak checked at or above operating pressure before use

- All receiving tanks will be equipped with liquid-level indicators and interlocked with the corresponding supply pump to prevent overfilling

- Process piping designs, tank designs, and equipment inspections will be performed in accordance with the WAC 173-303-640.

Secondary containment will be provided for equipment and piping where required by WAC 173-303-640. Welded piping will be used whenever possible for process piping at the waste water pilot plant. However, due to the flexibility required to operate a waste water pilot plant, threaded and flanged fittings also will be used to allow the necessary piping changes. Containment pans will be used at the threaded or flanged fittings. Because all equipment has not been purchased at this time and also because of the flexibility required to successfully complete the waste water pilot plant mission, specific containment pan designs are not possible at this time. The

following criteria will be used for all secondary containment at the waste water pilot plant.

- The catch pan footprint will be at least 1 foot (0.3 meter) greater in each horizontal dimension than the footprint of the equipment.

- A minimum height of 3 inches (7.6 centimeters) will be used (height may be greater to increase volume of the containment).

- The volume of the containment for equipment will be adequate to hold a minimum of 110 percent of the retention volume for that piece of equipment.

- Drip pans under pipe fittings will have a minimum capacity of 5 gallons (19 liters). Frequency of inspection and pipe operating pressure also will be considered in sizing of the pans.

- Material of construction will be either aluminum or stainless steel. Stainless steel will be used whenever the possibility of corrosion exists with the material being contained (i.e., acids or caustics).

- Flanged fittings with an operating pressure greater than 50 pounds per square inch (345 kilopascals) gage will be fitted with spray guards. Spray guards will be required for the reverse osmosis and the filtration units as discussed in Sections 4.1.5.3.1.2 and 4.1.5.4.2.

- The WAC 173-303-640 will be used to determine containment requirements.

- Labels will be affixed to equipment in accordance with WAC 173-303-640.

Examples of this criteria is shown in Table 4-1 for the two types of test equipment that currently are available.

The waste water pilot plant will have two double-shell 3,000-gallon (11,000-liter) interim storage tanks that will be capable of storing the waste water between tests on different treatment technologies or as feed material. These two storage tanks will be placed outside the 1706-KE Building (Figure 4-1) and will be plumbed to provide 6,000 gallons (22,700 liters) of storage. The inner shell of these tanks will be of stainless steel construction with outer shells of carbon steel. Both tanks will be vented to the 1706-KE Building ventilation system. The two 3,000-gallon (11,350-liter) interim storage tanks will be inspected before use as required in WAC 173-303-640. Leak detection inspection will be provided through access ports to the annular space of the storage tanks. The two tanks also will have liquid-level monitors interlocked to the feed pumps to prevent overflow conditions.

The purpose of the interim storage tanks is to provide operational flexibility during testing. Some testing will not require use of the interim storage tanks at all. The tanks may not be cleaned or flushed in

between tests because the waste to be tested is expected to be relatively homogeneous. If flushing of the tanks between tests is deemed necessary, the tanks will be flushed with either demineralized water or potable water, as appropriate. Tank flushing requirements would normally be given in the individual test procedure. A demineralized water line is currently available in the 1706-KE Building.

As an added containment control, the concrete floor of the waste water pilot plant area will have all drains sealed and will be coated with an epoxy resin sealer. The walls of the waste water pilot plant also will be sealed with an epoxy resin sealer. The sealing of the floor and walls will provide a third level of containment in the unlikely event of a breaching of the secondary containment or 'spraying' at a leak developed at a pipe joint. The epoxy products will be compatible with the waste.

4.1.3 Waste Water Pilot Plant Ventilation System

The process area, process equipment, and interim storage tanks will be vented through the existing 1706-KEL Building ventilation system. This system has a rated capacity of 12,250 cubic feet (347 cubic meters) per minute at a static pressure of 4 inches (10 centimeters) of water vacuum. A flow diagram for the ventilation system is included in the waste water pilot plant flow diagram presented in Figure 4-2. The ventilation system also services a decontamination laboratory for Hanford Facility RCRA activities, where soil sampling equipment is cleaned. This decontamination laboratory is located in the 1706-KE Building and is independent of the pilot plant operations.

4.1.3.1 High Efficiency Particulate Filtration. The HEPA filter is made of a pleated, dry type media and constructed to seal with the filter housing to prevent any air from bypassing the filter. Nuclear facilities operated by the DOE require that the HEPA filters be tested for resistance and penetration by the manufacturer and again by one of the three quality assurance stations operated for DOE. When the filters are received at the Hanford Site, they are again tested by the Hanford Environmental Health Foundation. The filters are again tested by the operations contractor following installation. Once the filters are installed, they must meet the following criteria.

- Filter in-place leak test requirements. All filters shall remove at least 99.95 percent of dioctyl phthalate (DOP) or dioctyl sebacate (DOS) particles, ranging in size from 0.1 micron to 3.0 microns, with a mean particle size of 0.5 micron.

- The HEPA filter cartridges shall be replaced when continuous exposure rates exceed 1 rad per hour at 6 inches or when the pressure drop across the filter exceeds 4 inches water gage.

Primary HEPA filtration for the waste water pilot plant ventilation system is provided by a ventilation housing containing nine 24 inch by 24 inch HEPA filters in a parallel configuration. These are preceded by nine roughing filters of the same size and configuration, to minimize loading on the HEPA filters. The roughing filters are disposable filters of the same construction

as household furnace filters. A second stage of HEPA filtration is provided by in-line HEPA filters installed in the waste water pilot plant area ductwork. The primary HEPA filtration system also services the RCRA equipment decontamination lab.

Projected source term values for radionuclide air emissions from the waste water pilot plant are given in Appendix 4A. This document has been submitted to the Washington State Department of Health.

4.1.3.2 Controls for Volatile Organics. Emissions of volatile organics are controlled in two ways; the waste water pilot plant will be engineered to minimize the potential for volatilization and activated charcoal will be utilized in the ventilation system for removal of volatile organics. Also, the amount of volatiles introduced into the pilot plant via the waste water and associated spikes, is controlled by the operating envelope outlined in Section 3.3.

Release of volatile organics along with volatile radionuclides and volatile inorganics (e.g. mercury, arsenic, ammonia) to the ventilation system is possible during transfers of the waste water. To minimize the release of these components, and to maintain the integrity of the waste water composition to be studied, transfer points will be engineered to minimize volatilization. To minimize volatilization while filling the tanker, a fill tube extending to the bottom of the tanker will be used. Once the tanker arrives at 1706-KE Building, any receiving tank will also be bottom filled to control release of volatile components.

The first processing step at the 1706-KE Building will be to adjust the pH to a range of 5.0 to 6.5. At this pH, most of the ammonia will be converted to ammonium ion and will no longer be vulnerable to release. The adsorption of ammonia on charcoal is negligible. Other potentially volatile inorganics will have a vapor pressure of less than 1 millimeter of mercury at the maximum operating temperatures of the waste water pilot plant. As a result, these potentially volatile inorganics are not considered to be vulnerable for release.

The waste water pilot plant ventilation system will contain a charcoal adsorption system to control the escape of volatile organics to the environment. The capacity of this system is in excess of the amount of volatile organic chemicals that can be provided by the waste water and addition of spiking compounds. The charcoal adsorption units are commercially available 35 gallon (133 liter) drum units containing 110 pounds (50 kilograms) of activated charcoal (Tigg* Model N50 or equivalent). This size unit was chosen so that it can be placed into a 55 gallon (208 liter) drum overpack for disposal. Location of the activated charcoal units is shown in the process flow diagram (Figure 4-2). Additional activated charcoal units may be added to individual processes or tanks in the final installation of equipment because it may simplify pipe routings and installation.

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*Tigg is a trademark of the Tigg Corporation.

Table 4-2 shows the design requirements for the charcoal adsorption system. The volatile organics characterized in Table 3-1 were identified, along with expected concentrations. From this data, and the conservative assumption that 100% of the maximum (90% confidence interval) expected concentrations will be volatilized, it was calculated that 1.6 pounds (0.72 kilograms) of charcoal would be required to control the volatile organic emissions for each 5,000 gallon (18,927 liter) tanker. This would mean that a single drum of charcoal would be adequate to control over 60 tankers in the worst case scenario, not including spiking chemicals. The amount of waste water to be treated at the pilot plant facility will not approach 60 tankers. Also shown, for reference, in Table 4-2 is the maximum emission rate for each volatile organic if there were no charcoal controls present.

A redundant charcoal adsorption system will be installed on the waste water pilot plant ventilation system. Two charcoal units will be installed in series, so that if breakthrough occurs on the primary unit, a second unit will provide backup. A continuous organic vapor analyzer (Thermal Environmental Instruments Co. Model 52, or equivalent) will be used to sample the air stream after the first charcoal unit to detect any breakthrough of the charcoal. If breakthrough is detected, the primary charcoal unit will be removed and the secondary unit would become the primary unit. A fresh unit then would be installed as the secondary unit.

4.1.3.3 Emission Monitoring Equipment. Stack effluent radionuclide content will be monitored with a particulate record sampler. These sampling systems remove a sample from the stack and pass the sample through a 1.9 inch (47 millimeter) filter. The sample flowrates are controlled by a rotameter, which is calibrated routinely. The record sampler filter will be collected monthly and analyzed for total alpha and beta/gamma activity.

4.1.4 Waste Water Pilot Plant Capacity

The through-put of any operation at the waste water pilot plant will be nominally 5 gallons (19 liters) per minute which is the equivalent to 300 gallons (1,100 liters) per hour. The ultraviolet oxidation unit will operate at flow rates as high as 25 gallons (95 liters) per minute. The process diagram is shown in Figure 4-2. The waste water pilot plant can be operated with a maximum of 5,000 gallons (19,000 liters) per batch. This limit is based on the size of the tank trailer [5,000 gallons 19,000 liters)]. The test program will be structured to accommodate up to one 5,000 gallon (19,000 liter) batch per week [20,000 gallons (76,000 liters) per month]. A process rate of one tank trailer every two weeks is anticipated during normal operations. Storage capacity at the waste water pilot plant will include two 5,000 gallons (19,000 liter) tank trailers and two 3,000 gallon (11,000 liter) intermediate storage tanks for a total of 16,000 gallons (61,000 liters) of potentially available storage. Filtration equipment at LERF will be sized at 5 gallons (19 liters) per minute [300 gallons (1,100 liters) per hour)] or less. There will be no storage capacity associated with the LERF equipment.

The amounts of waste tested at the waste water pilot plant will exceed limits contained in the guidance document for research, development, and

demonstration permits (EPA 1986a). The guidance document specifies limits of 400 kilograms (100 gallons) per hour through-put, 15,000 kilograms (4,000 gallons) per month for treatment, and 15,000 kilograms (4,000 gallons) for storage. The conversion of kilograms to gallons was made using factors of 2.2 pounds per kilogram and 8.34 pounds per gallon of waste.

The guidance limits for through-put must be exceeded because 5 gallons (19 liters) per minute is the smallest ultraviolet oxidation unit that is commercially available. The flowsheet for the waste water pilot plant was developed around this 5 gallon (19 liters) per minute limit. The totals given for the amount of waste tested per month and the storage capacities are maximum values; actual operations are likely to be less. Normal operations at the waste water pilot plant will require storage of 5,000 gallons (19,000 liters) of waste.

4.1.5 Technologies to be Tested

The types of technologies that will be tested in the waste water pilot plant include the following:

- pH adjustment
- Organic removal (e.g., ultraviolet light mediated oxidation and granular activated carbon)
- Inorganic removal (e.g., reverse osmosis and ion exchange)
- Suspended solids removal (e.g., filtration).

Each of the technology types are summarized in the following sections. A general description of the technology, a description of the equipment to be used in testing, identification of the critical parameters of each technology, and a description of the safety features of each type of equipment are presented.

A summary of the critical parameters of each technology that will be part of the waste water pilot plant is presented in Table 4-3. Also presented is a more detailed description of the critical parameters and how the parameters affect the operation and safety of the equipment. The instrumentation used to monitor these critical parameters is specified in Table 4-4.

The following discussion has been organized under treatment technologies. Where specific equipment has been identified for that technology, a discussion of that equipment is included. Generally, equipment to be used for testing will be supplied by vendors as off-the-shelf stock items.

4.1.5.1 pH Adjustment. A pH adjustment step is required to change the waste water chemistry, to enhance the removal or recovery of desired contaminants by downstream process equipment, or to adjust the waste water pH to meet regulatory discharge limits.

The pH of the waste at both the 1706-KE Building and the LERF will be adjusted before treatment. The pH adjustment step is straight forward where either an acid or base is metered into the waste water and thoroughly mixed. The pH adjustment equipment consists of instrumentation and hardware to increase or decrease the process stream pH. This is accomplished either in batches in large feed makeup vessels or inline using two or more relatively small vessels that are well agitated.

4.1.5.1.1 Equipment Description. The feed material for the waste water pilot plant will be in the pH range of 7 to 11 requiring an automatic system for adding an acid in the precise amount to change the solution pH to a range of 5.0 to 6.5. This will be accomplished at the 1706-KE Building by metering 95 percent sulfuric acid into the feed stream, followed by a 100 gallon (379 liter) mixing vessel. The pH adjustment equipment is shown in Figure 4-2. As a result of adjusting the pH of the waste to 5 to 6.5 for process optimization. The waste will be compatible with all waste water pilot plant equipment and will not pose a threat to personnel due to corrosivity.

The mixing vessel used at the 1706-KE Building consists of two chambers separated by baffle plates to assure the maximum retention time of 20 minutes. The mixing vessel will contain 100 gallons (379 liters) of liquid, but has a total volume of 137 gallon (519 liters) with a 9-inch (23-centimeter) freeboard. The mixing vessel will be made of reinforced, 16-gage 304-L stainless steel. Each chamber will contain a agitator and pH analyzer. The pH analyzer in the first chamber will be used to control the acid flow.

The sulfuric acid will be fed from a 30 gallon (114 liter) tank, with two check valves on the feed line to assure that the water can not leak back into the acid feed tank. A typical flow rate of acid will range from 0.68 to 3.4 ounces (20 to 100 milliliters) per minute for the 5 gallon (18.9 liter) per minute waste water pilot plant feed.

The mixing vessel for the pH system used at the LERF will be of the same construction, except for size. The vessel at the LERF has a total volume of 374 gallons (1,416 liters) and will normally hold 280 gallons (1,060 liters). The extra volume is required to maintain the retention time necessary for mixing at the increased flowrates used at the LERF. This vessel will be constructed of 304L stainless steel plate 3/16 inch (4.8 millimeters) thick.

4.1.5.1.2 Critical Parameters and Safety Features. A critical parameter is the correct volume addition of the acid to reach the desired pH. Controllers will activate and adjust the metering pumps depending on the pH signal received from the mixing vessel. The pH of the waste water at each step of the pH adjustment process will be monitored using online pH instrumentation. The pH also will be verified in the laboratory to ensure that the online instrumentation is working properly.

The pH adjustment step will involve handling strong acids. A critical parameter is corrosion of the feed system. the acid feed tank, transfer lines, and metering pumps will be constructed of material compatible with the chemicals to minimize corrosion (e.g., 304-L stainless steel).

To assure containment, a liquid level switch in the mixing tank will shut down the feed pump to prevent overflow. Secondary containment will be a catch pan under the entire assembly, as described in Section 4.1.2.

The acid feed line will contain two check valves to prevent water from entering the acid feed tank. Chemical addition will use the waste water in the tank as a heat sink for any increase in temperature because of the heat of solution.

Tanks in the pH adjustment will be vented to the ventilation system.

4.1.5.2 Organic Removal. Organic compounds can be destroyed by using ultraviolet oxidation to convert organics to carbon dioxide and water. When an oxidant, such as hydrogen peroxide or ozone, is acted upon by ultraviolet light, a hydroxyl radical is formed that is a very reactive oxidant. This hydroxyl radical is used to oxidize the organics. The degree of organic oxidation depends on the residence time of the waste water in the ultraviolet reactor, the concentration of oxidant, and the intensity of the ultraviolet light source.

Granular activated carbon is used for removal of organic constituents. The equipment, critical parameters, and safety features are similar to ion exchange and are discussed with ion exchange in Section 4.1.5.3.2.

4.1.5.2.1 Equipment Description. The ultraviolet oxidation unit is a Perox-pure Model SSB-30 from Peroxidation Systems, Inc. The unit is skid mounted and contains a 316 stainless steel reaction vessel, hydrogen peroxide addition system, chemical resistant feed pump, and electrical power and control panels. The physical dimensions of the oxidation unit are approximately 3½ feet (1.1 meter) wide by 5 feet (1.5 meter) long by 6½ feet (2 meters) high, with a minimum of approximately 8 feet (2.4 meter) wide by 9½ feet (2.9 meter) long by 6½ feet (2 meters) high for maintenance on the electrical and control panels and for changing the ultraviolet lamps.

The ultraviolet oxidation piping and instrumentation diagram is presented in Figure 4-3. Figures 4-4 and 4-5 present elevation and plan views of the ultraviolet oxidation equipment. The oxidation unit has a reactor volume of approximately 30 gallons (114 liters) and is equipped with six ultraviolet lamps rated for 5 kilowatts each. The lamps are mercury vapor lamps, and are considered high intensity. Other vendors use low intensity lamps that are rated from 14 watts to 65 watts. A quartz sheath protects the lamps from the waste water solution. The six lamps have individual switches so any number of lamps can be activated at any one time. The reactor outlet acts as the vessel vent when filling the equipment and any gas generation during operation will be swept out the outlet piping of the unit to a vented storage tank. The equipment can be operated in a once-through mode or in a recycle mode. Hydrogen peroxide will be added to the ultraviolet oxidation reactor using a metering pump and will be injected into three areas of the reactor.

4.1.5.2.2 Critical Parameters and Safety Features. There are several safety features on the equipment that monitor critical parameters and cause an alarm, for which a response is required. The response to an alarm could be to

shut the system down, either automatically or manually, or to investigate the problem. The alarm condition is shown on the control panel. The critical parameters require the following safety systems.

- The reactor has a pressure limit of 20 pounds per square inch gage (137 kilopascals) because the reactor is not a rated pressure vessel. If the pressure in the reactor exceeds 20 pounds per square inch gage (137 kilopascals) a graphite rupture disk will split. When the rupture disk splits, a flow switch in the rupture disk line will cause an alarm to annunciate. The line on the rupture disk returns to the feed tank. A pressure switch located on the pump discharge will deactivate the pump at approximately 15 pounds per square inch gage. This pressure switch reduces the chances for excessive pressure in the reactor and provides redundant pressure control in the reactor.

- There is a positive seal around each end of the quartz sheathes to eliminate leakage past the sheath. If moisture does leak past the seal around the quartz sheath, a moisture sensor causes an alarm to annunciate.

- Flow and pressure sensors are located in the influent waste water line. If the sensors indicate no flow, an alarm annunciates. A pressure sensor is located in the hydrogen peroxide injection line to make sure there is oxidant flowing into the reactor. If this sensor indicates reduced pressure, the alarm annunciates.

- A limit switch on the lamp enclosure door causes the alarm to annunciate when the door is opened while the lamps are powered. The switch would also turn the lamps off.

- There are high temperature sensors for the liquid effluent that will cause an alarm to annunciate. The liquid temperature sensor will help preserve the integrity of the reactor due to overheating.

Other safety features in the ultraviolet oxidation unit are as follows.

- A cooling fan provides cooling for the lamp ballasts to prevent overheating.

- The view ports in the reactor are designed to filter the intense ultraviolet light to prevent eye damage to operators.

- The hydrogen peroxide injection system consists of redundant metering pumps with check valves and ball valves on both sides of each pump, and an additional spring loaded ball check valve to act as an antisiphon valve at the chemical injection ports. These hydrogen peroxide safety features will reduce operator contact and possible spillage when changing or maintaining the metering pumps and prevent waste water from entering the hydrogen peroxide lines.

- The ultraviolet oxidation unit has a bottom drain to thoroughly drain the unit.

4.1.5.3 Inorganic Removal. Reverse osmosis and ion exchange are the two types of inorganic removal discussed in the following sections. Granular activated carbon requires similar equipment to ion exchange and is discussed with ion exchange.

4.1.5.3.1 Inorganic Removal-Reverse Osmosis. Reverse osmosis is a technology that employs pressure to effect a separation of a solute (contaminants) and a solvent (water). The pressure applied must be great enough to overcome the natural osmotic pressure of the solution. The solution is passed over the surface of a semi-permeable membrane, with an applied pressure of between 100 to 700 pounds per square inch gage (689 to 4,826 kilopascals).

The membrane pore size, composition, surface charge, and thickness, permit the water molecules to preferentially diffuse through the membrane while retaining the contaminant molecules (principally inorganics) in a concentrated waste solution. This concentrated waste solution, which does not pass through the membrane, is called the retentate or concentrate stream, and the portion that passes through the membrane is called the permeate stream. The retentate stream can be processed through several membranes in series to recover more of the waste water as permeate. Likewise, the permeate can be processed through several membranes to increase permeate purity.

