This document was too large to scan as a single document. It has been divided into smaller sections.

Section 10 of 14

Document Information			
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The model estimated the mass flow rate for each of the fifty organic compounds in the post-evaporator, the LAW, and the HLW streams shown in Appendix A, Tables 2, 3, and 4, respectively. Each unmodeled organic compound was then assigned, by stream, a mass flow rate associated with the appropriate Henry's Grouping. Some of the Henry's Groupings contain more than one modeled compound. In that case, the mass flow rates were averaged, and the average value was assigned to the unmodeled organic compounds in that Henry's Grouping. Appendix A, Table 6 shows the Henry's Grouping number and corresponding mass flow rate assigned to each organic compound, both modeled and unmodeled, in the post-evaporator stream; Appendix A, Table 8 shows the LAW stream; and Appendix A, Table 9 shows the HLW stream.

The formula given in the EPA guidance (1995) in section 2.1 to estimate the release of organic compounds requires the organic concentration to be expressed as a weight fraction. The mass flow rates were converted to weight fractions using the respective density for the three streams. The density used for this calculation is the density of the liquid phase of the waste stream being evaluated since the model apportioned the organic compounds to the liquid phase. A conversion factor was calculated to convert from mass flow rate to weight fraction according to the following formula:

$$\text{Conversion Factor} = Q_M \text{ g/s} \cdot 60 \text{ s/min} \cdot \text{min}/Q_V \cdot 35.315 \text{ ft}^3/1000\text{L} \cdot 1000 \text{ mg/g} \cdot 1/\rho \text{ kg/L}$$

Where:
Q_M = mass flow rate of the individual organic compound
Q_V = volumetric flow rate of the evaluated stream
ρ = density of the liquid phase of the evaluated stream

Appendix A, Table 6 shows the mass flow rate and conversion to a weight fraction for each of the organic compounds for the post-evaporator stream. The individual weight fractions were summed to yield the waste stream organic weight fraction, WF_S, for the post-evaporator stream. Appendix A, Table 8 presents the same information for the LAW stream, and Appendix A, Table 9 presents the same information for the HLW stream. The waste stream organic weight fractions, WF_S, for each of the evaluated streams was entered into Appendix A, Table 1.

4 Estimated Release of Organic Compounds

The *Human Health Risk Assessment Protocol* (EPA 1998) presents a method to speciate the release of organic compounds by multiplying the weight ratio of each individual organic compound by the total release from the waste streams being evaluated. This method was used to estimate the individual organic compound released into the WTP process cells for each of the evaluated streams.

The weight ratio for each organic compound for each stream was determined by dividing the individual organic compound weight fraction by the total weight fraction of all organic compounds in that stream.

The estimated release of each individual organic compound for each stream, R_{IO}, was then determined by multiplying the estimated release for the stream, ER_O, from Appendix A, Table 1 times the individual organic compound weight ratio, WR_i. These calculations were made for the pretreatment feed stream, the post-evaporator stream, the LAW stream, and the HLW stream. The resulting estimated releases into the process cells are given in Appendix A, Tables 5, 6, 8, and 9, respectively.

5 Estimated Emission of Organic Compounds

This section discusses the calculation of the estimated emission of organic compounds from the WTP process cells.

5.1 Unabated Organic Compound Emissions

Only a portion of the organic compound released into the process cells will result in unabated emissions. Organic compounds that are particle-bound or particulate will be abated by the high-efficiency particulate air (HEPA) filters. The Emission Baseline Report (24590-WTP-RPT-03-008) separated the organic compounds into particle-bound or particulate, and vapor phase. According to the Emission Baseline Report (24590-WTP-RPT-03-008), HEPA filters will abate the particle-bound or particulate organic compounds at a decontamination factor of two hundred thousand. Therefore, particle-bound or particulate organic compounds were not considered as uncontrolled emissions in this calculation.

Vapor phase organic compounds released into the process cells will not be captured by the HEPA filters and will represent potential unabated emissions. Appendix A, Table 5 gives the estimated organic vapor emission, R_{VO}, from the pretreatment feed stream by listing the release of each vapor phase organic compound as an emission and each particle-bound or particulate organic compound as zero emission. This process is repeated for the post-evaporator stream in Appendix A, Table 6. The feed stream and post-evaporator stream releases are summed in Appendix A, Table 7 to give the estimated emission of organic compounds from the pretreatment process cells. Appendix A, Table 8 gives the estimated emission of organic compounds from the LAW process cells, and Appendix A, Table 9 gives the estimated emission of organic compounds from the HLW process cells.

5.2 Potential Emissions Not Considered

The Emission Baseline Report (24590-WTP-RPT-03-008) proposed that the temperature and conditions in the melters and thermal oxidation units are sufficient to generate products of incomplete combustion (PICs) that would be introduced into the offgas streams. The melter offgas containing the PICs will be treated by a melter submerged bed scrubber, which will recycle scrubber liquor back into the pretreatment process. However, the Emission Baseline Report (24590-WTP-RPT-03-008) predicted that PICs recycled to the pretreatment plant will be at concentrations orders-of-magnitude less than the constituent organic compounds. Thus, PICs were not included as emissions in this calculation.

6 References

6.1 Codes and Standards

EPA 1995. *Protocol for Equipment Leak Emission Estimates*, EPA-453/R-95-017. November 1995. US Environmental Protection Agency, Research Triangle Park, North Carolina, USA.

EPA 1998. *Human Health Risk Assessment Protocol*, EPA530-D-98-001A. July 1998. US Environmental Protection Agency, Research Triangle Park, North Carolina, USA.

WAC 173-400. *General Regulations for Air Pollution Sources*, as amended. Washington Administrative Code.

6.2 Project Documents

24590-LAW-RPT-ENG-01-001, Rev. 0, *LAW Vitrification Capacity and Availability Study.*

CCN 023430, Meeting Minutes from 9/6/2001 and 9/7/2001 Meeting with the following purpose: "Discuss Proposed Final Resolution of Remaining Open Comments on the Risk Assessment Work Plan, Item 27.

CCN 068045, E-mail message from Ian Tanner to John Sipkowski, 28 May 2003, "Jumper Breakdown for Environmental Risk Assessment."

CCN 068046, E-mail message from Steven Cross to John Sipkowski, 28 May 2003, "Jumper Counts – Slurry Carrying Jumpers."

CCN 068047, E-mail message from Connie Feuz to John Sipkowski, 4 June 2003, "Connector Count."

PIL-4.08.06, Plant Item List, September, 2001.

24590-WTP-RPT-PO-03-008, Rev. 0, *Integrated Emissions Baseline Report for the Hanford Tank Waste Treatment and Immobilization Plant.*

RPT-24590-EN00003, Rev. 0, *RPP-WTP Waste Feed Assessment.*

Appendix A

Excel Worksheets:

Table 1. Estimate of the Release of Organic Compounds from Ancillary Equipment A-1

Table 2. Post-Evaporator Concentration and Henry's Law Grouping A-2

Table 3. LAW Stream Concentration and Henry's Law Grouping A-3

Table 4. HLW Stream Concentration and Henry's Law Grouping A-4

Table 5. Estimate of Organic Emissions from the Pretreatment Feed Stream A-5

Table 6. Estimate of Organic Emissions from the Post-Evaporator Stream A-9

Table 7. Estimate of Organic Emissions from Pretreatment Process Cells A-14

Table 8. Estimate of Organic Emissions from the LAW Process Cells A-20

Table 9. Estimate of Organic Emissions from the HLW Process Cells A-25

The *Protocol for Equipment Lead Emission Estimates* (EPA 1995) provides the following formula to calculate the estimated release of organic material from ancillary equipment.

$E_{HO} = N \times R_{avg} \times WF_S \times H$, where:

E_{HO} = estimated annual release, kg/year

N = ancillary equipment count by equipment type; equipment count was obtained form Melter Systems group, Area Plant Design, and the Plant Item List (PIL-4.08.06)

R_{avg} = average release factor by equipment type, (kg/hour); from *Protocol for Equipment Leak Emission Estimates* (EPA 1995)

WF_S = weight fraction of organic material = WFs from tables 5, 6, 8, and 9 for Pretreatment Feed Stream, Post-Evaporator Stream, LAW Stream, and HLW Stream respectively * 1/(1000*1000) to convert from mg/kg to kg/kg

$ER_O = E_{HO}$ kg/yr * 1000 gm/kg / (365 d/yr * 24 hr/d *60 min/hr * 60 s/min) where:

ER_O = waste stream organic release (gm/s) by equipment type

$ER_{O\text{-}PTF}$ = sum of Pretreatment Feed Stream estimated release = Sum ER_O by equipment type

$ER_{O\text{-}PE}$ = sum of Post-Evaporator Stream estimated release = Sum ER_O by equipment type

$ER_{O\text{-}LA}$ = sum of LAW Stream estimated release = Sum ER_O by equipment type

$ER_{O\text{-}HL}$ = sum of HLW Stream estimated release = Sum ER_O by equipment type

Table 1. Estimate of the Release of Organic Compounds from Ancillary Equipment. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

Plant	Waste Stream	Equipment Type	Count N	R_{avg} (kg/hour)	Waste Stream Organic Weight Fraction WF_S	Operatmg Hours H hr/yr	Estimated Annual Release E_{HO} (kg/yr)	Estimated Release ER_O (gm/s)
Pretreatment	Pretreatment Feed Stream	Valves	15	0.00023	0.0083839	8760	0.2534	8.04E-06
		Connectors	170	0.00183	0.0083839	8760	22.8482	7.25E-04
	Pretreatment Feed Stream Total	**$ER_{O\text{-}PTF}$ =**						**7.33E-04**
	Post-Evaporator Stream	Valves	355	0.00023	0.0014825	8760	1.0604	3.36E-05
		Connectors	978	0.00183	0.0014825	8760	23.2426	7.37E-04
	Post-Evaporator Stream Total	**$ER_{O\text{-}PE}$ =**						**7.71E-04**
LAW	LAW Stream	Valves	32	0.00023	0.002454995	8760	0.1583	5.02E-06
		Connectors	44	0.00183	0.002454995	8760	1.7316	5.49E-05
	LAW Stream Total	**$ER_{O\text{-}LA}$ =**						**5.99E-05**
HLW	HLW Stream	Valves	26	0.00023	0.0010959	8760	0.0574	1.82E-06
		Connectors	48	0.00183	0.0010959	8760	0.8432	2.67E-05
	HLW Stream Total	**$ER_{O\text{-}HL}$ =**						**2.85E-05**

CF_{PE} = 60 sec/min x 1/ Q_V ft^3/min x 35.315 ft^3/1000 L x 1000 mg/L x ρ kg/L = Concentration mg/kg

CF_{PE} = Conversion Factor

Q_V = Volumetric Flow Rate from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet FEP03 = 1.19E+00 ft^3/min

ρ = Density from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet FEP03 = 1.50E+00 kg/L

Note: Un-rounded values for Q_V and ρ rom Sheet FET03 were used for the calculations.

CF_{PE} = 1190.702384

Q_M = Compound Mass Flow Rate from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet FEP03

WF_i = Weight Fraction = Q_M * CF_{PE}

Average Weight Fraction WF_a = average WF_i for Henry's Law Group

Table 2. Post-Evaporator Concentration and Henry's Law Grouping. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

Compound CAS#	Organic Compounds	Compound Mass Flow Rate Q_M g/s	Individual Organic Weight Fraction. WF_i mg/kg	Henry's Law Grouping HL	Henry's Law Group Average Organic Weight Fraction. WF_a mg/kg
100-21-0	p-Phthalic acid	4.82E-02	5.74E+01	1	5.74E+01
88-89-1	Picric acid	5.99E-02	7.13E+01	2	7.13E+01
144-62-7	Oxalic acid	4.83E-03	5.75E+00	3	5.75E+00
75-12-7	Formamide	4.80E-02	5.72E+01	4	5.72E+01
60-35-5	Acetamide	1.05E-02	1.24E+01	5	1.24E+01
87-86-5	Pentachlorophenol	4.63E-02	5.51E+01	6	5.51E+01
126-73-8	Tributyl phosphate	3.81E-02	4.54E+01	7	4.54E+01
108-95-2	Phenol	3.00E-02	3.57E+01	8	3.49E+01
84-66-2	Diethyl phthalate	2.24E-02	2.67E+01	8	3.49E+01
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	3.55E-02	4.23E+01	8	3.49E+01
62-75-9	N-Nitroso-N,N-dimethylamine	1.94E-02	2.31E+01	9	2.31E+01
122-39-4	N,N-Diphenylamine	1.33E-03	1.58E+00	10	8.11E-01
8001-35-2	Toxaphene	3.50E-05	4.17E-02	10	8.11E-01
4170-30-3	2-Butenaldehyde (2-Butenal)	4.69E-04	5.58E-01	11	1.90E+00
58-90-2	2,3,4,6-Tetrachlorophenol	2.34E-03	2.78E+00	11	1.90E+00
98-86-2	Acetophenone	1.98E-03	2.36E+00	11	1.90E+00
57-14-7	1,1-Dimethylhydrazine	1.63E-03	1.94E+00	12	1.94E+00
120-12-7	Anthracene	2.62E-04	3.12E-01	13	2.49E-01
75-05-8	Acetonitrile	1.56E-04	1.86E-01	13	2.49E-01
208-96-8	Acenaphthylene	8.79E-05	1.05E-01	14	1.05E-01
132-64-9	Dibenzofuran	2.88E-05	3.43E-02	15	3.43E-02
106-93-4	Ethylene dibromide (Dibromethane)	2.80E-06	3.33E-03	16	1.33E-03
76-44-8	Heptachlor	3.29E-07	3.92E-04	16	1.33E-03
91-20-3	Naphthalene	2.25E-07	2.68E-04	16	1.33E-03
120-82-1	1,2,4-Trichlorobenzene	1.08E-07	1.29E-04	17	1.29E-04
118-74-1	Hexachlorobenzene	6.76E-09	8.05E-06	18	8.05E-06
10061-01-5	cis-1,3-Dichloropropene	2.16E-08	2.57E-05	19	1.06E-05
108-88-3	Toluene	1.94E-09	2.31E-06	19	1.06E-05
71-43-2	Benzene	3.19E-09	3.80E-06	19	1.06E-05
79-01-6	Trichloroethylene	6.57E-10	7.82E-07	20	7.31E-07
87-68-3	Hexachlorobutadiene	5.70E-10	6.79E-07	20	7.31E-07
127-18-4	Perchloroethylene (tetrachloroethylene)	1.20E-10	1.43E-07	21	1.43E-07
56-23-5	Carbon tetrachloride	3.25E-11	3.86E-08	22	3.86E-08
106-99-0	1,3-Butadiene	1.78E-12	2.12E-09	23	2.12E-09
110-82-7	Cyclohexane	2.13E-13	2.53E-10	24	2.53E-10
108-87-2	Methylcyclohexane	9.07E-15	1.08E-11	25	1.08E-11
106-97-8	Butane	8.13E-16	9.68E-13	26	9.68E-13
110-54-3	n-Hexane	1.23E-16	1.47E-13	27	1.47E-13
111-84-2	n-Nonane	1.86E-17	2.22E-14	28	2.22E-14
76-15-3	Chloropentafluoroethane	4.19E-18	4.99E-15	29	4.99E-15
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	1.16E-04	1.38E-01	30	3.21E-01
50-32-8	Benzo(a)pyrene	4.23E-04	5.04E-01	30	3.21E-01
84-74-2	Dibutyl phthalate	1.29E-02	1.53E+01	31	1.53E+01
218-01-9	Chrysene	4.88E-03	5.81E+00	32	3.47E+00
58-89-9	gamma-BHC (Lindane)	1.73E-05	2.06E-02	32	3.47E+00
603-34-9	Triphenylamine	3.84E-03	4.57E+00	32	3.47E+00
129-00-0	Pyrene	2.21E-03	2.63E+00	33	1.33E+00
60-57-1	Dieldrin	1.86E-05	2.21E-02	33	1.33E+00
309-00-2	Aldrin	7.54E-06	8.98E-03	34	8.98E-03
1336-36-3	Polychlorinated biphenyls (PCBs)	5.01E-05	5.97E-02	35	5.97E-02

CF_{LA} = 60 sec/min x 1/ Q_V ft^3/min x 35.315 ft^3/1000 L x 1000 mg/L x ρ kg/L = Concentration mg/kg
CF_{LA} = Conversion Factor
Q_V = Volumetric Flow Rate from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet TCP03 = 4.24E-01 ft^3/min
ρ = Density from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet TCP03 = 1.76E+00 kg/L
Note. Un-rounded values for Q_V and ρ rom Sheet TCP03 were used for the calculations.
CF_{LA} = 2835.87806

Q_M = Compound Mass Flow Rate from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet FEP03
WF_i = Weight Fraction = Q_M * CF_{LA}
Average Weight Fraction WF_a = average WF_i for Henry's Law Group

Table 3. LAW Stream Concentration and Henry's Law Grouping. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

Compound CAS#	Organic Compounds	Compound Mass Flow Rate Q_m g/s	Individual Organic Weight Fraction. WF_i mg/kg	Henry's Law Grouping HL	Henry's Law Group Average Organic Weight Fraction. WF_a mg/kg
100-21-0	p-Phthalic acid	2.73E-02	77.48	1	7.75E+01
88-89-1	Picric acid	3.64E-01	1032.27	2	1.03E+03
144-62-7	Oxalic acid	2.73E-03	7.73	3	7.73E+00
75-12-7	Formamide	2.72E-02	77.05	4	7.71E+01
60-35-5	Acetamide	5.81E-03	16.47	5	1.65E+01
87-86-5	Pentachlorophenol	2.50E-02	70.99	6	7.10E+01
126-73-8	Tributyl phosphate	1.67E-02	47.44	7	4.74E+01
108-95-2	Phenol	1.04E-02	29.37	8	3.48E+01
84-66-2	Diethyl phthalate	5.83E-03	16.54	8	3.48E+01
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	2.06E-02	58.53	8	3.48E+01
62-75-9	N-Nitroso-N,N-dimethylamine	2.42E-03	6.86	9	6.86E+00
122-39-4	N,N-Diphenylamine	9.65E-05	0.27	10	1.38E-01
8001-35-2	Toxaphene	9.31E-07	0.00	10	1.38E-01
4170-30-3	2-Butenaldehyde (2-Butenal)	1.28E-05	0.04	11	1.24E-01
58-90-2	2,3,4,6-Tetrachlorophenol	6.86E-05	0.19	11	1.24E-01
98-86-2	Acetophenone	4.94E-05	0.14	11	1.24E-01
57-14-7	1,1-Dimethylhydrazine	3.45E-05	0.10	12	9.79E-02
120-12-7	Anthracene	9.40E-07	0.00	13	2.71E-03
75-05-8	Acetonitrile	9.73E-07	0.00	13	2.71E-03
208-96-8	A	1.13E-07	0.00	14	3.20E-04
132-64-9	Dibenzofuran	5.68E-09	0.00	15	1.61E-05
106-93-4	Ethylene dibromide (Dibromethane)	1.12E-11	0.00	16	1.06E-08
76-44-8	Heptachlor	0.00E+00	0.00	16	1.06E-08
91-20-3	Naphthalene	0.00E+00	0.00	16	1.06E-08
120-82-1	1,2,4-Trichlorobenzene	0.00E+00	0.00	17	0.00E+00
118-74-1	Hexachlorobenzene	0.00E+00	0.00	18	0.00E+00
10061-01-5	cis-1,3-Dichloropropene	0.00E+00	0.00	19	0.00E+00
108-88-3	Toluene	0.00E+00	0.00	19	0.00E+00
71-43-2	Benzene	0.00E+00	0.00	19	0.00E+00
79-01-6	Trichloroethylene	0.00E+00	0.00	20	0.00E+00
87-68-3	Hexachlorobutadiene	0.00E+00	0.00	20	0.00E+00
127-18-4	Perchloroethylene (tetrachloroethylene)	0.00E+00	0.00	21	0.00E+00
56-23-5	Carbon tetrachloride	0.00E+00	0.00	22	0.00E+00
106-99-0	1,3-Butadiene	0.00E+00	0.00	23	0.00E+00
110-82-7	Cyclohexane	0.00E+00	0.00	24	0.00E+00
108-87-2	Methylcyclohexane	0.00E+00	0.00	25	0.00E+00
106-97-8	Butane	0.00E+00	0.00	26	0.00E+00
110-54-3	n-Hexane	0.00E+00	0.00	27	0.00E+00
111-84-2	n-Nonane	0.00E+00	0.00	28	0.00E+00
76-15-3	Chloropentafluoroethane	0.00E+00	0.00	29	0.00E+00
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	3.42E-05	0.10	30	2.39E-01
50-32-8	Benzo(a)pyrene	1.34E-04	0.38	30	2.39E-01
84-74-2	Dibutyl phthalate	2.02E-03	5.73	31	5.73E+00
218-01-9	Chrysene	2.64E-04	0.75	32	4.21E-01
58-89-9	gamma-BHC (Lindane)	5.41E-07	0.00	32	4.21E-01
603-34-9	Triphenylamine	1.81E-04	0.51	32	4.21E-01
129-00-0	Pyrene	4.99E-05	0.14	33	7.11E-02
60-57-1	Dieldrin	2.65E-07	0.00	33	7.11E-02
309-00-2	Aldrin	1.30E-08	0.00	34	3.67E-05
1336-36-3	Polychlorinated biphenyls (PCBs)	6.02E-11	0.00	35	1.71E-07

CF_{HL} = 60 sec/min x 1/ Q_V ft^3/min x 35.315 ft^3/1000 L x 1000 mg/L x 1 ρ kg/L = Concentration mg/kg
CF_{HL} = Conversion Factor
Q_V = Volumetric Flow Rate from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet HLP09 = 7.65E-01 ft^3/min
ρ : Density from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet HLP09 = 1.04E+00 kg/L
Note Un-rounded values for QV and ρ from Sheet HLP09 were used for the calculations.
CF_{HL} = 2652.33539

Q_M = Compound Mass Flow Rate from the Emission Baseline Report (24590-WTP-RPT-PO-03-008), Sheet FEP03
WF_i = Weight Fraction = Q_M * CF_{HL}
Average Weight Fraction WF_a = average WF_i for Henry's Law Group

Table 4. HLW Stream Concentration and Henry's Law Grouping. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

Compound CAS#	Organic Compounds	Compound Mass Flow Rate Q_m g/s	Individual Organic Weight Fraction. WF_i mg/kg	Henry's Law Grouping HL	Henry's Law Group Average Organic Weight Fraction. WF_a mg/kg
100-21-0	p-Phthalic acid	7.49E-03	19.87	1	1.99E+01
88-89-1	Picric acid	9.30E-03	24.68	2	2.47E+01
144-62-7	Oxalic acid	7.51E-04	1.99	3	1.99E+00
75-12-7	Formamide	7.48E-03	19.85	4	1.98E+01
60-35-5	Acetamide	1.66E-03	4.40	5	4.40E+00
87-86-5	Pentachlorophenol	7.54E-03	20.00	6	2.00E+01
126-73-8	Tributyl phosphate	7.59E-03	20.14	7	2.01E+01
108-95-2	Phenol	7.39E-03	19.59	8	2.21E+01
84-66-2	Diethyl phthalate	6.97E-03	18.48	8	2.21E+01
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	1.07E-02	28.29	8	2.21E+01
62-75-9	N-Nitroso-N,N-dimethylamine	1.09E-02	28.81	9	2.88E+01
122-39-4	N,N-Diphenylamine	1.14E-03	3.02	10	1.57E+00
8001-35-2	Toxaphene	4.52E-05	0.12	10	1.57E+00
4170-30-3	2-Butenaldehyde (2-Butenal)	8.77E-04	2.33	11	7.83E+00
58-90-2	2,3,4,6-Tetrachlorophenol	4.09E-03	10.85	11	7.83E+00
98-86-2	Acetophenone	3.89E-03	10.32	11	7.83E+00
57-14-7	1,1-Dimethylhydrazine	3.65E-03	9.67	12	9.67E+00
120-12-7	Anthracene	1.23E-03	3.28	13	2.48E+00
75-05-8	Acetonitrile	6.35E-04	1.69	13	2.48E+00
208-96-8	Acenaphthylene	3.94E-04	1.05	14	1.05E+00
132-64-9	Dibenzofuran	9.06E-05	0.24	15	2.40E-01
106-93-4	Ethylene dibromide (Dibromethane)	2.33E-06	0.01	16	3.04E-03
76-44-8	Heptachlor	7.72E-07	0.00	16	3.04E-03
91-20-3	Naphthalene	3.32E-07	0.00	16	3.04E-03
120-82-1	1,2,4-Trichlorobenzene	2.66E-08	0.00	17	7.06E-05
118-74-1	Hexachlorobenzene	1.22E-09	0.00	18	3.23E-06
10061-01-5	cis-1,3-Dichloropropene	1.66E-09	0.00	19	1.55E-06
108-88-3	Toluene	2.73E-11	0.00	19	1.55E-06
71-43-2	Benzene	6.36E-11	0.00	19	1.55E-06
79-01-6	Trichloroethylene	4.37E-12	0.00	20	1.03E-08
87-68-3	Hexachlorobutadiene	3.44E-12	0.00	20	1.03E-08
127-18-4	Perchloroethylene (tetrachloroethylene)	2.48E-13	0.00	21	6.57E-10
56-23-5	Carbon tetrachloride	2.75E-14	0.00	22	7.29E-11
106-99-0	1,3-Butadiene	2.11E-16	0.00	23	5.60E-13
110-82-7	Cyclohexane	1.24E-24	0.00	24	3.30E-21
108-87-2	Methylcyclohexane	0.00E+00	0.00	25	0.00E+00
106-97-8	Butane	0.00E+00	0.00	26	0.00E+00
110-54-3	n-Hexane	0.00E+00	0.00	27	0.00E+00
111-84-2	n-Nonane	0.00E+00	0.00	28	0.00E+00
76-15-3	Chloropentafluoroethane	0 00E+00	0.00	29	0.00E+00
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	3 15E-05	0.08	30	1.97E-01
50-32-8	Benzo(a)pyrene	1.17E-04	0.31	30	1.97E-01
84-74-2	Dibutyl phthalate	7.33E-03	19.45	31	1.94E+01
218-01-9	Chrysene	5.79E-03	15.36	32	9.24E+00
58-89-9	gamma-BHC (Lindane)	1.99E-05	0.05	32	9.24E+00
603-34-9	Triphenylamine	4.65E-03	12.32	32	9.24E+00
129-00-0	Pyrene	4.82E-03	12.79	33	6.44E+00
60-57-1	Dieldrin	3.51E-05	0.09	33	6.44E+00
309-00-2	Aldrin	3.35E-05	0.09	34	8.88E-02
1336-36-3	Polychlorinated biphenyls (PCBs)	7.98E-05	0.21	35	2.12E-01

C_O = organic concentration; values are from the RPP-WTP Waste Feed Assessment (RPT-24590-EN00003)
ρ = density; values are from RPP-WTP Waste Feed Assessment (RPT-24590-EN00003)
$WF_i = C_O / \rho$
WF_i = the weight fraction of the individual organic compound
WF_S = Sum WF_i
WR_i = the ratio of the individual organic compound weight fraction to the sum of the individual weight fraction = WFi / WF_S
WR_S = Sum WR_i
$R_{IO} = WR_i * ER_{O\text{-}PTF}$; $ER_{O\text{-}PTF}$ is from Table 1
R_{VO} = vapor emissions; R_{VO} is "0" if the compound is a particle or is particle-bound
P = particle; cell has an "X" if the compound is a particle or is particle-bound

Table 5. Estimate of Organic Emissions from the Pretreatment Feed Stream. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compounds	Organic Conc. C_O mg/L	Density ρ kg/L	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
100-00-5	p-Nitrochlorobenzene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
100-21-0	p-Phthalic acid	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
100-25-4	1,4-Dinitrobenzene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
100-41-4	Ethyl benzene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
100-42-5	Styrene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
10061-01-5	cis-1,3-Dichloropropene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
10061-02-6	trans-1,3-Dichloropropene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
101-55-3	4-Bromophenylphenyl ether	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
101-84-8	Diphenyl ether	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
106-35-4	3-Heptanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
106-42-3	p-Xylene (Dimethyl benzene)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
106-46-7	1,4-Dichlorobenzene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
106-88-7	1,2-Epoxybutane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
106-93-4	Ethylene dibromide (Dibromethane)	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
106-97-8	Butane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
106-99-0	1,3-Butadiene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
107-02-8	Acrolein	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
107-05-1	3-Chloropropene (Allyl chloride)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
107-06-2	1,2-Dichloroethane (Ethylene chloride)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
107-12-0	Propionitrile	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
107-13-1	Acrylonitrile	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
107-18-6	2-Propene-1-ol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
107-31-3	Formic acid, methyl ester	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
107-66-4	Dibutylphosphate	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
107-87-9	2-Pentanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-03-2	1-Nitropropane	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
108-05-4	Vinyl acetate	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
108-10-1	Hexone (4-Methyl-2-pentanone or MIBK)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-20-3	Bis(isopropyl)ether	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-38-3	m-Xylene (Dimethyl benzene)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-39-4	m-Cresol	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-87-2	Methylcyclohexane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-88-3	Toluene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-90-7	Chlorobenzene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-93-0	Cyclohexanol	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-94-1	Cyclohexanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
108-95-2	Phenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
109-66-0	n-Pentane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
109-99-9	Tetrahydrofuran	39.6	1.35	29.3	3.50E-03	2.57E-06	2.57E-06	
110-12-3	5-Methyl-2-hexanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
110-43-0	2-Heptanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
110-54-3	n-Hexane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
110-62-3	n-Valeraldehyde	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
110-82-7	Cyclohexane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
110-83-8	Cyclohexene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
110-86-1	Pyridine	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
111-65-9	n-Octane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
111-76-2	Ethylene glycol monobutyl ether	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
111-84-2	n-Nonane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
117-84-0	n-Dioctyl phthalate	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
118-74-1	Hexachlorobenzene	1.8	1.35	1.3	1.60E-04	1.20E-07	1.20E-07	

Table 5. Estimate of Organic Emissions from the Pretreatment Feed Stream. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compounds	Organic Conc. C_O mg/L	Density ρ kg/L	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
120-12-7	Anthracene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
120-82-1	1,2,4-Trichlorobenzene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
120-83-2	2,4-Dichlorophenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
121-44-8	Triethylamine	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
121-69-7	Dimethylaniline	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
122-39-4	N,N-Diphenylamine	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
123-19-3	4-Heptanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
123-38-6	n-Propionaldehyde	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
123-51-3	3-Methyl-1-butanol	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
123-86-4	Acetic acid n-butyl ester	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
123-91-1	1,4-Dioxane	50.9	1.35	37.7	4.50E-03	3.30E-06	3.30E-06	
126-73-8	Tributyl phosphate	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
126-98-7	2-Methyl-2-propenenitrile (Methacrylonitrile)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
127-18-4	Perchloroethylene (tetrachloroethylene)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
127-19-5	N,N-Dimethylacetamide	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
128-37-0	2,6-Bis(tert-butyl)-4-methylphenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
129-00-0	Pyrene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
1321-64-8	Pentachloronaphthalene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
1321-65-9	Trichloronaphthalene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
132-64-9	Dibenzofuran	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
1335-87-1	Hexachloronaphthalene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
1335-88-2	Tetrachloronaphthalene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
1336-36-3	Polychlorinated biphenyls (PCBs)	29.4	1.35	21.8	2.60E-03	1.91E-06	0.00E+00	X
141-78-6	Acetic acid ethyl ester (Ethyl acetate)	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
141-79-7	4-Methyl-3-penten-2-one	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
142-82-5	n-Heptane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
144-62-7	Oxalic acid	8.5	1.35	6.3	7.50E-04	5.50E-07	5.50E-07	
156-60-5	trans-1,2-Dichloroethylene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
1582-09-8	Trifluralin	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
1634-04-4	Methyl tert-butyl ether	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
1836-75-5	Nitrofen	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
189-55-9	Dibenzo[a,i]pyrene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
189-64-0	Dibenzo[a,h]pyrene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
191-24-2	Benzo(g,h,i)perylene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
191-30-0	Benzo[a,i]pyrene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
192-65-4	Dibenzo[a,e]pyrene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
193-39-5	Indeno(1,2,3-cd)pyrene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
205-82-3	Benzo(j)fluoranthene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
205-99-2	Benzo(b)fluoranthene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
206-44-0	Fluoranthene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
207-08-9	Benzo(k)fluoranthene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
208-96-8	Acenaphthylene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
218-01-9	Chrysene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
2234-13-1	Octachloronaphthalene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
224-42-0	Dibenz[a,j]acridine	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
226-36-8	Dibenz[a,h]acridine	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
2385-85-5	Mirex	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
25551-13-7	Trimethyl benzene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
26140-60-3	Terphenyls	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
27154-33-2	Trichlorofluoroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
287-92-3	Cyclopentane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
309-00-2	Aldrin	1	1.35	0.7	9.00E-05	7.00E-08	0.00E+00	X
319-84-6	Hexachlorocyclohexane (Lindane) Alpha BHC	0.3	1.35	0.2	3.00E-05	2.00E-08	2.00E-08	
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	0.3	1.35	0.2	3.00E-05	2.00E-08	0.00E+00	X
319-86-8	Delta-BHC	0.3	1.35	0.2	3.00E-05	2.00E-08	0.00E+00	X
3697-24-3	5-Methylchrysene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
3825-26-1	Ammonium perfluorooctanoate	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
4170-30-3	2-Butenaldehyde (2-Butenal)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
465-73-6	Isodrin	0.6	1.35	0.4	5.00E-05	4.00E-08	4.00E-08	
50-00-0	Formaldehyde	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
50-29-3	4,4-DDT	0.6	1.35	0.4	5.00E-05	4.00E-08	0.00E+00	X
50-32-8	Benzo(a)pyrene	1.1	1.35	0.8	1.00E-04	7.00E-08	0.00E+00	X
53-70-3	Dibenzo(a,h)anthracene	0.1	1.35	0.1	1.00E-05	1.00E-08	0.00E+00	X
540-59-0	1,2-Dichloroethylene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	

Table 5. Estimate of Organic Emissions from the Pretreatment Feed Stream. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compounds	Organic Conc. C_O mg/L	Density ρ kg/L	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
540-84-1	2,2,4-Trimethylpentane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
541-73-1	1,3-Dichlorobenzene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
56-23-5	Carbon tetrachloride	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
563-80-4	3-Methyl-2-butanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
56-49-5	3-Methylcholanthrene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
56-55-3	Benzo(a)anthracene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
57-14-7	1,1-Dimethylhydrazine	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
58-89-9	gamma-BHC (Lindane)	0.3	1.35	0.2	3.00E-05	2.00E-08	0.00E+00	X
58-90-2	2,3,4,6-Tetrachlorophenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
591-78-6	2-Hexanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
59-50-7	4-Chloro-3-methylphenol	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
59-89-2	N-Nitrosomorpholine	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
602-87-9	5-Nitroacenaphthene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
60-29-7	Ethyl ether	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
603-34-9	Triphenylamine	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
60-34-4	Methylhydrazine	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
60-35-5	Acetamide	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
60-57-1	Dieldrin	0.6	1.35	0.4	5.00E-05	4.00E-08	0.00E+00	X
621-64-7	Di-n-Propylnitrosamine	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
624-83-9	Methyl isocyanate	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
627-13-4	Nitric acid, propyl ester	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
62-75-9	N-Nitroso-N,N-dimethylamine	158.4	1.35	117.3	1.40E-02	1.03E-05	1.03E-05	
630-20-6	1,1,1,2-Tetrachloroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
64-17-5	Ethyl alcohol	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
64-18-6	Formic acid	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
64-19-7	Acetic acid	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
67-56-1	Methyl alcohol (Methanol)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
67-63-0	2-Propyl alcohol (Isopropanol)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
67-64-1	2-Propanone (Acetone)	101.8	1.35	75.4	8.99E-03	6.59E-06	6.59E-06	
67-66-3	Chloroform	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
67-72-1	Hexachloroethane	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
684-16-2	Hexafluoroacetone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
71-23-8	n-Propyl alcohol	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
71-36-3	n-Butyl alcohol	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
71-43-2	Benzene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
72-20-8	Endrin	0.6	1.35	0.4	5.00E-05	4.00E-08	0.00E+00	X
72-43-5	Methoxychlor	2.8	1.35	2.1	2.50E-04	1.80E-07	0.00E+00	X
72-54-8	4,4-DDD	0.6	1.35	0.4	5.00E-05	4.00E-08	0.00E+00	X
72-55-9	4,4-DDE	0.6	1.35	0.4	5.00E-05	4.00E-08	0.00E+00	X
74-83-9	Bromomethane (Methyl bromide)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
74-87-3	Chloromethane (Methyl chloride)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
74-97-5	Bromochloromethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
74-99-7	Methylacetylene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
75-00-3	Chloroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-01-4	Vinyl chloride (1-Chloroethene)	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
75-05-8	Acetonitrile	26.6	1.35	19.7	2.35E-03	1.72E-06	1.72E-06	
75-07-0	Acetaldehyde	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
75-09-2	Dichloromethane (Methylene chloride)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-12-7	Formamide	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
75-15-0	Carbon disulfide	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-21-8	Ethylene oxide (Oxirane)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-27-4	Bromodichloromethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-34-3	1,1-Dichloroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-35-4	1,1-Dichloroethene (Vinylidene chloride)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-43-4	Dichlorofluoromethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-45-6	Chlorodifluoromethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-50-3	Trimethylamine	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-52-5	Nitromethane	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
75-55-8	2-Methylaziridine	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
75-61-6	Difluorodibromomethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-63-8	Trifluorobromomethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-65-0	2-Methyl-2-propanol	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-69-4	Trichlorofluoromethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	

Table 5. Estimate of Organic Emissions from the Pretreatment Feed Stream. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compounds	Organic Conc. C_O mg/L	Density ρ kg/L	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
75-71-8	Dichlorodifluoromethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
75-99-0	2,2-Dichloropropionic acid	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
76-03-9	Trichloroacetic acid	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
76-11-9	1,1,1,2-Tetrachloro-2,2-difluoroethane	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
76-12-0	1,1,2,2-Tetrachloro-1,2-difluoroethane	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
76-13-1	1,2,2-Trichloro-1,1,2-trifluoroethane (Freon 113)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
76-15-3	Chloropentafluoroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
76-44-8	Heptachlor	1.8	1.35	1.3	1.60E-04	1.20E-07	1.20E-07	
78-83-1	2-Methylpropyl alcohol (Isobutyl alcohol)	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
78-87-5	1,2-Dichloropropane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
78-92-2	1-Methylpropyl alcohol (2-Butanol)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
78-93-3	Methyl ethyl ketone (MEK, 2-Butanone)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
79-00-5	1,1,2-Trichloroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
79-01-6	Trichloroethylene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
79-09-4	Propionic acid	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
79-10-7	2-Propenoic acid	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
79-20-9	Methyl acetate	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
79-34-5	1,1,2,2-Tetrachloroethane	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
8001-35-2	Toxaphene	0.7	1.35	0.5	6.00E-05	4.00E-08	0.00E+00	X
82-68-8	Pentachloronitrobenzene (PCBN)	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
83-32-9	Acenaphthene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
84-66-2	Diethyl phthalate	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
84-74-2	Dibutyl phthalate	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
85-01-8	Phenanthrene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
85-68-7	Butylbenzyl phthalate	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
86-73-7	Fluorene	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
87-68-3	Hexachlorobutadiene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
87-86-5	Pentachlorophenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
88-06-2	2,4,6-Trichlorophenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
88-72-2	2-Nitrotoluene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
88-75-5	2-Nitrophenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
88-89-1	Picric acid	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
91-20-3	Naphthalene	2.8	1.35	2.1	2.50E-04	1.80E-07	1.80E-07	
91-22-5	Quinoline	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
91-58-7	2-Chloronapthalene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
92-52-4	1,1`-Biphenyl	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
92-93-3	4-Nitrobiphenyl	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
93-72-1	Silvex (2,4,5-TP)	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
93-76-5	2,4,5-T	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
94-75-7	2,4-D and esters (160C typed)	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
95-13-6	Indene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
95-47-6	o-Xylene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
95-48-7	o-Cresol (2-Methylphenol)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
95-49-8	2-Chlorotoluene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
95-50-1	o-Dichlorobenzene (1,2-Dichlorobenzene)	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
95-57-8	2-Chlorophenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
95-95-4	2,4,5-Trichlorophenol	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
96-22-0	3-Pentanone	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
96-69-5	Bis(3-tert-butyl-4-hydroxy-6-methyl-phenyl)sulfide	84.8	1.35	62.8	7.49E-03	5.49E-06	0.00E+00	X
98-51-1	p-tert-Butyltoluene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
98-82-8	Cumene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
98-83-9	alpha-Methylstyrene	18.7	1.35	13.9	1.65E-03	1.21E-06	1.21E-06	
98-86-2	Acetophenone	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
98-95-3	Nitrobenzene	84.8	1.35	62.8	7.49E-03	5.49E-06	5.49E-06	
	Weight Fraction Sum = WF_S =			8383.9				
	Weight Ratio Sum = WR_S =				1.0			
	Pretreatment Feed Stream Sum = $ER_{O\text{-}PTF}$ =					7.33E-04		
	Pretreatment Feed Stream Vapor Organic Release Sum = R_{VOS} =						5.11E-04	

HL = Henry's Law Groupings; values for HL are from the Emission Baseline Report (23590-WTP-RPT-PO-03-008)
WF_i = the weight fraction of the individual organic compound; values are assigned from Table 2 based on HL
WF_S = Sum WF_i
WR_i = the ratio of the individual organic compound weight fraction to the sum of the individual weight fraction = WFi / WF_S
WR_S = Sum WR_i
R_{IO} = WR_i * $ER_{O\text{-}PE}$; $ER_{O\text{-}PE}$ is from Table 1
R_{VO} = vapor emissions; R_{VO} is "0" if the compound is a particle or is particle-bound
R_{VOS} = Sum R_{VOi}
P = particle; cell has an "X" if the compound is a particle or is particle-bound

Table 6. Estimate of Organic Emissions from the Post-Evaporator Stream. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
100-00-5	p-Nitrochlorobenzene	10	8.11E-01	5.47E-04	4.00E-07	4.00E-07	
100-21-0	p-Phthalic acid	1	5.74E+01	3.87E-02	2.98E-05	2.98E-05	
100-25-4	1,4-Dinitrobenzene	6	5.51E+01	3.72E-02	2.86E-05	0.00E+00	X
100-41-4	Ethyl benzene	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
100-42-5	Styrene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
10061-01-5	cis-1,3-Dichloropropene	19	2.57E-05	0.00E+00	0.00E+00	0.00E+00	
10061-02-6	trans-1,3-Dichloropropene	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
101-55-3	4-Bromophenylphenyl ether	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
101-84-8	Diphenyl ether	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
106-35-4	3-Heptanone	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
106-42-3	p-Xylene (Dimethyl benzene)	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
106-46-7	1,4-Dichlorobenzene	18	8.05E-06	0.00E+00	0.00E+00	0.00E+00	
106-88-7	1,2-Epoxybutane	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
106-93-4	Ethylene dibromide (Dibromethane)	16	3.33E-03	2.20E-06	2.00E-09	2.00E-09	
106-97-8	Butane	26	9.68E-13	0.00E+00	0.00E+00	0.00E+00	
106-99-0	1,3-Butadiene	23	2.12E-09	0.00E+00	0.00E+00	0.00E+00	
107-02-8	Acrolein	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
107-05-1	3-Chloropropene (Allyl chloride)	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
107-06-2	1,2-Dichloroethane (Ethylene chloride)	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
107-12-0	Propionitrile	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
107-13-1	Acrylonitrile	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
107-18-6	2-Propene-1-ol	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
107-31-3	Formic acid, methyl ester	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
107-66-4	Dibutylphosphate	5	1.24E+01	8.39E-03	6.47E-06	0.00E+00	X
107-87-9	2-Pentanone	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
108-03-2	1-Nitropropane	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
108-05-4	Vinyl acetate	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
108-10-1	Hexone (4-Methyl-2-pentanone or MIBK)	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
108-20-3	Bis(isopropyl)ether	18	8.05E-06	0.00E+00	0.00E+00	0.00E+00	
108-38-3	m-Xylene (Dimethyl benzene)	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
108-39-4	m-Cresol	9	2.31E+01	1.56E-02	1.20E-05	1.20E-05	
108-87-2	Methylcyclohexane	25	1.08E-11	0.00E+00	0.00E+00	0.00E+00	
108-88-3	Toluene	19	2.31E-06	0.00E+00	0.00E+00	0.00E+00	
108-90-7	Chlorobenzene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
108-93-0	Cyclohexanol	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
108-94-1	Cyclohexanone	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
108-95-2	Phenol	8	3.57E+01	2.41E-02	1.86E-05	1.86E-05	
109-66-0	n-Pentane	26	9.68E-13	0.00E+00	0.00E+00	0.00E+00	
109-99-9	Tetrahydrofuran	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
110-12-3	5-Methyl-2-hexanone	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
110-43-0	2-Heptanone	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
110-54-3	n-Hexane	27	1.47E-13	0.00E+00	0.00E+00	0.00E+00	
110-62-3	n-Valeraldehyde	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
110-82-7	Cyclohexane	24	2.53E-10	0.00E+00	0.00E+00	0.00E+00	
110-83-8	Cyclohexene	22	3.86E-08	0.00E+00	0.00E+00	0.00E+00	

Table 6. Estimate of Organic Emissions from the Post-Evaporator Stream. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
110-86-1	Pyridine	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
111-65-9	n-Octane	28	2.22E-14	0.00E+00	0.00E+00	0.00E+00	
111-76-2	Ethylene glycol monobutyl ether	9	2.31E+01	1.56E-02	1.20E-05	1.20E-05	
111-84-2	n-Nonane	28	2.22E-14	0.00E+00	0.00E+00	0.00E+00	
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	30	3.21E-01	2.17E-04	1.67E-07	0.00E+00	X
117-84-0	n-Dioctyl phthalate	32	3.47E+00	2.34E-03	1.80E-06	0.00E+00	X
118-74-1	Hexachlorobenzene	18	8.05E-06	0.00E+00	0.00E+00	0.00E+00	
120-12-7	Anthracene	13	3.12E-01	2.11E-04	1.62E-07	1.62E-07	
120-82-1	1,2,4-Trichlorobenzene	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
120-83-2	2,4-Dichlorophenol	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
121-44-8	Triethylamine	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
121-69-7	Dimethylaniline	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
122-39-4	N,N-Diphenylamine	10	1.58E+00	1.07E-03	8.21E-07	8.21E-07	
123-19-3	4-Heptanone	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
123-38-6	n-Propionaldehyde	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
123-51-3	3-Methyl-1-butanol	12	1.94E+00	1.31E-03	1.01E-06	1.01E-06	
123-86-4	Acetic acid n-butyl ester	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
123-91-1	1,4-Dioxane	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
126-73-8	Tributyl phosphate	7	4.54E+01	3.06E-02	2.36E-05	2.36E-05	
126-98-7	2-Methyl-2-propenenitrile (Methacrylonitrile)	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
127-18-4	Perchloroethylene (tetrachloroethylene)	21	1.43E-07	0.00E+00	0.00E+00	0.00E+00	
127-19-5	N,N-Dimethylacetamide	5	1.24E+01	8.39E-03	6.47E-06	6.47E-06	
128-37-0	2,6-Bis(tert-butyl)-4-methylphenol	32	3.47E+00	2.34E-03	1.80E-06	1.80E-06	
129-00-0	Pyrene	33	2.63E+00	1.78E-03	1.37E-06	0.00E+00	X
1321-64-8	Pentachloronaphthalene	14	1.05E-01	7.06E-05	5.44E-08	0.00E+00	X
1321-65-9	Trichloronaphthalene	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
132-64-9	Dibenzofuran	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
1335-87-1	Hexachloronaphthalene	14	1.05E-01	7.06E-05	5.44E-08	0.00E+00	X
1335-88-2	Tetrachloronaphthalene	15	3.43E-02	2.31E-05	1.78E-08	0.00E+00	X
1336-36-3	Polychlorinated biphenyls (PCBs)	35	5.97E-02	4.03E-05	3.11E-08	0.00E+00	X
141-78-6	Acetic acid ethyl ester (Ethyl acetate)	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
141-79-7	4-Methyl-3-penten-2-one	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
142-82-5	n-Heptane	27	1.47E-13	0.00E+00	0.00E+00	0.00E+00	
144-62-7	Oxalic acid	3	5.75E+00	3.88E-03	2.99E-06	2.99E-06	
156-60-5	trans-1,2-Dichloroethylene	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
1582-09-8	Trifluralin	14	1.05E-01	7.06E-05	5.44E-08	0.00E+00	X
1634-04-4	Methyl tert-butyl ether	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
1836-75-5	Nitrofen	30	3.21E-01	2.17E-04	1.67E-07	0.00E+00	X
189-55-9	Dibenzo[a,i]pyrene	5	1.24E+01	8.39E-03	6.47E-06	0.00E+00	X
189-64-0	Dibenzo[a,h]pyrene	5	1.24E+01	8.39E-03	6.47E-06	0.00E+00	X
191-24-2	Benzo(g,h,i)perylene	30	3.21E-01	2.17E-04	1.67E-07	0.00E+00	X
191-30-0	Benzo[a,i]pyrene	5	1.24E+01	8.39E-03	6.47E-06	0.00E+00	X
192-65-4	Dibenzo[a,e]pyrene	5	1.24E+01	8.39E-03	6.47E-06	0.00E+00	X
193-39-5	Indeno(1,2,3-cd)pyrene	30	3.21E-01	2.17E-04	1.67E-07	0.00E+00	X
205-82-3	Benzo(j)fluoranthene	7	4.54E+01	3.06E-02	2.36E-05	0.00E+00	X
205-99-2	Benzo(b)fluoranthene	30	3.21E-01	2.17E-04	1.67E-07	0.00E+00	X
206-44-0	Fluoranthene	33	1.33E+00	8.96E-04	6.90E-07	0.00E+00	X
207-08-9	Benzo(k)fluoranthene	30	3.21E-01	2.17E-04	1.67E-07	0.00E+00	X
208-96-8	Acenaphthylene	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
218-01-9	Chrysene	32	5.81E+00	3.92E-03	3.02E-06	0.00E+00	X
2234-13-1	Octachloronaphthalene	14	1.05E-01	7.06E-05	5.44E-08	0.00E+00	X
224-42-0	Dibenz[a,j]acridine	4	5.72E+01	3.86E-02	2.97E-05	0.00E+00	X
226-36-8	Dibenz[a,h]acridine	4	5.72E+01	3.86E-02	2.97E-05	0.00E+00	X
2385-85-5	Mirex	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
25551-13-7	Trimethyl benzene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
26140-60-3	Terphenyls	34	8.98E-03	6.10E-06	4.70E-09	0.00E+00	X
27154-33-2	Trichlorofluoroethane	23	2.12E-09	0.00E+00	0.00E+00	0.00E+00	

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CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF, mg/kg	Individual Organic Weight Ratio WR, unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
287-92-3	Cyclopentane	24	2.53E-10	0.00E+00	0.00E+00	0.00E+00	
309-00-2	Aldrin	34	8.98E-03	6.10E-06	4.70E-09	0.00E+00	X
319-84-6	Hexachlorocyclohexane (Lindane) Alpha BHC	33	1.33E+00	8.96E-04	6.90E-07	6.90E-07	
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	30	1.38E-01	9.34E-05	7.20E-08	0.00E+00	X
319-86-8	Delta-BHC	30	3.21E-01	2.17E-04	1.67E-07	0.00E+00	X
3697-24-3	5-Methylchrysene	32	3.47E+00	2.34E-03	1.80E-06	0.00E+00	X
3825-26-1	Ammonium perfluorooctanoate	14	1.05E-01	7.06E-05	5.44E-08	0.00E+00	X
4170-30-3	2-Butenaldehyde (2-Butenal)	11	5.58E-01	3.77E-04	2.90E-07	2.90E-07	
465-73-6	Isodrin	35	5.97E-02	4.03E-05	3.11E-08	3.11E-08	
50-00-0	Formaldehyde	8	3.49E+01	2.35E-02	1.81E-05	1.81E-05	
50-29-3	4,4-DDT	33	1.33E+00	8.96E-04	6.90E-07	0.00E+00	X
50-32-8	Benzo(a)pyrene	30	5.04E-01	3.40E-04	2.62E-07	0.00E+00	X
53-70-3	Dibenzo(a,h)anthracene	7	4.54E+01	3.06E-02	2.36E-05	0.00E+00	X
540-59-0	1,2-Dichloroethylene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
540-84-1	2,2,4-Trimethylpentane	28	2.22E-14	0.00E+00	0.00E+00	0.00E+00	
541-73-1	1,3-Dichlorobenzene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
56-23-5	Carbon tetrachloride	22	3.86E-08	0.00E+00	0.00E+00	0.00E+00	
563-80-4	3-Methyl-2-butanone	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
56-49-5	3-Methylcholanthrene	28	2.22E-14	0.00E+00	0.00E+00	0.00E+00	X
56-55-3	Benzo(a)anthracene	33	1.33E+00	8.96E-04	6.90E-07	0.00E+00	X
57-14-7	1,1-Dimethylhydrazine	12	1.94E+00	1.31E-03	1.01E-06	1.01E-06	
58-89-9	gamma-BHC (Lindane)	32	2.06E-02	1.39E-05	1.07E-08	0.00E+00	X
58-90-2	2,3,4,6-Tetrachlorophenol	11	2.78E+00	1.88E-03	1.45E-06	1.45E-06	
591-78-6	2-Hexanone	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
59-50-7	4-Chloro-3-methylphenol	32	3.47E+00	2.34E-03	1.80E-06	0.00E+00	X
59-89-2	N-Nitrosomorpholine	6	5.51E+01	3.72E-02	2.86E-05	2.86E-05	
602-87-9	5-Nitroacenaphthene	9	2.31E+01	1.56E-02	1.20E-05	0.00E+00	X
60-29-7	Ethyl ether	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
603-34-9	Triphenylamine	32	4.57E+00	3.08E-03	2.37E-06	2.37E-06	
60-34-4	Methylhydrazine	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
60-35-5	Acetamide	5	1.24E+01	8.39E-03	6.47E-06	6.47E-06	
60-57-1	Dieldrin	33	2.21E-02	1.49E-05	1.15E-08	0.00E+00	X
621-64-7	Di-n-Propylnitrosamine	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
624-83-9	Methyl isocyanate	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
627-13-4	Nitric acid, propyl ester	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
62-75-9	N-Nitroso-N,N-dimethylamine	9	2.31E+01	1.56E-02	1.20E-05	1.20E-05	
630-20-6	1,1,1,2-Tetrachloroethane	18	8.05E-06	0.00E+00	0.00E+00	0.00E+00	
64-17-5	Ethyl alcohol	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
64-18-6	Formic acid	7	4.54E+01	3.06E-02	2.36E-05	2.36E-05	
64-19-7	Acetic acid	6	5.51E+01	3.72E-02	2.86E-05	2.86E-05	
67-56-1	Methyl alcohol (Methanol)	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
67-63-0	2-Propyl alcohol (Isopropanol)	11	1.90E+00	1.28E-03	9.90E-07	9.90E-07	
67-64-1	2-Propanone (Acetone)	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
67-66-3	Chloroform	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
67-72-1	Hexachloroethane	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
684-16-2	Hexafluoroacetone	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
71-23-8	n-Propyl alcohol	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
71-36-3	n-Butyl alcohol	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
71-43-2	Benzene	19	3.80E-06	0.00E+00	0.00E+00	0.00E+00	
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	21	1.43E-07	0.00E+00	0.00E+00	0.00E+00	
72-20-8	Endrin	32	3.47E+00	2.34E-03	1.80E-06	0.00E+00	X
72-43-5	Methoxychlor	7	4.54E+01	3.06E-02	2.36E-05	0.00E+00	X
72-54-8	4,4-DDD	32	3.47E+00	2.34E-03	1.80E-06	0.00E+00	X
72-55-9	4,4-DDE	34	8.98E-03	6.10E-06	5.00E-09	0.00E+00	X
74-83-9	Bromomethane (Methyl bromide)	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
74-87-3	Chloromethane (Methyl chloride)	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
74-97-5	Bromochloromethane	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	

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CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
74-99-7	Methylacetylene	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
75-00-3	Chloroethane	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
75-01-4	Vinyl chloride (1-Chloroethene)	22	3.86E-08	0.00E+00	0.00E+00	0.00E+00	
75-05-8	Acetonitrile	13	1.86E-01	1.25E-04	9.65E-08	9.65E-08	
75-07-0	Acetaldehyde	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
75-09-2	Dichloromethane (Methylene chloride)	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
75-12-7	Formamide	4	5.72E+01	3.86E-02	2.97E-05	2.97E-05	
75-15-0	Carbon disulfide	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
75-21-8	Ethylene oxide (Oxirane)	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
75-27-4	Bromodichloromethane	18	8.05E-06	0.00E+00	0.00E+00	0.00E+00	
75-34-3	1,1-Dichloroethane	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
75-35-4	1,1-Dichloroethene (Vinylidene chloride)	22	3.86E-08	0.00E+00	0.00E+00	0.00E+00	
75-43-4	Dichlorofluoromethane	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
75-45-6	Chlorodifluoromethane	22	3.86E-08	0.00E+00	0.00E+00	0.00E+00	
75-50-3	Trimethylamine	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
75-52-5	Nitromethane	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
75-55-8	2-Methylaziridine	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
75-61-6	Difluorodibromomethane	22	3.86E-08	0.00E+00	0.00E+00	0.00E+00	
75-63-8	Trifluorobromomethane	25	1.08E-11	0.00E+00	0.00E+00	0.00E+00	
75-65-0	2-Methyl-2-propanol	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
75-69-4	Trichlorofluoromethane	23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-71-8	Dichlorodifluoromethane	25	1.08E-11	0.00E+00	0.00E+00	0.00E+00	
75-99-0	2,2-Dichloropropionic acid	6	5.51E+01	3.72E-02	2.86E-05	2.86E-05	
76-03-9	Trichloroacetic acid	5	1.24E+01	8.39E-03	6.47E-06	6.47E-06	
76-11-9	1,1,1,2-Tetrachloro-2,2-difluoroethane	24	2.53E-10	0.00E+00	0.00E+00	0.00E+00	
76-12-0	1,1,2,2-Tetrachloro-1,2-difluoroethane	23	2.12E-09	0.00E+00	0.00E+00	0.00E+00	
76-13-1	1,2,2-Trichloro-1,1,2-trifluoroethane (Freon 113)	25	1.08E-11	0.00E+00	0.00E+00	0.00E+00	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	28	2.22E-14	0.00E+00	0.00E+00	0.00E+00	
76-15-3	Chloropentafluoroethane	29	4.99E-15	0.00E+00	0.00E+00	0.00E+00	
76-44-8	Heptachlor	16	3.92E-04	3.00E-07	0.00E+00	0.00E+00	
78-83-1	2-Methylpropyl alcohol (Isobutyl alcohol)	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
78-87-5	1,2-Dichloropropane	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
78-92-2	1-Methylpropyl alcohol (2-Butanol)	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
78-93-3	Methyl ethyl ketone (MEK, 2-Butanone)	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
79-00-5	1,1,2-Trichloroethane	17	1.29E-04	1.00E-07	0.00E+00	0.00E+00	
79-01-6	Trichloroethylene	20	7.82E-07	0.00E+00	0.00E+00	0.00E+00	
79-09-4	Propionic acid	8	3.49E+01	2.35E-02	1.81E-05	1.81E-05	
79-10-7	2-Propenoic acid	8	3.49E+01	2.35E-02	1.81E-05	1.81E-05	
79-20-9	Methyl acetate	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
79-34-5	1,1,2,2-Tetrachloroethane	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
8001-35-2	Toxaphene	10	4.17E-02	2.81E-05	2.17E-08	0.00E+00	X
82-68-8	Pentachloronitrobenzene (PCBN)	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
83-32-9	Acenaphthene	15	3.43E-02	2.31E-05	1.78E-08	1.78E-08	
84-66-2	Diethyl phthalate	8	2.67E+01	1.80E-02	1.39E-05	1.39E-05	
84-74-2	Dibutyl phthalate	31	1.53E+01	1.03E-02	7.96E-06	0.00E+00	X
85-01-8	Phenanthrene	13	2.49E-01	1.68E-04	1.29E-07	1.29E-07	
85-68-7	Butylbenzyl phthalate	31	1.53E+01	1.03E-02	7.96E-06	0.00E+00	X
86-73-7	Fluorene	14	1.05E-01	7.06E-05	5.44E-08	0.00E+00	X
87-68-3	Hexachlorobutadiene	20	6.79E-07	0.00E+00	0.00E+00	0.00E+00	
87-86-5	Pentachlorophenol	6	5.51E+01	3.72E-02	2.86E-05	2.86E-05	
88-06-2	2,4,6-Trichlorophenol	10	8.11E-01	5.47E-04	4.21E-07	4.21E-07	
88-72-2	2-Nitrotoluene	12	1.94E+00	1.31E-03	1.01E-06	1.01E-06	
88-75-5	2-Nitrophenol	12	1.94E+00	1.31E-03	1.01E-06	1.01E-06	
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	8	4.23E+01	2.85E-02	2.20E-05	0.00E+00	X
88-89-1	Picric acid	2	7.13E+01	4.81E-02	3.71E-05	0.00E+00	X
91-20-3	Naphthalene	16	2.68E-04	2.00E-07	0.00E+00	0.00E+00	
91-22-5	Quinoline	9	2.31E+01	1.56E-02	1.20E-05	1.20E-05	

Table 6. Estimate of Organic Emissions from the Post-Evaporator Stream. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{iO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
91-58-7	2-Chloronapthalene	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
92-52-4	1,1`-Biphenyl	16	1.33E-03	9.00E-07	1.00E-09	1.00E-09	
92-93-3	4-Nitrobiphenyl	10	8.11E-01	5.47E-04	4.21E-07	0.00E+00	X
93-72-1	Silvex (2,4,5-TP)	5	1.24E+01	8.39E-03	6.47E-06	0.00E+00	X
93-76-5	2,4,5-T	5	1.24E+01	8.39E-03	6.47E-06	0.00E+00	X
94-75-7	2,4-D and esters (160C typed)	6	5.51E+01	3.72E-02	2.86E-05	2.86E-05	
95-13-6	Indene	18	8.05E-06	0.00E+00	0.00E+00	0.00E+00	
95-47-6	o-Xylene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
95-48-7	o-Cresol (2-Methylphenol)	9	2.31E+01	1.56E-02	1.20E-05	1.20E-05	
95-49-8	2-Chlorotoluene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
95-50-1	o-Dichlorobenzene (1,2-Dichlorobenzene)	18	8.05E-06	0.00E+00	0.00E+00	0.00E+00	
95-57-8	2-Chlorophenol	11	1.90E+00	1.28E-03	9.87E-07	9.87E-07	
95-95-4	2,4,5-Trichlorophenol	9	2.31E+01	1.56E-02	1.20E-05	1.20E-05	
96-22-0	3-Pentanone	14	1.05E-01	7.06E-05	5.44E-08	5.44E-08	
96-69-5	Bis(3-tert-butyl-4-hydroxy-6-methyl-phenyl)sulfide	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	X
98-51-1	p-tert-Butyltoluene	21	1.43E-07	0.00E+00	0.00E+00	0.00E+00	
98-82-8	Cumene	20	7.31E-07	0.00E+00	0.00E+00	0.00E+00	
98-83-9	alpha-Methylstyrene	19	1.06E-05	0.00E+00	0.00E+00	0.00E+00	
98-86-2	Acetophenone	11	2.36E+00	1.59E-03	1.22E-06	1.22E-06	
98-95-3	Nitrobenzene	12	1.94E+00	1.31E-03	1.01E-06	1.01E-06	
	Weight Fraction Sum = WF_S =		1482.5				
	Weight Ratio Sum = WR_S =			1.0			
	Post-Evaporator Stream Sum = $ER_{O\text{-}PE}$ =				7.70E-04		
	Post-Evaporator Stream Vapor Organic Release Sum = R_{VOS} =					4.61E-04	

Total Pretreatment emissions = the sum of Pretreatment Feed Stream and Post-Evaporator Stream Emissions

$R_{VO} = R_{VO\text{-}PTF} + R_{VO\text{-}PE}$

Table 7. Estimate of Organic Emissions from Pretreatment Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Pretreatment Feed Stream Individual Organic Vapor Emission $R_{VO\text{-}PTF}$ gm/s	Post-Evaporator Individual Organic Vapor Emission $R_{VO\text{-}PE}$ gm/s	Total Pretreatment Organic Emission R_{VO} gm/s
100-00-5	p-Nitrochlorobenzene	5.49E-06	4.00E-07	5.89E-06
100-21-0	p-Phthalic acid	5.49E-06	2.98E-05	3.53E-05
100-25-4	1,4-Dinitrobenzene	0.00E+00	0.00E+00	0.00E+00
100-41-4	Ethyl benzene	1.21E-06	0.00E+00	1.21E-06
100-42-5	Styrene	1.21E-06	0.00E+00	1.21E-06
10061-01-5	cis-1,3-Dichloropropene	1.21E-06	0.00E+00	1.21E-06
10061-02-6	trans-1,3-Dichloropropene	1.21E-06	0.00E+00	1.21E-06
101-55-3	4-Bromophenylphenyl ether	5.49E-06	5.44E-08	5.54E-06
101-84-8	Diphenyl ether	1.21E-06	1.00E-09	1.21E-06
106-35-4	3-Heptanone	1.21E-06	5.44E-08	1.26E-06
106-42-3	p-Xylene (Dimethyl benzene)	1.21E-06	0.00E+00	1.21E-06
106-46-7	1,4-Dichlorobenzene	1.21E-06	0.00E+00	1.21E-06
106-88-7	1,2-Epoxybutane	1.21E-06	1.78E-08	1.23E-06
106-93-4	Ethylene dibromide (Dibromethane)	5.49E-06	2.00E-09	5.49E-06
106-97-8	Butane	1.21E-06	0.00E+00	1.21E-06
106-99-0	1,3-Butadiene	1.21E-06	0.00E+00	1.21E-06
107-02-8	Acrolein	1.21E-06	5.44E-08	1.26E-06
107-05-1	3-Chloropropene (Allyl chloride)	1.21E-06	0.00E+00	1.21E-06
107-06-2	1,2-Dichloroethane (Ethylene chloride)	1.21E-06	0.00E+00	1.21E-06
107-12-0	Propionitrile	1.21E-06	1.29E-07	1.34E-06
107-13-1	Acrylonitrile	1.21E-06	5.44E-08	1.26E-06
107-18-6	2-Propene-1-ol	5.49E-06	4.21E-07	5.91E-06
107-31-3	Formic acid, methyl ester	5.49E-06	1.78E-08	5.51E-06
107-66-4	Dibutylphosphate	0.00E+00	0.00E+00	0.00E+00
107-87-9	2-Pentanone	1.21E-06	5.44E-08	1.26E-06
108-03-2	1-Nitropropane	5.49E-06	5.44E-08	5.54E-06
108-05-4	Vinyl acetate	5.49E-06	1.00E-09	5.49E-06
108-10-1	Hexone (4-Methyl-2-pentanone or MIBK)	1.21E-06	5.44E-08	1.26E-06
108-20-3	Bis(isopropyl)ether	1.21E-06	0.00E+00	1.21E-06
108-38-3	m-Xylene (Dimethyl benzene)	1.21E-06	0.00E+00	1.21E-06
108-39-4	m-Cresol	1.21E-06	1.20E-05	1.32E-05
108-87-2	Methylcyclohexane	1.21E-06	0.00E+00	1.21E-06
108-88-3	Toluene	1.21E-06	0.00E+00	1.21E-06
108-90-7	Chlorobenzene	1.21E-06	0.00E+00	1.21E-06
108-93-0	Cyclohexanol	1.21E-06	4.21E-07	1.63E-06
108-94-1	Cyclohexanone	1.21E-06	9.87E-07	2.20E-06
108-95-2	Phenol	5.49E-06	1.86E-05	2.41E-05
109-66-0	n-Pentane	1.21E-06	0.00E+00	1.21E-06
109-99-9	Tetrahydrofuran	2.57E-06	1.29E-07	2.70E-06

Table 7. Estimate of Organic Emissions from Pretreatment Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Pretreatment Feed Stream Individual Organic Vapor Emission $R_{VO\text{-}PTF}$ gm/s	Post-Evaporator Individual Organic Vapor Emission $R_{VO\text{-}PE}$ gm/s	Total Pretreatment Organic Emission R_{VO} gm/s
110-12-3	5-Methyl-2-hexanone	1.21E-06	1.78E-08	1.23E-06
110-43-0	2-Heptanone	1.21E-06	1.78E-08	1.23E-06
110-54-3	n-Hexane	1.21E-06	0.00E+00	1.21E-06
110-62-3	n-Valeraldehyde	5.49E-06	1.78E-08	5.51E-06
110-82-7	Cyclohexane	1.21E-06	0.00E+00	1.21E-06
110-83-8	Cyclohexene	1.21E-06	0.00E+00	1.21E-06
110-86-1	Pyridine	5.49E-06	9.87E-07	6.48E-06
111-65-9	n-Octane	1.21E-06	0.00E+00	1.21E-06
111-76-2	Ethylene glycol monobutyl ether	5.49E-06	1.20E-05	1.75E-05
111-84-2	n-Nonane	1.21E-06	0.00E+00	1.21E-06
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	0.00E+00	0.00E+00	0.00E+00
117-84-0	n-Dioctyl phthalate	0.00E+00	0.00E+00	0.00E+00
118-74-1	Hexachlorobenzene	1.20E-07	0.00E+00	1.20E-07
120-12-7	Anthracene	5.49E-06	1.62E-07	5.65E-06
120-82-1	1,2,4-Trichlorobenzene	1.21E-06	0.00E+00	1.21E-06
120-83-2	2,4-Dichlorophenol	5.49E-06	4.21E-07	5.91E-06
121-44-8	Triethylamine	1.21E-06	1.78E-08	1.23E-06
121-69-7	Dimethylaniline	1.21E-06	1.29E-07	1.34E-06
122-39-4	N,N-Diphenylamine	1.21E-06	8.21E-07	2.03E-06
123-19-3	4-Heptanone	1.21E-06	1.29E-07	1.34E-06
123-38-6	n-Propionaldehyde	1.21E-06	5.44E-08	1.26E-06
123-51-3	3-Methyl-1-butanol	1.21E-06	1.01E-06	2.22E-06
123-86-4	Acetic acid n-butyl ester	5.49E-06	1.00E-09	5.49E-06
123-91-1	1,4-Dioxane	3.30E-06	4.21E-07	3.72E-06
126-73-8	Tributyl phosphate	5.49E-06	2.36E-05	2.91E-05
126-98-7	2-Methyl-2-propenenitrile (Methacrylonitrile)	1.21E-06	1.00E-09	1.21E-06
127-18-4	Perchloroethylene (tetrachloroethylene)	1.21E-06	0.00E+00	1.21E-06
127-19-5	N,N-Dimethylacetamide	1.21E-06	6.47E-06	7.68E-06
128-37-0	2,6-Bis(tert-butyl)-4-methylphenol	5.49E-06	1.80E-06	7.29E-06
129-00-0	Pyrene	0.00E+00	0.00E+00	0.00E+00
1321-64-8	Pentachloronaphthalene	0.00E+00	0.00E+00	0.00E+00
1321-65-9	Trichloronaphthalene	5.49E-06	1.78E-08	5.51E-06
132-64-9	Dibenzofuran	5.49E-06	1.78E-08	5.51E-06
1335-87-1	Hexachloronaphthalene	0.00E+00	0.00E+00	0.00E+00
1335-88-2	Tetrachloronaphthalene	0.00E+00	0.00E+00	0.00E+00
1336-36-3	Polychlorinated biphenyls (PCBs)	0.00E+00	0.00E+00	0.00E+00
141-78-6	Acetic acid ethyl ester (Ethyl acetate)	5.49E-06	5.44E-08	5.54E-06
141-79-7	4-Methyl-3-penten-2-one	5.49E-06	1.29E-07	5.62E-06
142-82-5	n-Heptane	1.21E-06	0.00E+00	1.21E-06
144-62-7	Oxalic acid	5.50E-07	2.99E-06	3.54E-06
156-60-5	trans-1,2-Dichloroethylene	1.21E-06	0.00E+00	1.21E-06
1582-09-8	Trifluralin	0.00E+00	0.00E+00	0.00E+00
1634-04-4	Methyl tert-butyl ether	1.21E-06	1.00E-09	1.21E-06

Table 7. Estimate of Organic Emissions from Pretreatment Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Pretreatment Feed Stream Individual Organic Vapor Emission $R_{VO\text{-}PTF}$ gm/s	Post-Evaporator Individual Organic Vapor Emission $R_{VO\text{-}PE}$ gm/s	Total Pretreatment Organic Emission R_{VO} gm/s
1836-75-5	Nitrofen	0.00E+00	0.00E+00	0.00E+00
189-55-9	Dibenzo[a,i]pyrene	0.00E+00	0.00E+00	0.00E+00
189-64-0	Dibenzo[a,h]pyrene	0.00E+00	0.00E+00	0.00E+00
191-24-2	Benzo(g,h,i)perylene	0.00E+00	0.00E+00	0.00E+00
191-30-0	Benzo[a,i]pyrene	0.00E+00	0.00E+00	0.00E+00
192-65-4	Dibenzo[a,e]pyrene	0.00E+00	0.00E+00	0.00E+00
193-39-5	Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	0.00E+00
205-82-3	Benzo(j)fluoranthene	0.00E+00	0.00E+00	0.00E+00
205-99-2	Benzo(b)fluoranthene	0.00E+00	0.00E+00	0.00E+00
206-44-0	Fluoranthene	0.00E+00	0.00E+00	0.00E+00
207-08-9	Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00
208-96-8	Acenaphthylene	5.49E-06	5.44E-08	5.54E-06
218-01-9	Chrysene	0.00E+00	0.00E+00	0.00E+00
2234-13-1	Octachloronaphthalene	0.00E+00	0.00E+00	0.00E+00
224-42-0	Dibenz[a,j]acridine	0.00E+00	0.00E+00	0.00E+00
226-36-8	Dibenz[a,h]acridine	0.00E+00	0.00E+00	0.00E+00
2385-85-5	Mirex	5.49E-06	0.00E+00	5.49E-06
25551-13-7	Trimethyl benzene	1.21E-06	0.00E+00	1.21E-06
26140-60-3	Terphenyls	0.00E+00	0.00E+00	0.00E+00
27154-33-2	Trichlorofluoroethane	1.21E-06	0.00E+00	1.21E-06
287-92-3	Cyclopentane	1.21E-06	0.00E+00	1.21E-06
309-00-2	Aldrin	0.00E+00	0.00E+00	0.00E+00
319-84-6	Hexachlorocyclohexane (Lindane) Alpha BHC	2.00E-08	6.90E-07	7.10E-07
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	0.00E+00	0.00E+00	0.00E+00
319-86-8	Delta-BHC	0.00E+00	0.00E+00	0.00E+00
3697-24-3	5-Methylchrysene	0.00E+00	0.00E+00	0.00E+00
3825-26-1	Ammonium perfluorooctanoate	0.00E+00	0.00E+00	0.00E+00
4170-30-3	2-Butenaldehyde (2-Butenal)	1.21E-06	2.90E-07	1.50E-06
465-73-6	Isodrin	4.00E-08	3.11E-08	7.11E-08
50-00-0	Formaldehyde	1.21E-06	1.81E-05	1.93E-05
50-29-3	4,4-DDT	0.00E+00	0.00E+00	0.00E+00
50-32-8	Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00
53-70-3	Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00
540-59-0	1,2-Dichloroethylene	1.21E-06	0.00E+00	1.21E-06
540-84-1	2,2,4-Trimethylpentane	1.21E-06	0.00E+00	1.21E-06
541-73-1	1,3-Dichlorobenzene	1.21E-06	0.00E+00	1.21E-06
56-23-5	Carbon tetrachloride	1.21E-06	0.00E+00	1.21E-06
563-80-4	3-Methyl-2-butanone	1.21E-06	5.44E-08	1.26E-06
56-49-5	3-Methylcholanthrene	0.00E+00	0.00E+00	0.00E+00
56-55-3	Benzo(a)anthracene	0.00E+00	0.00E+00	0.00E+00
57-14-7	1,1-Dimethylhydrazine	5.49E-06	1.01E-06	6.50E-06
58-89-9	gamma-BHC (Lindane)	0.00E+00	0.00E+00	0.00E+00
58-90-2	2,3,4,6-Tetrachlorophenol	5.49E-06	1.45E-06	6.94E-06

Table 7. Estimate of Organic Emissions from Pretreatment Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Pretreatment Feed Stream Individual Organic Vapor Emission R_{VO-PTF} gm/s	Post-Evaporator Individual Organic Vapor Emission R_{VO-PE} gm/s	Total Pretreatment Organic Emission R_{VO} gm/s
591-78-6	2-Hexanone	1.21E-06	5.44E-08	1.26E-06
59-50-7	4-Chloro-3-methylphenol	0.00E+00	0.00E+00	0.00E+00
59-89-2	N-Nitrosomorpholine	5.49E-06	2.86E-05	3.41E-05
602-87-9	5-Nitroacenaphthene	0.00E+00	0.00E+00	0.00E+00
60-29-7	Ethyl ether	5.49E-06	0.00E+00	5.49E-06
603-34-9	Triphenylamine	5.49E-06	2.37E-06	7.86E-06
60-34-4	Methylhydrazine	1.21E-06	4.21E-07	1.63E-06
60-35-5	Acetamide	1.21E-06	6.47E-06	7.68E-06
60-57-1	Dieldrin	0.00E+00	0.00E+00	0.00E+00
621-64-7	Di-n-Propylnitrosamine	5.49E-06	4.21E-07	5.91E-06
624-83-9	Methyl isocyanate	1.21E-06	0.00E+00	1.21E-06
627-13-4	Nitric acid, propyl ester	5.49E-06	0.00E+00	5.49E-06
62-75-9	N-Nitroso-N,N-dimethylamine	1.03E-05	1.20E-05	2.23E-05
630-20-6	1,1,1,2-Tetrachloroethane	1.21E-06	0.00E+00	1.21E-06
64-17-5	Ethyl alcohol	1.21E-06	4.21E-07	1.63E-06
64-18-6	Formic acid	5.49E-06	2.36E-05	2.91E-05
64-19-7	Acetic acid	5.49E-06	2.86E-05	3.41E-05
67-56-1	Methyl alcohol (Methanol)	1.21E-06	4.21E-07	1.63E-06
67-63-0	2-Propyl alcohol (Isopropanol)	1.21E-06	9.90E-07	2.20E-06
67-64-1	2-Propanone (Acetone)	6.59E-06	1.29E-07	6.72E-06
67-66-3	Chloroform	1.21E-06	0.00E+00	1.21E-06
67-72-1	Hexachloroethane	5.49E-06	0.00E+00	5.49E-06
684-16-2	Hexafluoroacetone	1.21E-06	0.00E+00	1.21E-06
71-23-8	n-Propyl alcohol	1.21E-06	9.87E-07	2.20E-06
71-36-3	n-Butyl alcohol	1.21E-06	9.87E-07	2.20E-06
71-43-2	Benzene	1.21E-06	0.00E+00	1.21E-06
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	1.21E-06	0.00E+00	1.21E-06
72-20-8	Endrin	0.00E+00	0.00E+00	0.00E+00
72-43-5	Methoxychlor	0.00E+00	0.00E+00	0.00E+00
72-54-8	4,4-DDD	0.00E+00	0.00E+00	0.00E+00
72-55-9	4,4-DDE	0.00E+00	0.00E+00	0.00E+00
74-83-9	Bromomethane (Methyl bromide)	1.21E-06	0.00E+00	1.21E-06
74-87-3	Chloromethane (Methyl chloride)	1.21E-06	0.00E+00	1.21E-06
74-97-5	Bromochloromethane	1.21E-06	0.00E+00	1.21E-06
74-99-7	Methylacetylene	5.49E-06	0.00E+00	5.49E-06
75-00-3	Chloroethane	1.21E-06	0.00E+00	1.21E-06
75-01-4	Vinyl chloride (1-Chloroethene)	5.49E-06	0.00E+00	5.49E-06
75-05-8	Acetonitrile	1.72E-06	9.65E-08	1.82E-06
75-07-0	Acetaldehyde	5.49E-06	1.29E-07	5.62E-06
75-09-2	Dichloromethane (Methylene chloride)	1.21E-06	0.00E+00	1.21E-06
75-12-7	Formamide	5.49E-06	2.97E-05	3.52E-05
75-15-0	Carbon disulfide	1.21E-06	0.00E+00	1.21E-06
75-21-8	Ethylene oxide (Oxirane)	1.21E-06	1.78E-08	1.23E-06

Table 7. Estimate of Organic Emissions from Pretreatment Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Pretreatment Feed Stream Individual Organic Vapor Emission R_{VO-PTF} gm/s	Post-Evaporator Individual Organic Vapor Emission R_{VO-PE} gm/s	Total Pretreatment Organic Emission R_{VO} gm/s
75-27-4	Bromodichloromethane	1.21E-06	0.00E+00	1.21E-06
75-34-3	1,1-Dichloroethane	1.21E-06	0.00E+00	1.21E-06
75-35-4	1,1-Dichloroethene (Vinylidene chloride)	1.21E-06	0.00E+00	1.21E-06
75-43-4	Dichlorofluoromethane	1.21E-06	0.00E+00	1.21E-06
75-45-6	Chlorodifluoromethane	1.21E-06	0.00E+00	1.21E-06
75-50-3	Trimethylamine	1.21E-06	5.44E-08	1.26E-06
75-52-5	Nitromethane	5.49E-06	1.29E-07	5.62E-06
75-55-8	2-Methylaziridine	5.49E-06	9.87E-07	6.48E-06
75-61-6	Difluorodibromomethane	1.21E-06	0.00E+00	1.21E-06
75-63-8	Trifluorobromomethane	1.21E-06	0.00E+00	1.21E-06
75-65-0	2-Methyl-2-propanol	1.21E-06	9.87E-07	2.20E-06
75-69-4	Trichlorofluoromethane	1.21E-06	0.00E+00	1.21E-06
75-71-8	Dichlorodifluoromethane	1.21E-06	0.00E+00	1.21E-06
75-99-0	2,2-Dichloropropionic acid	5.49E-06	2.86E-05	3.41E-05
76-03-9	Trichloroacetic acid	1.21E-06	6.47E-06	7.68E-06
76-11-9	1,1,1,2-Tetrachloro-2,2-difluoroethane	5.49E-06	0.00E+00	5.49E-06
76-12-0	1,1,2,2-Tetrachloro-1,2-difluoroethane	5.49E-06	0.00E+00	5.49E-06
76-13-1	1,2,2-Trichloro-1,1,2-trifluoroethane (Freon 113)	1.21E-06	0.00E+00	1.21E-06
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	1.21E-06	0.00E+00	1.21E-06
76-15-3	Chloropentafluoroethane	1.21E-06	0.00E+00	1.21E-06
76-44-8	Heptachlor	1.20E-07	0.00E+00	1.20E-07
78-83-1	2-Methylpropyl alcohol (Isobutyl alcohol)	5.49E-06	9.87E-07	6.48E-06
78-87-5	1,2-Dichloropropane	1.21E-06	0.00E+00	1.21E-06
78-92-2	1-Methylpropyl alcohol (2-Butanol)	1.21E-06	9.87E-07	2.20E-06
78-93-3	Methyl ethyl ketone (MEK, 2-Butanone)	1.21E-06	1.29E-07	1.34E-06
79-00-5	1,1,2-Trichloroethane	1.21E-06	0.00E+00	1.21E-06
79-01-6	Trichloroethylene	1.21E-06	0.00E+00	1.21E-06
79-09-4	Propionic acid	5.49E-06	1.81E-05	2.36E-05
79-10-7	2-Propenoic acid	5.49E-06	1.81E-05	2.36E-05
79-20-9	Methyl acetate	5.49E-06	5.44E-08	5.54E-06
79-34-5	1,1,2,2-Tetrachloroethane	1.21E-06	1.00E-09	1.21E-06
8001-35-2	Toxaphene	0.00E+00	0.00E+00	0.00E+00
82-68-8	Pentachloronitrobenzene (PCBN)	5.49E-06	1.29E-07	5.62E-06
83-32-9	Acenaphthene	5.49E-06	1.78E-08	5.51E-06
84-66-2	Diethyl phthalate	5.49E-06	1.39E-05	1.94E-05
84-74-2	Dibutyl phthalate	0.00E+00	0.00E+00	0.00E+00
85-01-8	Phenanthrene	5.49E-06	1.29E-07	5.62E-06
85-68-7	Butylbenzyl phthalate	0.00E+00	0.00E+00	0.00E+00
86-73-7	Fluorene	0.00E+00	0.00E+00	0.00E+00
87-68-3	Hexachlorobutadiene	1.21E-06	0.00E+00	1.21E-06
87-86-5	Pentachlorophenol	5.49E-06	2.86E-05	3.41E-05
88-06-2	2,4,6-Trichlorophenol	5.49E-06	4.21E-07	5.91E-06
88-72-2	2-Nitrotoluene	1.21E-06	1.01E-06	2.22E-06