Reverse osmosis does have a limitation as to how much separation can occur. This limiting factor depends on the solubility of the inorganic contaminants and the flowrate. When the solubility point is reached for a certain inorganic compound, a precipitate will form. If the flowrate is not adequate there will be a decrease in the effectiveness of the reverse osmosis operation by plugging the membrane. In most cases, cleaning mechanisms or chemicals can be used to restore the membrane to the same condition as before fouling.

4.1.5.3.1.1 Equipment Description. The main test apparatus is a 5 gallon (18.9 liter) per minute reverse osmosis unit manufactured by Applied Membranes, Inc. This system uses spiral wound, tangential flow, composite membranes. These membranes are anticipated to offer the highest strength and excellent permeate volume generation when compared to hollow fiber and plate and frame configurations. The unit uses up to 27 FT-30 series polyamide membranes manufactured by Filmtec, Incorporated. The membrane cartridges are 2½ inches (6.35 centimeters) in diameter and 40 inches (101.6 centimeters) long. The reverse osmosis unit dimensions are approximately 16½ feet (5.03 meters) long, 4½ feet (1.37 meters) wide and 6½ feet (1.98 meters) high. The unit has four stages with three pressure vessels in the first stage and two pressure vessels in each of the remaining stages. Each pressure vessel can contain three membranes. Membrane spacers can be used in pressure vessels when less than three membranes are needed. A flow schematic and piping and instrumentation diagram of the system is presented in Figure 4-6.

The retentate from each stage can be recycled back to a preceding stage. This recycle increases the velocity over the membranes and minimizes the retentate volume. The system is designed to provide flexibility on how much retentate is recycled and to where it is fed. A portion of the retentate from

stages 1, 2, and 3 can be returned to the influent of stage 1. The retentate from stage 4 is returned to the influent of stage 3 along with a portion of stage 3 retentate. Retentate can be discharged from stages 1 and 3 and treated as secondary waste. This concentrated secondary waste may be used for additional evaporation studies to further concentrate the secondary waste. The high velocity resulting from recycling the retentate will help to minimize fouling by sweeping away precipitate or biological material off the membrane surface. This increases the membrane surface area available for pure water to pass through.

The reverse osmosis unit contains all the piping, pumps, monitoring equipment, instrumentation, and chemical feed equipment necessary for operation. All pressure vessels, housings, and piping are stainless steel for chemical resistance. Flow, conductivity, and temperature instruments are stainless steel. The pH probes are polypropylene and provide adequate resistance to all chemicals in these tests. Pressure gages are liquid filled for shock absorbance.

The system instrumentation permits data collection from initial feed and final permeate and retentate points, and also from intermediate points to give online evaluation of the performance of individual stages. All instruments except pressure gages have 4 to 20 milliamperes output so data can be logged automatically. All instruments have continuous readouts located on a central panel board. The control panel is shown in Figure 4-7.

The reverse osmosis unit contains approximately 50 gallons (189 liters). A catch pan will be placed under the entire unit to provide secondary containment in case of any leaks or spills. No gases will be generated during reverse osmosis operation.

4.1.5.3.1.2 Critical Parameters and Safety Features. Pressure is the most critical parameter in the reverse osmosis system. Pressure provides the driving force to concentrate the waste stream by 'pushing' water through the membrane. The operating pressure of reverse osmosis is nominally 200 to 400 pounds per square inch gage (1,379 to 2,758 kilopascals). Pressure regulating valves are provided to control the desired operating pressure. The system is specified for operation up to 700 pounds per square inch gage (4,827 kilopascals).

Spray containment for the reverse osmosis module will be provided by a housing constructed of clear plastic panels (e.g., plexiglas) hung from the existing module framework (extended where necessary). The panels will be approximately 4' wide and will be removable for maintenance on the module. The bottom of the panels will extend to just inside the catch pan walls. Fans may be installed to provide for ventilation of the module.

Flow rate also is an important operating parameter. Adequate flow over the membranes is important to keep the membranes clean and fully functional. Flow control valves are provided so proper flow rates can be maintained.

Temperature is another important parameter. Temperature affects the flux (permeate generation rate per membrane surface area) and the purity of the

permeate stream. The system is designed for an operating temperature of 77 °F (25 ± 15 °C). This range is sufficient for the waste water pilot plant operation. Should the operating temperature exceed 104 °F (40 °C), the integrity of the membranes could be compromised by reducing the effective membrane life. However, no safety hazards are presented to the operating personnel.

There are two conditions that will shut down the system. The conditions are high and low pressure. When either of these conditions are met, the high pressure reverse osmosis pumps are shut down along with the booster pump. The high pressure shutdown is adjustable with a maximum of 700 pounds per square inch gage (4,827 kilopascals). This will prevent equipment damage and leakage. The reverse osmosis stainless steel pressure vessels are over designed to a pressure rating of 1,000 pounds per square inch gage (6,895 kilopascals). The low pressure switch is adjustable and will shut down the pump to prevent cavitation damage to the pump.

Several other safety features are designed into the equipment. All pump shafts, motor shafts, and couplings have a protective shield to protect personnel from moving parts. The control panel contains all pump controls and instrumentation for monitoring the condition and state of the equipment.

4.1.5.3.2 Ion Exchange and Granular Activated Carbon. Ion exchange and granular activated carbon will be considered together because the required test equipment and the critical parameters are very similar. The ion exchange and granular activated carbon process acts to concentrate the contaminants on the ion exchange or granular activated carbon media. The ion exchange resin and granular activated carbon can be used for polishing of the waste water. The granular activated carbon also can be used as an initial organic removal step.

The ion exchange process involves removing dissolved solids, including radionuclides, as ionic species from the waste water and binding the ions to a ion exchange media. The resin is usually in the form of small beads. The ion exchange resin is placed in a large vessel and the assemblies are called ion exchange beds. There could be several ion exchange beds placed in parallel or in series depending on the application. A flow distribution system within the ion exchange bed produces uniform waste water flow through the adsorption media. Uniform flow through an ion exchange bed is important to uniformly deplete the ion exchange resin to provide efficient use of the ion exchange resin capacity. The ion exchange bed can be regenerated to return the ion exchange resin to a state where the ion exchange again will remove contaminants. Regeneration of ion exchange resin is performed by using either an acid or base, depending on the resin, and passing the acid or base through the ion exchange resin bed. The concentrated contaminants are removed into the regeneration solution. This regeneration solution is handled as a secondary waste.

The granular activated carbon primarily is used to remove organic contaminants from water. The organic species are adsorbed physically and retained on the granular carbon particle. The method of handling and using

the granular activated carbon is very similar to ion exchange resins, except granular activated carbon is regenerated in a different manner.

4.1.5.3.2.1 Equipment Description. The ion exchange and granular activated carbon waste water pilot plant equipment is in the very early stages of conceptual design. The ion exchange and granular activated carbon equipment will be very similar, with the exception being that a regeneration system might be used for the ion exchange resin. No granular activated carbon regeneration testing is planned. Testing involving ion exchange and granular activated carbon will be performed as a side stream operation to reduce the equipment size and duration of testing. Figure 4-8 presents an ion exchange and granular activated carbon schematic drawing.

The ion exchange and granular activated carbon equipment will be sized to process less than 1 gallon (3.8 liter) per minute. The ion exchange or granular activated carbon vessel will be either a chromatography column or stainless steel pipe with fittings at each end. The column will have a mesh screen at each end sized to prevent the adsorption material from escaping the column. The column diameter will vary because of the test objective. Column sizes will be 2 inches (5.1 centimeters) or less in diameter. The influent waste water could be fed to the ion exchange or granular activated carbon column directly from the preceding unit operation using a flow control valve or from a small [less than 10 gallon (37.8 liter)] equalization tank by using a metering pump. Sample ports in the influent and effluent lines will allow sampling for process control and process efficiency. Samples could be collected automatically using a fraction collector that collects constant volume samples. Online process instrumentation, such as pH and conductivity, could be included for process control. Flow rate will be determined by use of a rotameter or other flow monitoring device.

The regeneration of the ion exchange resin could be accomplished by using metering pumps feeding from an acid or base storage tank [less than a 5-gallon (18.9 liter) tank]. An equally sized tank will be used to receive the chemical after regeneration. The ion exchange beds will be rinsed with deionized water to remove the concentrated chemicals. The rinsate will be considered secondary waste and disposed of according to approved operating procedures.

4.1.5.3.2.2 Critical Parameters and Safety Features. The critical parameter for ion exchange and granular activated carbon is the capacity of the adsorbent. The type and capacity of the adsorbent will determine the amount of adsorbent required and the size of the column will set the regeneration or disposal cycle.

The primary safety features that will be designed into the ion exchange and granular activated carbon testing equipment are the secondary containment pan to contain leaks and a plexiglass shield around any columns made of glass construction. This system will not be automated, except for a possible auto-sampling device, and will require constant surveillance. The ion exchange regeneration acid and base lines will have check valves to prevent backward flow of waste water into the concentrated chemical tanks.

4.1.5.4 Suspended Solids Removal. The waste water pilot plant filtration testing will be performed at the 1706-KE Building and at the LERF. The purpose of testing filtration is to identify a filter or filters that can successfully remove the suspended solids (grit, colloids, biological growth, etc.) from waste water. The removal of these solids is essential for the protection of the downstream treatment systems and for the removal of other contaminants (e.g., organics, inorganics). A successful filter will be identified as one that is capable of maintaining a design flow rate with a minimum generation of secondary waste and fouling.

The filtration operation can be enhanced through use of a pretreatment step. The pretreatment can include pH adjustment or coagulation and flocculation. The pH adjustment was discussed in Section 4.1.5.1. The coagulation and flocculation steps can be used with pH adjustment. Coagulation and flocculation involves the addition of an iron, alumina, or magnesium compound that will form a precipitate at a pH usually greater than 8. This precipitate enhances removal of heavy metals. The precipitate can be removed by using a filter with a precoat, or a clarifier. The precipitate can be dewatered using a filter press.

4.1.5.4.1 Equipment Description. The three filter systems currently planned for testing include tubular polymeric ultrafiltration with sponge ball wash out, polymeric backwashable ultrafiltration, and centrifugal ultrafiltration.

Figure 4-9 illustrates the proposed location of the LERF filtration equipment. The filtration waste water pilot plant equipment will be skid mounted and set next to the LERF. The waste contained in the LERF will be pumped to the pilot plant equipment through a LERF sample port using a submersible pump. After passing through the filtration equipment, the waste will be returned to the LERF via a second sample port. The locations of the selected sample ports are shown in Figure 4-9. A filtration flow diagram is presented in Figure 4-10.

The tubular polymeric ultrafiltration system, as shown in Figure 4-11, consists of 4 membrane modules, each containing a polymeric membrane that allows water to pass through the membrane while concentrating the particulates. This system is operated at a high velocity within each tube that acts to clean the polymeric membrane. The waste water is fed to a staging tank (the exact size is not yet defined); from there the waste water is pumped to the tubular filters. Specially designed sponge balls will be added periodically to clean the polymeric membrane.

The polymeric backwashable ultrafiltration system, shown in Figure 4-12, consists of a filter housing containing a polypropylene filter. The filter is backwashed on a pressure differential cycle as follows:

1) The automatic opening of a bottom drain valve and startup of a backwash pump from a vessel containing filtered water

2) The pump pressure forces the liquid backwards through the filter dislodging any particulate material from the filter media

3) The filtrate vessel drain valve automatically closes and the backwash pump shuts off, stopping the backwashing process.

The pressure vessel is filled with filtrate again in order to be ready for the next backwash cycle. The particulate material can be discharged through a port at the base of the filter housing. The pressure required to backwash the filter is about 50 to 80 pounds per square inch gage (345 to 552 kilopascals). The pressure is measured in the inlet and outlet side of the filter.

The centrifugal ultrafilter flow diagram is shown in Figure 4-13.

4.1.5.4.2 Critical Parameters and Safety Features. The critical parameters for filtration are pressure and temperature. The filtration equipment will be operated at a maximum 150 pounds per square inch gage and will be fully pressure tested before processing waste water. The temperature can affect the performance of the polymeric filter assemblies or membranes. The one polymer identified so far is polypropylene, which has a maximum operating temperature of about 176 °F (80 °C).

The following are safety features that will be built into the filtration systems. The detailed safety features are only conceptual at this time. Pressure switches are installed to avoid equipment failure and damage at low pressure and high pressure. Pressure relief valves will be used as a backup safety feature for the high pressure switch. Thermocouples will monitor the system temperature so that the operational temperature of the filter material is not exceeded. High- and low-level switches on all staging tanks alarm to prevent tank overfilling and as a backup to the low pressure switch to prevent running a pump dry.

The waste water pilot plant filtration equipment will be designed to meet the secondary containment requirements of WAC 173-303-640. The waste water pilot plant filtration equipment will have welded pipe joints, where possible, catch pans, and pump interlocks. Piping will be pressure tested before processing waste water. The systems are still in the conceptual stage so details are not available at this time.

Each LERF filtration module will be provided with a weather tight enclosure to prevent the accumulation of rainwater in the catch pan and its consequent drainage to the LERF. These enclosures will also serve as spray guards for containment of any leak of the module equipment.

The filtration module at the 1706-KE Building will have either a clear plastic total enclosure such as that described in 4.1.5.3.1.2 for the reverse osmosis module, or, sheet metal or plastic spray deflectors around each non-welded pipe connection. This system will be similar to the backwashable filter system to be placed at the LERF. The 1706-KE Building system will contain only one process vessel instead of two and the system will not include turbiditimeters.

4.2 WASTE WATER PILOT PLANT TESTING AT THE LIQUID EFFLUENT RETENTION FACILITY

Pilot plant testing of several filtration systems will be carried out at the LERF as described in Section 4.1.5.4. To support filtration testing, a pH adjustment step will be carried out as described in Section 4.1.5.1. The testing will be conducted at the site to minimize sample transport and the impact on the particulate characteristics.

4.3 WASTE TRANSFER OPERATIONS

Waste water pilot plant testing at the 1706-KE Building of the 242-A Evaporator process condensate stored in the LERF will require the waste water be transferred back and forth between the LERF and the 1706-KE Building. The transfer will be routed over Hanford Facility roadways over a distance of approximately 10 miles (16 kilometers) (one way). The transfers will use two tank trailers. The following sections discuss the tank trailers and the waste unloading and loading areas at the LERF and the 1706-KE Building. The actual transportation of the waste between the LERF and the 1706-KE Building is not performed by the waste water pilot plant and is not included within the scope of this permit application.

4.3.1 Transfer Process Description

Transfers will be accomplished using two 5,000 gallon (18,927 liter) tank trailers. The tank trailers will be pulled by tractors operated by certified drivers. These single-walled tank trailers are built to U.S. Department of Transportation Specification MC-312-SS, and modified to meet waste water pilot plant requirements. The tankers are certified for the transport of hazardous liquids over U.S. public highways (copy of certificate is provided in Appendix 4B).

The waste requiring transport to the waste water pilot plant is the 242-A Evaporator process condensate. The 242-A Evaporator process condensate will be stored at the LERF until the 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility is operational. This is a dilute aqueous liquid containing low levels of suspended solids, dissolved solids, and organics. A fraction of the suspended and dissolved solids are radioactive. The waste has a radioactive waste classification of low specific activity (LSA) per 49 CFR 173.403(n).

At LERF, the waste will be loaded into the tank trailers using a submersible pump lowered down an existing LERF Basin 43 riser. The riser connects LERF Basin 43 to the existing LERF catch basin. There will be continuous operator surveillance of the loading lines and the tank liquid level during filling. Unloading at the LERF will be accomplished using a pump mounted over the existing LERF catch basin.

Unloading at the south side of the 1706-KE Building will be accomplished using a self-priming pump located over a catch tank at the unload station. Loading of the tank trailer on the north side of the 1706-KE Building will be

accomplished using internal 1706-KE Building process pumps. These process pumps will be interlocked to the liquid level instrumentation of the tank trailer to prevent overfill.

Onsite waste transfer sheets will be used to document the transfer-out and transfer-in of the waste at the LERF basins.

4.3.2 Equipment Description

The equipment required for transporting the waste to and from the LERF consists of the tank trailers, and the loading and unloading equipment at the LERF and 1706-KE Building.

4.3.2.1 Tank Trailer. A side elevation of the tank trailer is presented in Figure 4-14. Each of the two identical tank trailers consist of a nominal 5,000 gallon (18,927 liter) horizontal cylinder 37 feet (11.3 meters) in length and 57.17 inches (145.2 centimeters) internal diameter, with 8-gage wall [0.1644 inch (0.418 centimeter) nominal thickness]. The dished heads have minimum wall thickness of 0.1255 inch (0.318 centimeter). Material of construction is 316 stainless steel. The tank trailer is U.S. Department of Transportation certified to carry corrosives, acids, and caustics. The waste water processed in the pilot plant will not approach the operating limits of the tank trailer.

The tank trailer, as modified, has no bottom unloading capability per 49 CFR 173.425(c)(2)(ii). The only tank penetrations are located on the top centerline of the tank. These penetrations are enclosed by drip pans that are an integral part of the trailer (Figure 4-15). The penetrations are for the following equipment:

- 2-inch (5.08-centimeter) diameter load-in/load-out port with a dip tube extending into an 8.25 inch (21 centimeter) diameter sump in the bottom of the tank; the port is equipped with a ball valve and valved quick-disconnect, located near the rear of the tank

- 2-inch (5.08-centimeter) flanged port with a 1/2-inch (1.3-centimeter) dip tube for liquid-level instrumentation; the dip tube is equipped with a ball valve and valved quick disconnect for liquid level instrumentation; the port also has a 3/4-inch (1.91-centimeter) pipe teed to a pressure gage and a vacuum relief device set to open at 0.5 to 5 inches (1.3 to 12.7 centimeter) of mercury, located in the rear third of the tank

- 20-inch (50.8-centimeter) ~~di~~ameter manhole secured with wing nuts and security wiring; the manhole is located in the rear third of the tank

- 2-inch (5.08-centimeter) diameter vent port with ball valve and valved quick-disconnect; the vent port is located near the center of the tank

- 4-inch (10.2-centimeter) diameter load-out port with dip tube extending down into an 8.25-inch (20.9-centimeter) diameter sump in

the tank bottom; the load-out port is equipped with a ball valve and valved quick-disconnect, located in the center of the tank; this port is not planned for use during waste water pilot plant operations

- 2-inch (5.08-centimeter) diameter port for American Society of Mechanical Engineers (ASME 1989) high pressure rupture disk [52 pounds per square inch (358 kilopascals)], located near center of the tank.

4.3.2.2 Waste Load/Unload Station at the LERF. Tank trailer loading and unloading operations will take place at the LERF load/unload station. The load/unload station will be located adjacent to the existing catch basin for LERF Basin 43. The load/unload station will utilize the catch basin and utilities wherever possible. The following sections describe tank trailer loading and unloading at the LERF.

4.3.2.2.1 Waste Loading at the LERF. The waste water will be transferred out of the LERF basin #43 using a submersible pump lowered down one of the existing emergency pumpout risers. The emergency pumpout riser terminates in the LERF catch basin (Figure 4-16). The discharge line from the pumpout riser will quick-connect to an all welded load/unload line that will run from the LERF catch basin along an overhead piping support structure (Figure 4-17). The support structure will be located over the position where the tank trailer will be spotted for both loading and unloading. At the outer end of this structure, the line will terminate in a flex hose. The terminal end of this flex hose will quick-connect to the load/unload port on the tank trailer. The on/off controls for the pump will be located at the load/unload station.

The tank trailer ventilation line will run from the LERF basin #43 carbon adsorber, located in the LERF catch basin, up and over the tank trailer utilizing the same piping support structure (Figure 4-17). The ventilation line will utilize a terminal end flexible hose with a quick-connector to make the final connection to the tank trailer vent port. This ventilation line configuration will be the same for both loading and unloading of the tank trailer at LERF.

Bottled nitrogen gas maintained at the LERF catch basin will be supplied to the tank trailer for use in liquid-level indicator. The nitrogen line will be run up and over the tank trailer using the piping support structure described above (Figure 4-17). A terminal end flexible hose with quick-connect fitting will make the final connection to the tank trailer bubble pipe port. This same line configuration will be used for both tank trailer loading and unloading. The liquid-level indicator output will be located at the load/unload station.

4.3.2.2.2 Waste Unloading at the LERF. For unloading, the tank trailer will be spotted at the same location as during loading. The ventilation and liquid level instrumentation connections will be the same as for loading. Also, the waste water connection at the tank trailer will be the same as for loading. The unloading pump will be located on a platform lying above the LERF catch basin. For unloading operations, the waste water line from the tank trailer will be quick-connected to the inlet of an unloading pump

(Figure 4-18). The discharge of the unloading pump will be hard piped to a second LERF Basin 43 riser in the LERF catch basin (Figure 4-16). The on/off controls for this pump will be located at the load/unload station.

4.3.2.2.3 Containment and Surveillance at the LERF Load/Unload Station. Included in WAC 173-303-395 are requirements that loading and unloading areas be constructed to contain spills and leaks that might occur during loading and unloading. Because the requirements of WAC 173-303-395 apply only to treatment, storage, or disposal facilities that ship manifested shipments, the requirement does not apply to the LERF load/unload station. All waste shipped from the LERF load/unload station are shipped 'onsite' and are not subject to the manifest requirements of WAC 173-303.

The LERF load/unload station will have partial secondary containment. Double containment of the waste line will be provided through the use of a double-contained flex hose that drains back to the LERF catch basin. The catch basin drains back to the LERF basin. Single encased all-welded waste piping will be used over the support structure. All of the connections made at the tank trailer ports are protected with drip pans that are integral to the tank trailer. The drains from the drip pans will be piped back to the LERF catch basin. Any leaks from the unloading pump will drain into the LERF catch basin.

During tank trailer loading and unloading, sheet plastic will be placed over the ground where the trailer is spotted and the area roped off. The plastic will be removed after loading or unloading, and the area decontaminated back to its original status, if necessary.

The load/unload processes will take approximately 2 hours each. An operator and health physics technician will provide continuous surveillance during these operations. Local tank trailer liquid-level indication is continuously available and the load or unload pump can be locally shut down promptly at any sign of leakage.

4.3.2.3 Tank Trailer Unloading and Loading at the 1706-KE Building. The unloading of the waste before testing and the loading of the waste after testing will occur at separate loading and unloading stations at the 1706-KE Building.

Waste transfers between the tank trailers and the 1706-KE Building will be intermittent, depending on the laboratory schedule for the waste water pilot plant. Also, the transfer rate will be relatively low, i.e., approximately 5 gallons (19 liters) per minute. The intermittent nature of the unloading and loading at the 1706-KE Building will essentially establish the tank trailers as a short-term storage containers, periodically located outside the 1706-KE Building. Because the trailer tankers are single walled, provisions will be made for the tank trailer secondary containment and surveillance required by WAC 173-303-630(7) (Section 4.3.2.4.3).

4.3.2.3.1 1706-KE Building Unload Station. The tank trailer unload station at the 1706-KE Building will be located outside, and adjacent to, the south side of the building. An overhead piping support structure will be

located over the trailer spotting position (Figure 4-19). A self-priming, low-capacity pump will be positioned over a small catch tank. The pump will be used to feed the waste water to the pilot plant process equipment. The suction of this pump will connect to a hard piped single-encased all-welded line that runs out to the end of the overhead piping support structure. A flex hose provides continuation of the line. The flex hose terminal end is equipped with a quick connect fitting for connection to the tank trailer load-in/load-out port. The discharge of the pump is connected to single-encased all-welded piping that leads into the 1706-KE building. The pump on/off switch is located inside the building at the central control panel.

Tank trailer ventilation during unloading is provided via a tie-in to the 1706-KE Building ventilation system, which is equipped with carbon adsorbers and HEPA filters (Figure 4-19). Using a tee in the vent line to the 3,000 gallon (11,356 liter) storage tanks (located at the west side of the building), a hard piped line is run from the storage tanks to the end of the tank trailer unload piping support structure. At this point, the line is continued using a flex hose. A valved quick-connect at the terminal end of the flex hose provides the final connection to the trailer vent port.

As at LERF, bottled nitrogen gas is supplied for trailer tank liquid level indication (Figure 4-19). The supply line is hard piped out to the end of the piping support structure. From this point a flex line with quick disconnect provides the connection to the bubble-pipe port on the trailer. Liquid level indication and alarm will be provided at the central control panel inside the 1706-KE Building.

4.3.2.3.2 1706-KE Building Load Station. The tank trailer load station at the 1706-KE Building will be located outside, adjacent to, the north side of the building. A overhead piping support structure will be provided adjacent to the trailer loading spotting position (Figure 4-20). Loading of the trailer with treated waste will be accomplished using the 1706-KE waste water pilot plant process pumps. A single-encased all-welded pipe will carry the discharge of these pumps through the building wall and out to the end of the overhead piping support structure. A flex hose will provide continuation of this line. The terminal end of this hose will be provided with a quick connect for final connection to the trailer load-in/load-out port.

Trailer ventilation and liquid level indication will be provided in the same manner as described for the unload system (Section 4.3.2.4.1), using separate equipment.

4.3.2.3.3 Containment and Surveillance at the 1706-KE Building Unloading and Loading Stations. The tank trailer loading and unloading areas at the 1706-KE Building will be protected from leaks or spills by using inflatable secondary containment structures that comply with requirements of WAC 173-303-630(7). The inflatable berms are shown on Figures 4-19 and 4-20). The secondary containment structure most likely to be selected for use is the Port-A-Berm inflatable secondary containment structure manufactured by Aero Tec Laboratories Inc. (or equivalent). Vendor information is included in Appendix 4C. This product has been used as secondary containment for

hazardous waste/material loading and unloading areas by government agencies and private industry.

The Porta-A-Berm units will be 45 feet long by 16 feet wide by 17 inches high (13.7 meters by 4.9 meters by 43.2 centimeters) with a total capacity 7,600 gallons (28,769 liters). This capacity allows for the 5,000 gallons capacity of the tank trailer plus more than sufficient capacity to contain the 673 gallons (2,549 liters) that could result from a 25-year, 24-hour storm as required by WAC 173-303-630(7). The 25-year, 24-hour storm event is calculated to deliver 1.5 inches (3.8 centimeters) of rain. Precipitation data were obtained from the U.S. Weather Bureau *Rainfall Frequency Atlas of the United States* (U.S. Weather Bureau 1961, p. 101)

The Port-A-Berms will be placed on smooth asphalt or groomed soil surfaces following the manufacturers recommendations. The bottom will be sloped to allow liquids to be collected and removed.

The walls of the Port-A-Berm consist of an inflatable tube that has an inflated height of approximately 17 inches (43 centimeters). The liner material is draped over the top of the inflated tube and fastened to the tube (Appendix 4C). The inflatable tube material is an air-holding grade of vinyl coated polyester. The liner is designed to prevent the inflatable tubes from contact with the waste during a leak or spill.

To allow entry and egress from the bermed area, one of the walls is deflated and removed. As an alternative, a truck can drive over the deflated wall. The liner will be protected by laying plywood (or similar sheeting) between the liner and the truck tires. The manufacturer indicates that this provides adequate protection for the liner.

The bottom liner of the secondary containment structure is composed of two layers of poly vinyl chloride (PVC) -coated polyester fabric. Each layer is 0.035 inches (0.089 centimeters) thick. The liner material is a PVC modified with Elvaloy (a product of E. I. Dupont de Nemours & Company). The modification makes the PVC more flexible and chemically resistant. The general chemical resistance characteristics of the liner material is given in the vendor information (Appendix 4C). A sample of the PVC obtained from the manufacturer will be tested for compatibility with the expected composition of the 242-A Evaporator process condensate. The compatibility is expected to be good due to the dilute nature of the waste. If tests indicate there are compatibility problems, a different material will be tested and used as liner material.

The waste water piping is single-encased all-welded construction except for the unload pump connections and the flex hose. Secondary containment for the unload pump connections is provided by a catch tank with leak detector. The trailer drip pan provides secondary containment for the flex hose. At the unload station the drip pan will drain to the unload pump catch tank. At the load station the drip pan will drain to the inflatable berm.

At the unload station, a leak detector will be installed in the unload station pump catch tank (Figure 4-19), and will be interlocked to shutdown the

unload pump and alarm at the central control panel in the 1706-KE Building. At the load station, liquid level indicators will be interlocked to shutdown the pilot plant process pumps at high level. The inflatable berms will be inspected at least every 24 hours.

4.3.3 Critical Parameters and Safety Features

Certain waste transfer system design features and operating procedural requirements are critical to operator safety and protection of the environment. These are provided in the following sections:

4.3.3.1 Design Features. Waste transfer design features are as follows:

- Tank trailer has a factory-installed ASME pressure relief rupture disk - rated at 52 ± 5 pounds per square inch (359 ± 34 kilopascals)
- Tank trailer has a Hanford-installed vacuum relief device - rated at 0.5 to 5 inches (1.3 to 12.7 centimeter) of mercury
- Tank trailer gaseous discharges are tied into the 1706-KE Building or LERF ventilation system
- 1706-KE Building tank trailer loading pump is interlocked to the tank trailer liquid-level instrumentation
- 1706-KE Building unload station discharge pump is interlocked to the pump catch basin leak detector and the 1706-KE Building receiving tank liquid-level instrumentation
- All alarm switches activate visible and audible alarms at the central control panel, as well as the appropriate interlocks.

4.3.3.2 Operating Parameters. Waste transfer operating parameters are as follows:

- Ventilation line valve is open during loading and unloading. Heat tracing to prevent freezing is functional when ambient temperatures below 40 °F (4.4 °C)
- Pumpout line valve alignment sequence is verified correct before initiation of pumping
- Tank trailer and liquid-level instrumentation is under continuous manned surveillance during loading and unloading at the LERF
- Reviewed and approved operating procedures used for loading and unloading
- Protection of the area where the truck is spotted with waterproof ground cover during the LERF loading and unloading processes

- Surveillance, at least once every 24 hours, of the load and unload stations at the 1706-KE Building

- Verification that the waste water is ≤ Low Specific Activity prior to shipment (Section 3.0)

- Verification that waste water characteristics fall within the operating envelope prior to waste unloading at the 1706-KE Building.

4.4 EQUIPMENT DECONTAMINATION

On completion of testing of a specific waste water, the equipment will be decontaminated to prevent cross-contamination of waste. This decontamination will consist of triple-rinsing equipment that has been contacted by a dangerous waste. A guideline decontamination procedure has been developed that meets the triple-rinsing criteria for vessels that have previously held hazardous waste. The waste water pilot plant equipment could also be decontaminated using this triple-rinsing procedure at any time during a testing program. The triple-rinsing procedure is included in Appendix 4D.

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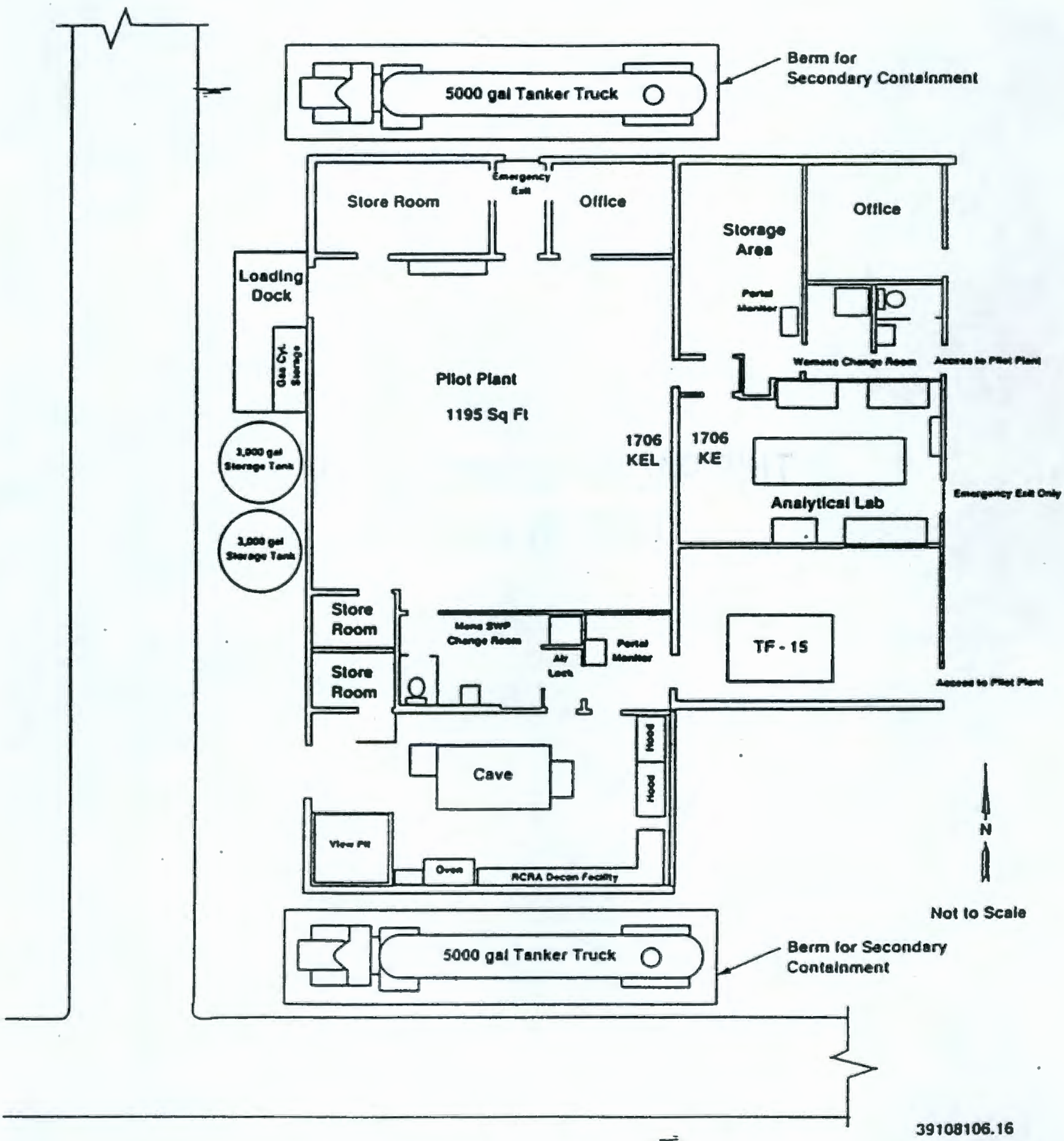

Figure 4-1. Waste Water Pilot Plant Floor Plan.

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WASTE WATE

STREAM CHARACTERISTICS

LOCATION	(1) FEED	(2) ACID FEED	(3) pH OUT	(4) FILTRATE	(5) PEROXIDE FEED	(6) UV/OX OUT	(7) RO PERMEATE	(8) RO RETENTATE
FLOW (GPM)	5	0.004	5	5	0.004	5-25	4.5	0.5
TEMP (F)	AMBIENT	60 - 70	60 - 70	60 - 70	60 - 70	80 - 90	60 - 70	60 - 70
pH	7 - 11		5 - 6.5	5 - 6.5	5 - 6.5	5 - 6.5	5 - 6.5	5 - 6.5
VOC (PPM)								
OTHER	-	98% H2SO4	-	-	50% H2O2	-	-	-

TA

TANK
FEED TANKER
H2SO4 ACID FEED
FILTRATE STORAGE
UV/OX FEED SURGE
H2O2 SUPPLY
RO FEED SURGE
RETENTATE CATCH
INTERMEDIATE STORAGE
RECEIVING TANKER

NOTE: DOTTED LINES AROUND UNIT OPERATIONS DENOTE THE BOUNDARIES OF THE REFERENCED FIGURES

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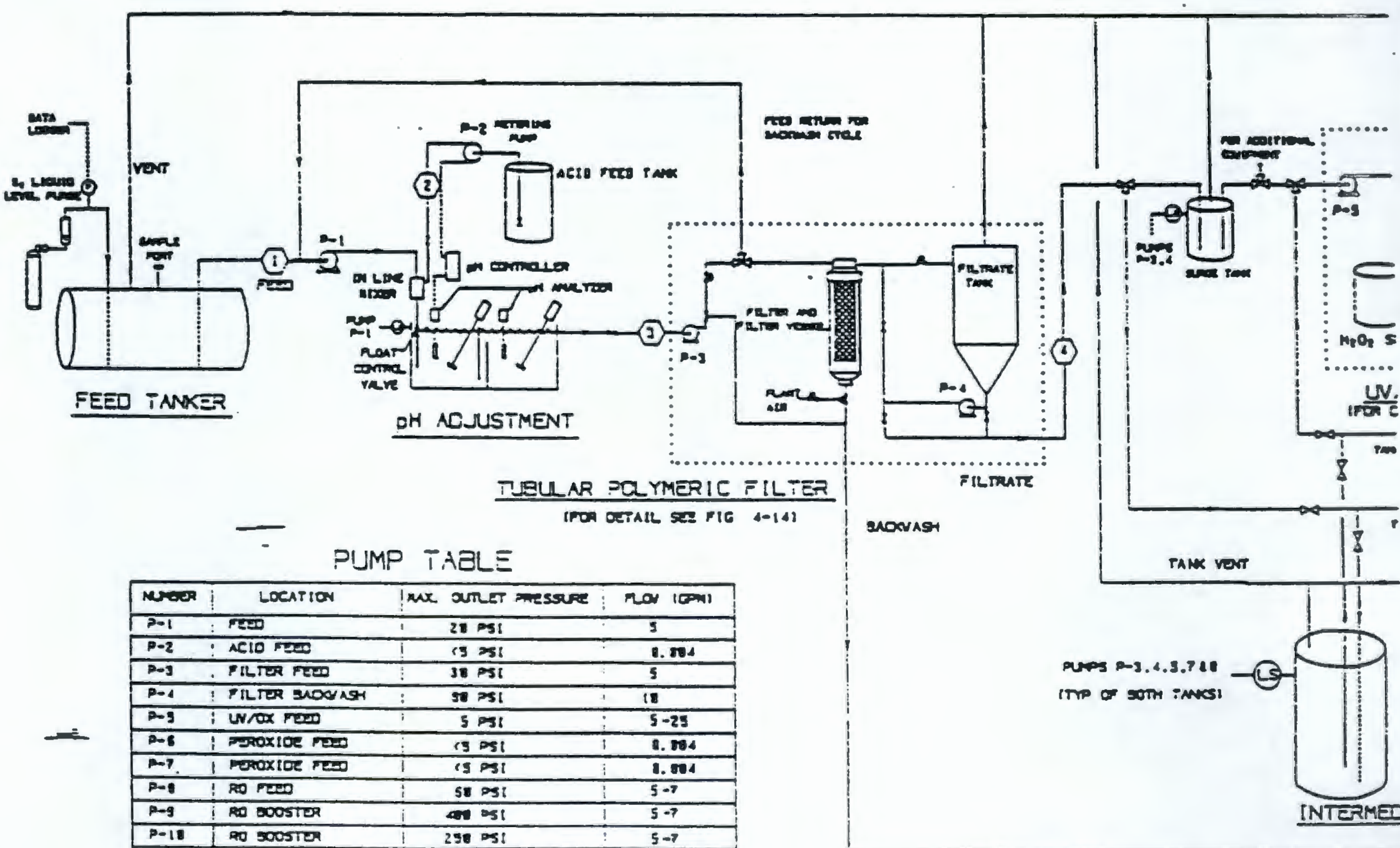


PUMP TABLE

NUMBER	LOCATION	MAX. OUTLET PRESSURE	FLOW (GPM)
P-1	FEED	20 PSI	5
P-2	ACID FEED	<5 PSI	0.004
P-3	FILTER FEED	30 PSI	5
P-4	FILTER BACKWASH	50 PSI	10
P-5	UV/OX FEED	5 PSI	5-25
P-6	PEROXIDE FEED	<5 PSI	0.004
P-7	PEROXIDE FEED	<5 PSI	0.004
P-8	RO FEED	50 PSI	5-7
P-9	RO BOOSTER	400 PSI	5-7
P-10	RO BOOSTER	250 PSI	5-7
P-11	RETENTATE	10 PSI	0.5

R PILOT PLANT

TABLE

...TITY	CAPACITY (GALLONS)
[illegible]	5,000
[illegible]	30
[illegible]	100
[illegible]	200
[illegible]	95
[illegible]	100
[illegible]	95
[illegible]	3,000
[illegible]	5,000