Table 7. Estimate of Organic Emissions from Pretreatment Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Pretreatment Feed Stream Individual Organic Vapor Emission $R_{VO\text{-}PTF}$ gm/s	Post-Evaporator Individual Organic Vapor Emission $R_{VO\text{-}PE}$ gm/s	Total Pretreatment Organic Emission R_{VO} gm/s
88-75-5	2-Nitrophenol	5.49E-06	1.01E-06	6.50E-06
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	0.00E+00	0.00E+00	0.00E+00
88-89-1	Picric acid	0.00E+00	0.00E+00	0.00E+00
91-20-3	Naphthalene	1.80E-07	0.00E+00	1.80E-07
91-22-5	Quinoline	5.49E-06	1.20E-05	1.75E-05
91-58-7	2-Chloronapthalene	5.49E-06	1.00E-09	5.49E-06
92-52-4	1,1`-Biphenyl	5.49E-06	1.00E-09	5.49E-06
92-93-3	4-Nitrobiphenyl	0.00E+00	0.00E+00	0.00E+00
93-72-1	Silvex (2,4,5-TP)	0.00E+00	0.00E+00	0.00E+00
93-76-5	2,4,5-T	0.00E+00	0.00E+00	0.00E+00
94-75-7	2,4-D and esters (160C typed)	5.49E-06	2.86E-05	3.41E-05
95-13-6	Indene	5.49E-06	0.00E+00	5.49E-06
95-47-6	o-Xylene	1.21E-06	0.00E+00	1.21E-06
95-48-7	o-Cresol (2-Methylphenol)	1.21E-06	1.20E-05	1.32E-05
95-49-8	2-Chlorotoluene	5.49E-06	0.00E+00	5.49E-06
95-50-1	o-Dichlorobenzene (1,2-Dichlorobenzene)	1.21E-06	0.00E+00	1.21E-06
95-57-8	2-Chlorophenol	5.49E-06	9.87E-07	6.48E-06
95-95-4	2,4,5-Trichlorophenol	5.49E-06	1.20E-05	1.75E-05
96-22-0	3-Pentanone	1.21E-06	5.44E-08	1.26E-06
96-69-5	Bis(3-tert-butyl-4-hydroxy-6-methyl-phenyl)sulfide	0.00E+00	0.00E+00	0.00E+00
98-51-1	p-tert-Butyltoluene	5.49E-06	0.00E+00	5.49E-06
98-82-8	Cumene	5.49E-06	0.00E+00	5.49E-06
98-83-9	alpha-Methylstyrene	1.21E-06	0.00E+00	1.21E-06
98-86-2	Acetophenone	5.49E-06	1.22E-06	6.71E-06
98-95-3	Nitrobenzene	5.49E-06	1.01E-06	6.50E-06
	Sum of column = R_{VOS} =	5.11E-04	4.61E-04	9.72E-04

HL = Henry's Law Groupings; values for HL are from the Emission Baseline Report (23590-WTP-RPT-PO-03-008)
WF_i = the weight fraction of the individual organic compound; values are assigned from Table 3 based on HL
WF_S = Sum WF_i
WR_i = the ratio of the individual organic compound weight fraction to the sum of the individual weight fraction = WFi / WF_S
WR_S = Sum WR_i
R_{IO} = WR_i * ER_{O-LA}; ER_{O-LA} is from Table 1
R_{VO} = vapor emissions; R_{VO} is "0" if the compound is a particle or is particle-bound
R_{VOS} = Sum R_{VOi}
P = particle; cell has an "X" if the compound is a particle or is particle-bound

Table 8. Estimate of Organic Emissions from the LAW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
100-00-5	p-Nitrochlorobenzene	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
100-21-0	p-Phthalic acid	1	7.75E+01	3.16E-02	1.89E-06	1.89E-06	
100-25-4	1,4-Dinitrobenzene	6	7.10E+01	2.89E-02	1.73E-06	0.00E+00	X
100-41-4	Ethyl benzene	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
100-42-5	Styrene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
10061-01-5	cis-1,3-Dichloropropene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
10061-02-6	trans-1,3-Dichloropropene	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
101-55-3	4-Bromophenylphenyl ether	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
101-84-8	Diphenyl ether	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
106-35-4	3-Heptanone	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
106-42-3	p-Xylene (Dimethyl benzene)	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
106-46-7	1,4-Dichlorobenzene	18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
106-88-7	1,2-Epoxybutane	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
106-93-4	Ethylene dibromide (Dibromethane)	16	3.17E-08	0.00E+00	0.00E+00	0.00E+00	
106-97-8	Butane	26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
106-99-0	1,3-Butadiene	23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
107-02-8	Acrolein	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
107-05-1	3-Chloropropene (Allyl chloride)	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
107-06-2	1,2-Dichloroethane (Ethylene chloride)	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
107-12-0	Propionitrile	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
107-13-1	Acrylonitrile	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
107-18-6	2-Propene-1-ol	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
107-31-3	Formic acid, methyl ester	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
107-66-4	Dibutylphosphate	5	1.65E+01	6.71E-03	4.02E-07	0.00E+00	X
107-87-9	2-Pentanone	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
108-03-2	1-Nitropropane	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
108-05-4	Vinyl acetate	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
108-10-1	Hexone (4-Methyl-2-pentanone or MIBK)	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
108-20-3	Bis(isopropyl)ether	18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
108-38-3	m-Xylene (Dimethyl benzene)	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
108-39-4	m-Cresol	9	6.86E+00	2.79E-03	1.67E-07	1.67E-07	
108-87-2	Methylcyclohexane	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
108-88-3	Toluene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
108-90-7	Chlorobenzene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
108-93-0	Cyclohexanol	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
108-94-1	Cyclohexanone	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
108-95-2	Phenol	8	2.94E+01	1.20E-02	7.17E-07	7.17E-07	
109-66-0	n-Pentane	26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
109-99-9	Tetrahydrofuran	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
110-12-3	5-Methyl-2-hexanone	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
110-43-0	2-Heptanone	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	

Table 8. Estimate of Organic Emissions from the LAW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{iO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
110-54-3	n-Hexane	27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
110-62-3	n-Valeraldehyde	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
110-82-7	Cyclohexane	24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
110-83-8	Cyclohexene	22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
110-86-1	Pyridine	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
111-65-9	n-Octane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
111-76-2	Ethylene glycol monobutyl ether	9	6.86E+00	2.79E-03	1.67E-07	1.67E-07	
111-84-2	n-Nonane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	30	2.39E-01	9.70E-05	5.81E-09	0.00E+00	X
117-84-0	n-Dioctyl phthalate	32	4.21E-01	1.72E-04	1.03E-08	0.00E+00	X
118-74-1	Hexachlorobenzene	18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
120-12-7	Anthracene	13	2.67E-03	1.00E-06	6.00E-11	6.00E-11	
120-82-1	1,2,4-Trichlorobenzene	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
120-83-2	2,4-Dichlorophenol	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
121-44-8	Triethylamine	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
121-69-7	Dimethylaniline	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
122-39-4	N,N-Diphenylamine	10	2.74E-01	1.11E-04	6.65E-09	6.65E-09	
123-19-3	4-Heptanone	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
123-38-6	n-Propionaldehyde	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
123-51-3	3-Methyl-1-butanol	12	9.79E-02	4.00E-05	2.40E-09	2.40E-09	
123-86-4	Acetic acid n-butyl ester	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
123-91-1	1,4-Dioxane	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
126-73-8	Tributyl phosphate	7	4.74E+01	1.93E-02	1.16E-06	1.16E-06	
126-98-7	2-Methyl-2-propenenitrile (Methacrylonitrile)	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
127-18-4	Perchloroethylene (tetrachloroethylene)	21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
127-19-5	N,N-Dimethylacetamide	5	1.65E+01	6.71E-03	4.02E-07	4.02E-07	
128-37-0	2,6-Bis(tert-butyl)-4-methylphenol	32	4.21E-01	1.72E-04	1.03E-08	1.03E-08	
129-00-0	Pyrene	33	1.41E-01	5.80E-05	3.47E-09	0.00E+00	X
1321-64-8	Pentachloronaphthalene	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	X
1321-65-9	Trichloronaphthalene	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
132-64-9	Dibenzofuran	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
1335-87-1	Hexachloronaphthalene	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	X
1335-88-2	Tetrachloronaphthalene	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	X
1336-36-3	Polychlorinated biphenyls (PCBs)	35	1.71E-07	0.00E+00	0.00E+00	0.00E+00	X
141-78-6	Acetic acid ethyl ester (Ethyl acetate)	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
141-79-7	4-Methyl-3-penten-2-one	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
142-82-5	n-Heptane	27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
144-62-7	Oxalic acid	3	7.73E+00	3.15E-03	1.89E-07	1.89E-07	
156-60-5	trans-1,2-Dichloroethylene	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1582-09-8	Trifluralin	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	X
1634-04-4	Methyl tert-butyl ether	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
1836-75-5	Nitrofen	30	2.39E-01	9.70E-05	5.81E-09	0.00E+00	X
189-55-9	Dibenzo[a,i]pyrene	5	1.65E+01	6.71E-03	4.02E-07	0.00E+00	X
189-64-0	Dibenzo[a,h]pyrene	5	1.65E+01	6.71E-03	4.02E-07	0.00E+00	X
191-24-2	Benzo(g,h,i)perylene	30	2.39E-01	9.70E-05	5.81E-09	0.00E+00	X
191-30-0	Benzo[a,i]pyrene	5	1.65E+01	6.71E-03	4.02E-07	0.00E+00	X
192-65-4	Dibenzo[a,e]pyrene	5	1.65E+01	6.71E-03	4.02E-07	0.00E+00	X
193-39-5	Indeno(1,2,3-cd)pyrene	30	2.39E-01	9.70E-05	5.81E-09	0.00E+00	X
205-82-3	Benzo(j)fluoranthene	7	4.74E+01	1.93E-02	1.16E-06	0.00E+00	X
205-99-2	Benzo(b)fluoranthene	30	2.39E-01	9.70E-05	5.81E-09	0.00E+00	X
206-44-0	Fluoranthene	33	7.11E-02	2.90E-05	1.74E-09	0.00E+00	X
207-08-9	Benzo(k)fluoranthene	30	2.39E-01	9.70E-05	5.81E-09	0.00E+00	X
208-96-8	Acenaphthylene	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	

Table 8. Estimate of Organic Emissions from the LAW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
218-01-9	Chrysene	32	7.49E-01	3.05E-04	1.83E-08	0.00E+00	X
2234-13-1	Octachloronaphthalene	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	X
224-42-0	Dibenz[a,j]acridine	4	7.71E+01	3.14E-02	1.88E-06	0.00E+00	X
226-36-8	Dibenz[a,h]acridine	4	7.71E+01	3.14E-02	1.88E-06	0.00E+00	X
2385-85-5	Mirex	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
25551-13-7	Trimethyl benzene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
26140-60-3	Terphenyls	34	3.67E-05	0.00E+00	0.00E+00	0.00E+00	X
27154-33-2	Trichlorofluoroethane	23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
287-92-3	Cyclopentane	24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
309-00-2	Aldrin	34	3.67E-05	0.00E+00	0.00E+00	0.00E+00	X
319-84-6	Hexachlorocyclohexane (Lindane) Alpha BHC	33	7.11E-02	2.90E-05	1.74E-09	1.74E-09	
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	30	9.70E-02	3.90E-05	2.34E-09	0.00E+00	X
319-86-8	Delta-BHC	30	2.39E-01	9.70E-05	5.81E-09	0.00E+00	X
3697-24-3	5-Methylchrysene	32	4.21E-01	1.72E-04	1.03E-08	0.00E+00	X
3825-26-1	Ammonium perfluorooctanoate	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	X
4170-30-3	2-Butenaldehyde (2-Butenal)	11	3.62E-02	1.50E-05	9.00E-10	9.00E-10	
465-73-6	Isodrin	35	1.71E-07	0.00E+00	0.00E+00	0.00E+00	
50-00-0	Formaldehyde	8	3.48E+01	1.42E-02	8.50E-07	8.50E-07	
50-29-3	4,4-DDT	33	7.11E-02	2.90E-05	1.74E-09	0.00E+00	X
50-32-8	Benzo(a)pyrene	30	3.81E-01	1.55E-04	9.28E-09	0.00E+00	X
53-70-3	Dibenzo(a,h)anthracene	7	4.74E+01	1.93E-02	1.16E-06	0.00E+00	X
540-59-0	1,2-Dichloroethylene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
540-84-1	2,2,4-Trimethylpentane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
541-73-1	1,3-Dichlorobenzene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
56-23-5	Carbon tetrachloride	22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
563-80-4	3-Methyl-2-butanone	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
56-49-5	3-Methylcholanthrene	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	X
56-55-3	Benzo(a)anthracene	33	7.11E-02	2.90E-05	1.74E-09	0.00E+00	X
57-14-7	1,1-Dimethylhydrazine	12	9.79E-02	4.00E-05	2.40E-09	2.40E-09	
58-89-9	gamma-BHC (Lindane)	32	1.53E-03	1.00E-06	6.00E-11	0.00E+00	X
58-90-2	2,3,4,6-Tetrachlorophenol	11	1.95E-01	7.90E-05	4.73E-09	4.73E-09	
591-78-6	2-Hexanone	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
59-50-7	4-Chloro-3-methylphenol	32	4.21E-01	1.72E-04	1.03E-08	0.00E+00	X
59-89-2	N-Nitrosomorpholine	6	7.10E+01	2.89E-02	1.73E-06	1.73E-06	
602-87-9	5-Nitroacenaphthene	9	6.86E+00	2.79E-03	1.67E-07	0.00E+00	X
60-29-7	Ethyl ether	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
603-34-9	Triphenylamine	32	5.13E-01	2.09E-04	1.25E-08	1.25E-08	
60-34-4	Methylhydrazine	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
60-35-5	Acetamide	5	1.65E+01	6.71E-03	4.02E-07	4.02E-07	
60-57-1	Dieldrin	33	7.51E-04	0.00E+00	0.00E+00	0.00E+00	X
621-64-7	Di-n-Propylnitrosamine	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
624-83-9	Methyl isocyanate	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
627-13-4	Nitric acid, propyl ester	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
62-75-9	N-Nitroso-N,N-dimethylamine	9	6.86E+00	2.79E-03	1.67E-07	1.67E-07	
630-20-6	1,1,1,2-Tetrachloroethane	18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
64-17-5	Ethyl alcohol	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
64-18-6	Formic acid	7	4.74E+01	1.93E-02	1.16E-06	1.16E-06	
64-19-7	Acetic acid	6	7.10E+01	2.89E-02	1.73E-06	1.73E-06	
67-56-1	Methyl alcohol (Methanol)	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
67-63-0	2-Propyl alcohol (Isopropanol)	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
67-64-1	2-Propanone (Acetone)	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
67-66-3	Chloroform	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
67-72-1	Hexachloroethane	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

Table 8. Estimate of Organic Emissions from the LAW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
684-16-2	Hexafluoroacetone	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
71-23-8	n-Propyl alcohol	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
71-36-3	n-Butyl alcohol	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
71-43-2	Benzene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
72-20-8	Endrin	32	4.21E-01	1.72E-04	1.03E-08	0.00E+00	X
72-43-5	Methoxychlor	7	4.74E+01	1.93E-02	1.16E-06	0.00E+00	X
72-54-8	4,4-DDD	32	4.21E-01	1.72E-04	1.03E-08	0.00E+00	X
72-55-9	4,4-DDE	34	3.67E-05	0.00E+00	0.00E+00	0.00E+00	X
74-83-9	Bromomethane (Methyl bromide)	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
74-87-3	Chloromethane (Methyl chloride)	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
74-97-5	Bromochloromethane	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
74-99-7	Methylacetylene	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-00-3	Chloroethane	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-01-4	Vinyl chloride (1-Chloroethene)	22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-05-8	Acetonitrile	13	2.76E-03	1.00E-06	6.00E-11	6.00E-11	
75-07-0	Acetaldehyde	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
75-09-2	Dichloromethane (Methylene chloride)	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-12-7	Formamide	4	7.71E+01	3.14E-02	1.88E-06	1.88E-06	
75-15-0	Carbon disulfide	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-21-8	Ethylene oxide (Oxirane)	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
75-27-4	Bromodichloromethane	18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-34-3	1,1-Dichloroethane	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-35-4	1,1-Dichloroethene (Vinylidene chloride)	22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-43-4	Dichlorofluoromethane	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-45-6	Chlorodifluoromethane	22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-50-3	Trimethylamine	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
75-52-5	Nitromethane	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
75-55-8	2-Methylaziridine	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
75-61-6	Difluorodibromomethane	22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-63-8	Trifluorobromomethane	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-65-0	2-Methyl-2-propanol	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
75-69-4	Trichlorofluoromethane	23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-71-8	Dichlorodifluoromethane	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-99-0	2,2-Dichloropropionic acid	6	7.10E+01	2.89E-02	1.73E-06	1.73E-06	
76-03-9	Trichloroacetic acid	5	1.65E+01	6.71E-03	4.02E-07	4.02E-07	
76-11-9	1,1,1,2-Tetrachloro-2,2-difluoroethane	24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-12-0	1,1,2,2-Tetrachloro-1,2-difluoroethane	23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-13-1	1,2,2-Trichloro-1,1,2-trifluoroethane (Freon 113)	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-15-3	Chloropentafluoroethane	29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-44-8	Heptachlor	16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
78-83-1	2-Methylpropyl alcohol (Isobutyl alcohol)	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
78-87-5	1,2-Dichloropropane	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
78-92-2	1-Methylpropyl alcohol (2-Butanol)	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
78-93-3	Methyl ethyl ketone (MEK, 2-Butanone)	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
79-00-5	1,1,2-Trichloroethane	17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
79-01-6	Trichloroethylene	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
79-09-4	Propionic acid	8	3.48E+01	1.42E-02	8.50E-07	8.50E-07	
79-10-7	2-Propenoic acid	8	3.48E+01	1.42E-02	8.50E-07	8.50E-07	
79-20-9	Methyl acetate	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
79-34-5	1,1,2,2-Tetrachloroethane	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
8001-35-2	Toxaphene	10	2.64E-03	1.00E-06	6.00E-11	0.00E+00	X

Table 8. Estimate of Organic Emissions from the LAW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
82-68-8	Pentachloronitrobenzene (PCBN)	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
83-32-9	Acenaphthene	15	1.61E-05	0.00E+00	0.00E+00	0.00E+00	
84-66-2	Diethyl phthalate	8	1.65E+01	6.74E-03	4.04E-07	4.04E-07	
84-74-2	Dibutyl phthalate	31	5.73E+00	2.33E-03	1.40E-07	0.00E+00	X
85-01-8	Phenanthrene	13	2.71E-03	1.00E-06	6.00E-11	6.00E-11	
85-68-7	Butylbenzyl phthalate	31	5.73E+00	2.33E-03	1.40E-07	0.00E+00	X
86-73-7	Fluorene	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	X
87-68-3	Hexachlorobutadiene	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
87-86-5	Pentachlorophenol	6	7.10E+01	2.89E-02	1.73E-06	1.73E-06	
88-06-2	2,4,6-Trichlorophenol	10	1.38E-01	5.60E-05	3.35E-09	3.35E-09	
88-72-2	2-Nitrotoluene	12	9.79E-02	4.00E-05	2.40E-09	2.40E-09	
88-75-5	2-Nitrophenol	12	9.79E-02	4.00E-05	2.40E-09	2.40E-09	
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	8	5.85E+01	2.38E-02	1.43E-06	0.00E+00	X
88-89-1	Picric acid	2	1.03E+03	4.20E-01	2.52E-05	0.00E+00	X
91-20-3	Naphthalene	16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
91-22-5	Quinoline	9	6.86E+00	2.79E-03	1.67E-07	1.67E-07	
91-58-7	2-Chloronapthalene	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
92-52-4	1,1`-Biphenyl	16	1.06E-08	0.00E+00	0.00E+00	0.00E+00	
92-93-3	4-Nitrobiphenyl	10	1.38E-01	5.60E-05	3.35E-09	0.00E+00	X
93-72-1	Silvex (2,4,5-TP)	5	1.65E+01	6.71E-03	4.02E-07	0.00E+00	X
93-76-5	2,4,5-T	5	1.65E+01	6.71E-03	4.02E-07	0.00E+00	X
94-75-7	2,4-D and esters (160C typed)	6	7.10E+01	2.89E-02	1.73E-06	1.73E-06	
95-13-6	Indene	18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
95-47-6	o-Xylene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
95-48-7	o-Cresol (2-Methylphenol)	9	6.86E+00	2.79E-03	1.67E-07	1.67E-07	
95-49-8	2-Chlorotoluene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
95-50-1	o-Dichlorobenzene (1,2-Dichlorobenzene)	18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
95-57-8	2-Chlorophenol	11	1.24E-01	5.00E-05	3.00E-09	3.00E-09	
95-95-4	2,4,5-Trichlorophenol	9	6.86E+00	2.79E-03	1.67E-07	1.67E-07	
96-22-0	3-Pentanone	14	3.20E-04	0.00E+00	0.00E+00	0.00E+00	
96-69-5	Bis(3-tert-butyl-4-hydroxy-6-methyl-phenyl)sulfide	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	X
98-51-1	p-tert-Butyltoluene	21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
98-82-8	Cumene	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
98-83-9	alpha-Methylstyrene	19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
98-86-2	Acetophenone	11	1.40E-01	5.70E-05	3.41E-09	3.41E-09	
98-95-3	Nitrobenzene	12	9.79E-02	4.00E-05	2.40E-09	2.40E-09	
		Weight Fraction Sum = WF_S =	2454.995				
		Weight Ratio Sum = WR_S =		1.00			
		LAW Stream Sum = $ER_{O\text{-}LA}$ =			5.99E-05		
		LAW Stream Vapor Organic Release Sum = R_{VOS} =				2.09E-05	

HL = Henry's Law Groupings; values for HL are from the Emission Baseline Report (23590-WTP-RPT-PO-03-008)
WF_i = the weight fraction of the individual organic compound; values are assigned from Table 4 based on HL
WF_S = Sum WF_i
WR_i = the ratio of the individual organic compound weight fraction to the sum of the individual weight fraction = WFi / WF_S
WR_S = Sum WR_i
R_{IO} = WR_i * $ER_{O\text{-}HL}$; $ER_{O\text{-}HL}$ is from Table 1
R_{VO} = vapor emissions; R_{VO} is "0" if the compound is a particle or is particle-bound
R_{VOS} = Sum R_{VOi}
P = particle; cell has an "X" if the compound is a particle or is particle-bound

Table 9. Estimate of Organic Emissions from the HLW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
100-00-5	p-Nitrochlorobenzene	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
100-21-0	p-Phthalic acid	1	1.99E+01	1.81E-02	5.16E-07	5.16E-07	
100-25-4	1,4-Dinitrobenzene	6	2.00E+01	1.83E-02	5.22E-07	0.00E+00	X
100-41-4	Ethyl benzene	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
100-42-5	Styrene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
10061-01-5	cis-1,3-Dichloropropene	19	4.41E-06	0.00E+00	0.00E+00	0.00E+00	
10061-02-6	trans-1,3-Dichloropropene	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
101-55-3	4-Bromophenylphenyl ether	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
101-84-8	Diphenyl ether	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
106-35-4	3-Heptanone	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
106-42-3	p-Xylene (Dimethyl benzene)	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
106-46-7	1,4-Dichlorobenzene	18	3.23E-06	0.00E+00	0.00E+00	0.00E+00	
106-88-7	1,2-Epoxybutane	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
106-93-4	Ethylene dibromide (Dibromethane)	16	6.18E-03	0.00E+00	0.00E+00	0.00E+00	
106-97-8	Butane	26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
106-99-0	1,3-Butadiene	23	5.60E-13	0.00E+00	0.00E+00	0.00E+00	
107-02-8	Acrolein	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
107-05-1	3-Chloropropene (Allyl chloride)	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
107-06-2	1,2-Dichloroethane (Ethylene chloride)	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
107-12-0	Propionitrile	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
107-13-1	Acrylonitrile	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
107-18-6	2-Propene-1-ol	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
107-31-3	Formic acid, methyl ester	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
107-66-4	Dibutylphosphate	5	4.40E+00	4.00E-03	1.14E-07	0.00E+00	X
107-87-9	2-Pentanone	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
108-03-2	1-Nitropropane	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
108-05-4	Vinyl acetate	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
108-10-1	Hexone (4-Methyl-2-pentanone or MIBK)	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
108-20-3	Bis(isopropyl)ether	18	3.23E-06	0.00E+00	0.00E+00	0.00E+00	
108-38-3	m-Xylene (Dimethyl benzene)	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
108-39-4	m-Cresol	9	2.88E+01	2.63E-02	7.50E-07	7.50E-07	
108-87-2	Methylcyclohexane	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
108-88-3	Toluene	19	7.25E-08	0.00E+00	0.00E+00	0.00E+00	
108-90-7	Chlorobenzene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
108-93-0	Cyclohexanol	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
108-94-1	Cyclohexanone	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
108-95-2	Phenol	8	1.96E+01	1.79E-02	5.11E-07	5.11E-07	
109-66-0	n-Pentane	26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
109-99-9	Tetrahydrofuran	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
110-12-3	5-Methyl-2-hexanone	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
110-43-0	2-Heptanone	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	

Table 9. Estimate of Organic Emissions from the HLW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
110-54-3	n-Hexane	27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
110-62-3	n-Valeraldehyde	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
110-82-7	Cyclohexane	24	3.30E-21	0.00E+00	0.00E+00	0.00E+00	
110-83-8	Cyclohexene	22	7.29E-11	0.00E+00	0.00E+00	0.00E+00	
110-86-1	Pyridine	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
111-65-9	n-Octane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
111-76-2	Ethylene glycol monobutyl ether	9	2.88E+01	2.63E-02	7.50E-07	7.50E-07	
111-84-2	n-Nonane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	30	1.97E-01	2.00E-04	5.70E-09	0.00E+00	X
117-84-0	n-Dioctyl phthalate	32	9.24E+00	8.40E-03	2.40E-07	0.00E+00	X
118-74-1	Hexachlorobenzene	18	3.23E-06	0.00E+00	0.00E+00	0.00E+00	
120-12-7	Anthracene	13	3.28E+00	3.00E-03	8.56E-08	8.56E-08	
120-82-1	1,2,4-Trichlorobenzene	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
120-83-2	2,4-Dichlorophenol	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
121-44-8	Triethylamine	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
121-69-7	Dimethylaniline	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
122-39-4	N,N-Diphenylamine	10	3.02E+00	2.80E-03	7.99E-08	7.99E-08	
123-19-3	4-Heptanone	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
123-38-6	n-Propionaldehyde	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
123-51-3	3-Methyl-1-butanol	12	9.67E+00	8.80E-03	2.51E-07	2.51E-07	
123-86-4	Acetic acid n-butyl ester	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
123-91-1	1,4-Dioxane	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
126-73-8	Tributyl phosphate	7	2.01E+01	1.84E-02	5.25E-07	5.25E-07	
126-98-7	2-Methyl-2-propenenitrile (Methacrylonitrile)	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
127-18-4	Perchloroethylene (tetrachloroethylene)	21	6.57E-10	0.00E+00	0.00E+00	0.00E+00	
127-19-5	N,N-Dimethylacetamide	5	4.40E+00	4.00E-03	1.14E-07	1.14E-07	
128-37-0	2,6-Bis(tert-butyl)-4-methylphenol	32	9.24E+00	8.40E-03	2.40E-07	2.40E-07	
129-00-0	Pyrene	33	1.28E+01	1.17E-02	3.34E-07	0.00E+00	X
1321-64-8		14	1.05E+00	1.00E-03	2.85E-08	0.00E+00	X
1321-65-9	Trichloronaphthalene	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
132-64-9	Dibenzofuran	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
1335-87-1	Hexachloronaphthalene	14	1.05E+00	1.00E-03	2.85E-08	0.00E+00	X
1335-88-2	Tetrachloronaphthalene	15	2.40E-01	2.00E-04	5.70E-09	0.00E+00	X
1336-36-3	Polychlorinated biphenyls (PCBs)	35	2.12E-01	2.00E-04	5.70E-09	0.00E+00	X
141-78-6	Acetic acid ethyl ester (Ethyl acetate)	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
141-79-7	4-Methyl-3-penten-2-one	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
142-82-5	n-Heptane	27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
144-62-7	Oxalic acid	3	1.99E+00	1.80E-03	5.13E-08	5.13E-08	
156-60-5	trans-1,2-Dichloroethylene	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
1582-09-8	Trifluralin	14	1.05E+00	1.00E-03	2.85E-08	0.00E+00	X
1634-04-4	Methyl tert-butyl ether	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
1836-75-5	Nitrofen	30	1.97E-01	2.00E-04	5.70E-09	0.00E+00	X
189-55-9	Dibenzo[a,i]pyrene	5	4.40E+00	4.00E-03	1.14E-07	0.00E+00	X
189-64-0	Dibenzo[a,h]pyrene	5	4.40E+00	4.00E-03	1.14E-07	0.00E+00	X
191-24-2	Benzo(g,h,i)perylene	30	1.97E-01	2.00E-04	5.70E-09	0.00E+00	X
191-30-0	Benzo[a,i]pyrene	5	4.40E+00	4.00E-03	1.14E-07	0.00E+00	X
192-65-4	Dibenzo[a,e]pyrene	5	4.40E+00	4.00E-03	1.14E-07	0.00E+00	X
193-39-5	Indeno(1,2,3-cd)pyrene	30	1.97E-01	2.00E-04	5.70E-09	0.00E+00	X
205-82-3	Benzo(j)fluoranthene	7	2.01E+01	1.84E-02	5.25E-07	0.00E+00	X
205-99-2	Benzo(b)fluoranthene	30	1.97E-01	2.00E-04	5.70E-09	0.00E+00	X
206-44-0	Fluoranthene	33	6.44E+00	5.90E-03	1.68E-07	0.00E+00	X
207-08-9	Benzo(k)fluoranthene	30	1.97E-01	2.00E-04	5.70E-09	0.00E+00	X
208-96-8	Acenaphthylene	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	

Table 9. Estimate of Organic Emissions from the HLW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
218-01-9	Chrysene	32	1.54E+01	1.40E-02	3.99E-07	0.00E+00	X
2234-13-1	Octachloronaphthalene	14	1.05E+00	1.00E-03	2.85E-08	0.00E+00	X
224-42-0	Dibenz[a,j]acridine	4	1.98E+01	1.81E-02	5.16E-07	0.00E+00	X
226-36-8	Dibenz[a,h]acridine	4	1.98E+01	1.81E-02	5.16E-07	0.00E+00	X
2385-85-5	Mirex	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
25551-13-7	Trimethyl benzene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
26140-60-3	Terphenyls	34	8.88E-02	1.00E-04	2.85E-09	0.00E+00	X
27154-33-2	Trichlorofluoroethane	23	5.60E-13	0.00E+00	0.00E+00	0.00E+00	
287-92-3	Cyclopentane	24	3.30E-21	0.00E+00	0.00E+00	0.00E+00	
309-00-2	Aldrin	34	8.88E-02	1.00E-04	2.85E-09	0.00E+00	X
319-84-6	Hexachlorocyclohexane (Lindane) Alpha BHC	33	6.44E+00	5.90E-03	1.68E-07	1.68E-07	
319-85-7	Hexachlorocyclohexane (Lindane) Beta BHC	30	8.35E-02	1.00E-04	2.85E-09	0.00E+00	X
319-86-8	Delta-BHC	30	1.97E-01	2.00E-04	5.70E-09	0.00E+00	X
3697-24-3	5-Methylchrysene	32	9.24E+00	8.40E-03	2.40E-07	0.00E+00	X
3825-26-1	Ammonium perfluorooctanoate	14	1.05E+00	1.00E-03	2.85E-08	0.00E+00	X
4170-30-3	2-Butenaldehyde (2-Butenal or Crotonaldehyde)	11	2.33E+00	2.10E-03	5.99E-08	5.99E-08	
465-73-6	Isodrin	35	2.12E-01	2.00E-04	5.70E-09	5.70E-09	
50-00-0	Formaldehyde	8	2.21E+01	2.02E-02	5.76E-07	5.76E-07	
50-29-3	4,4-DDT	33	6.44E+00	5.90E-03	1.68E-07	0.00E+00	X
50-32-8	Benzo(a)pyrene	30	3.11E-01	3.00E-04	8.56E-09	0.00E+00	X
53-70-3	Dibenzo(a,h)anthracene	7	2.01E+01	1.84E-02	5.25E-07	0.00E+00	X
540-59-0	1,2-Dichloroethylene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
540-84-1	2,2,4-Trimethylpentane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
541-73-1	1,3-Dichlorobenzene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
56-23-5	Carbon tetrachloride	22	7.29E-11	0.00E+00	0.00E+00	0.00E+00	
563-80-4	3-Methyl-2-butanone	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
56-49-5	3-Methylcholanthrene	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	X
56-55-3	Benzo(a)anthracene	33	6.44E+00	5.90E-03	1.68E-07	0.00E+00	X
57-14-7	1,1-Dimethylhydrazine	12	9.67E+00	8.80E-03	2.51E-07	2.51E-07	
58-89-9	gamma-BHC (Lindane)	32	5.28E-02	0.00E+00	0.00E+00	0.00E+00	X
58-90-2	2,3,4,6-Tetrachlorophenol	11	1.08E+01	9.90E-03	2.82E-07	2.82E-07	
591-78-6	2-Hexanone	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
59-50-7	4-Chloro-3-methylphenol	32	9.24E+00	8.40E-03	2.40E-07	0.00E+00	X
59-89-2	N-Nitrosomorpholine	6	2.00E+01	1.83E-02	5.22E-07	5.22E-07	
602-87-9	5-Nitroacenaphthene	9	2.88E+01	2.63E-02	7.50E-07	0.00E+00	X
60-29-7	Ethyl ether	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
603-34-9	Triphenylamine	32	1.23E+01	1.12E-02	3.19E-07	3.19E-07	
60-34-4	Methylhydrazine	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
60-35-5	Acetamide	5	4.40E+00	4.00E-03	1.14E-07	1.14E-07	
60-57-1	Dieldrin	33	9.32E-02	1.00E-04	2.85E-09	0.00E+00	X
621-64-7	Di-n-Propylnitrosamine (N-Nitroso-di-n-propylamine)	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
624-83-9	Methyl isocyanate	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
627-13-4	Nitric acid, propyl ester	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
62-75-9	N-Nitroso-N,N-dimethylamine (Dimethylnitrosamine)	9	2.88E+01	2.63E-02	7.50E-07	7.50E-07	
630-20-6	1,1,1,2-Tetrachloroethane	18	3.23E-06	0.00E+00	0.00E+00	0.00E+00	
64-17-5	Ethyl alcohol	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
64-18-6	Formic acid	7	2.01E+01	1.84E-02	5.25E-07	5.25E-07	
64-19-7	Acetic acid	6	2.00E+01	1.83E-02	5.22E-07	5.22E-07	
67-56-1	Methyl alcohol (Methanol)	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
67-63-0	2-Propyl alcohol (Isopropanol; Propan-2-01)	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
67-64-1	2-Propanone (Acetone)	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
67-66-3	Chloroform	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
67-72-1	Hexachloroethane	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	

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CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
684-16-2	Hexafluoroacetone	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
71-23-8	n-Propyl alcohol	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
71-36-3	n-Butyl alcohol	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
71-43-2	Benzene	19	1.69E-07	0.00E+00	0.00E+00	0.00E+00	
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	21	6.57E-10	0.00E+00	0.00E+00	0.00E+00	
72-20-8	Endrin	32	9.24E+00	8.40E-03	2.40E-07	0.00E+00	X
72-43-5	Methoxychlor	7	2.01E+01	1.84E-02	5.25E-07	0.00E+00	X
72-54-8	4,4-DDD	32	9.24E+00	8.40E-03	2.40E-07	0.00E+00	X
72-55-9	4,4-DDE	34	8.88E-02	1.00E-04	2.85E-09	0.00E+00	X
74-83-9	Bromomethane (Methyl bromide)	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
74-87-3	Chloromethane (Methyl chloride)	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
74-97-5	Bromochloromethane	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
74-99-7	Methylacetylene	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
75-00-3	Chloroethane	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
75-01-4	Vinyl chloride (1-Chloroethene)	22	7.29E-11	0.00E+00	0.00E+00	0.00E+00	
75-05-8	Acetonitrile	13	1.69E+00	1.50E-03	4.28E-08	4.28E-08	
75-07-0	Acetaldehyde	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
75-09-2	Dichloromethane (Methylene chloride)	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
75-12-7	Formamide	4	1.98E+01	1.81E-02	5.16E-07	5.16E-07	
75-15-0	Carbon disulfide	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
75-21-8	Ethylene oxide (Oxirane)	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
75-27-4	Bromodichloromethane	18	3.23E-06	0.00E+00	0.00E+00	0.00E+00	
75-34-3	1,1-Dichloroethane	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
75-35-4	1,1-Dichloroethene (Vinylidene chloride)	22	7.29E-11	0.00E+00	0.00E+00	0.00E+00	
75-43-4	Dichlorofluoromethane	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
75-45-6	Chlorodifluoromethane	22	7.29E-11	0.00E+00	0.00E+00	0.00E+00	
75-50-3	Trimethylamine	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
75-52-5	Nitromethane	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
75-55-8	2-Methylaziridine	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
75-61-6	Difluorodibromomethane	22	7.29E-11	0.00E+00	0.00E+00	0.00E+00	
75-63-8	Trifluorobromomethane	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-65-0	2-Methyl-2-propanol	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
75-69-4	Trichlorofluoromethane	23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-71-8	Dichlorodifluoromethane	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75-99-0	2,2-Dichloropropionic acid	6	2.00E+01	1.83E-02	5.22E-07	5.22E-07	
76-03-9	Trichloroacetic acid	5	4.40E+00	4.00E-03	1.14E-07	1.14E-07	
76-11-9	1,1,1,2-Tetrachloro-2,2-difluoroethane	24	3.30E-21	0.00E+00	0.00E+00	0.00E+00	
76-12-0	1,1,2,2-Tetrachloro-1,2-difluoroethane	23	5.60E-13	0.00E+00	0.00E+00	0.00E+00	
76-13-1	1,2,2-Trichloro-1,1,2-trifluoroethane (Freon 113)	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-15-3	Chloropentafluoroethane	29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76-44-8	Heptachlor	16	2.05E-03	0.00E+00	0.00E+00	0.00E+00	
78-83-1	2-Methylpropyl alcohol (Isobutyl alcohol)	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
78-87-5	1,2-Dichloropropane	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
78-92-2	1-Methylpropyl alcohol (2-Butanol)	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
78-93-3	Methyl ethyl ketone (MEK, 2-Butanone)	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
79-00-5	1,1,2-Trichloroethane	17	7.06E-05	0.00E+00	0.00E+00	0.00E+00	
79-01-6	Trichloroethylene	20	1.16E-08	0.00E+00	0.00E+00	0.00E+00	
79-09-4	Propionic acid	8	2.21E+01	2.02E-02	5.76E-07	5.76E-07	
79-10-7	2-Propenoic acid	8	2.21E+01	2.02E-02	5.76E-07	5.76E-07	
79-20-9	Methyl acetate	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
79-34-5	1,1,2,2-Tetrachloroethane	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
8001-35-2	Toxaphene	10	1.20E-01	1.00E-04	2.85E-09	0.00E+00	X

Table 9. Estimate of Organic Emissions from the HLW Process Cells. Calc. No. 24590-WTP-HAC-50-00001, Rev. C

CAS#	Organic Compound	Henry's Law Grouping HL	Individual Organic Weight Fraction. WF_i mg/kg	Individual Organic Weight Ratio WR_i unitless	Individual Organic Release R_{IO} gm/s	Individual Organic Vapor Emission R_{VO} gm/s	Particle P
82-68-8	Pentachloronitrobenzene (PCBN or quintobenzene)	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
83-32-9	Acenaphthene	15	2.40E-01	2.00E-04	5.70E-09	5.70E-09	
84-66-2	Diethyl phthalate	8	1.85E+01	1.69E-02	4.82E-07	4.82E-07	
84-74-2	Dibutyl phthalate	31	1.94E+01	1.77E-02	5.05E-07	0.00E+00	X
85-01-8	Phenanthrene	13	2.48E+00	2.30E-03	6.56E-08	6.56E-08	
85-68-7	Butylbenzyl phthalate	31	1.94E+01	1.77E-02	5.05E-07	0.00E+00	X
86-73-7	Fluorene	14	1.05E+00	1.00E-03	2.85E-08	0.00E+00	X
87-68-3	Hexachlorobutadiene	20	9.11E-09	0.00E+00	0.00E+00	0.00E+00	
87-86-5	Pentachlorophenol	6	2.00E+01	1.83E-02	5.22E-07	5.22E-07	
88-06-2	2,4,6-Trichlorophenol	10	1.57E+00	1.40E-03	3.99E-08	3.99E-08	
88-72-2	2-Nitrotoluene	12	9.67E+00	8.80E-03	2.51E-07	2.51E-07	
88-75-5	2-Nitrophenol	12	9.67E+00	8.80E-03	2.51E-07	2.51E-07	
88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	8	2.83E+01	2.58E-02	7.36E-07	0.00E+00	X
88-89-1	Picric acid	2	2.47E+01	2.25E-02	6.42E-07	0.00E+00	X
91-20-3	Naphthalene	16	8.81E-04	0.00E+00	0.00E+00	0.00E+00	
91-22-5	Quinoline	9	2.88E+01	2.63E-02	7.50E-07	7.50E-07	
91-58-7	2-Chloronapthalene	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
92-52-4	1,1`-Biphenyl	16	3.04E-03	0.00E+00	0.00E+00	0.00E+00	
92-93-3	4-Nitrobiphenyl	10	1.57E+00	1.40E-03	3.99E-08	0.00E+00	X
93-72-1	Silvex (2,4,5-TP)	5	4.40E+00	4.00E-03	1.14E-07	0.00E+00	X
93-76-5	2,4,5-T	5	4.40E+00	4.00E-03	1.14E-07	0.00E+00	X
94-75-7	2,4-D and esters (160C typed)	6	2.00E+01	1.83E-02	5.22E-07	5.22E-07	
95-13-6	Indene	18	3.23E-06	0.00E+00	0.00E+00	0.00E+00	
95-47-6	o-Xylene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
95-48-7	o-Cresol (2-Methylphenol)	9	2.88E+01	2.63E-02	7.50E-07	7.50E-07	
95-49-8	2-Chlorotoluene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
95-50-1	o-Dichlorobenzene (1,2-Dichlorobenzene)	18	3.23E-06	0.00E+00	0.00E+00	0.00E+00	
95-57-8	2-Chlorophenol	11	7.83E+00	7.10E-03	2.02E-07	2.02E-07	
95-95-4	2,4,5-Trichlorophenol	9	2.88E+01	2.63E-02	7.50E-07	7.50E-07	
96-22-0	3-Pentanone	14	1.05E+00	1.00E-03	2.85E-08	2.85E-08	
96-69-5	Bis(3-tert-butyl-4-hydroxy-6-methyl-phenyl)sulfide	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	X
98-51-1	p-tert-Butyltoluene	21	6.57E-10	0.00E+00	0.00E+00	0.00E+00	
98-82-8	Cumene	20	1.03E-08	0.00E+00	0.00E+00	0.00E+00	
98-83-9	alpha-Methylstyrene	19	1.55E-06	0.00E+00	0.00E+00	0.00E+00	
98-86-2	Acetophenone	11	1.03E+01	9.40E-03	2.68E-07	2.68E-07	
98-95-3	Nitrobenzene	12	9.67E+00	8.80E-03	2.51E-07	2.51E-07	
	Weight Fraction Sum = WF_S =		1095.9				
	Weight Ratio Sum = WR_S =			1.00E+00			
	HLW Stream Sum = $ER_{O\text{-}HL}$ =				2.85E-05		
	LAW Stream Vapor Organic Release Sum = R_{VOS} =					1.87E-05	

Drawings and Documents

Attachment 51 – Appendix 7.7
WTP Common
Specifications

The following drawings have been incorporated into Appendix 7.7 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering.**

Drawing/Document Number	***Description***
24590-WTP-3PS-AFPS-TP006, Rev 0	Engineering Specification for Field Applied Special Protective Coatings for Secondary Containment Areas
24590-WTP-3PS-G000-TP002, Rev 4	Engineering Specification for Positive Material Identification (PMI)
24590-WTP-3PS-HD00-TP001, Rev 0	Maintenance Decontamination Equipment
24590-WTP-3PS-M000-TP001, Rev 0	Engineering Specification for Air Displacement Slurry Pumps
24590-WTP-3PS-MACS-TP004, Rev 0	Engineering Specification for High Pressure Centrifugal Blowers
24590-WTP-3PS-MBTV-TP001, Rev 0	Engineering Specifications for Thermal Catalytic Oxidizers/Reducers
24590-WTP-3PS-MCE0-TP002, Rev. 2	**Engineering Specification for Process Ejector / Eductor**
24590-WTP-3PS-MES0-TP001, Rev 1	Engineering Specification for Shell and Tube Heat Exchanger
24590-WTP-3PS-MKE0-TP001, Rev 0	Engineering Specification for Wet Electrostatic Precipitators
24590-WTP-3PS-MKH0-TP002, Rev 1	Engineering Specification for HEPA Filters
24590-WTP-3PS-MPC0-TP001, Rev 0	Engineering Specification for Centrifugal Pumps to Meet Requirements of API Standard 610, Eighth Edition, and for Quality Levels QL-1 and QL-2
24590-WTP-3PS-MPC0-TP002, Rev 1	Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components
24590-WTP-3PS-MPC0-TP003, Rev 1	Engineering Specification for Sealless Centrifugal Pumps to Meet Requirements of API Standard 685,1st Ed, Quality Levels QL-1& 2)
24590-WTP-3PS-MPC0-TP008, Rev 0	Engineering Specification for Vessel-Mounted Vertical Transfer Pumps-LAW

	Facility
24590-WTP-3PS-MPC0-TP009, Rev 0	Engineering Specification for Vessel Mounted Vertical Transfer Pumps - HLW Facility
24590-WTP-3PS-MPVS-TP001, Rev 1	Engineering Specification for Submersible Centrifugal Sump Pumps
24590-WTP-3PS-MTF5-TP001, Rev 0	Engineering Specification for Field-Erected Tanks Design and Fabrication
24590-WTP-3PS-MV00-TP001, Rev 2	Engineering Specification for Pressure Design and Fabrication
24590-WTP-3PS-MV00-TP002, Rev 2	Engineering Specification for Seismic Qualification Criteria for Pressure Vessels
24590-WTP-3PS-MV00-TP003, Rev 2	Engineering Specification for Pressure Vessel Fatigue Analysis
24590-WTP-3PS-MWK0-TP001, Rev 0	Engineering Specifications for Activated Carbon Bed Absorber
24590-WTP-3PS-MX00-TP001, Rev 2	Engineering Specification for Process Bulge Design and Fabrication
24590-WTP-3PS-PX04-TP001, Rev 1	Engineering Specification for Shop Applied Fusion Bonded Epoxy Coating for Underground Carbon Steel Pipe
24590-WTP-PEN-ENV-03-001	Equivalency Notice for 24590-WTP-3PS-MV00-TP002, Rev. 1
24590-WTP-PEN-ENV-03-002	Equivalency Notice for 24590-WTP-3PS-MV00-TP003, Rev. 1
RESERVED	RESERVED

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

Process Ejector / Eductor

ERIC B. ISERN
STATE OF WASHINGTON
33449
REGISTERED PROFESSIONAL ENGINEER
11/2/05
EXPIRES: 07/28/07

This bound document contains a total of 15 pages.

Content applicable to ALARA? ☒ Yes ☐ No

ADR No.
N/A

Rev
N/A

Quality Designator
QL
DOE Contract No. DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	BY	CHECK	REVIEW	E&NS	QA	DPEM
2	11/2/05				N/A	N/A	
1	4/02/03	J. Jackson	J. Preston	C. Morley	N/A	N/A	M. Hoffmann
0	12/7/02	J. Jackson	J. Karpati	N/A	N/A	N/A	C. Morley

SPECIFICATION No.
24590-WTP-3PS-MCE0-TP002

Rev
2

Revision History

Revision	Reason for Revision
0	Issued for Permitting Use
1	Issued for Permitting Use
2	Issued for Permitting Use

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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1 Scope

1.1 Project Description and Location

The River Protection Project – Waste Treatment and Immobilization Plant (RPP-WTP) is a complex of waste treatment facilities where the U.S. Department of Energy (DOE) Hanford Site tank waste will be put into stable glass form. The WTP Contractor will design, build, and startup the RPP-WTP pretreatment and vitrification facilities for the DOE Office of River Protection (ORP). The waste treatment facilities will pretreat and immobilize the low activity waste (LAW) and high level waste (HLW) currently stored in underground storage tanks at the Hanford Site.

The Hanford Site occupies an area of about 560 square miles and is located along the Columbia River, north of the city of Richland, Washington. The RPP-WTP Facility will be constructed at the east-end of the Hanford Site. The Counties of Benton, Franklin, and Grant surround the Hanford Site.

1.2 Equipment, Material, and Services Required

The Seller shall be responsible for analysis, design, fabrication, inspection, testing, special tools, handling instructions, packaging, storage instructions, and documentation for all equipment covered by this specification.

The Buyer will provide all required design inputs in the following documents: Specification, Material Requisition (MR), and Mechanical Data Sheets. It is further expected that the Seller will specify to the Buyer all additional design inputs and information that may be needed for the Seller to execute the provisions of this specification and the material requisition(s). The Seller shall advise the WTP of all known requirements and limitations regarding deployment and operation of ejector equipment.

Seller responsibilities for equipment and supporting documentation required under the provisions of this specification include, but are not limited to:

1.2.1 Development and Submittal of a schedule for Seller deliverables. Schedule dates will be negotiated and agreed to by authorized representatives of the Seller's and the Buyer's organizations.

1.2.2 The Seller shall submit Outline and Shop Detail drawings. These drawings shall include overall dimensions, mounting details, and fabrication details.

1.2.3 Fabrication and Delivery of Process Ejectors. The Process ejectors when delivered shall require only connection to the Buyer's piping system.

1.2.4 Testing of each model ejector/eductor to demonstrate that the device meets the Buyer approved acceptance criteria for performance.

1.2.5 The Seller shall prepare submit Installation, Operation, and Maintenance manuals for Buyer's review.

1.2.6 Provision of load weights, envelope dimensions, and external nozzle sizes for each Process ejector model that may be specified for inclusion in the WTP systems.

1.3 Work by Others

1.3.1 Shipping to job site

1.3.2 Material unloading and storage at job site

1.3.3 Installation labor

1.3.4 Interconnecting pipe work external to the equipment.

1.4 Definitions (Acronyms/Abbreviations)

1.4.1 **ASME** American Society of Mechanical Engineers

1.4.2 **ASNT** American Society of Nondestructive Testing

1.5 Safety/Quality Classifications

1.5.1 Quality Level (QL)

The quality level identifies the quality requirements to be applied to the equipment. The identified quality levels are QL-1, QL-2, QL-3, QL-4, AP (Air Permit), and CM (Commercial). Quality requirements are specifically defined on the associated Mechanical Data Sheets and supplier quality assurance program requirements data sheets.

1.5.2 Seismic Category (SC)

Specific requirements for each seismic category are defined in the reference specifications 24590-WTP-3PS-SS90-T0001 and 24590-WTP-3PS-FB01-T0001 (See section 2.5). The seismic category is identified on the Mechanical Data Sheet.

2 Applicable Documents

2.1 General

2.1.1 Work shall be done in accordance with the referenced codes, standards and documents listed below, which are an integral part of this specification.

2.1.2 When specific chapters, section, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or

paragraphs of the document are applicable and shall be applied. If a date or revision is not listed in section 2, the latest issue, including addenda, at the time of request for quote (RFQ) shall apply. The dates and revisions listed in section 2 shall apply to all subsequent references to codes and standards within this specification. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

2.2 Codes

2.2.1	ASME B31.3 - 1996	Process Piping
2.2.2	ASME NQA-1-1989	Quality Assurance Program Requirements for Nuclear Facilities

2.3 Industry Standards

2.3.1	ASNT SNT-TC-1A, 1984	Recommended Practice (including Non-Destructive Examination [NDE] personnel certification)

2.4 Engineering Standards

Any additional engineering specifications and standards proposed for use by the Seller shall be reviewed by the Buyer prior to incorporation into the design.

2.5 Reference Documents/Drawings

24590-WTP-3PS-SS90-T0001	Engineering Seismic Qualification of Seismic Category I/II Equipment and Tanks
24590-WTP-3PS-PS02-T0001	Engineering Specification for Shop Fabrication of Piping
24590-WTP-3PS-FB01-T0001	Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks
24590-WTP-3PS-G000-T0003	Engineering Specification for Packaging, Handling and Storage Requirements
24590-WTP-3PS-G000-TP002	Engineering Specification for Positive Material Identification (PMI) for Positive Material Identification requirements.
24590-WTP-3PS-G000-T0001 Program	General Specification Seller Quality Assurance Requirements

24590-WTP-PW-P30T-00001 WTP End Prep Detail for Field Buttweld

3 Design Requirements

3.1 Basic Function

The basic ejector or eductor cycle is an operating media entrains a suction fluid in the suction chamber whereby a two phase flow regime is discharged. Ejectors or eductors have no moving parts; hence routine maintenance is not required.

Ejectors are employed in various pumping and heating applications, and use high pressure motive media to lift and pump a lower pressure water based hazardous (corrosive / erosive) fluid with suspended fines.

Eductors are used in various liquid heating and mixing applications. The intimate contact between the motive media and the process liquid makes the eductor ideal for mixing and heating application.

It is a requirement that process ejector components shall remain operable throughout the 40-year life of the WTP facility with zero maintenance access in the majority of ejector installations.

Process ejector connections in the piping system are butt welded.

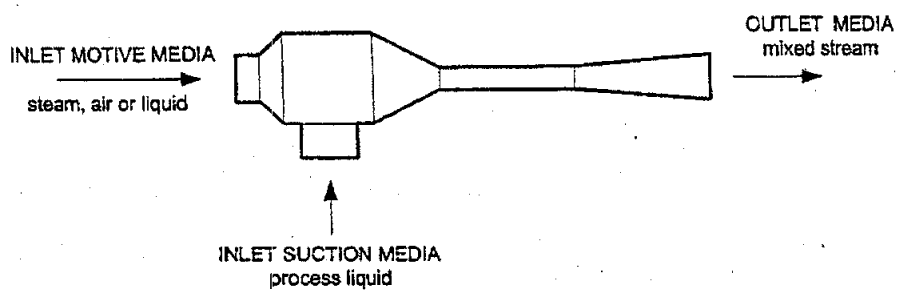

Figure 1 Inlet/Outlet Flow of the Process Ejector

3.2 Applications

Process ejectors and eductors are utilized in the WTP for liquid transfer, heating, and mixing in process vessels. The ejector and eductors are also used for sump emptying applications.

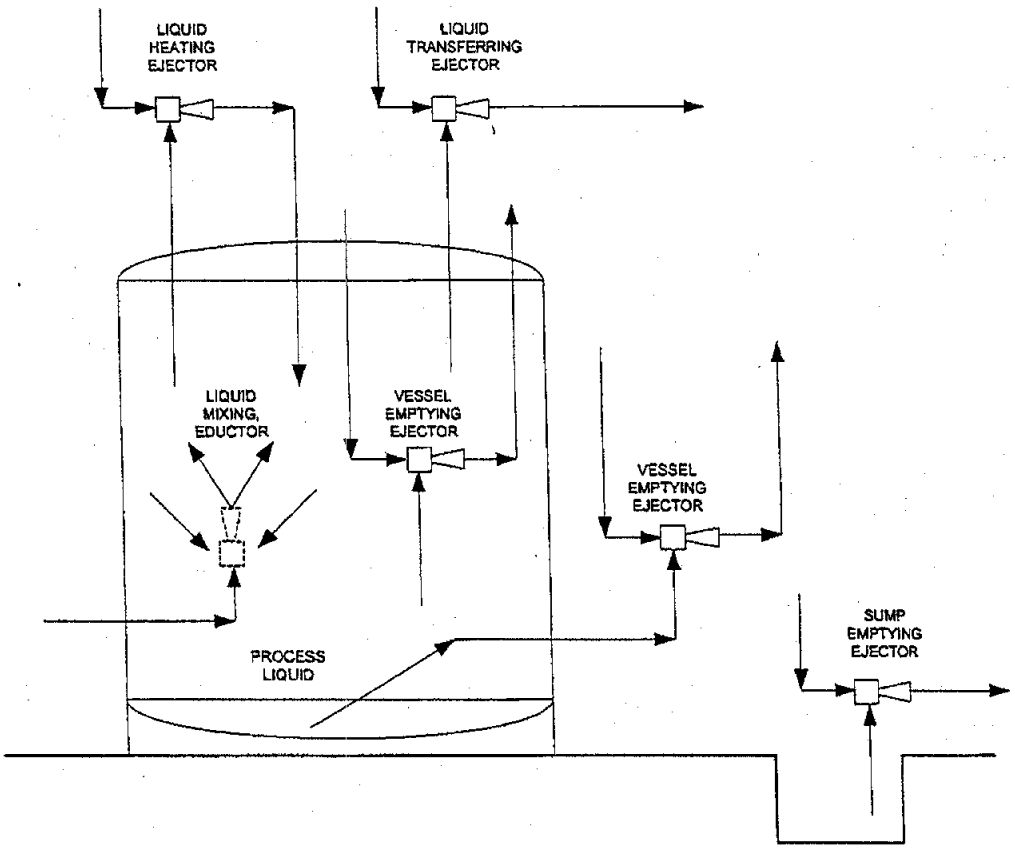

Figure 2 *Applications of the process ejector*

3.3 Performance

Requirements for each ejector or eductor are specified on Buyer provided Mechanical Data Sheets. Seller shall supply the ejector or eductor performance curves.

3.4 Design Conditions

3.4.1 Ejectors or eductors shall be designed in accordance with the Buyer's Mechanical Data Sheets.

3.4.2 The equipment and appurtenances will be used in a plant that has a design life of 40 years. The design life for the process ejectors and eductors shall also be 40 years.

3.4.3 All dimensions shall be U.S. Standard.

3.4.4 The end connection (butt weld, flange, or threaded) of the ejector or eductor will be specified on the ejector / eductor Mechanical Data Sheet and shall be prepared

for installation in the Buyer's piping systems. Components requiring jumper connections will be identified by the Buyer.

3.5 Environmental Conditions

3.5.1 The RPP-WTP is at approximately 700 feet above sea level.

3.5.2 Buyer will be provided the site and operating conditions of the ejector and eductor on the Mechanical Data Sheet.

3.5.3 Sound pressure levels around equipment shall be limited to maximum 85 dBA at 3 feet horizontal distance from noise producing components under any normal operating conditions. Seller to provide one data sheet specifying ejector or eductor noise level for each equipment model.

3.6 Mechanical Requirements

3.6.1 All materials and fabrication procedures shall be in accordance with the ejector / eductor Mechanical Data Sheet.

3.6.2 Ejectors and eductors fabricated by 100% butt-welded construction (including internals) shall be examined using 100% radiography for Quality Level (QL) components.

3.6.3 Radiography is not required for Commercial (CM) components.

3.7 Loadings

Inlet, suction and discharge pipe ends, which will be butt welded to project piping, shall meet seismic load capability requirements as defined in project specification 24590-WTP-3PS-SS90-T0001 or 24590-WTP-3PS-FB01-T0001, as applicable.

3.8 Corrosion and Erosion Allowance

Corrosion and erosion allowance is specified on the Mechanical Data Sheet and shall be applied to each surface exposed to process vapor or liquid. Ejectors and eductors internal to vessel shall have the specified corrosion allowance applied to both internal and external surfaces.

3.9 Electrical Requirements

N/A

3.10 Instrumentation and Control Requirements

N/A

3.11 Accessibility and Maintenance

3.11.1 Ejectors and eductors are not intended to require routine maintenance. Recommendations for system flushing and methods for recovery of blocked process ejectors shall be discussed in the Seller submitted operations and maintenance manuals (see section 1.2.5).

3.11.2 The Seller shall provide clear pre-operation maintenance and preservation instructions so as to keep the equipment in like new condition until ready for use.

4 Materials

4.1 Positive Material Identification

4.1.1 Refer to specification 24590-WTP-3PS-G000-TP002, Positive Material Identification (PMI), for positive material identification requirements.

4.2 Construction

4.2.1 The Seller shall furnish legible copies of mill test reports from the supplier of fabrication materials for all Process Ejectors / Eductors.

4.2.2 Construction material of the Process ejector will be specified on the Buyer's Mechanical Data Sheet.

4.3 Prohibited Materials

Materials containing aluminum, antimony, bronze, cadmium, copper, lead, teflon, tin, zinc, or other low melting point metals, their alloys, or materials containing bleachable halogens or sulfates, shall not be used in direct contact with stainless steel or nickel-based alloys.

4.4 Special Requirements

Where special requirements or restrictions are to be applied to the established items, these will be specified in accompanying contractual documentation. In the absence of such instructions, the manufacturers standard product shall be supplied as specified or as approved by the Buyer.

4.5 Storage of Materials

The Seller shall advise any special storage and preservation requirements.

5 Fabrication

The Seller shall obtain a written final design acceptance of all submitted procedures and drawings from the Buyer prior to the start of fabrication activities

5.1 Welding

5.1.1 Welding shall be performed by qualified welders per welding procedures prepared and qualified in accordance with ASME B31.3 - 1996.

5.1.2 Weld repair records shall be available for shop inspection and be submitted with the documentation package.

5.1.3 Weld procedures and procedure qualification records shall be submitted to the Buyer for review and acceptance prior to start of fabrication

5.2 Assembly

Preparations of field butt weld ends shall be in accordance with 24590-WTP-PW-P30T-00001.

5.3 Heat Treatment

N/A

6 Tests and Inspections

6.1 General

The Seller shall submit an inspection and test plan. A quality assurance manual with the relevant procedures for review and acceptance will also be submitted. The Buyer shall specify the following to be verified: the design requirements, the amount of inspection or testing, and the organizational element responsible for performing the inspection.

The seller shall be responsible for performing all tests and inspections.

6.2 Non-Destructive Examinations

The personnel performing non-destructive examinations or reviewing such tests results shall be certified to ASNT Standard SNT-TC-1A-1984.

6.2.1 Dye Penetrant Test (PT) or Radiographic Tests (RT) shall be performed on welds. Testing shall be performed and documented per the requirements of ASME B31.3 –1996. PT shall be performed on welds that cannot be RT'd. RT shall be performed on all accessible welds. Seller shall obtain Buyers agreement on welds not to be RT'd.

6.2.2 Hydrostatic testing shall be performed and documented on each completed process ejector and eductor per the requirements of ASME B31.3 – 1996.

6.2.3 A NDE and Hydrostatic report shall be submitted to document findings of all required examinations.

6.3 Shop Tests

6.3.1 Seller shall conduct and be responsible for both the Mechanical Test Procedure and Performance testing of each model ejector and eductor. Seller shall provide Buyer certified performance curves for each ejector and eductor model test.

6.3.2 Seller shall furnish all facilities necessary for the performance of such tests. In the event Seller's own facilities are not suitable for such tests, Seller shall advise Buyer and obtain permission for using alternative facilities.

6.4 Site Tests

Seller shall provide recommendations for operation of each process ejector system and shall be available for review and consultation of results from startup testing.

6.5 Control of Nonconforming Items

The control of nonconforming items is per specification 24590-WTP-3PS-G000-T0001.

7 Preparation for Shipment

7.1 Cleanliness

See instructions in the 24590-WTP-3PS-PS02-T0001 (Specification for Shop Fabrication of Piping) and 24590-WTP-3PS-G000-T0003 (Specification for Packaging, Handling, and Storage).

7.2 Painting

N/A

7.3 Tagging

Each Process ejector shall be legibly stamped or permanently tagged with its assigned Plant Item (equipment) Number. Where thin wall materials are used or where stamping is not permitted or advisable, the Seller shall submit for the Buyer's approval an alternate proposal for equipment identification.

7.4 Packaging

See instructions in 24590-WTP-3PS-G000-T0003, Engineering Specification for Packaging, Handling, and Storage.

7.5 Shipping Instructions

Shipping of ejector units to job site will be performed by the BNI.

8 Quality Assurance

8.1 General Requirements

8.1.1 Seller's Quality Assurance Program (QAP) requirements are specified in Buyer document # 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements.*

8.1.2 Seller's QAP manual shall be submitted to the Buyer for review in accordance with Buyer document # 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements.*

8.1.3 Seller's QAP, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements data sheet listed in section 2 of the MR.

8.2 Quality Related Components

8.2.1 Seller shall have in place a QAP meeting the requirements of ASME-NQA-1-1989, marked as applicable in Supplier Quality Assurance Program Requirements Data Sheet attached to the MR, and Buyer document # 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements.*

8.2.2 The successful bidder must pass a pre-award survey by the Buyer. Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. Seller shall allow the Buyer, its agents, and DOE access to their facility and records pertaining to this purchase order for the purpose of QA audits and surveillance at mutually agreed times.

8.2.3 All items shall be manufactured in accordance with Seller's QAP that meets the requirements of ASME NQA-1-1989, and has been previously evaluated and accepted by the WTP Quality Assurance Organization.

8.2.4 Seller shall submit their QAP and work plan to the Buyer for review prior to commencement of work. The plan shall include documents and procedures to implement the work and include a matrix of essential QA elements cross referenced with the documents or procedures.

9 Configuration Management

9.1 General

Refer to Section 3 of the Material Requisition and forms G-321-E and G-321-V with their associated instructions for the required documents and submittals.

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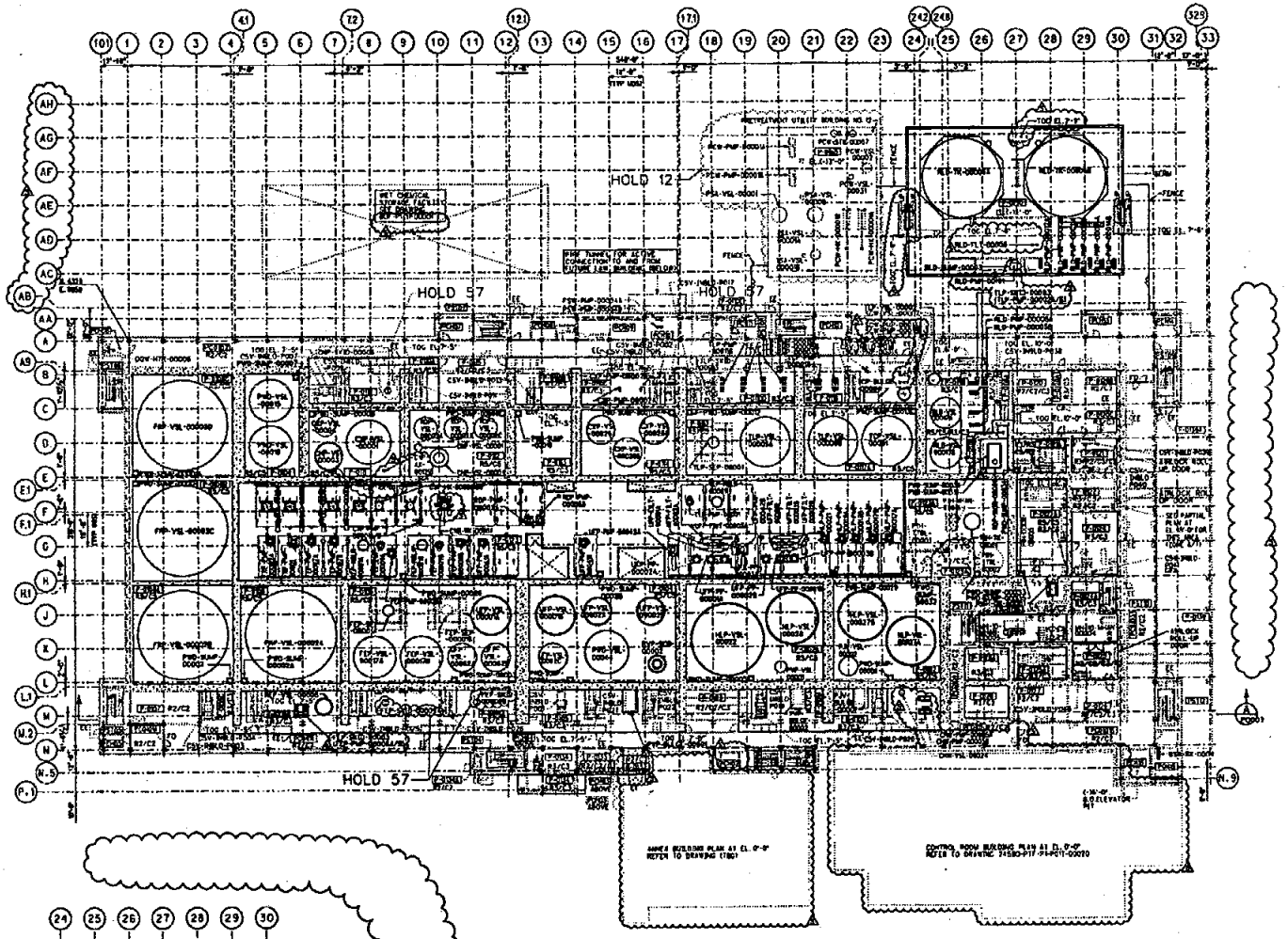
Drawings and Documents

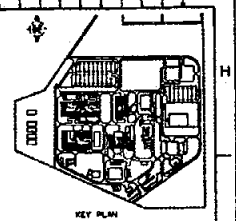
Attachment 51 – Appendix 8.4
Pretreatment Building
General Arrangement Drawings

The following drawings have been incorporated into Appendix 8.4 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering**.

Drawing/Document Number	*Description*
~~24590-PTF-P1-P01T-P0001, Rev 4~~	~~General Arrangement Plan El. 0~~
24590-PTF-P1-P01T-P0001, Rev 5	**General Arrangement Plan El. 0**
~~24590-PTF-P1-P01T-P0002, Rev 2~~	~~General Arrangement Plan El. 28~~
24590-PTF-P1-P01T-P0002, Rev 3	**General Arrangement Plan El. 28**
24590-PTF-P1-P01T-P0003, Rev 0	General Arrangement Plan El. 56
24590-PTF-P1-P01T-P0004, Rev 0	General Arrangement Plan El. 77
24590-PTF-P1-P01T-P0006, Rev 2	General Arrangement Plan El. -45
~~24590-PTF-P1-P01T-P0007, Rev 5~~	~~General Arrangement Section A-A~~
24590-PTF-P1-P01T-P0007, Rev 6	**General Arrangement Section A-A**
~~24590-PTF-P1-P01T-P0008, Rev 5~~	~~General Arrangement Section B-B~~
~~24590-PTF-P1-P01T-P0009, Rev 8~~	~~General Arrangement Section C-C~~
~~24590-PTF-P1-P01T-P0010, Rev 5~~	~~General Arrangement Section D-D~~
~~24590-PTF-P1-P01T-P0011, Rev 6~~	~~General Arrangement Section E-E~~
~~24590-PTF-P1-P01T-P0012, Rev 6~~	~~General Arrangement Sections F-F and G-G~~
~~24590-PTF-P1-P01T-P0013, Rev 5~~	~~General Arrangement Sections H-H and J-J~~
~~24590-PTF-P1-P01T-P0014, Rev 7~~	~~General Arrangement Sections K-K and L-L~~
~~24590-PTF-P1-P01T-P0015, Rev 7~~	~~General Arrangement Sections M-M and N-N~~
~~24590-PTF-P1-P01T-P0016, Rev 5~~	~~General Arrangement Sections P-P and Q-Q~~
~~24590-PTF-P1-P01T-P0017, Rev 5~~	~~General Arrangement Plans Section R-R~~
RESERVED	RESERVED

24590-PTF-P1-P01T-P0001





KEY PLAN

GENERAL NOTES:

1. FOR REFERENCE, SEE PLOT PLAN DRAWING No. 24590-BOF-PP50-00001.
2. ALL OPERATING AREAS ARE DESIGNATED R2/C2 UNLESS NOTED OTHERWISE.
3. ALL SUB-CHANGE ROOMS ARE DESIGNATED R2/C2/C3 UNLESS NOTED OTHERWISE.
4. DELETED.
5. REFER TO DRAWING No. 24590-BOF-C2-C001-00005 FOR CONVERSIONS FROM PT FACILITY TO SITE DESIGNATIONS. PT FACILITY ELEVATION 0'-0" EQUALS SITE ELEVATION 678'-0" ABOVE SEA LEVEL.
6. FOR ELECTRICAL AND C&I EQUIPMENT TAG AND LOCATION, REFER TO INDEX KEY PLAN DRAWING No. 24590-PTF-YE470.
7. FOR ROOM NUMBERS AND DESCRIPTION, REFER TO DRAWING No. 24590-PTF-PTP237-00050.
8. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
9. REFER TO PTF/ANNEX EQUIPMENT LOCATION INDEX KEY PLAN DRAWING No. 24590-PTF-P1-P01T-P0001 (LISTING AND DRAWING) THAT PROVIDE A MORE DETAILED IDENTIFICATION OF EQUIPMENT.
10. DELETED.
11. ALL CONTROL BLDG ROOMS ARE DESIGNATED R1/C1 UNLESS NOTED OTHERWISE.
12. FOR RADIOLOGICAL CLASSIFICATION, REFER TO DOCUMENT No. 24590-PTF-CHP-RA00-0001.
13. THE CONTENTS OF THIS DRAWING SHOWN IN PURPLE ARE CONSIDERED NON-POTABLE AND ARE NOT SUBJECT TO THE REQUIREMENTS OF WAC 246-290 FOR THE CONSUMER WATER SUPPLY, TO THE EXTENT THAT THESE PORTIONS DO NOT IMPACT DANGEROUS WASTE AREAS/OPERATIONS.

LEGEND:

CA	CONTROLLED ACCESS
EE	EMERGENCY EXIT
FD	FIRE DOOR
TOG	TOP OF GRATING
P-1	ROOMS/CELLS/TUNNELS
P.1.1	ANNEX NUMBERING
	CORRIDORS & CONNECTING VESTIBULES
	CHASES
	MEZZANINES
	STAIRS
	EQUIPMENT REMOVAL/LAY DOWN AREA
	OPENING
	CONCRETE
	EMERGENCY SHOWER/EYEWASH (PLAN VIEW)
	EMERGENCY SHOWER/EYEWASH (ELEVATION VIEW)
	GRATING
	GYPSUM WALLBOARD

HOLDS:

12. PENDING FURTHER DESIGN DEVELOPMENT - PCW SYSTEM
57. PENDING FURTHER VENDOR DESIGN INFORMATION ON TEP, CHP, TLP SKIDS.

PLEASE NOTE THAT SOURCE, SPECIAL NUCLEAR AND BYPRODUCT MATERIALS AS DEFINED IN THE ATOMIC ENERGY ACT OF 1954 (AS AM. AND RELATED TO THE DEPARTMENT OF ENERGY (DOE) ACTS AND REGULATIONS) ARE REGULATED BY THE DEPARTMENT OF ENERGY (DOE) PURSUANT TO THE DOE'S AUTHORITY. DISCLAIMERS ARE ASSERTED THAT PERTAIN TO THE DOE'S AUTHORITY AND EXCLUSIVE RESPONSIBILITY AND AUTHORITY TO REGULATE SOURCE, SPECIAL NUCLEAR, AND BYPRODUCT MATERIAL AS DEFINED IN THE ATOMIC ENERGY ACT. INFORMATION CONTAINED HEREIN OR REFERENCED IN PROVIDED FOR PRIVATE RECEIPTION PURPOSES ONLY.

REV	DESCRIPTION	DRC	CHKD	KYHD	APPD	DATE
5	ISSUED FOR PERMITTING USE	CVG	[illegible]	[illegible]	[illegible]	5/12/05
4	ISSUED FOR PERMITTING USE	RT	FL	AM	KH	5/12/04
3	ISSUED FOR PERMITTING USE	RT	CVG	AM	KH	5/21/04
2	ISSUED FOR PERMITTING USE	CJ	AM	KH	SS	1/13/04
1	ISSUED FOR PERMITTING USE	CVG	AM	SCF	AM	8/17/02

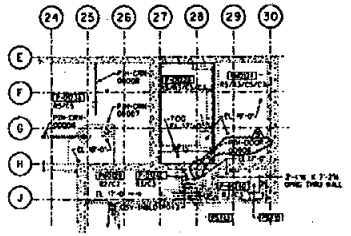
REVISION HISTORY

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

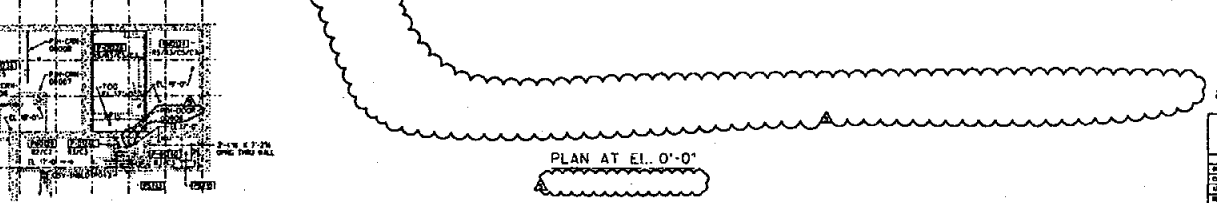
CONTRACT No. DE-AC27-01RV14136

PRETREATMENT FACILITY GENERAL ARRANGEMENT PLAN AT EL. 0'-0"

24590-PTF-P1-P01T-P0001 — REV 5

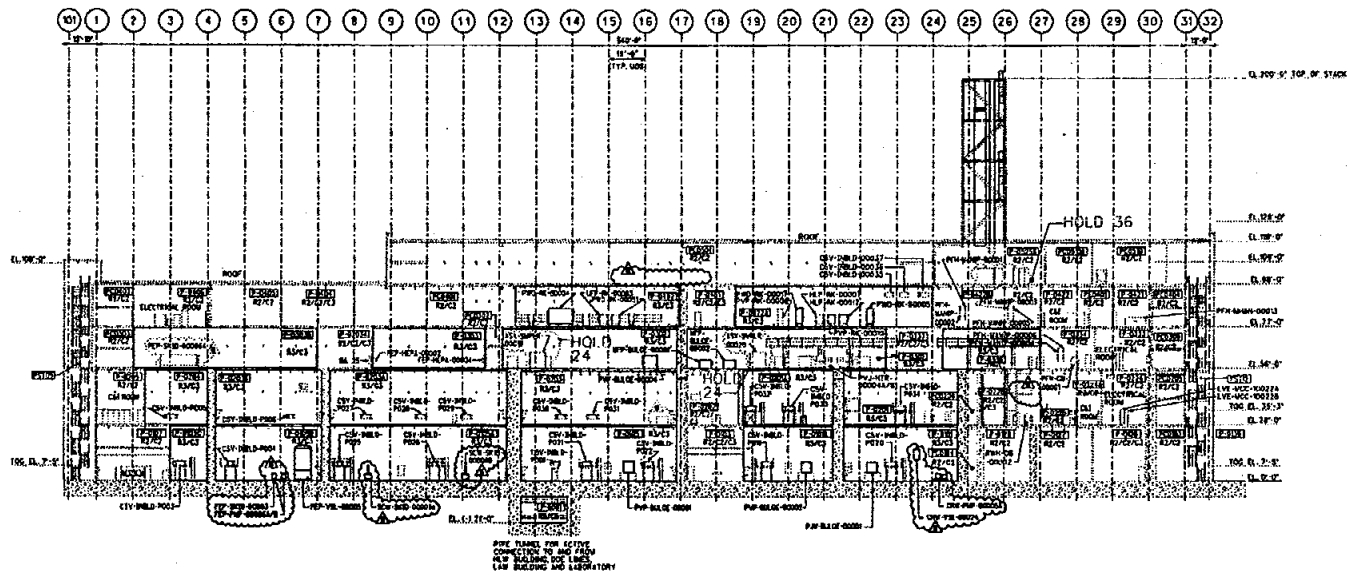


PARTIAL PLAN AT EL. 15'-0"



PLAN AT EL. 0'-0"

24590-PTF-P1-P01T-P0007



SECTION A
LOOKING NORTH THRU P0006

NOTES:

1. FOR GENERAL NOTES & LEGEND REFER TO DRAWINGS 24590-PTF-P1-P01T-P0001 THRU -P0006.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. DELETED.
4. THE PORTIONS OF THIS DRAWING SHOWN IN PHANTOM ARE CONSIDERED NON-PERMIT AFFECTING AND ARE NOT SUBJECT TO THE REGULATORY REQUIREMENTS OF THE WAC CODE FOR THE DANGEROUS WASTE PERMIT TO THE EXTENT THAT THOSE PORTIONS DO NOT IMPACT DANGEROUS WASTE AREAS/OPERATIONS.

HOLDS:

24. PENDING FURTHER VENDOR & MAINTENANCE DEVELOPMENT - 48K SAMPLER SYSTEM
27. DELETED
32. DELETED
36. PENDING VENDOR INFORMATION - RAD MONITORING SYST.
54. PENDING DESIGN DEVELOPMENT

PLEASE NOTE THAT SOMOS, SPECIAL NUCLEAR AND DYNAMIC MATERIALS AS DEFINED IN THE ATOMIC ENERGY ACT OF 1954 AND THE REGULATIONS OF THE US DEPARTMENT OF ENERGY WHICH FACILITIES OWNERSHIP BY THE DOE FLOWS THROUGH TO DFS AS AUTHORITY AND DESIGN, THAT PURSUANT TO THE DOE IS THE SOLE AND EXCLUSIVE STEWARDSHIP AND AUTHORITY TO SCHEDULE, MOVE, STORE, MANAGE, AND DISPOSE OF MATERIAL AT THE OWNER WHILE FACILITIES OPERATION CONTINUED WORK OF RESPONSIBILITY IS PROVIDED FOR PROCESS DESCRIPTION PURPOSES ONLY.

REV	DESCRIPTION	DRN	CHKD	APPROVED	DATE
5	ISSUED FOR PERMITTING USE	CKD	LAL		
4	ISSUED FOR PERMITTING USE	KT	DPC	JBW	8/13/04
3	ISSUED FOR PERMITTING USE	KT	CSR	JBW	12/12/04
2	ISSUED FOR PERMITTING USE	KT	CSR	JBW	12/12/04
1	ISSUED FOR PERMITTING USE	GJ	MC	EB	1/19/05
0	ISSUED FOR PERMITTING USE	CMB	JM	MCF	JBW	3/10/05

REVISION HISTORY

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99352

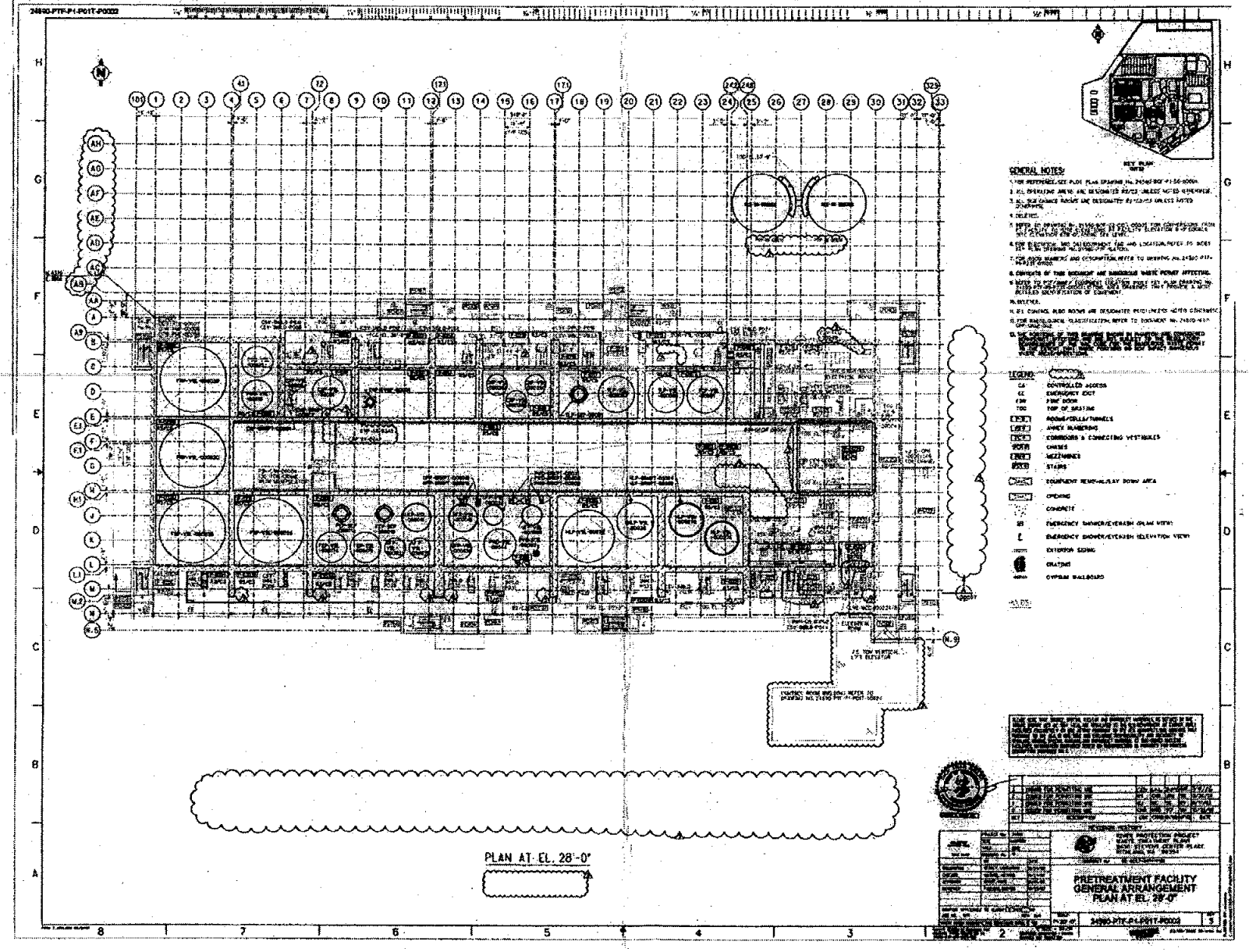
CONTRACT NO. DE-AC27-99RL14047

PRETREATMENT FACILITY GENERAL ARRANGEMENT SECTION A-A

SCALE: 1/8"=1'-0"

24590-PTF-P1-P01T-P0007

REV 5


PLAN AT EL. 28'-0"
GENERAL NOTES:
LEGEND:
PRETREATMENT FACILITY
GENERAL ARRANGEMENT
PLAN AT EL. 28'-0"

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Drawings and Documents

Attachment 51 – Appendix 8.5
Pretreatment Building
Civil, Structural, and Architectural Criteria and Typical Design Details

The following drawings have been incorporated into Appendix 8.5 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering.**

Drawing/Document Number	***Description***
24590-PTF- PER-M-02-006, Rev 5	Sump Data for PT Facility
24590-PTF- PER-M-03-002, Rev 0	Sump & Drain Data at 28 Ft Level for PT Facility
24590-PTF-PER-M-04-002, Rev 0	Sump & Drain Data at 56 ft. Level for PT Facility
24590-PTF-PER-M-04-0004, Rev 0	Sump & Drain Data at 77 ft. Level for PT Facility
24590-PTF-PER-M-04-0006, Rev 0	Leak Detection for Underground Transfer lines for PT Facility
24590-PTF-PER-M-04-0009, Rev 0	**Sump Data for PT Facility – Room P-0150**
RESERVED	RESERVED

R10538805

ISSUED BY
RPP-WTP PDC

Document title: **Sump Data for PT Facility - Room P-0150**

Contract number: DE-AC27-01RV14136

Department: Mechanical Systems

Author(s): G. Chiaramonte

Principal author signature:

Document number: 24590-PTF-PER-M-04-0009, Rev 0

Checked by: D. Reinemann

Checker signature:

Date of issue: 15 April 2005

Issue status: Issued for Permitting Use

Approved by: R. Smith

Approver's position: Area Project Engineering Manager

Approver signature:

GERALD RUSSEL CHIARAMONTE
STATE OF WASHINGTON
028043
REGISTERED
PROFESSIONAL ENGINEER

4-15-05

EXPIRES. 11/9/2006

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99354
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	4-15-05	Issue for Permitting Use	G. Chiaramonte

Contents

Notice ii
History Sheet iii
Acronyms and Abbreviations v
1 Introduction 1
2 Applicable Documents 1
3 Description 1
3.1 Room P-0150 Sump 1

Tables

Table 1 Room P-0150 Sump 2

Acronyms and Abbreviations

AEA	Atomic Energy Act of 1954
DOE	US Department of Energy
PT	pretreatment
RLD	radioactive liquid disposal
WAC	Washington Administrative Code

1 Introduction

The Washington Administrative Code, WAC 173-303, requires the use of secondary containment for systems containing dangerous waste.

Sump data for rooms within the PT facility have been addressed in prior issued documents. This report specifically addresses sump data for Room P-0150, a tank containment area located outside the PT building, which contains the Radioactive Liquid Disposal (RLD) tanks RLD-TK-00006A and RLD-TK-00006B.

2 Applicable Documents

- Washington Administrative Code, WAC 173-303, Dangerous Waste Regulations

3 Description

3.1 Room P-0150 Sump

Room P-0150 is a concrete containment area located outside the PT building on the northeast side of the building. It provides secondary containment for tanks RLD-TK-00006A/B which are the only tanks within this containment area. The secondary containment includes low point sump (RLD-SUMP-00003). The floor of the containment area also includes a covered trench between each tank and RLD-SUMP-00003. This trench allows the heel in a tank to be drained into the sump prior to accessing the tank internals for maintenance. The floor, sump, and interior walls of the containment area including the trench are treated with a special protective coating (epoxy type). The floor and the trench are sloped towards the sump. The sump is located at the (-) 2' - 0" level. The maximum operating volume of this sump is 583 gallons. This dry type sump is equipped with radar level detection and a pump that will discharge the liquid collected in the sump to RLD-VSL-00017A/B in the PT facility.

Information on the Pretreatment Facility sump in Room P-0150 is summarized given in Table 1.

Table 1 Room P-0150 Sump

##	Sump PIN	PT Room Number	Maximum Sump Capacity, GAL	Sump Type/Nominal Operating Volume, GAL	Sump Dimensions, Inch	P&ID Number	Leak Detection Type	Material of Fabrication
1	RLD-SUMP-00003	P-0150	583	Dry Sump	78" X 48" X 36" deep	24590-PTF-M6-RLD-P0002	Radar	Epoxy coating

R10656140

COGEMA-IA-083, Rev. 0

STRUCTURAL INTEGRITY ASSESSMENT OF THE PRETREATMENT FACILITY (PTF) ELEVATION (-) 2'-0" SECONDARY CONTAINMENT OF RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD) TANKS (RLD-TK-00006 A/B)

Bechtel National, Inc.

Job No. 24590

SUPPLIER DOCUMENT STATUS

1. [X] Work may proceed.
2. [ ] Revise and resubmit. Work may proceed subject to resolution of indicated comments.
3. [ ] Revise and resubmit. Work may not proceed.
4. [ ] Review not required. Work may proceed.

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED									ENS BHE

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by DC Pfluger (Print Name) DC Pfluger (Signature) 11/27/05 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

416 GP&S 7-03

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

24590-CM-HC4-HX9G-00138-02-00057 REV00A

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Drawing and Documents

Attachment 51 – Appendix 8.6
Pretreatment Building
Mechanical Drawing

The following Drawings have been incorporated into Appendix 8.6 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering.**

Drawing/Document Number	***Description***
24590-PTF-M2-FRP-P0001 Rev 2	Equipment Assembly Drawing for FRP-VSL-00002A
24590-PTF-M2-FRP-P0002 Rev 2	Equipment Assembly Drawing for FRP-VSL-00002B
24590-PTF-M2-FRP-P0003 Rev 2	Equipment Assembly Drawing for FRP-VSL-00002C
24590-PTF-M2-FRP-P0004 Rev 2	Equipment Assembly Drawing for FRP-VSL-00002D
24590-PTF-MED-CNP-P0003, Rev 0	Mechanical Data Sheet for CNP-HX-00002
24590-PTF-MED-CNP-P0004, Rev 1	Mechanical Data Sheet for CNP-HX-00004
24590-PTF-MED-CNP-P0005, Rev 0	Mechanical Data Sheet for CNP-HX-00001
24590-PTF-MED-CNP-P0010, Rev 0	Mechanical Data Sheet for CNP-HX-00003
24590-PTF-MED-FEP-P0003, Rev 0	Mechanical Data Sheet for FEP-COND-00001A
24590-PTF-MED-FEP-P0004, Rev 0	Mechanical Data Sheet for FEP-COND-00001B
24590-PTF-MED-FEP-P0005, Rev 0	Mechanical Data Sheet for FEP-COND-00002A
24590-PTF-MED-FEP-P0006, Rev 0	Mechanical Data Sheet for FEP-COND-00002B
24590-PTF-MED-FEP-P0007, Rev 0	Mechanical Data Sheet for FEP-COND-00003A
24590-PTF-MED-FEP-P0008, Rev 0	Mechanical Data Sheet for FEP-COND-00003B
24590-PTF-MED-FEP-P0009, Rev 0	Mechanical Data Sheet for FEP-RBLR-00001A
24590-PTF-MED-FEP-P0010, Rev 0	Mechanical Data Sheet for FEP-RBLR-00001B
24590-PTF-MED-TLP-P0001, Rev 0	Mechanical Data Sheet for TLP-COND-00001
24590-PTF-MED-TLP-P0002, Rev 0	Mechanical Data Sheet for TLP-COND-00002
24590-PTF-MED-TLP-P0003, Rev 0	Mechanical Data Sheet for TLP-COND-00003
24590-PTF-MED-TLP-P0004, Rev 0	Mechanical Data Sheet for TLP-RBLR-00001
24590-PTF-MKD-PVP-P0002, Rev 1	**Mechanical Data Sheet & Equipment Assembly Drawing for PVP-SCB-00002**
24590-PTF-MLD-UFP-P0007, Rev 1	Mechanical Data Sheet for UFP-FILT-00001A/ 1B/2A/2B/3A/3B/S1-S6

24590-PTF-MV-CNP-P0001, Rev 0	Equipment Assembly Drawing for CNP-VSL-00003
24590-PTF-MV-CNP-P0002, Rev 1	Equipment Assembly Drawing for CNP-VSL-00004
24590-PTF-MV-CNP-P0005, Rev 0	Equipment Assembly Drawing for CNP-VSL-00001
24590-PTF-MV-CXP-P0001, Rev 0	Equipment Assembly Drawing for CXP-VSL-00001
24590-PTF-MV-CXP-P0002, Rev 0	Equipment Assembly Drawing for CXP-VSL-00004
24590-PTF-MV-CXP-P0003, Rev 0	Equipment Assembly Drawing for CXP-VSL-00005
24590-PTF-MV-CXP-P0008, Rev 0	Equipment Assembly Drawing for CXP-VSL-00026A
24590-PTF-MV-CXP-P0009, Rev 0	Equipment Assembly Drawing for CXP-VSL-00026B
24590-PTF-MV-CXP-P0010, Rev 0	Equipment Assembly Drawings for CXP-VSL-00026C
24590-PTF-MVD-CNP-P0003, Rev 1	Mechanical Data Sheet for CNP-VSL-00003
24590-PTF-MVD-CNP-P0006, Rev 0	Mechanical Data Sheet for CNP-EVAP-00001
24590-PTF-MVD-CNP-P0007, Rev 2	Mechanical Data Sheet for CNP-VSL-00004
24590-PTF-MVD-CNP-P0010, Rev 0	Mechanical Data Sheet for CNP-VSL-00001
24590-PTF-MVD-CXP-P0007, Rev 0	Mechanical Data Sheet for CXP-VSL-00001
24590-PTF-MVD-CXP-P0015, Rev 0	Mechanical Data Sheet for CXP-VSL-00004
24590-PTF-MVD-CXP-P0016, Rev 0	Mechanical Data Sheet for CXP-VSL-00005
24590-PTF-MVD-CXP-P0021, Rev 1	Mechanical Data Sheet for CXP-VSL-00026A
24590-PTF-MVD-CXP-P0022, Rev 1	Mechanical Data Sheet for CXP-VSL-00026B
24590-PTF-MVD-CXP-P0023, Rev 1	Mechanical Data Sheet for CXP-VSL-00026C
24590-PTF-MVD-FEP-P0001, Rev 2	Mechanical Data Sheet for FEP-VSL-00017A
24590-PTF-MVD-FEP-P0002, Rev 2	Mechanical Data Sheet for FEP-VSL-00017B
24590-PTF-MVD-FEP-P0003, Rev 1	Mechanical Data Sheet for FEP-VSL-00005
24590-PTF-MVD-FEP-P0006,Rev 3	**Mechanical Data Sheet for FEP-SEP-00001A**
24590-PTF-MVD-FEP-P0007, Rev2	**Mechanical Data Sheet for FEP-SEP-00001B**
24590-PTF-MVD-FRP-P0005, Rev 3	Mechanical Data Sheet for FRP-VSL-00002-A
24590-PTF-MVD-FRP-P0006, Rev 3	Mechanical Data Sheet for FRP-VSL-00002-B
24590-PTF-MVD-FRP-P0007, Rev 3	Mechanical Data Sheet for FRP-VSL-00002-C
24590-PTF-MVD-FRP-P0008, Rev 3	Mechanical Data Sheet for FRP-VSL-00002-D
24590-PTF-MVD-HLP-P0006, Rev 1	Mechanical Data Sheet for HLP-VSL-00022
24590-PTF-MVD-HLP-P0007, Rev 1	Mechanical Data Sheet for HLP-VSL-00027A
24590-PTF-MVD-HLP-P0008, Rev 1	Mechanical Data Sheet for HLP-VSL-00027B
24590-PTF-MVD-HLP-P0009, Rev 1	Mechanical Data Sheet for HLP-VSL-00028
24590-PTF-MVD-PJV-P0003, Rev 0	Mechanical Data Sheet for PJV-VSL-00002
24590-PTF-MVD-PVP-P0001, Rev 0	Mechanical Data Sheet for PJV-VSL-00001

24590-PTF-MVD-PWD-P0001, Rev 2	Mechanical Data Sheet for PWD-VSL-00033
24590-PTF-MVD-PWD-P0001, Rev 3	**Mechanical Data Sheet for PWD-VSL-00033**
~~24590-PTF-MVD-PWD-P0002, Rev 2~~	~~Mechanical Data Sheet for PWD-VSL-00044~~
24590-PTF-MVD-PWD-P0002, Rev 3	**Mechanical Data Sheet for PWD-VSL-00044**
24590-PTF-MVD-PWD-P0003, Rev 2	Mechanical Data Sheet for PWD-VSL-00043
24590-PTF-MVD-PWD-P0010, Rev 1	Mechanical Data Sheet for PWD-VSL-00046
24590-PTF-MVD-PWD-P0011, Rev 3	Mechanical Data Sheet for PWD-VSL-00015
24590-PTF-MVD-PWD-P0012, Rev 3	Mechanical Data Sheet for PWD-VSL-00016
24590-PTF-MVD-RDP-P0005, Rev 1	Mechanical Data Sheet for RDP-VSL-00002A
24590-PTF-MVD-RDP-P0006, Rev 1	Mechanical Data Sheet for RDP-VSL-00002B
24590-PTF-MVD-RDP-P0007, Rev 3	Mechanical Data Sheet for RDP-VSL-00002C
24590-PTF-MVD-RDP-P0008, Rev 0	Mechanical Data Sheet for RDP-VSL-00004
~~24590-PTF-MVD-RLD-P0005, Rev 2~~	~~Mechanical Data Sheet for RLD-VSL-00017A~~
24590-PTF-MVD-RLD-P0005, Rev 3	**Mechanical Data Sheet for RLD-VSL-00017A**
~~24590-PTF-MVD-RLD-P0006, Rev 2~~	~~Mechanical Data Sheet for RLD-VSL-00017B~~
24590-PTF-MVD-RLD-P0006, Rev 3	**Mechanical Data Sheet for RLD-VSL-00017B**
24590-PTF-MVD-TCP-P0002, Rev 2	Mechanical Data Sheet for TCP-VSL-00001
24590-PTF-MVD-TLP-P0001, Rev 2	Mechanical Data Sheet for TLP-VSL-00009A
24590-PTF-MVD-TLP-P0002, Rev 2	Mechanical Data Sheet for TLP-VSL-00009B
24590-PTF-MVD-TLP-P0004, Rev 0	Mechanical Data Sheet for TLP-RBLR-00001
24590-PTF-MVD-TLP-P0005, Rev. 2	**Mechanical Data Sheet for TLP-SEP-00001**
24590-PTF-MVD-UFP-P0001, Rev 1	Mechanical Data Sheet for UFP-VSL-00001A
24590-PTF-MVD-UFP-P0002, Rev 1	Mechanical Data Sheet for UFP-VSL-00001B
24590-PTF-MVD-UFP-P0005, Rev 1	Mechanical Data Sheet for UFP-VSL-00062A
24590-PTF-MVD-UFP-P0006, Rev 1	Mechanical Data Sheet for UFP-VSL-00062B
24590-PTF-MVD-UFP-P0007, Rev 1	Mechanical Data Sheet for UFP-VSL-00062C
24590-PTF-MVD-UFP-P0014, Rev 0	Mechanical Data Sheet for UFP-VSL-00002A
24590-PTF-MVD-UFP-P0015, Rev 0	Mechanical Data Sheet for UFP-VSL-00002B
24590-PTF-MV-FEP-P0001, Rev 0	Equipment Assembly Drawing for FEP-VSL-00017A
24590-PTF-MV-FEP-P0002, Rev 0	Equipment Assembly Drawing for FEP-VSL-00017B
24590-PTF-MV-HLP-P0003, Rev 0	Equipment Assembly Drawing for HLP-VSL-00022
24590-PTF-MV-HLP-P0004, Rev 0	Equipment Assembly Drawing for HLP-VSL-00028
24590-PTF-MV-HLP-P0005, Rev 0	Equipment Assembly Drawing for HLP-VSL-00027B
24590-PTF-MV-HLP-P0006, Rev 0	Equipment Assembly Drawing for HLP-VSL-00027A
24590-PTF-MV-PJV-P0001, Rev 0	Equipment Assembly Drawing for PJV-VSL-

	00002
24590-PTF-MV-PVP-P0002, Rev 0	Equipment Assembly Drawing for PVP-VSL-00001
24590-PTF-MV-PWD-P0010 Rev 1	Equipment Assembly Drawing for PWD-VSL-00044
24590-PTF-MV-PWD-P0001001, Rev 1	Equipment Assembly Drawing for PWD-VSL-00033 (Sheet 1)
24590-PTF-MV-PWD-P0001002, Rev 1	Equipment Assembly Drawing for PWD-VSL-00033 (Sheet 2)
24590-PTF-MV-PWD-P0003001, Rev 1	Equipment Assembly Drawing for PWD-VSL-00043 (Sheet 1)
24590-PTF-MV-PWD-P0003002, Rev 1	Equipment Assembly Drawing for PWD-VSL-00043 (Sheet 2)
24590-PTF-MV-PWD-P0005, Rev 1	Equipment Assembly Drawing for PWD-VSL-00043
24590-PTF-MV-PWD-P0006, Rev 1	Equipment Assembly Drawing for PWD-VSL-00016
24590-PTF-MV-PWD-P0007, Rev 1	Equipment Assembly Drawing for PWD-VSL-00015
24590-PTF-MV-RDP-P0001, Rev 0	Equipment Assembly Drawing for RDP-VSL-00002A
24590-PTF-MV-RDP-P0002, Rev 0	Equipment Assembly Drawing for RDP-VSL-00002B
24590-PTF-MV-RDP-P0003, Rev 0	Equipment Assembly Drawing for RDP-VSL-00002C
24590-PTF-MV-RLD-P0001, Rev 0	Equipment Assembly Drawing for RLD-VSL-00017A
24590-PTF-MV-RLD-P0002, Rev 0	Equipment Assembly Drawing for RLD-VSL-00017B
24590-PTF-MV-TCP-P0002, Rev 1	Equipment Assembly Drawing for TCP-VSL-00001
24590-PTF-MV-TCP-P0002, Rev 1	Equipment Assembly Drawing for TCP-VSL-00001
24590-PTF-MV-TLP-P0001, Rev 1	Equipment Assembly Drawing for TLP-VSL-00009A
24590-PTF-MV-TLP-P0002, Rev 1	Equipment Assembly Drawing for TLP-VSL-00009B
24590-PTF-MV-UFP-P0001, Rev 1	Equipment Assembly Drawing for UFP-VSL-00001A
~~24590-PTF-MV-UFP-P0002, Rev 1~~	~~Equipment Assembly Drawing for UFP-VSL-00001B~~
24590-PTF-MV-UFP-P0002, Rev 2	**Equipment Assembly Drawing for UFP-VSL-00001B**
24590-PTF-MV-UFP-P0003, Rev 0	Equipment Assembly Drawing for UFP-VSL-00002A

24590-PTF-MV-UFP-P0004, Rev 0	Equipment Assembly Drawing for UFP-VSL-00002B
24590-PTF-MV-UFP-P0005, Rev 0	Equipment Assembly Drawing for UFP-VSL-00062A
24590-PTF-MV-UFP-P0006, Rev 0	Equipment Assembly Drawing for UFP-VSL-00062B
24590-PTF-MV-UFP-P0007, Rev 0	Equipment Assembly Drawing for UFP-VSL-00062C
24590-PTF-MWD-CNP-P0001, Rev 0	Mechanical Data Sheet for CNP-DISTC-00001
RESERVED	RESERVED

R10592142

Mechanical Data Sheet: PTF Vessel Vent Caustic Scrubber

Plant Item Number: 24590-PTF-MK-PVP-SCB-00002

Data Sheet Number: 24590-PTF-MKD-PVP-P0002, Rev 1

Project:	WTP	P&ID	24590-PTF-M6-PVP-P0017
Project No:	24590	Calculation	24590-PTF-MEC-PVP-00002
Project Site:	DOE Hanford	Process Data Sheet	None
Area No.	2000		
Building:	PTF	Vessel Drawing	Vendor Developed
System No.	PVP		

ISSUED BY RPP-WTP PDC

Service Data

Quality Level	QL-2	Fabrication Specification	24590-WTP-3PS-MV00-TP001 & 24590-PTF-3PS-MKAE-TP001
Seismic Category	SCII	Design Code	ASME Section VIII Division 1
Service/Contents	Radioactive Liquid	Code Stamp	Yes
Design Specific Gravity	1.04	NB Registration	Yes
Max Operating Volume	gal Note 1	Wind Design	None
Total Volume	gal Note 1	Snow/Ash Design	None
Postweld Heat Treat	Not Required	Seismic Design	24590-WTP-3PS-MV00-TP002
Seismic Base Moment	ft*lb Note 2		24590-WTP-3PS-S200-TP001
Environmental Qualification	N/A		

Design Data

Packed Column Inside Diameter (A)	72" max.	Note 1 & 2	Floor to Bottom of Sump Vessel (E)	108"	Corrosion Allowance		0.04" (Note3)
Sump Vessel Inside Diameter (B)	108"	Note 1 & 2	Scrubber Height (F)	600" max	Minimum Design temperature for Metal	°F	-20
Sump Height	63" min.		Ring Beam Height (G)	18"	Hydrostatic Test Pressure	PSIG	Note 2
Dimension D	642" max	Note 1 & 2	Ring Beam Center-to-Center Diameter (H)	108"			

		Vessel Operating	Vessel Design	Deleted	Notes
Internal Pressure	PSIG	-1	-5/+15	Deleted	
External Pressure	PSIG	0	0	Deleted	Deleted
Temperature	°F	120	150	Deleted	

Materials of Construction

Component	Material	Containment	Notes
Column Top Head	SA-240 316	Primary	Notes 4 and 8
Column Shell	SA-240 316	Primary	Notes 4 and 8
Sump Vessel Top Head	SA-240 316	Primary	Notes 4 and 8
Sump Vessel Shell	SA-240 316	Primary	Notes 4 and 8
Sump Vessel Bottom Head	SA-240 316	Primary	Notes 4 and 8
Vessel Internals	SA-240 316	N/A	Notes 4, 5 and 8
Dry Packing	UNS N08367/N08926	N/A	0.012" material thickness or maximum standard thickness available
Wet Packing	UNS N08367/N08926	N/A	0.012" material thickness or maximum standard thickness available
Vessel Support	SA-240 304	N/A	Note 4
Deleted			
Pipe	SA-312 TP316	Primary (Note 6)	Notes 4 and 8
Forgings/ Bar stock	SA-182 F316	N/A	Notes 4 and 8
Gaskets	None		
Bolting	None		
Mounting Base	Note 7	N/A	18" high ring beam (see sheet 4 for details)

Miscellaneous Data

Orientation	Vertical					
Support Type	Skirt					
Insulation Function	None					
Insulation Thickness	inch None					
Insulation Material	None					
External Finish	Welds descaled as laid					
Internal Finish	Welds ground smooth					
	Dry Weight	Dry Weight C.G.	Operating Weight	Operating Weight C.G.	Testing Weight	Shipping Weight
Scrubber	Note 2	Note 2	Note 2	Note 2	Note 2	Note 2
Packed Column	Note 2	Note 2	Note 2	Note 2		
Sump Vessel	Note 2	Note 2	Note 2	Note 2		

Note: Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Contents of this document are Dangerous Waste Permit affecting.

ERIC B. ISKEN — STATE OF WASHINGTON — 33449 — REGISTERED PROFESSIONAL ENGINEER — 11/21/05

EXPIRES: 07/28/07

This Bound Document Contains a total of 4 sheets

Rev.	Reason for Issue	Preparer	Checker	Reviewer	Approver	Date
1	Issued for Permitting Use	C. Thompson	D.J. Nickelson / L. Han	C. Morley	R. Hoffman	11/28/05
0	Issued for Permitting Use	C. Thompson	D. Pease	C. Morley	R. Hoffman	19-Nov-04

BECHTEL	**Mechanical Data Sheet:** **PTF Vessel Vent Caustic Scrubber**	Plant Item Number 24590-PTF-MX-PVP-SCB-00002 Data Sheet Number 24590-PTF-MXD-PVP-P8002, Rev 1

Notes

Note 1 : Seller shall determine based on information from the data sheet.
Note 2 : To be determined and provided by seller.
Note 3 : The corrosion allowance of 0.04" shall apply to all surfaces in contact with process fluids except for the dry and wet packings.
Note 4 : Material shall have a carbon content not to exceed 0.030%, dual certified.
Note 5 : Seller shall submit item details for customer review.
Note 6 : Nozzles are primary containment. The spare nozzle shall have a welded cap. See Note 8.
Note 7 : Ring beam web and top flange shall be SA-240 304L, bottom flange shall be A-572 GR50.
Note 8 : All welds forming part of the primary and auxiliary containments, including the nozzle attachment welds shall be subjected to 100% volumetric examination.
Note 9 : The scrubber is located in a Black Cell. (R5 / C5 area)

Notes for Outline Profile of the PTF Vessel Vent Caustic Scrubber

Note 1: See "Design Data" in sheet 1 of 4 for the bounding dimensions of the scrubber.

Note 2: The maximum sump batch volume shall be determined based on given dimensions:
- Seller to provide the batch volume and total time of operation per batch based on runback, maximum expected condensate and caustic makeup.

Note 3: The minimum allowance from maximum sump operating volume to overflow shall satisfy all three conditions below:
- minimum 2" liquid depth
- at least 2% of maximum operating liquid depth
- change in liquid level equivalent to 5 minutes of maximum liquid accumulation in the scrubber sump

Note 4: Nozzle requirements are as follows:
- Unless noted otherwise, nozzles shall extend 12 inches beyond the vessel.
- Nozzle schedule shall be determined by the Seller, taking into consideration all requirements stated in Buyer document # 24590-WTP-SPS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication.*
- All nozzles with connecting pipes shall be end-prepared per Buyer document # 24590-WTP-PW-P30T-00001, *WTP End Prep Detail for Field Butt Welds*, to tie in with the respective connecting pipe size and schedule in note 5.
- Seller shall confirm size and schedule/wall thickness for all nozzles specified in note 7 below.

Note 5: Ring Beam Detail
- Refer to Buyer document 24590-WTP-MV-M59T-00001, for ring beam details.

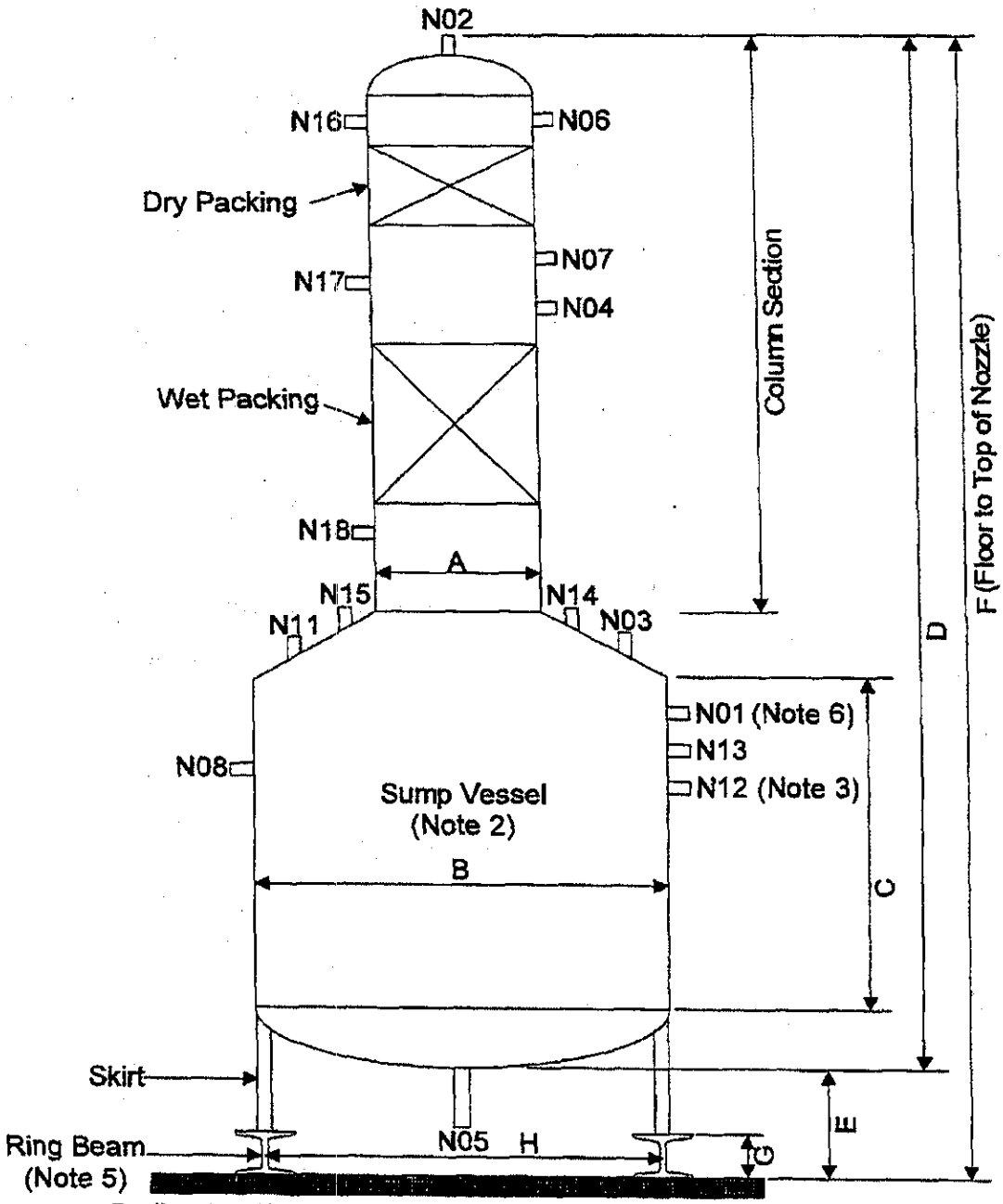
Note 6: Locate inlet nozzle (N01) on the sump vessel and use as inspection manway. Inlet nozzle (N01) must be higher than the overflow nozzle (N12).

Note 7: Nozzle data are as follows:

Nozzle		Connecting Pipe		Function
No.	Size	NPS	Schedule	
N01	24" NPS	24	0.375"	Offgas Inlet
N02	24" NPS	24	0.375"	Offgas Outlet
N03	2" NPS	2	40S	Recirculated Caustic Solution for Mixing
N04	2" NPS	2	40S	Recirculated Caustic Solution for Scrubbing
N05	4" NPS	4	40S	Pump Suction
N06	1" NPS	1	40S	Demineralized Water Inlet
N07	1" NPS	1	40S	Demineralized Water Inlet
N08	1.5" NPS	1.5	40S	Reagent Inlet (5M NaOH)
Deleted				
Deleted				
N11	1" NPS	1	40S	Sample Recirculation Return
N12	6" NPS	6	10S	Scrubber Sump Vessel Overflow
N13	6" NPS	1	40S	Bubbler Type Level Indicator (See Detail 19, Dwg. 24590-WTP-MV-M59T-00016002)
N14	3" NPS			Spare (with welded cap)
N15	2" OD	0.75	40S	Pressure Transmitter Leg (See Detail 6, Dwg 24590-WTP-MV-M59T-00016001)
N16	2" OD	0.75	40S	Pressure Transmitter Leg (See Detail 6, Dwg 24590-WTP-MV-M59T-00016001)
N17	2" OD	0.75	40S	Pressure Transmitter Leg (See Detail 6, Dwg 24590-WTP-MV-M59T-00016001)
N18	2" OD	0.75	40S	Pressure Transmitter Leg (See Detail 6, Dwg 24590-WTP-MV-M59T-00016001)
Deleted				
Deleted				

NPS - Nominal Pipe Size (inch)
OD - Outside Diameter (inch)

BECHTEL	**Mechanical Data Sheet:** **PTF Vessel Vent Caustic Scrubber**	Plant Item Number 24590-PTF-MK-PVP-SCB-00002 Data Sheet Number 24590-PTF-MKD-PVP-P0002, Rev 1



Outline Profile of the PTF Vessel Vent Caustic Scrubber

	Mechanical Data Sheet: PTF Vessel Vent Caustic Scrubber	Plant Item Number 24590-PTF-MKC-PVP-SCB-00002
BECHTEL		Data Sheet Number 24590-PTF-MKC-PVP-JP8002, Rev 1

Description		Instrument Tag	Unit	Operating Lo	Operating Normal	Operating Hi			Remarks
Inlet Offgas	Pressure	PC-0404	W.G.	-38.0"	-28.0"	-18"			
Inlet Offgas	Temperature	TI-0401	°F	113	120	130			
Inlet Offgas	Volume Flow Rate		SCFM	(Note 2)	3600	3600			
Inlet Offgas	Rel. Humidity		%		100	100			
Inlet Offgas	NO_2		ppm vol		130				
Inlet Offgas	NO		ppm vol		70				
Inlet Offgas	CO_2		ppm vol		330				
Scrubber Sump Vessel	Pressure	PI-0408	W.G.	-38.0"	-28.0"	-18"			
Scrubber Sump Vessel	Liquid Temperature	TC-0405	°F		111				
Scrubber Sump Vessel	Liquid Level	LI-0409		*	*	*			
Scrubbing Liquid	pH		pH	*	*	*			
Recirc. to sump - mixing	Flow Rate	FI-0461	GPM		60*				
Recirc. to packing - scrubbing	Flow Rate	FI-0444	GPM		60*				
Recirc. to packing - scrubbing	Temperature		°F		70				
Deleted									
Deleted									
Deleted									
Deleted									
Deleted									
Packed Section	Pressure Drop	PDI-0406	W.G.		*	8.0"			Max. allowable (Note 1)
Demineralized Water Inlet at Nozzle N06	Flow Rate		GPM	N.A.	50*	N.A.			
Dry Packing	Pressure Drop	PDI-0407	W.G.		*	1.0"			Max. allowable (Note 1)
Demineralized Water Inlet at Nozzle N07	Flow Rate		GPM	N.A.	50*	N.A.			
Outlet Offgas	Pressure		W.G.	-45.0"	-35.0"	-25"			
Outlet Offgas	Temperature		°F	77	77	77			
Outlet Offgas	Mass Flow Rate		kg/hr						
Outlet Offgas	Flow Rate		SCFM		3600	3600			
Outlet Offgas	Rel. Humidity		%		100	100			
Outlet Offgas	NO_2		ppm vol		*				
Outlet Offgas	NO		ppm vol		*				
Outlet Offgas	CO_2		ppm vol		*				
DF (minimum) for Nitrogen Oxides			DF		1.8*				
DF (minimum) for Solid Particulates			DF		3.5*				2.0 micron particulates

Notes:

* - Seller to verify/provide data.

1 - Maximum differential pressure across scrubber in clean condition shall not exceed 8 in-WG. Seller to provide data.

2 - Standard conditions of flow are 77 deg F and 1 atmosphere as dry air (density = 0.074 lb/ft^3) - humidity accounts for additional volume and mass flow

3 - Deleted

BECHTEL	Mechanical Data Sheet: Vessel	Plant Item No. 24590-PTF-MV-FEP-SEP-00001A Data Sheet No. 24590-PTF-MVD-FEP-P0006

R1063790

Project:	RPP-WTP	P&IDs	24590-PTF-M6-FEP-P0002
Project No:	24590		
Project Site:	DOE Hanford	Process Calculation	24590-PTF-MEC-FEP-00001
System No.	FEP		
Building:	PTF	Vessel Drawings	24590-QL-POA-MEVV-00001-01-194
Description:	Waste Feed Evaporator Separator Vessel FEP-SEP-00001A		

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Reference Data

Charge Vessels (Tag Numbers)	N/A
Pulse Jet Mixers / Agitators (Tag Numbers)	N/A
RFDs/Pumps (Tag Numbers)	N/A

Quality Level	QL-1	Fabrication Specification	24590-WTP-3PS-MV00-TP001
Seismic Category	SC-1	Design Code	ASME Section VIII Division 1
Service/Contents	Radioactive Slurry	Code Stamp	U1 Stamp
Design Specific Gravity	1.50	NB Registration	Yes
Max Operating Volume gal	3,341	Wind Design	None
Total Volume gal	13,359	Snow/Ash Design	None
Postweld Heat Treat	Not Required	Seismic Design	24590-WTP-3PS-MV00-TP002 24590-WTP-3PS-SS90-T0001
Seismic Base Moment* ft*lb	N/A		
Environmental Qualification	N/A 2		

Design Data

Inside Diameter** inch	7'6" (Upper), 11'6" (Lower)		Corrosion Allowance inch	0.04	
Length/Height** inch	406 3/4				
	Vessel Operating	Vessel Design	Coil/Jacket Design	Notes	
Internal Pressure PSIG	-13.4	50	N/A	Vessel operating at 1.3 psia	
External Pressure PSIG	0	14.7	N/A		
Temperature °F	129	175	N/A		
Min Design Metal Temp °F	49		Hydrostatic Test Pressure PSIG	65	

Materials of Construction

Component	Material	Containment	Notes
Top Head	SA 240 304 SS	Auxiliary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Shell	SA 240 304 SS	Primary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Bottom Head	SA 240 304 SS	Primary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Vessel Support	SA 240 304 SS	N/A	Maximum carbon content of 0.030% for welded components
Jacket/Coils/Half-Pipe Jacket	N/A	N/A	
Internals	SA 240 304 SS	Thermowell Primary (Note 6)	Maximum carbon content of 0.030% for welded components
Pipe	SA 312 304 SS	Note 6	Maximum carbon content of 0.030% for welded components
Forgings/ Bar stock	SA 479 304 SS	Note 1	Maximum carbon content of 0.030% for welded components
Gaskets	304 SS		Flexitallic spiral wound, Graphite Filler
Bolting	Nitronic 60		Dwg. 24590-QL-POA-00001-01-00302 (Captive Bolts) 2
Other (Fittings)	SA 403 WP 304 SS		Maximum carbon content of 0.030% for welded components

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EXPIRES: 07/28/07

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3	Issue for Permitting Use	E. Le	S. Crow	N/A	J. Julyk	10/1/05
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1	Issue for Permitting Use	J. Jackson	C. Slater	N/A	S. Kirk	3/17/2004
0	Issue for Permitting Use					10/29/2002

	Mechanical Data Sheet: Vessel	Plant Item No. 24590-PTF-MV-FEP-SEP-00001A Data Sheet No. 24590-PTF-MVD-FEP-P0006

Miscellaneous Data

Orientation	*Vertical*
Support Type	*Stainless steel legs*
Insulation Function	*None*
Insulation Thickness inch	*None*
Insulation Material	*None*
External Finish	*Welds descaled as laid*
Internal Finish	*Welds ground smooth; lower 16'-3 7/16" shell and cone to be #4 polished finish.*

Notes

(1) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MV00-T0001 for NDE requirements.
(2) Nozzle tolerance +/- 1/4"
(3) Material for demister pad is Inconel 625 fine mesh
(4) Non-replaceable 40 years design life (except demister pads section)
(5) NDE for this vessel must meet requirements per para. 6.1, 6.2 and 7.2 of specification 24590-WTP-3PS-MV00-TP001
(6) All welds forming part of the primary and auxiliary containments, including the nozzle attachment welds shall be subjected to 100% volumetric examination.
(7) This vessel is located in a Black Cell.
(8) Vendor to specify all metal thicknesses
(9) Contents of this document are Dangerous Waste Permit effecting 3
(10) All vessel nozzle loads due to thermal expansion are estimated based on the maximum operating temperature of 150 degree F. 3
(11) This vessel is Important-To-Safety (ITS) and must maintain containment post Design Basis Event (DBE). 3
However, Environmental Qualification is not applicable for this vessel since all the materials of construction are metallic (24590-WTP-GPG-ENG-088, Rev. 0) 3

BECHTEL	Mechanical Data Sheet: Vessel	Plant Item No. 24590-PTF-MV-FEP-SEP-00001B Data Sheet No. 24590-PTF-MVD-FEP-P0007

R10637901

Project:	RPP-WTP	P&IDs	24590-PTF-M6-FEP-P0004
Project No:	24590		
Project Site:	DOE Hanford	Process Calculation	24590-PTF-MEC-FEP-00001
System No.	FEP		
Building:	PTF	Vessel Drawings	24590-QL-POA-MEVV-00001-01-195
Description:	Waste Feed Evaporator Separator Vessel FEP-SEP-00001B		

ISSUED BY RPP-WTP PDC

Reference Data

Charge Vessels (Tag Number/s)	N/A
Pulse Jet Mixers / Agitators (Tag Numbers)	N/A
RFDs/Pumps (Tag Numbers)	N/A

Service Data

Quality Level	QL-1	Fabrication Specification	24590-WTP-3PS-MV00-TP001
Seismic Category	SC-1	Design Code	ASME Section VIII Division 1
Service/Contents	Radioactive Slurry	Code Stamp	U1 Stamp
Design Specific Gravity	1.50	NB Registration	Yes
Max Operating Volume gal	3,941	Wind Design	None
Total Volume gal	13,369	Snow/Ash Design	None
Postweld Heat Treat	Not Required	Seismic Design	24590-WTP-3PS-MV00-TP002 24590-WTP-3PS-SS90-T0001
Seismic Base Moment* ft*lb	N/A		
Environmental Qualification	N/A 2		

Design Data

Inside Diameter** inch	7'6" (Upper), 11'9" (Lower)		Corrosion Allowance inch	0.06
Length/Height** inch	408 3/4			
	Vessel Operating	Vessel Design	Coil/Jacket Design	Notes
Internal Pressure PSIG	-13.4	50	N/A	Vessel operating at 1.3 psia
External Pressure PSIG	0	14.7	N/A	
Temperature °F	129	175	N/A	
Min Design Metal Temp °F	49		Hydrostatic Test Pressure PSIG	65

Materials of Construction

Component	Material	Containment	Notes
Top Head	SA 240 304 SS	Auxiliary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Shell	SA 240 304 SS	Primary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Bottom Head	SA 240 304 SS	Primary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Vessel Support	SA 240 304 SS	N/A	Maximum carbon content of 0.030% for welded components
Jacket/Coils/Half-Pipe Jacket	N/A	N/A	
Internals	SA 240 304 SS	Thermowell Primary (Note 8)	Maximum carbon content of 0.030% for welded components
Pipe	SA 312 304 SS	Note 8	Maximum carbon content of 0.030% for welded components
Forgings/ Bar stock	SA 479 304 SS	Note 1	Maximum carbon content of 0.030% for welded components
Gaskets	304 SS		Flexitallic spiral wound, Graphite Filler
Bolting	Nitronic 60		Dwg. 24590-QL-POA-00001-01-00302 (Captive Bolts) 2
Other (Fittings) 2	SA 403 WP 304 SS		Maximum carbon content of 0.030% for welded components

Note: Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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Rev.	Reason for Revision	Preparer	Checker	Reviewer	Approver	Date
2	Issue for Permitting Use	E. Le	S. Crow	N/A	J. Julyk	11/1/05
1	Issue for Permitting Use	E. Le	D. Reinemann	N/A	J. Julyk	2/10/2005
0	Issue for Permitting Use	E. Le	D. Reinemann	N/A	J. Julyk	3/17/2004

	Mechanical Data Sheet: Vessel	Plant Item No. 24590-PTF-MV-FEP-SEP-000015
		Data Sheet No. 24590-PTP-MVD-FEP-P0007

Miscellaneous Data

Orientation	*Vertical*
Support Type	*Stainless steel legs*
Insulation Function	*None*
Insulation Thickness Inch	*None*
Insulation Material	*None*
External Finish	*Welds dressed as laid*
Internal Finish	*Welds ground smooth; lower 15'-3 7/16" shell and cone to be #4 polished finish.*

Notes

(1) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MV00-TP001 for NDE requirements.
(2) Nozzle tolerance +/- 1/4"
(3) Material for demister pad is Inconel 625 fine mesh
(4) Non-replaceable 40 years design life (except demister pads section)
(5) NDE for this vessel must meet requirements per para. 6.1, 6.2 and 7.2 of specification 24590-WTP-3PS-MV00-TP001
(6) All welds forming part of the primary and auxiliary containments, including the nozzle attachment welds shall be subjected to 100% volumetric examination.
(7) This vessel is located in a Black Cell.
(8) Vendor to specify all metal thicknesses
(9) Contents of this document are Dangerous Waste Permit affecting 2
(10) All vessel nozzle loads due to thermal expansion are estimated based on the maximum operating temperature of 150 degree F. 2
(11) This vessel is Important-To-Safety (ITS) and must maintain containment post Design Basis Event (DBE). 2
However, Environmental Qualification is not applicable for this vessel since all the materials of construction are metallic (24590-WTP-GPG-ENG-056, Rev. 0) 2

R10613725

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00033*

Project	*RPP-WTP*	P&ID	*24590-PTF-M6-PWD-P0002*
Project No	*24590*	Calculation 3	*24590-PTF-MVC-PWD-00029, 24590-PTF-MVC-PWD-00021* 3
Project Site	*Hanford*	Vessel Drawing	*24590-PTF-MV-PWD-P0001001*
Description	*Ultimate Overflow Vessel*		ISSUED BY RPP-WTP PDC

Reference Data

Charge Vessels (Tag Numbers)	*PWD-VSL-00131, PWD-VSL-00132*
Pulsejet Mixers / Agitators (Tag Numbers)	*PWD-PJM-00031, PWD-PJM-00032, PWD-PJM-00033, PWD-PJM-00034, PWD-PJM-00035, PWD-PJM-00036, PWD-PJM-00037, PWD-PJM-00038*
RFDs/Pumps (Tag Numbers)	*PWD-RFD-00131, PWD-RFD-00132*

Design Data

Quality Level		*QL-1*	Fabrication Specs	*24590-WTP-3PS-MV00-TP001*		
Seismic Category		*SC-I*	Design Code	*ASME VIII Div 1*		
Service/Contents		*Radioactive Liquid*	Code Stamp	*Yes*		
Design Specific Gravity		*1.57*	NB Registration	*Yes*		
Operating Volume	gal	*29,580*	Weights (lbs)	Empty	Operating	Test
Total Volume	gal	*41,650*	Estimated	*115,400*	*503,700*	*465,000*
Environmental Qualifications		*N/A*	Actual ** 3	*129,000*	*517,500* 3	*499,600* 3

Inside Diameter	inch	*288*			Wind Design	*Not Required*	
Length/Height (TL-TL)	inch	*89*			Snow Design	*Not Required*	
		Vessel Operation	Vessel Design	Coil/Jacket Design	Seismic Design	*24590-WTP-3PS-SS90-T0001* *24590-WTP-3PS-MV00-TP002*	
Internal Pressure	psig	*0*	*15*	*N/A*	Seismic Base Moment *	ft*lb	
External Pressure	psig	*0.22*	*FV*	*N/A*	Postweld Heat Treat	*Not Required*	
Temperature	°F	*218*	*225*	*N/A*	Corrosion Allowance	inch	*0.08 (Notes 7,8)*
Min. Design Metal Temp.	°F	*0*			Hydrostatic Test Pressure *	Psig	*19.5*

* As determined by the vendor. 3

** The actual weights shown herein are based on the original seismic data and these figures are subject to change, based on the new loads, obtained from the seismic redesign. 3

Note: Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	REVIEWER	APPROVER
3	2/26/06	Issued for Permitting Use	C. Thompson	B. Makadia/L. Han	C. Slater	J. Jalyk
2	3/28/05	Issued for Permitting Use	C. Thompson	H. Khurana	C. Slater	M. Hoffmann
1	12/22/03	Issued for Permitting Use	J. Jackson	R. Simmons	C. Slater	M. Hoffmann
0	10/03/03	Issued for Permitting Use	J. Jackson	C. Slater	N/A	S. Kirk

	MECHANICAL SYSTEMS DATA SHEET: VESSEL	PLANT ITEM No. 24590-PTF-MV-PWD-VSL-00033

Materials of Construction

Component	Material	Minimum Thickness / Size	Containment
Top Head	SA 240 316 with max. Carbon of 0.030 %	See Drawing	Auxiliary (Note 1)
Shell	SA 240 316 with max. Carbon of 0.030 %	See Drawing	Primary (Note 1)
Bottom Head	SA 240 316 with max. Carbon of 0.030 %	See Drawing	Primary (Note 1)
Support	SA 240 304 with max. Carbon of 0.030 % (Note 3)	See Drawing	N/A
Jacket/Coils/Half-Pipe Jacket	N/A	N/A	N/A
Internals	SA240 316 with max. Carbon of 0.030 %	See Drawing	Thermowell Primary (Note 1)
Pipe	SA312 TP316 Seamless with max. Carbon of 0.030%	See Drawing	See Note 1
Forgings/ Bar stock	SA182 F316/SA 479 316 with max. Carbon of 0.030%	See Drawing	As Note-1 for Nozzle Necks
Gaskets	N/A	N/A	N/A
Bolting	N/A	N/A	N/A

Miscellaneous Data

Orientation	Vertical	Support Type	Skirt
Insulation Function	Not Applicable	Insulation Material	Not Applicable
Insulation Thickness (Inch)	Not Applicable	Weld Surface Finish	De-scaled as laid

Remarks

Note 1: All welds forming part of the primary and auxiliary containments, including the nozzle attachment welds shall be subjected to 100% volumetric examination. Radiography is the preferred method of volumetric testing. If it is considered impractical to perform radiographic examination, the Seller may propose ultrasonic examinations.

Note 2: Vessel supports shall be designed to restrain the vessel in a fully buoyant state.

Note 3: Ring beam bottom flange material shall be A 572 Gr. 50.

Note 4: Vessel volumes are approximate and do not account for manufacturing tolerances, nozzles, and displacement of internals.

Note 5: Contents of this document are Dangerous Waste Permit affecting.

Note 6: Deleted per report # 24590-WTP-RPT-M-04-0007 Rev. 0 dated Nov. 1, 2004. 3

Note 7: Seller shall ensure that an additional 0.063" is available for erosion in the bottom head and shall report the minimum thickness required for all specified loading conditions, exclusive of erosion and corrosion allowances. 3

Note 8: Seller shall ensure that an additional 0.053" is available for erosion in the interior conical surface of the pulse jet mixers. 3

Note 9: Required data for thermal stress analysis for nozzles exposed to higher temperatures.

- Cell ambient temperature = 113°F
- Headspace temperature or Operating temperature = 218°F
- Ambient and headspace natural convection heat transfer coefficients = 0.895 Btu/hr ft²°F for vessel head and 0.852 Btu/hr ft²°F for vessel shell
- Inlet fluid transfer frequency and mass flow rate for nozzle N39.

  Steam max temperature = 352°F

  Transfer frequency = 1 transfer/month

  Steam mass flow rate = 1,399 lb/hr

Note 10: Deleted. 3

Note 11: Revision 3 of this data sheet incorporates CCN #'s 129149, 128549 and revises notes 7, 8 and 10 shown above. The CCN's added the words "...in the form of overblow pressures:", to the paragraph above the graph and further revised the note below the graph, as noted herein on sheet 4 of 6. Revised sheet 1 of 6 as noted, revised row 2 to read "Calculation". 3

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00033*

Equipment Cyclic Data Sheet

Plant Item Number	*24590-PTF-MV-PWD-VSL-00033*
Component Description	*Parent Vessel*

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

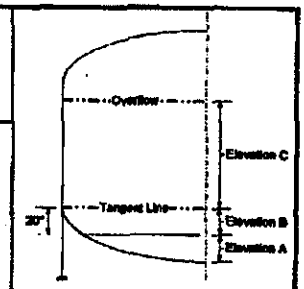
Materials of Construction	*SA 240 316 with max. Carbon of 0.030%*
Design Life	*40 years*
Component Function and Life Cycle Description	*The primary function of the Ultimate Overflow Vessel are to:* • *Collect gravity drains, and line flushes* • *Collect overflows from Pretreatment Facility process vessels.* • *Receive pit sump emptying ejector discharge* *The vessel is normally emptied once every fifty days. Washdown is not more than once per year.*

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	*FV*	*15*	*10*	*Nominal assumption*
Operating Pressure	psig	*-0.22*	*0*	*292*	
Operating Temperature	°F	*59*	*218*	*292*	*Uniform material temperature range, not between two points*
Contents Specific Gravity		*1.0*	*1.57*	*NA*	
Contents Level	inch	*Empty*	*Flooded*	*292*	*Coincident with pressure cycles*
Localized Features					
Nozzles		*Within 50°F of operating temperature range*		*As above*	

Hydrodynamic Loading

In normal operation, pulse jet mixers discharge liquid into the parent vessel imposing a cyclical hydrodynamic load on all internal components. Occasionally, an upset condition designated 'overblow' causes air to be discharged from any single pulse jet mixer. All internal components shall be designed for the combination of the normal operational hydrodynamic loads and overblow loads, and this load combination is also to be assumed to act concurrently with seismic loads.

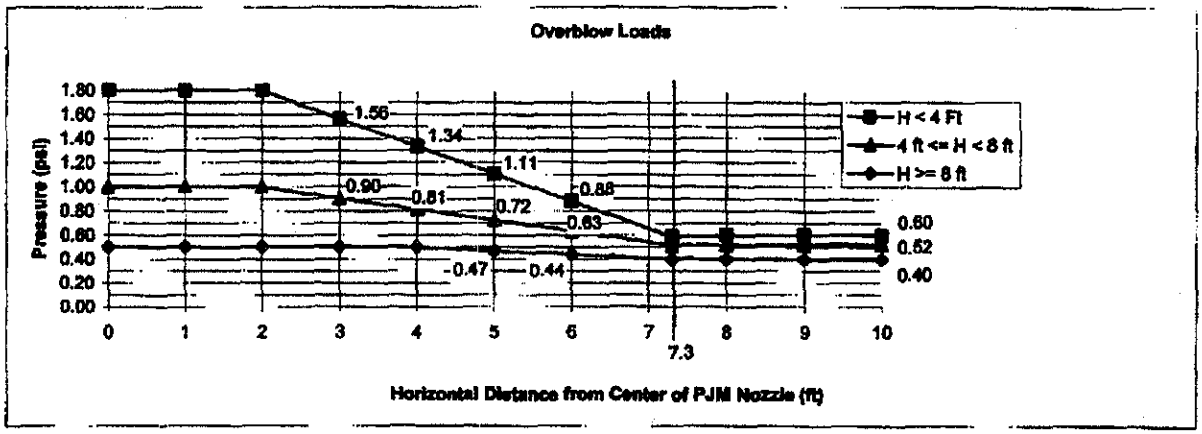
The following table indicates the normal hydrodynamic pressure at ranges of elevations in the vessel and the number of design cycles for each condition. The hydrodynamic forces cycle between the indicated pressure ranges applied across the projected area of the component. Positive hydrodynamic forces act in the radial, outward direction and the vertical, upward direction. Apply the radial load simultaneously in the radial direction and normal to the radial direction in the horizontal plane.



Normal Operation Hydrodynamic Pressure Range, psi						Number of Cycles
Elevation A		Elevation B		Elevation C		
Radial	Vertical	Radial	Vertical	Radial	Vertical	
-0.18 to 0.25	*-0.15 to 0.15*	*-0.05 to 0.12*	*-0.15 to 0.15*	*-0.03 to 0.10*	*-0.06 to 0.15*	*18.6 X 10⁶*

	MECHANICAL SYSTEMS DATA SHEET: VESSEL	PLANT ITEM No. 24590-PTF-MV-PWD-VSL-00033

Overblow loads vary as a function of the distance from the center of the overblowing pulse jet mixer nozzle and the elevation 'H' above the overblowing pulse jet mixer nozzle, up to the overflow level, as plotted in the form of overblow pressures: 3



For all vessel internal components other than the overblowing pulse jet mixer, the overblow forces shall be applied a) in the vertical upward direction, and b) in the horizontal direction radiating from the centerline of the overblowing pulse jet mixer. For the overblowing pulse jet mixer, the force shall be applied in the vertical upward direction only. The overblow force on all components, including the structures and supports, shall be calculated by applying the overblow pressure at the location of the nearest surface of the component and to the projected area of the component, facing the appropriate direction. The normal force component, specified for the normal pulse jet mixer operation condition, is not applicable to the overblow condition. Any single pulse jet mixer may overblow 1000 cycles. Reference CCN 123541 dated 07/27/05. 3

Notes

- *Cycle Increase: Increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.*
- *Nozzle N39 shall be fatigue assessed/analyzed for 500 temperature/pressure cycles from 0 psig at 59°F to 15 psig at 352°F, the pressure cycles shall coincide with the temperature cycles. See Note 8, on Page 2.*

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00033*

Equipment Cyclic Data Sheet

Plant Item Number:	*PWD-VSL-00131, PWD-VSL-00132*
Component Description	*Charge Vessels*

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

Materials of Construction	*SA 240 316 with max. Carbon of 0.030 %*
Design Life	*40 years*
Component Function and Life Cycle Description	*These charge vessels are cyclically loaded using vacuum to fully fill the charge vessel with process liquid and compressed air to fully empty the charge vessel. The charge vessels are contained within a parent vessel with varying liquid level. They shall be designed to cycle between the maximum design pressure and the minimum design pressure plus the external static head imposed by the parent vessel. The charge vessel supports shall be designed to cycle between fully buoyant (charge vessel empty and parent vessel full) and fully loaded (charge vessel full and parent vessel empty).*

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	*FV*	*55*	*10*	*Nominal assumption*
Operating Pressure	psig	*FV*	*30*	*18,100*	
Operating Temperature	°F	*69*	*218*	*292*	*Pressure cycles to be at 218 °F and non-coincident with temperature cycles. The range given is uniform material temperature range, not between adjacent points.*
Contents Specific Gravity		*1.0*	*1.57*	*N/A*	
Contents Level	inch	*Empty*	*Flooded*	*18,100*	*Coincident with pressure cycles*
Localized Features					
Supports		*As above*		*As above with contents level changing coincident with pressure cycles.*	

Notes

- *Cycle increase: The Seller must increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.*

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00033*

Equipment Cyclic Data Sheet

Plant Item Number:	*PWD-PJM-00031, PWD-PJM-00032, PWD-PJM-00033, PWD-PJM-00034, PWD-PJM-00035, PWD-PJM-00036, PWD-PJM-00037, PWD-PJM-00038*
Component Description	*Pulse Jet Mixers*

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

Materials of Construction	*SA 240 316 with max. Carbon of 0.030 %*
Design Life	*40 years*
Component Function and Life Cycle Description	*These pulse jet mixers (PJMs) are cyclically loaded using vacuum to fully fill the PJM with process liquid and compressed air to fully empty the PJM. The PJMs are contained within a parent vessel with varying liquid level. They shall be designed to cycle between the maximum design pressure and the minimum design pressure plus the external static head imposed by the parent vessel. The PJM supports shall be designed to cycle between fully buoyant (PJM empty and parent vessel full) and fully loaded (PJM full and parent vessel empty) in addition to thrust.*

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	*FV*	*85*	*10*	*Nominal assumption*
Operating Pressure	psig	*FV*	*60*	*16.6 x 10^6*	
Operating Temperature	°F	*59*	*218*	*16.6 x 10^6*	*Pressure cycles to be at 218 °F and non-coincident with temperature cycles. The range given is uniform material temperature range, not between adjacent points.*
Contents Specific Gravity		*1.0*	*1.57*	*N/A*	*Nominal assumption*
Contents Level	inch	*Empty*	*Flooded*	*16.6 x 10^6*	*Coincident with pressure cycles*
Thrust Load	lbf	*0*	*262*	*16.6 x 10^6*	*Coincident with pressure cycles*
Localized Features					
Supports		*As above*		*As above with contents level changing coincident with pressure cycles.*	

Notes

- ***Cycle Increase: The Seller must increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.***

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00044*

R10880652

Project	*RPP-WTP*	P&ID	*24590-PTF-M6-PWD-P0002/P0046* *24590-PTF-M6-UFP-P0007/8/9/11*
Project No	*24590*	Calculations:	*24590-PTF-MVC-PWD-00028 / 24590-PTF-MVC-PWD-00020* 3
Project Site	*Hanford*	Vessel Drawing	*24590-PTF-MV-PWD-P0010*
Description	*Plant Wash Vessel*		~~(ISSUED in~~ RPP-WTP PDC

Reference Data

Charge Vessels (Tag Numbers)	*PWD-VSL-00121, PWD-VSL-00122, PWD-VSL-00123, PWD-VSL-00124, PWD-VSL-00125*
Pulsejet Mixers / Agitators (Tag Numbers)	*PWD-PJM-00021, PWD-PJM-00022, PWD-PJM-00023, PWD-PJM-00024, PWD-PJM-00025, PWD-PJM-00026, PWD-PJM-00027, PWD-PJM-00028*
RFDs/Pumps (Tag Numbers)	*PWD-RFD-00121, PWD-RFD-00122, PWD-RFD-00123, PWD-RFD-00124, PWD-RFD-00125*

Design Data

Quality Level		*QL-1*	Fabrication Specs	*24590-WTP-3PS-MV00-TP001*		
Seismic Category		*SC-I*	Design Code	*ASME Section VIII, Div. 1*		
Service/Contents		*Radioactive Liquid*	Code Stamp	*YES*		
Design Specific Gravity		*1.27*	NB Registration	*YES*		
Operating Volume	gal	*88,631*	Weights (lbs)	Empty	Operating	Test
Total Volume	gal	*103,024*	Estimated	*227,000*	*1,158,000*	*1,088,000*
Environmental Qualifications		*N/A*	Actual ** 3	*204,600*	*1,127,100*	*1,064,900*

Inside Diameter	inch	*276*			Wind Design	*Not Required*	
Length/Height (TL-TL)	inch	*306*			Snow Design	*Not Required*	
		Vessel Operating	Vessel Design	Coil/Jacket Design	Seismic Design	*24590-WTP-3PS-MV00-TP002* *24590-WTP-3PS-SS90-T0001*	
Internal Pressure	psig	*0.00*	*15*	*N/A*	Seismic Base Moment *	ft*lb	
External Pressure	psig	*0.22*	*8.0*	*N/A*	Postweld Heat Treat	*Not Required*	
Temperature	°F	*212*	*237*	*N/A*	Corrosion Allowance	Inch	*0.08 (Notes 9, 10)*
Min. Design Metal Temp	°F	*40*			Hydrostatic Test Pressure *	Psig	

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2	4/7/05	Issued for Permitting Use	C. Thompson	H. Khurana	C. Slater	M. Hoffmann
1	3/19/04	Issued for Permitting Use	J. Jackson	H. Khurana	C. Slater	M. Hoffmann
0	10/29/02	Issued for Permitting Use	J. Jackson	C. Slater	N/A	S. Kirk

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** ***24590-PTF-MV-PWD-VSL-00044***

Materials of Construction

Component	Material	Minimum Thickness / Size	Containment
Top Head	***SA 240 316 Note 1***	***See Drawing***	***Auxiliary (See note 6)***
Shell	***SA 240 316 Note 1***	***See Drawing***	***Primary (See note 6)***
Bottom Head	***SA 240 316 Note 1***	***See Drawing***	***Primary (See note 6)***
Support	***SA 240 304 Note 1***	***See Drawing***	***N/A***
Jacket/Coils/Half-Pipe Jacket	***N/A***	***N/A***	***N/A***
Internals	***SA240 316 Note 1***	***See Drawing***	***Thermowell Primary***
Pipe	***SA312 TP316 Note 1***	***See Drawing***	***Primary (See note 6)***
Forgings/ Bar stock	***SA182 F316 Note 1***	***See Drawing***	***N/A***
Gaskets	***N/A***	***N/A***	***N/A***
Bolting	***N/A***	***N/A***	***N/A***

Miscellaneous Data

Orientation	***Vertical***	Support Type	***Skirt***
Insulation Function	***Not Applicable***	Insulation Material	***Not Applicable***
Insulation Thickness (inch)	***Not Applicable***	Internal Finish	***Note 3***
		External Finish	***Note 3***

Remarks

**** To be determined by the vendor.***

*****The actual weights shown herein are based on the original seismic data and these figures are subject to change, based on the new loads, obtained from the seismic redesign.*** 3

Note 1: Max. carbon of 0.030 %

Note 2: Deleted

Note 3: Welds descaled as laid.

Note 4: Vessel volumes are approximate and do not account for the manufacturing tolerances, nozzles, and displacement of internals.

Note 5: This vessel is in a Black cell.

Note 6: All welds forming part of the primary and auxiliary containment including nozzle attachment welds shall be subjected to 100% volumetric examination.

Note 7: Contents of this document are Dangerous Waste Permit affecting.

Note 8: Deleted per report NO. 24590-WTP-RPT-M-04-00007 dated Nov. 01, 2004 3

Note 9: BNI shall ensure that an additional 0.067" is available for erosion in the bottom head and shall report the minimum thickness required for all specified loading conditions, exclusive of erosion and corrosion allowances.

Note 10: BNI shall ensure that an additional 0.043" is available for erosion in the lower 4" of the interior conical surface of the pulse jet mixers.

Note 11: BNI shall include in its Dynamic Analysis, all hydrodynamic and overblow loads as per page 3 of this data sheet. 3

Note12: Revision 3 of this data sheet incorporates CCN 129149 and 128549. These CCN's added the words " in the form of overblow pressures" to the note shown above the overblow graph and further revised the note below the graph as noted herein on sheet 3. 3

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00044*

Equipment Cyclic Data Sheet

Component	*24590-PTF-MV-PWD-VSL-00044*
Component Description	*Parent Vessel*

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

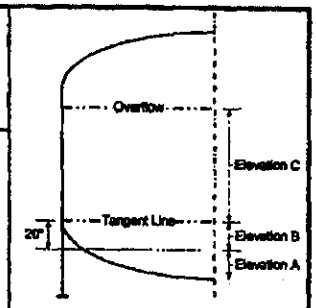
Materials of Construction	*SA 240 316 with max. Carbon of 0.030 %*
Design Life	*40 years*
Component Function and Life Cycle Description	*This is a "batch" vessel and cycle from nearly empty to nearly full. This vessel will be in the fill mode for one day, then in the discharge mode over the next day.*

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	*-8.0*	*15*	*10*	*Nominal assumption*
Operating Pressure	psig	*-0.22*	*0.00*	*7,300*	
Operating Temperature	°F	*59*	*212*	*7,300*	*Uniform material temperature range, not between two points*
Contents Specific Gravity		*1.00*	*1.27*	*N/A*	
Contents Level	inch	*Empty*	*Flooded*	*7,300*	*Coincident with pressure cycles*
Localized Features					
Nozzles		*Within 50°F of vessel operating range*		*As above*	

Hydrodynamic Loading

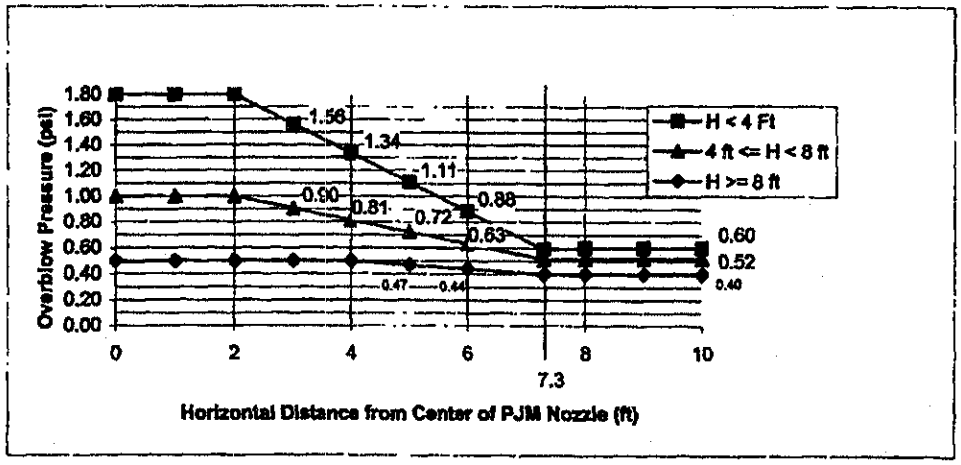
In normal operation, pulse jet mixers discharge liquid into the parent vessel imposing a cyclical hydrodynamic load on all internal components. Occasionally, an upset condition designated 'overblow' causes air to be discharged from any single pulse jet mixer. All internal components shall be designed for the combination of the normal operational hydrodynamic loads and overblow loads, and this load combination is also to be assumed to act concurrently with seismic loads.

The following table indicates the normal hydrodynamic pressure at ranges of elevations in the vessel and the number of design cycles for each condition. The hydrodynamic forces cycle between the indicated pressure ranges applied across the projected area of the component. Positive hydrodynamic forces act in the radial, outward direction and the vertical, upward direction. Apply the radial load simultaneously in the radial direction and normal to the radial direction in the horizontal plane.



Normal Operation Hydrodynamic Pressure Range, psi						Number of Cycles
Elevation A		Elevation B		Elevation C		
Radial	Vertical	Radial	Vertical	Radial	Vertical	
-0.15 to 0.25	*-0.15 to 0.15*	*-0.05 to 0.12*	*-0.15 to 0.15*	*-0.03 to 0.10*	*-0.06 to 0.15*	*17.3 X 10⁶*

Overblow loads vary as a function of the horizontal distance from the center of the overblowing pulse jet mixer nozzle and the elevation 'H' above the overblowing pulse jet mixer nozzle up to the overflow level as plotted in the form of overblow pressures: 3



For all vessel internal components other than the overblowing pulse jet mixer, the overblow forces shall be applied a) in the vertical upward direction, and b) in the horizontal direction radiating from the centerline of the overblowing pulse jet mixer. For the overblowing pulse jet mixer, the force shall be applied in the vertical upward direction only. The overblow force on all components, including structures and supports, shall be calculated by applying the overblow pressure at the location of the nearest surface of the component and to the projected area of the component, facing the appropriate direction. The normal force component, specified for the normal pulse jet mixer operation condition, is not applicable to the overblow condition. Any single pulse jet mixer may overblow 1000 cycles. Reference CCN 125541 dated 07/27/05. 3

Notes

- ***Cycle Increase: Increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.***

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00044*

Equipment Cyclic Data Sheet

Component	*PWD-VSL-00121, PWD-VSL-00122, PWD-VSL-00123, PWD-VSL-00124, PWD-VSL-00125*
Component Description	*Charge Vessels*

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

Materials of Construction	*SA 240 316 with max. Carbon of 0.030 %*
Design Life	*40 years*
Component Function and Life Cycle Description	*These charge vessels are cyclically loaded using vacuum to fully fill the charge vessel with process liquid and compressed air to fully empty the charge vessel. The charge vessels are contained within a parent vessel with varying liquid level. They shall be designed to cycle between the maximum design pressure and the minimum design pressure plus the external static head imposed by the parent vessel. The charge vessel supports shall be designed to cycle between fully buoyant (charge vessel empty and parent vessel full) and fully loaded (charge vessel full and parent vessel empty).*

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	*FV*	*55*	*10*	*Nominal assumption*
Operating Pressure	psig	*FV*	*30*	*1.8×10^4*	
Operating Temperature	°F	*59*	*212*	*7,300*	*Pressure cycles to be at 212° F and non-coincident with temperature cycles. The range given is uniform material temperature range, not between adjacent points.*
Contents Specific Gravity		*1.00*	*1.27*	*N/A*	
Contents Level	inch	*Empty*	*Flooded*	*1.8×10^4*	*Coincident with pressure cycles*
Localized Features					
Supports		*As above*		*As above with contents level changing coincident with pressure cycles.*	

Notes

Cycle Increase: The Seller must increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.

BECHTEL	**MECHANICAL SYSTEMS DATA SHEET: VESSEL**	**PLANT ITEM No.** *24590-PTF-MV-PWD-VSL-00044*

Equipment Cyclic Data Sheet

Plant Item Number	*PWD-PJM-00021, PWD-PJM-00022, PWD-PJM-00023, PWD-PJM-00024, PWD-PJM-00025, PWD-PJM-00026, PWD-PJM-00027, PWD-PJM-00028*
Component Description	*Pulse Jet Mixers*

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

Materials of Construction	*SA 240 316 with max. Carbon of 0.030 %*
Design Life	*40 years*
Component Function and Life Cycle Description	*These pulse jet mixers (PJMs) are cyclically loaded using vacuum to fully fill the PJM with process liquid and compressed air to fully empty the PJM. The PJMs are contained within a parent vessel with varying liquid level. They shall be designed to cycle between the maximum design pressure and the minimum design pressure plus the external static head imposed by the parent vessel. The PJM supports shall be designed to cycle between fully buoyant (PJM empty and parent vessel full) and fully loaded (PJM full and parent vessel empty) states. Thrust load shall be applied only to the fully buoyant state. Assume the parent vessel is full for 50% of the number of PJM cycles.*

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	*FV*	*85*	*10*	*Nominal assumption*
Operating Pressure	psig	*FV*	*60*	*1.73×10^7*	
Operating Temperature	°F	*59*	*212*	*1.73×10^7*	*Pressure cycles to be at 212° F and non-coincident with temperature cycles. The range given is uniform material temperature range, not between adjacent points.*
Contents Specific Gravity		*1.00*	*1.27*	*N/A*	
Contents Level	inch	*Empty*	*Flooded*	*1.73×10^7*	*Coincident with pressure cycles*
Thrust	lbf	*0*	*264*	*1.73×10^7*	
Localized Features					
Supports		*As above*		*As above with contents level changing coincident with pressure cycles.*	

Notes

- *Cycle increase: The Seller must increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.*

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R10684941

MECHANICAL DATA SHEET: VESSEL

PLANT ITEM No.
24590-PTF-MV-RLD-VSL-000017A

Project:	RPP-WTP	P&ID:	24590-PTF-M6-RLD-P0003
Project No:	24590	Process Calculation:	24590-PTF-MVC-RLD-00004 △3
Project Site:	Hanford	Vessel Drawing	24590-PTF-MV-RLD-P0001
Description:	Alkaline Effluent Vessel		

Reference Data

Charge Vessels Tag Numbers	N/A
Pulsejet Mixers / Agitators Tag Numbers	RLD-MXR-00001
RFDs/Pumps Tag Numbers	N/A

Design Data

Quality Level		CM	Fabrication Specs	24590-WTP-3PS-MV00-TP001		
Seismic Category		SC-III	Design Code	ASME Sec. VIII Div 1		
Service/Contents		Alkaline Effluent	Code Stamp	Yes		
Design Specific Gravity		1.10	NB Registration	Yes		
Maximum Operating Volume	gal	28,072	Weights (lbs)	Empty	Operating	Test
Total Volume	gal	34,340	Estimated	67,300	354,500	373,900
			Actual *	93,590	380,160	355,910

Inside Diameter	inch	192			Wind Design	Not Required	
Length/Height (TL-TL)	inch	210			Snow Design	Not Required	
		Vessel Operating	Vessel Design	Coil/Jacket Design	Seismic Design	24590-WTP-3PS-FB01-T0001	
						24590-WTP-3PS-MV00-TP002	
Internal Pressure	psig	0	15	N/A	Seismic Base Moment *	ft*lb	
External Pressure	psig	0.22	FV △3	N/A	Postweld Heat Treat	Not Required	
Temperature	°F	155	180	N/A	Corrosion Allowance	inch	0.06
Min. Design Metal Temp.	°F	40			Hydrostatic Test Pressure *	psig	

Note: Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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REV. 3 6/13/06

EXPIRES: 5/5/08

This Bound Document Contains a total of 3 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	REVIEWER	APPROVER
3	6/12/06	Issued for Permitting Use	C. Thompson	C. Chung / L. Han	B. Makadia	J. Julyk
2	1/25/05	Issued for Permitting Use	C. Thompson	C. Chung	C. Slater	M. Hoffmann
1	2/24/04	Issued for Permitting Use	K. Brightman	C. Chung	C. Slater	M. Hoffmann
0	12/18/02	Issued for Permitting Use	J. Jackson	C. Slater	N/A	M. Hoffmann

BECHTEL	**MECHANICAL DATA SHEET: VESSEL**	PLANT ITEM No. ***24590-PTF-MV-RLD-VSL-000017A***

Materials of Construction

Component	Material	Minimum Thickness / Size	Containment
Top Head	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Auxiliary***
Shell	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Primary***
Bottom Head	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Primary***
Support (Skirt)	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***N/A***
Jacket/Coils/Half-Pipe Jacket	***N/A***	***N/A***	***N/A***
Internals	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Thermowell Primary***
Pipe	***SA312 TP304 Seamless with max. Carbon of 0.030%***	***See Drawing***	***See Note-1***
Forgings/ Bar stock	***SA182 F304 with max. Carbon of 0.030 %***	***See Drawing***	***As Note-1 for Nozzle Necks***
Gaskets	***Spiral Wound, 304L Winding with Flexible Graphite Filler***	***See Drawing***	***As Note-1 for Nozzle Necks***
Bolting	***Austenitic SS type 304L***	***See Drawing***	***N/A***

Miscellaneous Data

Orientation	***Vertical***	Support Type	***Skirt***
Insulation Function	***Not Applicable***	Insulation Material	***Not Applicable***
Insulation Thickness (inch)	***Not Applicable***	Welds Surface Finish	***De-scaled as laid***

Remarks

* To be determined by the vendor.

Note 1: Nozzle necks below the high operating liquid level are Primary, others Auxiliary.

Note 2: NDE for this vessel must meet requirements per para. 6.4.2 of specification no. 24590-WTP-3PS-MV00-TP001.

Note 3: Vessel volumes are approximate and do not account for manufacturing tolerances, nozzles, and displacement of internals.

Note 4: Contents of this document are Dangerous Waste Permit affecting.

Note 5: Datasheet was revised to incorporate process requirements from CCN 088472 3

BECHTEL	**MECHANICAL DATA SHEET: VESSEL**	**PLANT ITEM No.** ***24590-PTF-MV-RLD-VSL-000017A***

Equipment Cyclic Data Sheet

Plant Item Number	***24590-PTF-MV-RLD-VSL-00017A***
Component Description	***Parent Vessel***

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

Materials of Construction	***SA 240 304 with max. Carbon of 0.030 %***
Design Life	***40 years***
Component Function and Life Cycle Description	***This is a "batch" vessel and cycles from nearly empty to nearly full. The vessel will be in the fill mode for two days, then in the discharge mode over the next two days.***

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	***FV***	***15***	***10***	***Nominal assumption***
Operating Pressure	psig	***-0.22***	***0***	***3500***	
Operating Temperature	°F	***59***	***155***	***3500***	***Uniform material temperature range, not between two points***
Contents Specific Gravity		***1.1***	***1.1***	***NA***	
Contents Level	inch	***Empty***	***Flooded***	***3500***	***Coincident with pressure cycles***
Localized Features					
Nozzles		***Within 50°F of vessel operating range***		***As above***	

Notes

Cycle Increase: The Seller must increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.

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R10684942

MECHANICAL DATA SHEET: VESSEL

PLANT ITEM No.
24590-PTF-MV-RLD-V3L-000017B

Project:	RPP-WTP	P&ID:	24590-PTF-M6-RLD-P0003
Project No:	24590	Process Calculation:	24590-PTF-MVC-RLD-00004 △3
Project Site:	Hanford	Vessel Drawing	24590-PTF-MV-RLD-P0002
Description:	Alkaline Effluent Vessel		

Reference Data

Charge Vessels Tag Numbers	NA
Pulsejet Mixers / Agitators Tag Numbers	RLD-MXR-00002
RFDs/Pumps Tag Numbers	NA

Design Data

Quality Level		CM	Fabrication Specs	24590-WTP-3PS-MV00-TP001		
Seismic Category		SC-III	Design Code	ASME Sec. VIII Div 1		
Service/Contents		Alkaline Effluent	Code Stamp	Yes		
Design Specific Gravity		1.10	NB Registration	Yes		
Maximum Operating Volume	gal	28,072	Weights (lbs)	Empty	Operating	Test
Total Volume	gal	34,340	Estimated	87,300	354,500	373,900
			Actual *	93,580	380,180	355,910

Inside Diameter	inch	192			Wind Design	Not Required	
Length/Height (TL-TL)	inch	210			Snow Design	Not Required	
		Vessel Operating	Vessel Design	Coil/Jacket Design	Seismic Design	24590-WTP-3PS-FB01-T0001	
						24590-WTP-3PS-MV00-TP002	
Internal Pressure	psig	0	15	NA	Seismic Base Moment *	ft*lb	
External Pressure	psig	0.22	FV △3	NA	Postweld Heat Treat	Not Required	
Temperature	°F	155	180	NA	Corrosion Allowance	inch	0.08
Min. Design Metal Temp.	°F	40			Hydrostatic Test Pressure *	psig	

Note: Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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REV. 3 6/13/06

EXPIRES: 5/5/08

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REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	REVIEWER	APPROVER
3	6/12/06	Issued for Permitting Use	C. Thompson	C. Chung / L. Han	B. Makadia	J. Julyk
2	1/25/05	Issued for Permitting Use	C. Thompson	C. Chung	C. Slater	M. Hoffmann
1	2/24/04	Issued for Permitting Use	K. Brightman	C. Chung	C. Slater	M. Hoffmann
0	12/18/02	Issued for Permitting Use	J. Jackson	C. Slater	N/A	M. Hoffmann

BECHTEL	**MECHANICAL DATA SHEET: VESSEL**	**PLANT ITEM No.** ***24590-PTF-MV-RLD-VSL-000017B***

Materials of Construction

Component	Material	Minimum Thickness / Size	Containment
Top Head	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Auxiliary***
Shell	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Primary***
Bottom Head	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Primary***
Support (Skirt)	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***N/A***
Jacket/Coils/Half-Pipe Jacket	***N/A***	***N/A***	***N/A***
Internals	***SA 240 304 with max. Carbon of 0.030 %***	***See Drawing***	***Thermowell Primary***
Pipe	***SA312 TP304 Seamless with max. Carbon of 0.030%***	***See Drawing***	***See Note-1***
Forgings/ Bar stock	***SA182 F304 with max. Carbon of 0.030 %***	***See Drawing***	***As Note-1 for Nozzle Necks***
Gaskets	***Spiral Wound, 304L Winding with Flexible Graphite Filler***	***See Drawing***	***As Note-1 for Nozzle Necks***
Bolting	***Austenitic SS type 304L***	***See Drawing***	***N/A***

Miscellaneous Data

Orientation	***Vertical***	Support Type	***Skirt***
Insulation Function	***Not Applicable***	Insulation Material	***Not Applicable***
Insulation Thickness (inch)	***Not Applicable***	Welds Surface Finish	***De-scaled as laid***

Remarks

* To be determined by the vendor.

Note 1: Nozzle necks below the high operating liquid level are Primary, others Auxiliary.

Note 2: NDE for this vessel must meet requirements per para. 6.4.2 of specification no. 24590-WTP-3PS-MV00-TP001.

Note 3: Vessel volumes are approximate and do not account for manufacturing tolerances, nozzles, and displacement of internals.

Note 4: Contents of this document are Dangerous Waste Permit affecting.

Note 5: Datasheet was revised to incorporate process requirements from CCN 068472. 3

BECHTEL	**MECHANICAL DATA SHEET: VESSEL**	**PLANT ITEM No.** ***24590-PTF-MV-RLD-VSL-00001B***

Equipment Cyclic Data Sheet

Plant Item Number	***24590-PTF-MV-RLD-VSL-00017B***
Component Description	***Parent Vessel***

The information below is provisional and envelopes operational duty for fatigue assessment. It is not to be used as operational data.

Materials of Construction	***SA 240 304 with max. Carbon of 0.030 %***
Design Life	***40 years***
Component Function and Life Cycle Description	***This is a "batch" vessel and cycles from nearly empty to nearly full. The vessel will be in the fill mode for two days, then in the discharge mode over the next two days.***

Load Type		Min	Max	Number of Cycles	Comment
Design Pressure	psig	***FV***	***15***	***10***	***Nominal assumption***
Operating Pressure	psig	***-0.22***	***0***	***3500***	
Operating Temperature	°F	***59***	***155***	***3500***	***Uniform material temperature range, not between two points***
Contents Specific Gravity		***1.1***	***1.1***	***NA***	
Contents Level	inch	***Empty***	***Flooded***	***3500***	***Coincident with pressure cycles***
Localized Features					
Nozzles		***Within 50°F of vessel operating range***		***As above***	

Notes

Cycle Increase: The Seller must increase the numbers of operational cycles given above by 10% to account for commissioning duty unless otherwise noted.