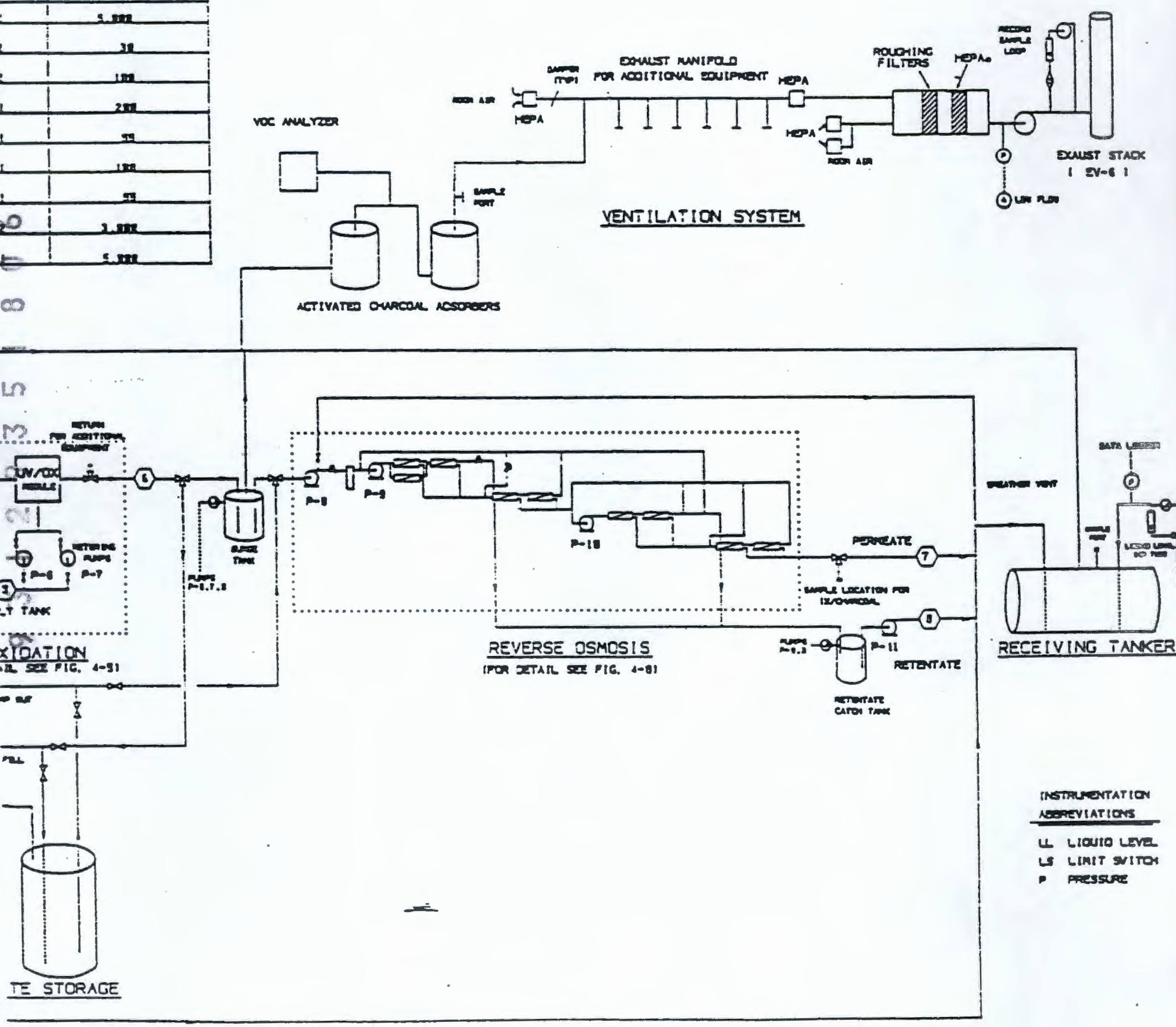
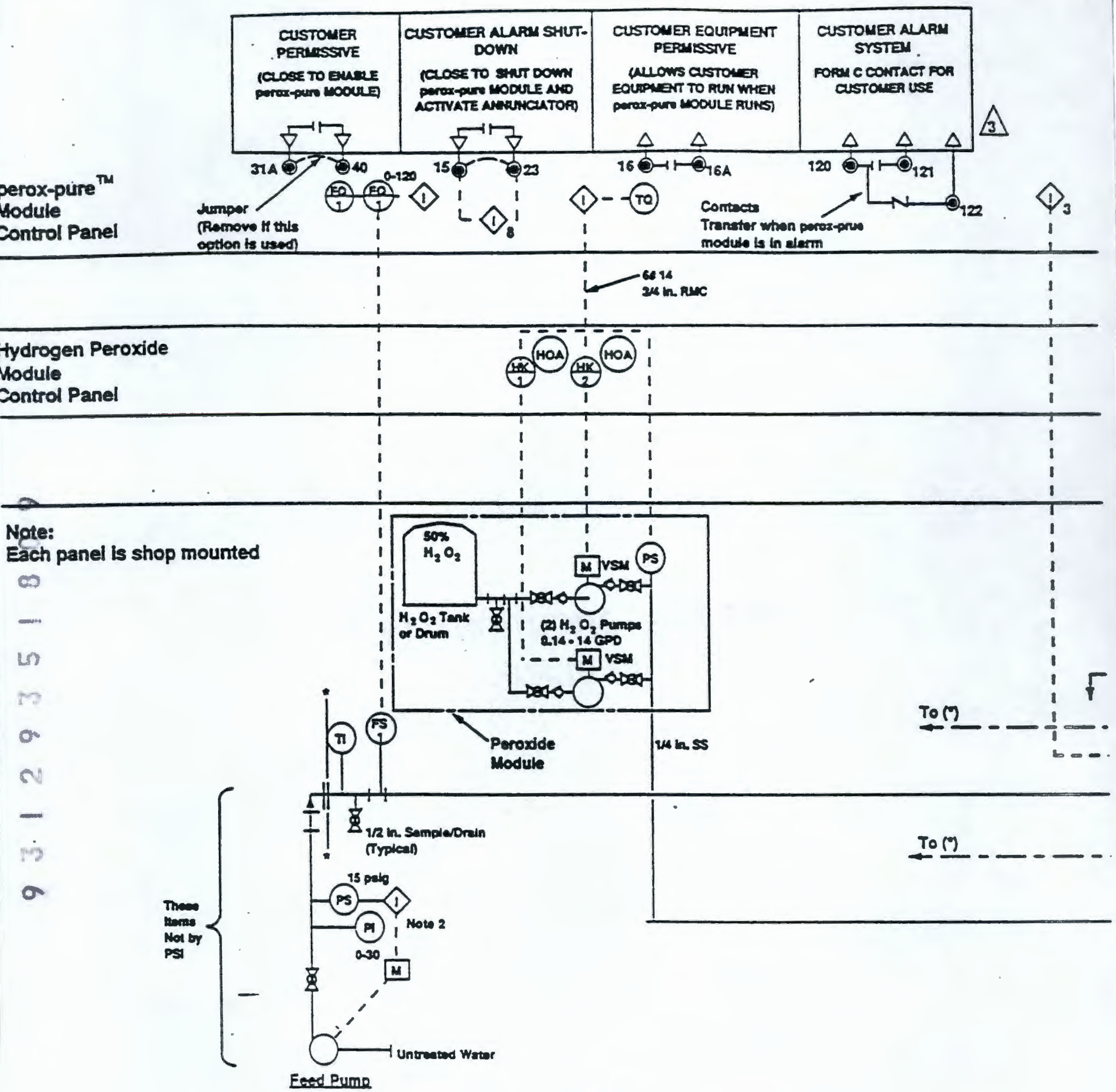


Figure 4-2. Waste Water Pilot Plant Process Flow Diagram.



NOTE

1) * Denotes PSI battery limits, all items within *—* were furnished by PSI

2) 15 PSIG maximum to perox-pure™ module

3) Spring loaded ball check at chemical injection por

4) perox-pure™ is a tradem Systems, Inc.

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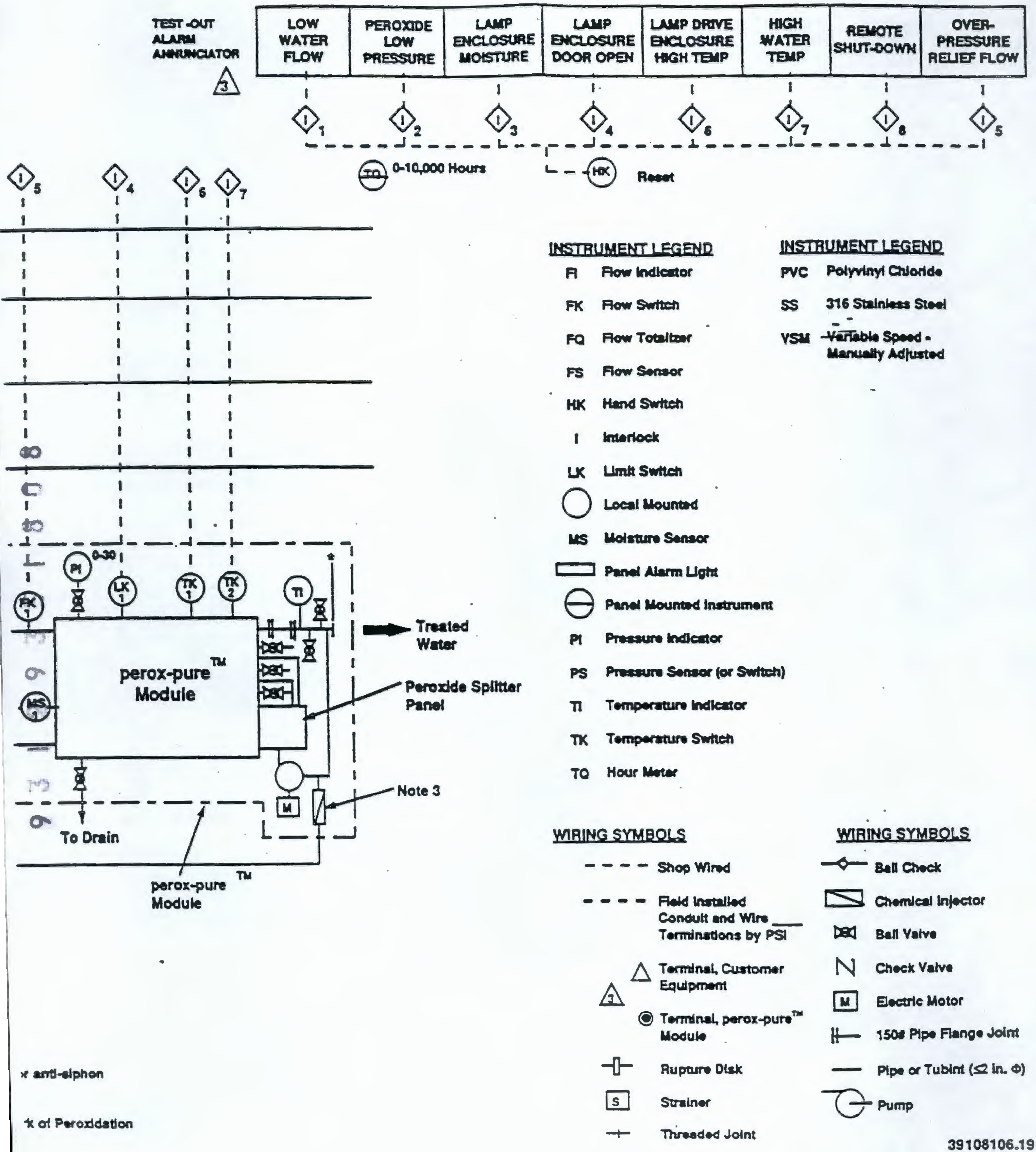


Figure 4-3. Ultraviolet Oxidation Piping and Instrumentation Diagram.

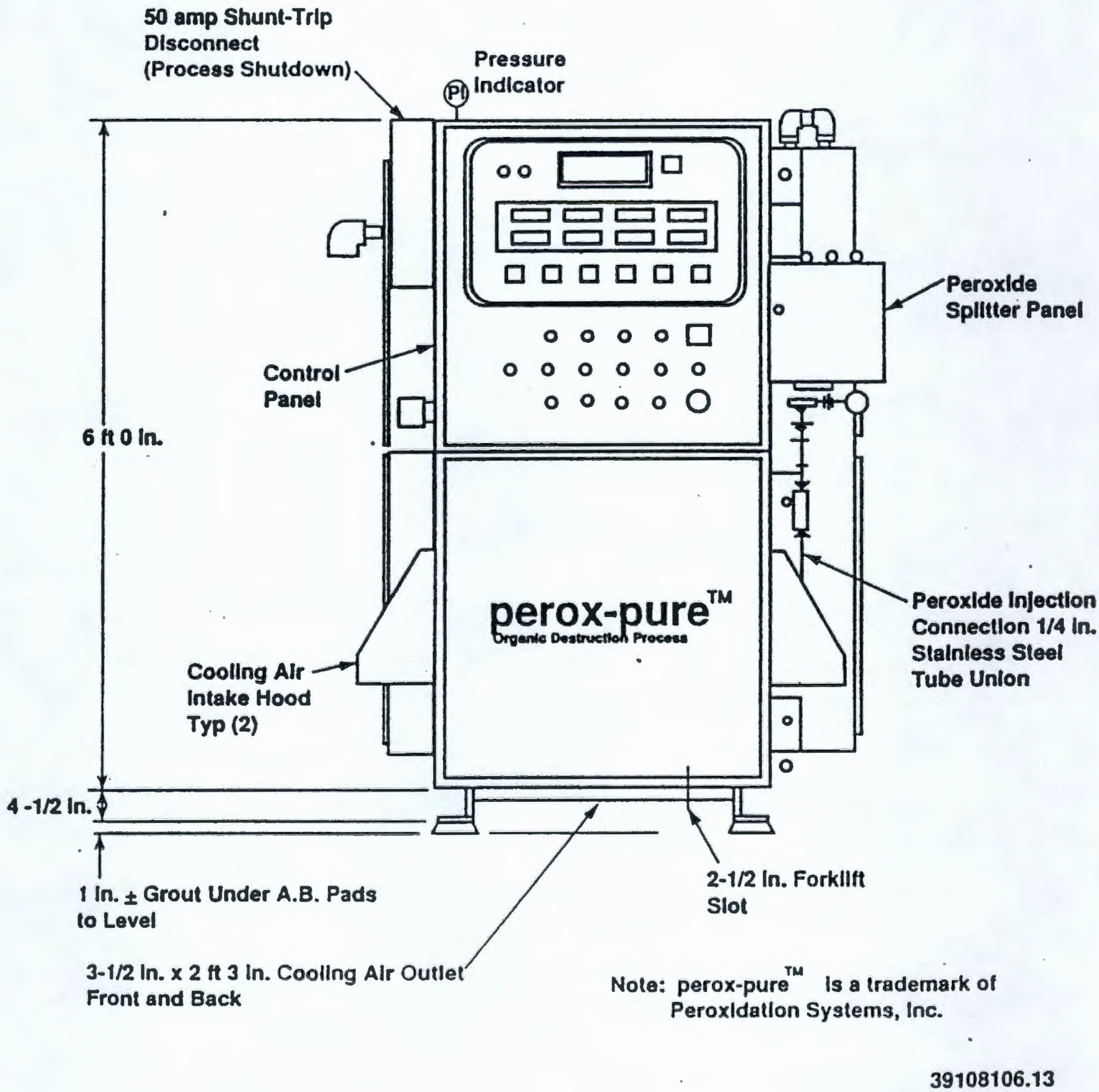


Figure 4-4. Ultraviolet Oxidation Equipment Section.

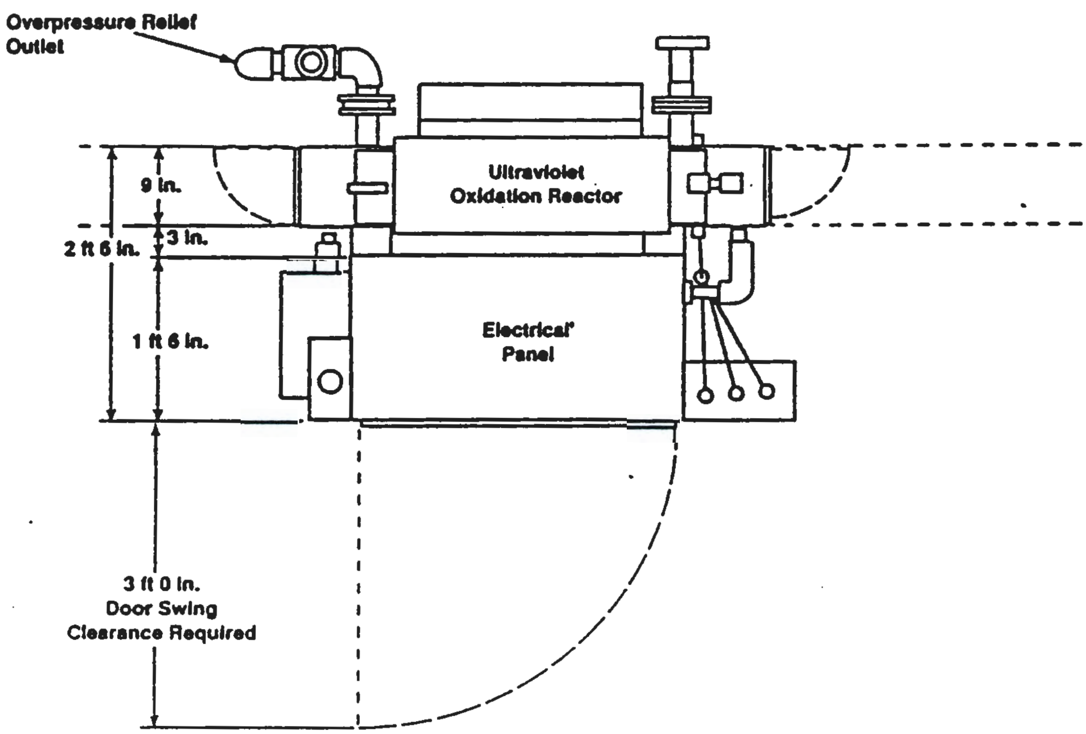


Figure 4-5. Ultraviolet Oxidation Equipment Plan.

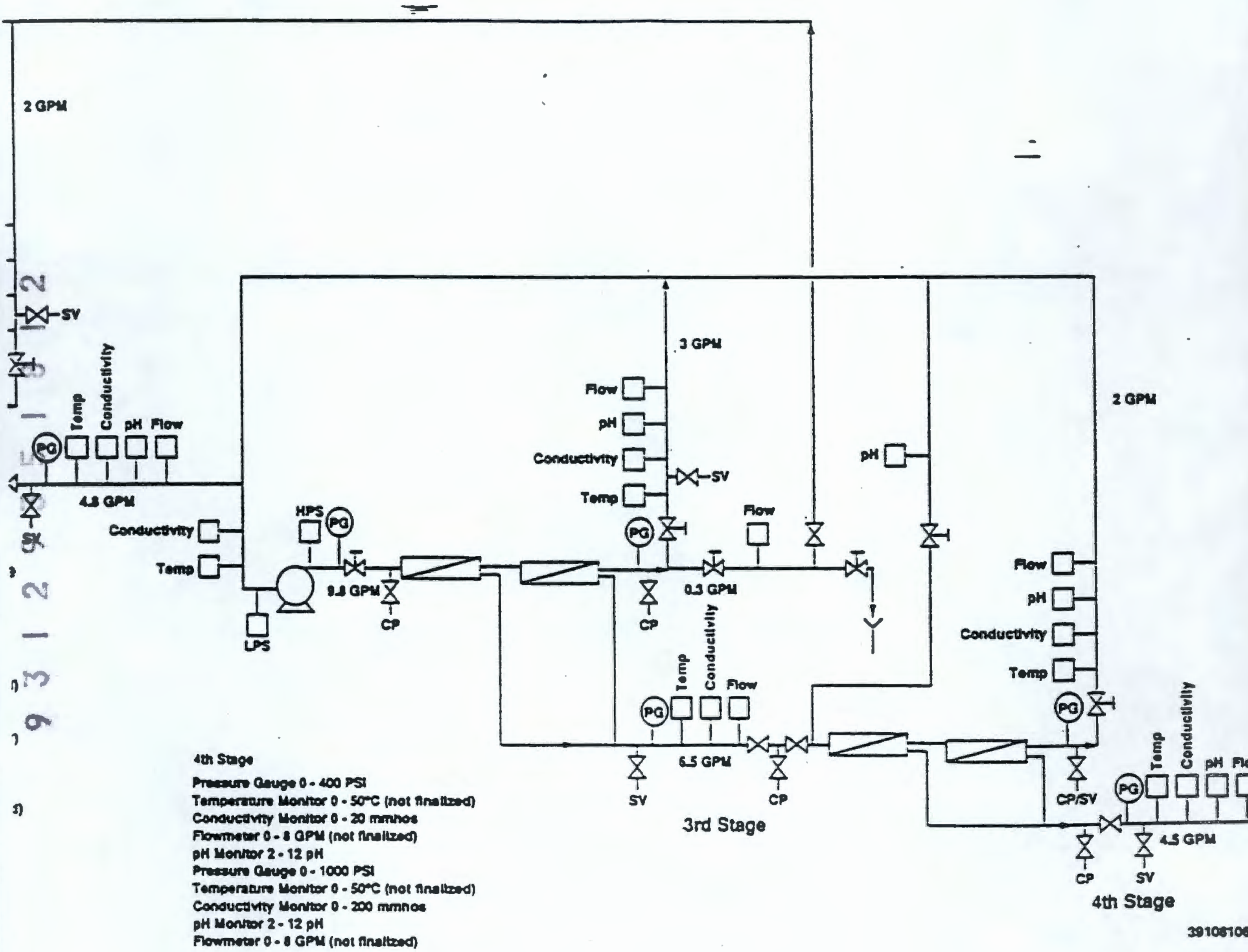
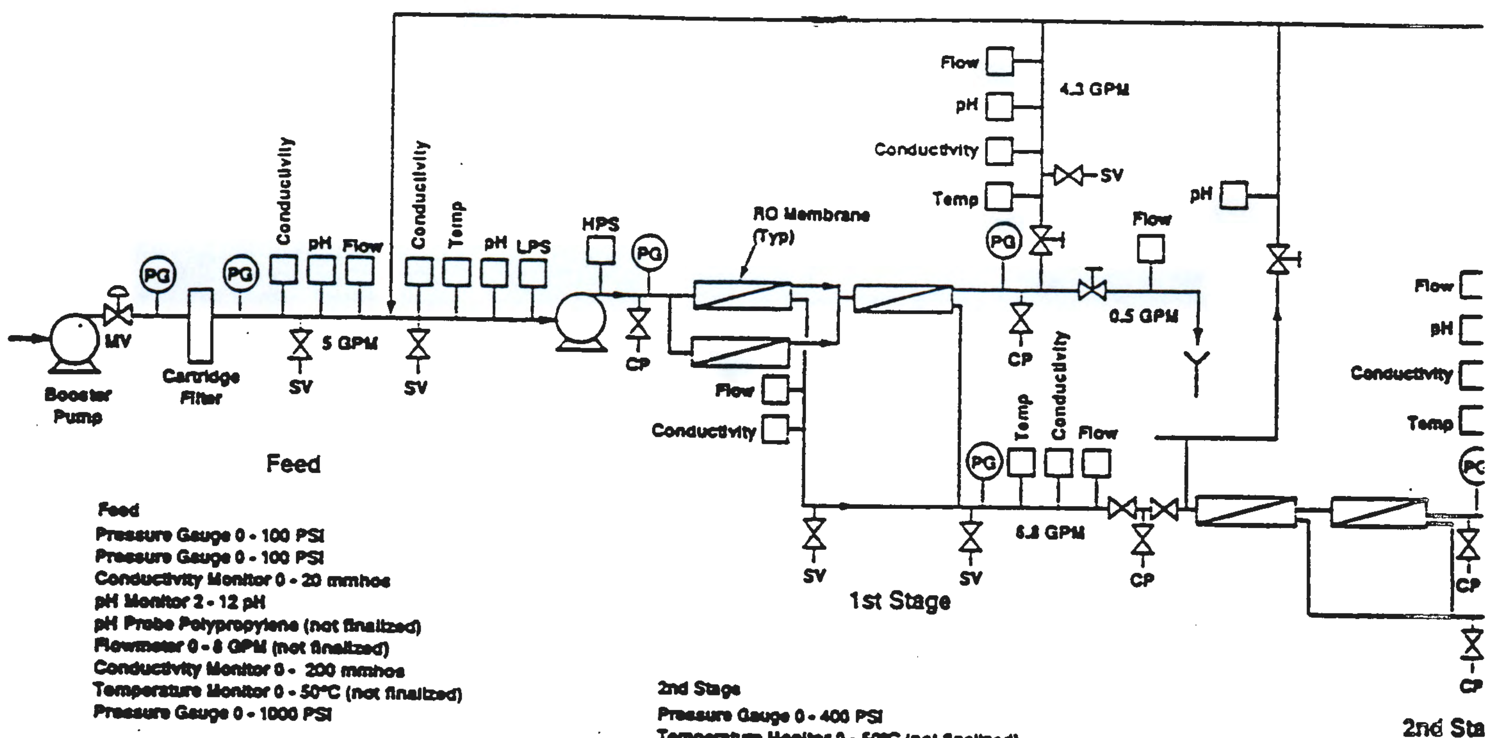


Figure 4-6. Reverse Osmosis Piping and Instrumentation Drawing.



Feed
Pressure Gauge 0 - 100 PSI
Pressure Gauge 0 - 100 PSI
Conductivity Monitor 0 - 20 mmhos
pH Monitor 2 - 12 pH
pH Probe Polypropylene (not finalized)
Flowmeter 0 - 8 GPM (not finalized)
Conductivity Monitor 0 - 200 mmhos
Temperature Monitor 0 - 50°C (not finalized)
Pressure Gauge 0 - 1000 PSI

1st Stage
Pressure Gauge 0 - 1000 PSI
Flowmeter 0 - 8 GPM (not finalized)
Conductivity Monitor 0 - 20 mmhos
Pressure Gauge 0 - 600 PSI
Temperature Monitor 0 - 50°C (not finalized)
Conductivity Monitor 0 - 20 mmhos
Flowmeter 0 - 8 GPM (not finalized)
pH Monitor 2 - 12 pH
Pressure Gauge 0 - 1000 PSI
Temperature Monitor 0 - 50°C (not finalized)
Conductivity Monitor 0 - 200 mmhos
pH Monitor 2 - 12 pH
Flowmeter - 8 GPM (not finalized)
Flowmeter 0 - .5 GPM (not finalized)

2nd Stage
Pressure Gauge 0 - 400 PSI
Temperature Monitor 0 - 50°C (not finalized)
Conductivity Monitor 0 - 20 mmhos
Flowmeter 0 - 8 GPM (not finalized)
pH Monitor 2 - 12 pH
Pressure Gauge 0 - 1000 PSI
Temperature Monitor 0 - 50°C (not finalized)
Conductivity Monitor 0 - 200 mmhos
pH Monitor 2 - 12 pH
Flowmeter 0 - 8 GPM (not finalized)

3rd Stage
Conductivity Monitor 0 - 200 mmhos
Temperature Monitor 0 - 50°C (not finaliz
Pressure Gauge 0 - 1000 PSI
Pressure Gauge 0 - 600 PSI
Temperature Monitor 0 - 50°C (not finaliz
Conductivity Monitor 0 - 20 mmhos
Flowmeter 0 - 8 GPM
Pressure Gauge 0 - 1000 PSI
Temperature Monitor 0 - 50°C (not finalit
Conductivity Monitor 0 - 200 mmhos
pH Monitor 2 - 12 pH
Flowmeter 0 - 8 GPM (not finalized)
Flowmeter 0 - .5 GPM (not finalized)

Abbreviations

CP	-	Cleanout Port
GPM	-	Gallons Per Minute
HPS	-	High-Pressure Sensor
LPS	-	Low-Pressure Sensor
mmhos	-	micromhos
PG	-	Pressure Gauge
PSI	-	Pounds Per Square Inch
SV	-	Sample Valve

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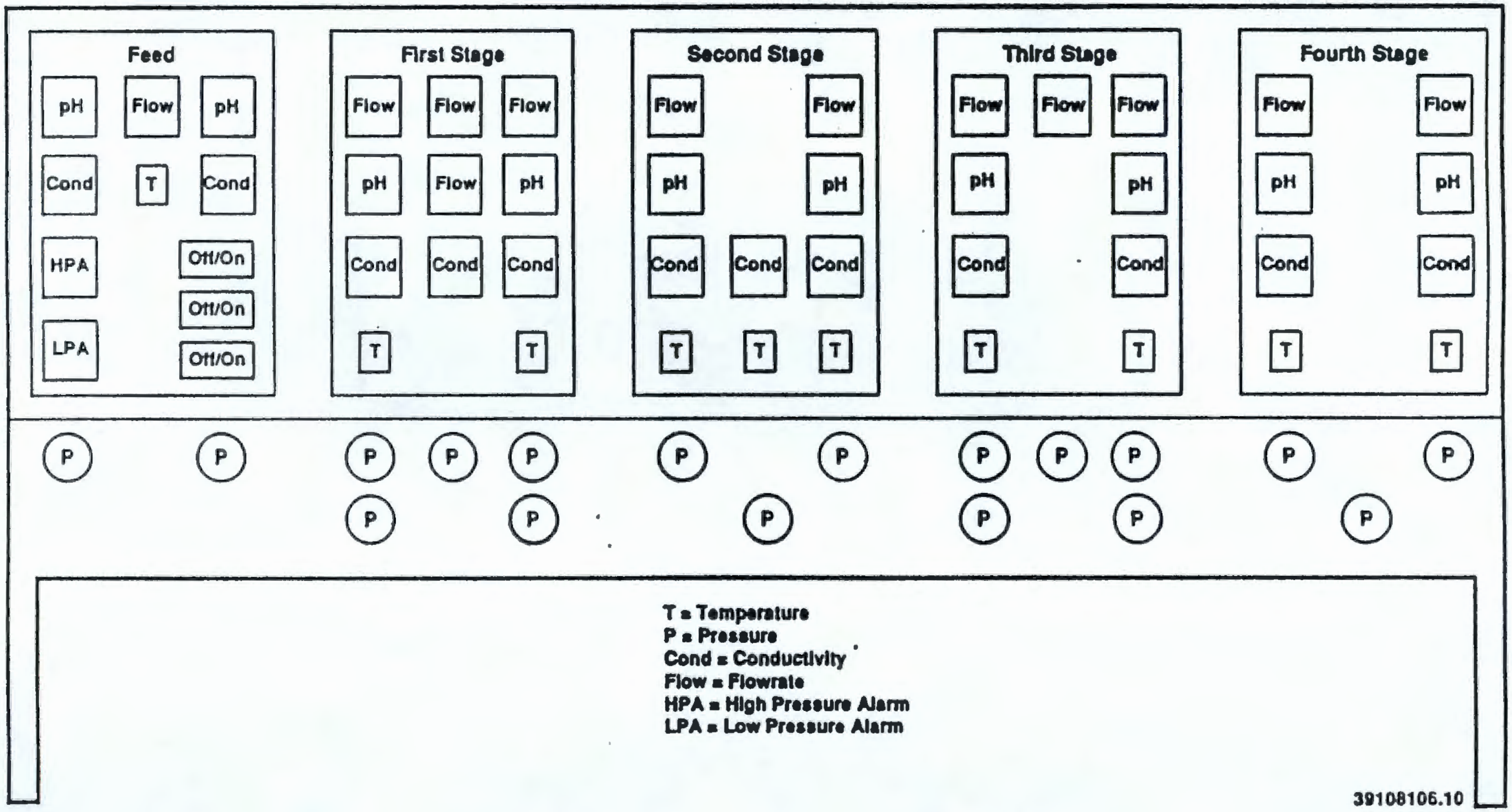


Figure 4-7. Reverse Osmosis Panel Board.

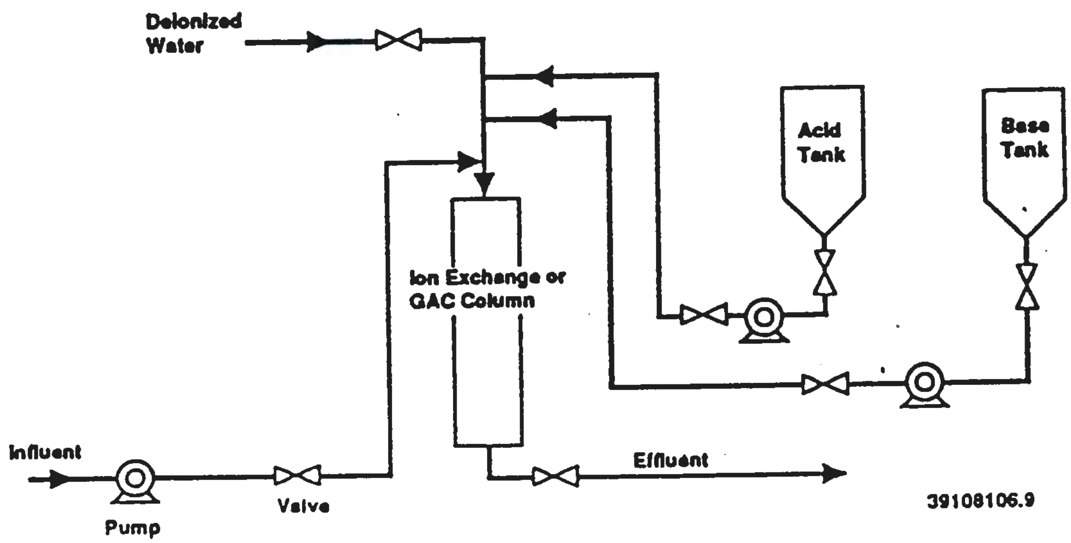


Figure 4-8. Ion Exchange and Granular Activated Carbon Conceptual Flow Diagram.

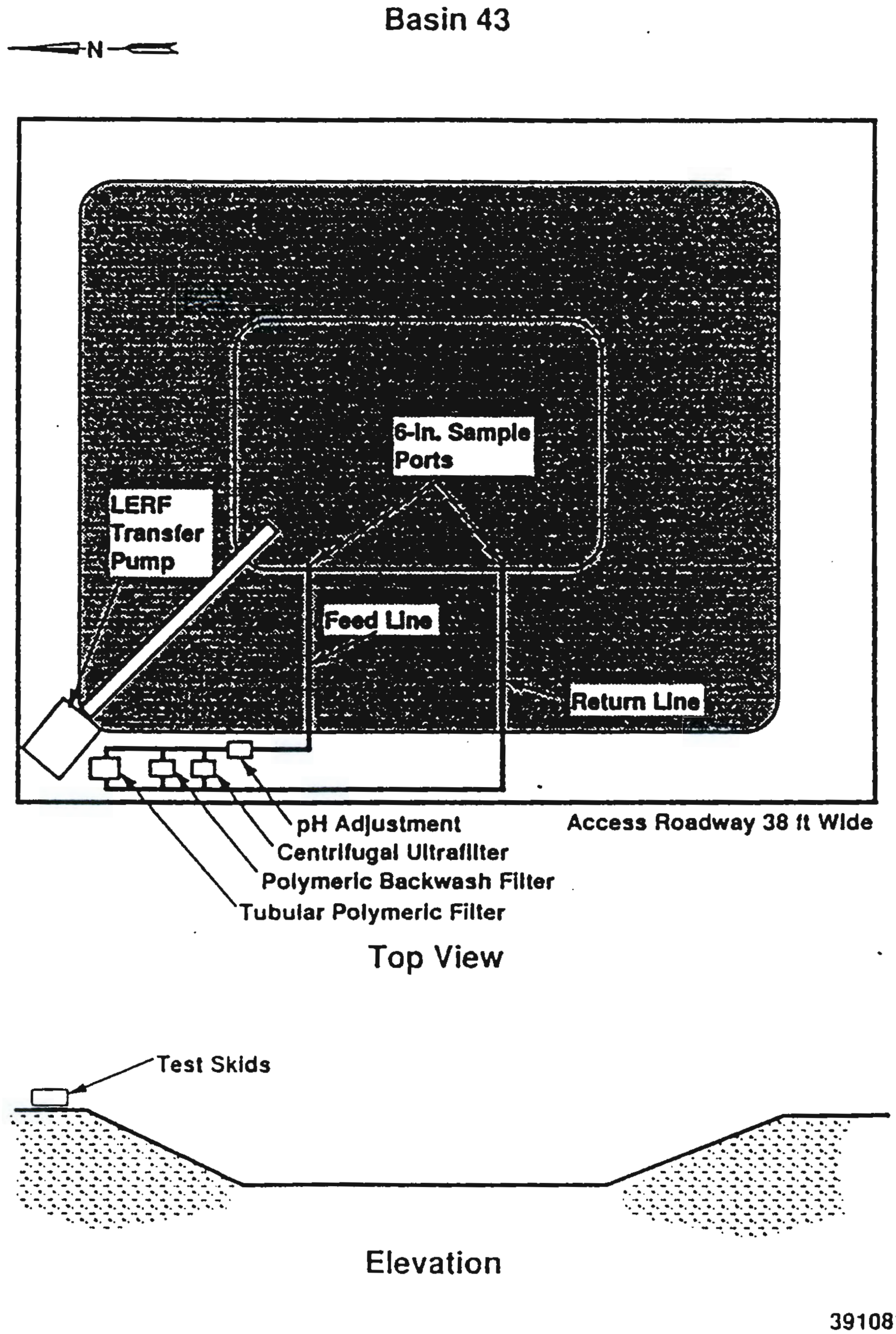
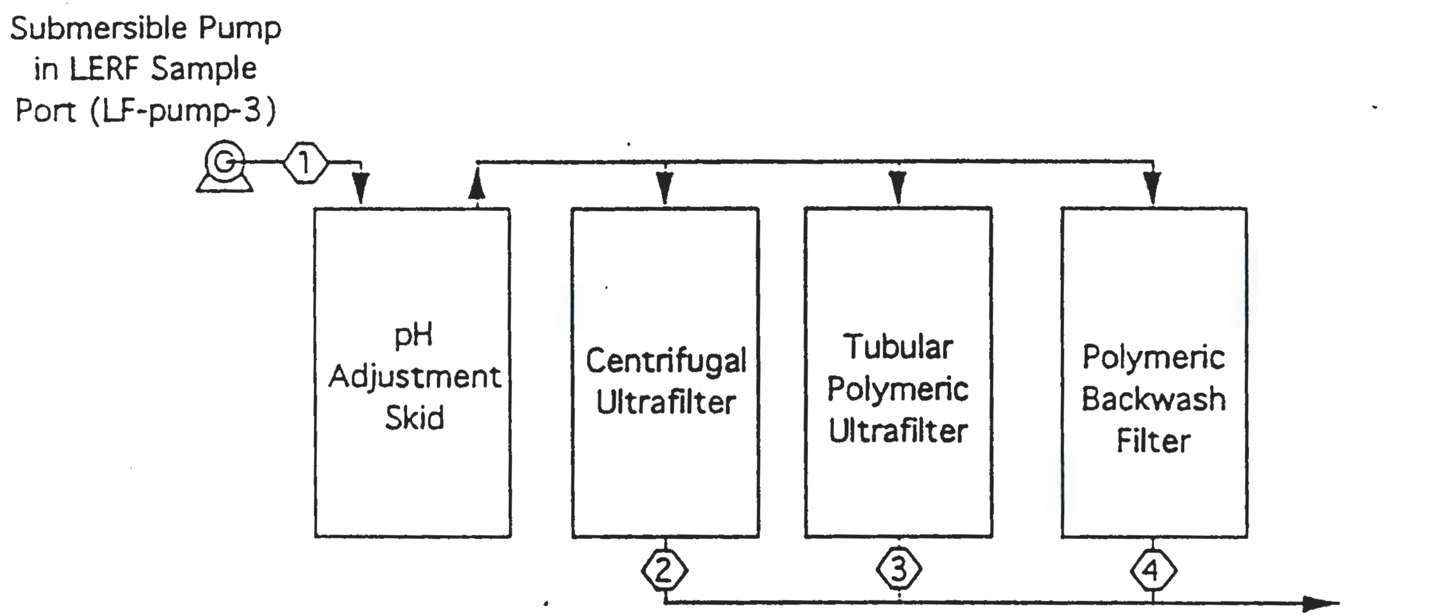


Figure 4-9. Filtration Equipment Location at Liquid Effluent Retention Facility.



	1	2	3	4
FLOW (GPM)	9-15	3-5	3-5	3-5
TEMPERATURE (°F)	AMB	AMB	AMB	AMB
PRESSURE (PSI)	20-30	20-30	20-30	10-30

Figure 4-10. The LERF Filtration Flow Diagram.