	Mechanical Data Sheet: Vessel	Plant Item No. 24590-PTF-MV-TLP-SEP-00001 Data Sheet No. 24590-PTF-MVD-TLP-P0005

R10637902

Project:	RPP-WTP	P&IDs	24590-PTF-M6-TLP-P0003
Project No:	24590		
Project Site:	DOE Hanford	Process Calculation	24590-PTF-MEC-TLP-00002
System No.	TLP		
Building:	PTF	Vessel Drawings	24590-QL-POA-MEVV-00001-01-196
Description:	Treated LAW Evaporator Separator Vessel TLP-SEP-00001		

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Reference Data

Charge Vessels (Tag Numbers)	N/A
Pulse Jet Mixers / Agitators (Tag Numbers)	N/A
RFDs/Pumps (Tag Numbers)	N/A

Service Data

Quality Level		QL-1	Fabrication Specification	24590-WTP-3PS-MV00-TP001
Seismic Category		SC-1	Design Code	ASME Section VIII Division 1
Service/Contents		Radioactive Slurry	Code Stamp	U1 Stamp
Design Specific Gravity		1.57	NB Registration	Yes
Max Operating Volume	gal	3,341	Wind Design	None
Total Volume	gal	13,359	Snow/Ash Design	None
Postweld Heat Treat		Not Required	Seismic Design	24590-WTP-3PS-MV00-TP002 24590-WTP-3PS-SS90-T0001
Seismic Base Moment*	ft*lb	N/A		
Environmental Qualification		N/A 2		

Design Data

Inside Diameter**	inch	7'6" (Upper), 11'5" (Lower)	Corrosion Allowance inch	0.04
Length/Height**	inch	406 3/4		

		Vessel Operating	Vessel Design	Coil/Jacket Design	Notes
Internal Pressure	PSIG	-13.4	50	N/A	Vessel operating at 1.3 psia
External Pressure	PSIG	0	14.7	N/A	
Temperature	°F	135 2	175	N/A	
Min Design Metal Temp	°F	49		Hydrostatic Test Pressure PSIG	65

Materials of Construction

Component	Material	Containment	Notes
Top Head	SA 240 304 SS	Auxiliary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Shell	SA 240 304 SS	Primary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Bottom Head	SA 240 304 SS	Primary (Note 6)	1/2" thickness; maximum carbon content of 0.030% for welded components
Vessel Support	SA 240 304 SS	N/A	Maximum carbon content of 0.030% for welded components
Jacket/Coils/Half-Pipe Jacket	N/A	N/A	
Internals	SA 240 304 SS	Thermowell Primary (Note 6)	Maximum carbon content of 0.030% for welded components
Pipe	SA 312 304 SS	Note 8	Maximum carbon content of 0.030% for welded components
Forgings/ Bar stock	SA 479 304 SS	Note 1	Maximum carbon content of 0.030% for welded components
Gaskets	304 SS		Flexitallic spiral wound, Graphite Filler
Bolting	Nitronic 60		Dwg. 24590-QL-POA-00001-01-00302 (Captive Bolts) 2
Other (Fittings) 2	SA 403 WP 304 SS		Maximum carbon content of 0.030% for welded components

Note: Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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11/1/05
EXPIRES: 07/28/07

This Bound Document Contains a total of 2 sheets

Rev.	Reason for Revision	Preparer	Checker	Reviewer	Approver	Date
2	Issue for Permitting Use	E. Le	E. Le S. Crow	N/A	J. Julyk	11/1/05
1	Issue for Permitting Use	E. Le	S. Crow	N/A	J. Julyk	12/10/2005
0	Issue for Permitting Use	E. Le	D. Reinemann	N/A	J. Julyk	3/17/2004

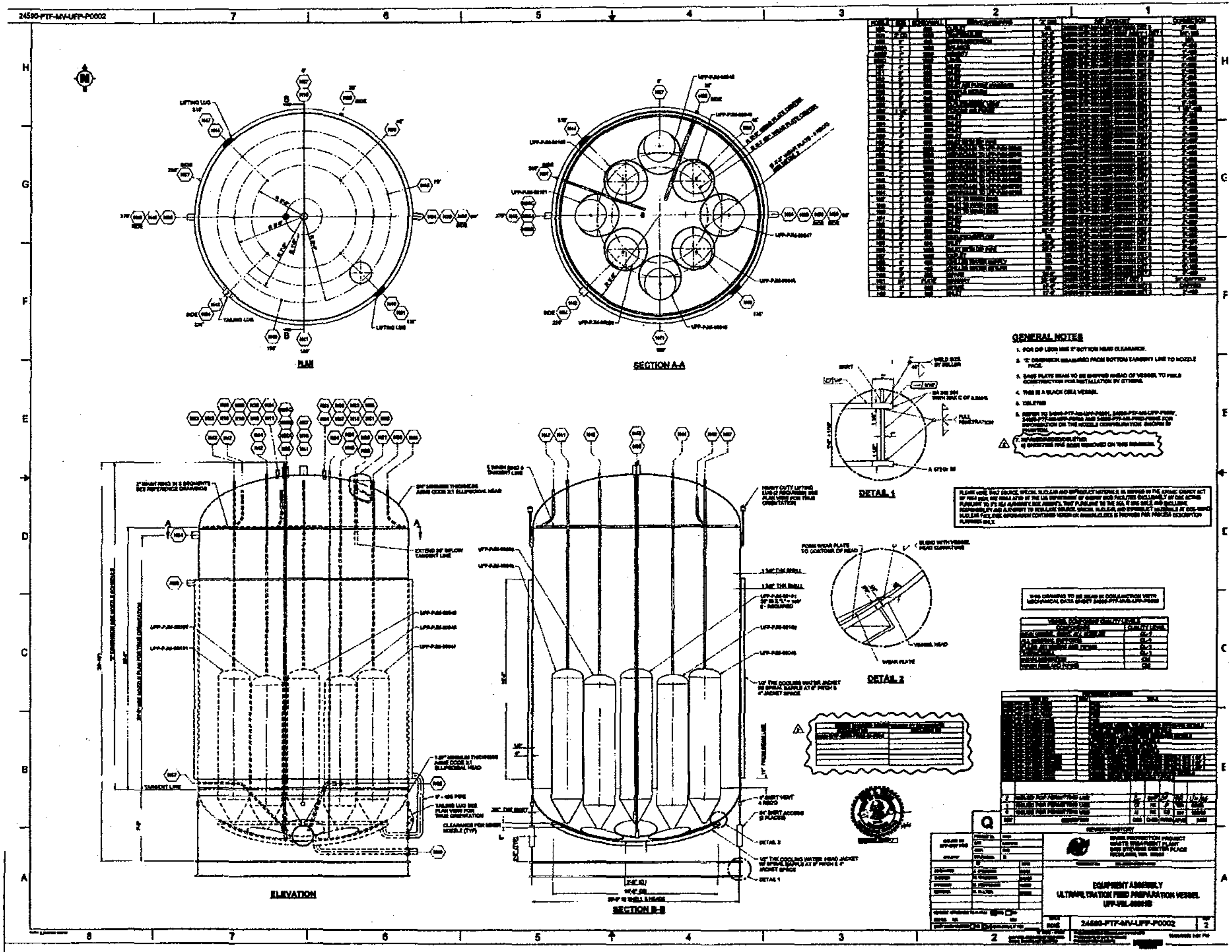
	Mechanical Data Sheet: Vessel	Plant Item No. 24590-PTF-MV-TLP-SEP-00001
		Data Sheet No. 24590-PTF-MVD-TLP-P0005

Miscellaneous Data

Orientation	*Vertical*
Support Type	*Stainless steel legs*
Insulation Function	*None*
Insulation Thickness inch	*None*
Insulation Material	*None*
External Finish	*Welds descaled as laid*
Internal Finish	*Welds ground smooth; lower 16'-3 7/16" shell and cone to be #4 polished finish.*

Notes

(1) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MV00-TP001 for NDE requirements.
(2) Nozzle tolerance +/- 1/4"
(3) Material for demister pad is Inconel 625 fine mesh
(4) Non-replaceable 40 years design life (except demister pads section)
(5) NDE for this vessel must meet requirements per para. 6.1, 6.2 and 7.2 of specification 24590-WTP-3PS-MV00-TP001
(6) All welds forming part of the primary and auxiliary containments, including the nozzle attachment welds shall be subjected to 100% volumetric examination.
(7) This vessel is located in a Black Cell.
(8) Vendor to specify all metal thicknesses
(9) Contents of this document are Dangerous Waste Permit affecting 2
(10) All vessel nozzle loads due to thermal expansion are estimated based on the maximum operating temperature of 150 degree F. 2
(11) Environmental Qualification is not applicable since this vessel is not important-to-Safety (non-ITS) and all the materials of construction are metallic (24590-WTP-GPG-ENG-008, Rev. 0) 2


24590-PTF-MV-UFP-P0002
PLAN
SECTION A-A
ELEVATION
SECTION B-B
DETAIL 1
DETAIL 2
LIFTING LUG
TAILING LUG
TANGENT LINE
GENERAL NOTES
1. FOR DIP LEGS USE 3" BOTTOM HEAD CLEARANCE.
2. "E" DIMENSION MEASURED FROM BOTTOM TANGENT LINE TO NOZZLE FACE.
3. BASE PLATE BEAM TO BE SHIPPED AHEAD OF VESSEL TO FIELD CONSTRUCTION FOR INSTALLATION BY OTHERS.
4. THIS IS A BLACK CELL VESSEL.
5. DELETED
REVISION HISTORY
Q
RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
EQUIPMENT ASSEMBLY
ULTRAFILTRATION FEED PREPARATION VESSEL
24590-PTF-MV-UFP-P0002
2

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Drawings and Documents

Attachment 51 – Appendix 8.7
Pretreatment Building
Specifications

The following drawings have been incorporated into Appendix 8.7 and can be viewed at the Ecology Richland Office. See Appendix 7.7 for specification documents common to the Pretreatment, LAW, HLW, and Laboratory buildings. **New drawings are in bold lettering.**

Drawing/Document Number	***Description***
~~24590-PTF-3PS-MEVV-TP001, Rev 1~~	~~Engineering Specification for Forced Circulation Vacuum Evaporator System~~
24590-PTF-3PS-MEVV-TP001, Rev 2	**Engineering Specification for Forced Circulation Vacuum Evaporator System**
24590-PTF-3PS-MEVV-TP002, Rev 0	Engineering Specification for Cesium Nitric Acid Recovery Forced Circulation Vacuum Evaporator System
24590-PTF-3PS-MKAS-TP001, Rev 0	Engineering Specification for PTF Vessel Vent Caustic Scrubber
24590-PTF-3PS-MLFP-TP001, Rev 1	Engineering Specification for Ultrafilters
24590-PTF-3PS-MPCO-T0001, Rev 0	Engineering Specification for PTF Hot Cell Slurry Pumps to Meet Requirements of API Standard 610, Eighth Edition
24590-PTF-3PS-MWD0-TP003, Rev 1	Engineering Specification for RDP Spent Resin Dewatering Equipment Package
24590-WTP-PEN-ENV-04-0001, Rev N/A	Equivalency Notice for 24590-WTP-3PS-MV00-TP001, Rev. 1
RESERVED	RESERVED

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RPP-WTP PDC

R10869531

Quarter Ending 03/31/2006

24590-PTF-PCN-ENV-05-014

Hanford Facility RCRA Permit Modification Notification Form

Part III, Chapter 10 and Attachment 51

Waste Treatment and Immobilization Plant

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Page 2 of 2: Hanford Facility RCRA Permit, Part III, Chapter 10, Attachment 51
Update *Engineering Specification for Forced Circulation Vacuum Evaporator System* (24590-PTF-3PS-MEVV-TP001) in Appendix 8.7 of the Dangerous Waste Permit

Submitted by Co-Operator:

D. Klein — 1/11/06 Date

Reviewed by ORP Program Office:

R. J. Schepens — 2/8/06 Date

Best Available Copy

Quarter Ending 03/31/2006

24590-PTF-PCN-ENV-05-014

Hanford Facility RCRA Permit Modification Notification Form

Unit:	Permit Part & Chapter:
Waste Treatment and Immobilization Plant	**Part III, Chapter 10 and Attachment 51**

Description of Modification:

The purpose of this modification is to update *Engineering Specification for Forced Circulation Vacuum Evaporator System* (24590-PTF-3PS-MEVV-TP001) currently in Appendix 8.7 of the Dangerous Waste Permit (DWP).

The following are the major changes to this permit specification:

- Rearrangement of the listing of equipment included in the Waste Feed Evaporator (FEP) and Treated LAW Evaporator (TLP) Systems
- Seller requirements for:
  - Design and fabrication of reboiler and support frame assemblies and nozzles
  - Painting
  - Provision of inspection, testing, and handling services.
- Removal of demister pad removal system design by upgrading the demister pad from 304L stainless steel to Inconel 625 to ensure a 40 year operating life
- Deletion of an Appendix on nozzle loads, which are instead provided in a referenced document
- Deletion of an Appendix on dimensional requirements, which are instead provided in a referenced document
- Addition of an Appendix providing acceleration response spectra for seismic design equipment and supports

These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment.

Please replace the following specification in the DWP:

Appendix 8.7			
Replace:	24590-PTF-3PS-MEVV-TP001 Rev. 1	With:	24590-PTF-3PS-MEVV-TP001 Rev. 2

WAC 173-303-830 Modification Class: [1 2]	Class 1	Class [1]1	Class 2	Class 3
Please mark the Modification Class:		X		

Enter Relevant WAC 173-303-830, Appendix I Modification citation number: N/A

Enter wording of WAC 173-303-830, Appendix I Modification citation: N/A

In accordance with WAC 173-303-830(4)(d)(i), this modification notification is requested to be reviewed and approved as a Class [1]1 modification. WAC 173-303-830(4)(d)(ii)(A) states, "Class 1 modifications apply to minor changes that keep the permit current with routine changes to the facility or its operation. These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment. In the case of Class 1 modifications, the director may require prior approval."

Modification Approved: [✓] Yes [ ] No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

S. Dahl 3/14/06 Date

[1] Class 1 modifications requiring prior Agency approval.

[2] This is only an advanced notification of an intended Class [1]1, 2, or 3 modification, this should be followed with a formal modification request, and consequently implement the required Public Involvement processes when required.

R10660923

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

Forced Circulation Vacuum Evaporator System

This bound document contains a total of 197 pages.

ERIC B. ISERN
STATE OF WASHINGTON
33449
REGISTERED PROFESSIONAL ENGINEER
12/15/05
EXPIRES: 07/28/07

Content applicable to ALARA? ☒ Yes ☐ No

ADR No.
N/A

Rev
N/A

ISSUED BY
RPP-WTP PDC

Quality Designator
QL

DOE Contract No.
DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	BY	CHECK	REVIEW	E&NS	QA	DPEM
2	12/27/05		E. Han / E. Le		N/A	N/A	
1	10/13/03	E. Le	G. Butt	N/A	N/A	N/A	S. Grabowski
0	10/30/02	J. Jackson	E. Le	N/A	N/A	N/A	S. Kirk

SPECIFICATION No.
24590-PTF-3PS-MEVV-TP001

Rev
2

Revision History

Revision	Reason for Revision
0	Issued for Permitting Use
1	Issued for Permitting Use
2	Issued for Permitting Use

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

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1 Scope

1.1 Project Description and Location

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy (DOE) Hanford Site tank waste will be pretreated and immobilized into stable glass form via vitrification. The WTP Contractor will design, build, and startup the WTP pretreatment and vitrification facilities for the DOE Office of River Protection (ORP). The waste treatment facilities will pretreat and immobilize the low-activity waste (LAW) and high-level waste (HLW) currently stored in underground storage tanks at the Hanford Site.

The Hanford Site occupies an area of about 560 square miles and is located along the Columbia River, north of Richland, WA in the U.S.A. The WTP Facility will be constructed at the east end of the 200 East Area of the Hanford Site. The counties of Benton, Franklin, and Grant surround the Hanford Site.

1.2 Equipment, Material, and Services Required

This specification provides the requirements for the design, analysis, fabrication, quality assurance, inspection, testing, qualification, and labeling of three (3) forced circulation vacuum evaporator systems for use in the WTP Pretreatment Facility. This specification also provides the requirements for the supply of services, manuals, instructions, procedures, and other associated documentation.

The scope of work for the Seller includes all work defined in this specification and its addenda and attachments. Work shall include, but is not limited to, the following:

1.2.1 Provide fully detailed designs, drawings, diagrams, supporting calculations, supporting analyses, procedures, installation instructions, and all labor, materials, equipment, and services necessary to manufacture, test, inspect, label and package for shipment three (3) sets of the forced circulation vacuum evaporator system hardware, including handling and servicing equipment, all fabricated to appropriate NQA-1 requirements in accordance with all specification requirements, with the deliverables being reports, calculations, procedures, data sheets, drawings and diagrams as outlined in this specification and the Material Requisition (MR). Refer to tables below for what shall be included as part of evaporator systems to be provided.

Waste Feed Evaporator (FEP) Systems

Equipment	Tag
Two (2) FEP Separator Vessels. Each vessel with support structure, three layers of de-entrainment trays, two layers of mesh pads and sprays.	FEP-SEP-00001A FEP-SEP-00001B
Two (2) FEP Reboilers with Graylocs and PUREX nozzles installed in accordance with this specification and stainless steel structural support frames.	FEP-RBLR-00001A FEP-RBLR-00001B
Two (2) FEP Recirculation Pumps. Each pump includes motor, pump seals, and adjustable speed drive. The pump inlet and outlet pipe ends prepared for butt welding.	FEP-PMP-00009A FEP-PMP-00009B
Two (2) FEP Condenser skid. Each skid consisting of Primary Condenser, 1st stage steam ejector, Intercondenser, 2nd stage steam ejector, Aftercondenser and interconnecting piping.	FEP-COND-00001A FEP-COND-00002A FEP-COND-00003A FEP-EJCTR-00040 FEP-EJCTR-00041 FEP-COND-00001B FEP-COND-00002B FEP-COND-00003B FEP-EJCTR-00042 FEP-EJCTR-00043
One (1) FEP Condensate Vessel for both FEP systems. Vessel includes skirt and support ring.	FEP-VSL-00005
Two (2) FEP Condensate Pumps include base plate, motor, variable speed drive, and mechanical seal mounted on common skid.	FEP-PMP-00006A FEP-PMP-00006B
One (1) Antifoam Vessel serves the FEP and TLP separators. Vessel includes skirt.	AFR-TK-00001
Three (3) Antifoam Pumps (common for FEP and TLP systems) with base plate and motor mounted on common skid.	AFR-PMP-00006 AFR-PMP-00007 AFR-PMP-00008
Two (2) sets of FEP offgas piping 30" diameter from separator to Primary condenser. Piping includes pipe hangers.	"Note 1"
Two (2) FEP Steam Conditioning Assembly consisting of a steam supply flow control valve, desuperheater and flow element.	FEP-SKID-00006A FEP-SKID-00006B
Four (4) lifting yokes. One lifting yoke for three (3) separator vessels, two lifting yokes for three (3) reboiler and support frame assemblies, and one lifting yoke for three (3) recirculation pumps	"Note 1"
Two (2) FEP Reboiler Steam Condensate Transfer Stations including level tank, transfer pump and condensate recycle pump.	FEP-VSL-00021 FEP-PMP-00010A FEP-PMP-00010B FEP-VSL-00022 FEP-PMP-00011A FEP-PMP-00011B

Note 1: Stainless steel or plastic tags (foil strip is not acceptable) shall be firmly attached by stainless steel wire or stainless steel screws to each separate item. Each tag shall be stamped with, as a minimum: (1) Purchase Order Number, (2) Purchase Order item number, and (3) Equipment/Instrument Tag number.

Treated LAW Evaporator (TLP) System

Equipment	Tag
One (1) TLP Separator Vessel with support structure, three layers of de-entrainment trays, two layers of mesh pads and sprays.	TLP-SEP-00001
One (1) TLP Reboiler with Graylocs and PUREX nozzles installed in accordance with this specification and stainless steel structural support frame.	TLP-RBLR-00001
One (1) TLP Recirculation Pump including motor, pump seals, and adjustable speed drive. The pump inlet and outlet pipe ends prepared for butt welding.	TLP-PMP-00001
Two (2) LAW SBS Feed Pumps with base plate, motor, pump seals, and adustable speed drive.	TLP-PMP-00005A TLP-PMP-00005B
Two (2) TLP Concentrate Pumps with base plate, motor, pump seals, and adjustable speed drive.	TLP-PMP-00011A TLP-PMP-00011B
One (1) TLP Condenser skid consisting of Primary Condenser, 1st stage steam ejector, Intercondenser, 2nd stage steam ejector, Aftercondenser and interconnecting piping.	TLP-COND-00001 TLP-COND-00002 TLP-COND-00003 TLP-EJCTR-00064 TLP-EJCTR-00067
One (1) TLP Condensate Vessel with support.	TLP-VSL-00002
Two (2) Condensate Pumps include base plate, motor, variable speed drive, and mechanical seal mounted on common skid.	TLP-PMP-00002A TLP-PMP-00002B
One (1) set of offgas piping 30" diameter from Separator to Primary Condenser with pipe hangers.	"Note 1"
One (1) TLP steam conditioning Assembly consisting of a steam supply flow control valve, a desuperheater and flow element.	TLP-SKID-00008
One (1) TLP Reboiler Steam Condensate Transfer Station including level tank, transfer pump and condensate recycle pump.	TLP-VSL-00047 TLP-PMP-00012A TLP-PMP-00012B

Note 1: Stainless steel or plastic tags (foil strip is not acceptable) shall be firmly attached by stainless steel wire or stainless steel screws to each separate item. Each tag shall be stamped with, as a minimum: (1) Purchase Order Number, (2) Purchase Order item number, and (3) Equipment/Instrument Tag number.

1.2.2 Provide a guarantee that all equipment listed in section 1.2.1 will perform in accordance with the requirements of this specification and all referenced codes, standards, and documentation in section 2 of this specification. Process warranty shall include demonstration of compliance of the Seller's provided evaporator system during testing per section 7.2 of this specification with the boil-off and decontamination factor requirements.. The process warranty is provided with the following conditions: (1) the evaporator systems are operated per Seller's instructions within mutually agreed parameters and chemical analytes that are representative of waste and process conditions, and (2) mutual agreement that foaming within the Separator Vessel is adequately controlled by the Buyer-supplied antifoaming reagent.

1.2.3 Perform sizing calculations and process performance modeling to ensure that each component of the evaporator systems is properly specified to ensure desired performance.

1.2.4 Provide the following nonreplaceable components/equipment which shall attain a 40-year life:

- Separator vessels and all their internal parts (exception made for demister pad life).
- Section of separator offgas pipework located inside the R5/C5 black cells.

1.2.5 Deleted.

1.2.6 Provide three (3) steam conditioning equipment skids necessary to reduce plant low-pressure steam of 40 psig and 286 °F to Seller's provided optimal saturated steam condition for reboiler operation. Provide specifications (i.e pipe diameter, associated equipment and layout) for reboiler shell vacuum/vent line.

1.2.7 Provide specifications and data sheets during contract performance for Buyer to procure the following equipment/components.

- FEP feed pumps (FEP-PMP-00007A/B).
- FEP concentrate pumps (FEP-PMP-00008A/B).

1.2.8 Provide evaporator skids, equipment, components, and structural supports with the materials of construction as specified per this specification and on the attached data sheets in section 2 of the MR. The structural supports for evaporator equipment shall match with Buyer's provided embed layout.

1.2.9 Provide evaporator systems that accommodate the wall penetrations, piping layout, equipment dimension envelopes, and equipment locations as specified in Appendices H, I, and J.

1.2.10 Provide stainless steel skid framing to match Buyer embed plates for all three separator vessels. The vessel skid shall conform to the proposed skid layout dimensions shown in the Appendix F.

1.2.11 Provide below-the-hook lifting devices for installation, commissioning, and operation/maintenance of the demister pads assembly, reboiler, and recirculation pump. These will include lifting yokes, beams, fixtures, etc., according to Buyer design constraints for remote handling, which will be provided in 30 % design review stage. Seller is also to provide all special lifting equipment required for installation and maintenance of the evaporator systems.

1.2.12 Provide seismic analysis for evaporator structures, systems, and components. Seismic analysis shall also be performed for reboiler and support frame assemblies. Seismic model shall include: (1) vessel/equipment, (2) skid frames, and (3) supporting posts. For post/embeds locations and details, see drawings 24590-PTF-DD-S13T-00023 thru -0030, 24590-PTF-DD-S13T-00049, 24590-PTF-SS-S15T-00311 thru -00318, 24590-PTF-SS-S15T-00352, and 24590-PTF-SS-S15T-00354. For recirculation pumps, design inputs such as allowable loads,

acceleration, interface points shall be provided for Buyer to perform structural analysis. Seismic response spectra for the reboilers at the steel frame supports are provided in Appendix R. The structural analysis will include dynamic loading resulting from seismic excitation while the vessel is operating under normal operating conditions. Buyer will provide the appropriate seismic response spectra and damping values for the performance of the seismic analysis. The seismic qualification of the evaporator systems equipment and components including their anchorage to the facility structure shall be accomplished using either Equivalent Static Analysis or Dynamic Analysis based on the characteristics and complexity of the equipment/components.

1.2.13 Provide the thermal and static stress analyses for the evaporator structures, systems, and components. Seller shall also provide fatigue analysis to support a 40 year design life for the evaporator system. The fatigue analysis shall include all calculations and all supporting data. Buyer will provide the necessary cyclic data for Seller to perform an assessment regarding the fatigue life of the equipment. However, Seller will be responsible for confirmation that the cyclic data has been accurately interpreted before proceeding with the component fatigue analysis.

1.2.14 Identify all interfaces and requirements for external connections with equipment and services supplied by the Buyer. The interface system data parameters for use in each of the evaporator systems shall include, as a minimum, the following:

Inlet Conditions:
- Feed (flow rate @ 77 °F)
- High pressure steam (mass flow rate @ 109 psig)
- Low pressure steam (mass flow rate @ 40 psig)
- Service Water (flow rate)
- Antifoam (flow rate)
- Instrument air (flow rate @ pressure)
- Cooling water (flow rate @ 75 °F)
- Operating electrical (kW)
- Installed electrical (kW)

Outlet Conditions:
- Steam Condensate (volumetric flow rate & temperature)
- Process Condensate (volumetric flow rate & temperature)
- Vent System (mass flow rate & temperature)
- Concentrate waste (volumetric flow rate & temperature)

1.2.15 Provide completed Instrument and Mechanical data sheets for all instruments and equipment in the 60 % design review package, utilizing Buyer's supplied instrument data sheet samples attached in the section 2 of the MR as templates. Buyer will procure the required instruments as detailed by the Seller's control philosophy documents (data sheets) for installation by others. Instrumentation shall conform to 24590-WTP-3PS-JQ07-T0001. Seller's design may differ from

the Buyer proposed evaporator Piping and Instrumentation sketches in Appendix L of this specification.

1.2.16 Provide the following for instrumentation and controls of Seller's supplied evaporator systems, equipment, and components to support Seller's software development. Any effect that the evaporator control strategy has on equipment operating parameters (i.e., pump flow rates, line flushes, feed and concentrate takeoff strategies, temperature, or pressure) will be mutually agreed upon prior to being implemented into the design.

- P&IDs
- Instrument data sheets
- Instrument loop diagrams
- Instrument location diagrams
- Control philosophies
- Functional descriptions
- Installation details
- Instrument index which includes functional test and operational set points
- Control and sequencing requirements
- Instrumentation and controls for the FEP evaporator feed and concentrate systems.

1.2.17 Provide a reliability analysis and documentation for each of the three (3) evaporator systems in accordance with the following:

1.2.17.1 A complete Failure Modes and Effects Analysis (FMEA) shall be performed on all the equipment that falls within Seller's scope of supply. This shall include associated components such as vessels, remote handling equipment, pumps have associated valves, (for isolation, for maintenance, for cross-ties, etc.) that have electronic control system which are used for process variability (e.g., flow rate). All support systems (e.g., power, air, water, steam, etc.) will be assumed to be 100 % reliable and will not be considered in the FMEA. Structural failure modes will be limited to seismic events, based on whatever seismic analyses have been performed to support the design. The FMEA shall follow in MIL-STD-1629A as close as possible. The equivalent standard actually used to perform the FMEA shall be provided as a reference (including version and year) at the 60 % design review. Also, an explanation shall be included to demonstrate how the standard has been applied. Failure modes for a reboiler are at least as follows: (1) pin hole, (2) crack, and (3) tube rupture. In addition, Seller shall indicate the possibility of the reboiler tube rupture without precursor of pin hole or crack. Determination of the possibility of reboiler tube rupture without a precursor of a pin hole or crack can be made with a qualitative argument based on fracture mechanics. No stress analysis or fracture mechanics calculations will be required to support the qualitative assessment. Failure modes for the remaining components covered

by the FMEA shall be as determined by the Seller; however, the basis for the failure mode shall be specified.

1.2.17.2 Failure rate data for the purposes of an availability assessment (performed by Seller) will be derived using the following hierarchy:

- Supplier In-Service Data
- In-Service Data of similar equipment, preferably in similar applications
- Generic Documented Failure Rate Data – data taken from recognized data sources, e.g., Dexter & Perkins, NPRD 1995, etc.

The specific data source shall be provided at the 60 % design review.

1.2.17.3 A maintainability analysis will be undertaken in concert with the Buyer. The analysis will address preventative and corrective maintenance activities and estimate the required maintenance for the reboiler and appurtenances.

1.2.17.4 A recommended spare parts list, operations manuals, and maintenance manuals shall be provided.

1.2.17.5 Assume operations are 8,760 operating hours per year.

1.2.18 Provide an analysis of operating life for separator vessel, including its internal demister pads, separation trays, and feed distribution, reboiler, and recirculation pump. Justify all assumptions and references.

1.2.19 Provide structural support requirements and recommended support locations for recirculation pumps (i.e., load points, weight distribution, and maximum weight, geometry of equipment, and location of center gravity). In addition, identify areas that cannot be used as load points. Equipment support locations shall be mutually agreed with the Buyer due to remote handling requirements in the hot cell.

1.2.20 Provide design and fabrication of three support frames for reboilers. The support frame shall be welded to the reboiler and designed to force the thermal expansion of all nozzles (PUREX and remote clamp connectors) upward. Upper support points can be maintained for a lateral guide support. The structural supports for reboiler shall meet BNI remoteability requirements such as weight, remotely removable, airlock sizing, crane and impact wrench specified in this document.

1.2.21 Nozzles shall be located to ± 1/4 inch diametric tolerance by the hole in support frame as relative to the master dowel of the reboiler and support frame assembly. Nozzles shall be perpendicular / parallel within 0.5 degree or 1/4 inch whichever is smaller relative to the datum formed by the lower base plate of the reboiler and support frame assembly.

1.2.22 For reboiler nozzle locations, see Appendix P. Nozzles shall be located in accordance with 1.2.21.

1.2.23 Provide demonstration and recorded VHS format video tape for demister pad removal and replacement in Seller shop test. Buyer shall be notified prior to demonstration.

1.2.24 Provide radiographic film with technique and reader sheets. Exposed film must be sent, along with a copy of the technique and reader sheets in accordance with section 3 of the MR. Film must be suitably packaged to preclude moisture and handling damage.

1.2.25 Provide any necessary special remote repair tools for the reboiler and support frame assemblies and recirculation pumps. Special tools shall not include tools readily available in the commercial market. Also, provide a list of commercially available tools needed.

1.2.26 Provide final inspection of completed vessels. Buyer will not be designating a representative to carry out final inspections of the vessels as described per Buyer specification 24590-WTP-3PS-MV00-TP001, *Pressure Vessel Design and Fabrication.*

1.2.27 Provide personnel to perform dimensional measurements for reboiler and support frame assembly, and recirculation pumps at the Seller's shop.

1.2.28 Provide certified reports for all components subject to any heat treatment during manufacture.

1.2.29 Provide procedures suggesting how the integrated testing of evaporator system functionality be conducted by Buyer at the Hanford jobsite per section 7.2 of this specification. Technical support for installation, testing and commissioning will be under a separate contract.

1.2.30 Provide design documents in progressively complete package form. Design reviews at 30 %, 60 %, 90 % and Final Design to resolve all outstanding issues are planned to include face-to-face discussions between Buyer's personnel and Seller's personnel at Buyer's location. Future meetings will be arranged after Design Review Package Materials have been reviewed and meeting agenda have been established. The discussions are intended to help establish/clarify interface points in system requirements, review design/design progress, design documents, exchange ideas/information, provide design direction. See G-321-E Form for document submittal requirements.

1.3 Work by Others

Any item not specifically listed as being supplied by the Buyer shall be provided by the Seller.

1.3.1 Provide installation labor.

1.3.2 Provide equipment shipment, unloading and storage at Buyer's site.

1.3.3 Provide Instrumentation and controls (including installation). Provide Buyer internal standards for digital control system equipment and will specify and procure the control system equipment based on the necessary I/O requirements detailed by Seller.

1.3.4 Instrument location information for instrument location drawings.

1.3.5 Generate control logic in Buyer standard format using the final control loop definitions, system interlocks and alarms, system control philosophies, and control and sequencing requirements provided by Seller.

1.3.6 Procure the digital control system components. Buyer will provide the "Device" and "I/O" address of the serial communications link for each instrument for inclusion in the Instrument Index.

1.3.7 Perform the inspection of dimensional measurement activities for separator vessels, reboilers, and recirculation pumps.

1.3.8 Perform remote handling verification test for reboilers and support frame assemblies, recirculation pumps, and recirculation pipework jumper functionality at Buyer site. Lift tests shall be performed per section 3.19.8 by Seller prior to shipment.

1.3.9 Provide the appropriate seismic response spectra and damping values for Seller to perform the evaporator equipment skid (including reboiler and support frame assemblies) seismic analyses.

1.3.10 Provide video/camera systems for the Seller's provided demister pad removal systems.

1.3.11 Provide heat tracing, seismic review, and any necessary uninterruptible power supplies.

1.3.12 Provide all the piping, instrumentation and controls for the antifoam systems per Seller design and specification.

1.3.13 Provide all valves (including control valves) located in the jumpers for remote maintenance in the R5/C5 hot cell.

1.3.14 Provide design and fabrication for all piping, jumpers, and connectors for the recirculation pipework. This includes the piping connecting the separator vessel to the recirculation pump, the recirculation pump to the reboiler nozzle, and the reboiler nozzle to the separator vessel for two FEP evaporator systems and the TLP evaporator system.

1.3.15 Provide structural supports per Seller's structural support requirements for three recirculation pumps (FEP-PMP-00009A/B and TLP-PMP-00001) and recirculation piping/jumpers.

1.3.16 Provide hot cell process equipment platform (PEP) for all reboiler and support frame assemblies and recirculation pumps.

1.3.17 Provide the necessary cyclic data for Seller to perform an assessment regarding the fatigue life of the equipment. However, Seller will be responsible for confirmation that the cyclic data has been accurately interpreted before proceeding with the component fatigue analysis.

1.3.18 Provide remote handling verification test for reboiler and support frame assemblies, recirculation pumps, and recirculation pipework jumper functionality.

1.3.19 Provide all jumpers, jumper mounted equipment, and pipework connections to the separator vessel (excluding the separator offgas pipework) within the black cell.

1.3.20 Provide all pipework between Seller's provided skids (excluding the evaporator separator offgas pipework and piping connecting condenser skids and steam ejectors).

1.3.21 Provide specification of process and utility piping jumper interfaces and their locations.

1.3.22 Provide Jumper stack-up tolerance study.

1.3.23 Provide shielding for penetrations through the walls and floors.

1.3.24 Provide hot cell remote handling equipment (including impact wrenches and standard lifting equipment).

1.3.25 Provide specification for antifoam reagents.

1.3.26 Provide feed vessels (FEP-VSL-00017A/B and TLP-VSL-00009A/B).

1.3.27 Provide concentrate receipt vessels (UFP-VSL-00001A/B and TCP-VSL-00001).

1.3.28 Provide Vessel Vent system.

1.3.29 Provide steam condensate collection vessel, pump, and eductor (refer to 1.2.7).

1.3.30 Provide FEP feed pumps (FEP-PMP-00007A/B) and concentrate pumps (FEP-PMP-00008A/B) (refer to 1.2.7).

1.3.31 Provide utility (i.e., air, steam, cooling water) supply systems. However, Seller is responsible to provide steam condition skids for reboiler operation.

1.3.32 Interface drawings for evaporator equipment skids.

1.4 Definitions

1.4.1 *Skid:* A skid is a group of components that can be manufactured and installed as a unit. These skid units are structurally self-supporting, allowing the skid to be handled by crane. Whenever practical, skids will contain all the equipment associated with the process, including vessels, piping, and supports.

1.4.2 *ALARA:* As Low As Reasonably Achievable (ALARA) documentation requirements apply to systems, structures, and components (SSCs) that have the potential to affect radiation doses, contamination levels, or releases to the environment.

1.4.3 *Buyer's Representative(s)*: The Buyer's designee(s), who shall witness onsite operations at the Seller and sub-seller sites and perform onsite inspections and surveillances.

1.4.4 *Black Cell (R5/C5)*: is a sealed concrete structure containing very high radiation and contamination where human access is prohibited during the normal operating lifetime of the cell and maintenance is not performed in the cell.

1.4.5 *C1:* Uncontrolled Area.

1.4.6 C2: Controlled area. Personnel must be verified free of contamination prior to exit.

1.4.7 *C3:* Contamination classification for plant areas that are ordinarily free of contamination, but have the potential of being contaminated.

1.4.8 *C5:* Contamination classification for plant areas that are considered high contamination areas. Access to C5 areas is not permitted.

1.4.9 *Design Basis Earthquake (DBE):* A specification of the ground motion at the site. For the WTP site, the DBE is defined by horizontal and vertical acceleration response spectra anchored to a peak ground acceleration of 0.26g and 0.18g, respectively.

1.4.10 *Hot Cell (R5/C5)*: A room that is restricted from personnel due to high radiation. A hot cell is constructed with thick concrete walls usually lined internally with stainless steel sheet. Process equipment located in the hot cell is connected to wall nozzles using jumpers. Process equipment in the hot cell is skid mounted and designed for either remote maintenance using crane-mounted services or, preferably, no maintenance over the 40 year design life of the WTP.

1.4.11 *Important to Safety (ITS):* SSCs that serve to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the workers and the public. ITS encompasses the broad class of facility features addressed (not necessarily explicitly) in the top-level radiological, nuclear, and process safety standards and principles that contribute to the safe operation and protection of workers and the public during all phases and aspects of facility operations (i.e., normal operation as well as accident mitigation). ITS includes

SSCs designated as Safety Design Class (SDC), Safety Design Significant (SDS), and Risk Reduction Class (RRC).

1.4.12 *Jumper:* A remotely removable section of pipework usually incorporating connector heads and some items of process equipment (i.e., valves, instruments, etc.).

1.4.13 *Commercial Material (CM)*: SSC items and associated services (those that are not designated as SDC or SDS) that are manufactured using standard commercial practices.

1.4.14 *Paragraph*: When a paragraph of this specification, referenced documents, referenced codes, or referenced standards is referenced in this specification, the paragraph referenced and all subparagraphs and sub-subparagraphs of the paragraph referenced shall be considered inclusive.

1.4.15 *Quality Level 1 (QL-1):* SDC items. NQA-1 (1989) compliance is required.

1.4.16 *Quality Level 2 (QL-2):* SDS items. QL-2 shall also be used to identify other items and activities for which NQA-1 (1989) compliance is required.

1.4.17 *Rad*: A unit of energy absorbed from ionizing radiation, equal to 100 ergs per gram or 0.01 joules per kilogram of irradiated material.

1.4.18 *Risk Reduction Class*: RRC SSCs are ITS SSCs that are neither SDC nor SDS.

1.4.19 *R1*: Unrestricted area.

1.4.20 *R2*: Radiation controlled area.

1.4.21 *R3:* Radiation classification for plant areas considered average. Contamination area requiring anti-contamination clothing for entry. At early design stages, when insufficient information is available regarding worker occupancy, an initial target radiation level of 2.5 mRad/hr is to be used for the R3 classification.

1.4.22 *R4:* Radiation area (maximum).

1.4.23 *R5:* Radiation classification for areas considered to be high or very high radiation areas.

1.4.24 *Reboiler and support frame assembly:* Reboiler and pipe work up to and including PUREX nozzles, remote clamp connector hubs, and all permanently attached frame work.

1.4.25 *Safety Design Class (SDC):* SSCs that, by performing their specified safety function, prevent workers or the maximally exposed member of the public from receiving a radiological exposure that exceeds the accident exposure standards defined in the Safety Requirements Document (SRD). SDC also applies to those features that, by functioning, prevent the worker or maximally exposed member of the public from receiving a chemical exposure that exceeds the ERPG-2

(AIHA 1988) chemical release standard. Those features credited for the prevention of a criticality event are also designated as SDC.

1.4.26 *Safety Design Significant (SDS)*: SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; and SSCs that can, if they fail or malfunction, place frequent demands on or adversely affect the function of SDC SSCs.

1.4.27 *Seismic Category I (SC-I)*: Equipment/tanks important to safety, which have a seismic safety function. For the design of Seismic Category I equipment/tanks, no credit for inelastic energy absorption is allowed. Seismic Category I equipment/tanks shall be functional during and after a Design Basis Earthquake (DBE).

1.4.28 *Seismic Category II (SC-II)*: Equipment/tanks important to safety whose failure during a seismic event could prevent a Seismic Category I structure, system, or component (SSC) from performing its seismic safety function. For the design of Seismic Category II equipment/tanks, credit for inelastic energy absorption is allowed. Seismic Category II equipment/tanks shall maintain control and confinement of hazardous materials during and after a Design Basis Earthquake (DBE), but do not need to be functional.

1.4.29 *Seismic Category III Equipment (SC-III)*: (a) SDC and SDS SSCs that do not have a natural phenomena hazard (NPH) safety function. (b) SSCs that have a seismic safety function solely because they protect workers and members of the public from exposure to chemical hazards. (c) RRC SSCs that provide primary confinement of significant inventories of radioactive materials, but in amounts less than quantities that require an SDC or SDS designation.

1.4.30 *Seismic Category IV (SC-IV)*: RRC SSCs that have been designated as RRC do not provide primary confinement of significant inventories of radioactive materials.

1.4.31 *Special Tools*: Any tooling which is not commercially available required to perform maintenance on the evaporator system.

1.4.32 *Acronyms*

- ALARA — As Low As Reasonably Achievable
- AISC — American Institute of Steel Construction
- ANSI — American National Standards Institute
- ASD — Adjustable Speed Drive
- ASD — Manual of Steel Construction (Allowable Stress Design)
- ASME — American Society of Mechanical Engineers
- ASNT — American Society of Nondestructive Testing
- ASTM — American Society for Testing and Materials
- AWS — American Welding Society
- CFR — Code of Federal Regulations
- CM — Commercial grade
- DBE — Design Basis Earthquake

- DOE — US Department of Energy
- DOT — Department of Transportation
- FEP — Waste Feed Evaporator Process System
- GPM — Gallons per minute
- ITS — Important to Safety
- LAW — Low-Activity Waste
- M — Molarity
- MDS — Material Data Sheet
- MR — Material Requisition
- MSDS — Material Safety Data Sheet
- NDE — Nondestructive Evaluation/Examination
- NPS — Nominal Pipe Size
- NQA — Nuclear Quality Assurance
- OBE — Operating Basis Earthquake
- ORP — DOE Office of River Protection
- PEP — Process Equipment Platform
- PMI — Positive Material Identification
- P&ID — Piping and Instrumentation Diagram
- PTF — Pretreatment Facility
- QA — Quality Assurance
- QAP — Quality Assurance Program
- QAM — Quality Assurance Manual
- QL — Quality Level
- RRC — Risk Reduction Class
- SBS — Submerged Bed Scrubber
- SDC — Safety Design Class
- SDS — Safety Design Significant
- SC — Seismic Category
- SSCs — Structures, Systems, and Components
- SSPC — The Society for Protective Coating
- RPP-WTP — River Protection Project-Waste Treatment Plant
- TID — Total Integrated Dose
- TLP — Treated LAW Evaporator Process System
- SC — Seismic Category
- SDDR — Supplier Deviation Disposition Request
- SG — Specific Gravity
- UBC — Uniform Building Code
- WT.% — Weight percent
- WTP — Hanford Tank Waste Treatment and Immobilization Plant

1.5 Mechanical Data Sheets

Specific design parameters and requirements for evaporator components will be shown on the individual Mechanical Data Sheet (MDS) in section 2 of the MR. The data shall be considered as preliminary. Seller shall verify thermal, hydraulic, mechanical and process designs. Where necessary, the Seller shall change the data in order to furnish complete

thermal, hydraulic, mechanical, and process guarantees. Any difference between Seller's final design and Buyer's preliminary data shall be brought to Buyer's attention for resolution and approval. Seller shall supply evaporator components that meet specified materials of construction, quality level, and seismic category as described on the MDS. The nominal feed chemistries used for the design should be based on Appendix A and B of this specification. Process design of the evaporator system is given in Appendix D of this specification.

1.6 Safety/Quality Classifications

1.6.1 The quality level (QL) and seismic category (SC) of the major components of the evaporator system are specified on the data sheets in section 2 of the MR and Appendix E of this specification.

1.6.2 Seismic category (SC) classification requirements are specified in 24590-WTP-3PS-SS90-T0001, Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks and 24590-WTP-3PS-FB01-T0001, Specification for Seismic Qualification for Seismic Category III/IV Equipment and Tanks.

2 Applicable Documents

2.1 General

2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.

2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of award shall apply. Pre-approved acceptable alternate editions are listed in section 4.2.12. For codes and standards listed below, the specific revision or effective date of codes and standards that they incorporate by reference (daughter codes and standards), shall be followed. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing. For commercial grade quality items, Seller may use any year of the ASME or ASTM standards for materials.

2.2 Codes and Industry Standards

2.2.1 ASME B31.3-1996, Process Piping

2.2.2 ASME B16.5-1988, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Addenda A

2.2.3 ASME B16.47-1990, Large Diameter Steel Flanges NPS 26 through NPS 60 Addenda A

2.2.4 ASME B18.15-1985, Forged Eye Bolts

2.2.5 ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessel

2.2.6 ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications

2.2.7 ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facility Applications

2.2.8 ASME Y14.100, Engineering Drawing Practices

2.2.9 AISC ASD, 9th Edition, Manual of Steel Construction, Allowable Stress Design

2.2.10 AISC N690-1994, Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities

2.2.11 ANSI N14.6, For Radioactive Materials-Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More

2.2.12 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

2.2.13 ASTM F594, Standard Specification for Stainless Steel Nuts

2.2.14 AWS D1.6, Structural Welding Code-Stainless Steel

2.2.15 AWS D9.1, Sheet Metal Welding Code

2.2.16 IEEE Std 1023, IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations

2.2.17 MIL-STD-1629A, Military Standard, Procedures for Performing A Failure Mode, Effects and Criticality Analysis

2.2.18 UBC-1997, Uniform Building Code

2.2.19 10 CFR 835, Occupational Radiation Protection

2.2.20 49 CFR 173, General Requirements for Shipments and Packaging. Code of Federal Regulations. U.S. Department of Transportation, Washington, D.C.

2.2.21 29 CFR 1910, Occupational Safety and Health Standards

2.2.22 NFPA 101, Code for Safety to Life from Fire in Buildings and Structures

2.2.23 NFPA 70 -1999, National Electric Code

2.2.24 SSPC-SP10, Near White Metal Blast Cleaning

2.2.25 SSPC-SP11, Power Tool Cleaning to Bare Metal

2.2.26 WAC 296-24, General Safety and Health Standards

2.2.27 595, Colors Used in Government Procurement

2.2.28 E 709, Standard Test Method for Magnetic Particle Examination

2.3 Reference Documents

2.3.1 Interfacing References

2.3.1.1 24590-WTP-3PS-G000-T0001,General Specification for Supplier Quality Assurance Program Requirements

2.3.1.2 24590-WTP-3PS-G000-TP002, Specification for Positive Material Identification (PMI)

2.3.1.3 24590-WTP-3PS-G000-T0003, General Specification for Packaging, Shipping, Handling, and Storage Requirements

2.3.1.4 24590-WTP-3PS-NWP0-T0001, Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping

2.3.1.5 24590-WTP-3PS-P000-T0001, Engineering Specification for Piping Material Classes General Description and Summary

2.3.1.6 24590-WTP-3PS-SS00-T0002, Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel

2.3.1.7 24590-WTP-3PS-SS90-T0001, Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks

2.3.1.8 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks

2.3.1.9 24590-WTP-3PS-EVV1-T0001, Specification for Low Voltage Adjustable Speed Drives

2.3.1.10 24590-WTP-3PS-MUMI-T0002, Specification for Low Voltage Induction Motors

2.3.1.11 24590-WTP-3PS-MPC0-TP002, Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components

2.3.1.12 24590-WTP-3PS-M000-T0002, General Specification for Mechanical Handling Equipment Design and Manufacture

2.3.1.13 24590-WTP-3PS-MJJ0-T0001, Engineering Specification for Lifting Beams for Mechanical Handling Equipment Important to Safety Quality Level II

2.3.1.14 24590-WTP-3PS-MV00-TP001, Engineering Specification for Pressure Vessel Design and Fabrication

2.3.1.15 24590-WTP-3PS-MV00-TP002, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels

2.3.1.16 24590-WTP-3PS-MES0-TP001, Engineering Specification for Shell and Tube Heat Exchangers

2.3.1.17 24590-WTP-3PS-MVB2-T0001, Engineering Specification for Welding of Pressure Vessels, Heat Exchangers, and Boilers

2.3.1.18 24590-WTP-3PS-JQ07-T0001, Engineering Specification for Instrumentation for Package Systems

2.3.1.19 24590-WTP-3PS-PS02-T0001, Engineering Specification for Shop Fabrication of Piping

2.3.1.20 24590-WTP-3PS-SS00-T0001, Engineering Specification for Welding of Carbon Structural Steel.

2.3.1.21 24590-WTP-3PS-EKP0-T0001, Engineering Specification for Electrical Requirements for Packaged Equipment

2.3.1.22 24590-WTP-3PS-PP00-T0002, Engineering Specification for Dimensional Record Program.

2.3.2 Developmental References

2.3.2.1 24590-PTF-3YD-FEP-00001, System Description for Waste Feed Evaporation Process (FEP)

2.3.2.2 24590-PTF-3YD-TLP-00001, System Description for Treated LAW Evaporation Process (TLP)

2.3.2.3 24590-WTP-3PS-MV00-TP003, Engineering Specification for Pressure Vessel Fatigue Analysis

2.4 Reference Drawings / Data Sheets

2.4.1 24590-WTP-MV-M59T-00001, Pressure Vessel Tolerances Standard Details

2.4.2 24590-WTP-MV-M59T-00007, Thermowell Connection Standard Details

2.4.3 24590-WTP-MV-M59T-00009, Lifting Lugs Standard Details

2.4.4 24590-WTP-MV-M59T-00010, Tailing Lug Standard Details

2.4.5 24590-WTP-MV-M59T-00011, Wash Rings Standard Details

2.4.6 24590-WTP-MV-M59T-00012, Grounding Lug Standard Details

2.4.7 24590-WTP-MV-M59T-00016001, Vessel Connections Standard Details Sheet 1 of 3

2.4.8 24590-WTP-MV-M59T-00016002, Vessel Connections Standard Details Sheet 2 of 3

2.4.9 24590-WTP-MV-M59T-00016003, Vessel Connections Standard Details Sheet 3 of 3

2.4.10 24590-WTP-MV-M59T-00017, Vessel Inspection Manway Standard Details

2.4.11 24590-WTP-MV-M59T-00018, Vessel Name Plate Standard Details

2.4.12 24590-WTP-MV-M59T-00026, Anchor Bolt Chair Details for Vertical Vessels

2.4.13 24590-WTP-M0-M10T-00004, HLW & PTF Vitrification Systems HSH, RWH, PFH, PIH Design Proposal Drawing 3 Ton Capacity Lifting Hook

2.4.14 24590-WTP-M6-50-P0001, P&ID Symbol and Legend Sheet 1 of 6

2.4.15 24590-WTP -M6-50-P0002, P&ID Symbol and Legend Sheet 2 of 6

2.4.16 24590-WTP -M6-50-P0003, P&ID Symbol and Legend Sheet 3 of 6

2.4.17 24590-WTP -M6-50-P0004, P&ID Symbol and Legend Sheet 4 of 6

2.4.18 24590-WTP -M6-50-P0005, P&ID Symbol and Legend Sheet 5 of 6

2.4.19 24590-WTP -M6-50-P0006, P&ID Symbol and Legend Sheet 6 of 6

2.4.20 24590-PTF-P1-P01T-P0001, Pretreatment Building General Arrangement Plan at El. 0'-0"

2.4.21 24590-PTF-P1-P01T-P0002, Pretreatment Building General Arrangement Plan at El. 28'-0"

2.4.22 24590-PTF-P1-P01T-P0007, Pretreatment Building General Arrangement Section A-A

2.4.23 24590-PTF-P1-P01T-P0008, Pretreatment Building General Arrangement Section B-B

2.4.24 24590-PTF-P1-P01T-P0009, Pretreatment Building General Arrangement Section C-C

2.4.25 24590-PTF-P1-P01T-P0010, Pretreatment Building General Arrangement Section D-D

2.4.26 24590-PTF-P1-P01T-P0011, Pretreatment Building General Arrangement Section E-E

2.4.27 24590-PTF-P1-P01T-P0012, Pretreatment Building General Arrangement Sect. F-F and Sect. G-G

2.4.28 24590-PTF-P1-P01T-P0013, Pretreatment Building General Arrangement Sect. H-H and Sect. J-J

2.4.29 24590-PTF-P1-P01T-P0014, Pretreatment Building General Arrangement Sect. K-K and Sect. L-L

2.4.30 24590-PTF-P1-P01T-P0015, Pretreatment Building General Arrangement Sect. M-M and Sect. N-N

2.4.31 24590-PTF-P1-P01T-P0016, Pretreatment Building General Arrangement Sect. P-P and Sect. Q-Q

2.4.32 24590-PTF-P1-P01T-P0017, Pretreatment Building General Arrangement Sect. R-R

2.4.33 24590-PTF-DD-S13T-00022, Pretreatment Facility Structural Concrete Embedments Key Plan Elevation 0 ft – 0 in

2.4.34 24590-PTF-DD-S13T-00023, Pretreatment Facility Structural Concrete Embedments Key Plan Elevation 0 ft – 0 in Sh 1

2.4.35 24590-PTF-DD-S13T-00025, Pretreatment Facility Structural Concrete Embedments Plan El 0 ft – 0 in Sh 3

2.4.36 24590-PTF-DD-S13T-00026, Pretreatment Facility Structural Concrete Embedments Plan El 0 ft – 0 in Sh 4

2.4.37 24590-PTF-DD-S13T-00027, Pretreatment Facility Structural Concrete Embedments Plan Elevation 0 ft – 0 in Sh 5

2.4.38 24590-PTF-DD-S13T-00028, Pretreatment Facility Structural Concrete Embedments Plan Elevation 0 ft – 0 in Sh 6

2.4.39 224590-PTF-DD-S13T-00029, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0" Sh 7

2.4.40 24590-PTF-DD-S13T-00030, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0" Sh 8

2.4.41 24590-PTF-DD-S13T-00031, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0" Sh 9

2.4.42 24590-PTF-DD-S13T-00036, Pretreatment Facility Structural Concrete Embedments EL 0 ft – 0 in Vessels Sh 1

2.4.43 24590-PTF-DD-S13T-00039, Pretreatment Facility Structural Concrete Embedments EL 0 ft – 0 in Vessels Sh 2

2.4.44 24590-PTF-DD-S13T-00042, Pretreatment Facility Structural Concrete Embedment Details EL 0 ft – 0 in Vessels Sh 1

2.4.45 24590-PTF-DD-S13T-00043, Pretreatment Facility Structural Concrete Embedment Details EL 0 ft – 0 in Vessels Sh 2

2.4.46 24590-PTF-DD-S13T-00044, Pretreatment Facility Structural Concrete Embedment Details EL 0 ft – 0 in Vessels Sh 3

2.4.47 24590-PTF-DD-S13T-00047, Pretreatment Facility Structural Concrete Embedment EL 0 ft – 0 in Misc Sh1

2.4.48 24590-PTF-DD-S13T-00049, Pretreatment Facility Structural Concrete Embedment EL 0 ft – 0 in Misc Sh 3

2.4.49 24590-PTF-MJD-PIH-00001, Mechanical Handling Data Sheet for Overhead Mast Power Manipulator

2.4.50 24590-PTF-M0-PIH-00008, Pretreatment System PIH Design Proposal Drawing 30 Ton Capacity Lifting Hook

2.4.51 24590-WTP-M61-P23T-00056, WTP Details Lower Holder Bottom Outlet Electrical Connector 2"

2.4.52 24590-PTF-SS-S15T-00311, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 1

2.4.53 24590-PTF-SS-S15T-00312, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 2

2.4.54 24590-PTF-SS-S15T-00313, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 3

2.4.55 24590-PTF-SS-S15T-00314, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 4

2.4.56 24590-PTF-SS-S15T-00315, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 5

2.4.57 24590-PTF-SS-S15T-00316, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 6

2.4.58 24590-PTF-SS-S15T-00317, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 7

2.4.59 24590-PTF-SS-S15T-00318, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 8
SS-S15T 9 1.6.06

2.4.60 24590-PTF-~~DD-S13T~~-00352, Pretreatment Facility Structural Misc Support Steel Details Sh 3
SS-S15T 9 1.6.06

2.4.61 24590-PTF-~~DD-S13T~~-00354, Pretreatment Facility Structural Misc Support Steel Details Sh 5

2.4.62 24590-WTP-M61-P23T-00056, WTP Details Lower Holder Bottom Outlet Electrical Connector 2".

2.4.63 24590-WTP-M61-P23T-00057, WTP Assembly Lower Holder Electrical Connector 2 Inch.

2.4.64 24590-WTP-M61-P23T-00005, WTP Details - Nozzles PUREX Male Connector 1", 2", 3", 4"

2.4.65 24590-WTP-M61N-P23T-00006, Nozzles PUREX Connector 1", 2", 3", 4"

2.4.66 24590-WTP-M61-P23T-00040, WTP Details - Kickoff Plates PUREX Connector 1", 2", 3", 4"

2.4.67 24590-WTP-M61-P23T-00057, WTP Assembly Lower Holder Electrical Connector 2 Inch.

2.4.68 24590-WTP-P61-P27T-00001, WTP Standard Jumper Details

2.4.69 24590-PTF-M6-FEP-P0001, P&ID - PTF Waste Feed Evaporation Process System Evaporator Feed Vessels FEP-VSL-00017A/B.

2.4.70 24590-PTF-M6-FEP-P0002, P&ID - PTF Waste Feed Evaporation Process System Separator FEP-SEP-00001A.

2.4.71 24590-PTF-M6-FEP-P0003, P&ID - PTF Waste Feed Evaporation Process System Condensers & Condensate Collection FEP-VSL-00005.

2.4.72 24590-PTF-M6-FEP-P0004, P&ID - PTF Waste Feed Evaporation Process System Separator FEP-SEP-00001B.

2.4.73 24590-PTF-M6-FEP-P0005, P&ID - PTF Waste Feed Evaporation Process System Condensers.

2.4.74 24590-PTF-M6-TLP-P0001, P&ID - PTF Treated LAW Evaporation Process System LAW SBS Condensate Receipt TLP-VSL-00009A & 9B.

2.4.75 24590-PTF-M6-TLP-P0002, P&ID - PTF Treated LAW Evaporation Process System Condensate Collection TLP-VSL-00002.

2.4.76 24590-PTF-M6-TLP-P0003, P&ID - PTF Treated LAW Evaporation Process System Separator TLP-SEP-00001.

2.4.77 24590-PTF-M6-STR-00001, P&ID - PTF Strontium Nitrate, Sodium Permanganate, and Anti-foam Reagent Distribution (CM).

3 Design Requirements

3.1 General

3.1.1 As Low As Reasonably Achievable (ALARA) principles shall be factored into the design and maintenance of the evaporator systems per 10 CFR 835, *Occupational Radiation Protection*.

3.1.2 Unless otherwise specified, the evaporator systems shall be designed and fabricated per applicable documents listed in section 2.0 of this specification, and the data sheets in section 2 of the MR. No changes, substitutions, or deviations shall be made without Buyer's concurrence.

3.1.3 The evaporator system design shall comply with the requirements stipulated in this specification. Seller shall conform with Buyer's requirements for hot cell wall penetrations, recirculation piping/jumper configuration, layout, dimension, location as shown in the Appendices I, J, and K. Seller shall confirm locations for all evaporator equipment are adequate for system functionality. Seller shall submit any variances to these requirements during design review stage for concurrence.

3.1.4 The evaporator piping and instrumentation sketches provided in the Appendix L of this specification illustrate the conceptual piping and instrument control of the evaporator systems. All evaporator systems or components shall have adequate control features to bring evaporator operations to a safe and stable 'shutdown' condition during an abnormal event. Seller's control design philosophy can differ from Buyer's conceptual control; however, the Seller's control system design shall conform to Buyer's specification 24590-WTP-3PS-JQ07-T0001.

3.1.5 General Arrangement drawings should be used to convey approximate equipment locations for skids. Equipment locations shown in the Appendices I, J, and K shall be maintained unless the design dictates an alternate location.

3.1.6 The Seller shall be responsible for the evaporator system design including component specification such as design parameters, sizing, pipe support loads, pipe hangers, anchors, pipe slopes and environmental protection (temperature, humidity, etc.) as required.

3.1.7 A means shall be provided to avoid accumulation of settled solids (e.g., sparging or removal of separator contents) in event of recirculation pump failure.

3.1.8 All heat exchangers including reboilers and condensers shall comply with ASME section VIII and TEMA standard, Class B. "Code Stamp" shall be provided for all Seller's provided heat exchangers.

3.1.9 Seller shall comply with nozzle loading requirements specified in the 24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication.*

3.1.10 Gusset plates cannot be utilized to accommodate the required nozzle loading on safety class vessels and heat exchangers.

3.1.11 The equipment shall be designed such that personnel sound level exposure outside of R5/C5 area shall not exceed 85 dBA. Seller shall clearly state how the specified sound level limit will be met.

3.1.12 All calculations, modeling, analyses, drawings, and documentation shall utilize U.S. customary units.

3.1.13 Design of the evaporator systems shall incorporate the latest and best proven technology, components, and materials for the required service conditions and performance.

3.1.14 The evaporator system model analysis, thermal analysis, design analysis, and seismic analysis shall be verified such that the final system, equipment and component design meet the requirements of this specification as well as its addenda and attachments.

3.1.15 Evaporator system equipment shall be furnished as discrete skid mounted units that are ready to integrate with the Buyer's structures, systems, and components.

3.1.16 The evaporator systems shall be identical in component count, capacity, and mode of operation and shall utilize common component types and equipment manufacturers.

3.1.17 The FEP and TLP Evaporator systems shall be designed in accordance with following feed conditions:

- Design FEP feed flow of 50 gpm.
- Design TLP feed flow of 38
- Design feed temperature of 77 °F
- Waste feed pH of 11 – 14
- LAW SBS pH of 6.8

3.1.18 Normal design cooling water temperature of 75 °F with a peak summer maximum of 83 °F shall be used for designing/sizing all condensers. The cooling water temperature of 75 °F is valid for 85 % of the time through a year. During 15 % of the time when cooling water temperature is above 75 °F, the TLP evaporator system can be operated at a higher temperatures (i.e., 1.2 psia, 127 °F – 131 °F). This operating strategy is for short term operation and is to minimize cooling water flow.

3.1.19 Evaporator systems and components should be designed to prevent the migration of contamination into the utility / reagent systems.

3.1.20 Human factors and ergonomics shall be designed into all evaporator equipment requiring manual operations per IEEE Std 1023, *IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations*.

3.1.21 Quality level, seismic category, materials of construction, design pressure, and design temperature shall be in accordance with the data sheets in section 2 of the MR and Appendix E of this specification. If a change to the requirements for materials and/or the equipment types to be used during the execution of the contract is dictated because of design analyses, then the Seller is required to provide Buyer its recommendation for review and concurrence prior to incorporation into the design of the evaporator systems.

3.1.22 All equipment in evaporator systems requiring maintenance or removal shall have flushing and draining capability to facilitate decontamination. Design features shall minimize the need for decontamination by including sloping features, replacing sharp bends with gradual bends, etc. where practical, consistent with ALARA practices.

3.1.23 Provision for temperature instrumentation shall be jumper nozzles incorporating the required thermowell details.

3.1.24 Nozzle and flange alignment shall be within ± 0.5 degrees of design specifications.

3.1.25 Jumper nozzle connections shall be included in the evaporator systems to interface with the Buyer supplied jumpers. Location and details of the connections shall be per Appendix P.

3.1.26 The reboiler support frame detail sketches provided in the Appendix P of this specification illustrate the conceptual design to support remoteability.

3.1.27 Seller's reboiler frame design shall not protrude into the crane path as specified in Appendix P.

3.1.28 The hub type (remote clamp) connectors and PUREX nozzles are the only government-furnished equipment, which will be sent to Seller for installation. Buyer will provide Seller hydro test blanks for the remote clamp connectors (Grayloc) and the remote PUREX and other connectors for installation on the axial flow pumps and reboilers.

3.1.29 Nozzles for reboiler and support frame assemblies are to be designed to maintain positional tolerance during operational loading conditions and maintain structural integrity during and after a DBE. Preliminary loading information for the nozzle loads at Grayloc connections on the reboilers are provided in Appendix P.

3.1.30 All adjustable speed drives for pumps can be designed for non-radiation environment.

3.1.31 Seller's fabrication drawings shall be used as the document of record for fabrication of the components. Seller's specification drawings are not required to be revised and maintained in total agreement with approved fabrication drawings.

3.1.32 Regarding Buyer's specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packing, Handling, and Storage requirements*, the center of gravity and sling points are not needed for off-gas piping pieces and separator vessel support towers because they are awkward hollow parts that do not allow a meaningful center of gravity to be determined or designed. Multiple sling configurations are possible to affect a successful lift and should be at the discretion of site construction supervisor.

3.1.33 Seller shall provide evaporator systems in the skids for ease of transportation, installation, and replacement. Seller is responsible for equipment skid sizing and layout to fit Buyer's facility. For the baseline design, each evaporator system will comprise the following skids:

- Separator vessel skids
- Reboiler and support frame assemblies.
- TLP feed pumps skid
- TLP concentrate pumps skid
- Primary condenser skids
- Secondary condenser skids which includes inter-condenser, after-condenser, and steam ejector.
- Process condensate skids which includes vessel and pump
- Steam conditioning system which includes a pressure reducing valve and control and a desuperheater
- Antifoam skids which include vessel and pumps

3.2 Basic Function

The evaporator systems employ forced circulation and vacuum evaporation. The Waste Feed Process (FEP) evaporator system consists of two (2) identical evaporators which will be installed at the west end of the pretreatment facility (PTF). The Treated Low Activity Waste Process (TLP) evaporator system will be installed at the east end of the PTF.

Each evaporator will be designed to process 100 % of the design feed flow (50 gpm for each FEP system and 39 gpm for TLP system) with an evaporation feed rate of 30 gpm and to operate independent of each other. Normal operation of the FEP evaporator system consists of one evaporator operating at a time but simultaneous operation is possible. The FEP evaporators partially evaporate Waste Feed from the Department of Energy (DOE) and various recycle streams from within the pretreatment process. The Waste Feed is evaporated in order to optimize the operation of downstream unit operations. The Waste Feed flow is varied in order to control the level in the FEP separator. The FEP evaporator shall be designed to achieve a sodium concentration of 5 to 6M.

The LAW Submerged Bed Scrubber (SBS) condensate and treated LAW are fed to the TLP evaporator simultaneously. The treated LAW feed is fed continuously and at a constant rate while the flow of SBS condensate is varied in order to control the level in the TLP separator vessel. The TLP evaporator shall be designed to achieve a sodium concentration of 8 to 10M.

The feed stream is introduced into the recirculation loop on the suction side of the recirculation pump. The recirculation pump circulates the liquor at a rate of approximately 11,000 gpm. The pump discharges liquor through evaporator reboiler, which raises the temperature of the liquor by approximately 2 to 4 °F using 2.5 psig steam throttled from 40 psig low pressure steam supply to the building. This small temperature rise is necessary to prevent the liquor from boiling (fouling) in the tubes before it reaches the separator vessel. Sufficient hydrostatic head is maintained to suppress boiling inside the reboiler. When the recirculating liquor reaches the separator vessel, flash evaporation occurs due to the reduced pressure in the vessel. The vapor flows through a series of separation trays and a removable demister pad section which are internal parts of the separator vessel. The vapor then flows to the primary condenser where the majority of the vapor is condensed. The noncondensables and a small amount of moisture are vented to the ejector/condenser vacuum system. The secondary condenser system consists of primary ejector, secondary ejector, inter-condenser, and after-condenser. The humid noncondensables from the primary condenser flow to the suction side of the primary ejector which discharges to the inter-condenser. The vent from the inter-condenser flows to the suction side of the secondary ejector which discharges into the after-condenser. The vent from the after-condenser flows to the facility vessel vent system. The secondary condenser system is designed to achieve a pressure of 1.0 to 1.3 psia in the separator vessel during normal operating conditions. The operating pressure is automatically controlled by an air in-bleed into the suction line of the primary ejector. This operating pressure lowers the boiling point of the liquor to approximately 122 °F which reduces potential corrosion of the evaporator by chlorides. Condensate from the condensers flows by gravity to the condensate vessel. Some of the condensate is drawn off and used to wash the demister pads in the separator vessel. Because of the foaming tendencies of evaporator feed chemistry, when foaming is anticipated in the separator vessel, antifoam will be continuously added.

3.3 Performance

3.3.1 All three (3) evaporator systems shall be capable of continuous operation while achieving a feed evaporation rate ranging from 10 to 30 gpm. The design feed evaporator rate shall exclude all water/fluid addition to demister pads spray, separation trays, and antifoam injection.

3.3.2 Each evaporator system shall operate independently.

3.3.3 Each evaporator system shall have the ability to be placed on "total reflux" mode.

3.3.4 A minimum decontamination factor of 8.0E+06 shall be achieved as defined in section 7.2.1, function test requirements, with consideration to achieving the evaporator stream operating conditions described in subsection 3.4 and the ALARA general design condition in subsection 3.1.

3.3.5 Evaporator system operating parameters shall minimize reboiler fouling by using low differential temperature and high tube velocity to the extent practical in the design.

3.3.6 The FEP evaporator systems shall produce waste concentration of 5 to 6M sodium (1.23 to 1.50 SG).

3.3.7 The TLP evaporator system shall produce waste concentration of 8 to 10M sodium (1.33 to 1.57 SG).

3.3.8 All evaporator system components within the R5/C5 black cell (except the demister pads) shall be nonreplaceable components with a design life of 40 years. Reboilers and recirculation pumps in the R5/C5 hot cell shall be remotely replaceable.

3.4 Design Conditions

3.4.1 General

3.4.1.1 For nominal conditions refer to Appendix A and Appendix B for the FEP evaporator and TLP evaporator stream data, respectively. The data defines the system performance operating conditions and requirements. For predicted maximum radionuclides, refer to Appendix C.

3.4.1.2 All equipment skids shall meet applicable Department of Transportation (DOT) requirements for road transportation per 49 CFR 173.

3.4.2 Physical Constraints/Interfaces

3.4.2.1 The FEP evaporator separator vessels (FEP-SEP-00001A/B) with demister pads shall be located in the R5/C5 black cell, room P-0106 on the 0-ft floor elevation. The TLP evaporator separator vessel (TLP-SEP-00001) shall be located in the R5/C5 black cell, room P-0117 on the 0-ft floor elevation. Demister pad assemblies shall be accessed through a sealed, shielded aperture in the 56 ft floor (10-ft diameter maximum). Refer to Appendices I and J for their locations and layout.

3.4.2.2 All Reboiler and support frame assemblies and recirculation pumps shall be located in the R5/C5 hot cell, room P-0123 on the 0-ft floor elevation. Each reboiler and support frame assemblies shall not weigh more than 27.5 tons including all lifting fixtures and lifting beams. The available space for each reboiler (excluding nozzles) has dimensions of 6 ft diameter by 15 ft high. All equipment assembly must fit through a 13 ft by 13 ft air lock door and shall not exceed 21 ft length. Assume air lock transportation cart is 3 ft high. The space envelope limitation of 6 feet diameter shall be used for mounting of remote connectors and seal flush reservoir on the recirculation pump

assembly. Refer to Appendix P for location of reboiler and recirculation pump.

3.4.2.3 FEP evaporator primary condensers (FEP-COND-00001A/B) and secondary condenser system (FEP-COND-00002A/B, -00003A/B, and FEP-EJCTR-00040, -00041, -00042, -00043) shall be designed to fit in room P-0304 on the 56-ft floor elevation. TLP evaporator primary condenser (TLP-COND-00001) and secondary condenser system (TLP-COND-00002, -00003, and TLP-EJCTR-00064, -00067) shall be designed to fit in room P-0311 on the 56-ft floor elevation. Refer to Appendices I and J for locations and layout.

3.4.2.4 FEP evaporator condensate vessel and pump system (FEP-VSL-00005 and FEP-PMP-00006A/B) shall be designed to fit in room P-0105B (R2/C3) on the 0-ft floor elevation. TLP evaporator condensate vessel and pump system (TLP-VSL-00002 and TLP-PMP-00002A/B) shall be designed to fit in room P-0118 (R2/C3) on the 0-ft floor elevation. Refer to Appendices I and J for locations and layout.

3.4.2.5 Antifoam vessel and pump system (AFR-TK-00001 and AFR-PMP-00006, -00007, -00008) shall be designed to fit in room P-0429 on the 77-ft floor elevation (R2/C2). Refer to Appendix K for locations and layout.

3.4.3 Buyer Supplied Utilities

Values for all utility supply pressures and temperatures are nominal values.

3.4.3.1 Plant service air and instrument air will be supplied at approximately 100 psig and 65 °F.

3.4.3.2 Low pressure steam will be supplied at approximately 40 psig and 286 °F.

3.4.3.3 High pressure steam will be supplied at approximately 109 psig and 343 °F.

3.4.3.4 Cooling water will be supplied at approximately 45 psig and 75 °F with a peak summer maximum of 83 °F. The cooling water temperature of 75 °F is valid for 85 % of the time through a year.

3.4.3.5 Demineralized water will be supplied at approximately 72.5 psig and 75 °F for demister pad and separation tray spray in the event that sufficient process condensate is unavailable.

3.4.3.6 Water, 5 M nitric acid at approximately 75 psig and 77 °F, or 50 % wt caustic at approximately 75 psig and 77 °F can be supplied for the Seller's flushing system.

3.5 Environmental Conditions

Environmental qualification is not applicable per Buyer's equipment qualification design guide.

3.5.1 Storage

Prior to installation, the evaporator systems may be stored outdoors at ambient temperature extremes ranging from –30 °F dry-bulb to 117 °F dry-bulb and with a relative humidity of 0-100 %.

3.5.2 Evaporator Separator Vessels

The separator vessels (FEP-SEP-00001A/B and TLP-SEP-00001) will be installed indoors in an R5/C5 black cell maintained between 59 to 113 °F dry-bulb temperature during normal operation. Radiation exposure for the FEP separator vessels (FEP-SEP-00001A/B) will be 1,000 – 1,800 Rad/hr. Radiation exposure for the TLP separator vessel (TLP-SEP-00001) will be 0.5 Rad/hr.

3.5.3 Reboilers and Recirculation Pumps

The reboilers (FEP-RBLR-00001A/B and TLP-RBLR-00001) and recirculation pumps (FEP-PMP-00009A/B and TLP-PMP-00001) will be installed indoors in an R5/C5 hot cell maintained between 59 to 113 °F dry-bulb temperature during normal operation. Radiation exposure will be 1,000 Rad/hr.

3.5.4 Primary and secondary condensers

The FEP primary condensers (FEP-COND-00001A/B) and FEP secondary condensers (FEP-COND-00002A/B, -00003A/B, and FEP-EJCTR-00040, -00041, -00042, -00043) will be installed indoors in an R5/R3/C3 area maintained between 59 to 113 °F dry-bulb temperature during normal operation. The TLP primary condenser (TLP-COND-00001) and TLP secondary condensers (TLP-COND-00002, -0003, and TLP-EJCTR-00064, -00067) will be installed indoors in an R3/C3 area maintained between 59 to 113 °F dry-bulb temperature. Radiation exposure will be 10 mRad/hr during normal operation.

3.5.5 Condensate Vessels, Antifoam Vessel, Condensate Pumps, Antifoam Pumps, FEP Feed Pumps, FEP Concentrate pumps, and FEP/TLP Reboiler Steam Condensate Transfer Stations

The condensate vessels (FEP-VSL-00005 and TLP-VSL-00002), condensate pumps (FEP-PMP-00006A/B and TLP-PMP-00002A/B), and FEP/TLP reboiler steam condensate transfer stations (FEP-VSL-00021, FEP-PMP-00010A/B, FEP-VSL-00022, FEP-PMP-00011A/B, TLP-VSL-00047, TLP-PMP-00012A/B) will be installed indoors in an R2/C3 area. The antifoam vessel (AFR-TK-00001) and antifoam pumps (AFR-PMP-00006, -00007, and -00008) will be installed indoors in an R2/C2 area. The R2/C3 and R2/C2 areas are maintained between

59 to 113 °F dry-bulb temperature during normal operation. Radiation exposure will be 0.5 mRad/hr.

3.6 Feed Pumps

3.6.1 For feed pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.

3.6.2 Two TLP feed pumps (TLP-PMP-00005A/B) shall be supplied by the Seller in accordance with Buyer's specification 24590-WTP-3PS-MPC0-TP002, *Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components.*

3.6.3 The TLP feed pumps shall be centrifugal type. Each pump shall be provided with a pump motor mounted on a common base plate for contact maintenance. The pumps are plumbed together for operational flexibility. Seal flush plan to API 7353.

3.6.4 Each TLP feed pump shall be provided with an adjustable speed drive (ASD). The ASD shall be compliant with specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives* and specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors.*

3.6.5 LAW SBS Condensate feed pumps (TLP-PMP-00005A/B) for the TLP evaporator system shall be supplied by the Seller. These pumps shall be designed for contact maintenance and designed for the following operating conditions. All fluid properties are referenced at 77 °F.

- 10 to 38 gpm
- to 16.3 cP
- to 1.41 SG
- 68 to 167 °F
- less than 3 wt % feed solids.

3.6.6 For FEP feed pumps (FEP-PMP-00007A/B), the sections for liquid property and operating conditions on the Mechanical Data Sheets (section 2 of the MR) shall be specified by the Seller. The Buyer will procure pumps which meet these criteria unless otherwise directed by the Seller as described in section 1.2.16. The following operating conditions shall apply. All fluid properties are referenced at 77 °F.

- 20 to 50 gpm
- 4.2 to 12 cP
- to 1.29 SG
- 59 to 122 °F
- 0 to 10 wt % suspended solids

3.6.7 Treated LAW Collection vessel feed pump (CXP-PMP-00002A/B) for the Treated LAW evaporator system will be specified and provided by the Buyer for the following operating conditions. All fluid properties are referenced at 77 °F.

- 22 to 34 gpm
- 0.6 to 5.0 cP
- to 1.26 SG
- 59 to 113 °F
- 0 wt % suspended solids

3.6.8 The feed pump flow rate shall be controlled by the separator vessel liquid level.

3.6.9 All waste feeds shall be transferred by the feed pump into the recirculation line on the suction side of the recirculation pump.

3.6.10 Deleted

3.7 Recirculation Pumps

3.7.1 For recirculation pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.

3.7.2 The recirculation pumps shall be axial-flow type mounted vertically in an elbow of the recirculation loop. Structural support requirements for the recirculation pump shall be provided by the Seller with provision to transfer loads from the pump to the structural base rather than the pump nozzles or pump shaft/impeller.

3.7.3 Each recirculation pump shall be provided with a pump motor and an adjustable speed drive (ASD). Motors shall be provided with radiation resistant insulation, rated for 10^9 TID rad (gamma). The ASD shall be compliant with specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives* and specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors.*

3.7.4 The recirculating pumps shall have dual mechanical seals that will be lubricated/flushed with water. Flush piping will be based on API Plan 53. Seller shall coordinate with Buyer for details.

3.7.5 Inlet and outlet pipe ends of the recirculation pumps shall be prepared for butt welding.

3.7.6 Seller shall comply with API 610 nozzle loading requirements.

3.7.7 The recirculation pump nozzle locations shall be within (±) 1/4 inch tolerance. However, the tolerance measurement device shall have a minimum of 1/1000 inch accuracy.

3.7.8 The recirculation pump remote flange mating surface shall be approximately at 12 ft-11 inches plant elevation. The pump and motor withdrawal length shall not be greater than 6 ft-1 inch. The dowel pins shall be 2 in diameter with the master

being 1 ft-3 3/4 inches and the secondary being 1ft-3/4 inch. The bolts shall be 1-1/4 inch ACME studs with 2 inches nuts.

3.7.9 The recirculation pumps shall be designed with the following features to ensure ease of process operating with a long expected mechanical lifetime:

- Low operating speed, high flow, and low head process conditions.
- Low casing fluid velocity to minimize wear on the casing.
- Top mounted motor and vertical removal design for easy crane access.
- The recirculation pump motor, impeller, shafting, and seals shall be remotely removable as one unit by using a single crane hook and crane mounted impact wrench with CCTV cameras.

3.7.10 FEP recirculation pumps (FEP-PMP-00009A/B) shall be designed for the following operating conditions. All fluid properties are referenced at 77 °F.

- 11,000 gpm
- 5.5 to 12 cP
- 1.23 to 1.50 SG
- 59 to 140 °F
- 1 to 20 wt % suspended solids

3.7.11 TLP recirculation pump (TLP-PMP-00001) shall be designed for the following operating conditions. All fluid properties are referenced at 77 °F.

- 11,000 gpm
- 0.68 to 30 cP
- 1.33 to 1.57 SG
- 77 to 145 °F
- less than 4 wt % suspended solids

3.8 Concentrate Pumps

3.8.1 For concentrate pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.

3.8.2 Two TLP concentrate pumps (TLP-PMP-00011A/B) shall be supplied by the Seller in accordance with Buyer's specification 24590-WTP-3PS-MPC0-TP002, *Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components.*

3.8.3 Deleted

3.8.4 The TLP concentrate pumps shall be centrifugal type. Each pump shall be provided with a pump motor mounted on a common base plate for contact maintenance. The pumps are plumbed together for operational flexibility. Seal flush plan to API 7353.

3.8.5 Each TLP concentrate pump shall be provided with an adjustable speed drive (ASD). The ASD shall be compliant with specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for LAW Voltage Adjustable Speed Drives* and specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors.*

3.8.6 The concentrate pump flow rate shall be controlled by the specific gravity of the waste concentrate in the evaporator separator vessel.

3.8.7 For FEP concentrate pumps (FEP-PMP-00008A/B), the sections for liquid property and operating conditions on the Mechanical Data Sheets (section 2 of the MR) shall be specified by the Seller. The Buyer will procure pumps which meet these criteria unless otherwise directed by the Seller as described in section 1.2.16. The following operating conditions shall apply. All fluid properties are referenced at 77 °F.

- 3 to 34 gpm
- 5.5 to 12 cP
- 1.23 to 1.50 SG
- 59 to 140 °F
- 1 to 20 wt % suspended solids

3.8.8 The TLP concentrate pumps (TLP-PMP-00011A/B) shall be supplied by the Seller. The pumps shall be designed for contact maintenance and designed for the following operating conditions. All fluid properties are referenced at 77 °F.

- 5 to 14 gpm
- 0.68 to 30 cP
- 1.4 to 1.57 SG
- 68 to 145 °F
- less than 4 wt % suspended solids

3.9 Reboilers

3.9.1 For reboiler requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.

3.9.2 The reboilers shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MES0-TP001, *Specification for Shell and Tube Heat Exchangers.*

3.9.3 The reboilers (FEP-RBLR-00001A/B and TLP-RBLR-00001) shall be of all welded construction on both tube and shell sides.

3.9.4 Reboiler tubes shall be seamless and welded to the tubesheet(s) with full strength welds. The tubes shall include a corrosion allowance of 0.04 inch for the process side.

3.9.5 The reboilers shall be capable of sustaining a water evaporation rate of 10 to 30 gpm based on a final SG of 1.50 for the FEP evaporator systems and 1.57 for the TLP evaporator system.

3.9.6 Reboiler process fluid velocity shall be greater than 4.0 ft/sec for solid suspension and not exceed 10 ft/sec velocities for minimal erosion effects.

3.9.7 The reboiler and support frame assemblies shall be designed for remote installation and replacement as one unit.

3.9.8 The reboiler and support frame assemblies shall be designed for horizontal transportation as one unit within the hot cell but for vertical installation with integral tailing features.

3.9.9 The maximum dimensions for a reboiler shall be 6 ft diameter and 15 ft height. The reboiler design shall be either multi-pass or U-tube heat exchanger with side bottom process fluid inlet and outlet.

3.9.10 The reboiler process fluid inlet and outlet nozzles shall be sized not greater than 24 inch diameter. Inlet and outlet pipe ends of the reboiler shall be prepared for butt welding.

3.9.11 Seller shall supply as-built dimensions for the nozzle locations upon completion of fabrication. Measurements shall be taken to the nearest 0.001 inch measuring equipment accuracy shall be within ± 0.006 inch.

3.9.12 Deleted

3.9.13 Low pressure steam of 40 psig will be provided by Buyer. The Seller is responsible for providing steam conditioning skids. Each skid will include a pressure reducing valve and control and a desuperheater to produce Seller's specified saturated pressure steam for reboiler operation.

3.9.14 Seller shall provide specifications for steam condensate removal system. The steam condensate will travel from the reboiler through approximately 100 lateral feet and 2 vertical feet of pipe to the steam condensate vessel.

3.9.15 The reboiler shall be designed such that the static pressure of the process fluid above the reboiler is sufficient to suppress the boiling in the reboiler tubes. Boiling shall occur only near or at the liquid surface in the evaporator separator vessel.