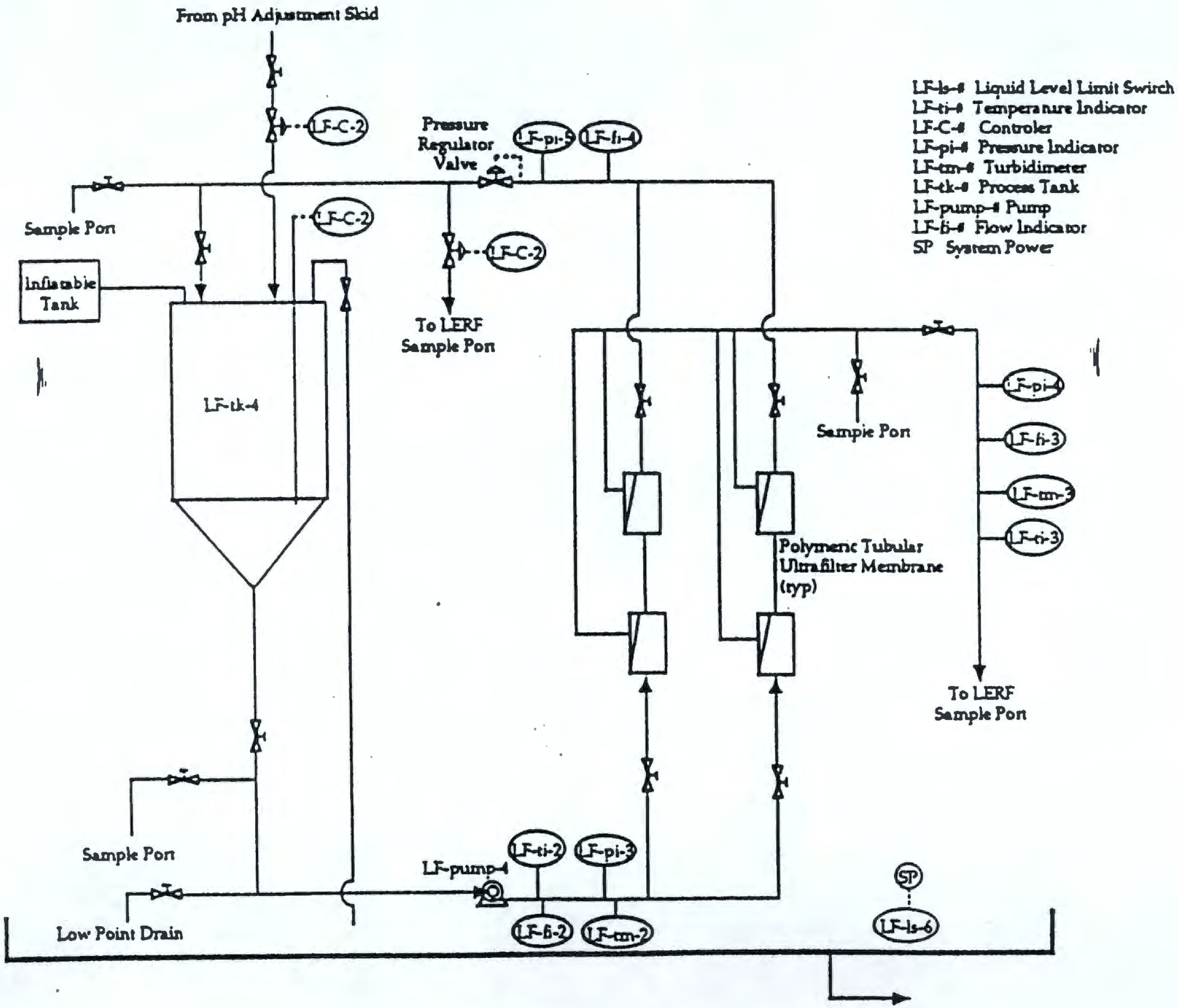


Figure 4-11. Tubular Polymeric Ultrafiltration System.

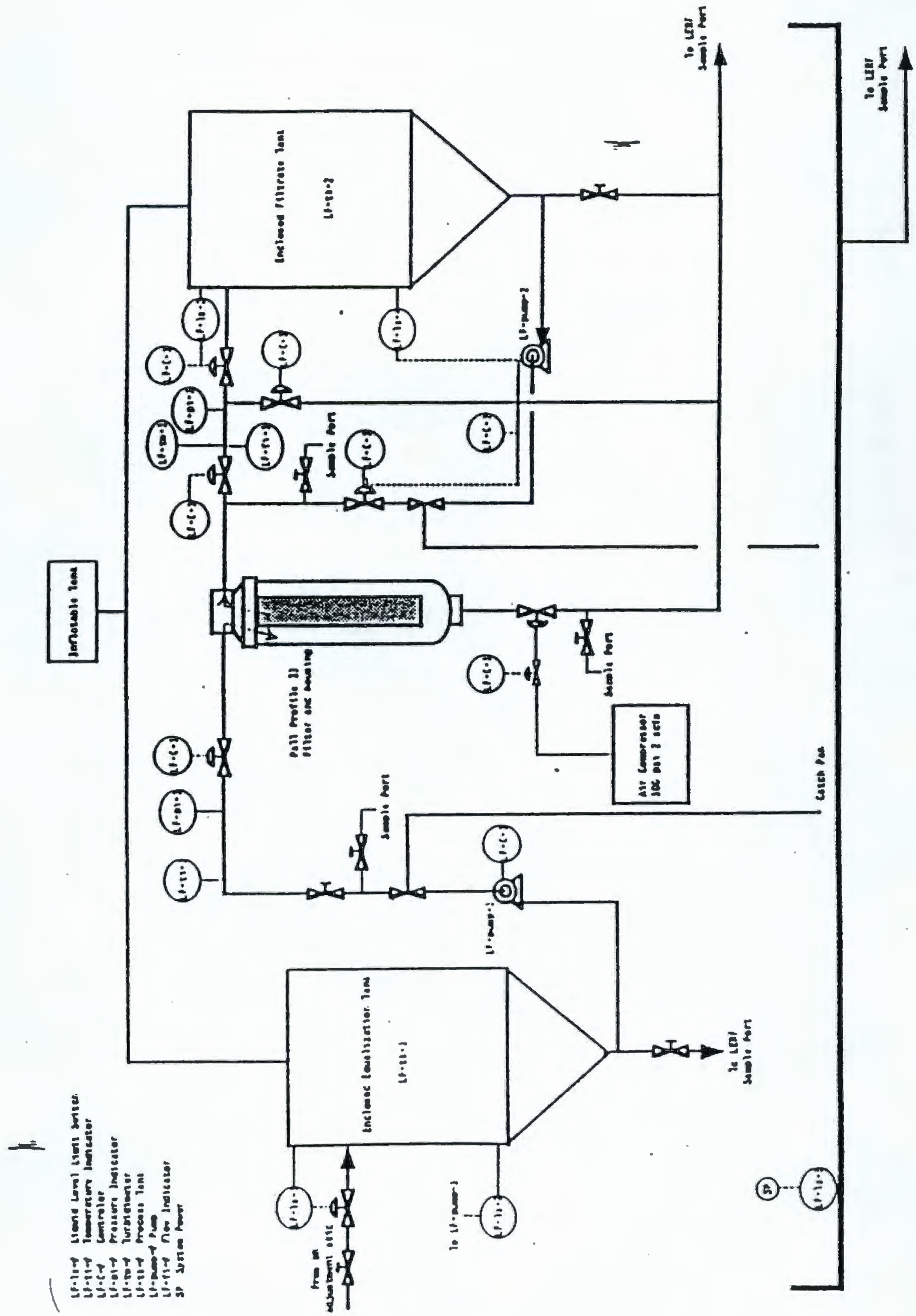


Figure 4-12. Polymeric Backwashable Ultrafiltration System.

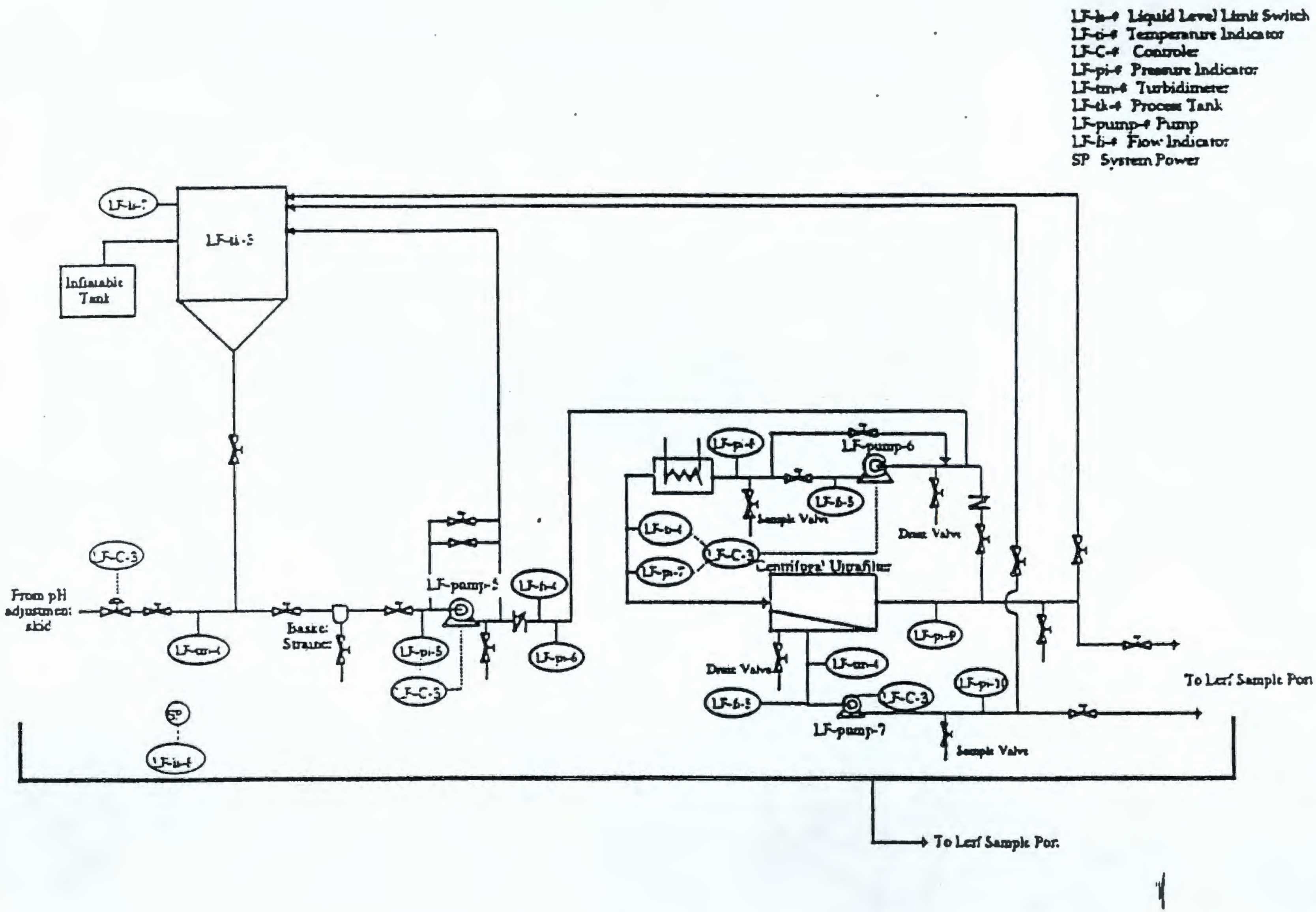


Figure 4-13. Centrifugal Ultrafilter Flow Diagram.

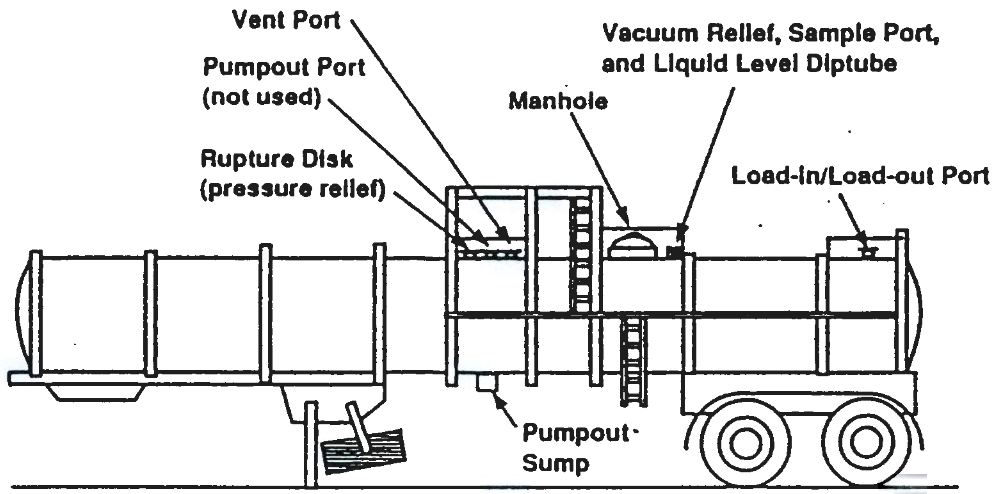


Figure 4-14. Tank Trailer Side Elevation.

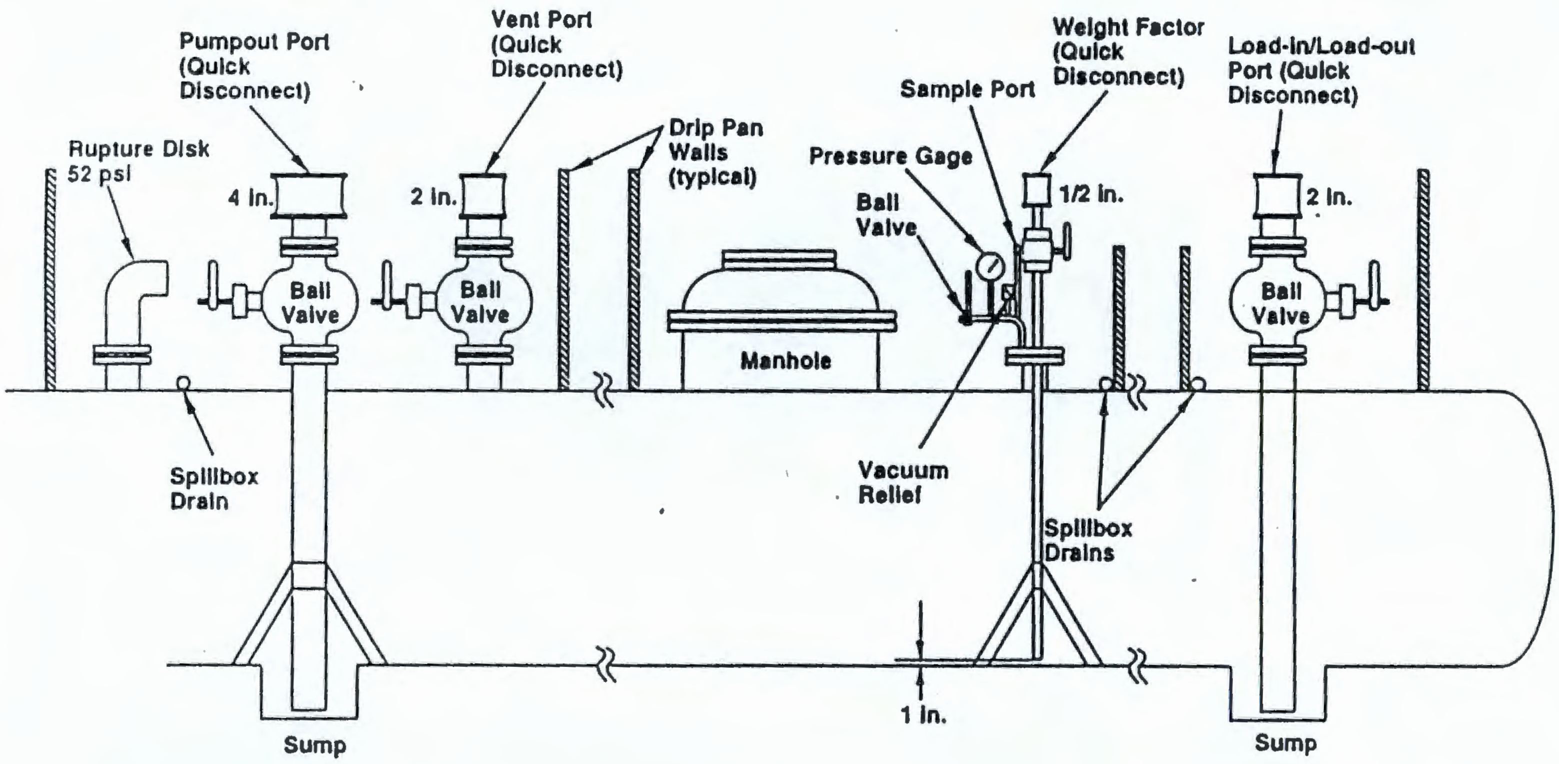


Figure 4-15. Tank Trailer Penetrations.

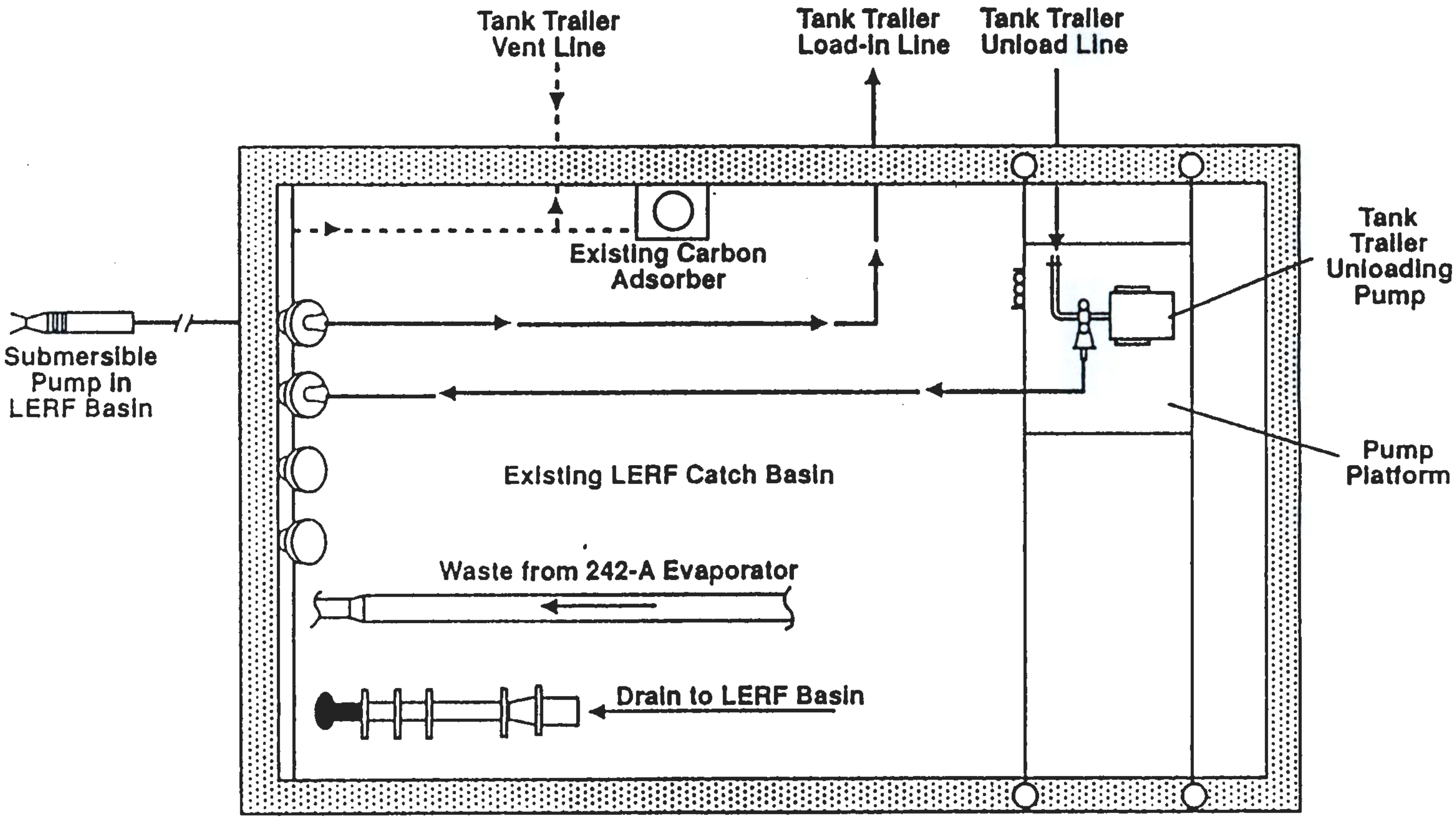


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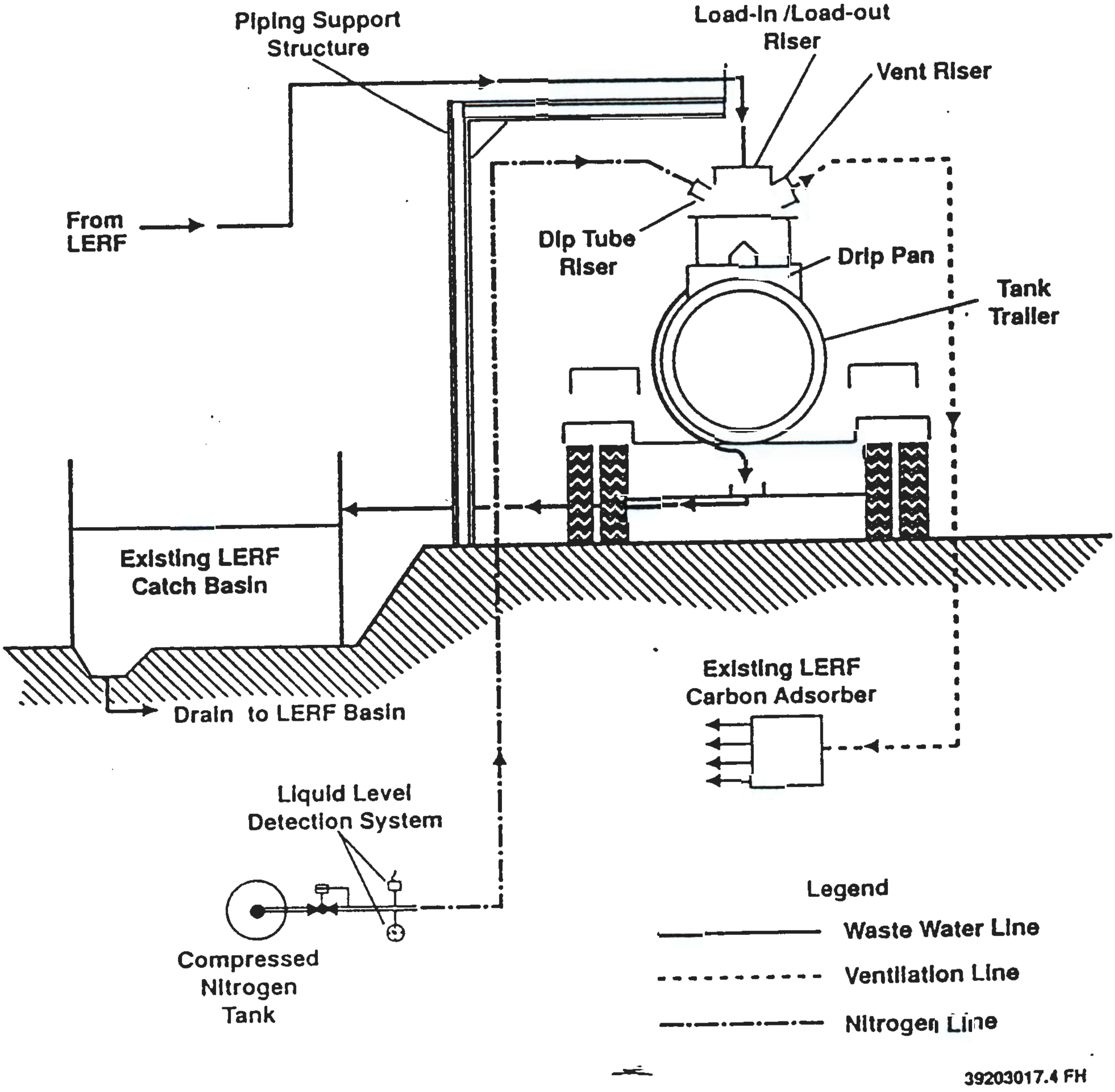
Figure 4-16. The LERF Catch Basin Piping Configuration.



9 3 1 2 9 3 5 1 8 2 5

Figure 4-17. Tank Trailer Configuration for Filling at the LERF.

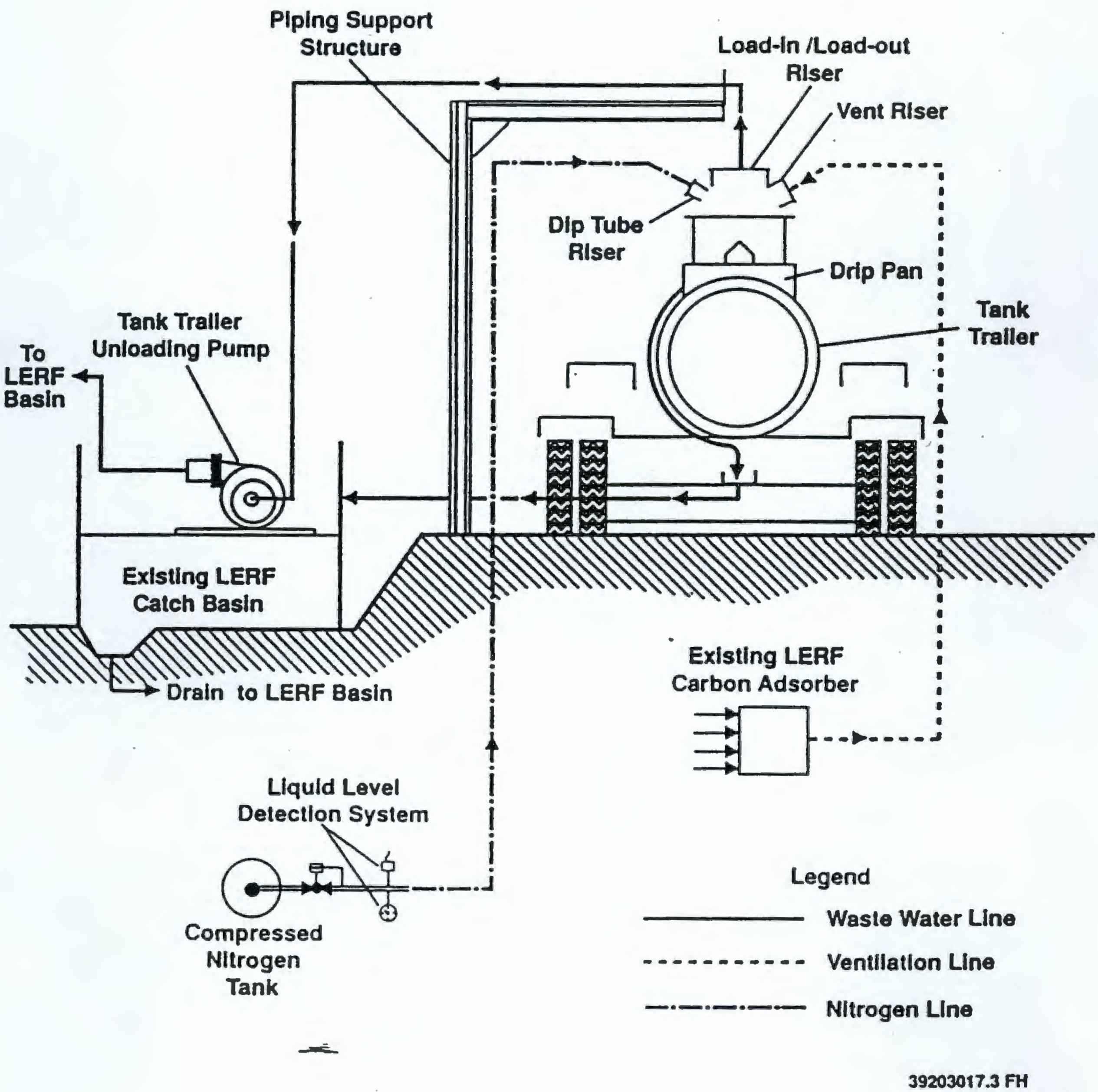


Figure 4-18. Tank Trailer Configuration for Unloading at the LERF.

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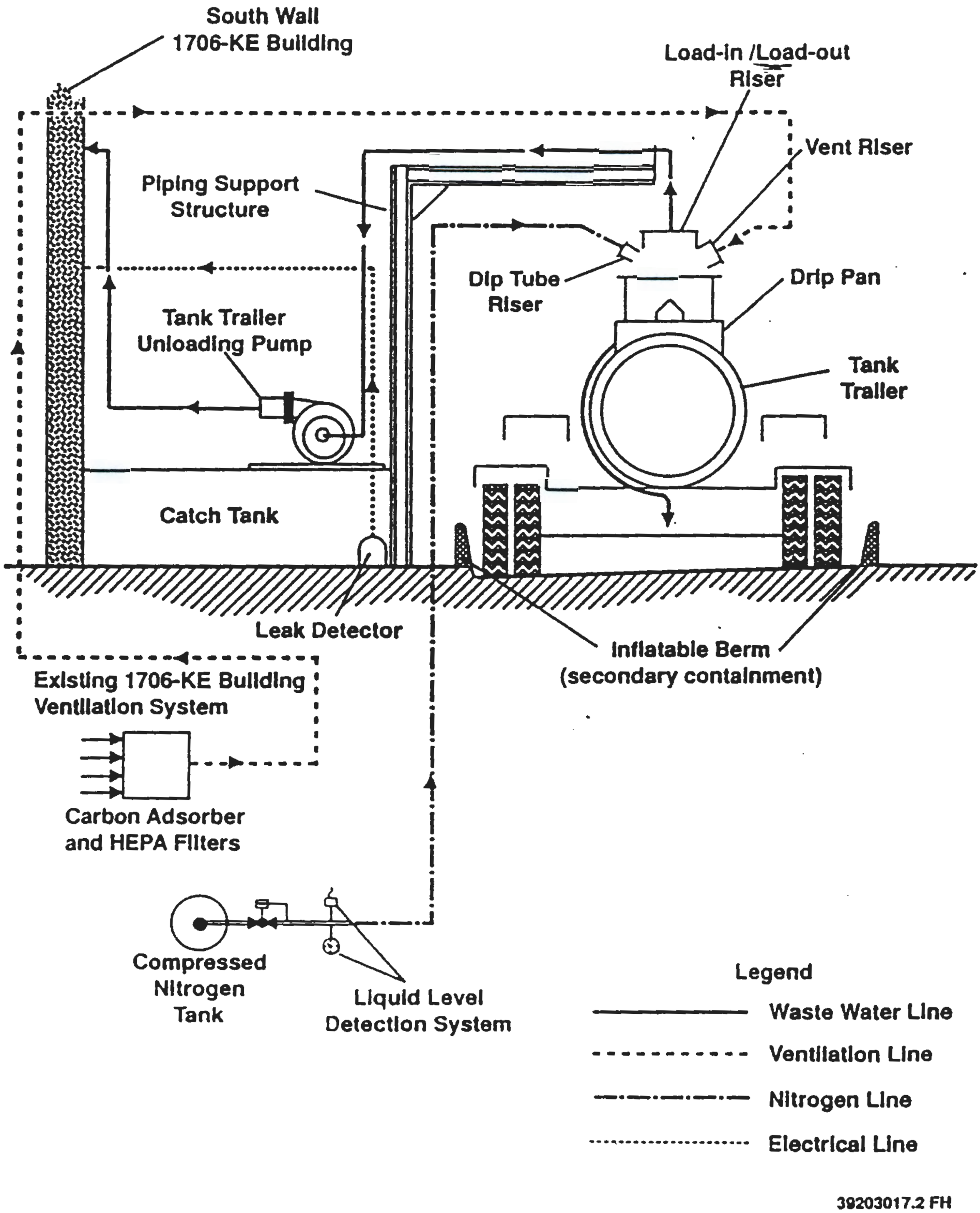
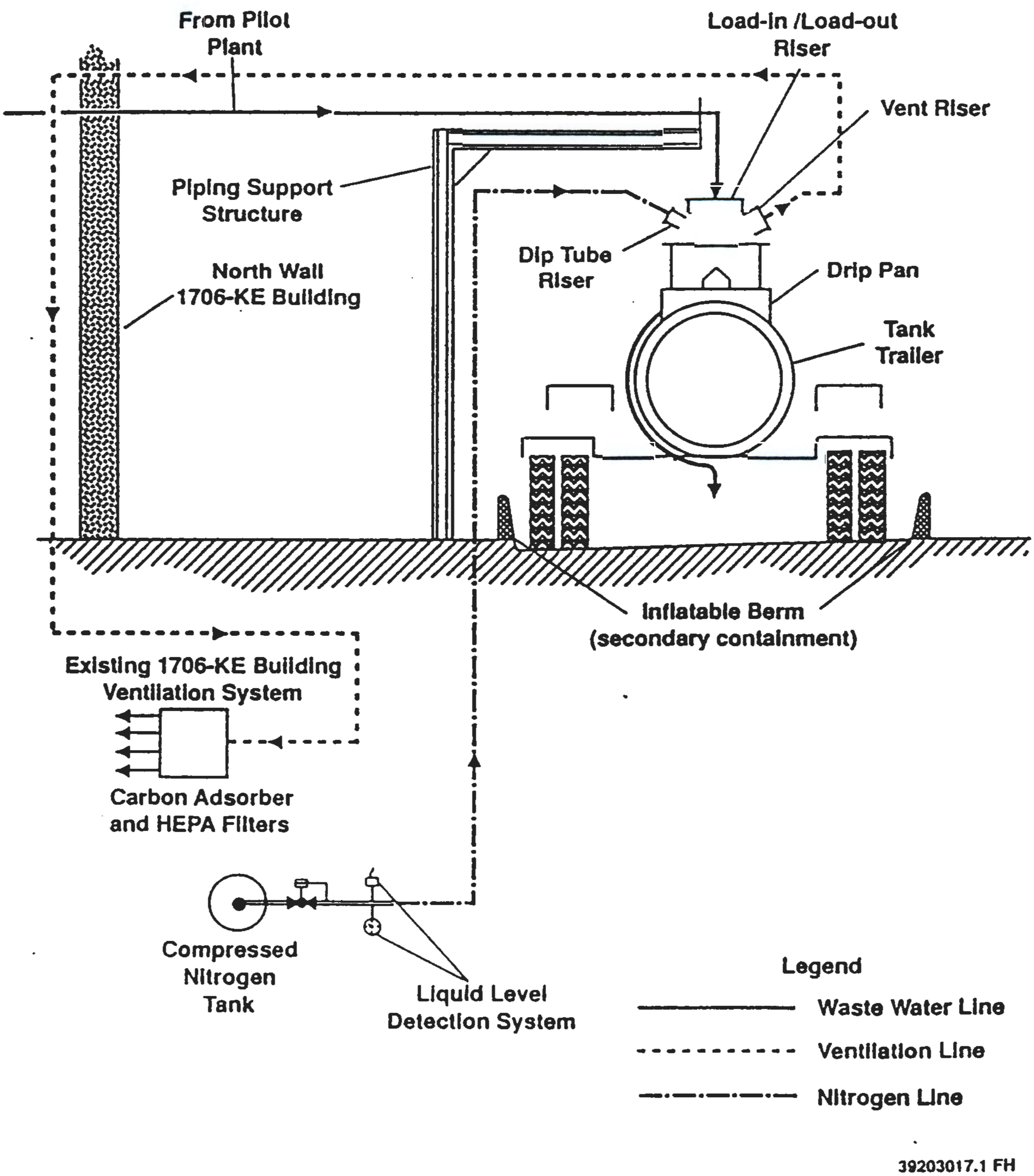


Figure 4-19. Tank Trailer Configuration for Unloading at the 1706-KE Building.



9 3 1 2 9 3 5 1 8 2 8

Figure 4-20. Tank Trailer Configuration for Loading at the 1706-KE Building.

Table 4-1. Secondary Containment Dimensions for Test Equipment.

Equipment	Expected footprint area (feet)	Expected holdup volume	Minimum[a] pan dimensions
Ultraviolet oxidation	3-1/2 feet wide by 5 feet long by 6-1/2 feet high	30 gallons	4-1/2 feet wide by 6 feet long by 4 inches high
Reverse osmosis	4-1/2 feet wide by 16-1/2 feet long by 6-1/2 feet high	50 gallons	6 feet wide by 17-1/2 feet long by 4 inches high

[a] Pans may be larger to include associated pipe fittings and accessory equipment such as pumps.

Table 4-2. Predicted Effectiveness of Activated Charcoal on Ventilation System.

Volatile organic compound	Feed concentration (ppb)		Pounds per tanker		Charcoal retentivity	Maximum charcoal required per tanker (lb)[d]	Maximum emission rate if uncontrolled (lb/hr)[de]
	Average	90% C.I.[a]	Average	Maximum 90% C.I.			
Acetone	980	1,000	0.0409	0.0417	15	0.278	0.00250
1-Butanol	9,800	11,000	0.4085	0.4585	36	1.274	0.02751
2-Butanone (MEK)	51	53	0.0021	0.0022	26	0.008	0.00013
Butraldehyde (butanal)	56	62	0.0023	0.0026	21	0.012	0.00016
Chloroform (trichloromethane)	14	14	0.0006	0.0006	32	0.002	0.00004
Ethyl alcohol (ethanol)	2	4[b]	0.0001	0.0002	21	0.001	0.00001
Metrylene chloride (dichloromethane)	120	140	0.0050	0.0058	25	0.023	0.00035
Methyl n-propyl ketone (2-pentanone)	9	10	0.0004	0.0004	15[c]	0.003	0.00003
Methyl n-butyl ketone (2-hexanone)	13	14	0.0005	0.0006	15[c]	0.004	0.00004
Methyl isobutyl ketone (hexone)	11	14	0.0005	0.0006	30	0.002	0.00004
2-Propanol (isopropyl alcohol)	22	44[b]	0.0009	0.0018	26	0.007	0.00011
Tetrahydrofuran	37	39	0.0015	0.0016	21	0.008	0.00010
1,1,1-Trichloroethane	4	10[b]	0.0002	0.0004	15[c]	0.003	0.00003
Totals	11,120	12,404	0.4535	0.5171		1.625	0.03102

[a]C.I. = confidence interval
[b]Not enough data to determine 90% C.I., assumed C.I.=2 times average.
[c]No retentivity data. Assumed lowest value of 15.
[d]Calculations assumed 100% volatilization of Volatile Organics, 90% C.I. concentrations.
[e]Calculations assume 5 gallon per minute flowrate.

Table 4-3. Control of Critical Parameters.
(sheet 1 of 4)

Equipment number and description	Parameter	Hazard	Control method(s)	Control device	Control setpoint	Alarm setpoint and response
TT-tk-1,-2 trailer tanks	high pressure	tank rupture followed by personnel injury and environmental contamination	factory installed rupture disk; pressure tested, DOE certified tank	rupture disk TT-pr-1,-2	55±5 psi	NA
			administrative control of vent valve during loading	operator inspection required by procedure	vent valves TT-hv-1,-2 open	NA
	excessive vacuum	tank collapse followed by personnel injury and environmental contamination	factory installed vacuum relief device; DOT certified tank	vacuum relief device TT-vr-1,-2	0.5 - 5" Hg vacuum	NA
			administrative control of vent valve during unloading	operator inspection required by procedure	vent valves TT-hv-1,-2 open	NA
TT-tk-1,-2 trailer tanks	high radiation	personnel exposure	DOT MC-312 requirements of 49 CFR 173.425(c)(2)(iii) and (1)(iii)	LERF waste water analysis prior to loading trailer	≤10% of LSA levels; total fission product activity ≤0.001 mCi/g	NA
LL LERF trailer load/unload station	leakage of waste water during transfer	environmental contamination	secondary containment	LERF catch catch basin LL-cb	NA	NA
			administrative control by procedure	visual monitoring by operator	no visible leakage	shutdown transfer pump
KU 1706-KE trailer unloading station	leakage of waste water during waste transfer	environmental contamination	double containment with daily inspections	inflatable berm KU-cb-1 under trailer; catch basin KU-cb-2 under transfer pump	no visible liquid	shutdown feed pump; troubleshoot and repair

Table 4-3. Control of Critical Parameters.
(sheet 2 of 4)

Equipment number and description	Parameter	Hazard	Control method(s)	Control device	Control setpoint	Alarm setpoint and response
			leak detection	leak detector element KU-lde in transfer pump catch basin KU-cb-2	≥1" of liquid in catch basin	leak detector switch KU-lds will shut down transfer pump P-1 and activate visible alarm KU-lah and audible alarm KG-aa
KL 1706-KE trailer loading station	leakage of waste water during	environmental contamination	double containment with daily inspections	inflatable berm KL-cb under trailer	no visible liquid in sump	shut down loading pump; troubleshoot and repair
UV-vsl uv/ox reactor vessel	high pressure	vessel rupture followed by personnel injury and building or equipment contamination	vendor installed rupture disk	rupture disk UV-pr	20 psig	actuates flow switch UV-fk-1 which in turn activates visible and audible alarms on module control panel
			vendor installed pressure switch at feed pump P-5	pressure switch UV-ps	15 psig	actuates visible alarm on module control panel and shuts down feed pump P-5
			pressure indicator UV-pi-1	administrative control	15 psig	operator shuts down feed pump
	high temperature	thermal stress on quartz sheaths and uv lamps resulting in breach of containment followed by personnel injury and building or equipment contamination	vendor installed temperature switch, alarm, and electrical interlock	temperature switches UV-TK-1,-2	150 °F	actuates visible alarm on module control panel and shuts down feed pump P-5
UV-vsl uv/ox reactor vessel	ultraviolet light	personnel exposure to intense uv light	uv filtration	uv filters on view ports	NA	NA

Table 4-3. Control of Critical Parameters.
(sheet 3 of 4)

Equipment number and description	Parameter	Hazard	Control method(s)	Control device	Control setpoint	Alarm setpoint and response
			door closure	door closure limit switch UV-ls-1	NA	open door deactivates electric power to lamps
LF filtration module at LERF	high pressure	equipment rupture followed by personnel injury and equipment contamination	pressure switch shuts down feed pump	pressure switch LF-ps	150 psig	≥150 psig activates visible alarm and shuts down feed pump
			pressure relief	pressure relief valve	(___) psig	NA
RO reverse osmosis module	high pressure	equipment rupture followed by personnel injury and equipment or building contamination	vendor installed pressure switch shuts down feed pumps	pressure switch RO-rps-1,-2 interlocked to feed pumps	400 psig	400 psig activates visible alarms, audible alarm KG-aa, and shuts down feed pumps P-8, P-9, and P-10
			administrative control	operator monitors pressure indicators RO-pg-1 through -12	approximately (300 psig)	at pressure ≥400 psig operator shuts down feed pumps
PH-tk-1 pH adjustment tank	liquid level	waste water overflow resulting in equipment contamination	liquid level control	liquid level control loop consisting of limit switch PH-ls and feed control valve PH-cv	liquid level corresponding to 80% of tank volume	liquid level corresponding to 90% of tank volume activates high level visible alarm PH-lah, audible alarm KG-aa, and shuts down feed pump KU-pmp
PH-tk-2 sulfuric acid feed tank for pH adjustment	corrosion	loss of containment resulting in personnel injury and equipment or building contamination	administrative: proper design (including material selection), construction, and maintenance	review of engineering design and construction media, operations and maintenance procedures; leak test before use	NA	NA

Table 4-3. Control of Critical Parameters.
(sheet 4 of 4)

Equipment number and description	Parameter	Hazard	Control method(s)	Control device	Control setpoint	Alarm setpoint and response
			double containment	spill pan with ≥110% of tank capacity, walls ≥3 inches, footprint ≥1 foot beyond module	NA	NA
			administrative	operator inspection required by procedure	no visible liquid in spill pan	shutdown, troubleshoot and repair/replace failed item
PH-vsl sulfuric acid feed tank for pH adjustment	corrosive chemical	chemical burns to skin or eyes	administrative control of the chemical handling	personnel protective gear including eye wash station, protective eye wear, rubber gloves	NA	immediately flush affected tissue with copious amount of water, then contact first aid
UV-vsl-2 hydrogen peroxide feed tank for uv/ox reactor	corrosive chemical (50-wt% aqueous hydrogen peroxide)	chemical burns to skin or eyes	administrative control of the chemical handling	personnel protective gear including eye wash station, protective eye wear, rubber gloves	NA	immediately flush affected tissue with copious amount of water, then contact first aid
VV-heps 1706-KE vessel vent HEPA filtration system	high differential pressure (dp)	HEPA filter rupture followed by contamination release to the outside atmosphere	dp control	dp indicating switch VV-dpis activates alarm	≥3 inch water	actuates high dp alarm VV-dpah and audible alarm KG-aa; troubleshoot
	low differential pressure (dp)	indicates filter rupture followed by contamination release to the outside atmosphere	dp control	dp indicating switch VV-dpis activates alarm	<0.3 inch water	actuates low dp alarm VV-dpal and audible alarm KG-aa; troubleshoot
VV 1706-KE vessel vent system	low vacuum	contamination of lab atmosphere	vessel vent continuous vacuum measurement	vacuum switch VV-ps activates alarm	<0.5 inch water	actuates visible alarm VV-pal and audible alarm KG-aa; troubleshoot

Table 4-4. Monitoring Device Specifications.