3.9.16 The temperature rise of the process fluid as it passes through the reboiler shall be approximately 2 – 4 °F design basis to minimize the potential for tube fouling.

3.9.17 Reboiler will be installed without insulation. Reboiler duty and steam demand calculations shall include heat loss from all reboiler surfaces without insulation.

3.10 Evaporator Separator Vessels

3.10.1 For separator vessel requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.

3.10.2 The separator vessels shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

3.10.3 The separator vessels shall be designed to maximize liquid – vapor separation and to achieve a 30 gpm feed evaporation rate.

3.10.4 The separator vessels shall incorporate nozzle connections for temperature (including thermowells), pressure, level, and density instrumentation as required. The Seller shall propose reliable measurement instrumentation for Buyer to review.

3.10.5 Deleted.

3.10.6 The top section of the separator vessel shall incorporate lateral guides to the 56 ft floor to minimize horizontal forces and base overturning moments during a seismic event.

3.10.7 The centerline elevation of the separator vessel offgas nozzles shall be no higher than 47 ft-0 inch plant elevation.

3.10.8 The separator vessel heads shall be removable for access to the demister pads section, which contains two layers of 12 inch thick Inconel 625 fine mesh.

3.10.9 The separator vessel shall incorporate a 2 inch inlet nozzle to supply sufficient dilution air to negate hydrogen buildup.

3.10.10 The separator vessel shall incorporate a series of three internal separation trays and an internal two-layer demister pads section to deentrain the steam droplets and remove solids from the vapor.

3.10.11 Spray nozzles shall be provided to allow nitric acid cleaning of the demister mesh and separation trays. The placement of spray nozzles shall accommodate demister section removal and not hinder maintenance operations.

3.10.12 A spray pipe with nozzles located below the lower demister pad shall be provided to spray demin water or recycled condensate into the steam flow to assist in mesh performance.

3.10.13 To improve demister efficiency and facilitate decontamination, the demister pads shall be sprayed from above and below with recycled condensate or 5 M nitric acid from a spray control system located at the 56 ft elevation. Sections of the demister pads shall be able to be sprayed either individually or collectively.

3.10.14 Differential pressure across a series of separation trays and the demisters pad section shall not significantly elevate boiling point.

3.10.15 All nozzle connection points shall be provided clear and below any surrounding floor structural steel at 56 ft plant elevation.

3.10.16 The antifoam nozzles of the evaporator separator vessel shall be located above the uppermost liquid level.

3.11 Primary Condensers

3.11.1 For primary condenser requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.

3.11.2 Primary condensers shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MES0-TP001, *Specification for Shell and Tube Heat Exchangers*.

3.11.3 The primary condensers (FEP-COND-00001A/B and TLP-COND-00001) shall be of all welded construction on the process fluid side. Tubes shall be welded to the tubesheets(s) with full strength welds.

3.11.4 Seller shall comply with nozzle loading requirements specified in Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication*.

3.11.5 Condensers shall be designed with hinged bonnets to allow isolation of leaking tubes utilizing contact maintenance techniques.

3.11.6 Condensers shall be designed for retubing as part of the maintenance strategy.

3.11.7 Condensers shall be designed to maximize vapor condensation from the offgas streams at a nominal rate of 30 gpm.

3.11.8 Average cooling water temperature rise of 18 °F shall be used for condenser design.

3.11.9 Cooling water (tube side) pressure must exceed the process vapor (shell side) pressure.

3.11.10 The primary condensers shall be compatible with process condensate that has a pH of 7 to10, a temperature of 122 °F, and a 0 to 300 ppm ammonium ion concentration. They shall also be compatible with 5M nitric acid used for separator vessel decontamination.

3.11.11 Primary condenser will be installed without insulation. Primary condenser duty and cooling water demand calculations shall include heat loss from all primary condenser surfaces without insulation.

3.12 Secondary Condenser System

3.12.1 The secondary condenser system shall consist of inter-condenser, after-condenser, and two steam ejectors. For secondary condenser system requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.

3.12.2 Inter-condensers and after-condensers shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MES0-TP001, *Specification for Shell and Tube Heat Exchangers*.

3.12.3 Seller shall comply with nozzle loading requirements specified in Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication*.

3.12.4 Inter-condensers and after-condensers shall be of all welded construction on the process fluid side. Tubes shall be welded to the tubesheets(s) with full strength welds.

3.12.5 The boiling point elevation range of the evaporator concentrate for the FEP evaporator system is approximately 11 to 18 °F and for TLP evaporator system is approximately 17 to 24 °F.

3.12.6 The evaporator separator vessel pressure shall be maintained by a two-stage vacuum ejector system. The first stage shall maintain a vacuum on the primary condenser and consists of a steam ejector, air in-bleed control valve, and an inter-condenser. The vapor discharged from the inter-condenser enters the second stage of the vacuum system. The second stage shall consist of a second steam ejector and an after-condenser.

3.12.7 The secondary condenser systems shall provide capability for operating at a vacuum as low as practicably achievable.

3.12.8 The two-stage vacuum ejector system shall be designed to control the separator vessel pressures at between 1.0 and 1.3 psia.

3.12.9 The desired vacuum within the separator vessel shall be obtained by automatically controlling the air in-bleed into the suction side of the first-stage vacuum ejectors.

3.12.10 Process condensate from each condenser shall be individually routed to the process condensate vessel.

3.12.11 All components of secondary condenser skid will be installed without insulation. The duty, cooling water demand, and steam demand calculations shall include heat loss from all surfaces without insulation.

3.12.12 Cooling water pressure must exceed the process vapor pressure.

3.13 Evaporator Process Condensate Vessels & Pumps

3.13.1 For process condensate vessel and pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification

3.13.2 The evaporator process condensate vessels shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

3.13.3 Seller shall comply with nozzle loading requirements for vessels specified in Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

3.13.4 The FEP evaporator process condensate vessel (FEP-VSL-00005) shall be designed for an operating volume of 4144 gallons (911-gallon batch).

3.13.5 The support frame shall be made such that the overflow nozzle centerline for the FEP evaporator process condensate vessel shall be at or above 15 ft-5 3/8 inches plant elevation.

3.13.6 The TLP evaporator process condensate vessel (TLP-VSL-00002) shall be designed for an operating volume of 2304 gallons (375-gallon batch).

3.13.7 The support frame shall be made such that the overflow nozzle centerline for the TLP evaporator process condensate vessel shall be at or above 17 ft-5 7/8 inches in plant elevation.

3.13.8 The evaporator process condensate vessels shall be equipped with interior wash rings to facilitate decontamination per standard drawing 24590-WTP-MV-M59T-00011.

3.13.9 Evaporator process condensate vessels and pumps shall be designed for contact maintenance.

3.13.10 Process condensate pumps shall be in accordance with Buyer's specification 24590-WTP-3PS-MPC0-TP002, *Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components.*

3.13.11 Each process condensate pump shall be provided with an adjustable speed drive (ASD). The ASD shall be compliant with specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives* and specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors.*

3.13.12 The process condensate pumps (FEP-PMP-00006A/B and TLP-MPM-00002A/B) shall be centrifugal type. Each pump shall be provided with a pump motor mounted on a common base plate for contact maintenance. The pumps are plumbed together for operational flexibility.

3.13.13 The FEP evaporator process condensate pumps (FEP-PMP-00006A/B) shall be designed for the maximum feed evaporation rate of 60 gpm (30 gpm per FEP evaporator) and maximum steam ejector demands. The TLP Evaporator condensate pumps (TLP-PMP-00002A/B) shall be designed for the maximum feed evaporation rate of 30 gpm and maximum steam ejector demands.

3.13.14 The process condensate vessels and pumps shall be compatible with process condensate that has a pH of 7 to10, a temperature of 68 to 145 °F, and a 0 to 300 ppm ammonium ion concentration. They shall also be compatible with 5M nitric acid used for separator vessel decontamination.

3.13.15 The process condensate pumps shall have the ability to supply adequate condensate to the separation trays and demister pad sprays in the separator vessels.

3.13.16 Single mechanical seals shall be incorporated in each process condensate pump in accordance with American Petroleum Institute (API) Plan 11.

3.13.17 The process condensate pumps shall be designed to comply with pump nozzle loading requirements specified in API 610.

3.14 Antifoam Skid and FEP/TLP Reboiler Condensate Transfer Stations

3.14.1 For antifoam vessel and pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendix K of this specification.

3.14.2 The antifoam vessel and reboiler condensate vessels shall be designed in accordance with Specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

3.14.3 Seller shall comply with nozzle loading requirements specified Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

3.14.4 One (1) antifoam system composed of a vessel (AFR-TK-00001) with three metering pumps (AFR-PMP-00006, -00007, -00008) shall supply antifoam reagent to both FEP and TLP evaporator systems.

3.14.5 The antifoam vessel (AFR-TK-00001) shall be designed for a maximum operating volume of 1500 gallons.

3.14.6 Deleted.

3.14.7 Each antifoam vessel shall be equipped with the following:

- Reagent inlet nozzle
- Demineralized water inlet nozzle
- Level instrumentation nozzle
- Agitator to provide homogeneous antifoam solutions

3.14.8 The antifoam pumps shall be positive displacement metering types. The metering pump design shall include an internal relief valve or an internal bypass valve that automatically stops the pumping action when the line pressure gets above a setpoint.

3.14.9 Antifoam vessels and pumps shall be designed for contact maintenance.

3.14.10 Seller shall supply three (3) identical transfer stations, which collect steam condensate drained from the reboilers.

3.14.11 The transfer stations shall be designed to support continuous steady state operation in maintaining nominal operating level while receiving and supplying steam condensate to steam conditioning desuperheater and to a general condensate receiver.

3.14.12 The condensate transfer vessel design and configuration shall support installation of pressure-differential level instrumentation and associated flanged "direct connect diaphragm seal pressure transmitters.

3.14.13 The condensate transfer vessel shall be a vertical oriented vessel constructed of 304L stainless steel with a capacity of 225 gallons.

3.14.14 Each condensate transfer vessel shall be designed to be attached to a mounting ring which will be installed using anchor bolts.

3.14.15 The condensate transfer vessel shall be designed to support a minimum operating volume of 80 gallons.

3.14.16 The condensate transfer pumps shall be vertical turbine pumps with a by-pass valve to limit the pump discharge pressure preventing the motor to become overloaded. The pumps along with their motors shall be mounted on the transfer stations.

3.14.17 Single mechanical seals shall be incorporated in each condensate transfer pump in accordance with American Petroleum Institute (API) Plan 11.

3.14.18 The condensate transfer pumps shall be designed to comply with pump nozzle loading requirements specified in API 610.

3.14.19 The condensate transfer pumps and accessories shall be made of 300 series stainless steel. The pump materials of construction for wetted arts shall be cast high alloy steel 316 SS.

3.15 Mechanical Handling Requirements

3.15.1 Equipment located in the R5/C5 hot cell shall be designed in accordance with Buyer's specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture.*

3.15.2 Seller designed equipment shall incorporate jumper connector nozzles to facilitate process, utility, instrument, and power connections to the Buyer supplied jumpers and systems.

3.15.3 Equipment skids shall incorporate jumper nozzles for process pipework (e.g., pump suction and discharge connections, utilities, instrumentation, and power, as required).

3.15.4 Seller shall identify all interface points for systems requiring connection to the Buyer's process piping, jumpers, and utility systems.

3.15.5 The nozzle tolerance requirements for reboiler and recirculation pumps in the R5/C5 hot cell shall be ±1/4 inch. The nozzle tolerance measurement device shall have a minimum of ±1/1000 inch accuracy. Jumpers shall be built to as-built dimensions and replaced with equipment as necessary.

3.15.6 Deleted

3.15.7 Deleted

3.16 Loadings

3.16.1 The evaporator equipment assemblies shall be self-supporting, capable of carrying the static loads of components, and capable of handling stresses imposed during shipment, installation, operation and an earthquake.

3.16.2 Loads to be considered for the structural design of evaporator vessel, equipment, and components shall be in accordance with applicable codes, standards, and reference documents listed in section 2 of this specification.

3.16.3 All vessels or equipment with SC-I and SC-II designation shall be seismically analyzed and qualified in accordance with AISC N690.

3.16.4 All vessels or equipment with SC-III and SC-IV designation shall be seismically analyzed and qualified in accordance with the AISC ASD and UBC zone 2B.

3.16.5 Seller shall complete a seismic analysis of the evaporator package designs, including skids, and skid anchorage, equipment and pressure vessel anchorage, piping anchorage. Loadings shall be calculated in accordance with the appropriate requirements of Buyer's specifications 24590-WTP-3PS-SS90-T0001, Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks, and 24590-WTP-3PS-FB01-T0001, Structural Design Loads for Seismic Category III & IV Equipment and Tanks. Analysis shall show that the evaporator system and components are capable of withstanding seismic loadings.

3.16.6 All vessels, heat exchangers, and any other pressure containing vessels or equipment shall be seismically analyzed and qualified by the Seller per Buyer's specification 24590-WTP-3PS-MV00-TP002, *Engineering Specification for Seismic Qualification Criteria for Pressure Vessels*, Buyer's specification 24590-

WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

3.16.7 The Seller shall perform thermal and static stress analyses for all evaporator structures, systems, and components.

3.16.8 Except for reboiler and recirculation pump skids, all equipment skids shall be designed for a maximum floor loading of 160 lbs/ft^2. Refer to drawings 24590-PTF-DD-S13T-00022, 24590-PTF-DD-S13T-00025, 24590-PTF-DD-S13T-00028, 24590-PTF-DD-S13T-00027, 24590-PTF-DD-S13T-00036, 24590-PTF-DD-S13T-00042, 24590-PTF-DD-S13T-00043, and 24590-PTF-DD-S13T-00044 for structural concrete embed details.

3.16.9 The embed location for reboilers are detailed on drawings 24590-PTF-DD-S13T-00025, 24590-PTF-DD-S13T-00027, 24590-PTF-DD-S13T-00028, AND 24590-PTF-DD-S13T-00049.. Each embed has a support post which connects to the PEP.. To avoid displacement in skid under the heavy reboiler weight, reboiler frame shall rest upon support posts with the embeds underneath.. These embeds are type "D" which have been esigned for ultimate compressive strength of 100 kips.

3.16.10 The flow meter unit of the steam conditioning skids for the FEP and TLP evaporator systems are SC-III items and may not be qualified at the accelerations defined in the Buyer's specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks, and 24590-WTP-3PS-FB01-T0001.. Equivalent test can be performed and considered successful if there is no physical damage to the instrument.. For the equivalent test, the flow meter units will undergo a frequency sweep (0 to 500 Hz) to determine their resonant frequency. Once the resonant frequency is determined, the units are tested at 1 g vertical and then 1 g horizontal for a period of twenty minutes each, all while being excited at the resonant frequency.

3.17 Electrical Requirements

3.17.1 The electric motor drive shall conform to the requirements set forth in Buyer's specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives.*

3.17.2 The pump motor and all other motors in this evaporator package shall conform to the requirements set forth in Buyer's specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors.*

3.17.3 Seller shall comply with the requirements set forth in Buyer's specification 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment.*

3.18 Instrumentation and Control Requirements

3.18.1 General

3.18.1.1 All controls, control systems, control panels, alarm systems, analyzers, instrumentation, and their installation into the evaporator system shall conform to the requirements set forth in Buyer's specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems.*

3.18.1.2 The Seller shall provide instrument data sheets and installation details. The Buyer will use this information for procurement and installation of required instrumentation.

3.18.1.3 The Seller shall provide functional test set points and recommended operating set points with the packaged systems.

3.18.1.4 The Seller shall supply the control requirements, which shall consist of the control loop definitions, system interlocks, alarms, and control philosophy.

3.18.1.5 The Buyer will use the Seller's control requirements to provide the software requirement specification for logic programming and DCS hardware, which will integrate the Seller's control requirements into the Buyer's overall control system.

3.18.1.6 Seller shall comply with NQA-1 1989, 11S-2, for computer program testing.

3.18.1.7 The following table describes the work processes and the division of the responsibilities:

	Buyer's Responsibility	Seller's Responsibility
Blank Instrument Data Sheet	•	
Complete Instrument Data Sheet		•
Instrument Installation Details		•
Instrumentation Procurement	•	
Instrumentation Installation	•	
Functional Test Set Points		•
Operating Set Points		•
Control Requirements		•
Software Requirements Specification	•	
Logic Programming	•	
DCS Hardware	•	

3.18.2 Other

The Seller shall select level, specific gravity, temperature, and pressure instrumentation that shall provide accuracy of the measured range as specified in Buyer's specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems.*

3.19 Lifting Requirements

3.19.1 Seller shall identify the weight and center of gravity of each equipment skid.

3.19.2 Seller shall provide yokes for separator vessels, reboiler and support assemblies, and recirculation pumps for installation and remote maintenance. Each part will be made of 304SS. The yokes shall be designed for balanced lifting and handling by a single hook crane. The yokes shall be designed in accordance with ANSI N14.6 and Buyer's specification 24590-WTP-3PS-MJJ0-T0001, *Specification for Lifting Beams for Mechanical Handling Equipment.*

3.19.3 All evaporator equipment and skids shall have lift points and attachment mechanism. Lifting bail design shall comply with proposal hook design shown in Appendix G.

3.19.4 All lifting attachments shall have either a safety factor of three (3), based on the material yield strength, or five (5), based on the material ultimate strength, whichever is more conservative. The lifting points shall have a label clearly identifying its safe working load. If forged bolts are used, they shall be used in accordance with ASME B18.15.

3.19.5 The reboiler and support assemblies shall be designed for horizontal transportation in the hot cell. The reboiler and support assemblies shall have tailing lug and tilt-up features for vertical installation with a 2-ton hoist for tailing operation.

3.19.6 The lifting lugs shall be designed to permit lifting the equipment skid without distortion or damage to the components of the equipment skid.

3.19.7 All lifting points shall be proof tested in situ. Test and examination certificates shall be provided to the Buyer review.

3.19.8 Each reboiler and support frame assembly shall be lift tested by the Seller to demonstrate proper vertical orientation using the Seller-supplied lifting fixture. This testing includes verification of all tilt up features. Each reboiler shall be balanced after fabrication. Actual vertical lift (with vessel empty) shall not be more than 1/4 inch from true verticality. Permanent deflection or a change in the assembly alignment is unacceptable. The Seller shall notify the Buyer a minimum of 15 working days in advance of reboiler and support frame assembly lift test. The Buyer may send representatives to witness the inspections or perform an independent inspection.

3.20 Accessibility and Maintenance

3.20.1 General Maintenance Requirements

Accessibility and maintenance requirements shall be per this specification and its addenda and attachments.

3.20.2 R5/C5 Black Cell Equipment Maintenance Requirements

3.20.2.1 No equipment requiring maintenance, with the exception of demister pads, shall be located inside the R5/C5 black cells (rooms P-0106 and P-0117). The nonreplaceable 40-year life components shall include offgas piping, separator vessels and all its internal parts (except demister pads) and their supporting structures/anchorage.

3.20.2.2 Demister pad assembly shall be remotely removable and replaceable through a 10-foot diameter opening from the 56-foot elevation floor, rooms P-0304 and P-0311, which are directly above the black cells P-0106 and P-0117. If the water connections for the spray connections for the spray down mechanism are incorporated into the pad assembly, the connections shall utilize a quick disconnect type connection for the water source. Due to potential radiation and contamination concerns, viewing and removal of the of the demister pad will be accomplished with the top demister pads submerged approximately 6-inch below the water during the maintenance duration. Seller shall demonstrate and record on VHS format video tape demister pad removal and replacement in their shop test.

3.20.3 R5/C5 Hot Cell Equipment Maintenance Requirements

3.20.3.1 Reboiler and support frame assemblies and recirculation pumps in the R5/C5 hot cell shall be designed to be remotely removable and replaceable in accordance with specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design and Manufacture*. No components shall require special tools.

3.20.3.2 Reboiler and support frame assemblies and recirculation pumps in R5/C5 hot cell shall be designed in accordance with the requirements stated within this specification.

3.20.3.3 Each reboiler and support frame assembly shall not weigh more than 27.5 tons, including all required lifting fixtures.

3.20.3.4 All fittings, pipe connections, electrical power, and control connections for equipment in R5/C5 hot cell shall be engineered on jumpers suitable for remote operation using a crane hook and crane mounted impact wrench with CCTV cameras.

3.20.3.5 Reboiler and support frame and recirculation pumps shall be made suitable for remote operation utilizing features such as trunnions, guide pins, location dowels, captive bolts, and lead-ins on bolts, and be able to be removed using a crane hook and crane mounted impact wrench with CCTV cameras. Refer to Appendix G for remote impact wrench and drawings nos. 24590-WTP-M0-M10T-00004 and 24590-PTF-M0-PIH-00008 for crane details.

3.20.3.6 The use of shims to position reboiler and support frame assemblies or recirculation pumps in the R5/C5 hot cell is not allowed. All

surfaces shall be machined to locate equipment and support remote handling and replaceability.

3.20.3.7 Due to the requirement of a 12-foot reserved path for equipment removal in the hot cell, Seller shall comply with the location requirements for reboiler and support frame assemblies and recirculation pumps as shown in sketches in Appendices I and Q.

3.20.3.8 All services to or from the recirculation pumps shall be provided using jumper connections.

3.20.3.9 The maximum height of any 2-inch hex nut (jumper connector), oriented vertically, is 24 ft-6 inches in plant elevation.

3.20.3.10 The maximum height of any 2-inch hex nut (jumper connector), oriented horizontally, is 25 ft-6 inches in plant elevation.

3.20.3.11 The maximum height of the 2 ton slewing hoist is 28 ft-6 inches.

3.20.3.12 The maximum height and hook approach of the 30 ton hook is distinctly different than the 2 ton hoist. Refer to the crane data sheet, 24590-PTF-MJD-PIH-00001 for details.

3.20.4 Deleted.

4 Materials

4.1 Positive Material Identification

Refer to Buyer's specification 24590-WTP-3PS-G000-TP002, *Specification for Positive Material Identification (PMI)* for PMI requirements. Seller shall submit documentation of all PMI test results which show chemical properties and material classification.

4.2 Construction

4.2.1 Seller shall specify surface finish for all materials and submit to Buyer for review.

4.2.2 Seller shall maintain a record of ASTM numbers, material test reports, and manufacturer material certifications for all materials used for construction of evaporator equipment/skids. Seller shall provide copies to the Buyer.

4.2.3 All stainless steel bolts and studs shall conform to ASTM F593.

4.2.4 All stainless steel nuts shall conform to ASTM F594.

4.2.5 Seller shall provide Material Safety Data Sheets (MSDSs) for all materials installed or used.

4.2.6 Process fluids may contain caustic solutions (50 wt % caustic), however 5 M nitric acid solutions may also be used for decontamination of the pipework, pumps, valves, and instruments/instrument tubing both inside and outside of the pipework assembly.

4.2.7 All flanges and pipe fittings shall conform to ASME B31.3 1996 and be weld-neck and long radius type, respectively, unless otherwise specified. Flanges shall also be in accordance with ASME B16.5, and B16.47 Series A, as applicable.

4.2.8 No threaded flanges or fittings shall be used.

4.2.9 Certified material test reports shall be supplied for all stainless steel pipe, plate, sheet, and sections.

4.2.10 Selection of materials for threaded components shall minimize galling. Where the Seller determines that potential for galling is present assuming proper removal and reinstallation, designs shall be considered that favor components that are difficult to replace remotely. The Seller shall also consider different material selection, sleeving, etc. where practical.

4.2.11 All materials used in the construction of the evaporator equipment shall be new and unused. Where specific criteria are not provided, material section shall be determined by the Seller and have properties and composition suitable for the specific service conditions and consistent with this specification and its addenda and attachments.

4.2.12 The alternate ASTM and ASTM standard editions listed below can be used in lieu of the edition in effect.

Alternate Materials	Specified Materials
ASTM A182-98, A182-01	ASTM A182/A182M-99
ASTM A312-04	ASTM A312/A312M-00c
ASTM A403-95	ASTM A403/A403M-99
ASTM A403-99	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-403 / ASTM A403-95
ASTM A182-98	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-182 / ASTM A182-99
ASME 2001 Edition SA-312, 2003 Addenda SA-312 ASME 1995 Edition SA-312, 1995 Addenda SA-312	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-312 / ASTM A312-00c
ASME 1998 Edition SA-240, 2003 Addenda SA-240	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-240 / ASTM A240-97a

ASME 1997 Addenda SA-240	
ASTM A240-00, -02, -03, -03c, - 04a	ASTM A240/A240M-03b
ASME SFA 5.22 Part C - 1995 Edition 1996 Addenda	ASME SFA 5.22, Section II, Part C 2001 Edition 2002 Addenda
ASTM A480-03c	ATM A480-03b
ASTM 554-98, -03	ASTM 554-98el
ASME SFA-5.9, SFA5.22 Sec III, Subsec NB, 1995 Edition, 1996 Addenda	ASME Code, Section II, 2001 Edition with 2002 Addenda (weld wire)
ASME A240-00, -00 /A240-01	ASME A240/A240M-03b

4.3 Vessels

Vessel materials shall conform to individual MDS in section 2 of the MR.

4.4 Pipework

Pipework material shall meet the piping material requirements in Buyer's specification 24590-WTP-3PS-P000-T0001, *Specification for Piping Material Classes.*

4.5 Prohibited Materials

4.5.1 Mercury and other low melting point metals, their alloys, or materials containing such metals as their basic constituents shall not be used in the construction of any components of the evaporator systems.

4.5.2 Molybdenum and halides shall not be used in direct contact with stainless steel.

4.5.3 Asbestos shall not be included in any component of the evaporator systems.

4.5.4 Halide containing materials shall not be used in any component of the evaporator systems.

4.5.5 "Teflon" or compounds thereof must be qualified for use with the radiation levels specified in this specification.

4.6 Storage of Special Materials (e.g., stainless steel) prior to work

4.6.1 The Seller shall meet the storage requirements in Buyer's specification 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Shipping, Handling, and Storage Requirements.*

4.6.2 Stainless steel is susceptible to corrosion caused by the contact and interaction with incompatible materials. All stainless steel material shall be stored in separate areas away from other materials.

5 Fabrication

The Seller shall obtain written Final Design Review from the Buyer prior to the start of fabrication activities.

5.1 General

5.1.1 Fabrication of vessels shall be performed in accordance with Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

5.1.2 Fabrication of pipework shall be performed in accordance with Buyer's specification 24590WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping*.

5.1.3 Fabrication of mechanical handling equipment shall be performed in accordance with Buyer's specification 24590WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design and Manufacture*.

5.1.4 All fabrication shall be performed by personnel qualified in accordance with this specification and applicable documents in section 2 of this specification.

5.2 Welding

5.2.1 Seller shall develop detailed welding, weld inspection, NDE, and weld repair procedures for fabrication of the evaporator vessel, equipment, and structural supports. Seller shall submit them to the Buyer for review prior to fabrication. Procedures shall include acceptance criteria. The procedures shall conform to the following, as applicable:

- Buyer's Specification 24590-WTP-3PS-SS00-T0002
- Buyer's Specification 24590-WTP-3PS-NWP0-T0001
- Buyer's Specification 24590-WTP-3PS-MVB2-T0001
- ASME Boiler and Press Vessel Code, section VIII, Div. 1
- ASME B31.3-1996
- AWS D1.6

- AWS D9.1

5.2.2 Welding, weld inspection, NDE, and weld repair shall be carried out in accordance with the applicable procedures developed per section 5.2.1 above.

5.2.3 Each procedure shall be prepared and qualified in accordance with the requirements of the listed specification and standards in 5.2.1 above or ASME section IX, whichever is more stringent.

5.2.4 Welder qualifications shall be performed in accordance with ASME section IX or AWS as required.

5.2.5 Personnel performing weld inspection shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, section VIII, Div. 1 and Buyer's specification 24590-WTP-3PS-SS00-T0002, *Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

5.2.6 Repairs required as a result of weld rejection by either the Buyer's or Seller's final inspection shall be fully documented in accordance with Seller's Quality Assurance Program (QAP). Weld repairs shall be performed in accordance with ASME Boiler and Pressure Vessel Code, section VIII. Weld repair records shall be included with Seller's quality verification document package to be submitted to Buyer.

6 Inspections and Examinations

6.1 Nondestructive Examinations

6.1.1 Unless otherwise specified, all vessel welds shall be inspected in accordance with the requirements outlined in the Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication*.

6.1.2 Unless otherwise specified all pipework welds shall be inspected in accordance with the requirements outlined in Buyer's specification 24590-WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping*. For nondestructive examination (NDE) of fabricated pipe welds. Appendix O of this evaporator specification, 24590-PTF-3PS-MEVV-TP001, shall be used in replacement of Appendix A of specification for Shop Fabrication of Piping, 24590-WTP-3PS-PS02-T0001.

6.2 Dimensional Inspections

6.2.1 Refer to Buyer's specification 24590-WTP-3PS-PP00-T0002, *Specification for Dimensional Record Program*, for final dimensional measurement requirements. Third party validation of special dimensional inspection is not required.

6.2.2 Buyer's specification 24590-WTP-3PS-PP00-T0002, *Specification for Dimensional Record Program*, is applicable only to recirculation pumps and reboiler and support frame assemblies and does not apply to any other components.

6.2.3 For recirculation pumps, a dimensional record is required for remotable pump features that are not part of the process jumper. The process portion of the recirculation pump will be installed in a jumper, and the jumper dimensional record will be performed by the Buyer.

6.2.4 For reboilers, all remote connector nozzles shall be measured to precise as-built dimensions.

6.2.5 Seller shall furnish personnel to perform measurement activities.

6.3 Visual Weld Inspections

6.3.1 The Seller shall develop and implement a procedure to perform visual weld inspections (visual tests, VT) to inspect each weld. The inspection procedure shall be developed in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding Pressure Vessels, Heat Exchangers and Boilers* and ASME B31.3 1996, and shall include inspection materials and acceptance criteria.

6.3.2 Acceptance criteria for visual weld inspections for vessels shall be in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding Pressure Vessels, Heat Exchangers and Boilers* and for pipework shall be in accordance with ASME B31.3 1996.

6.3.3 The Seller shall prepare a visual weld inspection report for each fabricated item.

6.3.4 Deleted.

6.3.5 Deleted.

6.3.6 The Seller shall notify the Buyer in advance of inspections. The Buyer may send representatives to witness inspections or perform independent inspections.

6.4 Liquid Penetrant Test

6.4.1 The Seller shall develop and implement a procedure to perform a liquid penetrant test (PT) to inspect each weld. The procedure shall be developed in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding Pressure Vessels, Heat Exchangers and Boilers* and ASME B31.3 1996, and shall include inspection materials, dwell time for dye and developer, and acceptance criteria.

6.4.2 Acceptance criteria for PT inspection shall be in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding*

Pressure Vessels, Heat Exchangers and Boilers and for pipework shall be in accordance with ASME B31.3 1996.

6.4.3 The Seller shall prepare a liquid penetrant test report for each weld connection on each fabricated item.

6.4.4 Deleted.

6.4.5 Deleted.

6.4.6 The Seller shall notify the Buyer in advance of testing. The Buyer may send representatives to witness testing or perform independent tests.

6.5 Radiography

6.5.1 Radiographic examinations shall be carried out on all primary containment pipework butt-welds using 100 % radiography for QL components. For all other quality levels, refer to Appendix O of this specification for radiographic examination requirements.

6.5.2 The Seller shall develop and implement a procedure to perform radiographic weld examinations of piping butt-welds. The procedure shall be developed in accordance with ASME B31.3 1996, and shall include examination materials and acceptance criteria.

6.5.3 Deleted.

6.5.4 Deleted.

6.5.5 The Seller shall provide radiographic film with technique and reader sheets. Exposed film must be sent, along with a copy of the technique and reader sheets in accordance with section 3 of the MR. Film must be suitably packaged to preclude moisture and handling damage.

6.5.6 The Seller shall notify the Buyer in advance of examinations. The Buyer may send representatives to witness or perform independent examinations.

6.6 Magnetic Particle Examination

6.6.1 The Seller shall develop and implement a procedure to perform magnetic particle examination. The procedure shall be submitted to the Buyer for review prior to fabrication.

6.6.2 Magnetic particle examination (MT) shall be in accordance with ASTM Specification E709.

6.6.3 Acceptance criteria shall be in accordance with the AWS code.

6.7 Final Inspection

6.7.1 The Seller shall develop and implement a procedure for final inspection of each fabricated item. The inspections shall be performed after completion of all fabrication, cleaning, and testing, and just prior to final packaging. The inspections shall include inspection of all surfaces for contamination. Visible evidence of contamination is not acceptable.

6.7.2 The Seller shall prepare a final inspection report for each item, which documents the results of the final inspection. The Seller shall include the final inspection report in the documentation package for each piece.

6.8 Inspection and Test Status

The Seller shall maintain a positive system for identifying inspection and testing status of items and systems.

6.9 Control of Nonconforming Items

The Seller shall use the Supplier Deviation Disposition Request per MR section 2 to notify the Buyer of fabricated items and fabrication activities not conforming to the requirements. Any nonconforming work shall be redone by the Seller at Seller's cost.

7 Testing

7.1 Shop Tests

7.1.1 The Buyer reserves the right to witness all shop tests and shall be given a minimum of 10 working days written notice prior to each test date.

7.1.2 All pipework shall be hydrostatically tested in accordance with ASME B31.3 1996. Test water used for hydrostatic testing shall be tested for chlorides. The chloride content of the test water shall not exceed 50 ppm and the water temperature shall not exceed 120 °F. Buyer shall review all test pressures prior to commencement of any testing. The testing results shall be documented and provided to Buyer.

7.1.3 Testing of vessels shall be performed in accordance with Buyer's specification 24590-WTP-3PS-MV00-TP001, *Specification for Pressure Vessel Design and Fabrication.*

7.1.4 Functional tests of evaporator equipment/skids shall be performed by the Seller.

7.1.5 Seller shall demonstrate and record on VHS format video tape demister pad removal. Test shall be done with equipment representative of what will actually be installed and utilized in the Buyer's facility.

7.1.6 Seller will furnish lifting yokes details for separator vessels, reboiler and support frame assemblies, and recirculation pumps. All Seller supplied lifting yokes shall be load tested to 1.5 times the design load.

7.1.7 Each evaporator equipment skid shall be lift tested by the Seller to demonstrate proper vertical orientation using the Seller-supplied tooling and fixtures. This testing includes verification of all tilt up features. During the lift test the deflection at the midpoint of each skid shall be monitored and recorded to ensure that proper alignment is maintained. The centerline of the evaporator skid shall be within ±1 inch of true vertical when measured from the lift point. Permanent deflection or a change in the evaporator skid alignment is unacceptable.

7.1.8 Seller shall furnish blind flanges or other acceptable closures for the nozzles, as required for hydrotesting. Closures shall be removed after testing, unless they are required for shipment.

7.1.9 Deleted.

7.1.10 All test results shall be documented, certified, and submitted to the Buyer for review.

7.2 Integrated Acceptance Tests

An Integrated Acceptance Test will be performed by the Buyer at the Buyer's site on each fully assembled evaporator system to verify that the functional requirements and process control requirements of this specification have been met. Tests shall be performed per Buyer's testing program. Seller shall provide the Buyer procedures suggesting how the evaporator systems shall be functionally tested. The Seller shall be responsible for equipment performance during the tests. The procedures shall include the following:

7.2.1 Performance Testing

7.2.1.1 Limiting the entrainment of radionuclides from the evaporator to the primary condenser is an important safety function. During cold commissioning, the performance of the evaporator system will be measured using surrogate chemicals to determine the degree of entrainment from the evaporator to the primary condenser. Stable (nonradioactive) cesium will be the surrogate of choice for simulating radionuclide carryover to the condensing system.

7.2.1.2 Steady state operation is defined as:

- Liquid density of the concentrate ranges from 1.22 to 1.25 g/ml at operating temperature.
- Sodium cation and nitrate, hydroxide, chloride anions are the predominate soluble chemical analytes in the concentrate.
- The soluble concentration of stable (nonradioactive) cesium in the evaporator bottoms (concentrate) is no greater than 41.5 milligrams per liter.

7.2.1.3 The following criteria must be met prior to final acceptance of the evaporator system design:

- At steady state operation, the time-average mass rate of stable (nonradioactive) cesium carry-over from the evaporator to the condensing system shall not exceed 1.0 E-04 gram during any 24 hour period.

- At steady state operation, the instantaneous mass rate of stable (nonradioactive) cesium carry-over from the evaporator to the condensing system shall not exceed 1.0 E-03 gram in any one (1) hour period.

7.2.1.4 The performance testing and acceptance criteria shall apply over a boil-off range from 10 gpm to 30 gpm of total condensate, as measured in the condensate receiver vessel.

7.2.1.5 Performance testing shall be corrected for uncertainty in instrument and analytical measurements.

7.2.1.6 Relative performance indicators include:

- The estimated mass distribution ratio (mass rate of cesium removed with the overhead/mass rate of cesium in the feed) at steady state is approximately 1.0E-07.
- The estimated decontamination factor (concentration of cesium in the feed / concentration of cesium in the overheads) at steady state is approximately 8.0E+06.
- The estimated concentration of cesium in the condensate from the condensing system ranges from 6.0E-04 to 1.8E-03 microgram per liter.

7.2.2 A full simulation of abnormal shutdown conditions.

8 Preparation for Shipment

8.1 General Requirements

8.1.1 The evaporator equipment/skids shall be packaged/prepared for shipment, handled, and stored in accordance with the following requirements in

- Section 7 of the MR.
- Buyer's Specification 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Shipping, Handling, and Storage Requirements.*
- Buyer's Specification 24590-WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping.*
- Buyer's Specification 24590-WTP-MV00-TP001, *Pressure Vessel Design and Fabrication.*

8.1.2 Seller shall ensure that appropriate documentation is prepared and, if required, signed by the appropriate person(s). The shipping documentation shall accurately reflect specific traceability to the items being shipped.

8.1.3 Seller shall ensure that appropriate documentation is prepared for the evaporator equipment/skids. At a minimum, documentation shall include the following information, as applicable:

- Manufacturer name, model number, and serial number.
- Skid number.
- Plant item number.

8.1.4 Solvents and cleaning solutions used on stainless steel shall have a halogen content of less than 200 ppm.

8.1.5 Recirculation pumps will be shipped only in temporary shipping skids not meant for installation. The reboiler and support frame assemblies shall be transported from the Seller site to the Buyer site in the horizontal orientation due to air lock size limits.

8.1.6 Separator vessels will be shipped on temporary shipping skids. The installation skids are shipped separately, each in two pieces because of their height.

8.1.7 Lifting weight shall be clearly marked on both the equipment skid and its shipping documentation.

8.1.8 Regarding Buyer's Specification 24590-WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping*, polyethylene wrap can be used and subsequent blocking using Styrofoam cushioning and equivalent backed by plywood/wood to provide protection against damage or access by elements. Special end caps are not required.

8.2 Painting

8.2.1 Stainless steel shall not have coating applied.

8.2.2 Seller shall submit the information requested on Form H (see appendix S) along with technical data sheet and MSDS. Supplier shall provide Certificate of Conformance verifying application of coating in compliance with coating manufacturer's Technical Product Data Sheet.

8.2.3 All painting and coating shall be applied in accordance with the manufacturer's directions for application.

8.2.4 Exposed carbon steel surface shall be primed and painted with enamel base coating in accordance with the coating manufactures surface and application requirements. All visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter shall be removed prior to application of primer. See section 8.2.14 and 8.2.15 for custom fabricated equipment.

8.2.5 In the absence of standard manufacturer's colors, the finish coat of all carbon steel items and equipment shall be ANSI 70 Gray. Contrasting colors shall be used for fasteners and bails.

8.2.6 Repainting by the Seller, or custom finishing by the manufacturer shall not be required when commercially available components and equipment which are normally mass produced, inventoried, supplied from stock, and have been coated with the manufacturer's standard coating system.

8.2.7 Surfaces exposed to the environment, but inaccessible after assembly, shall be coated prior to assembly.

8.2.8 Painting of interior and enclosed surfaces of the equipment, such as inside a welded box section, is not required.

8.2.9 Machined carbon steel mating surfaces and other surfaces not protected by coating system (such as seal surfaces, threaded surfaces, lifting hooks, hook nuts, wheel treads, gears, shafts, pinions, and couplings), shall be protected with a solvent cutback asphalt temporary preservative (Dauber Chemical Tectyl 891, EF Houghton Chemical Rust Veto 342 or Buyer's accepted equivalent) for shipment and storage. The Seller shall specify which preservatives must be removed and how the preservatives are removed by the Buyer before operation of the equipment.

8.2.10 Welds shall be coated only after completion of the required tests. Required tests include leak tightness, hydrostatic testing or other NDE of the welds.

8.2.11 Filler, sealant, and caulking compounds shall be compatible with the coating system.

8.2.12 The lifting fixtures for separator vessel shall be safety yellow # 13655 in accordance with FEP-STD 595B, *Colors Used in Government Procurement*. The lifting fixtures can be coated with the manufacturer's standard coating systems.

8.2.13 Items covered by 8.2.14 and 8.2.15, shall be surface prepared in accordance with SSPC SP10. For repair, the surfaces shall be prepared in accordance with SPPC SP11.

8.2.14 For support frames for steam conditioning skids and reboiler transporter, Seller shall use two coats (P04) of Epoxy with 4-6 mils per coat. Acceptable coating products for P04 are as follows:

8.2.14.1 Amercoat 385 from Ameron

8.2.14.2 Carboguard 890 from Carbonline

8.2.14.3 224HS from Devoe

8.2.14.4 Protecto-Coat 330 or 300 from Dudick

8.2.14.5 Intergard 475HS from International

8.2.14.6 Macropoxy 646 from Sherwin Williams

8.2.15 For reboiler and recirculation pump lifting beams, Seller shall use three coats with 1st coat (P02) of Epoxy Primer with 3-5 mils and (P06) Epoxy Novolac with 5 - 10 mils for 2nd and 3rd coats. Acceptable coating products for P02 are as follows:

8.2.15.1 Amercoat 68HS from Ameron

8.2.15.2 Carbozinc 859 from Carbonline

8.2.15.3 313 from Devoe

8.2.15.4 Interzinc 52 from International

8.2.15.5 Zinc Clad IV from Sherwin Williams

Acceptable coating products for P06 are as follows:

8.2.15.6 Amercoat 91 from Ameron

8.2.15.7 Phenoline 1205 FR from Carbonline

8.2.15.8 253 from Devoe

8.2.15.9 Protecto-Coat 100XT or EN from Dudick

8.2.15.10 Intertherm 875 HS from International

8.2.15.11 Macropoxy 646 from Sherwin Williams

8.3 Tagging

8.3.1 Tagging of the evaporator component, equipment, and skids shall be per this specification and the applicable documents listed in section 2 of this specification. Plant item numbers for evaporator component/equipment shall be per the data sheets that are in section 2 of the MR.

8.3.2 Instruments shall have nameplates installed per section 8 of Buyer's specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems.*

8.3.3 Motors shall have nameplates per section 3 of Buyer's specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors.*

8.3.4 Packages shall be suitably marked on the outside to facilitate identification of the purchase order, the procurement specification, the package contents, and any special handling instructions.

8.3.5 Slinging points and orientation for storage shall be clearly marked.

8.3.6 Temporary material such as bolting and shipping material shall have clear identification per sections 3.13 and 3.13.12 of Buyer's specification 24590-WTP-GPP-GCB-00100, *Field Materials Management.*

8.3.7 A stainless steel nameplate shall be rigidly attached to the evaporator equipment skid packages in a prominent position for ease of visibility, and shall include the following:

- Manufacturer's name.
- Shop location.
- Date of manufacture.
- Serial number.
- Equipment rating (pressure, temperature and flow).
- Skid number.
- Plant item number.
- Weight of assembly.
- Purchase order number.

9 Quality Assurance

9.1 General Commercial Designation (CM) Requirements

9.1.1 The Seller's Quality Assurance Program (QAP) Requirements are included in 24590-WTP-3PS-G000-T0001, *Supplier Quality Assurance Program.*

9.1.2 Seller's QAP Manual shall be submitted to buyer for review in accordance with 24590-WTP-3PS-G000-T0001, *Supplier Quality Assurance Program.*

9.1.3 Seller's QAP, as a minimum, shall contain the requirements of DOE Order 414.1A as detailed in the Supplier Quality Assurance Program Requirements Data Sheets listed in section 2 of the MR. The very same requirements shall be passed down to any lower tier subcontractor.

9.2 Quality Level (QL) Requirements

9.2.1 Seller shall have in place a QA program meeting the requirements marked as applicable in Supplier Quality Assurance Program Requirements Data Sheet attached to the MR, and Buyer's specification 24590-WTP-3PS-G000-T0001.

9.2.2 Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. The Supplier shall allow the Buyer, its agent, and DOE access to their facilities and records pertaining to this purchase order for the purpose of QA Audits and Surveillance at mutually agreed times.

9.2.3 All items shall be manufactured in accordance with the Supplier's Quality Assurance Program that has been previously evaluated and accepted by the RPP-

WTP Quality Organization. The very same requirements shall be passed down to any lower tier subcontractor.

9.2.4 Seller shall submit their QA program and work plan to Buyer for review prior to commencement of work. The plan shall include documents and procedures to implement the work and include a matrix of essential Quality Assurance elements cross referenced with the documents/procedures.

10 Configuration Management

Equipment and/or components covered by this specification are identified with Plant Item Numbers shown in the attached data sheets in section 2 of the MR. Each item shall be identified in accordance with section 8.3 of this specification.

11 Documentation and Submittals

11.1 General

11.1.1 Seller shall submit to Buyer all detailed designs, drawings, documentation, procedures, instructions, calculations, analyses, manufacturer documentation, manufacturer data, inspection reports, test reports, certifications, certificates, manuals, MSDSs, video tapes, and drawings required per this specification, the applicable codes, standards, and reference documents in section 2 of this specification, and the MR.

11.1.2 All detailed designs, drawings, assembly drawings, shop drawings, final P&IDs, MDSs, supporting calculation, supporting analyses, and all other requirements in the 60 % design stage shall be issued to the Buyer for review prior to fabrication of evaporator vessels and equipment.

11.1.3 Seller shall submit to Buyer Engineering and Quality Verification documents in the forms and quantities shown in Form G-321-E, *Engineering Document Requirements*, and Form G-321-V, *Quality Verification Document Requirements* attached to the MR, section 3.

11.1.4 Seller shall submit a report identifying any deviations and/or conflicts per section 2 of the MR to the Buyer for review.

11.1.5 Each documentation transmittal package shall have a documentation inventory sheet attached listing all documents and the number of pages each.

11.1.6 All documents submitted for review (e.g., General Arrangement, Shop Details, Calculations must contain their own unique NAME AND IDENTIFICATION NUMBER) Example:

Calculations for Item:
Document No: Calc TLP-PMP-00001-0001

11.1.7 Data sheets in section 2 of the MR shall be marked up by the Seller and submitted to the Buyer for review with the detailed design. Seller shall fill in all information that is marked as asterisk or TBD and markup actual overall dimensions for each evaporator component, equipment, and skid based on the detailed design.

11.1.8 All drawings shall be produced per the drawing practices set forth in ASME Y14.100, Engineering Drawing Practices.

11.2 Calculations

11.2.1 All calculations to be provided shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include:

- A concise statement of the purpose of the calculation.
- Input data, applicable criteria, and stated assumptions.
- A list of references used, including drawings, codes, standards, and computer programs (indicate the version or issue date).
- A discussion of rationale used for design assumption basis.
- Equations used for all computations.
- Numerical calculation including identification of units used.
- A concise statement addressing the calculation results and/or recommendations.
- A table of contents for complex calculations.

11.3 As-Built Drawings

11.3.1 Progress As-Builts

During construction, the Seller shall keep an updated marked-up set of progress as-built drawings on the jobsite as an accurate record of all deviations between the work, as shown on the Buyer reviewed drawings, and work as fabricated. These drawings shall be available to the Buyer for inspection at any time during regular business hours.]

11.3.2 Final As-Builts

Seller shall furnish to Buyer final as-built drawings with AS-BUILT clearly printed on each sheet for all final work left in place. Seller shall accurately and neatly transfer all deviations from progress as-builts to final as-builts.

11.4 Dimensional Record Drawings

See 24590-WTP-3PS-PP00-T0002 for final dimensional measurement requirements. Third party validation of special dimensional inspection is not required. Seller shall furnish to Buyer dimensional record drawings for reboiler and support frame assemblies, and recirculation pumps with all their associated lifting yokes and/or lifting lugs.

11.5 Project Start

Seller shall submit drawing index and detailed schedule of engineering document submittals, material purchases, fabrication, shop test, and ready for shipment. Include bar charts or critical path method diagrams, which detail the chronological sequence of activities.

11.6 30 % Design Review

11.6.1 Provide drawings with outline dimensions, services, foundations, and mounting details of all three (3) evaporator systems. Drawings shall show external envelope, including lugs, centerline(s), location and size for electrical cable, conduit, fluid, other service connections, isometrics, and details related to foundations and mountings.

11.6.2 Provide preliminary dimension, location, and layout for all evaporator component, equipment, and skids.

11.6.3 Provide preliminary design of the demister pads replacement methodology.

11.6.4 Provide preliminary system description. Describe general system functions and basis of design. It shall include a systematic process flow diagram for system operation.

11.6.5 Provide preliminary Piping and Instrumentation Diagrams (P&IDs).

11.6.6 Provide preliminary instrument control requirements. Include system interlocks and control philosophy. Provide flow charts, schematics, logic diagrams, or function diagrams showing the equipment functional controls.

11.6.7 Provide document that describes the proposed equipment skids, including sketches of typical skids indicating skid-to-skid and skid-to-building interfaces, as well as the components included.

11.6.8 Identify all large and heavy items of equipment to ensure lifting capability during construction, maintenance, and decommissioning.

11.6.9 Provide preliminary electrical drawings, schematics, wiring drawings, and motor data sheets per Buyer's specifications 24590-WTP-3PS-MUMI-T0002 and 24590-WTP-3PS-EKP0-T0001.

11.7 60 % Design Review

11.7.1 Provide final P&IDs.

11.7.2 Provide final skid constructability study.

11.7.3 Provide final evaporator component, equipment, skid size, and layout.

11.7.4 Provide assembly drawings.

11.7.5 Provide shop detail drawings with sufficient detail to facilitate fabrication, manufacture, or installation. This includes a complete Bill of Materials (BOM), pipe spool drawings, internal piping and wiring details, cross-section details, and structural details.

11.7.6 Provide wiring diagrams including schematic diagrams, equipment internal wiring diagrams, and interconnection wiring diagrams for electrical items.

11.7.7 Submit completed Instrument and Mechanical data sheets for all instruments and equipment, utilizing Buyer's supplied instrument data sheet samples attached in section 2 of the MR as templates.

11.7.8 Provide functional test setpoints and recommended operating set points for the instrumentation and control packaged systems.

11.7.9 Provide final instrument control requirements including control loop definitions, system interlocks, alarms, and control philosophies. Control and sequencing requirements of the system and its components shall be detailed as described in section 3.5 of 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems.*

11.7.10 Submit all final detailed drawings, calculations, analyses, and information necessary for evaporator vessels and equipment fabrication.

11.7.11 Submit all FMEA documentation.

11.7.12 Provide final electrical drawings, schematics, wiring drawings, motor data sheets, nameplates per Buyer's specifications 24590-WTP-3PS-MUMI-T0002 and 24590-WTP-3PS-EKP0-T0001.

11.8 90 % Design Review

11.8.1 Provide detailed written procedures, instructions, and drawings (including all lifting requirements) for evaporator system erection/installation.

11.8.2 Provide complete remote installation instructions for the utilization of the hot cell existing cranes for the needed reorientation, installation, and extraction of the reboiler.

11.8.3 Provide instrument installation details.

11.8.4 Provide list of required spares.

11.8.5 Provide startup and commissioning spares list, including all components or equipment that may be needed during startup and commissioning.

11.8.6 Provide operation manuals with detailed written instructions describing how the evaporator systems and components should be operated. Manuals shall include specific instructions, procedures, and illustrations for the following:

11.8.6.1 Safety Precautions – List personnel hazards and equipment or product safety precautions for all operating conditions.

11.8.6.2 Operator Prestart – Include requirements to set up and prepare each system for use.

11.8.6.3 Start-up, Shutdown, and Post-shutdown Procedures – Include a control sequence for each of these operations.

11.8.6.4 Normal Operations – Include control diagrams with data to explain operation and control of systems and specific equipment.

11.8.6.5 Emergency Operations – Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, over-pressure, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

11.8.6.6 Operator Service Requirements – Include instructions for services to be performed by the operator, such as lubrication, adjustments, and inspections.

11.8.6.7 Environmental Conditions – Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

11.8.6.8 Lay-up Instructions – Include step-by-step instructions for lay-up.

11.8.7 Provide maintenance manuals with detailed written instructions to disassemble, reassemble, and maintain systems or components in an operating condition. Manuals shall include specific instructions, procedures, and illustrations for the following phases of maintenance:

11.8.7.1 Preventive Maintenance - Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair:

11.8.7.1.1 Lubrication Data – Include lubrication data, other than instructions for lubrication, in accordance with operator service requirements to be included in operation manuals.

11.8.7.1.2 Preventive Maintenance Plan and Schedule – Include manufacturer's schedule for routine preventive maintenance, inspections, testing, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair.

Provide manufacturer's projection of preventive maintenance frequency of work, and hours to complete the task. Provide surveillance and in-service inspection recommendations.

11.8.7.2 Corrective Maintenance – Include manufacturer's schedule for procedures and instructions for correcting problems and making repairs. Include the following information for performing corrective maintenance:

11.8.7.2.1 Troubleshooting Guide and Diagnostic Techniques – Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

11.8.7.2.2 Wiring Diagrams and Control Diagrams – Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factor-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing, as well as the terminals for each type, identical to actual installation numbering.

11.8.7.2.3 Maintenance and Repair Procedures – Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

11.8.7.2.4 Removal and Replacement Instructions – Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide all tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of text and illustrations.

11.8.7.2.5 Recommended Spare Parts and Supply Lists – Include list of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Include the cost of each item.

11.8.7.2.6 MSDSs – Include MSDSs for all chemicals and hazardous materials supplied as part of the product,

system, or equipment. In addition, include MSDSs for all chemicals and hazardous materials required to be added (lubricants, antifreeze, etc.).

11.8.7.2.7 Parts Identification – Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustration and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

11.8.7.2.8 Other than Seller's Commercial Practice – End item manufacturer may add a cross-reference to implement component assemblies and parts requirements when implementation in manual form varies significantly from the style, format, and method of Seller's standard commercial practice.

11.8.7.2.9 Warranty Information – List and explain the various warranties and include the servicing and technical precautions prescribed by the Seller or contract documents to keep warranties in force.

11.8.7.2.10 Personnel Training Requirements – Provide information available from the Seller to use for training designated personnel to operate and maintain the equipment and systems properly.

11.8.7.3 Calibration Testing Equipment and Special Tool Information – Include information on test equipment required to perform specific tests and on special tools needed for the operation, maintenance, and repair of components.

11.8.8 Provide system, component, and instrumentation descriptions as identified below:

11.8.8.1 System Descriptions - Include comprehensive system description describing, in detail, how the overall system functions, and the basic design basis. Include component interfaces and interactions. Provide a systematic process flow diagram for system operation.

11.8.8.2 Component Descriptions – Include comprehensive component descriptions describing, in detail, how each individual process component functions and the basic design basis. Include other component interfaces and interactions. Provide a systematic process flow diagram for component operation.

11.8.8.3 Instrument Descriptions – Include a list or table describing instrument ID number, ID name, location, and basic operating function. Include separately, in systematic descriptive detail, instrument controls and logic that correspond to instrumentation and logic diagrams.

11.8.9 Provide design and operational requirements per the following:

11.8.9.1 Design requirements – Include a list or table describing the maximum design limits and conditions required to safely operate the equipment (i.e., temperatures, pressures, etc.).

11.8.9.2 Operational requirements – Include a list or table describing the normal operating ranges for equipment (i.e., temperatures, pressures, etc.).

11.8.10 Provide analysis and design reports, including analytical data (stress, electrical loading, fluid dynamics, etc.) which demonstrates that an item satisfies all specified requirements.

11.8.11 Provide seismic analysis or test data reports providing data and demonstrating suitability of materials, components, or systems in relation to the conditions imposed by the stated seismic criteria.

11.8.12 Provide thermal stress analysis or test data reports providing data and demonstrating suitability of materials, components, or systems in relation to the conditions imposed by thermal stresses.

11.8.13 Provide site storage and handling manuals including the requirements and time period for lubrication, rotation, heating, lifting, or other handling requirements to prevent damage or deterioration during storage and handling at job site. Include return shipping instructions.

11.8.14 Provide inspection and test plan including detailed descriptions of the inspections and tests planned during the receipt, manufacturing, and conformance verification activities. Include identification of witness and hold points.

11.8.15 Provide welding procedures, specifications, and supporting qualification records required for welding, hard facing, overlaying, brazing, and soldering.

11.8.16 Provide material control procedures including controlling issuance, handling, storage, and traceability of materials such as weld rod.

11.8.17 Provide PMI procedures for performing PMI testing of materials.

11.8.18 Provide repair procedures including controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection.

11.8.19 Provide pressure testing procedures including hydro, air, leak, separation, or vacuum test procedures for performing hydrostatic or pneumatic structural integrity and leakage tests.

11.8.20 Provide inspection procedures for the purpose of determining that specified requirements (i.e., dimensions, properties, performance results, etc.) are met.

11.8.21 Provide radiographic testing procedures for identifying the presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film.

11.8.22 Provide liquid penetrant testing procedures for detection of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.

11.8.23 Provide functional shop test procedures to demonstrate that design function and operational parameters are met (e.g., pump performance data, valve stroking, load, temperature rise, calibration, environment, etc.).

11.8.24 Provide integrated acceptance test requirements document per engineering specifications to demonstrate design function and operational parameters for the complete assembled evaporator systems.

11.8.25 Provide electrical test procedures to demonstrate that design function and operational parameters are met (e.g., impulse, overload, continuity, voltage, temperature rise, calibration, saturation loss, etc.).

11.8.26 Provide shipping preparation procedures for cleaning, packaging, and handling.

11.9 Final Design Review

Provide final design report including all design documents, manuals, and drawings that are specified in this specification. All procedures and instructions shall be completed and submitted to the Buyer a minimum of eight (8) weeks prior to evaporator components, equipment, and skid shipment.

APPENDIX A

WASTE FEED EVAPORATOR STREAM DATA

Stream Description	Evaporator Feed	Evaporator Concentrate	Process Condensate
Specific Gravity	1.050882E+00	1.197295E+00	1.000072E+00
pH	1.227066E+01	1.305375E+01	9.325531E+00
Total Volume (gpm)	1.962454E+01	3.234591E+00	1.710009E+01
Total Mass (lb/hr)	1.030370E+04	1.934908E+03	8.544156E+03
Na Molarity	8.231085E-01	5.000000E+00	3.116202E-05
Activity (Ci/gallon)			
129-I	1.070549E-07	6.456333E-07	7.335298E-10
134-Cs	6.794152E-06	4.120906E-05	2.202542E-09
137-Cs	1.531654E-01	9.292679E-01	1.866905E-09
14-C	4.343208E-06	2.632459E-05	4.923495E-09
126-Sn	3.687065E-07	2.235285E-06	3.195409E-10
233-U	7.147865E-07	4.333113E-06	6.729994E-10
235-U	5.308471E-09	3.218466E-08	4.216552E-12
152-Eu	1.787821E-06	1.083834E-05	1.612622E-09
154-Eu	1.047067E-04	6.347777E-04	9.210747E-08
155-Eu	2.783818E-05	1.688275E-04	1.307200E-08
237-Np	1.743947E-07	1.057294E-06	1.462592E-10
238-Pu	1.558783E-06	9.457271E-06	1.600678E-13
239-Pu	2.427044E-05	1.472509E-04	1.683651E-12
240-Pu	6.791157E-06	4.120253E-05	7.334047E-13
241-Am	1.539731E-04	9.341677E-04	4.075735E-11
243-Am	5.791005E-05	3.513452E-04	7.425120E-12
242-Cm	2.927004E-07	1.774511E-06	2.511805E-10
241-Pu	5.791005E-05	3.513452E-04	7.425120E-12
243-Cm	4.125221E-08	2.501032E-07	3.356803E-11
244-Cm	8.401929E-07	5.093914E-06	6.825013E-10
3-H	1.025165E-05	2.637668E-05	6.775766E-06
60-Co	1.897588E-06	1.150925E-05	6.773841E-10
90-Sr	2.251101E-02	1.365762E-01	1.437153E-09
99-Tc	5.315124E-04	3.223320E-03	2.669563E-07
125-Sb	6.485595E-05	3.931850E-04	1.619373E-07
Specific Mass (wt%)			
Ag+	0.0000851	0.0004528	0.0000000
Al+3	0.1407107	0.7486167	0.0001564
B+3	0.0002618	0.0013935	0.0000002
Ba+2	0.0001225	0.0006518	0.0000001
Bi+3	0.0001670	0.0008883	0.0000002
Ca+2	0.0023604	0.0125596	0.0000022
Cd+2	0.0006340	0.0033758	0.0000000
Cl-	0.0256441	0.1362996	0.0000587
CO3-2	0.3966942	2.1103727	0.0004730
Cr(TOTAL)	0.0140436	0.0747823	0.0000005
Cs+	0.0001128	0.0006007	0.0000000

F-	0.0209444	0.1115277	0.0000010
Fe+3	0.0111118	0.0591522	0.0000045
Hg+2	0.0001399	0.0007446	0.0000001
K+	0.0677068	0.3604479	0.0000230
La+3	0.0004065	0.0021647	0.0000000
Li+	0.0002899	0.0015438	0.0000000
Mg+2	0.0002586	0.0013766	0.0000001
Mn+4	0.0012678	0.0067511	0.0000001
Mo+6	0.0002105	0.0011200	0.0000002
Na+	1.8061286	9.6176128	0.0000717
NH3	0.0163755	0.0051900	0.0185725
Ni+2	0.0023278	0.0023372	0.0022779
NO2-	0.4747226	2.5269331	0.0002360
NO3-	3.5169979	18.6961248	0.0073514
OH(BOUND)	0.1876967	0.9986652	0.0001926
OH-	0.0301822	0.1605662	0.0000360
Pb+2	0.0007719	0.0040181	0.0000209
Phosphor containing components	0.0646907	0.3441493	0.0000768
Se+6	0.0010836	0.0057700	0.0000001
Si+4	0.0121852	0.0648277	0.0000137
SO4-2	0.0669264	0.3561423	0.0000570
Sr+2	0.0000854	0.0004544	0.0000001
Ti+4	0.0000312	0.0001660	0.0000000
TOC	0.0494322	0.2459911	0.0039049
U(TOTAL)	0.0002514	0.0013377	0.0000003
Zn+2	0.0001314	0.0006996	0.0000000
Zr+4	0.0115379	0.0613963	0.0000102
H2O	92.3882691	63.2687429	99.9664571
H+	0.0000000	0.0000000	0.0000000
CO2	0.0000000	0.0000000	0.0000000
Total Dissolved Solids (Na Excluded) (wt%)	5.0601243	26.7981844	0.0334712
Total Suspended Solids (wt%)	0.7454780	0.3154599	0.0000000

Note: Table extracted from 24590-PTF-M4C-V11T-00006 REV. B

APPENDIX B

TREATED LAW EVAPORATOR STREAM DATA

Stream Description	Feed Treated LAW	Feed Neutralized Effluent	Concentrated LAW	Condensate from LAW Evap
Specific Gravity	1.201279E+00	9.960371E-01	1.354830E+00	1.000211E+00
pH	1.400000E+01	1.199980E+01	1.400000E+01	1.108047E+01
Total Volume (gpm)	1.398842E+01	9.800359E+00	8.316158E+00	1.574299E+01
Total Mass (lb/hr)	8.395616E+03	4.877051E+03	5.629209E+03	7.867172E+03
Na Molarity	4.654928E+00	9.564147E-02	8.001080E+00	1.384081E-04
Activity (Ci/gallon)				
129-I	4.749081E-07	0.000000E+00	7.940393E-07	2.531875E-09
134-Cs	1.575297E-08	4.663790E-10	2.703969E-08	4.038980E-12
137-Cs	3.359384E-04	9.978015E-06	5.768332E-04	3.256697E-12
14-C	3.582432E-05	0.000000E+00	6.019971E-05	3.147259E-08
126-Sn	1.430030E-06	0.000000E+00	2.403044E-06	1.256318E-09
233-U	8.109593E-07	0.000000E+00	1.362748E-06	7.124486E-10
235-U	7.044819E-09	0.000000E+00	1.183822E-08	6.189054E-12
152-Eu	1.012468E-05	0.000000E+00	1.701366E-05	8.894794E-09
154-Eu	1.453164E-04	0.000000E+00	2.441918E-04	1.276642E-07
155-Eu	3.750157E-05	0.000000E+00	6.301818E-05	3.294609E-08
237-Np	6.467932E-07	0.000000E+00	1.086881E-06	5.682244E-10
238-Pu	1.128371E-06	0.000000E+00	1.898007E-06	2.681847E-13
239-Pu	2.250086E-05	0.000000E+00	3.784818E-05	5.347876E-12
240-Pu	6.141525E-06	0.000000E+00	1.033052E-05	1.459683E-12
241-Am	1.046161E-04	0.000000E+00	1.759723E-04	6.571346E-11
243-Am	4.604254E-05	0.000000E+00	7.744709E-05	1.094313E-11
242-Cm	3.178432E-07	0.000000E+00	5.341082E-07	2.792334E-10
241-Pu	4.604254E-05	0.000000E+00	7.744709E-05	1.094313E-11
243-Cm	4.969903E-08	0.000000E+00	8.351496E-08	4.366187E-11
244-Cm	9.701220E-07	0.000000E+00	1.630207E-06	8.522771E-10
3-H	4.475971E-05	0.000000E+00	3.012124E-05	2.385981E-05
60-Co	5.350007E-06	0.000000E+00	8.990228E-06	4.700118E-09
90-Sr	1.768254E-02	0.000000E+00	2.974328E-02	6.760816E-08
99-Tc	1.119640E-04	0.000000E+00	1.881459E-04	9.836324E-08
125-Sb	2.554858E-04	0.000000E+00	4.293221E-04	2.244509E-07
Specific Mass (wt%)				
Ag+	0.0001789	0.0000000	0.0002666	0.0000002
Al+3	0.8781368	0.0000000	1.3083917	0.0009266
B+3	0.0011040	0.0000000	0.0016449	0.0000012
Ba+2	0.0003972	0.0000000	0.0005919	0.0000004
Bi+3	0.0009166	0.0000000	0.0013656	0.0000010
Ca+2	0.0036401	0.0000000	0.0054235	0.0000039
Cd+2	0.0001758	0.0000000	0.0002620	0.0000002
Cl-	0.1927241	0.3081970	0.5533995	0.0007536
CO3-2	1.8709695	0.0000000	2.7876764	0.0019741
Cr(TOTAL)	0.0436851	0.0000000	0.0651518	0.0000013

Cs+	0.0000002	0.0000000	0.0000003	0.0000000
F-	0.1369480	0.0311205	0.2312023	0.0000068
Fe+3	0.0051922	0.0000000	0.0077362	0.0000055
Hg+2	0.0002119	0.0017125	0.0002775	0.0000002
K+	0.4371071	0.0000000	0.6517338	0.0001319
La+3	0.0000717	0.0000000	0.0001068	0.0000001
Li+	0.0001031	0.0000000	0.0001537	0.0000001
Mg+2	0.0007039	0.0000000	0.0010487	0.0000007
Mn+4	0.0003630	0.0000000	0.0005408	0.0000004
Mo+6	0.0014914	0.0000000	0.0022221	0.0000016
Na+	8.9124915	0.2205096	13.4830308	0.0003183
NH3	0.0556091	0.0000000	0.0046946	0.0559853
Ni+2	0.0010718	0.0000000	0.0000905	0.0010791
NO2-	3.6214624	0.0000000	5.3989608	0.0015931
NO3-	8.2610982	0.1691503	12.4458561	0.0154626
OH(BOUND)	1.2709676	0.0000000	1.8936954	0.0013410
OH-	1.9297357	0.0170413	2.8899856	0.0020466
Pb+2	0.0022422	0.0000000	0.0032374	0.0000764
Phosphor containing components	0.2305136	0.0000000	0.3434569	0.0002432
Se+6	0.0007265	0.0000000	0.0010825	0.0000008
Si+4	0.0190601	0.0000000	0.0283989	0.0000201
SO4-2	0.4242482	0.0000000	0.6322928	0.0003199
Sr+2	0.0002059	0.0000000	0.0003067	0.0000002
Ti+4	0.0000875	0.0000000	0.0001303	0.0000001
TOC	0.1782369	0.0000016	0.2481087	0.0126807
U(TOTAL)	0.0014123	0.0000000	0.0021042	0.0000015
Zn+2	0.0001606	0.0000000	0.0002393	0.0000002
Zr+4	0.0092074	0.0000000	0.0137187	0.0000097
H2O	71.5070307	98.7871894	55.3633120	99.9050111
H+	0.0000000	0.0000000	0.0000000	0.0000000
CO2	0.0000000	0.0000000	0.0000000	0.0000000
Total Dissolved Solids (Na Excluded) (wt%)	19.5804777	0.5272233	29.5260185	0.0946707
Total Suspended Solids (wt%)	0.0000000	0.4650777	1.6276387	0.0000000

Note: Table extracted from 24590-PTF-M4C-V11T-00006 REV. B

APPENDIX C

Predicted Maximum Radionuclide

Stream Number	Waste Feed Evaporators			Treated LAW Evaporator		
Stream Description	FEP Feed	FEP Concentrate	FEP Overhead	TLP Feed	TLP Concentrate	TLP overhead
Specific Gravity	1.108297E+00	1.291591E+00	1.000111E+00	1.105304E+00	1.278000E+00	1.000163E+00
pH	1.312459E+01	1.389913E+01	1.017151E+01	1.321351E+01	1.386570E+01	1.029492E+01
Total Volume (gpm)	1.921589E+01	3.462492E+00	2.248903E+00	1.074593E+01	2.391253E+00	1.179073E+00
Total Mass (lb/hr)	1.066579E+04	2.239702E+03	8.426084E+03	5.948428E+03	1.530498E+03	4.417929E+03
Na Molarity	1.678973E+00	1.000000E+01	6.235205E-05	2.217504E+00	9.964802E+00	8.915611E-05
Activity (Ci/gallon)						
129-I	1.118972E-06	5.133318E-06	1.657679E-06	6.388461E-07	2.124451E-06	1.513816E-06
134-Cs	1.129467E-04	6.250516E-04	2.728177E-06	2.084563E-08	9.341234E-08	5.370692E-10
137-Cs	4.359059E+00	2.419159E+01	2.232506E-06	4.525083E-04	2.033504E-03	4.407797E-10
14-C	1.530790E-05	8.491637E-05	5.895986E-08	8.056168E-06	3.616737E-05	7.268873E-08
126-Sn	1.923017E-04	1.067222E-03	1.486077E-10	2.043400E-08	9.173655E-08	1.841322E-10
233-U	1.150416E-06	6.384484E-06	1.248818E-11	1.717230E-09	7.709344E-09	1.547408E-11
235-U	6.946466E-07	3.853045E-06	3.162332E-09	4.348219E-07	1.952093E-06	3.918211E-09
152-Eu	6.188336E-04	3.434357E-03	6.581440E-10	9.049626E-08	4.062746E-07	8.154683E-10
154-Eu	6.562753E-02	3.642143E-01	8.345943E-07	1.147543E-04	5.151790E-04	1.034060E-06
155-Eu	3.737761E-02	2.074354E-01	2.034016E-07	2.796783E-05	1.255590E-04	2.520201E-07
237-Np	9.537993E-05	5.293324E-04	2.536272E-10	3.487470E-08	1.565667E-07	3.142584E-10
238-Pu	4.520421E-04	2.508710E-03	2.573295E-11	1.309172E-06	5.883206E-06	3.191544E-11
239-Pu	3.985830E-03	2.212027E-02	5.228669E-11	2.660106E-06	1.195409E-05	6.484898E-11
240-Pu	2.153818E-04	1.195310E-03	4.564062E-11	2.321981E-06	1.043461E-05	5.660605E-11
241-Am	4.833846E-02	2.682652E-01	3.172753E-09	6.111128E-05	2.746230E-04	3.937305E-09
241-Pu	2.838034E-02	1.575032E-01	8.472452E-10	4.310391E-05	1.937020E-04	1.050802E-09
242-Cm	4.706917E-15	2.611634E-14	8.863463E-18	1.212658E-15	5.444115E-15	1.092735E-17
243-Am	1.646951E-06	9.139638E-06	7.551321E-10	1.033137E-07	4.638171E-07	9.309668E-10
243-Cm	1.726031E-04	9.578996E-04	7.809701E-10	1.073837E-07	4.820890E-07	9.676419E-10
244-Cm	3.700041E-03	2.053421E-02	1.637305E-08	2.251301E-06	1.010701E-05	2.028663E-08
3-H	2.663313E-04	8.683912E-04	9.386773E-04	1.255884E-04	2.257503E-04	6.867589E-04
60-Co	1.287961E-02	7.147826E-02	6.882351E-08	9.462625E-06	4.248158E-05	8.526838E-08
90-Sr	1.320134E+01	7.326381E+01	2.292527E-06	7.286412E-03	3.274264E-02	2.857525E-06
99-Tc	3.006068E-02	1.668241E-01	6.876193E-06	2.174950E-04	9.764235E-04	1.959863E-06
125-Sb	4.141097E-02	2.298192E-01	6.367954E-09	8.755757E-07	3.930816E-06	7.889875E-09
Specific Mass (wt%)						
Ag+	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Al+3	0.635506	3.025530	0.000224	0.266638	1.035288	0.000355
B+3	0.000135	0.000642	0.000000	0.080263	0.311642	0.000107
Ba+2	0.000074	0.000352	0.000000	0.000044	0.000172	0.000000
Bi+3	0.000068	0.000325	0.000000	0.000001	0.000004	0.000000
Ca+2	0.024847	0.117371	0.000000	0.050340	0.195456	0.000068
Cd+2	0.000067	0.000320	0.000000	0.000159	0.000619	0.000000
Cl-	0.003163	0.015034	0.000008	0.005424	0.021042	0.000014

CO3-2	1.242770	5.913663	0.001220	1.128055	4.379954	0.001504
Cr(TOTAL)	0.035967	0.171277	0.000001	0.030544	0.118710	0.000001
Cs+	0.001630	0.007759	0.000001	0.000000	0.000001	0.000000
F-	0.044968	0.214134	0.000002	0.067028	0.260499	0.000004
Fe+3	0.482484	2.297630	0.000007	0.019977	0.077566	0.000027
Hg+2	0.000456	0.002170	0.000000	0.000000	0.000000	0.000000
K+	1.096415	5.219836	0.000385	1.327461	5.157862	0.000500
La+3	0.010410	0.049572	0.000000	0.000119	0.000464	0.000000
Li+	0.000448	0.002130	0.000001	0.018270	0.070937	0.000024
Mg+2	0.000003	0.000016	0.000000	0.009913	0.038490	0.000013
Mn+4	0.047130	0.224438	0.000000	0.000360	0.001397	0.000000
Mo+6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Na+	3.931713	18.722852	0.000143	4.614350	17.933525	0.000205
NH3	0.011529	0.032152	0.006048	0.000354	0.000000	0.000448
Ni+2	0.021794	0.101921	0.000495	0.000086	0.000020	0.000108
NO2-	1.354414	6.447289	0.000698	1.559829	6.059939	0.000861
NO3-	4.344527	20.654158	0.009333	6.329382	24.557934	0.014488
OH(BOUND)	1.748240	8.324258	0.000297	0.274711	1.066633	0.000366
OH-	0.201424	0.958261	0.000252	0.251582	0.976831	0.000335
Pb+2	0.011534	0.054916	0.000003	0.000091	0.000342	0.000004
Phosphor components	0.040853	0.194443	0.000028	0.026038	0.101099	0.000035
Se+6	0.001869	0.008898	0.000001	0.001729	0.006714	0.000002
Si+4	0.074861	0.356440	0.000016	0.083117	0.322721	0.000111
SO4-2	0.494661	2.353991	0.000441	0.869199	3.375827	0.000831
Sr+2	0.001500	0.007143	0.000000	0.000039	0.000151	0.000000
Ti+4	0.000406	0.001934	0.000000	0.000638	0.002479	0.000001
TOC	2.874880	13.677296	0.003535	3.269664	12.695283	0.004358
U(TOTAL)	0.121728	0.579682	0.000001	0.000868	0.003370	0.000001
Zn+2	0.000235	0.001118	0.000000	0.030679	0.119120	0.000041
Zr+4	0.266983	1.271405	0.000001	0.008245	0.032015	0.000011
H2O	80.763931	8.482255	99.976817	79.669593	21.055761	99.975139
H+	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
CO2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Total Dissolved Solids (Na Excluded) (wt%)	11.304045	53.744832	0.023039	15.716052	61.010697	0.024656
Total Suspended Solids (wt%)	4.000310	19.050061	0.000000	0.000004	0.000016	0.000000

Note: Information contained in this table is from 24590-PTF-M4C-V11T-00008 REV. A. which is the best available data at time of release. Table will be updated to current information when it becomes available in the next revision.

APPENDIX D

EVAPORATOR PROCESS DATA

PROCESS DATA SHEET: Mechanical Pump

PLANT ITEM No.
24590-PTF-FEP-PMP-00007A

Project:	RPP-WTP		System:		FEP		
Project No:	24590		Description:		Waste Feed Evaporator Feed Pump		
Site:	Hanford		Supporting Calcs No.		24590-PTF-MEC-FEP-00001, Rev. A		
Building No.:	10		Associated Drawings:		24590-PTF-M5-V177-00004001, Rev. B		
PROCESS DATA	Units	Mode 1 (Note 1)	Mode 2 (Note2)	Mode 3 (Note 3)	Mode 4	ETC.	
Capacity Normal (Note 4)	gpm	50	39	36			
Capacity Rated	gpm	60	N/A	N/A			
Minimum Pumping Temperature	°F	59	59	59			
Normal Pumping Temperature	°F	77	77	77			
Maximum Pumping Temperature	°F	122	122	122			
Density at Normal Pumping Temperature (Note 7)	lb/ft³	75.9	67.8	68.9			
Sp Gravity at Normal Pumping Temperature (Note 7)		1.23	1.08	1.10			
Viscosity at Normal Pumping Temperature	cP	11.8	11.8	11.8			
Vapor Press at Normal Pumping Temp	psia	0.43	0.44	0.44			
Origin Pressure	psia	14.61	14.61	14.61			
Delivery Pressure	psia	(Note 5)	(Note 5)	(Note 5)			
FLUID COMPOSITION							
Content Code (e.g., Type/Name of Liquid)							
Solids Content	% wt/wt	4	7	2			
Solids Size Range	microns	(Note 6)	(Note 6)	(Note 6)			
Solids Characteristics		(Note 6)	(Note 6)	(Note 6)			

Notes:
1. Mode 1 represents Envelope A waste feed and recycles required to meet production rate of 60 Mt/d LAW glass.
2. Mode 1 represents Envelope B waste feed and recycles required to meet production rate of 60 Mt/d LAW glass.
3. Mode 1 represents Envelope C waste feed and recycles required to meet production rate of 30 Mt/d LAW glass.
4. Minimum flowrate is 20 gpm for Envelope A, 25 gpm for Envelope B, and 23 gpm for Envelope C.
5. Delivery pressure to be determined by waste feed evaporator vendor.
6. Solids size range and characteristics to be determined by R&T.
7. Density and Specific Gravity based on pretreated AW-101 of same molarity. Does not include weight percent solids.

PROCESS DATA SHEET: Mechanical Pump

PLANT ITEM No.
24590-PTF-FEP-PMP-000078

Project:	RPP-WTP		System:		FEP		
Project No:	24590		Description:		Waste Feed Evaporator Feed Pump		
Site:	Hanford		Supporting Calcs No.		24590-PTF-MEC-FEP-00001, Rev. A		
Building No.:	10		Associated Drawings:		24590-PTF-M5-V17T-00004001, Rev. B		
PROCESS DATA	Units	Mode 1 (Note 1)	Mode 2 (Note2)	Mode 3 (Note 3)	Mode 4	ETC	
Capacity Normal (Note 4)	gpm	50	39	36			
Capacity Rated	gpm	60	N/A	N/A			
Minimum Pumping Temperature	°F	59	59	59			
Normal Pumping Temperature	°F	77	77	77			
Maximum Pumping Temperature	°F	122	122	122			
Density at Normal Pumping Temperature (Note 7)	lb/ft³	75.9	67.6	68.9			
Sp Gravity at Normal Pumping Temperature (Note 7)	———	1.23	1.08	1.10			
Viscosity at Normal Pumping Temperature	cP	11.8	11.8	11.8			
Vapor Press at Normal Pumping Temp	psia	0.43	0.44	0.44			
Origin Pressure	psia	14.61	14.61	14.61			
Delivery Pressure	psia	(Note 5)	(Note 5)	(Note 5)			
FLUID COMPOSITION							
Content Code (e.g., Type/Name of Liquid)							
Solids Content	% w/wt	4	7	2			
Solids Size Range	microns	(Note 6)	(Note 6)	(Note 6)			
Solids Characteristics	———	(Note 6)	(Note 6)	(Note 6)			

Notes:
1. Mode 1 represents Envelope A waste feed and recycles required to meet production rate of 60 Mt/d LAW glass.
2. Mode 1 represents Envelope B waste feed and recycles required to meet production rate of 60 Mt/d LAW glass.
3. Mode 1 represents Envelope C waste feed and recycles required to meet production rate of 30 Mt/d LAW glass.
4. Minimum flowrate is 20 gpm for Envelope A, 25 gpm for Envelope B, and 23 gpm for Envelope C.
5. Delivery pressure to be determined by waste feed evaporator vendor.
6. Solids size range and characteristics to be determined by R&T.
7. Density and Specific Gravity pretreated AW-101 of same molarity. Does not include weight percent solids.

BECHTEL

PROCESS DATA SHEET: Mechanical Pump

PLANT ITEM No.
24590-PTF-FEP-PMP-00008A

Project:	RPP-WTP	System:	FEP
Project No:	24590	Description:	Waste Feed Evaporator Concentrate Pump
Site:	DOE Hanford	Supporting Calcs No.	24590-PTF-MEC-FEP-00001, Rev. A
Building No.:	10	Associated Drawings:	24590-PTF-M5-V17T-00004002, Rev. B

PROCESS DATA	Units	Mode 1 (Note 1)	Mode 2 (Note2)	Mode 3(Note 3)	Mode 4	ETC
Capacity Normal (Note 4)	gpm	28	14	14		
Capacity Rated	gpm	34	N/A	N/A		
Minimum Pumping Temperature	°F	59	59	59		
Normal Pumping Temperature	°F	122	122	122		
Maximum Pumping Temperature	°F	122	122	122		
Density at Normal Pumping Temperature (Note 7)	lb/ft³	75.9	75.9	76.6		
Sp Gravity at Normal Pumping Temperature (Note 7)		1.23	1.23	1.25		
Viscosity at Normal Pumping Temperature	cP	5.5	5.5	5.5		
Vapor Press at Normal Pumping Temp	psia	1.3	1.3	1.2		
Origin Pressure	psia	Note 5	Note 5	Note 5		
Delivery Pressure	psia	14.6	14.6	14.6		
FLUID COMPOSITION						
Content Code (e.g., Type/Name of Liquid)						
Solids Content	% w/w	5	15	3		
Solids Size Range	microns	Note 6	Note 6	Note 6		
Solids Characteristics		Note 6	Note 6	Note 6		

Notes:
1. Mode 1 represents Envelope A concentrate required to meet production rate of 60 Mt/d LAW glass.
2. Mode 2 represents Envelope B concentrate required to meet production rate of 60 Mt/d LAW glass.
3. Mode 3 represents Envelope C concentrate required to meet production rate of 30 Mt/d LAW glass.
4. Minimum flowrate is 12 gpm for Envelope A, 4 gpm for Envelope B, and 3 gpm for Envelope C.
5. Origin pressure to be determined by treated LAW evaporator vendor.
6. Solids size range and characteristics to be determined by R&T.
7. Density and Specific Gravity based on pretreated AW-101 solutions of same molarity. Does not include weight percent solids.

BECHTEL

PROCESS DATA SHEET: Mechanical Pump

PLANT ITEM No.
24590-PTF-FEP-PMP-000088

Project:	RPP-WTP	System:	FEP
Project No:	24590	Description:	Waste Feed Evaporator Concentrate Pump
Site:	Hanford	Supporting Calcs No.	24590-PTF-MEC-FEP-00001, Rev. A
Building No.:	10	Associated Drawings:	24590-PTF-M5-V177-00004002, Rev. B

PROCESS DATA	Units	Mode 1 (Note 1)	Mode 2 (Note2)	Mode 3(Note 3)	Mode 4	ETC.
Capacity Normal (Note 4)	gpm	28	14	14		
Capacity Rated	gpm	34	N/A	N/A		
Minimum Pumping Temperature	°F	59	59	59		
Normal Pumping Temperature	°F	122	122	122		
Maximum Pumping Temperature	°F	122	122	122		
Density at Normal Pumping Temperature (Note 7)	lb/ft³	75.9	75.9	76.6		
Sp Gravity at Normal Pumping Temperature (Note 7)		1.23	1.23	1.26		
Viscosity at Normal Pumping Temperature	cP	5.5	5.5	5.5		
Vapor Press at Normal Pumping Temp	psia	1.3	1.3	1.2		
Origin Pressure	psia	Note 5	Note 5	Note 5		
Delivery Pressure	psia	14.6	14.6	14.6		
FLUID COMPOSITION						
Content Code (e.g. Type/Name of Liquid)						
Solids Content	% wt/wt	5	15	3		
Solids Size Range	microns	Note 6	Note 6	Note 6		
Solids Characteristics		Note 6	Note 6	Note 6		

Notes:
1. Mode 1 represents Envelope A concentrate required to meet production rate of 60 Mt/d LAW glass.
2. Mode 2 represents Envelope B concentrate required to meet production rate of 60 Mt/d LAW glass.
3. Mode 3 represents Envelope C concentrate required to meet production rate of 30 Mt/d LAW glass.
4. Minimum flowrate is 12 gpm for Envelope A, 4 gpm for Envelope B, and 3 gpm for Envelope C.
5. Origin pressure to be determined by treated LAW evaporator vendor.
6. Solids size range and characteristics to be determined by R&T.
7. Density and Specific Gravity based on pretreated AW-101 solutions of same molarity. Does not include weight percent solids.