Monitoring device	Specification
Pressure indicator	Bourdon-tube pressure sensing device with direct readout dial. Pressure gages sized to indicate normal operating pressure between 30 to 75 percent of full-scale. Maximum error is 2 percent of full-scale.
Pressure switch	Diaphragm type pressure sensing device with manual set-point adjustment. Pressure switches sized for normal operating pressure between 30 to 75 percent of full range. Maximum error is 2 percent of full range
Delta pressure switch	Diaphragm type pressure sensing device. Pressure switches sized for normal delta operating pressure between 30 to 75 percent of full range. Maximum error is 2 percent of full range.
Pressure/vacuum switch	Diaphragm type pressure sensing device with manual set-point adjustment. Pressure switches sized for normal operating pressure between 30 to 75 percent of full range. Maximum error is 2 percent of full range.
Rupture disk	Sized for the specific application and factory calibrated to rupture within 2 percent of rating.
Temperature switch	Type K or type J thermocouples to operate between 0 to 150 °C. Maximum error is 2 percent of full range.
Temperature indicator	Readouts from type K or J thermocouples to read between 0 to 150 °C. Dial thermometers to read between 0 to 150 °C. Maximum error is 2 percent of full range.
Thermocouple	Type K or type J thermocouples to operate between 0 to 150 °C. Maximum error is 2 percent of full range.
Level switch	Float switch or conductivity switch to indicate high or low liquid level.

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APPENDIX 4C

MANUFACTURER'S DATA REPORT FOR INFLATABLE BERMS

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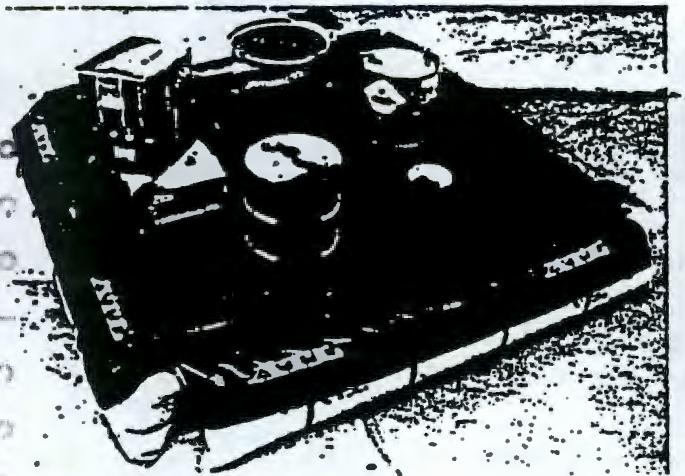
PORT-A-BERM™

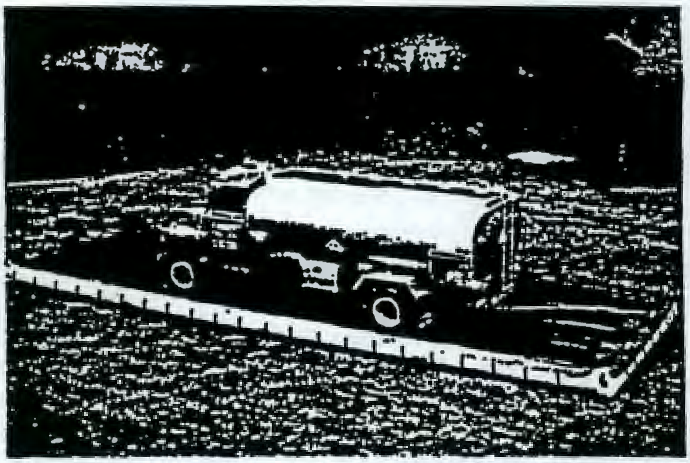
INFLATABLE SECONDARY CONTAINMENT

TECHNICAL DATA SHEET

- Spill Containment
- Leak Collection
- DeCon Operations
- Toxic Waste Isolation



Port-A-Berm contains leaking tanks, drums, barrels, crates, pails etc.



Port-A-Berm confines heavy duty equipment during filling, discharging and cleaning.

STANDARD UNITS AVAILABLE

P-A-B Part No.	Dimensions L x W x H	Max. Capacity	Req'd Air Volume	Single or Dbl. Lined	Empty Weight
125110	10' x10' x17"	750 gal.	70 c.f.	S	100 lbs.
125117	13' x13' x17"	1,800 gal.	80 c.f.	S	150 lbs.
125111	18' x18' x17"	3,400 gal.	130 c.f.	S	200 lbs.
125112	24' x24' x17"	6,100 gal.	170 c.f.	S	280 lbs.
125113	32' x32' x17"	10,800 gal.	230 c.f.	S	440 lbs.
125130	32' x32' x34"	21,600 gal.	920 c.f.	S	580 lbs.
125139	74' x34' x34"	53,400 gal.	1,500 c.f.	S	1,180 lbs.
125151	45' ~~x16'~~ x17"	7,600 gal.	220 c.f.	D	570 lbs.
125154	65' x16' x17"	11,000 gal.	290 c.f.	D	800 lbs.
125158	50' x22' x17"	11,600 gal.	260 c.f.	D	760 lbs.

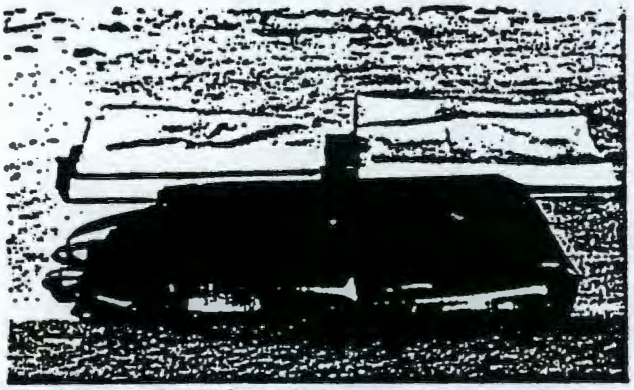
CUSTOM SIZES TO 300,000 GALLONS AVAILABLE

PORT-A-BERM™
THE *ULTIMATE* HAZ-MAT TOOL!

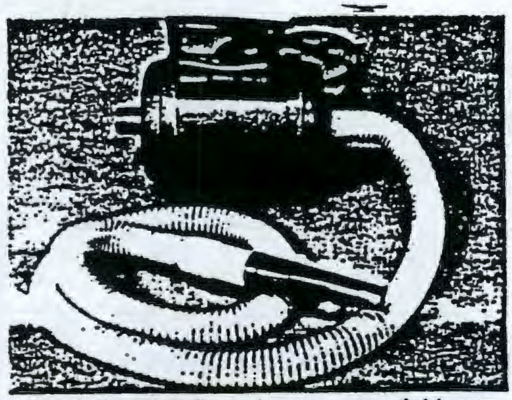
DS-407

PORT-A-BERM™

1) Port-A-Berms (P-A-B) may be set up on asphalt, concrete, sand or soil if the surface is well groomed and level. Rough or irregular terrain should be graded and covered with geotextile mat before deploying the P-A-B. Be certain the underlying surface is sufficient to support intended loads without shifting or damaging the P-A-B.



Port-A-Berm collapses into a neat compact bundle, only 1% of its full volume.



Optional high volume, low pressure air blower makes inflating Port-A-Berm quick and easy.

2) Four separate air chamber tubes are provided to form the inflatable berm or dike. These are to be positioned within the liner retention loops and filled with air using the inflation nozzle provided. Use a high volume, low pressure and non-sparking air source. Both the nozzle and each tube are equipped with a 2.5 psi relief valve to prevent over-pressurization.

3) If sharp or abrasive equipment is to be placed within the P-A-B liner, a protective "Type R" sheet or plywood panels should first be laid out inside the P-A-B.

4) Spills collected within a P-A-B should be neutralized or transferred to permanent containers promptly. P-A-B is a temporary holding medium to afford hours or a few days of containment. Chemical resistance data is based on an exposure limit of 7 days duration. Material samples are available for customers' immersion testing.

5) The P-A-B air inflation tubes are constructed of a special reinforced gray elastomer laminate. It is designed to provide abrasion resistance, low temperature flexibility and excellent air retention (low diffusion). However, this material does not exhibit quite the same outstanding chemical resistance as the unique P-A-B black liner material. As much as possible, avoid contact between the inflation tubes and any strong acids, alkalies, ketones or aromatics.

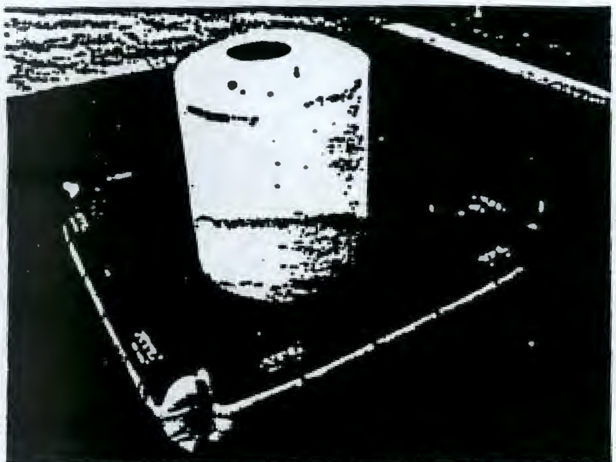
6) Before folding and storing, the Port-A-Berm liner should be thoroughly scrubbed, rinsed and dried.

Port-A-Berm segregates inventory for better Haz-Mat accounting during DEP, EPA, and ECRA clean-ups.

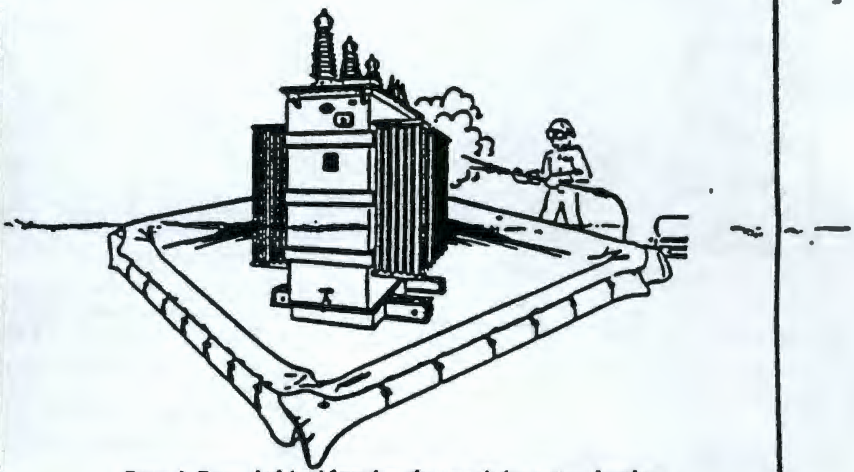
7) The deployed P-A-B is fully effective from 0° F to 140° F. However, folding and unfolding during packing and set-up operations should be performed at 40° F to 120° F to minimize fabric stresses.

8) In high wind environments, it is advisable to fill each tube 1/3 with water and the balance with air or nitrogen. Some make-up air may be necessary due to gas dissolution in water.

9) Rain water, snow, dirt etc. should be promptly and regularly removed from the P-A-B to maximize spill retention volume.



The entire contents of this 600 gallon tank can be contained by a 10' x 10' Port-A-Berm.



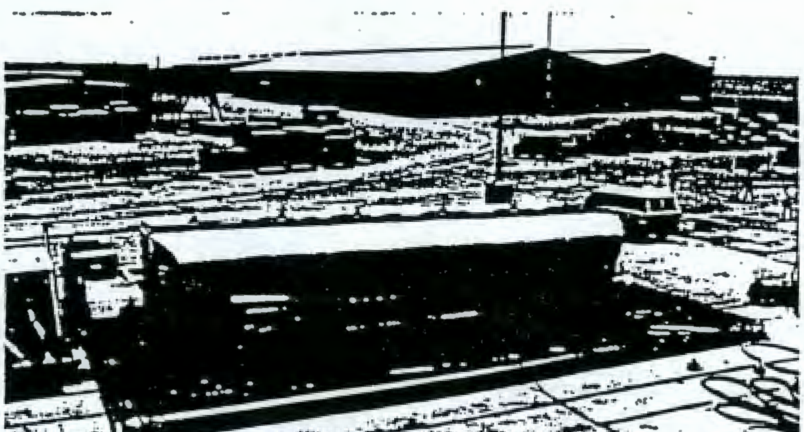
Port-A-Berm is ideal for cleaning and decontaminating all types of equipment.

10) To speed deflation, the P-A-B tubes may be removed from their retention straps and rolled up toward the fill/discharge fitting. Alternatively, they may be suction scavenged with a vacuum.

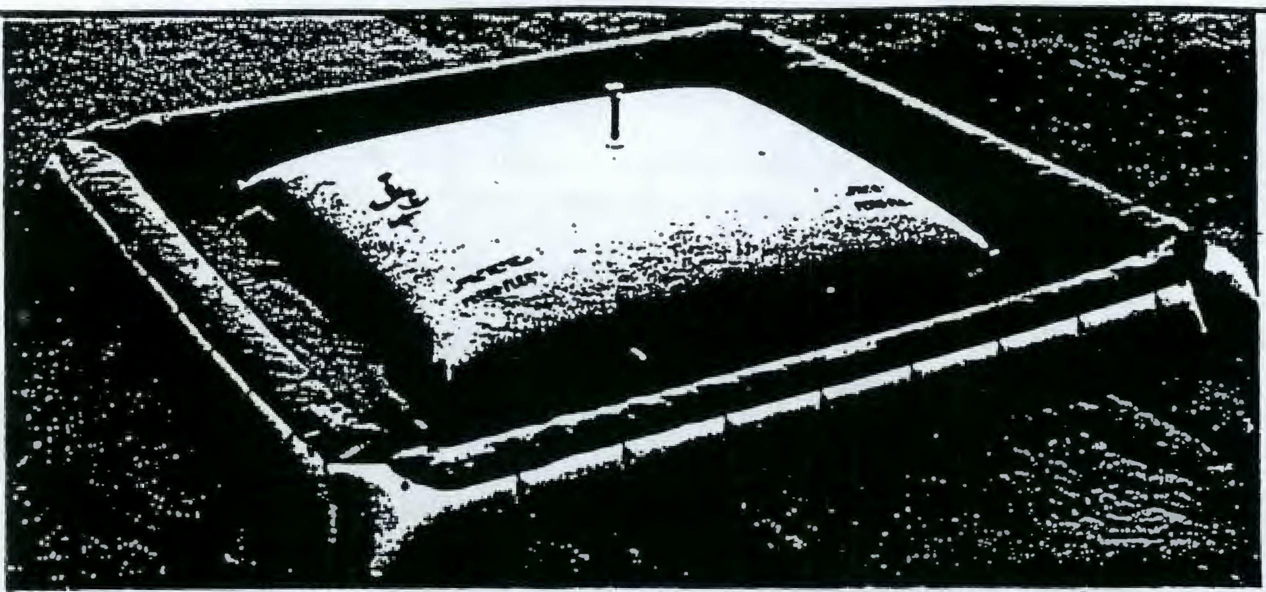
11) The P-A-B liner may be "over-lined" with a thin disposable polyethylene sheeting. This procedure is viable in many cases to eliminate cleaning and drying the primary P-A-B liner after a spill.

12) P-A-B part numbers between 125150 and 125160 designate a special Port-A-Berm with an added bottom ply. They are intended to collect spills and overflow from wheeled vehicles, tank trucks, ISO tank-containers and light aircraft.

13) Custom sized P-A-B systems are available on special order. Heights to 50 inches and lengths up to 100 feet are possible for a 300,000 gallon maximum capacity.



Port-A-Berms are used by all branches of the Armed Forces, especially at Army and Navy Maintenance Depots.



Port-A-Berm provides secondary containment for collapsible fabric tanks holding gasoline, jet fuel, toxic wastes, hazardous chemicals, contaminated water, etc.

GENERAL CHEMICAL RESISTANCE
7-DAY MAXIMUM EXPOSURE (ROOM TEMP.)
PORT-A-BERM LINER

A = little or no effect   B = minor to moderate effect   C = severe effect

Acetic Acid (5%)	B	Methyl Ethyl Ketone	C
Ammonium Phosphate	A	Mineral Spirits	A
Animal Oils	A	Motor Oil	A
Aqua Regia	C	Naptha	A
ASTM Fuel A&B	A	Nitric Acid (5%)	B
Benzene	B	Nitric Acid (50%)	C
Calcium Chloride Soln.	A	Perchloroethylene	C
Calcium Hydroxide	A	Phenol	C
Chlorine Solution (20%)	A	Phenol Formaldehyde	B
Ammonium Hydroxide (Conc.)	A	Phosphoric Acid (50%)	A
Corn Oil	A	Phthalate Plasticizer	C
Crude Oil	A	Potassium Chloride	A
Diesel Fuel	A	Potassium Sulphate	A
Ethyl Acetate	C	Salt Water (15%)	A
Ethanol	A	Sea Water	A
Furfural	C	Sodium Acetate Solution	A
Gasoline	B	Sodium Bisulfite Solution	A
Glycerine	A	Sodium Hydroxide (60%)	A
Hydraulic Fluid (Mineral)	A	Sodium Phosphate	A
Hydrochloric Acid (50%)	A	Sulphuric Acid (50%)	A
Hydrofluoric Acid (50%)	A	Tanic Acid (50%)	A
Hydrofluorosilic Acid (30%)	A	Toluene	B
Isopropyl Alcohol	A	Transformer Oil	A
JP-4 Jet Fuel	A	Turpentine	A
Kerosene	A	Urea Formaldehyde	A
Linseed Oil	A	Vegetable Oil	A
Magnesium Chloride	A	Water (200° F)	A
Magnesium Hydroxide	A	Xylene	B
		Zinc Chloride	A

ATL® PORT-A-BERM™ Liner System
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