PROCESS DATA SHEET: Evaporator

PLANT ITEM No.
24590-PTF-FEP-EVAP-00001A

Project:	RPP-WTP	System:	FEP
Project No:	24590	Description:	Waste Feed Evaporator
Site:	Hanford	Supporting Calcs No.	24590-PTF-MEC-FEP-00001, Rev. 8
Building No.:	10	Associated Drawings:	24590-PTF-M6-V11T-00004002, Rev. 0

UTILITIES DATA	Units	Cooling Water	Low Pressure Steam	High Pressure Steam	Instrument Air
		Note 1	Note 2	Note 3	
Temperature	°F	90	388	343	60
Pressure	psig	85	40	109	100

PROCESS DATA	Units	Envelope A					Evaporator Bypass (Envelop A) Feed (Recycle)		
		Feed		Concentrate	Overheads	Condensate			
		Minimum Na	Maximum Na				Minimum Na (Note 14)	Maximum Na (Note 14)	Concentrate (Note 14)
Liquid Flow (Note 4)	lb_m/hr	11,000	27,000	7,000 (Note 7)	N/A	14,800 (Note 8)	14,200	16,300 (Note 13)	14,200
Vapor Flow	lb_m/hr	N/A	N/A	N/A	Notes 5,6				
Noncondensables Flow	lb_m/hr	N/A	N/A	N/A	14,800	N/A	N/A	N/A	N/A
Temperature (Note 6)	°F	77	77	122	42.7	N/A	N/A	N/A	N/A
Na Molarity		1.4	4	5	111	111	77	77	122
Density	lb_m/ft^3	67.8	78.9	74.0	N/A	0	0.3	1	5
Specific Gravity		1.09	1.22	1.25	0.0039	61.9	63.4	66.6	76.9
Viscosity	cp	11.8	11.8	6.5	N/A	1	1.02	1.07	1.23
Specific Heat	$BTU/lb_m°F$	0.93	0.86	0.86	0.01	0.7	11.8	11.8	6.5
Thermal Conductivity	$BTU/hr\ ft\ °F$	0.36	0.34	0.39	0.45	1	0.90	0.94	0.68
					0.01	0.37	0.353	0.369	0.39

	Units	Envelope B			Envelope C		
		Feed		Concentrate	Feed		Concentrate
		Minimum Na	Maximum Na		Minimum Na	Maximum Na	
Liquid Flow (Note 4)	lb_m/hr	13,000	21,100	5,490 (Note10)	11,900	19,900	6790 (Note 11)
Vapor Flow	lb_m/hr	N/A	N/A	N/A	N/A	N/A	N/A
Non-Condensables Flow	lb_m/hr	N/A	N/A	N/A	N/A	N/A	N/A
Temperature (Note 6)	°F	77	77	122	77	77	122
Na Molarity		0.76	1.81	5	0.77	2.36	4
Density (Note 12)	$lbm/ft3$	64.6	67.8	74.0	64.9	68.9	76.6
Specific Gravity (Note 12)		1.04	1.08	1.21	1.04	1.10	1.25
Viscosity	cP	11.8	11.8	5.5	11.8	11.8	5.5
Specific Heat	$BTU/lbm°F$	0.94	0.91	0.89	0.94	0.91	0.88
Thermal Conductivity	$BTU/hr\ ft\ °F$	0.377	0.365	0.38	0.377	0.365	0.39

Notes:
1. Maximum temperature and pressure of cooling water supply.
2. Temperature and pressure of steam supply.
3. Delete.
4. Evaporator to require 60% turndown capability.
5. Evaporator overheads prior to condensate removal.
6. Vacuum system to enable concentration of feed at reduced temperature
7. Maximum transfer rate. Minimum Transfer rate is 7,300 lbs/hr
8. Maximum evaporator overhead condensate production capacity. Envelope A average conditions require 11,800 lbs/hr.
9. Maximum overhead vapor and noncondensable flow. Average vapor flow is 11,800 lbs/hr. Noncondensable flow also applies to average conditions.
10. Maximum transfer rate. Minimum transfer rate is 2430 lbs/hr
11. Maximum transfer rate. Minimum transfer rate is 1880 lbs/hr.
12. Density and Specific Gravity based on sodium hydroxide solutions of same molarity. Does not include weight percent solids.
13. Maximum transfer rate. Minimum transfer rate is 7,300 lbs/hr.
14. Based on evaporator semibatch operation.

PROCESS DATA SHEET: Evaporator

PLANT ITEM No.
24590-PTF-FEP-EVAP-000019

Project:	RPP-WTP	System:	FEP
Project No:	24590	Description:	Waste Feed Evaporator
Site:	Hanford	Supporting Calcs No.	24590-PTF-MEC-FEP-00001, Rev. 0
Building No.:	16	Associated Drawings:	24590-PTF-M6V171-00004002, Rev. 0

UTILITIES DATA	Units	Cooling Water	Low Pressure Steam	High Pressure Steam	Instrument Air
Temperature	°F	Note 1	Note 2	Note 2	
Pressure	psig	63	255	543	60
		65	40	100	100

PROCESS DATA	Units	Envelope A Feed Minimum Na	Envelope A Feed Maximum Na	Envelope A Concentrate	Envelope A Overheads	Envelope A Condensate	Evaporator Bypass (Envelop A) Feed (Recycles) Minimum Na (Note 14)	Evaporator Bypass (Envelop A) Feed (Recycles) Maximum Na (Note 14)	Evaporator Bypass (Envelop A) Concentrate (Note 14)
Liquid Flow (Note 4)	lb_m/hr	11,000	27,000	7,000 (Note 7)	N/A	14,900 (Note 8)	14,200	16,200 (Note 13)	14,200
Vapor Flow	lb_m/hr	N/A	N/A	N/A	14,900	N/A	N/A	N/A	N/A
Noncondensables Flow	lb_m/hr	N/A	N/A	N/A	42.7	N/A	N/A	N/A	N/A
Temperature (Note 6)	°F	77	77	122	111	111	77	77	122
Na Molarity		1.4	4	5	N/A	0	0.2	1	5
Density	lb_m/ft^3	67.8	75.9	74.0	0.0039	61.8	63.4	66.5	75.9
Specific Gravity		1.06	1.22	1.23	N/A	1	1.02	1.07	1.23
Viscosity	Cp	11.8	11.8	5.5	0.01	0.7	11.8	11.8	5.5
Specific Heat	$BTU/lb_m\cdot°F$	0.93	0.88	0.68	0.45	1	0.90	0.84	0.68
Thermal Conductivity	$BTU/hr\ ft\ °F$	0.39	0.38	0.39	0.01	0.37	0.353	0.360	0.39

	Units	Envelope B Feed Minimum Na	Envelope B Feed Maximum Na	Envelope B Concentrate	Envelope C Feed Minimum Na	Envelope C Feed Maximum Na	Envelope C Concentrate
Liquid Flow (Note 4)	lb_m/hr	13,000	21,100	6,490 (Note 10)	11,900	19,800	6790 (Note 11)
Vapor Flow	lb_m/hr	N/A	N/A	N/A	N/A	N/A	N/A
Non-Condensables Flow	lb_m/hr	N/A	N/A	N/A	N/A	N/A	N/A
Temperature (Note 6)	°F	77	77	122	77	77	122
Na Molarity		0.78	1.81	5	0.77	2.90	5
Density (Note 12)	$kgm/m3$	64.9	67.6	74.0	64.9	66.8	76.5
Specific Gravity (Note 12)		1.04	1.08	1.21	1.04	1.10	1.26
Viscosity	cP	11.8	11.8	5.5	11.8	11.8	3.5
Specific Heat	$BTU/lbm\ °F$	0.94	0.91	0.68	0.94	0.91	0.68
Thermal Conductivity	$BTU/hr\ ft\ °F$	0.377	0.365	0.39	0.377	0.366	0.39

Notes:
1. Maximum temperature and pressure of cooling water supply.
2. Temperature and pressure of steam supply.
3. Delete.
4. Evaporator to require 50% turndown capability.
5. Evaporator overheads prior to condensate removal.
6. Vacuum system to enable concentration of feed at reduced temperature.
7. Maximum transfer rate. Minimum Transfer rate is 7,300 lbs/hr.
8. Maximum evaporator overhead condensate production capacity. Envelope A average conditions require 11,600 lbs/hr.
9. Maximum overhead vapor and noncondensable flow. Average vapor flow is 11,800 lbs/hr. Noncondensable flow also applies to average conditions.
10. Maximum transfer rate. Minimum transfer rate is 2430 lbs/hr.
11. Maximum transfer rate. Minimum transfer rate is 1890 lbs/hr.
12. Density and Specific Gravity based on sodium hydroxide solutions of same molarity. Does not include weight percent solids.
13. Maximum transfer rate. Minimum transfer rate is 7,300 lbs/hr.
14. Based on evaporator rerefluxch operation.

PROCESS DATA SHEET: VESSEL & PUMPS				Plant Item No. 24590-PTF-MV-TLP-VSL-00009A 24590-PTF-MV-TLP-VSL-00009B 24590-PTF-MV-TLP-PMP-00005A 24590-PTF-MV-TLP-PMP-00005B
Project: RPP-WTP				
Project No: 24590	Description: Treated LAW SBS Condensate Receipt Vessels and Pumps			
Site: Hanford				
Building No.: 10	Associated Drawing: 24590-PTF-M5-V17T-00005			
SUMMARY DATA	Units	Minimum	Nominal	Maximum
Batch Volume	Gal	N/A	80,000	N/A
Transfer Rate	gpm	10	13	38
Receipt Rate	gpm	N/A	175	N/A
Fluid Temperature	°F	68	113	167
Specific Gravity	N/A	1.02	1.02	1.02
Viscosity	cP	1	1	1
Internal Pressure	psig	-0.22	-0.14	0
Solids Content	wt %	0.30	0.34	0.41

PROCESS DATA SHEET: SYSTEM TLP				
Project: RPP-WTP				
Project No: 24590		Description: Treated LAW Evaporation - System TLP		
Site: Hanford				
Building No.: 10		Associated Drawing: 24590-PTF-M5-V17T-00005		
SUMMARY DATA	Units	Minimum	Nominal	Maximum
Treated LAW (TXP14)				
Transfer Rate	gpm	11.4	14.3	17.9
Fluid Temperature	°F	59	77	113
Specific Gravity	N/A	1.15	1.20	1.22
Viscosity	cP	2.0	3.3	4.0
LAW SBS Condensate (RLD21)				
Batch Volume	Gal	N/A	80,000	N/A
Transfer Rate	gpm	10	13	38
Receipt Rate	gpm	N/A	175	N/A
Fluid Temperature	°F	68	113	167
Specific Gravity	N/A	1.02	1.02	1.02
Viscosity	cP	1	1	1
Thermal Conductivity	BTU/(hr*ft-°F)	N/A	0.372	N/A
Treated LAW Concentrate (TLP02)				
Transfer Rate	gpm	5.6	9.2	13.7
Fluid Temperature	°F	77	122	150
Specific Gravity	N/A	1.33	1.40	1.57
Viscosity	cP	12.8	12.8	30.0
Vapor Pressure	torr	55	67	77
Thermal Conductivity	BTU/(hr*ft-°F)	N/A	0.397	0.399

APPENDIX E

Quality Level and Seismic Category for Evaporator Equipment

FEP Separator Vessels	FEP-SEP-00001A/B	QL-1	SC-I
• Demister Pads	Pad Materials	CM	SC-II
• Upper Demister Pad Supports	Structural supports	CM	SC-II
• Lower Demister Pad Supports	Structural supports	QL-2	SC-II
• Internal Piping/Misc.	Bubble trays, spray rings, dip legs, etc.	QL-2	SC-II
TLP Separator Vessel	TLP-SEP-00001	QL-1*	SC-I*
• Demister Pads	Pad Materials	CM	SC-II
• Upper Demister Pad Supports	Structural supports	CM	SC-II
• Lower Demister Pad Supports	Structural supports	QL-2	SC-II
• Internal Piping/Misc.	Bubble trays, spray rings, dip legs, etc.	QL-2	SC-II
Reboilers	FEP-RBLR-00001A/B	QL-1	SC-I
	TLP-RBLR-00001	QL-1*	SC-I*
Recirculation Pumps, Motors, Speed Adjustable Drives, and Seal Barrier Systems	FEP-PMP-00009A/B, FEP-MTR-00009A/B	QL-1	SC-I
	TLP-PMP-00001, TLP-MTR-00001	QL-1*	SC-I*
	FEP-ASD-00009A/B, TLP-ASD-00001, and Pump Seal Barrier Systems	CM	SC-III
Feed Pumps, Motors, and Speed Adjustable Drives	TLP-PMP-00005A/B, TLP-MTR-00005A/B, TLP-ASD-00005A/B	CM	SC-III
Concentrate Pumps, Motors, and Speed Adjustable Drives	TLP-PMP-00011A/B, TLP-MTR-00011A/B, TLP-ASD-00011A/B	CM	SC-III
Black Cell Separator Vessel Offgas Pipework	Piping from the top section of the FEP Evaporator separator vessels to the 56' Elev. floor (ceiling of black cell).	QL-1	SC-I*
	Piping from the top section of the TLP Evaporator separator vessel to the 56' Elev. floor (ceiling of black cell).	QL-1*	SC-I*
Out-Cell Separator Vessel Offgas Pipework	Piping from 56' Elev. floor to the FEP Evaporator primary condenser in C3 room.	QL-1	SC-I*
	Piping from 56' Elev. floor to the TLP Evaporator primary condenser in C3 room.	QL-1*	SC-I*
	FEP-COND-00001A/B FEP-COND-00002A/B FEP-COND-00003A/B FEP-EJCTR-00040, -00041, -00042,and -00043	QL-1	SC-I*
	TLP-COND-00001 TLP-COND-00002 TLP-COND-00003 TLP-EJCTR-000064 and -00067	QL-1*	SC-I*
Condensate Collection Vessels	FEP-VSL-00005	CM	SC-III
	TLP-VSL-00002	CM	SC-III
Condensate Pumps, Motors, and Speed Adjustable Drives	FEP-PMP-00006A/B, FEP-MTR-00006A/B, FEP-ASD-00006A/B	CM	SC-III

	TLP-PMP-00002A/B, TLP-MTR-00002A/B, FEP-ASD-00002A/B	CM	SC-III
Antifoam Vessel	AFR-TK-00001	CM	SC-IV
Antifoam Pumps	AFR-PMP-00006, -00007, and –00008	CM	SC-IV
Steam Conditioning Skids	FEP Steam Conditioning Skids	CM	SC-III
	TLP Steam Conditioning Skid	CM	SC-III
Reboiler Steam Condensate Transfer Stations	FEP-VSL-00021, FEP-PMP-00010A/B FEP-VSL-00022, FEP-PMP-00011A/B	CM	SC-III
	TLP-VSL-00047, TLP-PMP-00012A/B	CM	SC-III

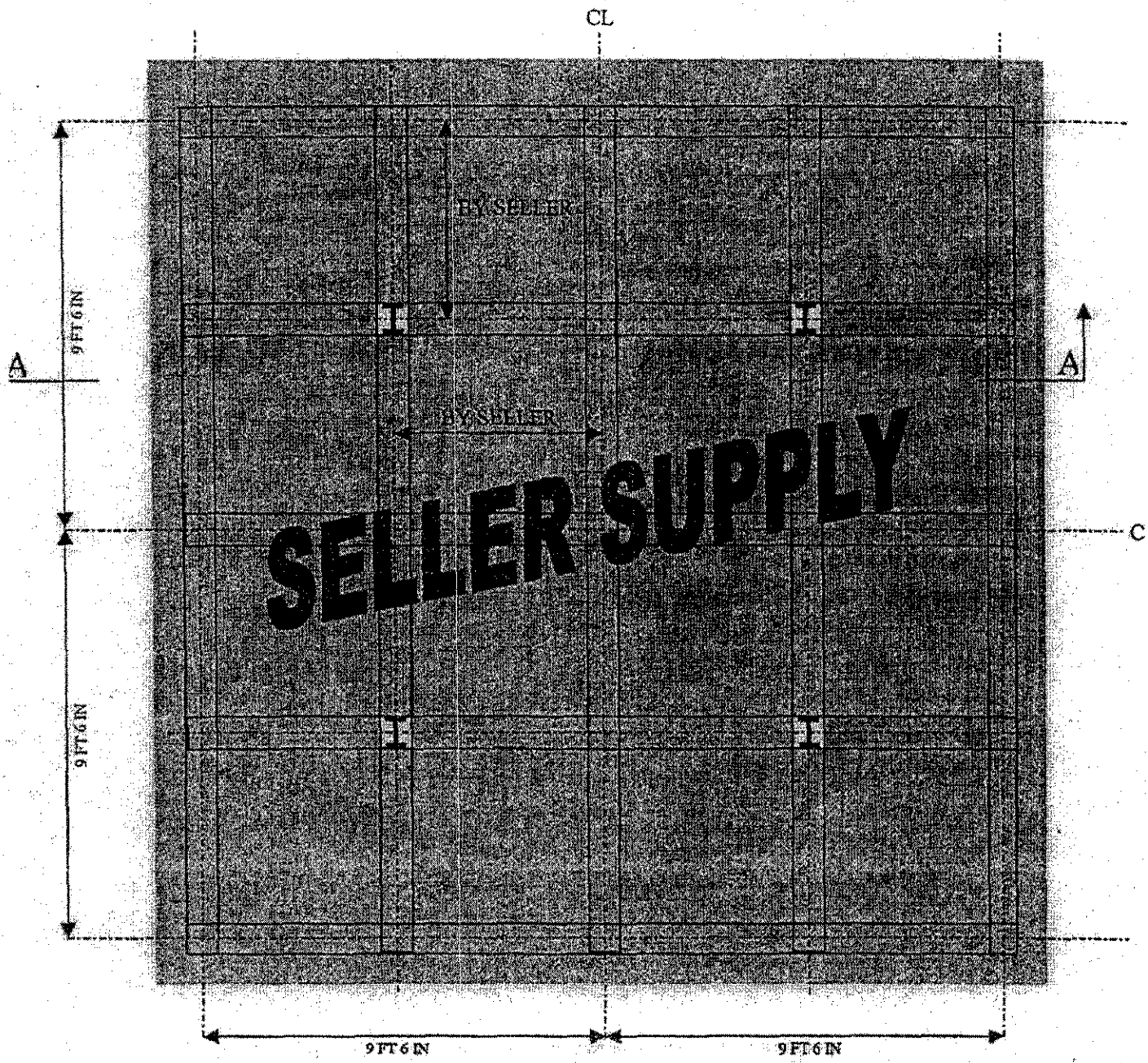
*These quality level and seismic category designations are higher than those required for safety as deemed necessary for commercial reasons. They are consistent with the Buyer's Authorization Basis document because they meet and exceed the minimum safety requirements. These designations are not necessarily reflected in their associated Buyer's P&IDs.

For CM material to the ASME or ASTM standards, any year of the standard is acceptable.

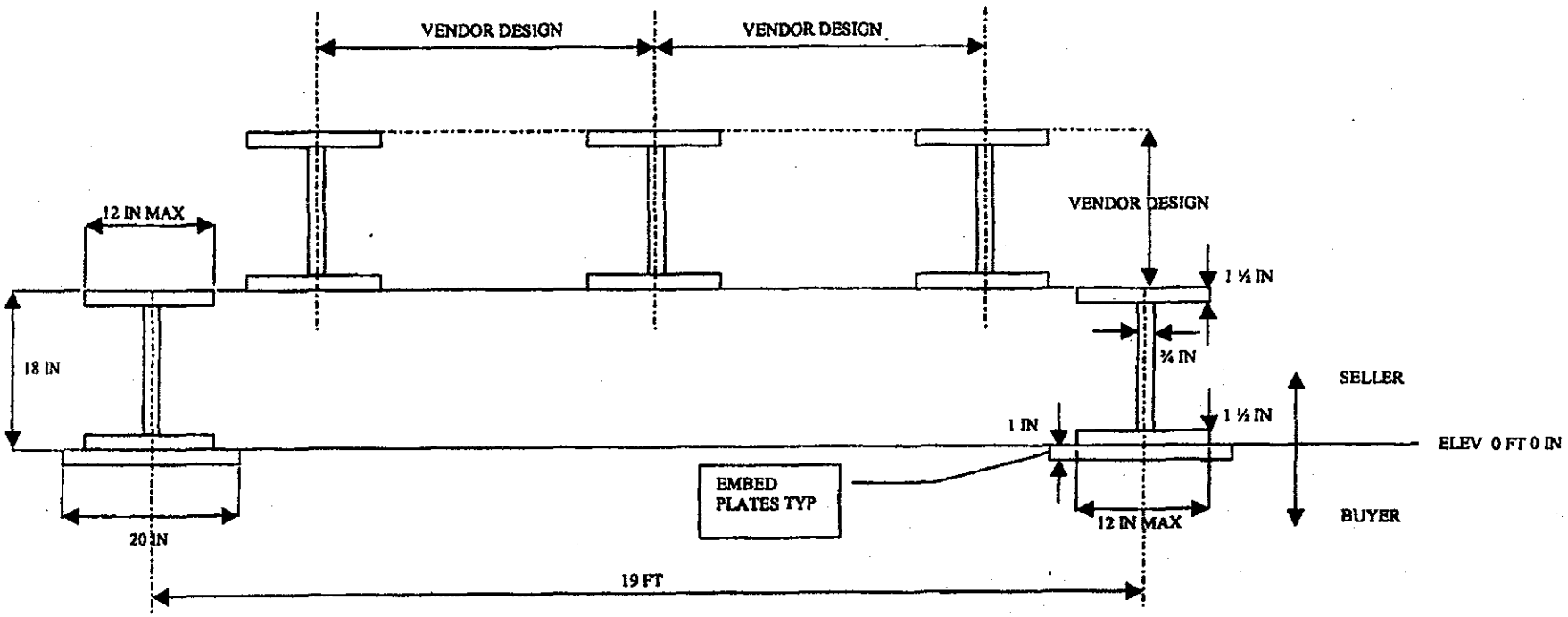
APPENDIX F

SEPARATOR VESSEL SKID SUPPORT LAYOUT

SEPARATOR VESSEL, EMBEDDED PLATES & SKID



SKID PLAN VIEW

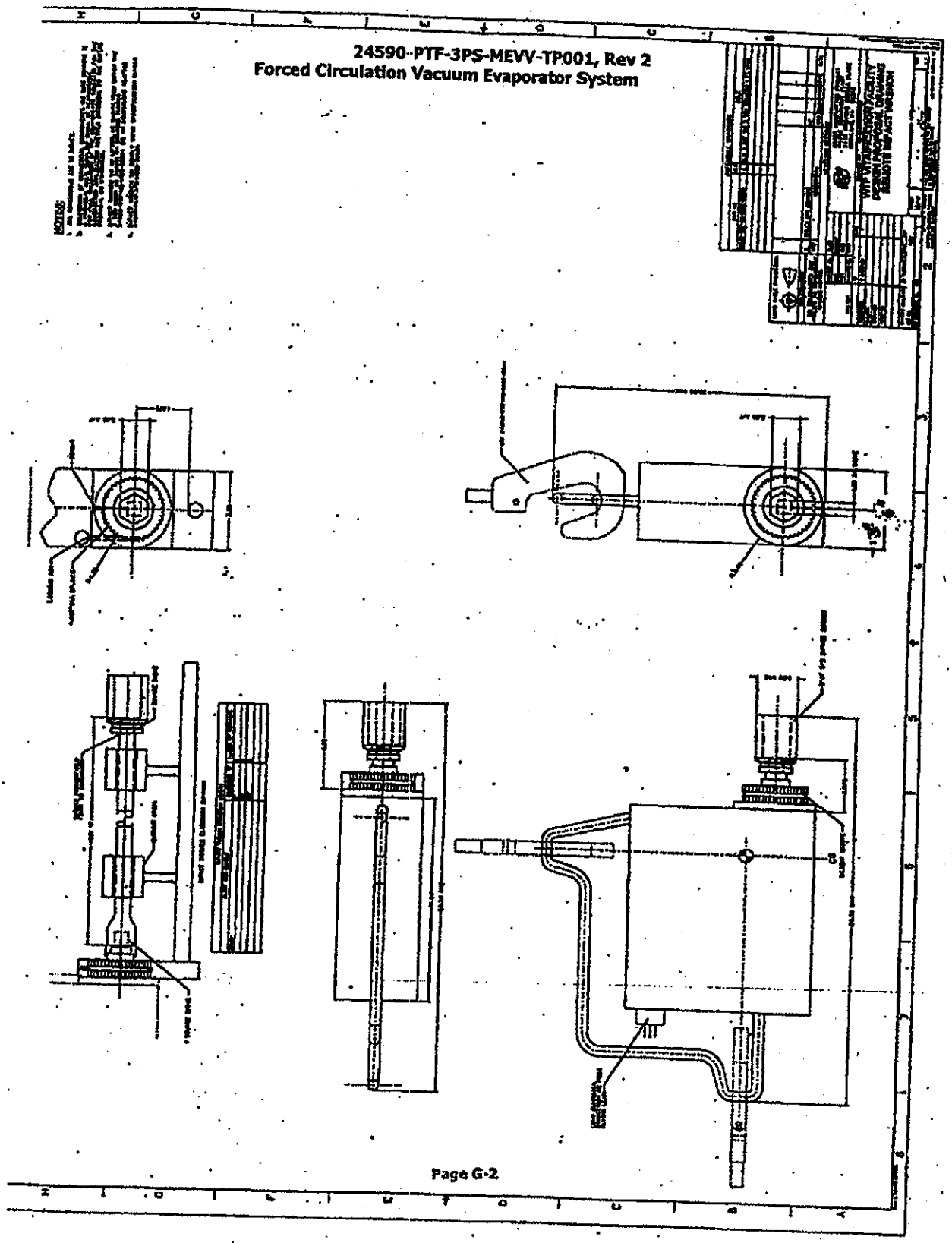

VENDOR DESIGN
VENDOR DESIGN
VENDOR DESIGN
12 IN MAX
18 IN
1 ½ IN
¾ IN
SELLER
1 IN
1 ½ IN
ELEV 0 FT 0 IN
EMBED
PLATES TYP
12 IN MAX
BUYER
20 IN
19 FT

SECTION A

APPENDIX G

HOT CELL REMOTE IMPACT WRENCH

24590-PTF-3PS-MEVV-TP001, Rev 2
Forced Circulation Vacuum Evaporator System



APPENDIX H

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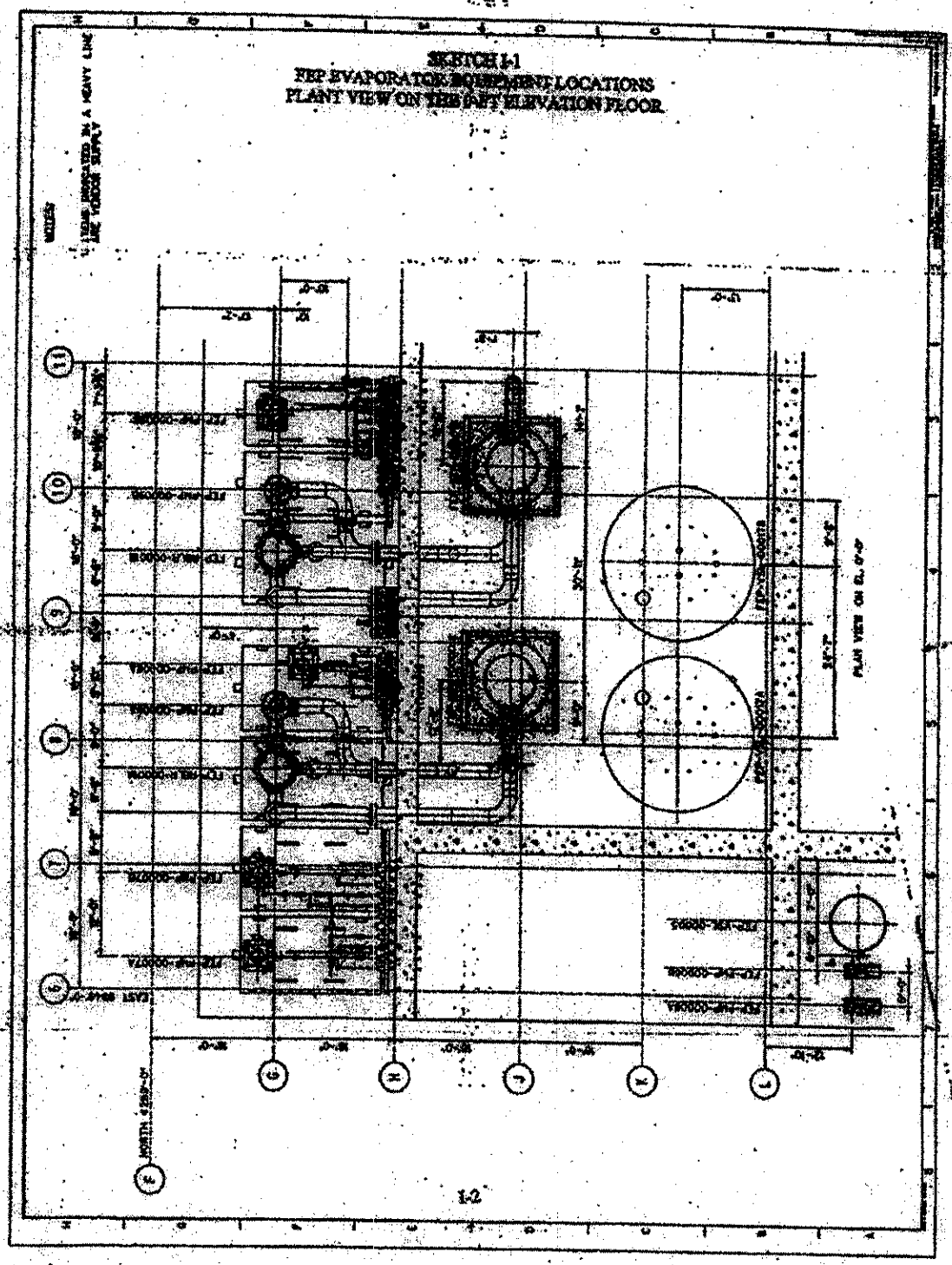
APPENDIX I

FEP EVAPORATOR EQUIPMENT SKIDS LOCATION AND LAYOUT SKETCHES

SKETCH 1-1
FEP EVAPORATOR EQUIPMENT LOCATIONS
PLANT VIEW ON THE (-)FT ELEVATION FLOOR



1-2

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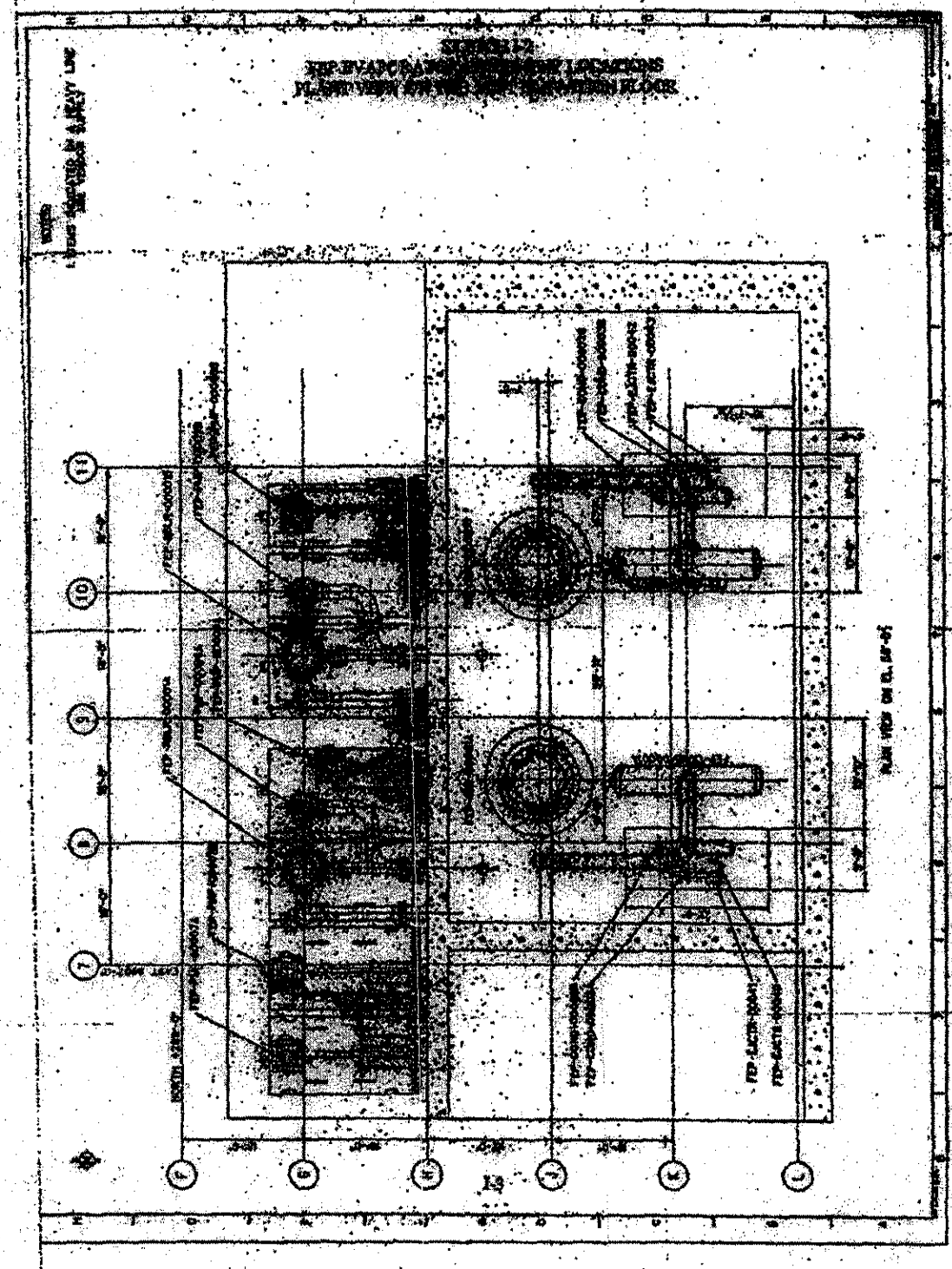

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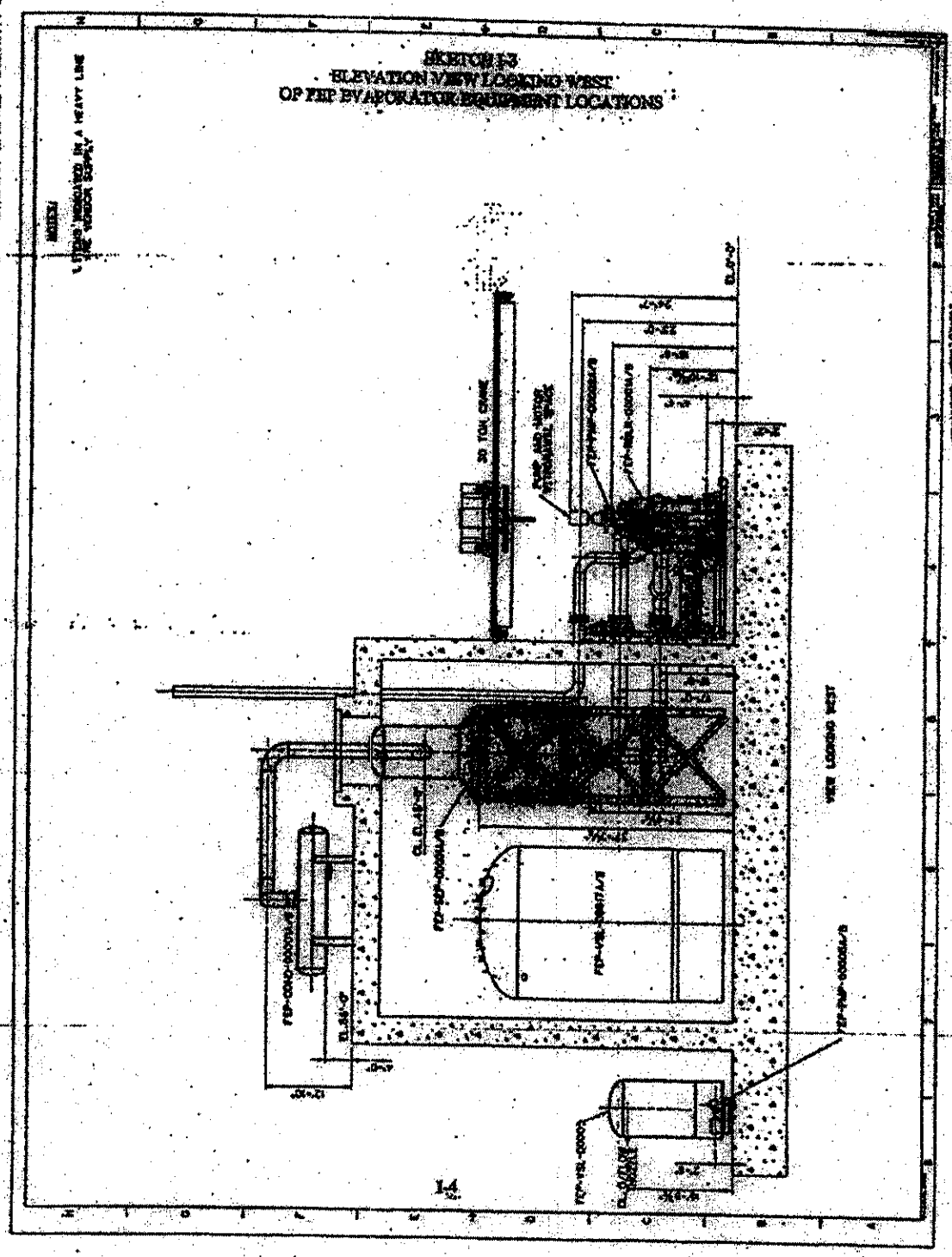

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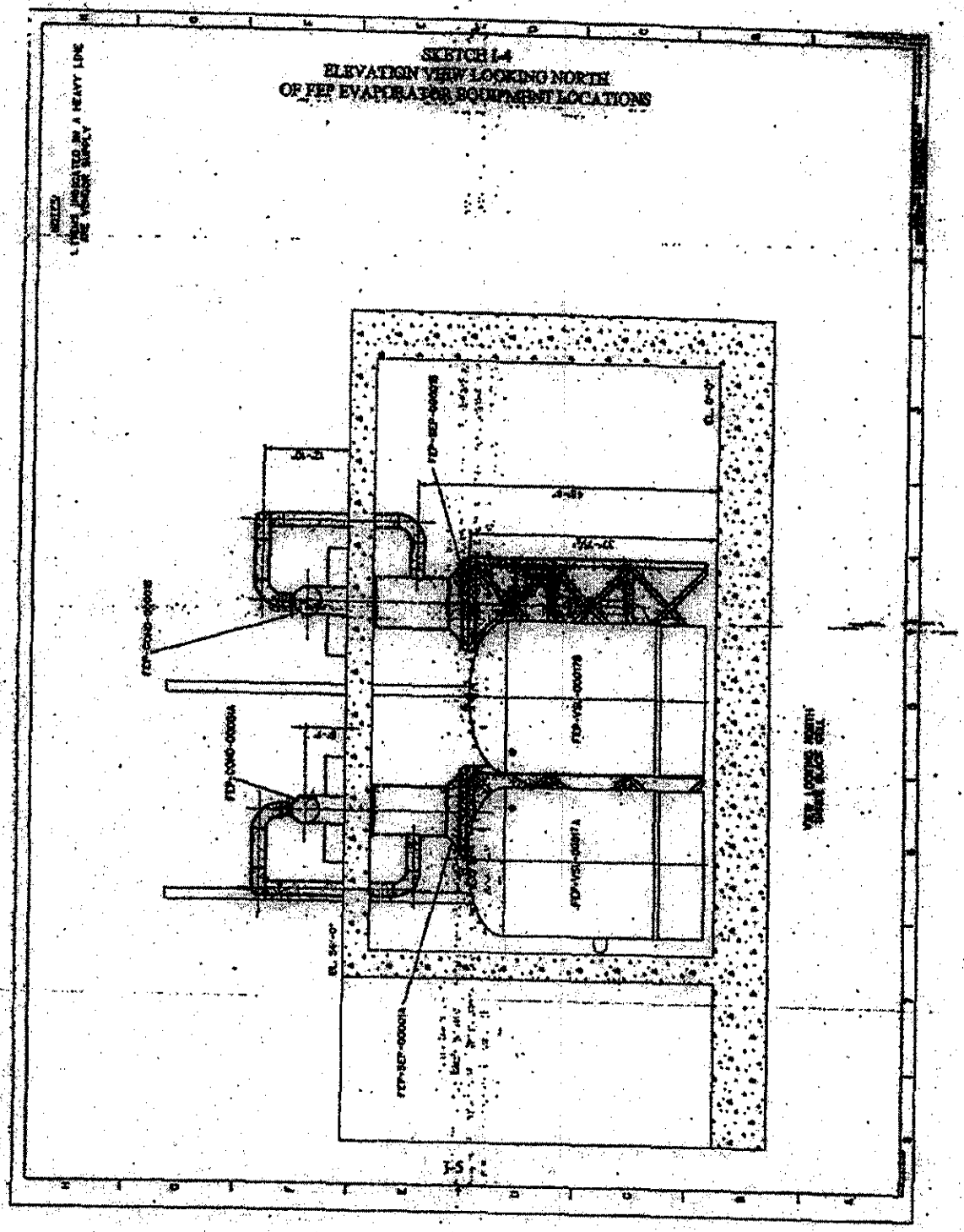

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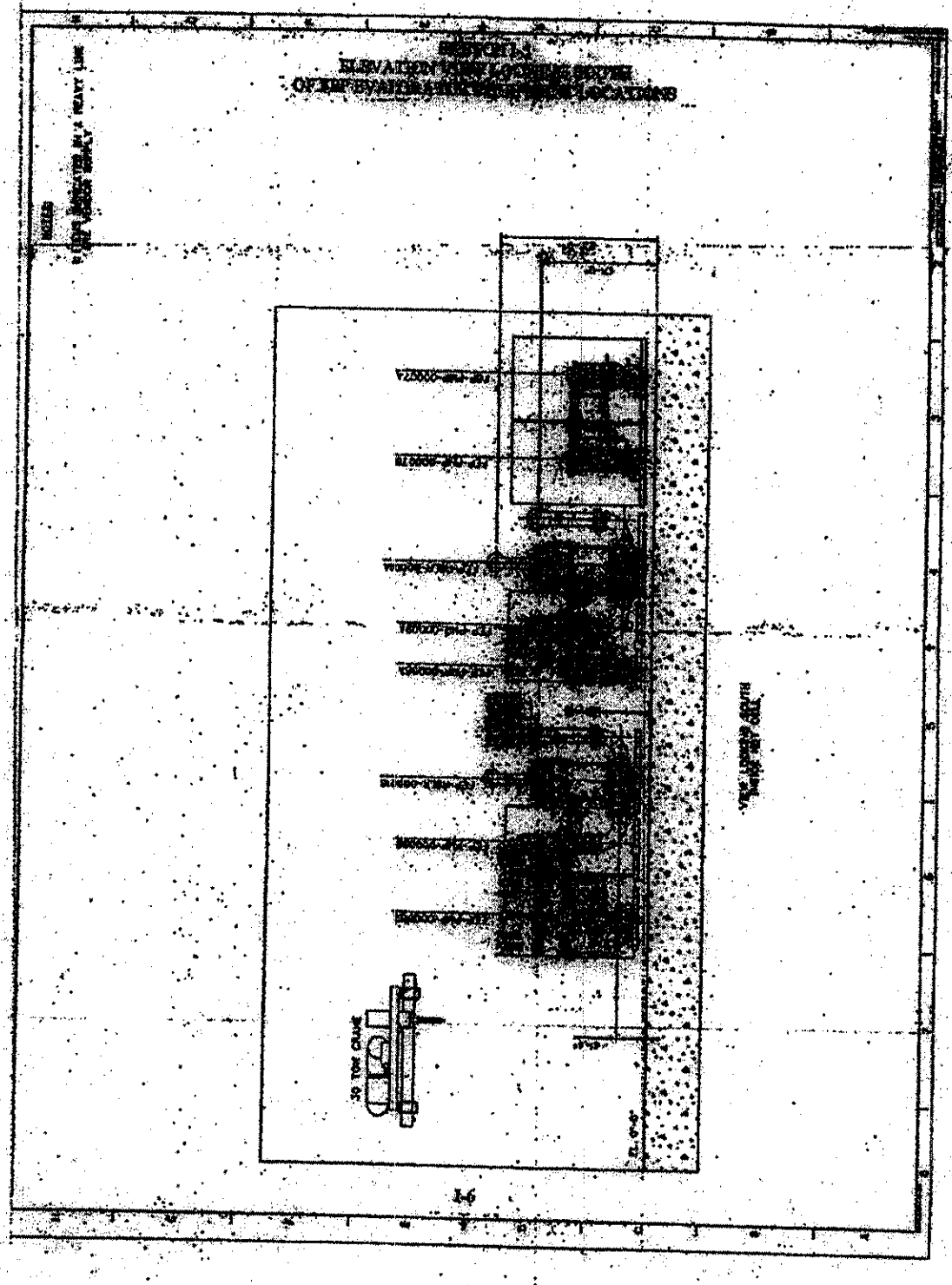

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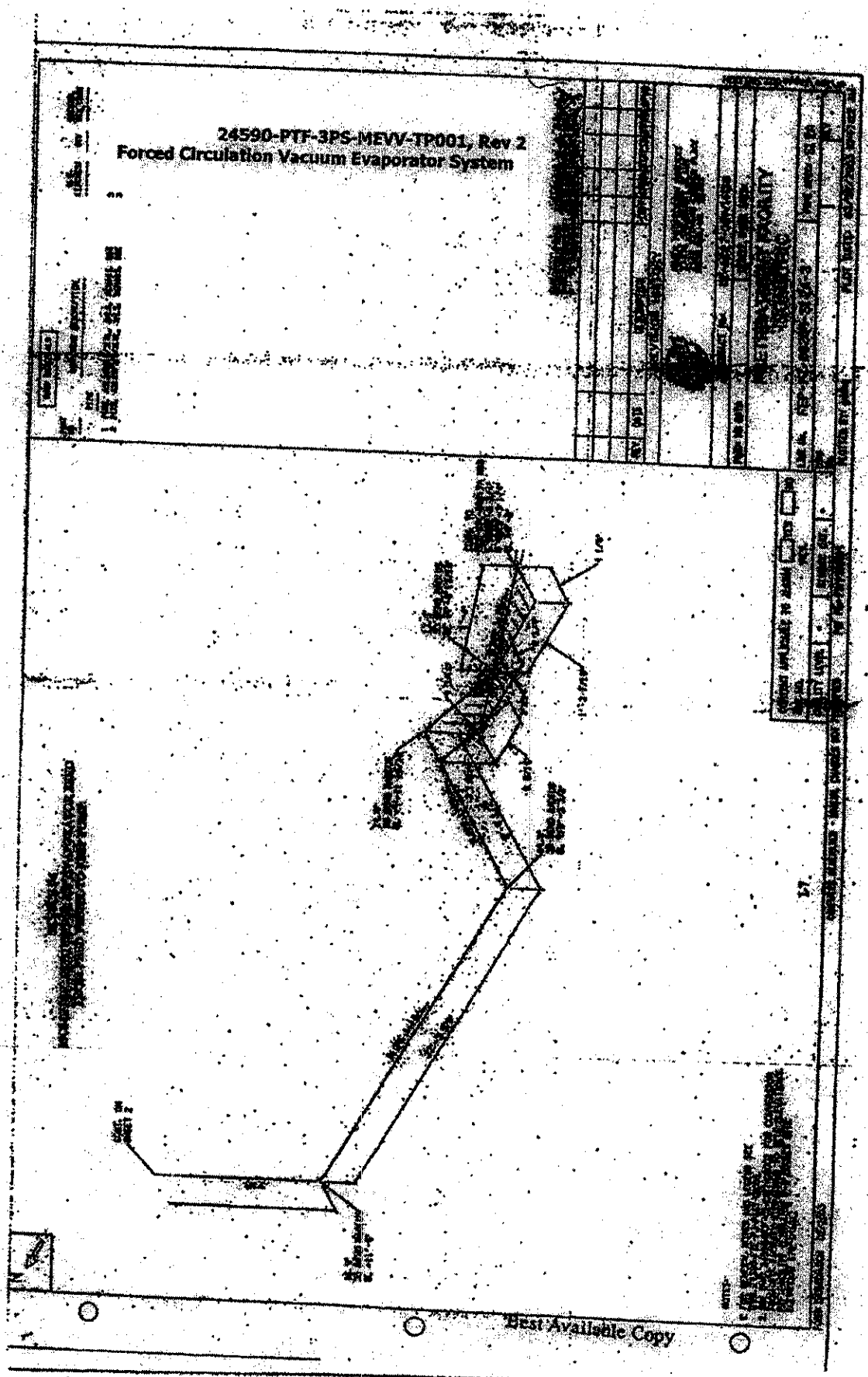
24590-PTF-3PS-MEVV-TP001, Rev 2
Forced Circulation Vacuum Evaporator System



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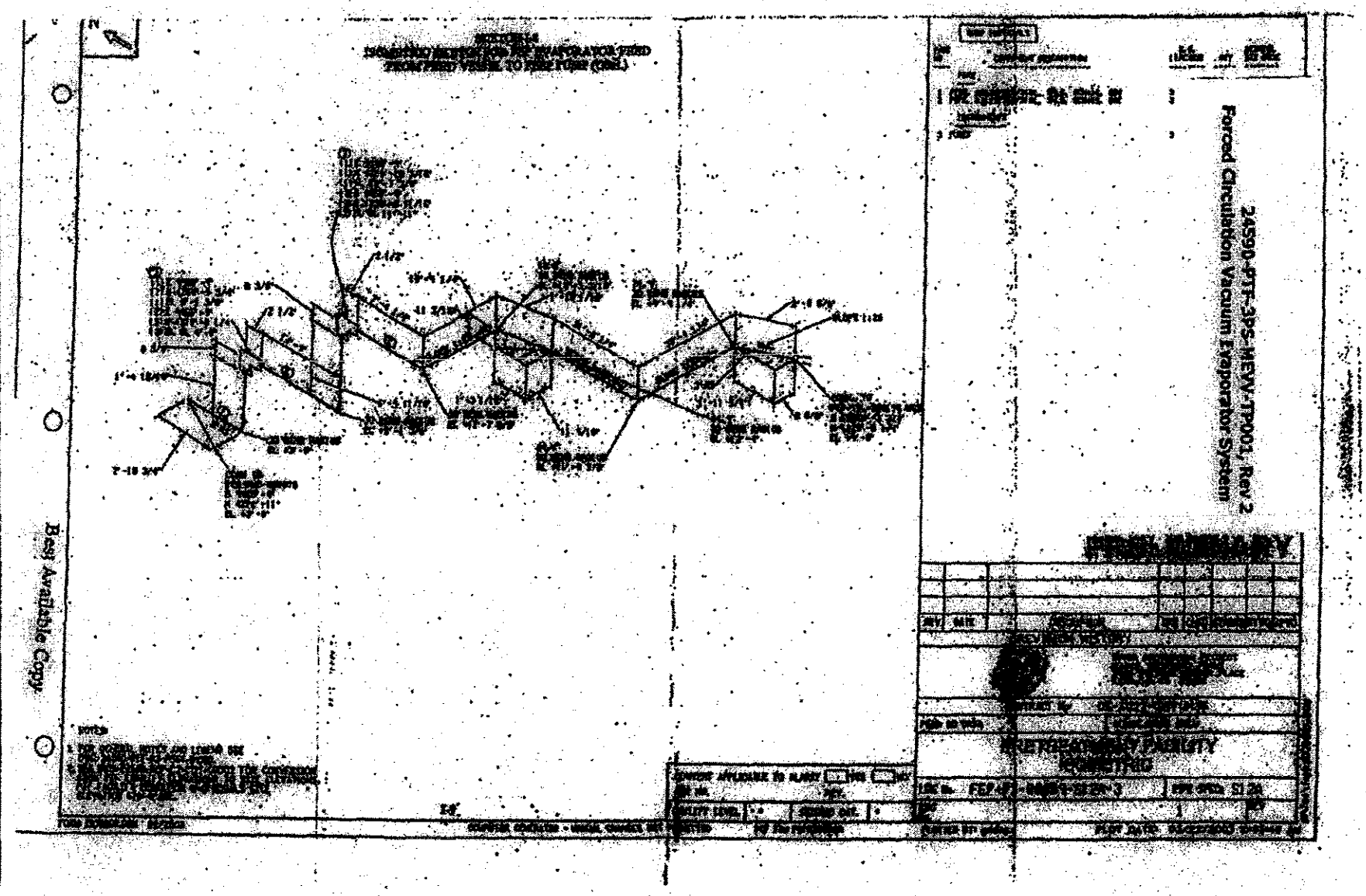

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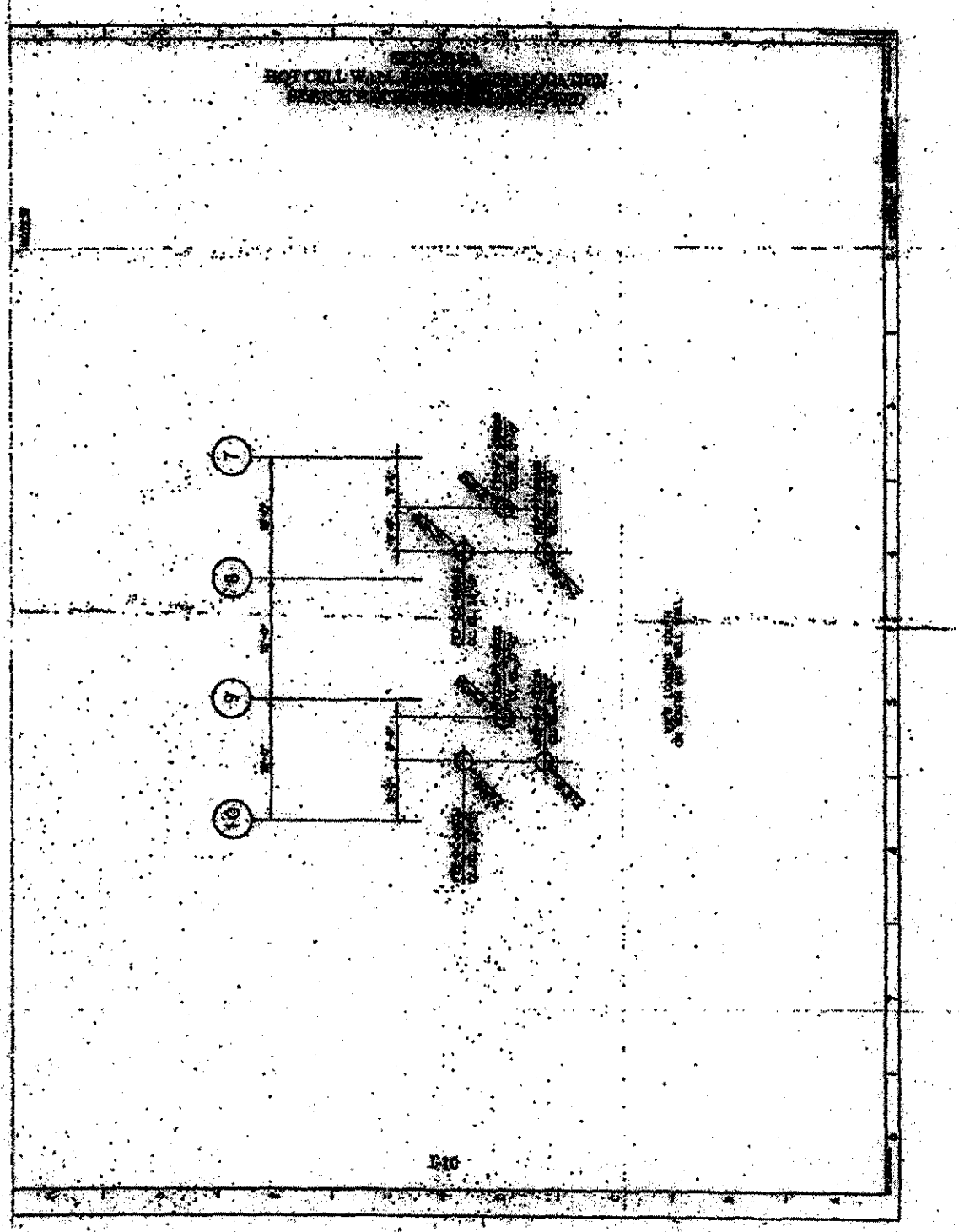

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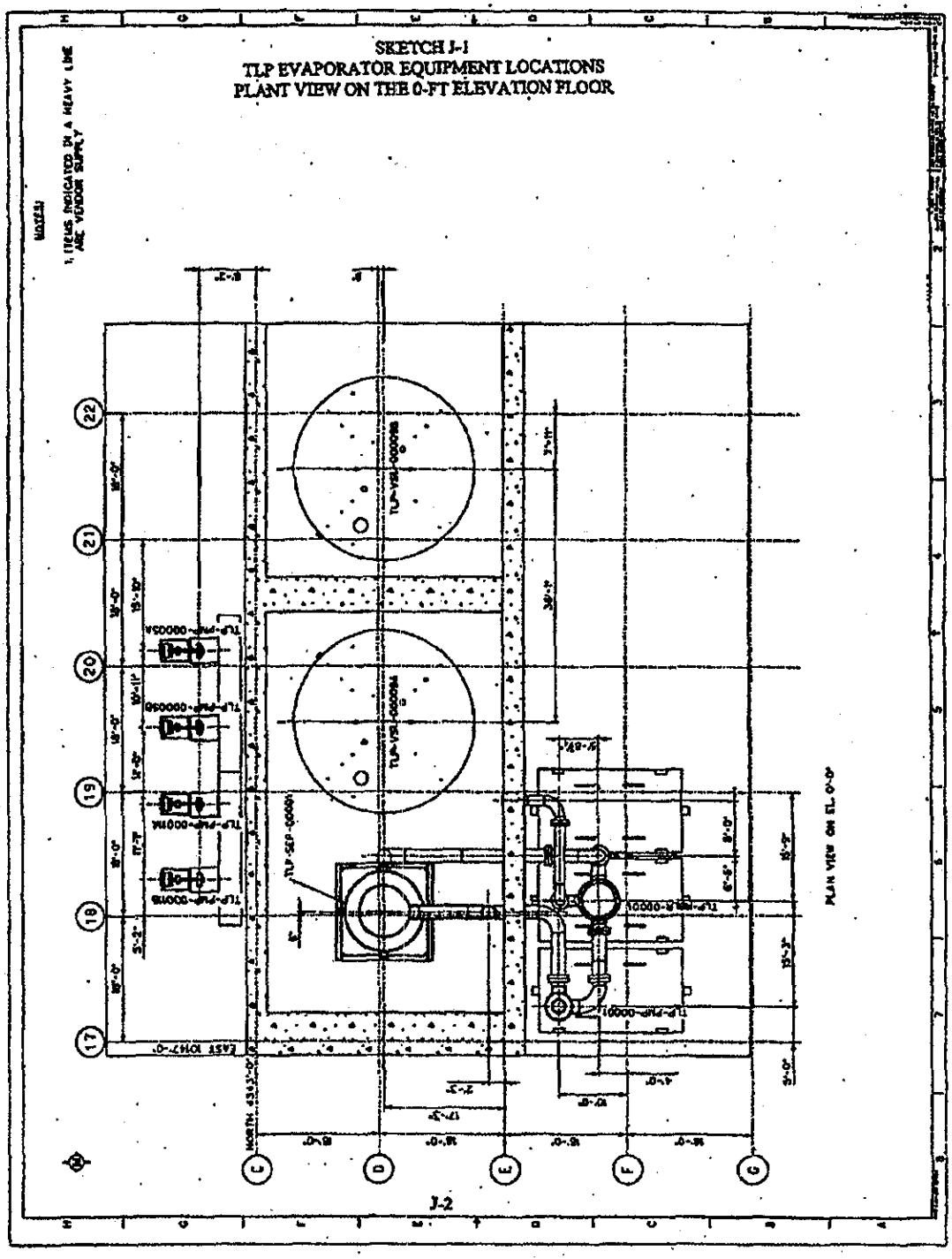
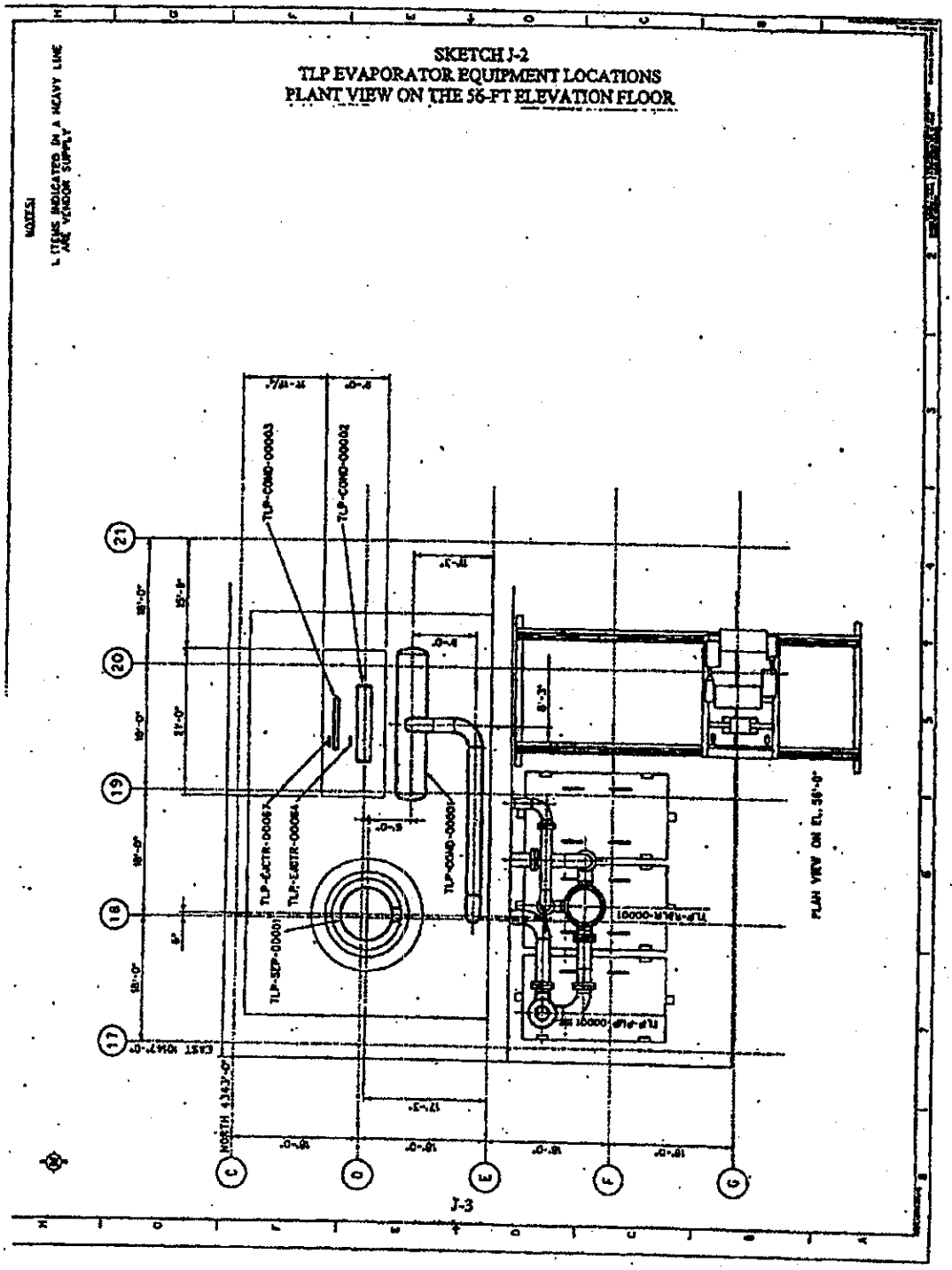
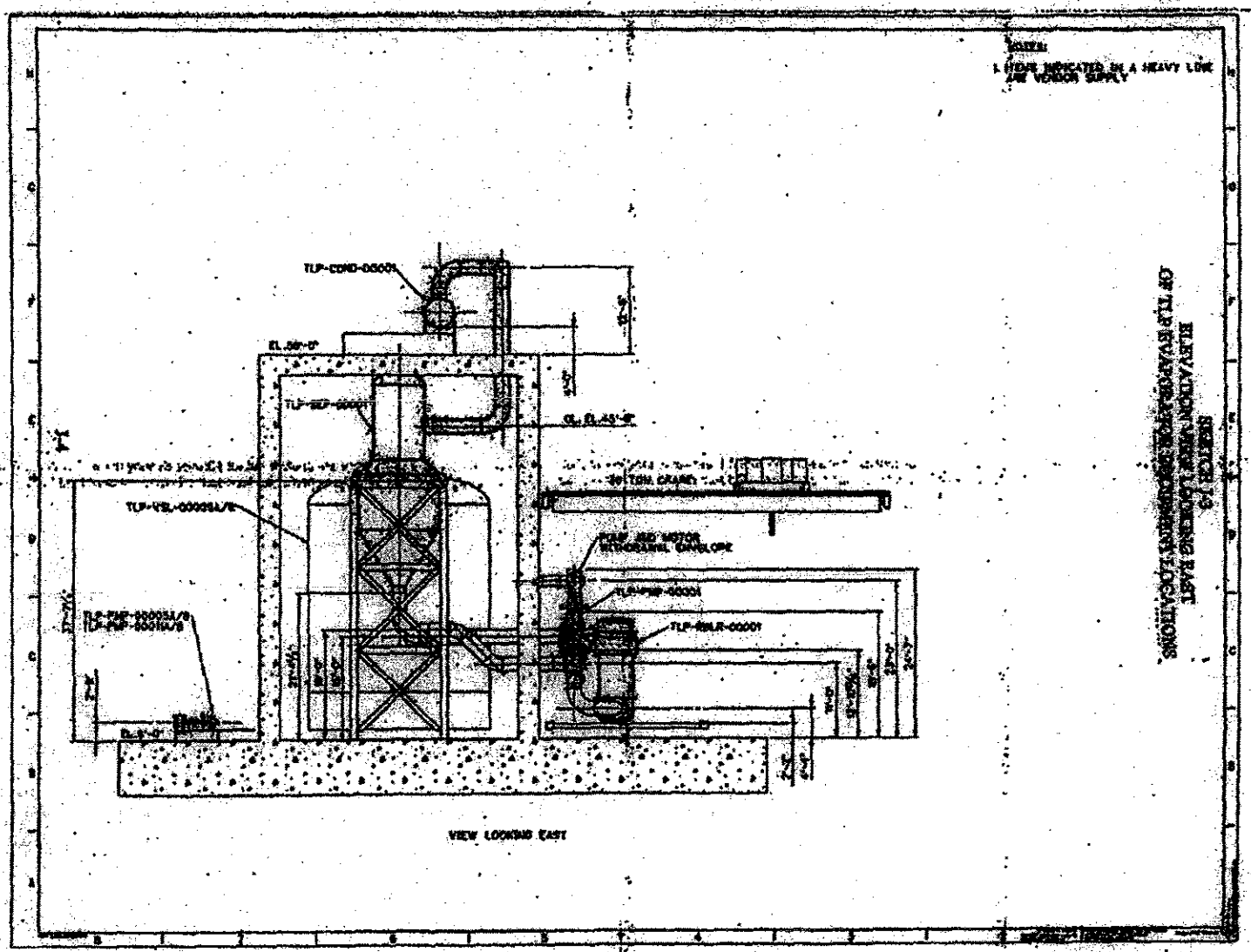
APPENDIX J

TLP EVAPORATOR EQUIPMENT SKIDS LOCATION AND LAYOUT SKETCHES

SKETCH J-1
TLP EVAPORATOR EQUIPMENT LOCATIONS
PLANT VIEW ON THE 0-FT ELEVATION FLOOR



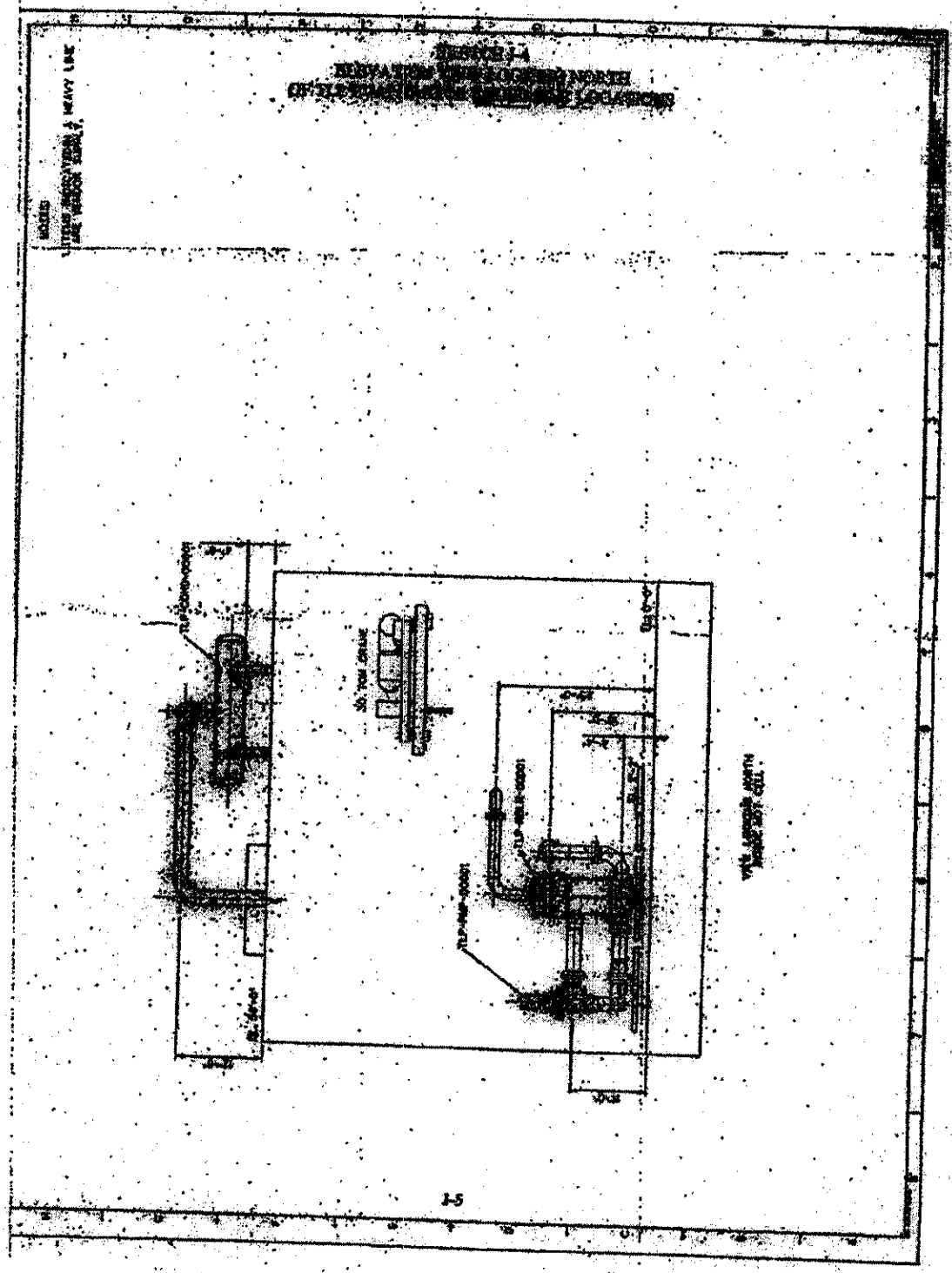

SKETCH J-2
TLP EVAPORATOR EQUIPMENT LOCATIONS
PLANT VIEW ON THE 56-FT ELEVATION FLOOR
NOTES:
1. ITEMS INDICATED IN A HEAVY LINE ARE VENDOR SUPPLY
TLP-COND-00003
TLP-COND-00002
TLP-EJCTR-00007
TLP-EJCTR-00004
TLP-SEP-00001
TLP-COND-00001
TLP-MLR-00001
TLP-PUP-00001
PLAN VIEW ON EL. 56'-0"
NORTH 43437'-0"
EAST 10147'-0"
21
20
19
18
17
C
D
E
F
G



24590-PTF-3PS-HEVV-TP001, Rev 2

Forced Circulation Vacuum Evaporator System

Best Available Copy



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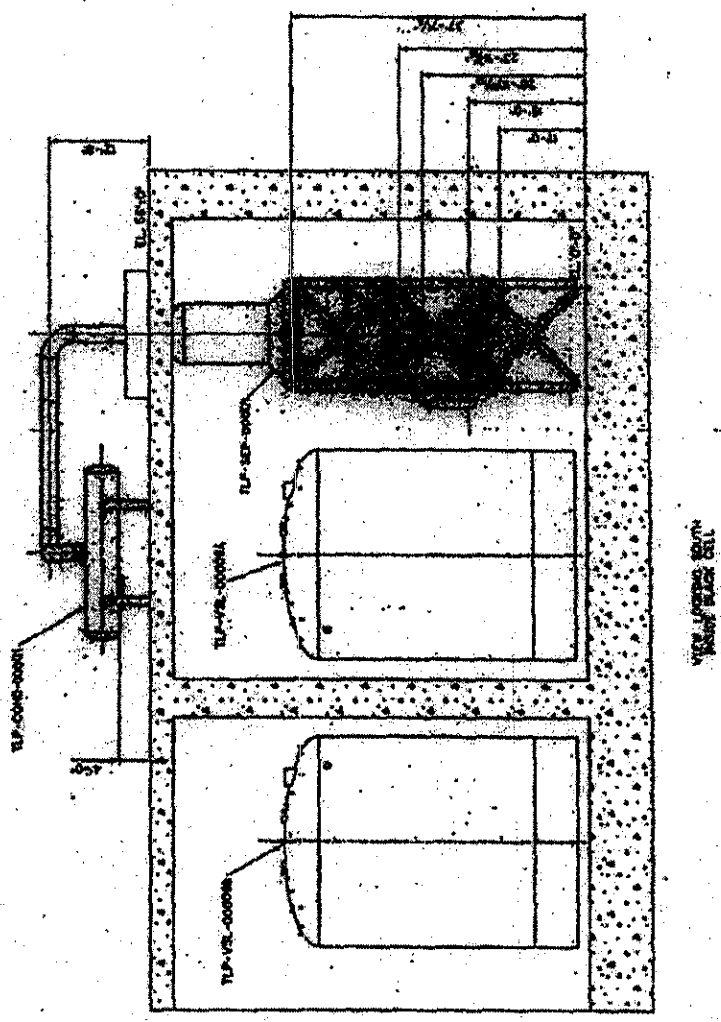
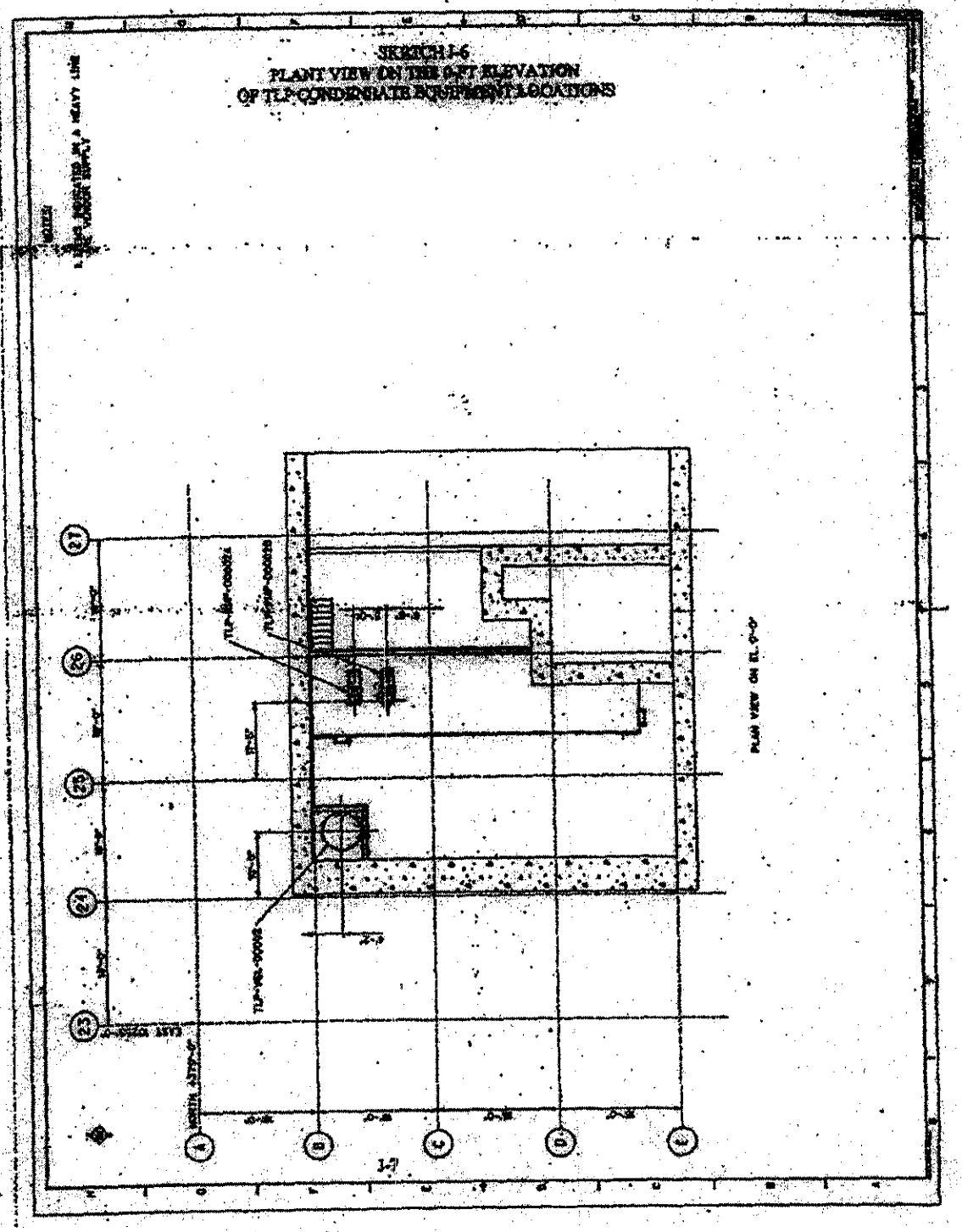
SKETCH J-5
ELEVATION VIEW LOOKING SOUTH
OF TLP EVAPORATOR EQUIPMENT LOCATIONS



J-6

Best Available Copy

SKETCH 1-6
PLANT VIEW ON THE PIT ELEVATION
OF TLP CONDENSATE EQUIPMENT LOCATIONS



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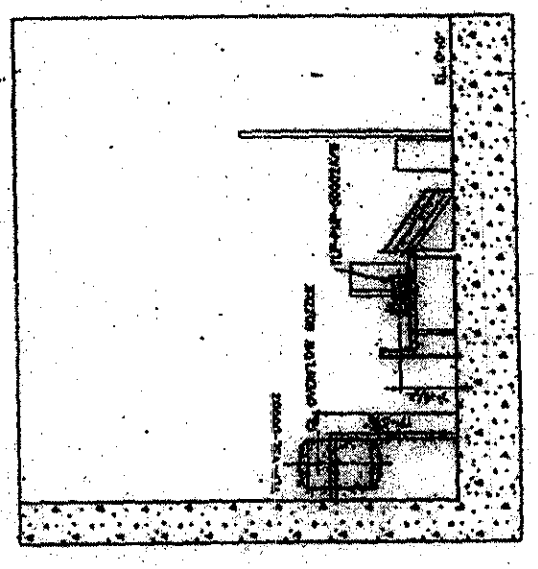
SKETCH 3-7
ELEVATION VIEW LOOKING NORTH
OF TLF CONDENSATE EQUIPMENT LOCATIONS



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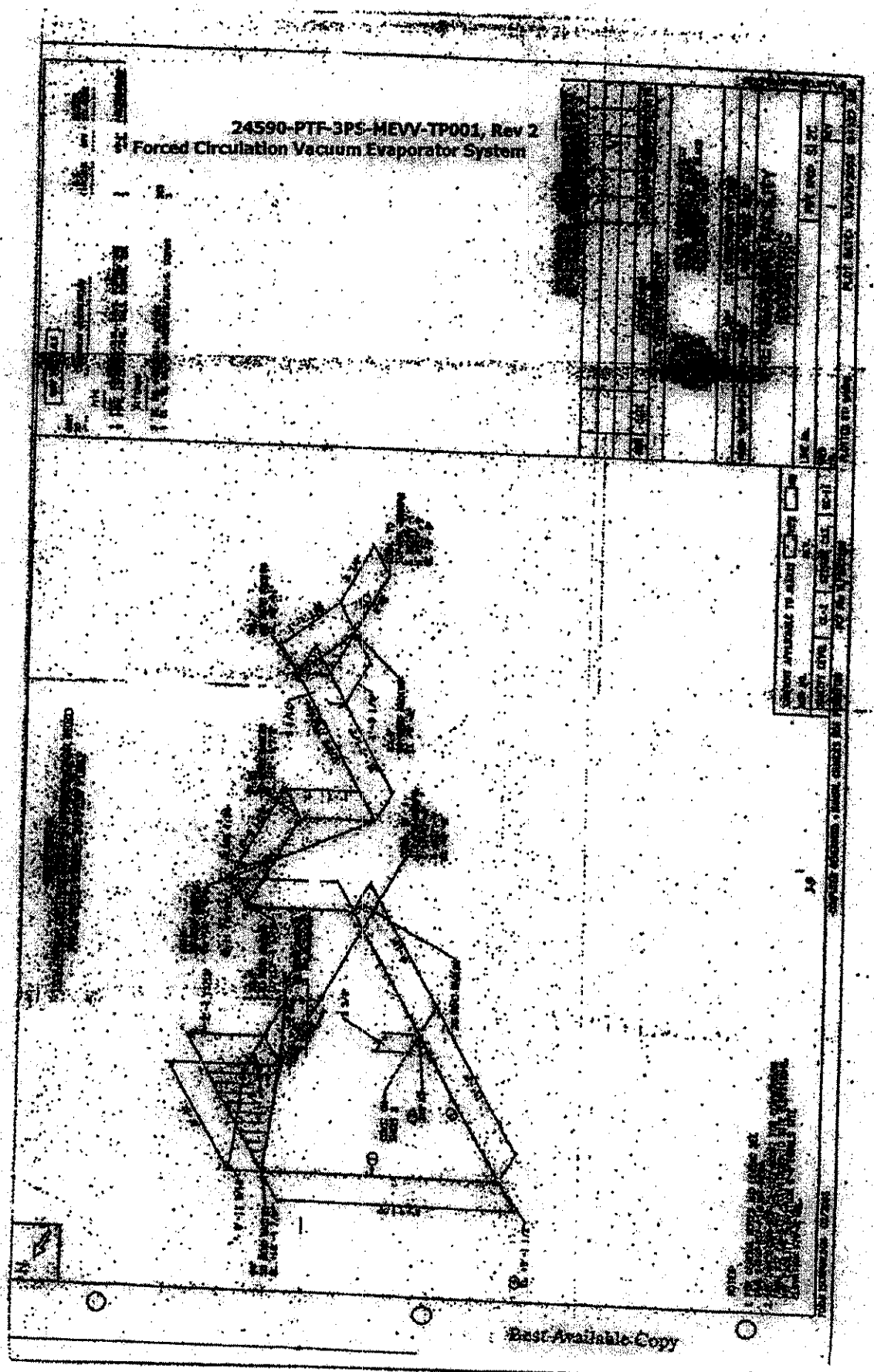
24590-PTF-3PS-MEVV-TP001, Rev 2

Forced Circulation Vacuum Evaporator System



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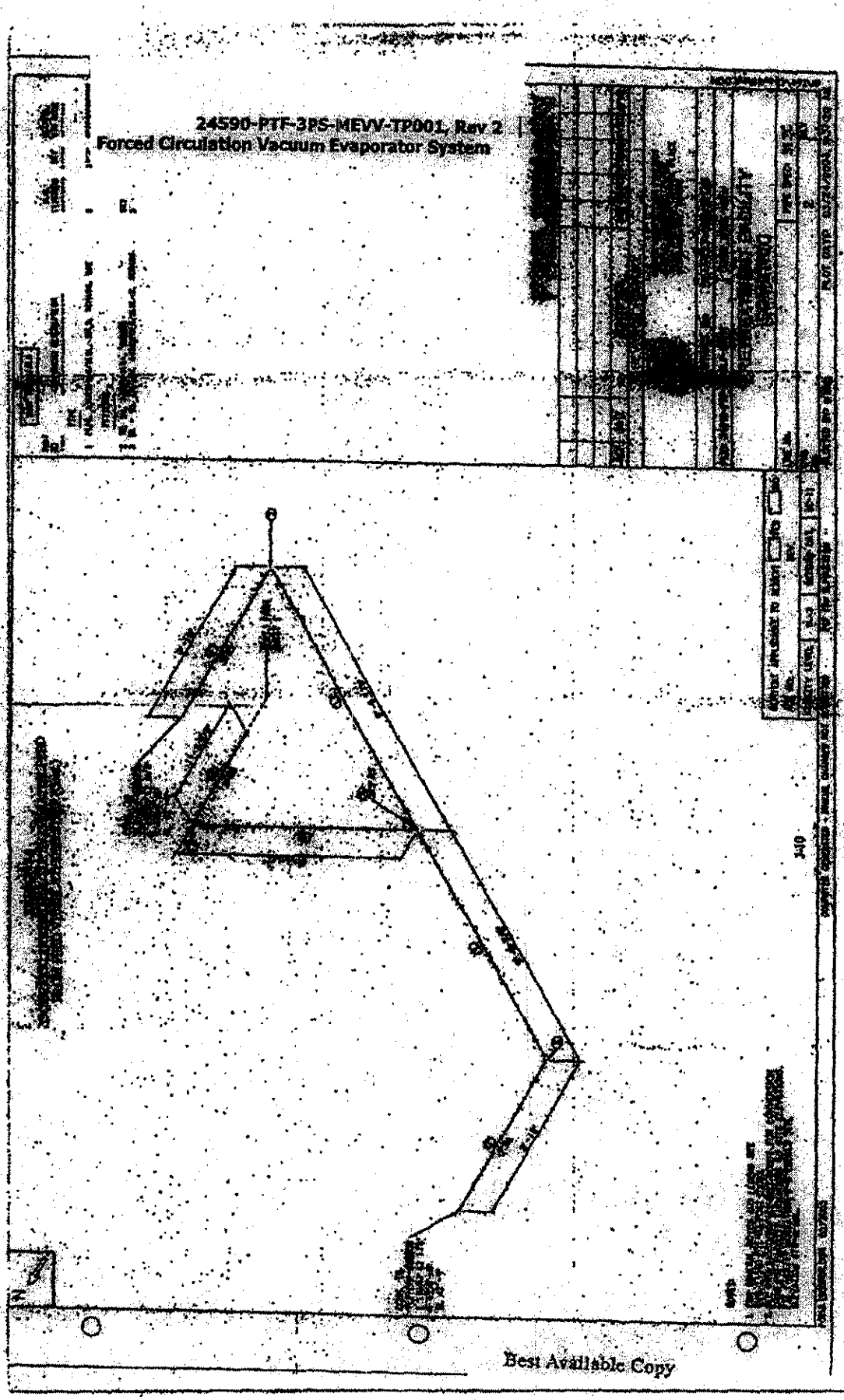
24590-PTF-3PS-MEVV-TP001, Rev 2

Forced Circulation Vacuum Evaporator System



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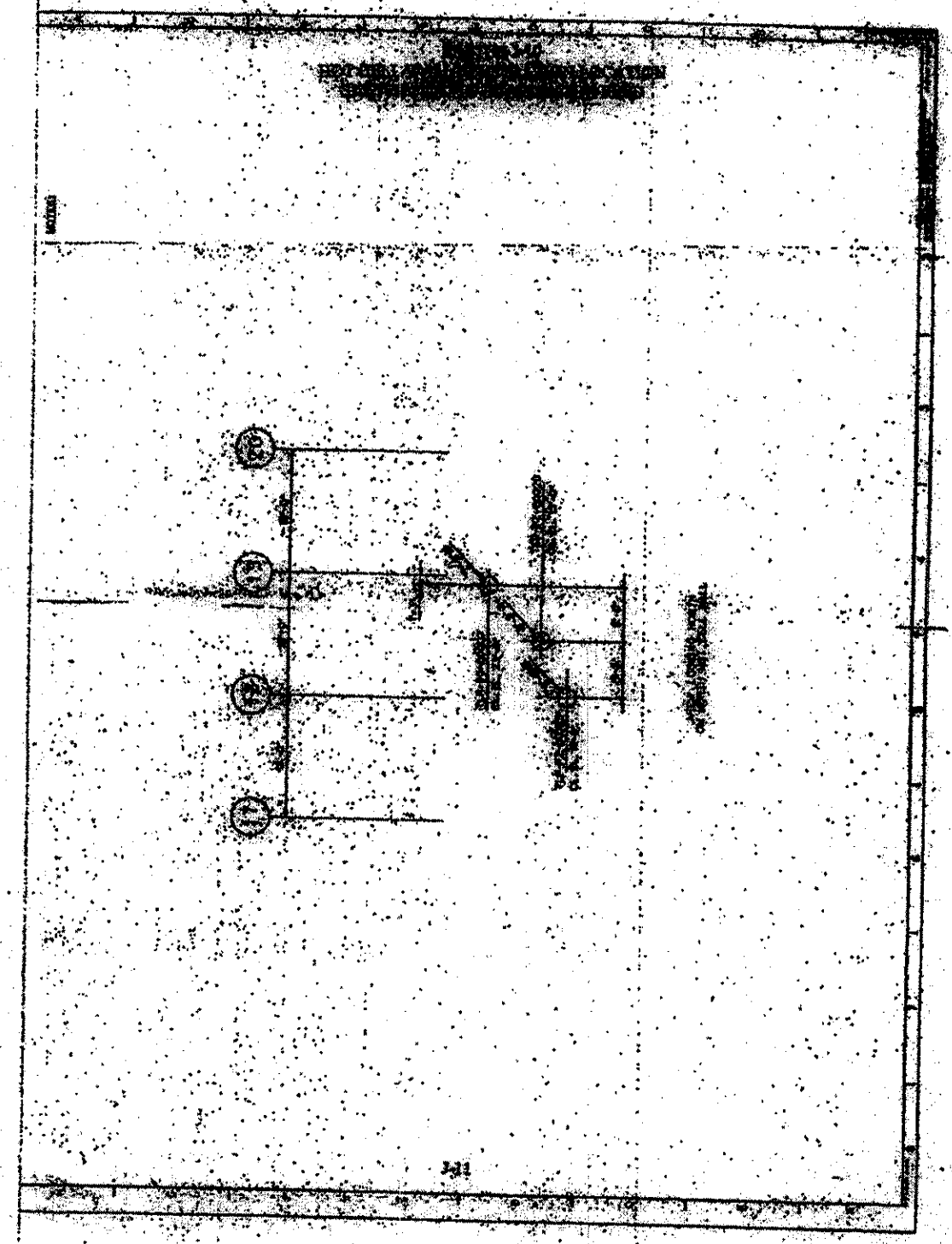

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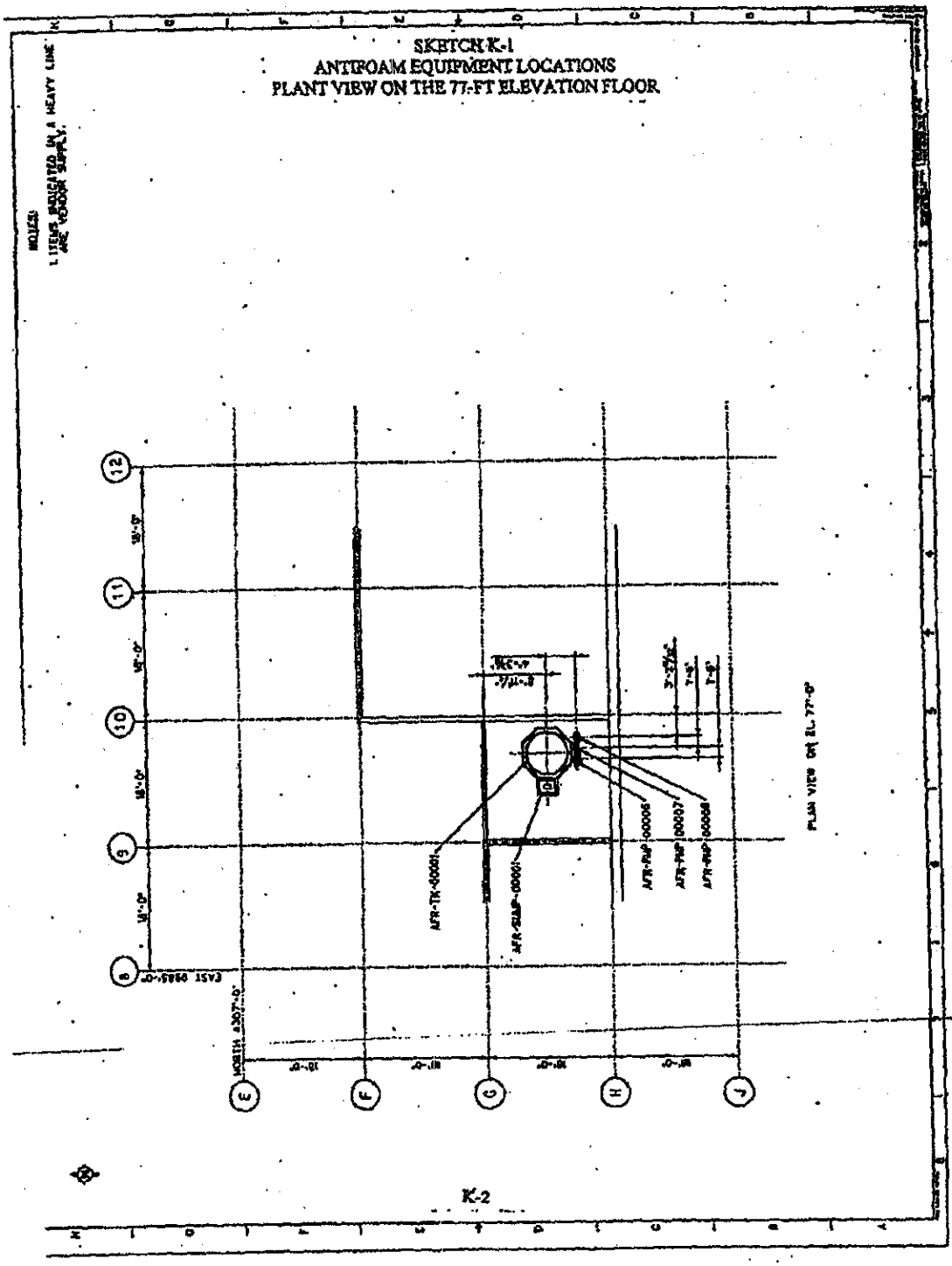
APPENDIX K

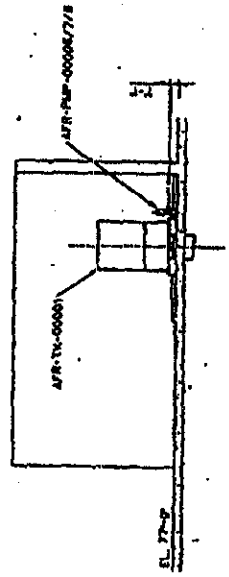
ANTIFOAM EQUIPMENT SKIDS LOCATION AND LAYOUT SKETCHES

SKETCH K-1
ANTIFOAM EQUIPMENT LOCATIONS
PLANT VIEW ON THE 77-FT ELEVATION FLOOR



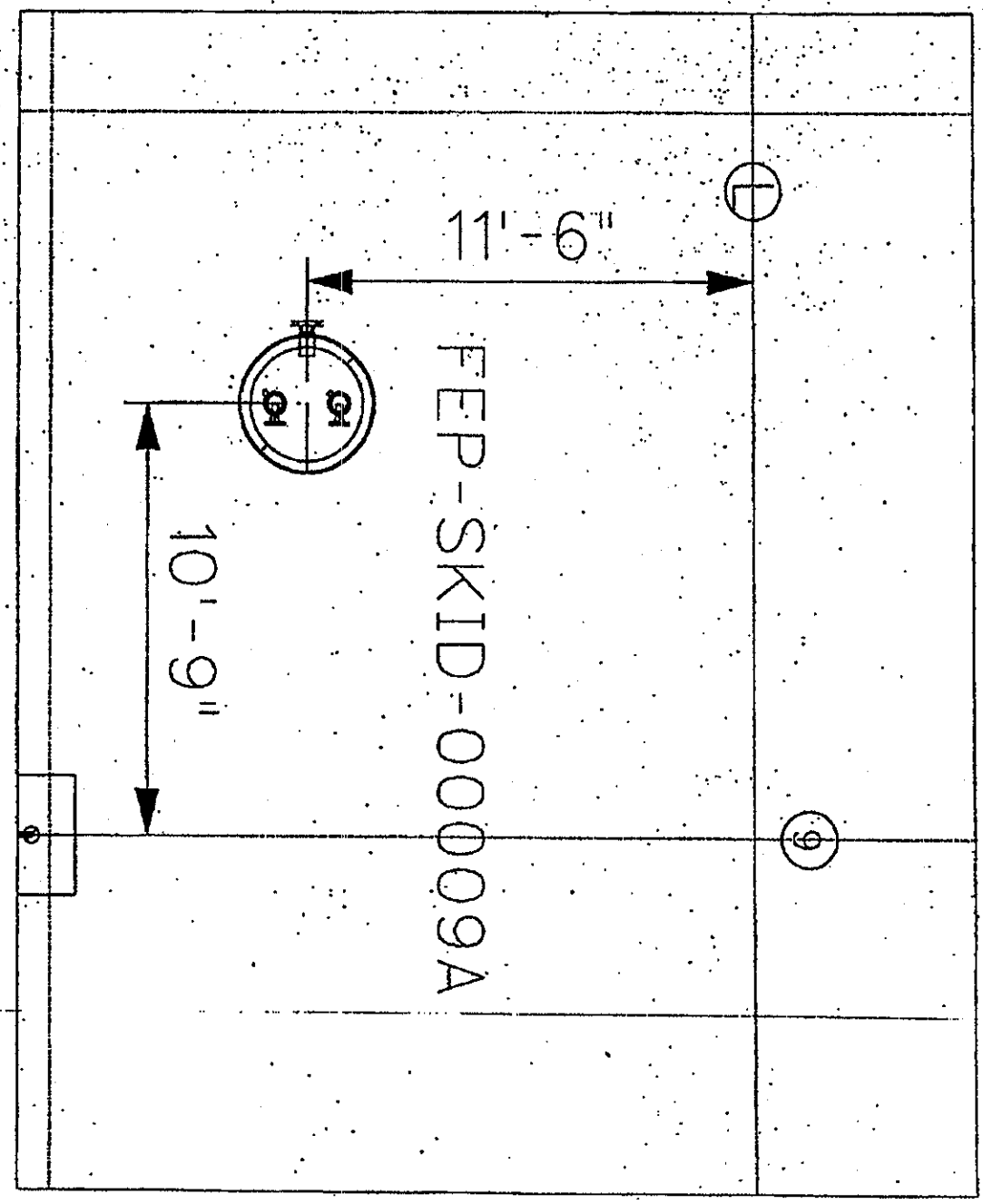
SKETCH K-2
ELEVATION VIEW LOOKING EAST
OF ANTIFOAM EQUIPMENT LOCATIONS

NOTES:
1. ITEMS INDICATED IN A HEAVY LINE ARE VENDOR SUPPLY.



APPENDIX L

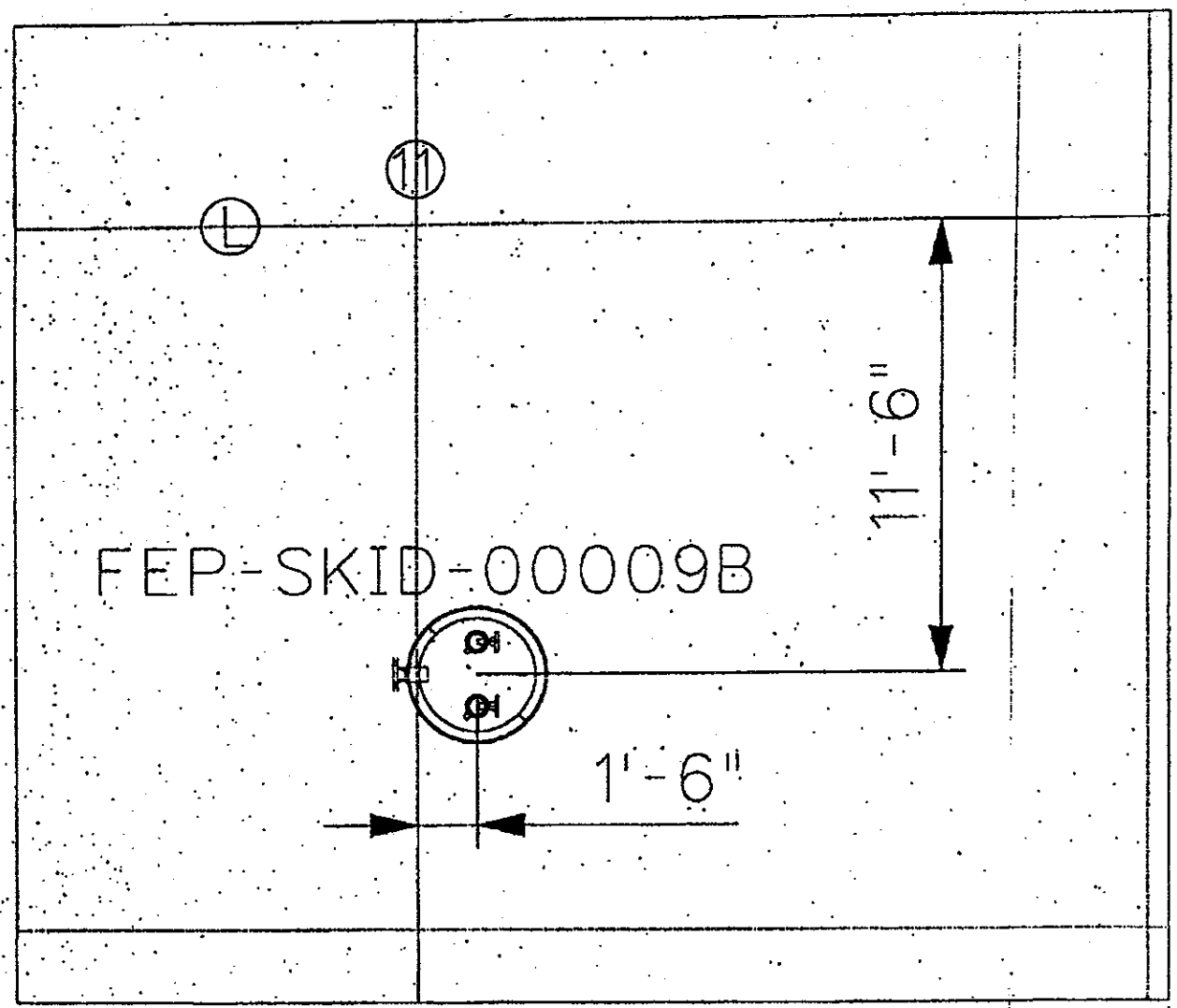
REBOILER STEAM CONDENSATE TRANSFER STATION LOCATION AND LAYOUT SKETCHES



Plan View @ 0'-0" elevation

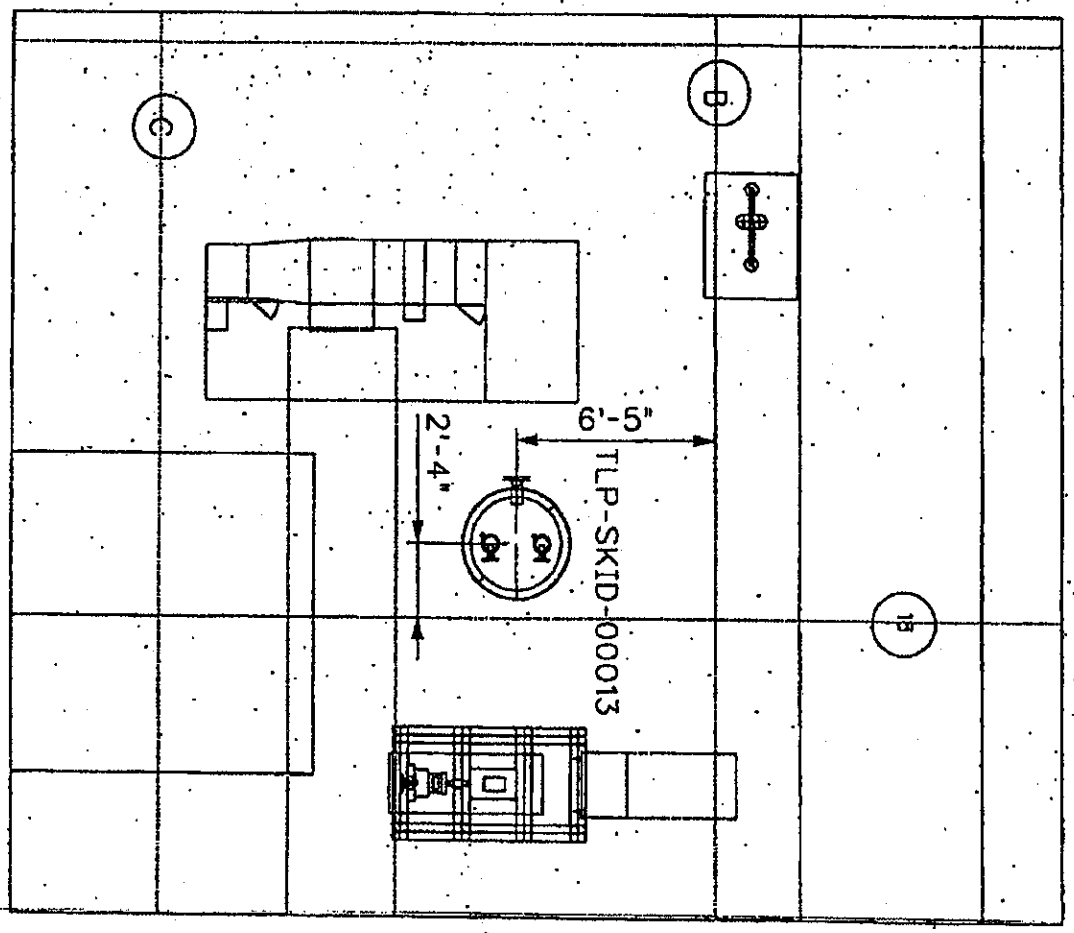
APPENDIX L

APPENDIX L



Plan view
@ 0'-0" elevation

APPENDIX L



Plan view @ 0'-0" Elevation

APPENDIX M

IN-STRUCTURE ACCELERATION RESPONSE SPECTRA (ISRS) INPUT FOR SC-I/SC-II EQUIPMENT

Lateral Displacements for the Soil Sstructure Interaction (SSI) Seismic Loads

Elevation	Vessel ID	Grid Lines	E-W	N-S
0 ft	FEP-SEP-00001A	J:8-9	0.307681 in.	0.319722 in.
0 ft	FEP-SEP-00001B	J:10-10.5	0.308585 in.	0.313252 in.
56 ft	FEP-SEP-00001A	J:8-9	0.382427 in.	0.636880 in.
56 ft	FEP-SEP-00001B	J:10-10.5	0.380884 in.	0.650265 in.
0 ft	TLP-VSL-00002	B-C: 24-24.5	0.292882 in.	0.300089 in.
41 ft	TLP-VSL-00002	B-C: 24-24.5	0.371610 in.	0.554610 in.
56 ft	TLP-VSL-00002	B-C: 24-24.5	0.396210 in.	0.638780 in.
0 ft	TLP-SEP-00001	D:17.5 - 18.5	0.304947 in.	0.301389 in.
56 ft	TLP-SEP-00001	D:17.5 - 18.5	0.366472 in.	0.657869 in.

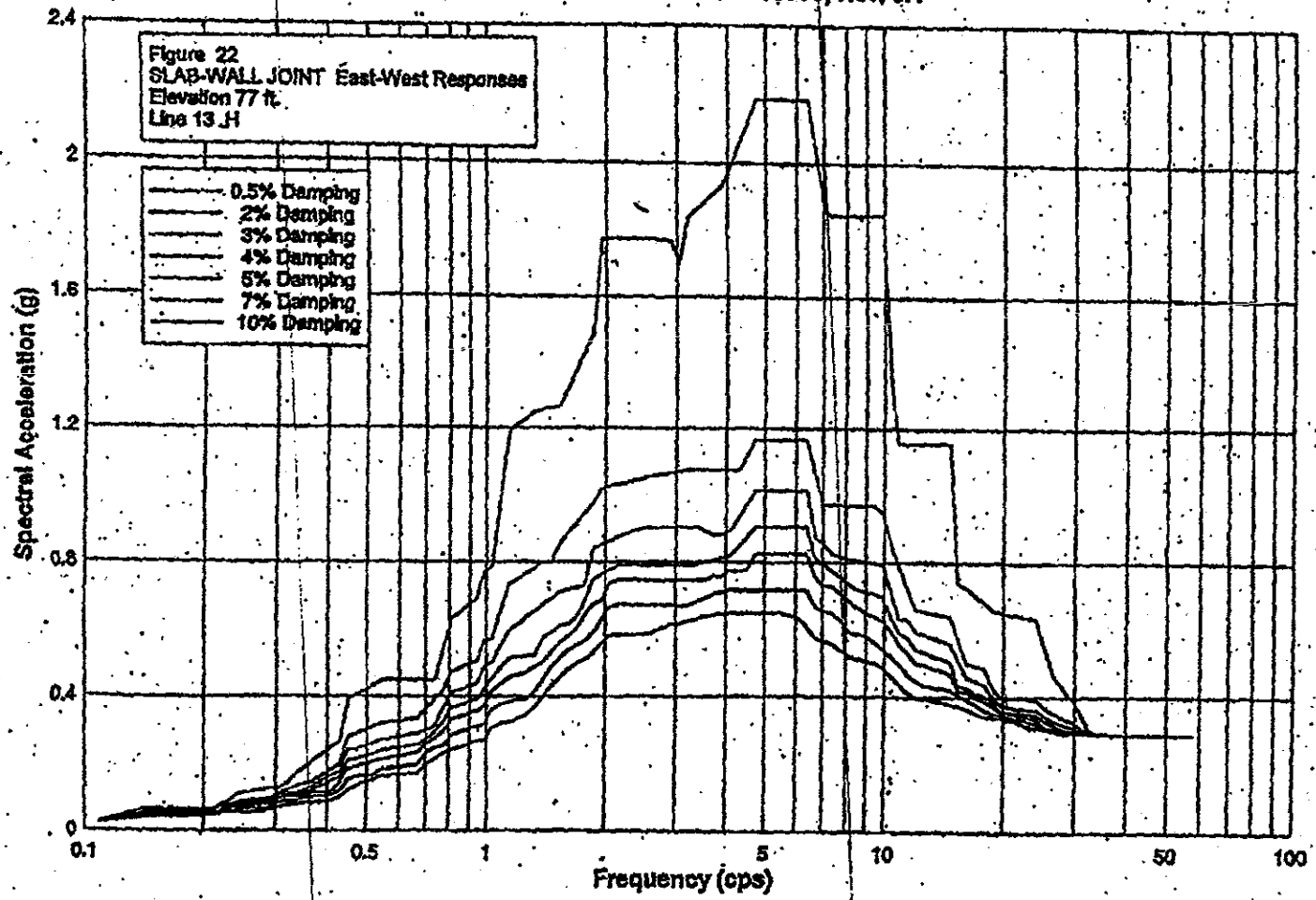
ISRS for Evaporator Equipment

Description	Location			ISRS Figure No. (See Notes below)
	Floor Elevation	Floor Thickness	Grid Lines	
FEP Antifoam System Skid	77'	1'	G-H/8-9.5	22,23,147
FEP Condenser Skid A	56'	4'	K-8	37,38,121
FEP Condenser Skid B	56'	4'	K-10	37,38,121
FEP Condensate Skid	0'	8'	M-9	64, 65, 24E
FEP Recirc Pump Skid A	0'	8'	H-8	67,68,24E
FEP Recirc Pump Skid B	0'	8'	G-9	67,68,24E
FEP Reboiler Skid A	0'	8'	G-8	67,68,24E
FEP Reboiler Skid B	0'	8'	G-8	67,68,24E
Separator Vessel (FEP-SEP-00001A)	0'	8'	J-8	67,68,24E
Separator Vessel (FEP-SEP-00001B)	0'	8'	J-10	67,68,24E
TLP Condenser Skid	56'	3'	D-E/19.5	40,41,115
TLP Recirc Pump Skid	0'	8'	F-18	67,68,24E
TLP Feed Pump Skid	0'	8'	B-C/20	70,71,24E
TLP Concentrate Pump Skid	0'	8'	B-C/19	70,71,24E
TLP Reboiler Skid	0'	8'	F-17	67,68,24E
Separator Vessel (TLP-SEP-00001)	0'	8'	D-18	67,68,24E
TLP Condensate Skid	0'	8'	C-25	70,71,24E

The skids are assumed rigid, i.e., the fundamental frequency in all directions is equal to or greater than 33 Hz.

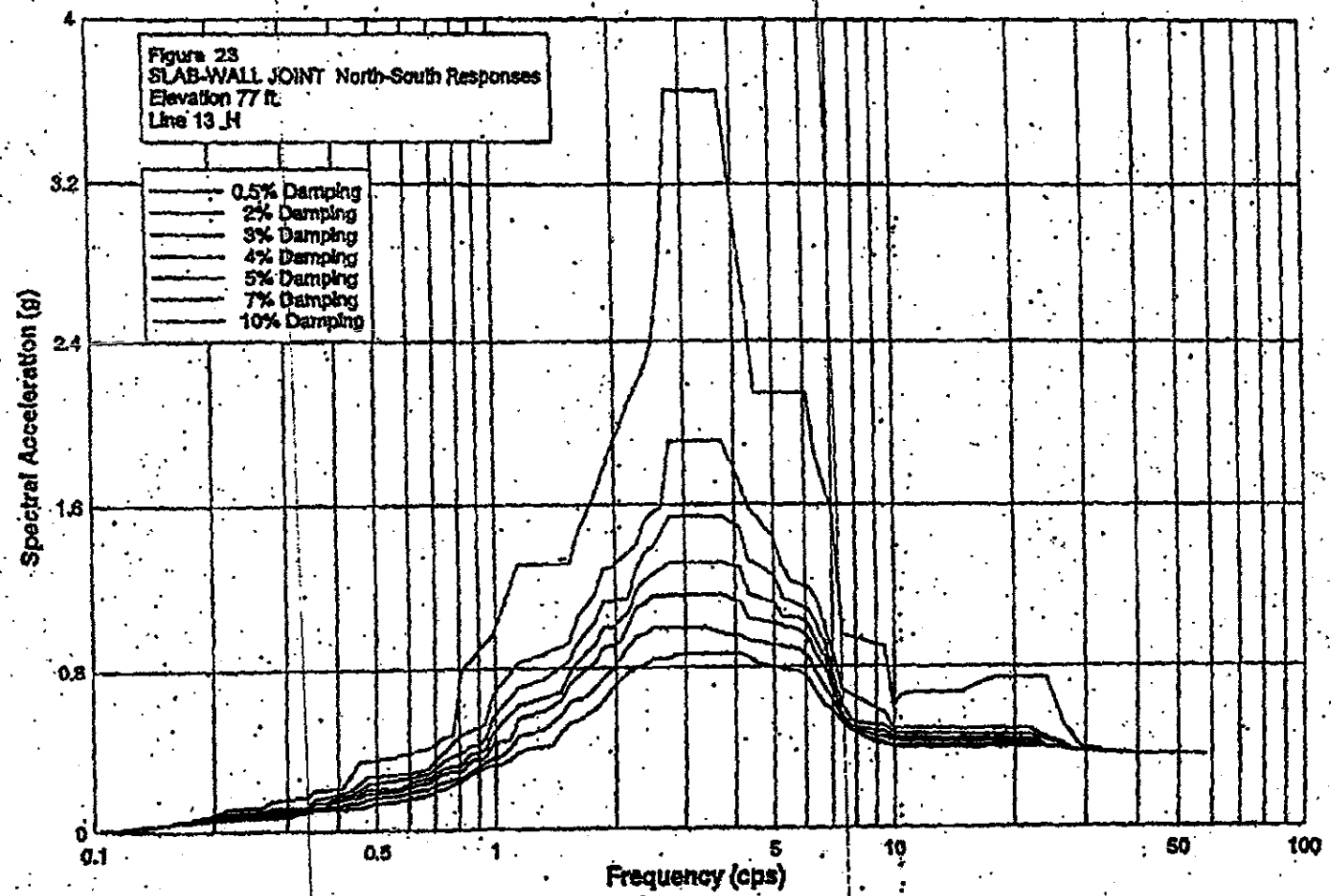
RPP-WTP Pretreatment Facility ISRS

Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0A



RPP-WTP Pretreatment Facility ISRS

Calc No.; 24590-PTF-S0C-S15T-00005, Rev. 0A



M-5

RPP-WTP Pretreatment Facility ISRS

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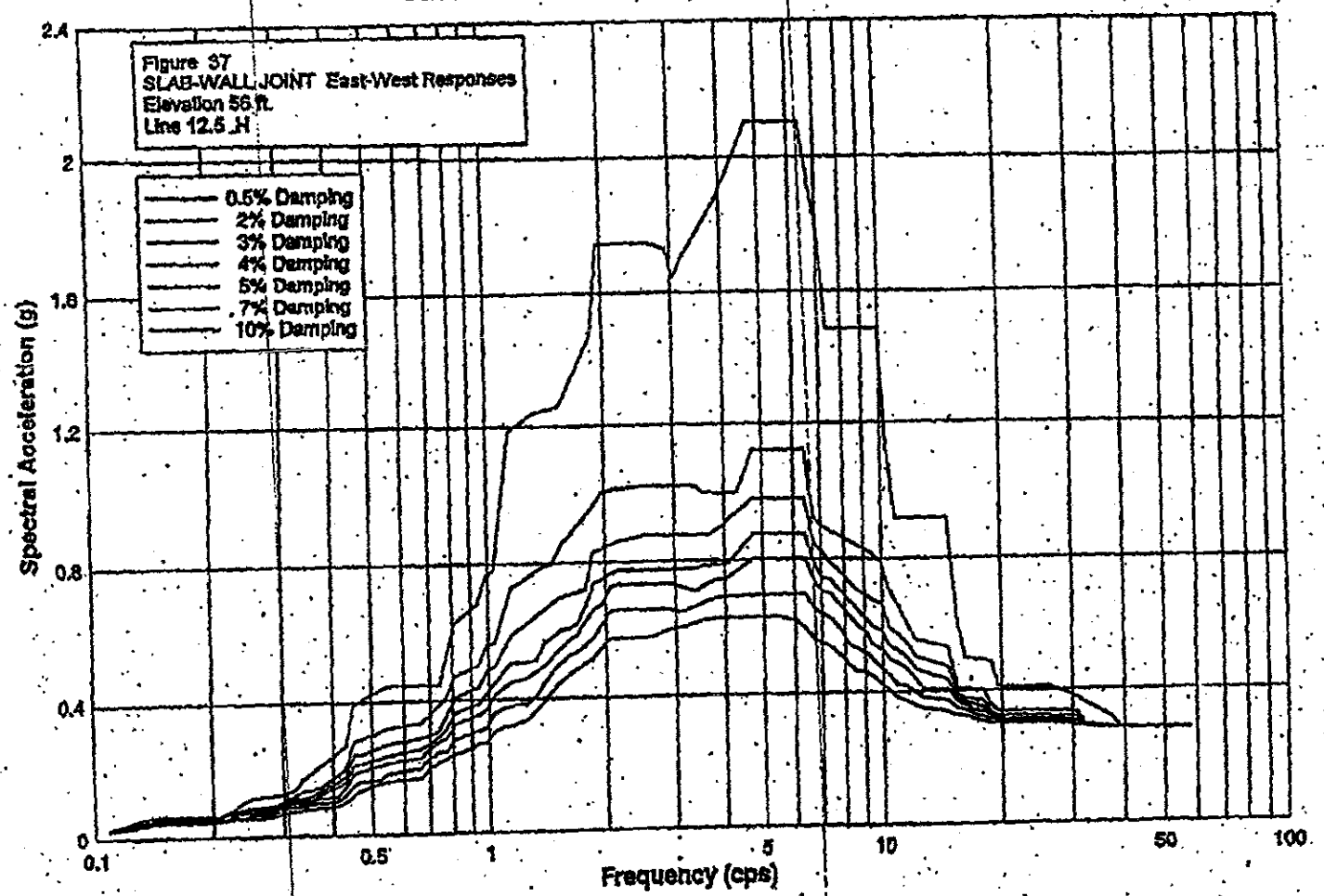

M-6

RPP-WTP Pretreatment Facility ISRS

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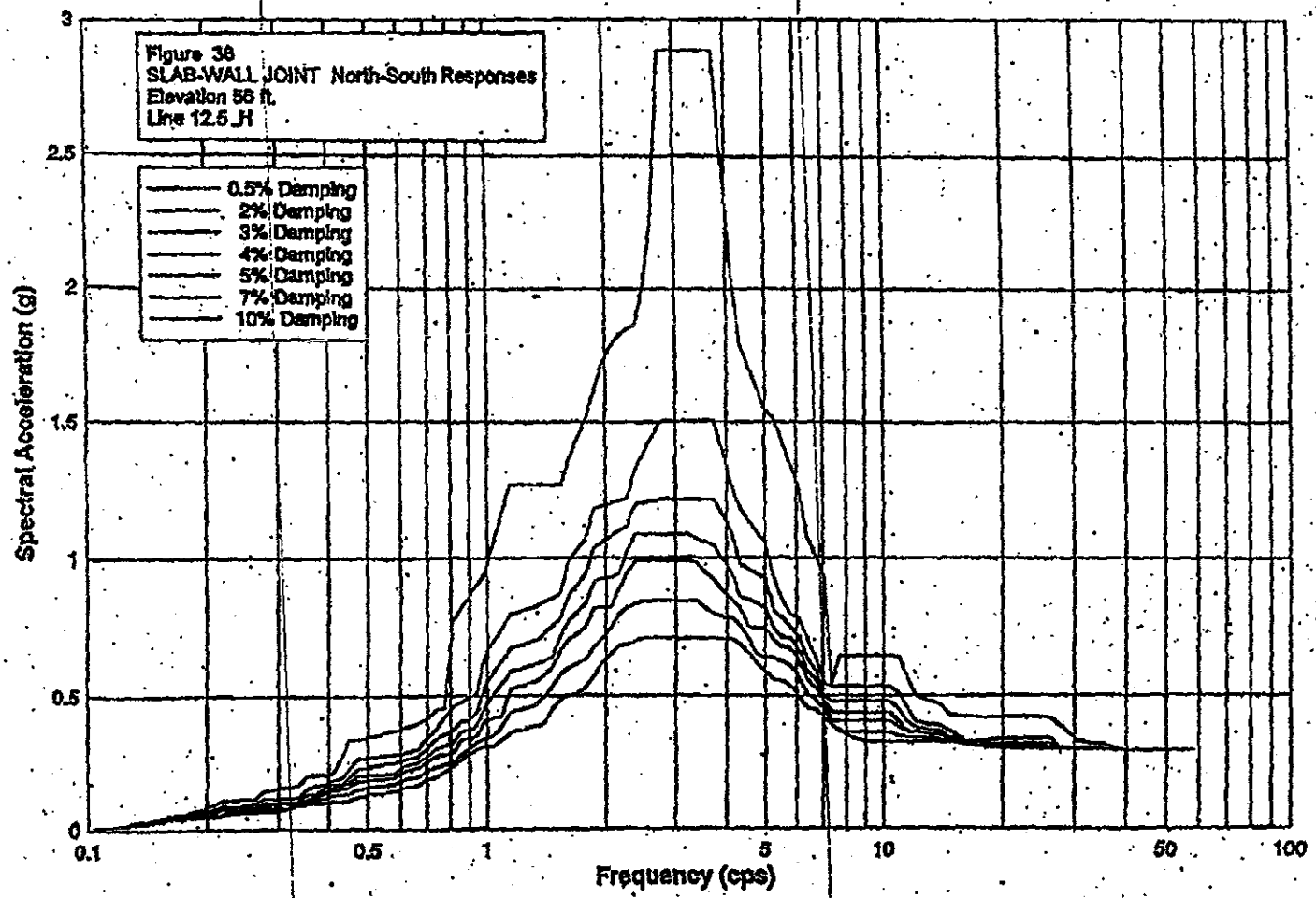

M-7

RPP-WTP Pretreatment Facility ISRS

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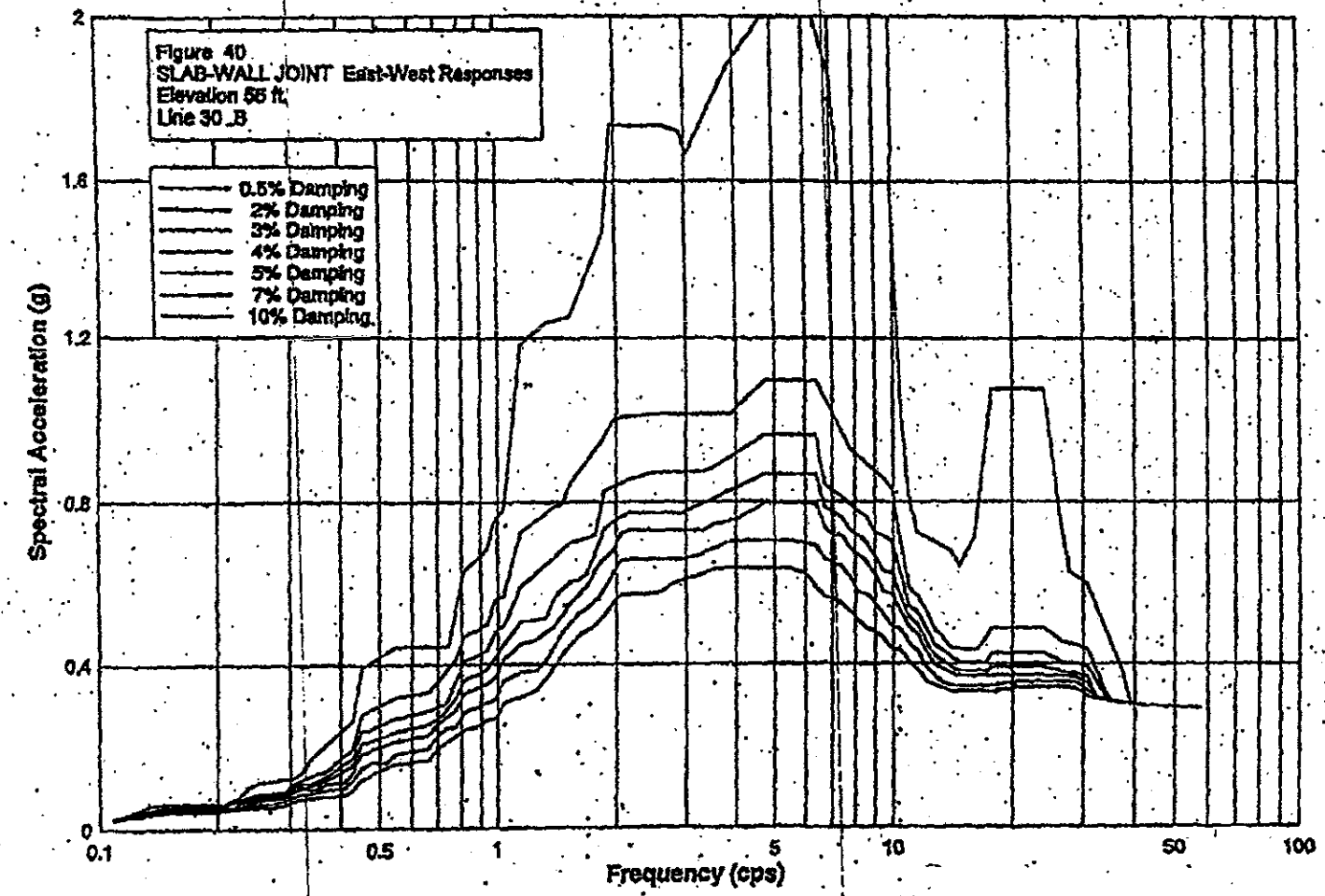

M-8

RPP-WTP Pretreatment Facility ISRS

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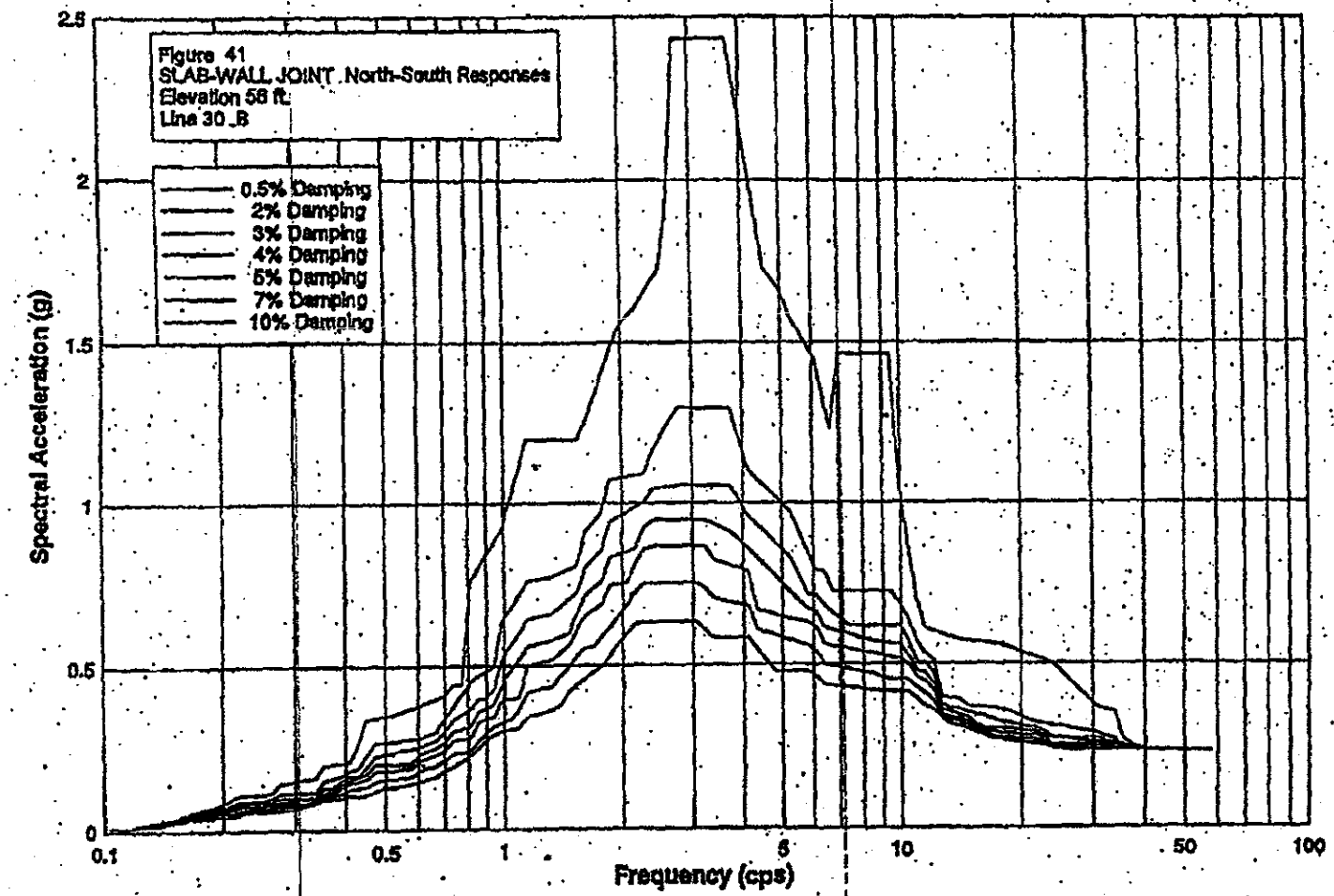

M-9

RPP-WTP Pretreatment Facility ISRS

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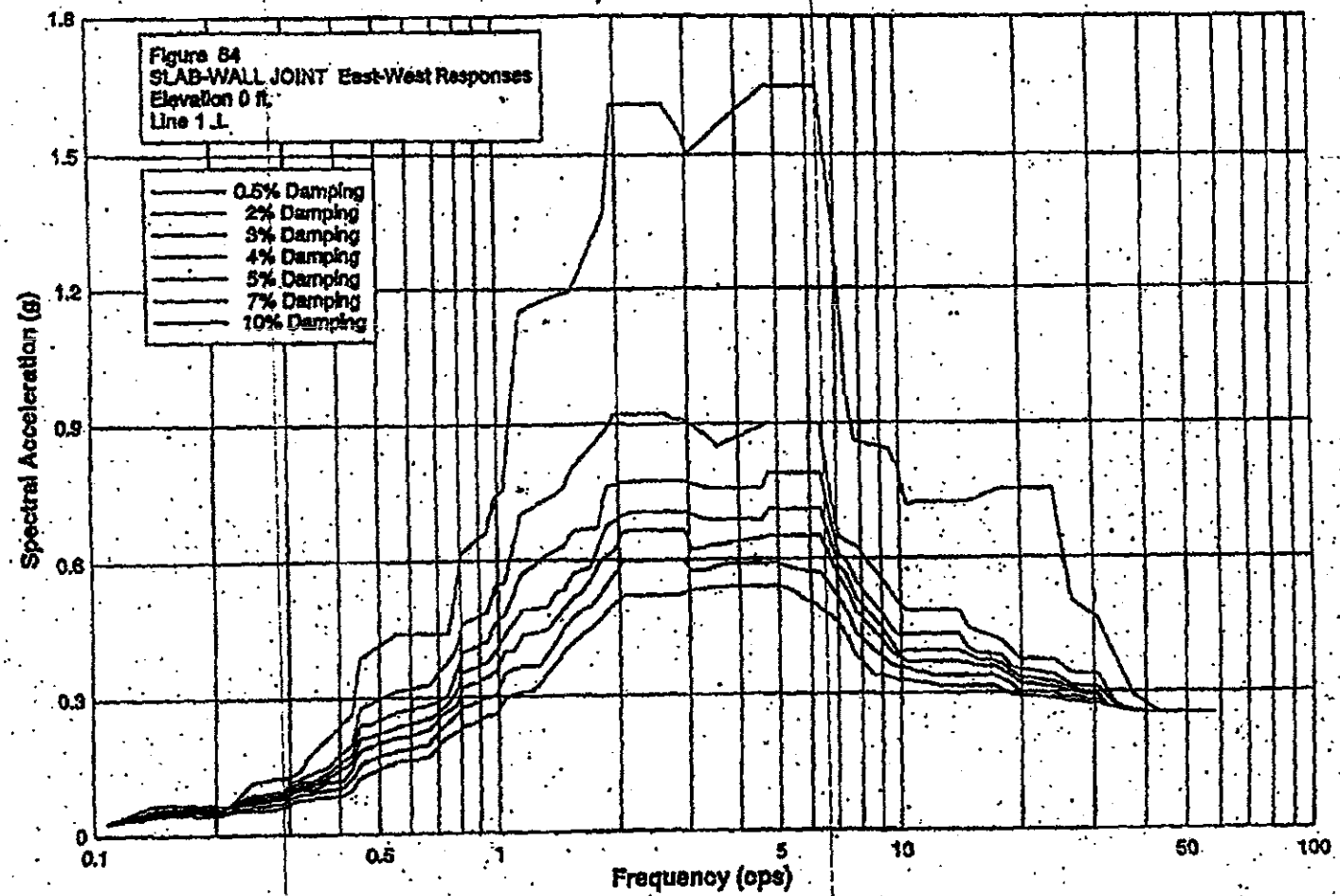

M-10

RPP-WTP Pretreatment Facility ISRS

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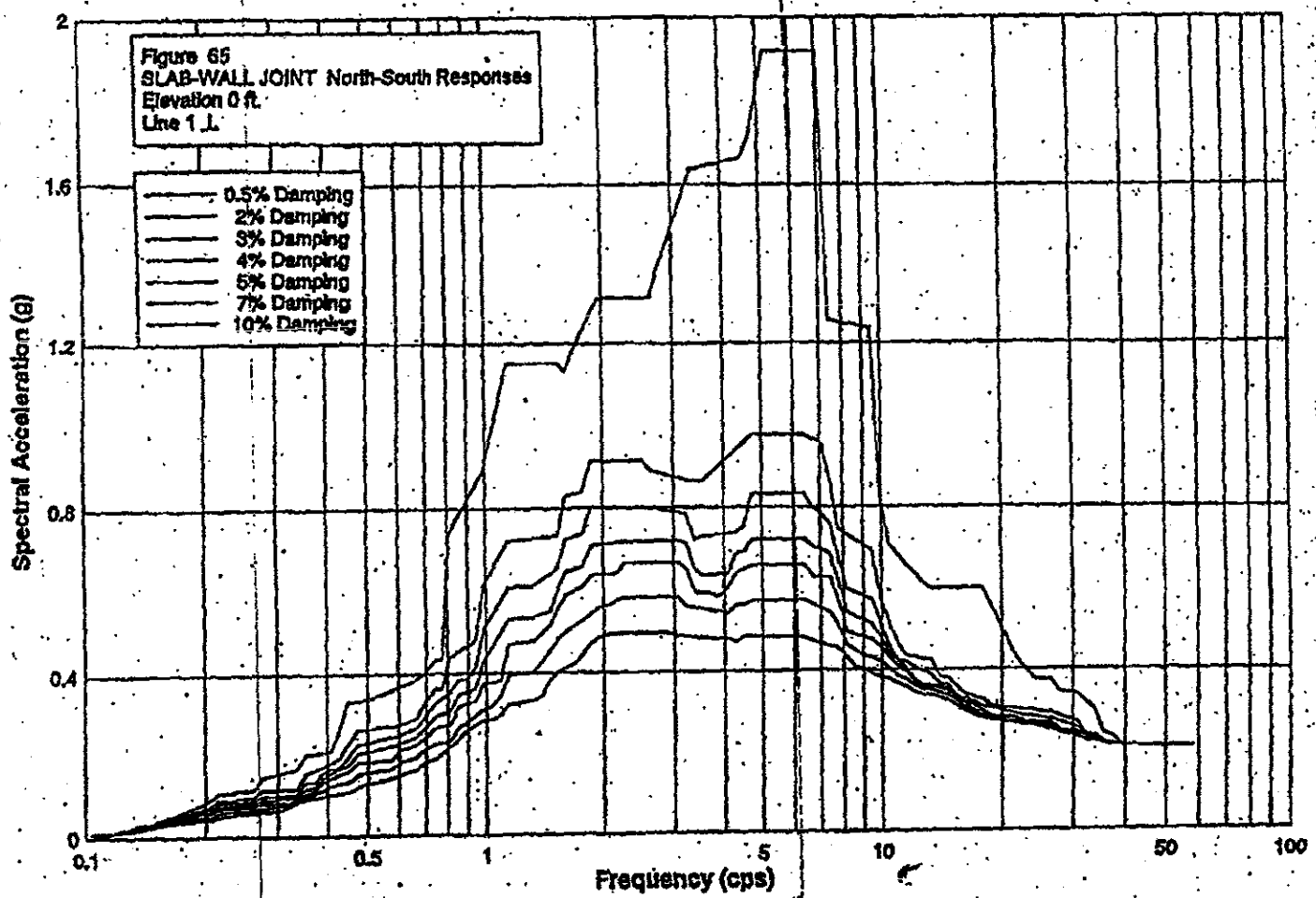

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RPP-WTP Pretreatment Facility ISRS

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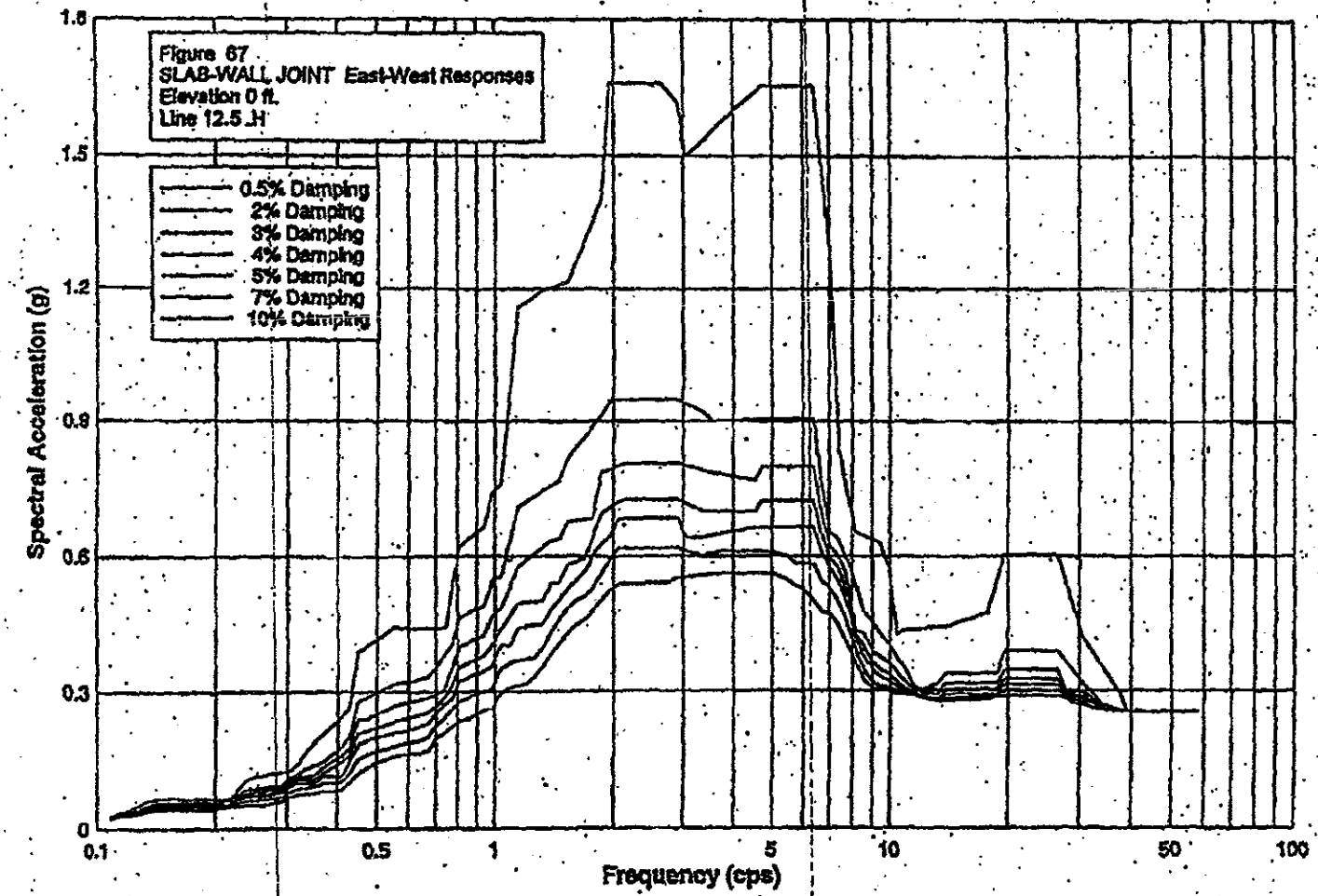

M-12

RPP-WTP Pretreatment Facility ISRS

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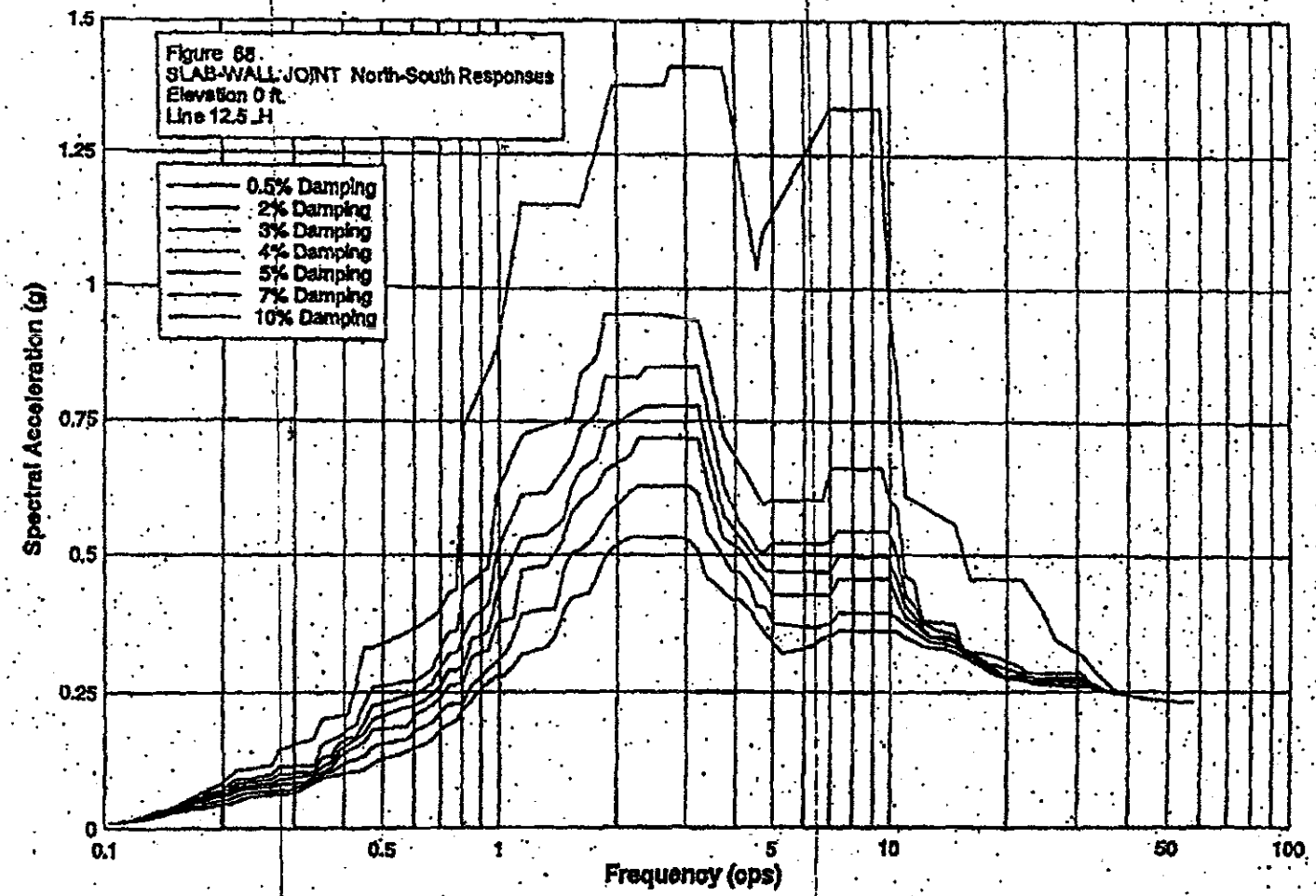

M-13

RPP-WTP Pretreatment Facility ISRS

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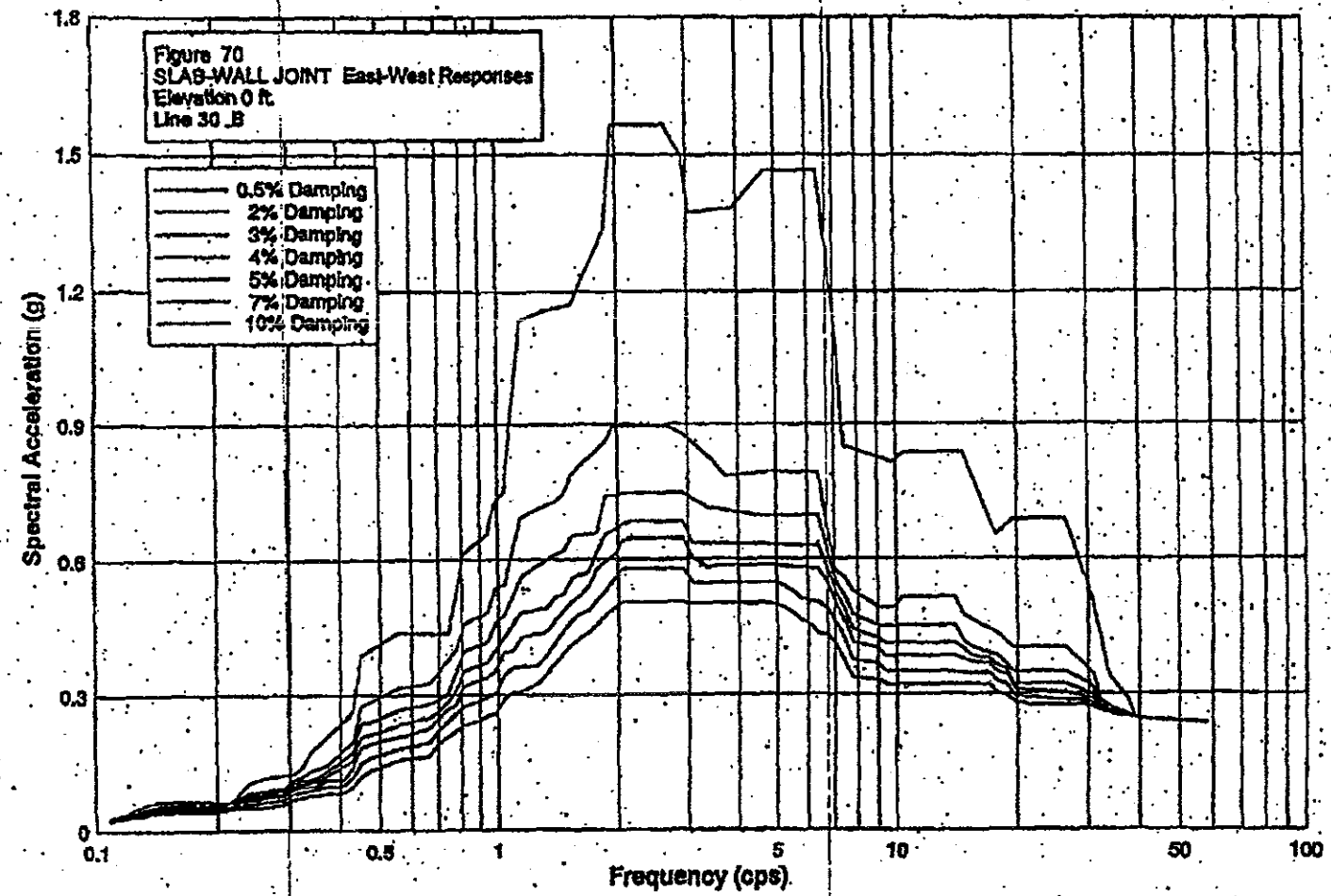

M-14

RPP-WTP Pretreatment Facility ISRS

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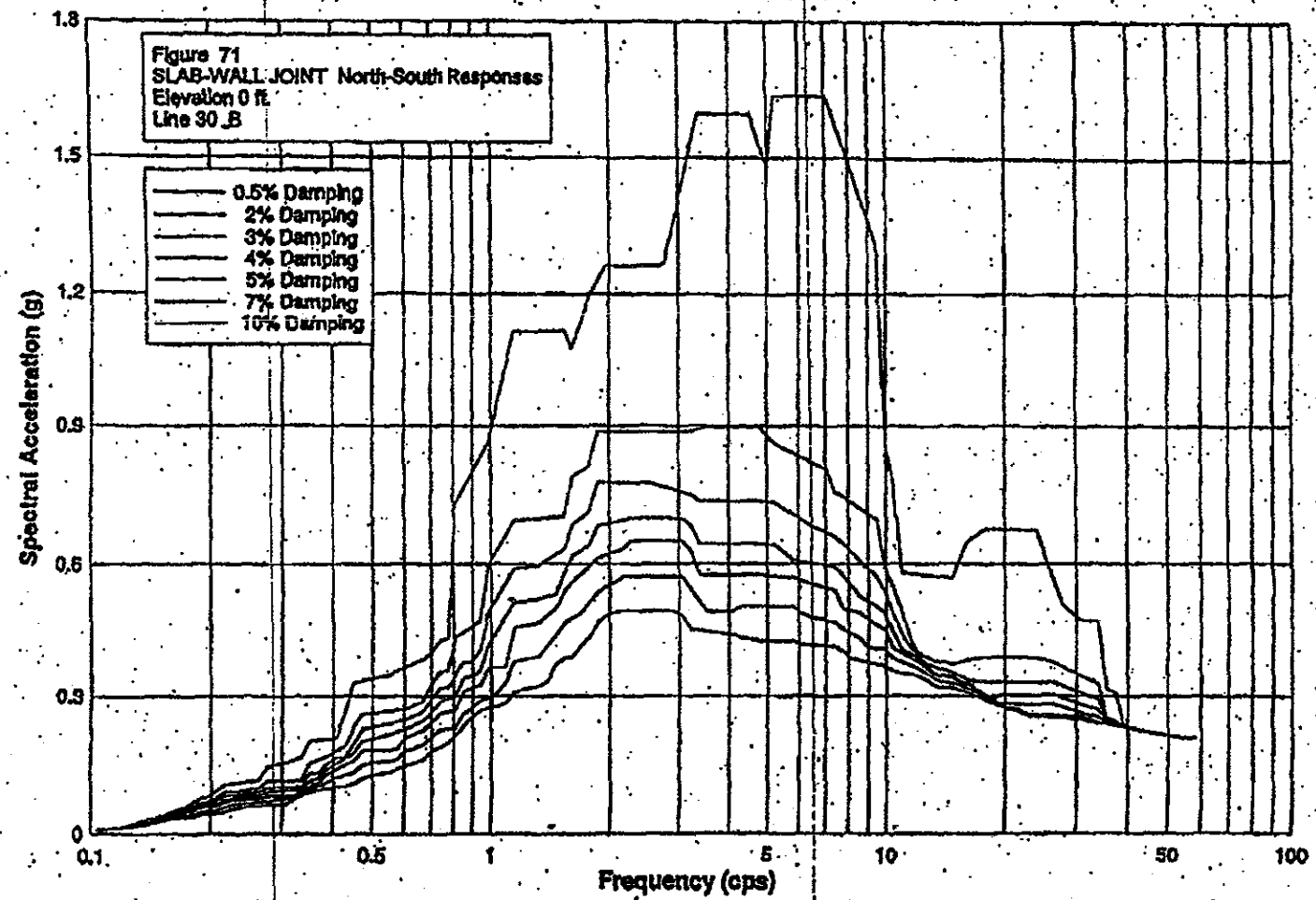

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RPP-WTP Pretreatment Facility ISRS

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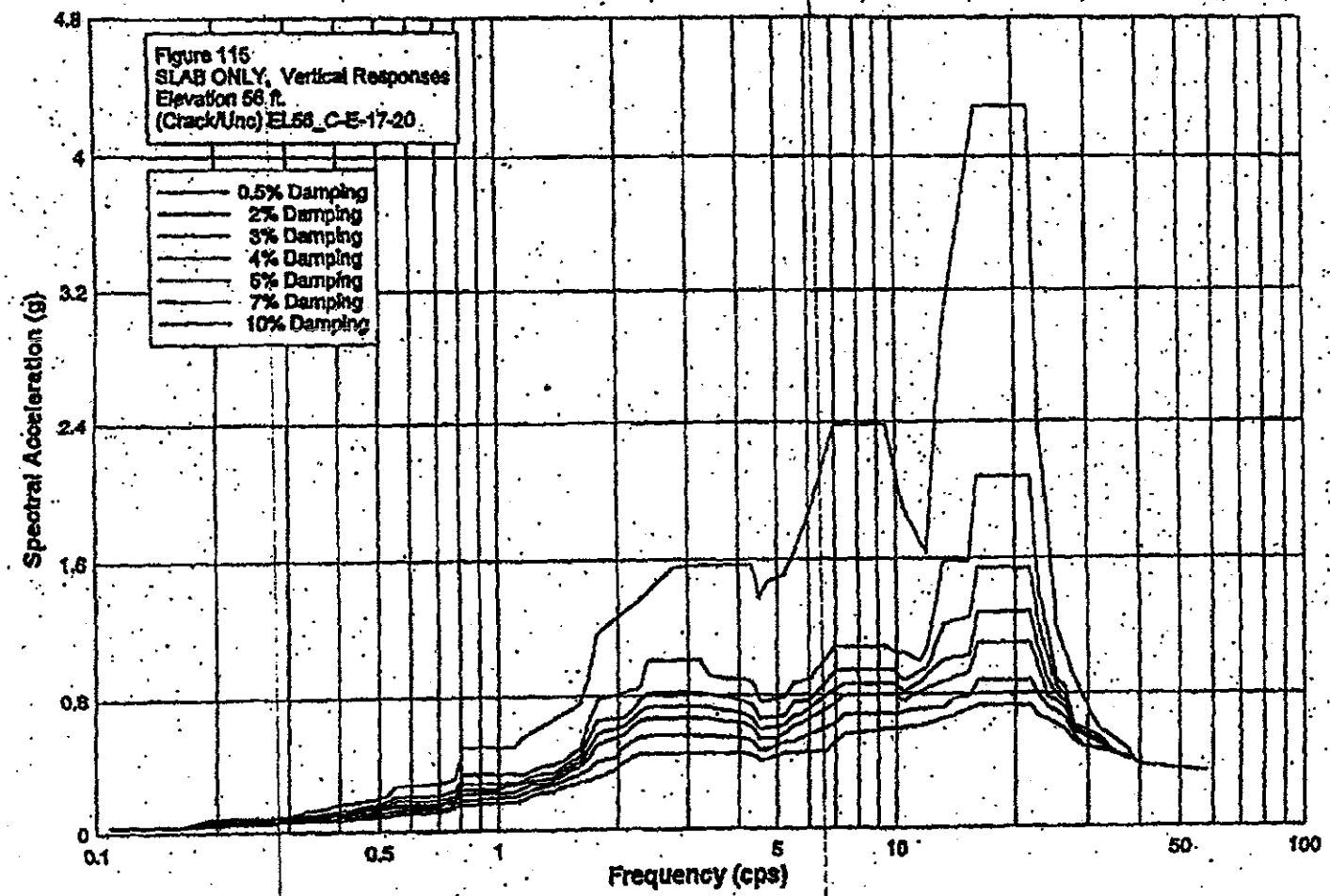

M-16

RPP-WTP Pretreatment Facility ISRS

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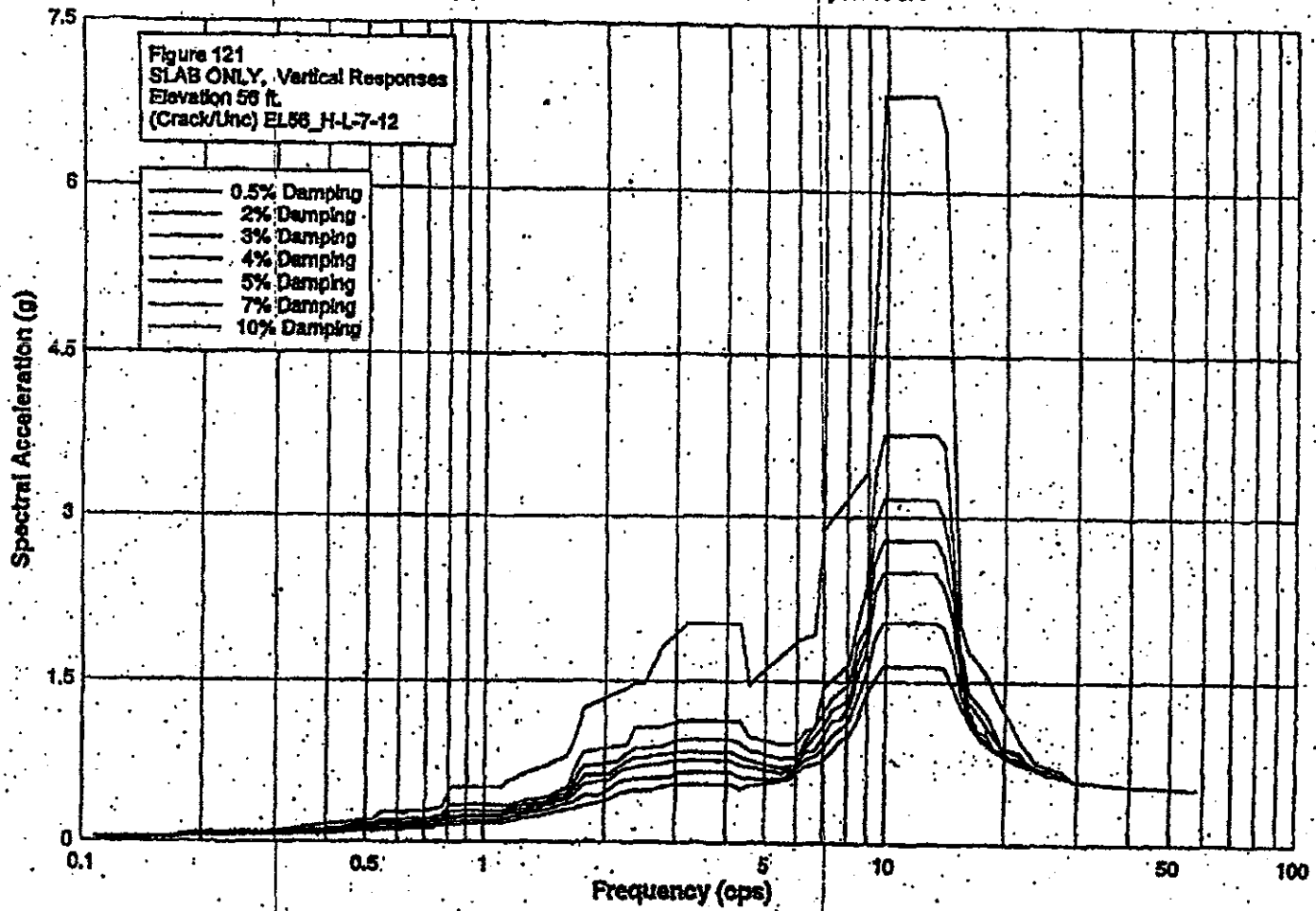

RPP-WTP Pretreatment Facility ISRS

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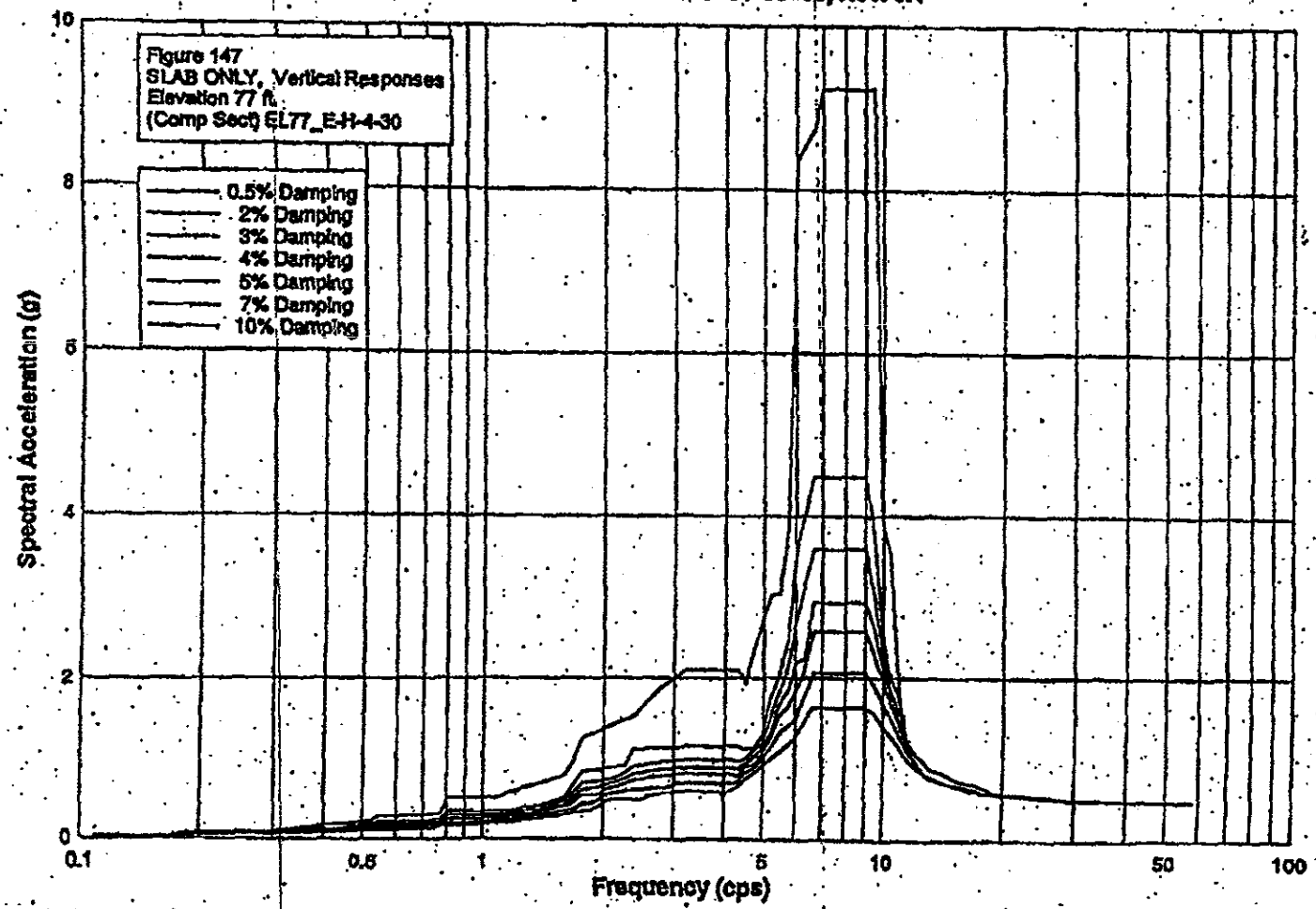

M-18

RPP-WTP Pretreatment Facility ISRS

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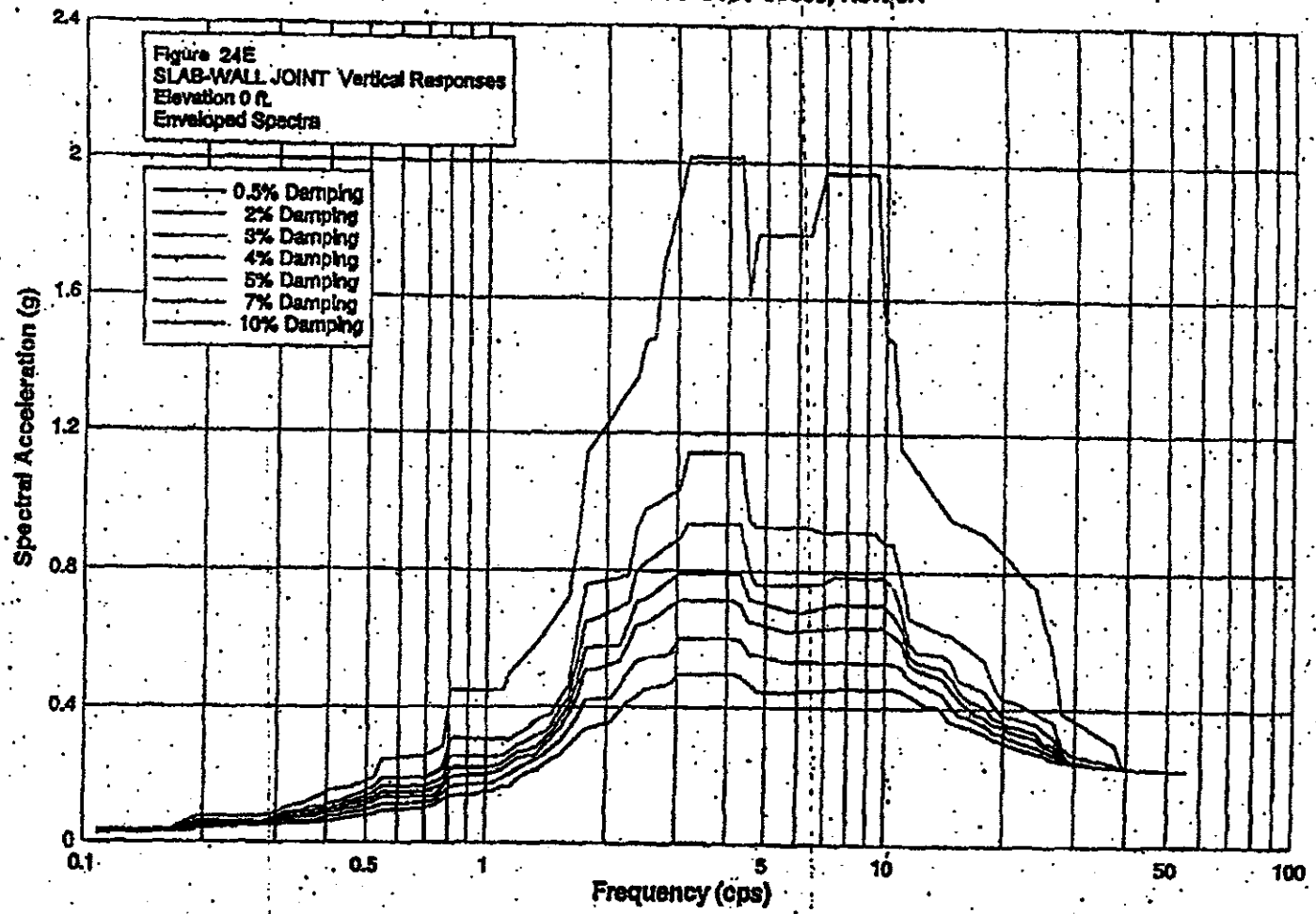

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RPP-WTP Pretreatment Facility ISRS

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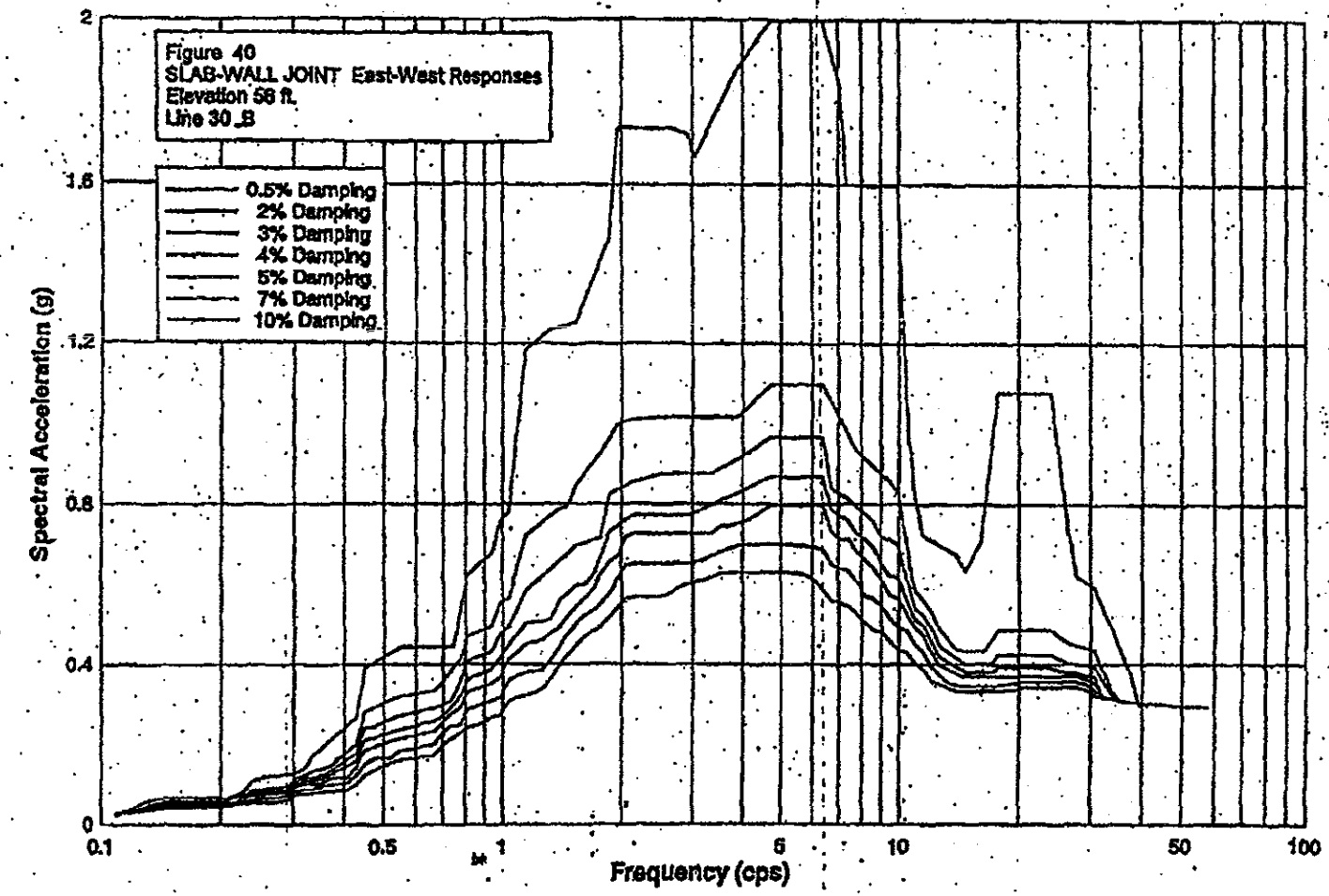

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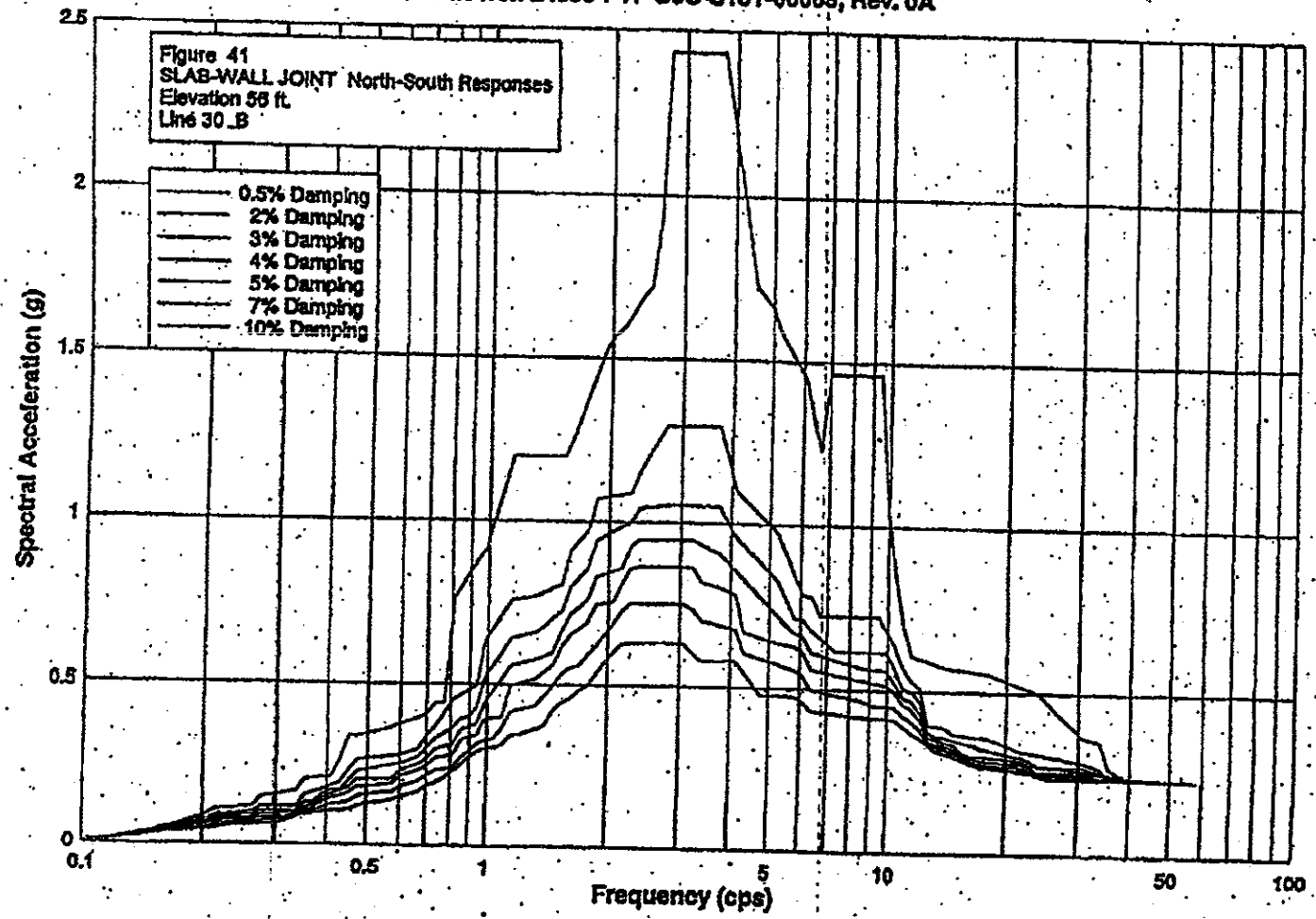

RPP-WTP Pretreatment Facility ISRS

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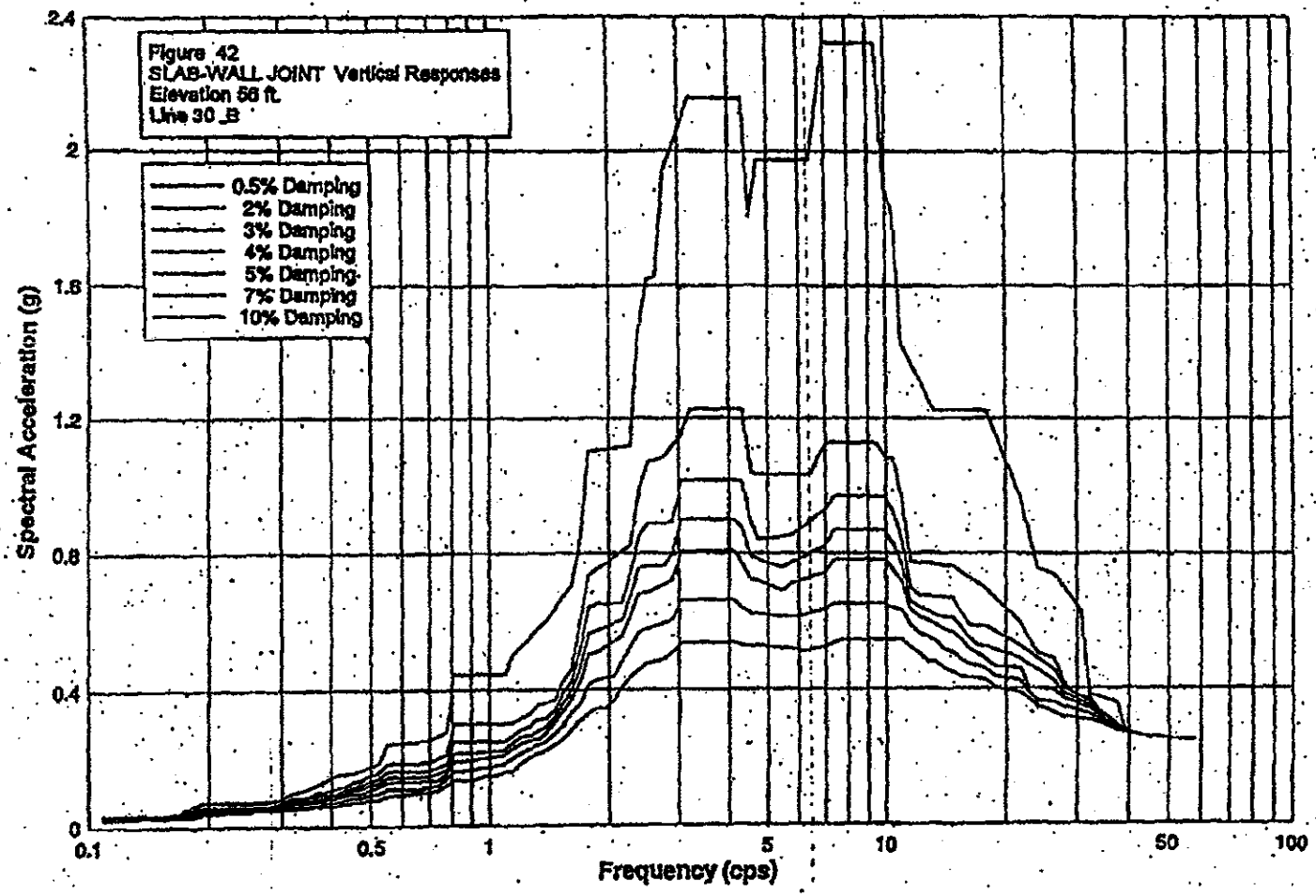

RPP-WTP Pretreatment Facility ISRS

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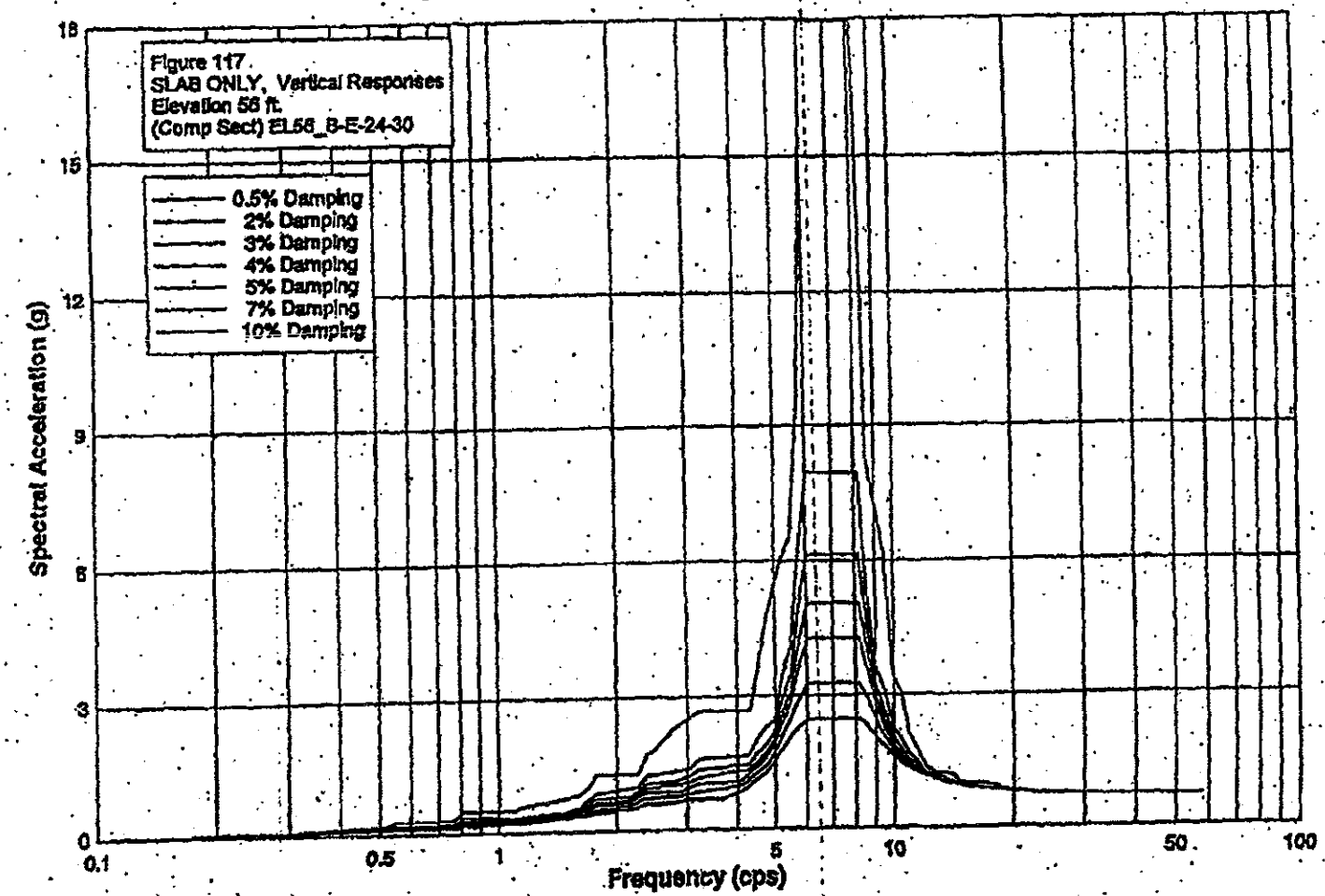

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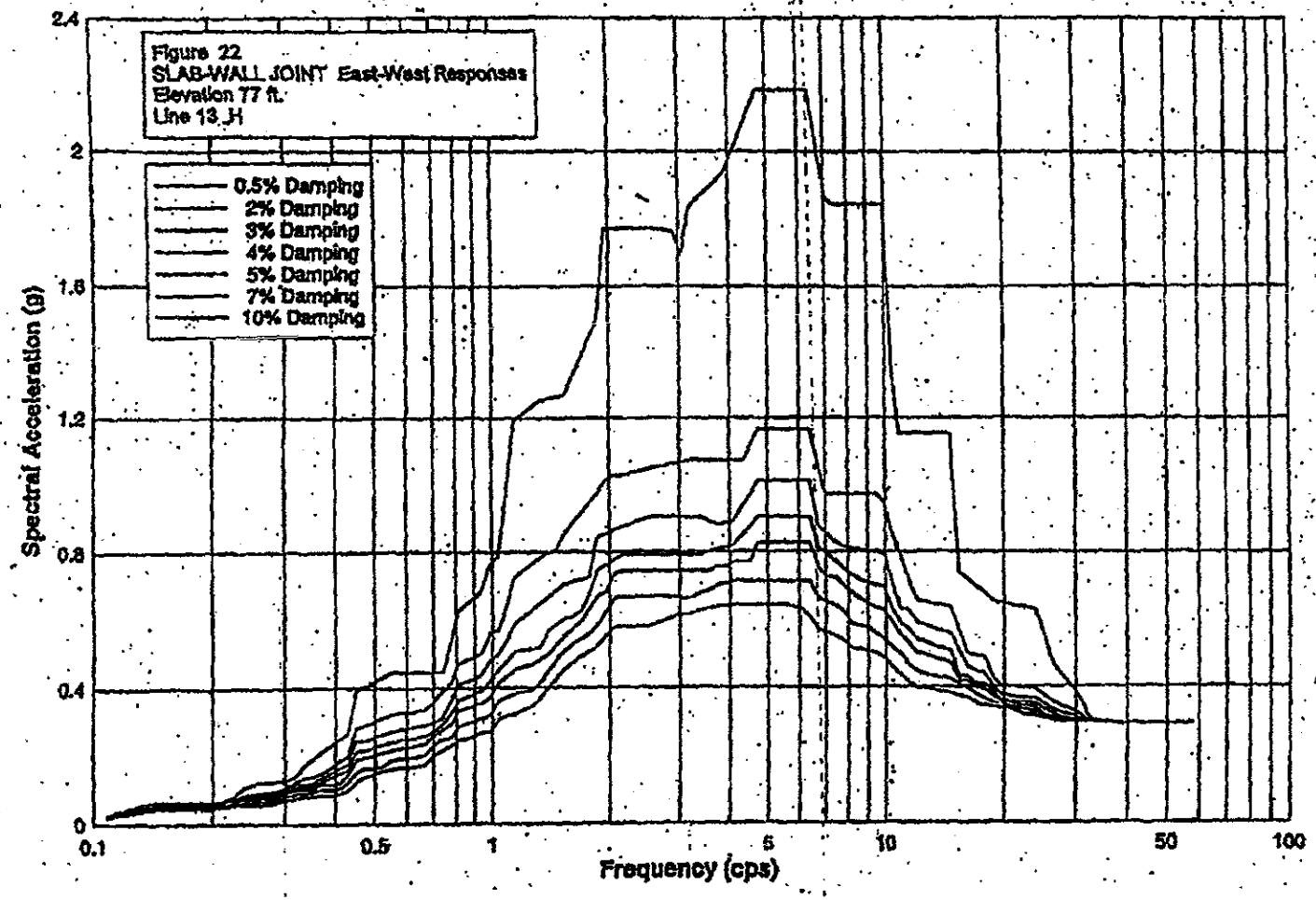

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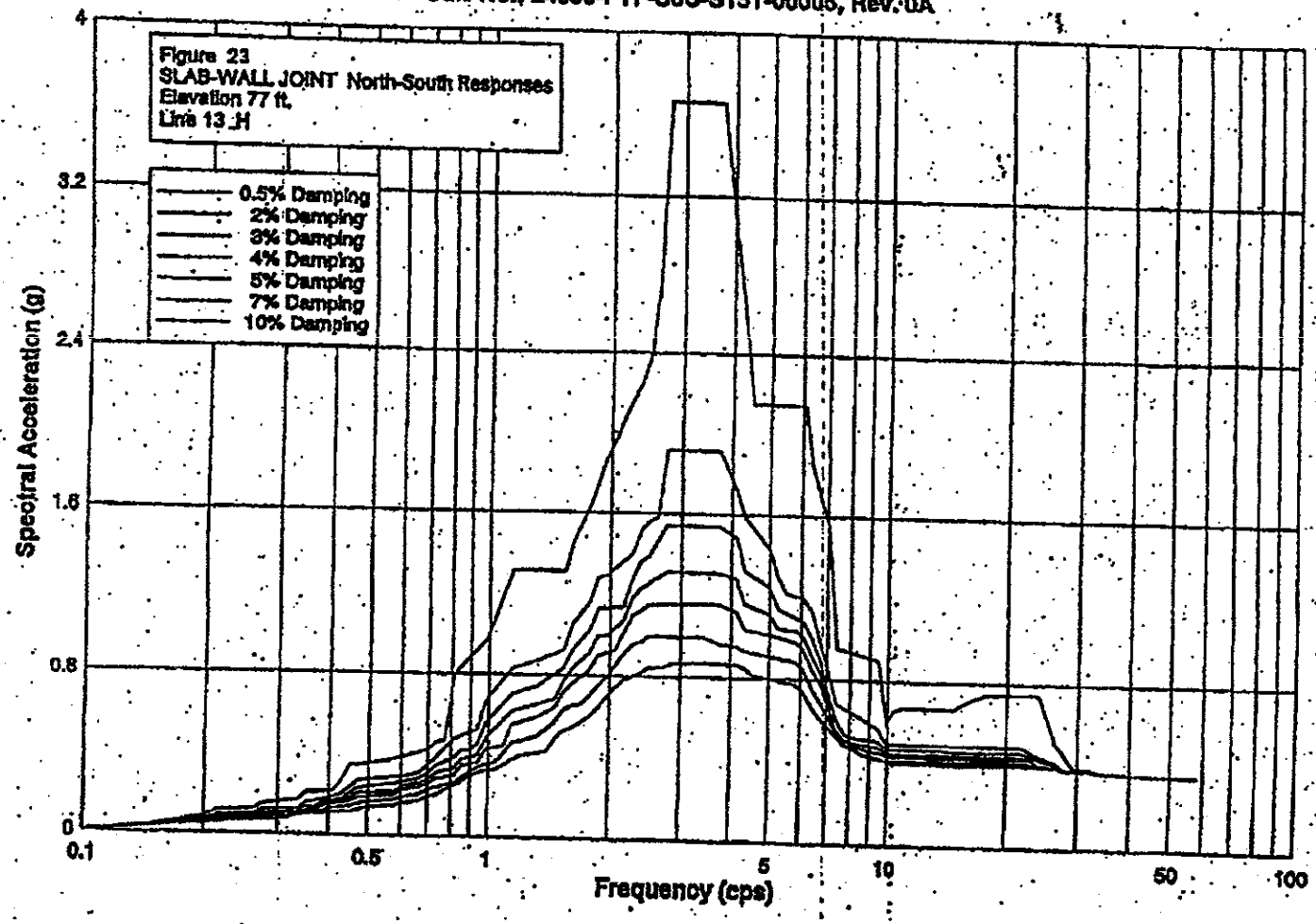

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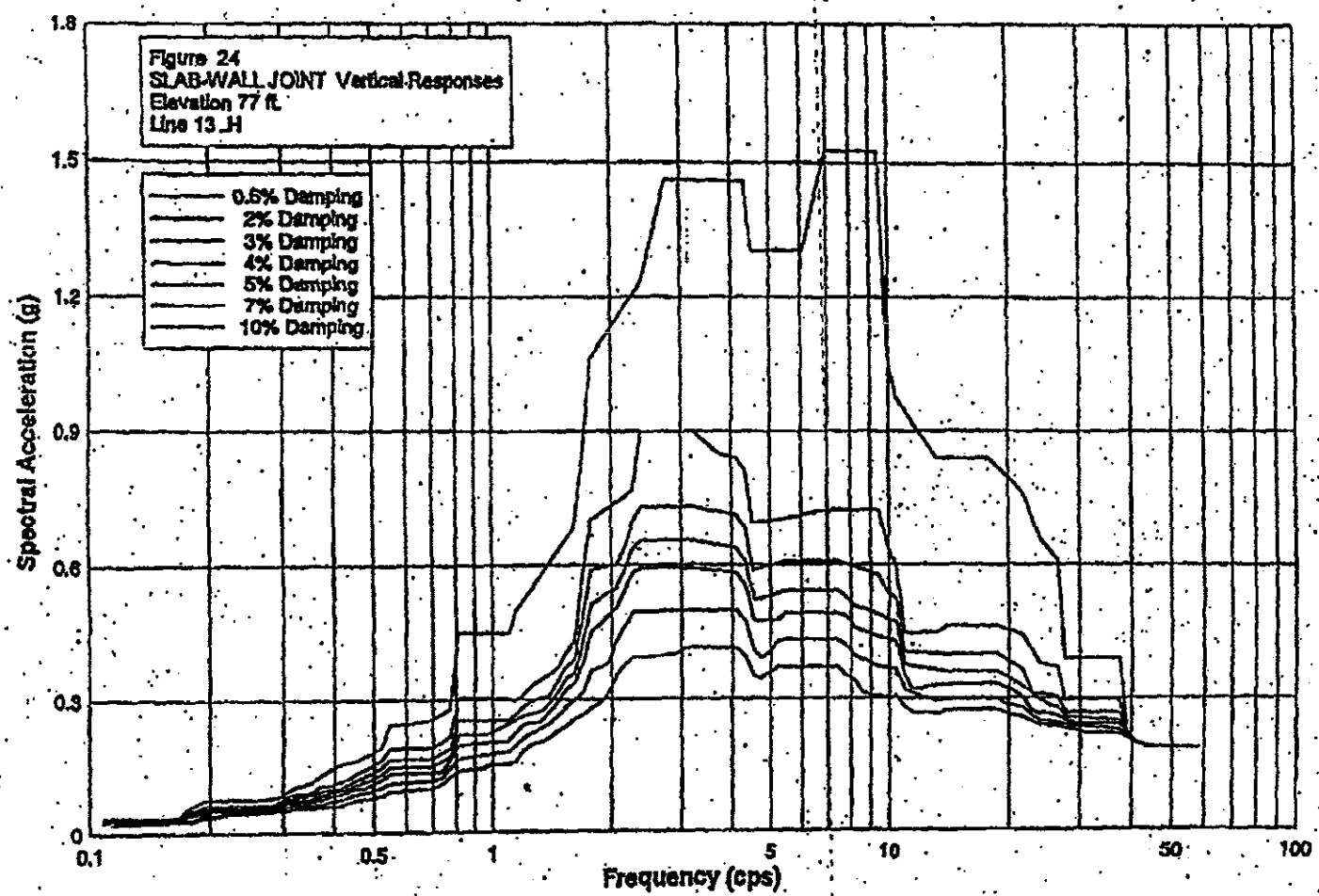

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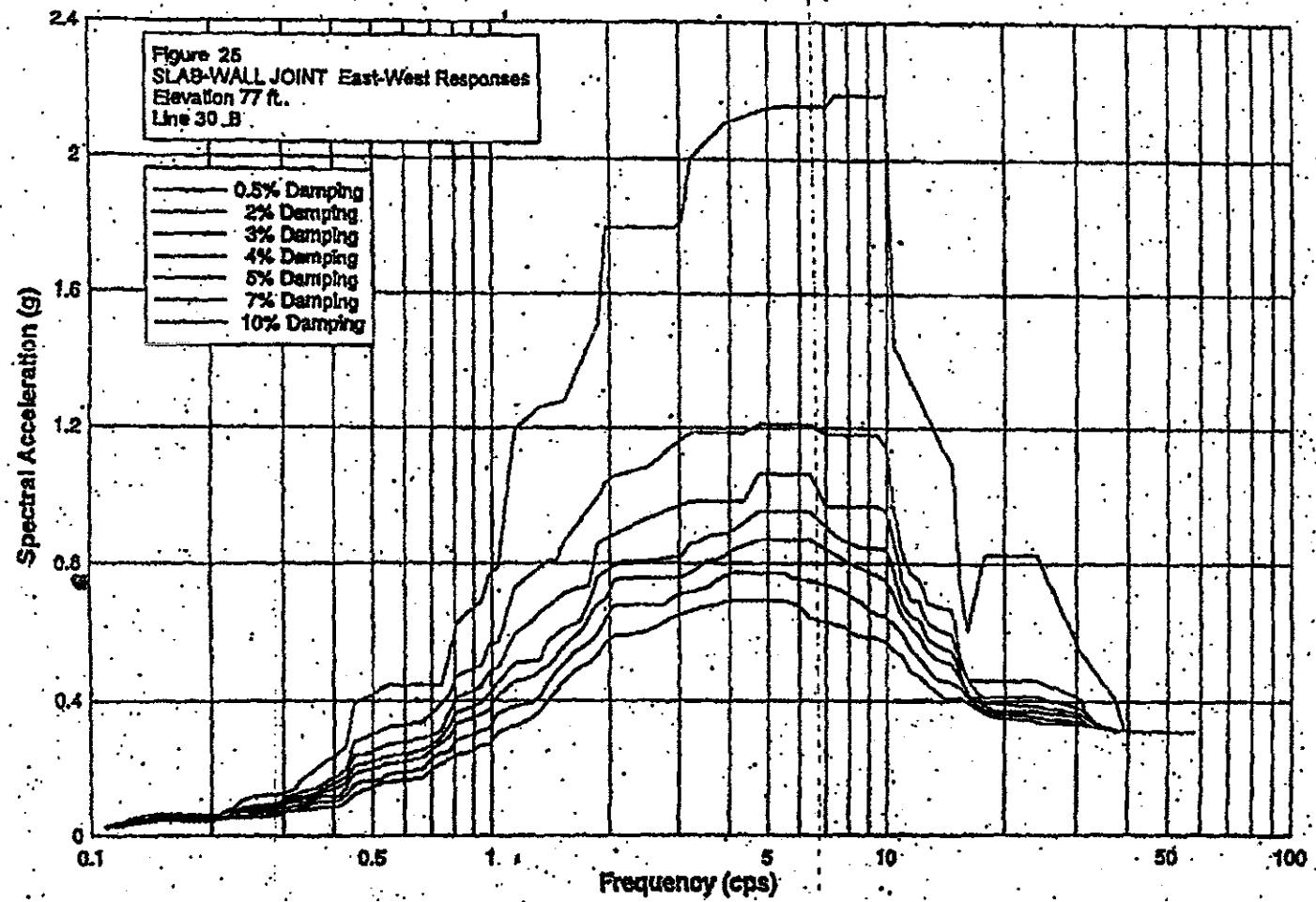

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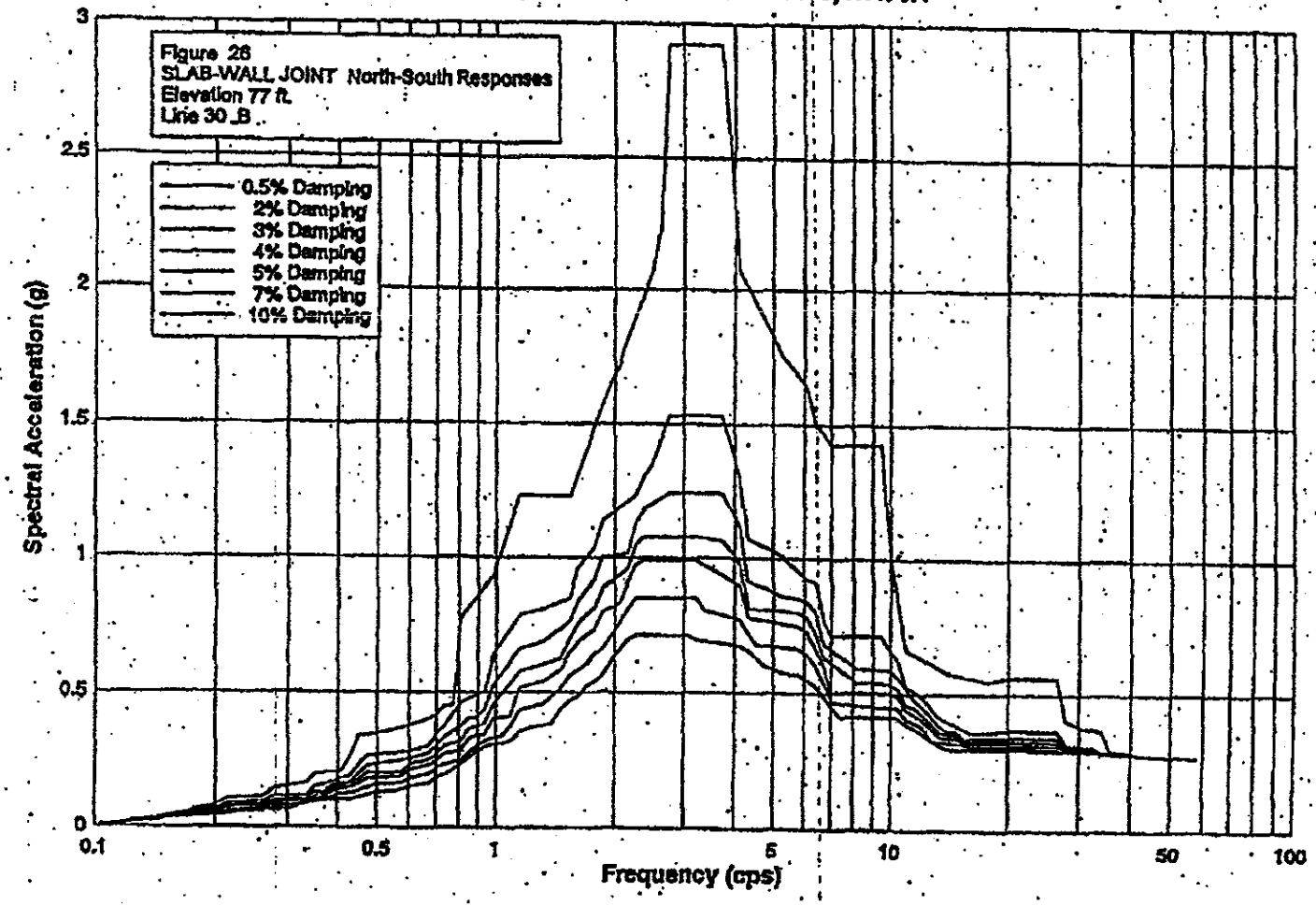

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RPP-WTP Pretreatment Facility ISRS

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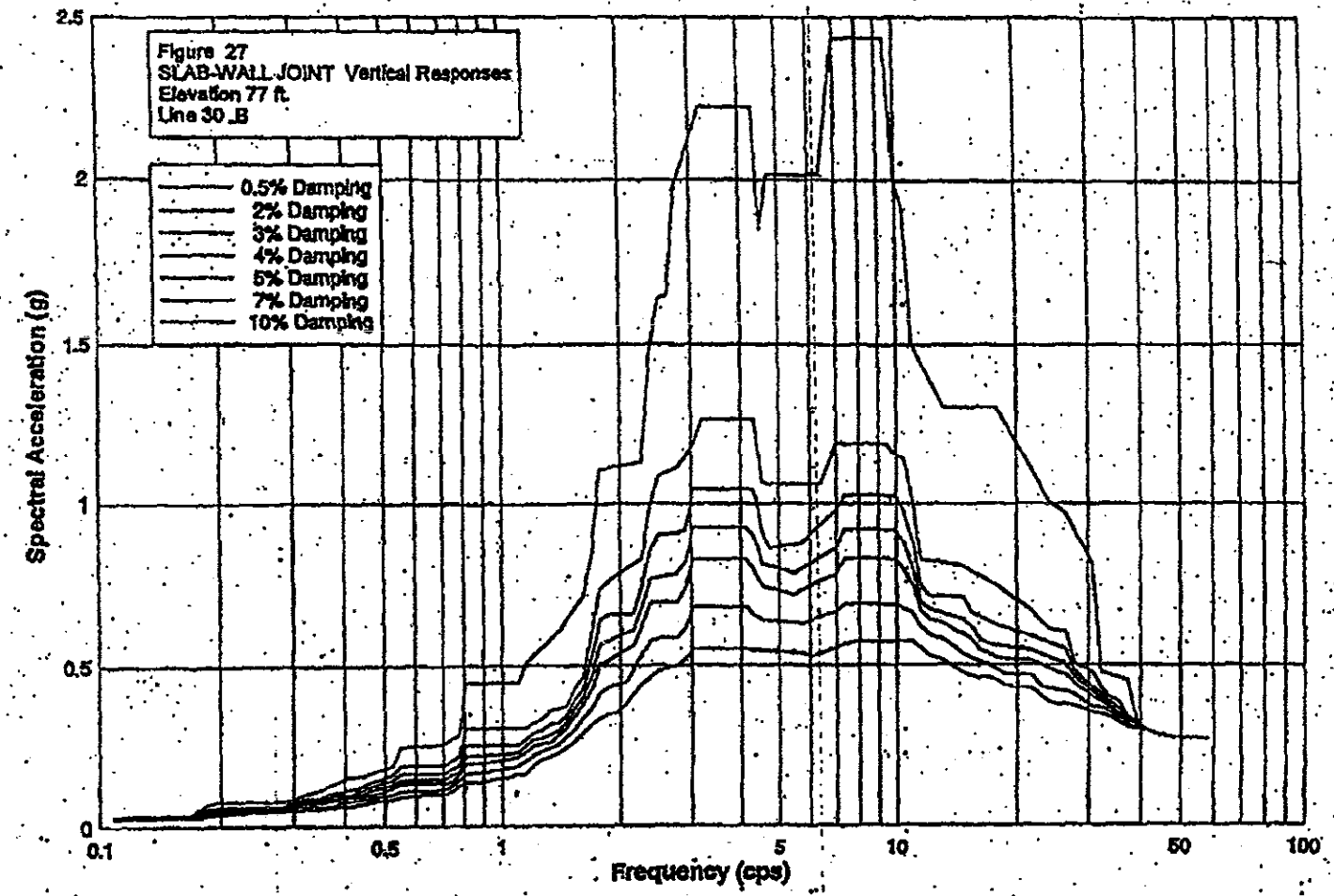

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RPP-WTP Pretreatment Facility ISRS

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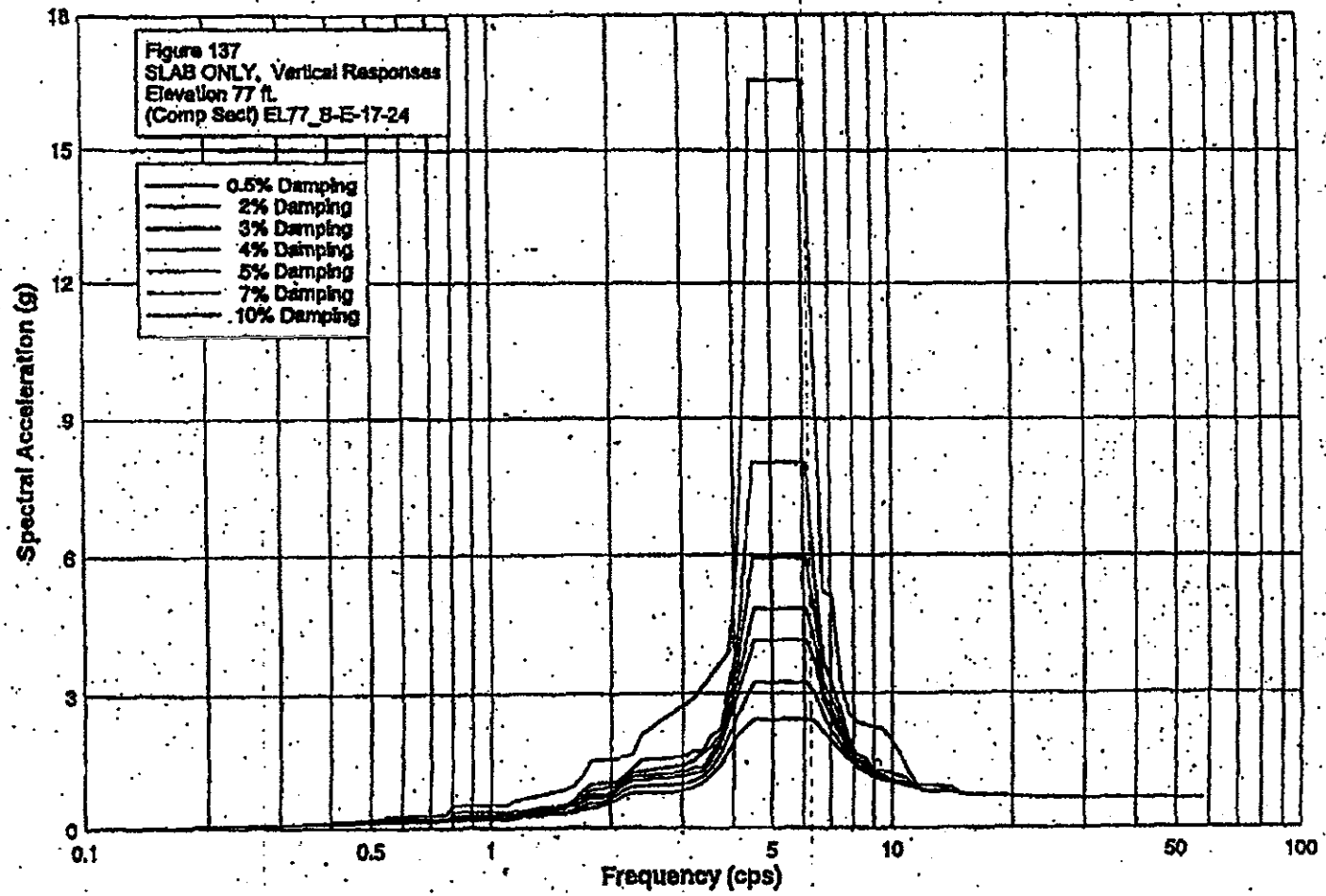


M-30

APPENDIX N

Deleted

APPENDIX O

Nondestructive Examination (NDE) of Fabricated Pipe Welds

Non-Destructive Examination (NDE) of Fabricated Pipe Welds

ASME B31.3 Process Piping							
Type of Weld	Cat. D	Normal Fluid Service Less than Class 1500	Normal Fluid Service Class 1500 and Greater	Cat. M Black Cells	Cat. M Dual Containment Pipe		Cat. M All Others
					Inner Pipe	Jacket	
Girth and Miter Welds	100 % VT	100 % VT 5 % RT	100 % VT 100 % RT	100 % VT & RT (1)	100 % VT & RT (1)	100 % VT 5 % RT (3)	100 % VT 20 % PT/MT
Branch Connection Welds and Fillet Welds including Socket and Attachment Welds for Branch Reinforcement and Support Welds	100 % VT	100 % VT	100 % VT	100 % PT/MT (2)	100 % PT/MT (2)	100 % VT	100 % VT 20 % PT/MT

NOTES:

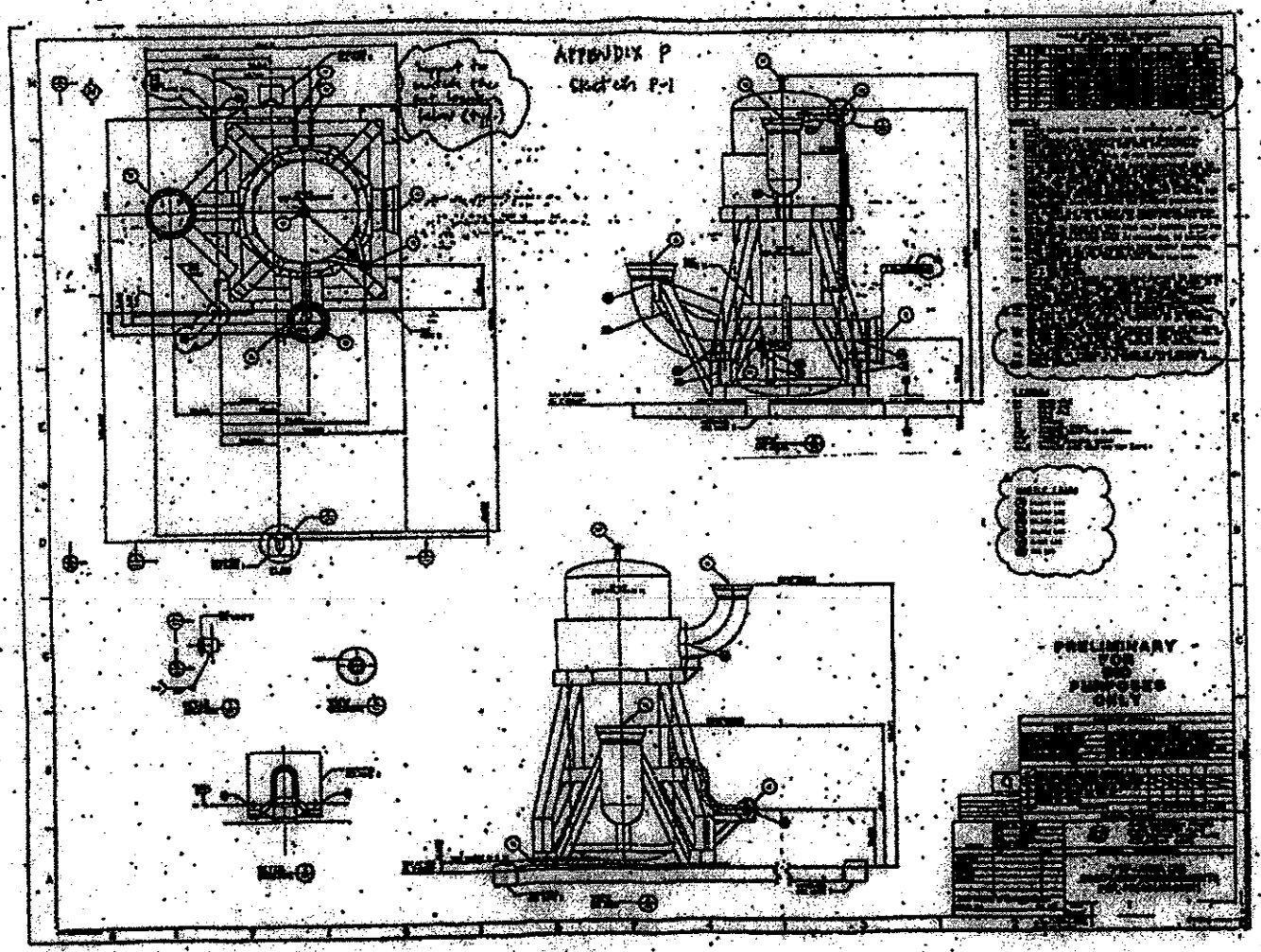
1. The radiographic acceptance criteria for normal fluid service applies except that incomplete penetration and undercut are not permitted.
2. The penetrant and magnetic particle test acceptance criteria shall be in accordance with B31.3 para. 344.4, except that no cracks are permitted.
3. A 5 % random in-process examination shall be performed in lieu of RT in accordance with ASME B31.3, Para. 341.4.1 & 344.7.
4. Black cells include Rm. No's. P-102, 104, 106, 108, 109, 111, 112, 113, 114 & 116 in the PT Building and Rm. No's. H-B005A, B032, B014, B021, B0005, B005A, B015, H-302 & H-308 in the HLW Building.

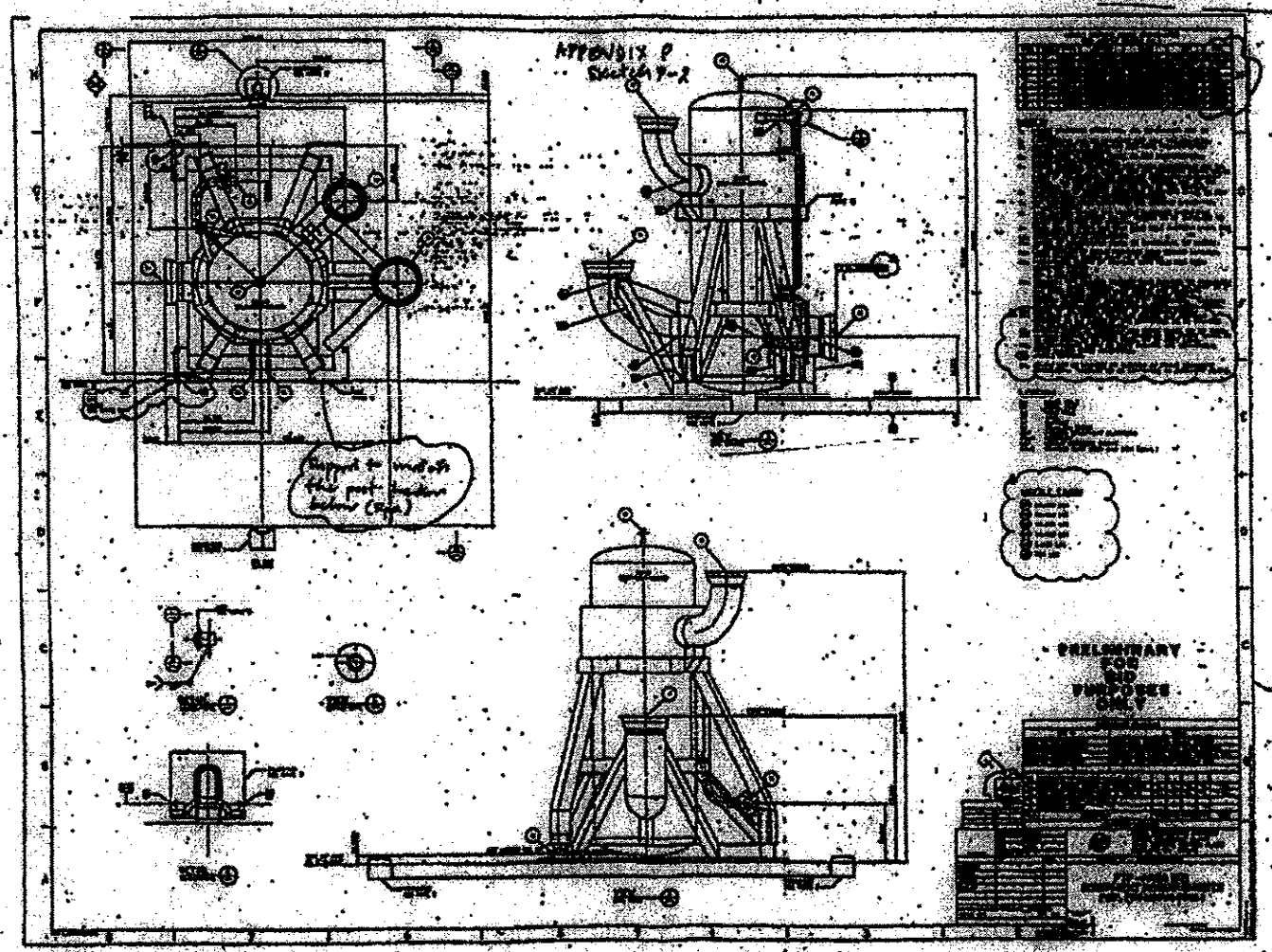
LEGEND:

RT – Radiographic Examination, PT/MT – Liquid Penetrant or Magnetic Particle Examination, VT – Visual Examination

APPENDIX P

REBOILER SKIDS AND PRELIMINARY NOZZLE LOADS AT GRAYLOC CONNECTIONS


APPENDIX P
Sketch P-1
PRELIMINARY
FOR
INFORMATION
PURPOSES
ONLY

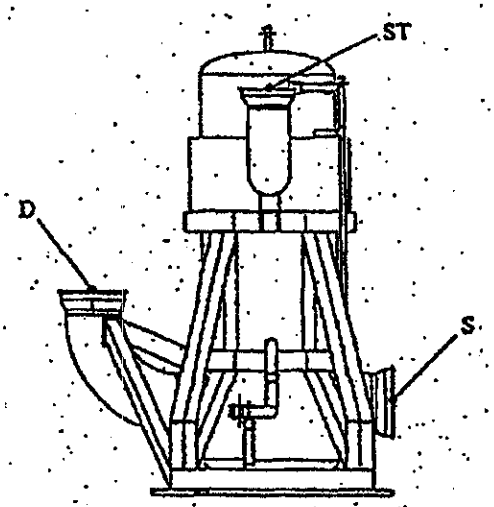

APPENDIX P
Sketch P-2
PRELIMINARY

APPENDIX P

FEP / TLP Large Bore Reboiler Connector Loads

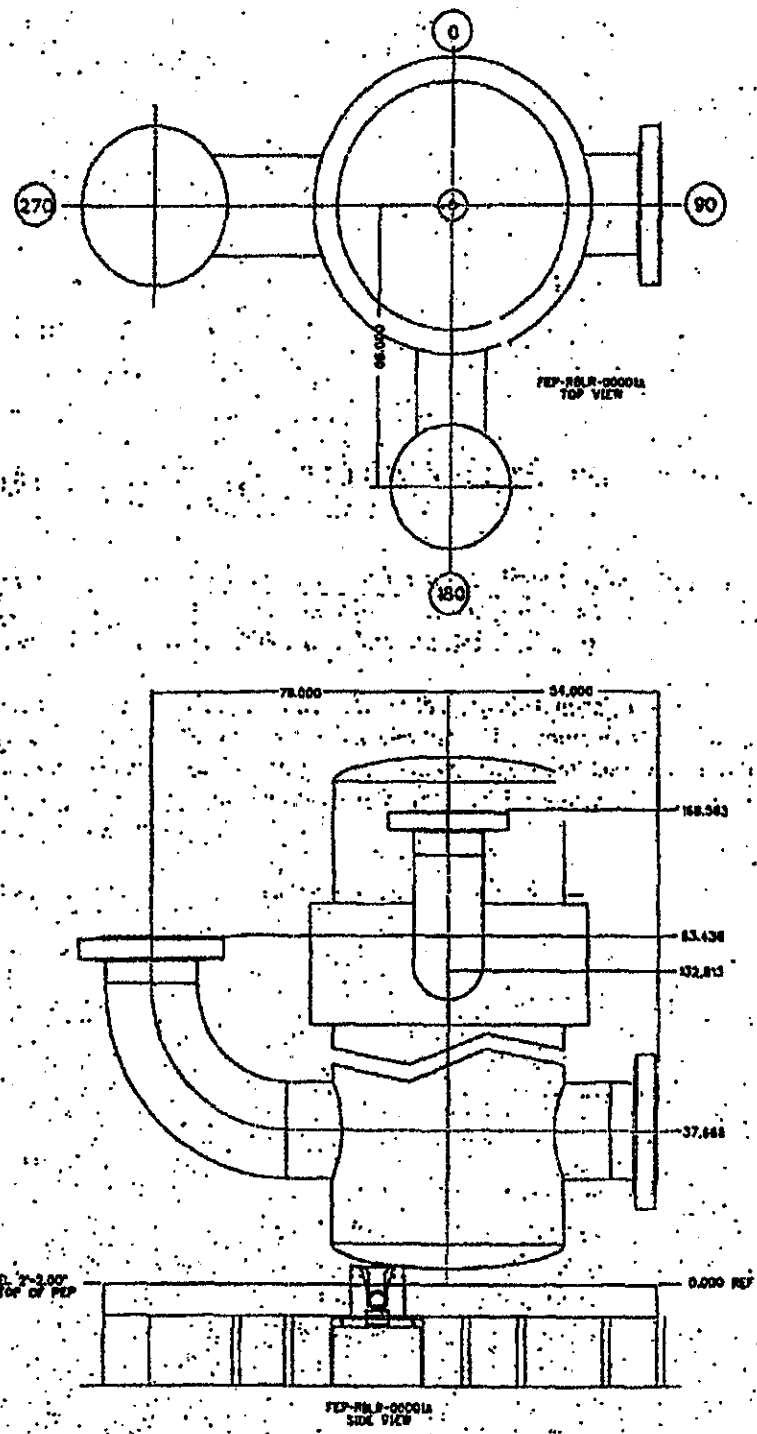
	System	Force		Moment	
		Axial	Resultant Shear	Torsion	Resultant Bending
		lbf	lbf	ft-lbf	ft-lbf
24-Inch					
AREA 17S	TLP	6400	15400	4300	33900
AREA 17D	TLP	11600	13900	31400	24000
AREA 26S	FEP	2100	8200	17100	30800
AREA 26D	FEP	14600	9900	19100	29300
AREA 27S	FEP	2100	8200	17100	30800
AREA 27D	FEP	14600	9900	19100	29300
18-Inch					
AREA 17ST	TLP	7600	3700	9000	8900
AREA 26ST	FEP	6700	4900	4600	11000
AREA 27ST	FEP	6700	4900	4600	11000

S - Suction D - Discharge ST - Steam



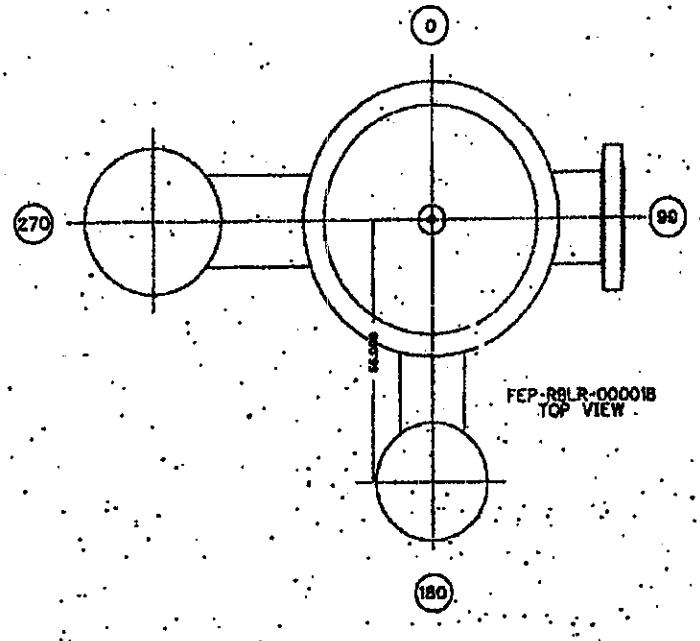
* The loads displayed in the table above are taken from unchecked / preliminary calculations. Loads occur at hub interface as shown in figure above.

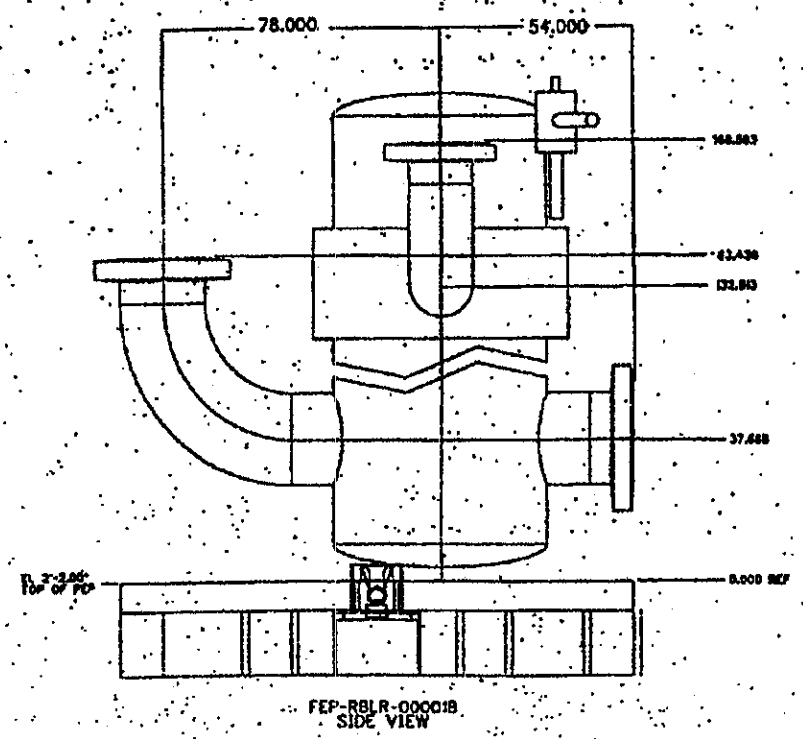
APPENDIX P



NOZZLE ORIENTATION, ELEVATION, AND DISTANCE FROM CENTERLINE
FEP-RBLR-00001A

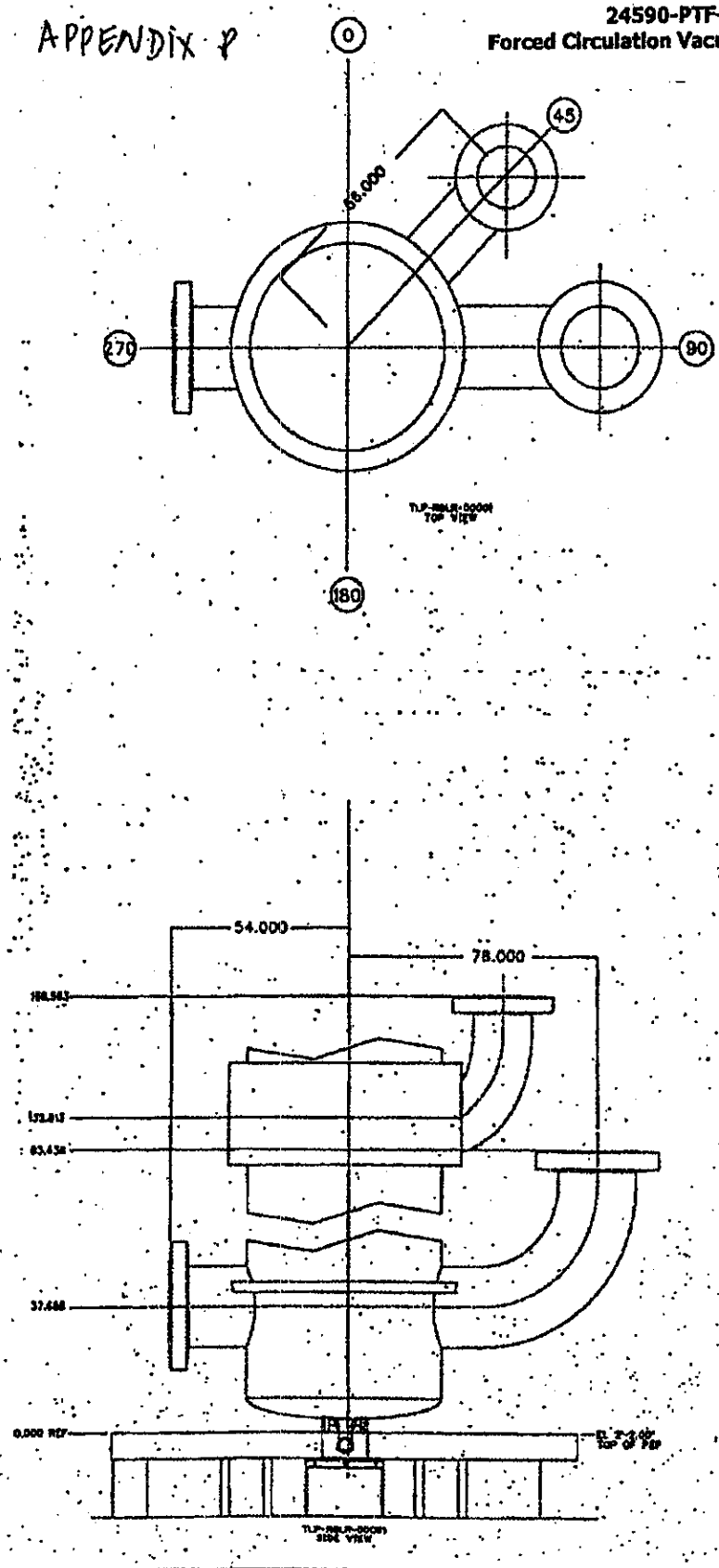
APPENDIX P





NOZZLE ORIENTATION, ELEVATION, AND DISTANCE FROM CENTERLINE
FEP-RBLR-00001B

APPENDIX P

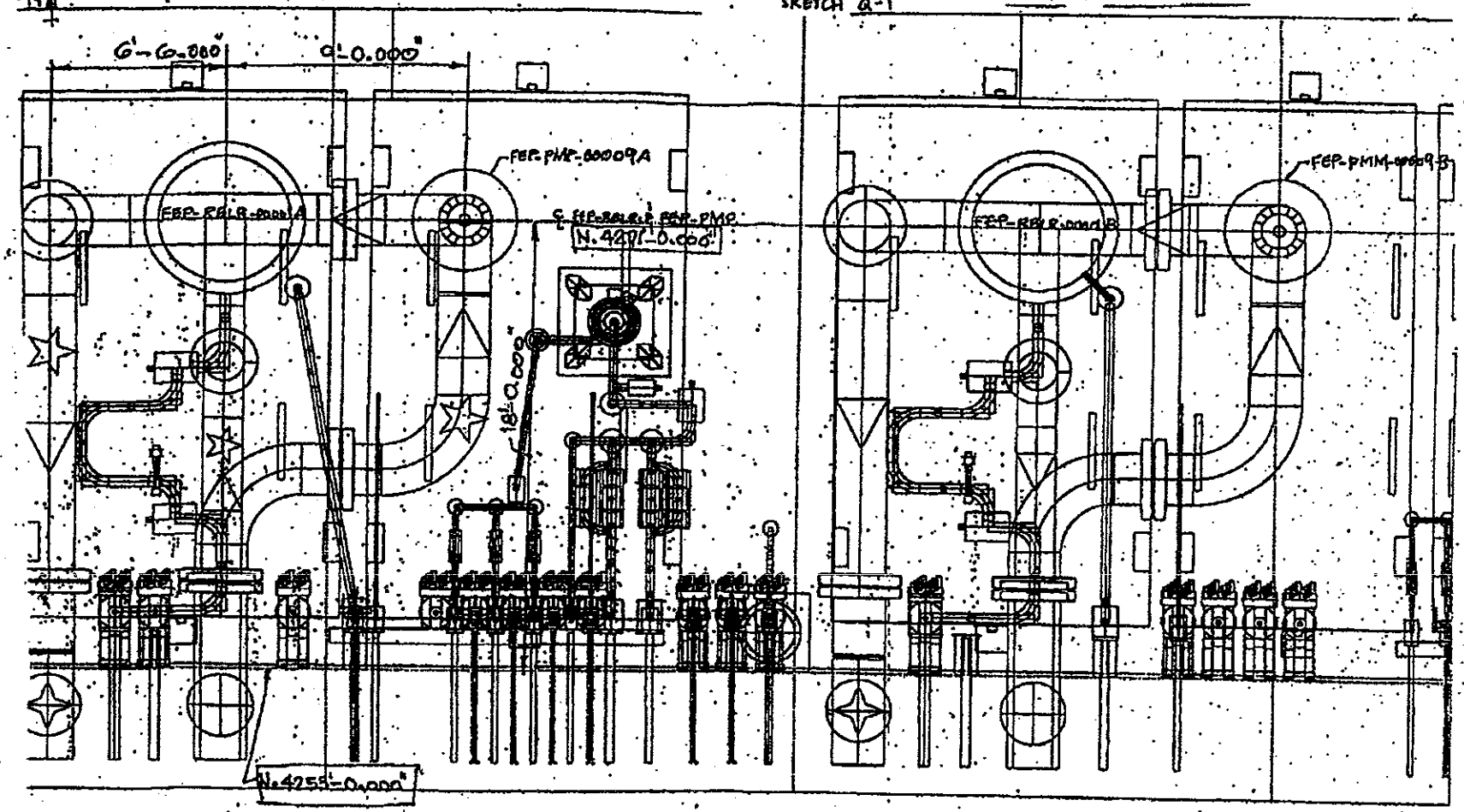


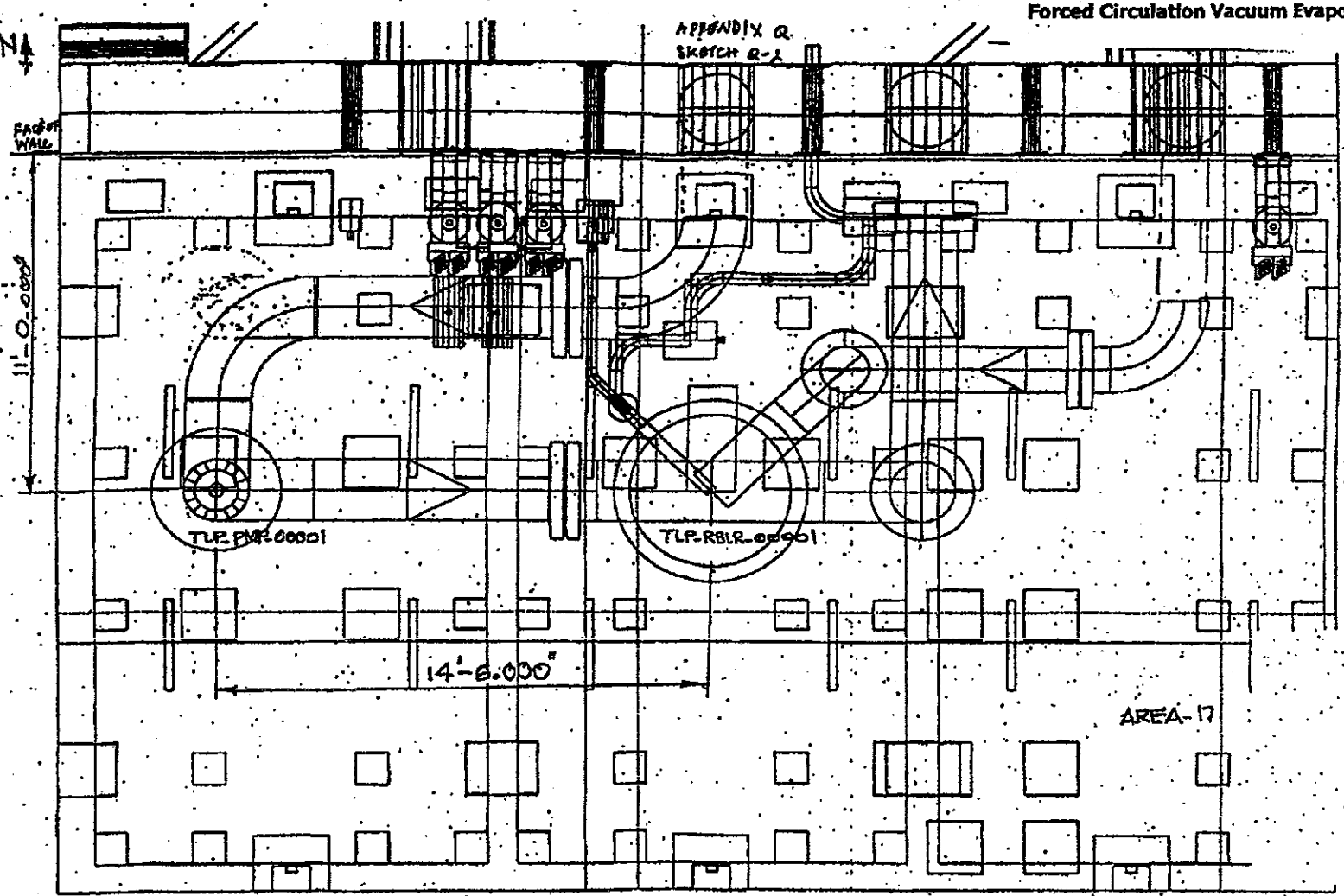
NOZZLE ORIENTATION, ELEVATION, AND DISTANCE FROM CENTERLINE
TLP-RBLR-00001

APPENDIX Q

REBOILERS AND RECIRCULATION PUMPS LAYOUT

APPENDIX Q
SKETCH Q-1




N
APPENDIX Q
SKETCH Q-2
FACE OF WALL
11'-0.000"
TLP-PMP-00001
TLP-RBLR-00001
14'-6.000"
AREA-17

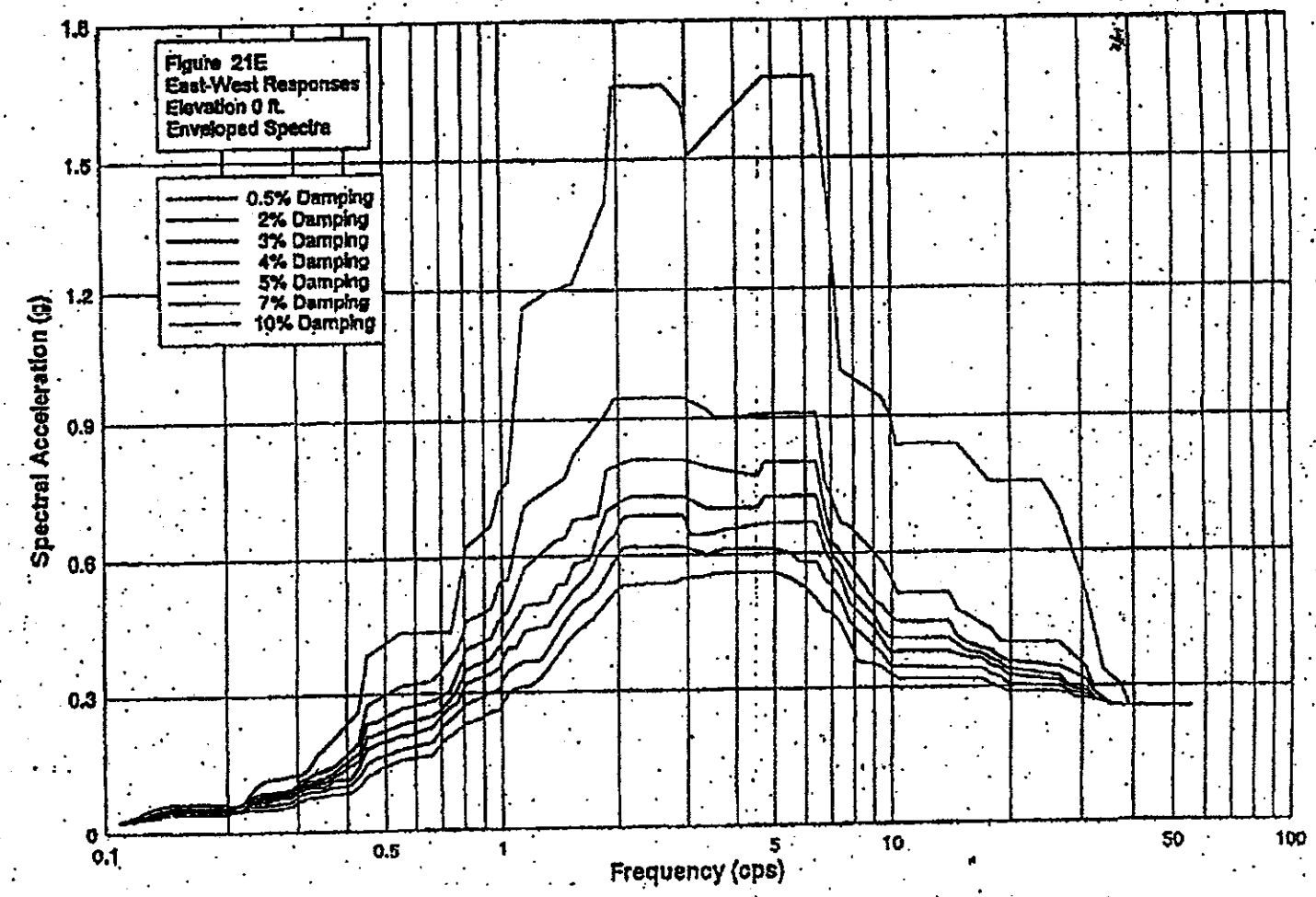
APPENDIX R

ISRS FIGURES FOR REBOILERS AT THE STEEL FRAM SUPPORTS

APPENDIX K
Sketch R-1

RPP-WTP Pretreatment Facility ISRS

Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0A



Page R-2

APPENDIX K

SKETCH K-2

RPP-WTP Pretreatment Facility ISRS

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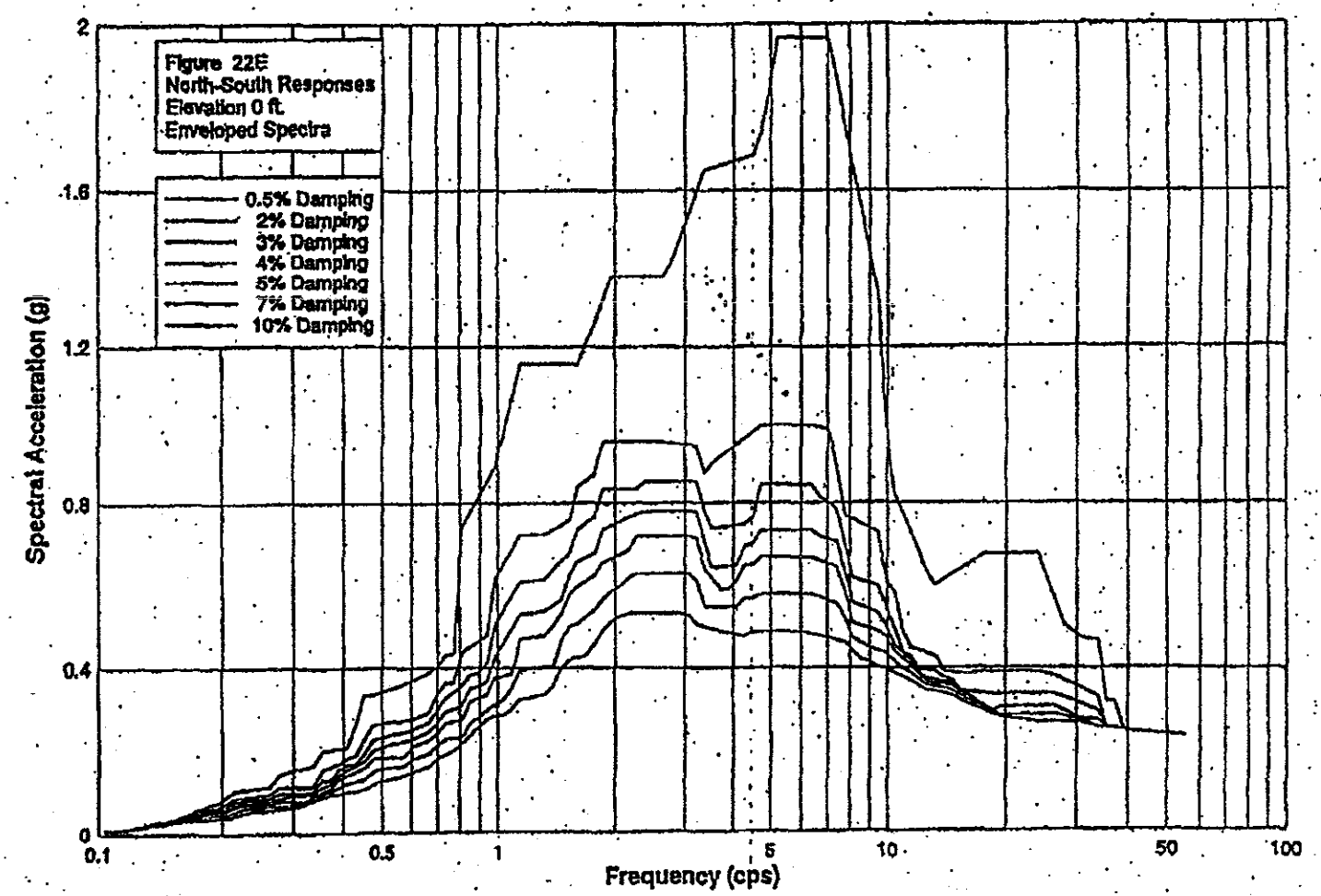
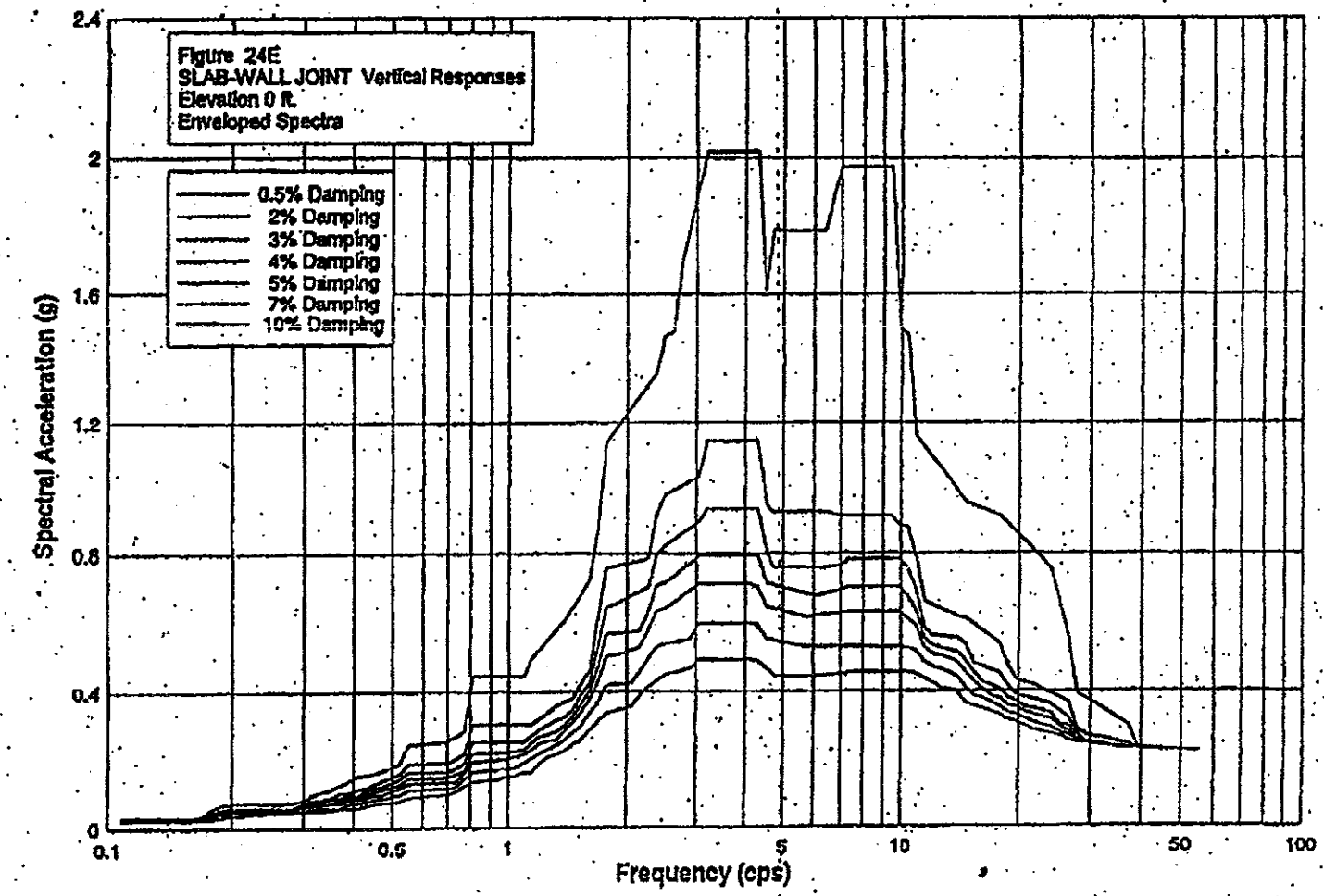


RPP-WTP Pretreatment Facility ISRS

Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0A



APPENDIX S

MANUFACTURERS STANDARD COATING DATA SHEET

Manufacturers Standard Coating Data Sheet

The SELLER proposes the following Manufacturers Standard (Mfg. Std.) or alternate coating system that is suitable for the exposure conditions of steel items and equipment in radiation and non-radiation areas.

1. **Equipment Description:** _____
   A. Tag Number _____
   B. Part(s) i.e. skirt, shell, channels, lugs, etc.* _____
   C. Design/Operating Temperatures, designate °F or °C..... _____ °F _____ °C
   D. Does Equipment Receive Steam out (Yes/No), Temperature _____ °F _____ °C
   E. Insulated/Uninsulated _____
   F. Fireproofing (Yes/No) _____
   G. Carbon Steel (CS), Stainless Steel (SS), other (List) _____
2. **Seller:** _____
3. **Surface Preparation:** SSPC No./Profile _____ / _____
4. **Coating System Designation:** (Code)

	First Coat	Second Coat	Third Coat
A. Type of Coating.....			
B. Coating Mfg./No.**			
C. Dry Film Thickness (Min/Max in mils)/(µm) ...			
D. Wet/Film Thickness (Min/Max in mils)/(µm)			
E. Curing Method.....			
F. Color.....			
G. Dry to Recoat			
H. Pot Life.....			
I. Thinner / %			

5. **Total DFT of System:** (Mils/µm)(Min/Max)..... _____ / _____ Min. _____ /Max.
6. **Material Storage:** Temperature Requirements (Min/Max) _____ / _____
7. **Shelf Life:**..... _____ Months
8. **Application Environmental Limits:**
   A. Temperature Ambient and Surface (Min/Max)..... _____ / _____ / _____
   B. Humidity (Min/Max)..... _____ / _____
   C. Dew Point ≥5°F above surface temp. (Yes/No)..... _____
9. **Protection of surfaces that will be inaccessible after equipment installation (such as underside of base plates, interior of fans, vessels or equipment housings)** _____
10. ***Rust Preventative for machined faces:*** (***Mfg./No.*) _____
11. **Quantity of touch-up coating supplied:** _____
12. **Additional information:** (attach extra page as necessary) _____

* Use additional copies of this form for each part described in 1 above that requires a different coating system. A completed copy of this data sheet shall be submitted to CONTRACTOR/BUYER with the initial vendor data submittal.

** Include manufacturers technical data sheets and MSDS' for each proposed coating, preservative & solvent

APPENDIX T

Design Evolution Inputs

T.1 Recirculation Pump Remote Connector Design Inputs

Design Input #1: The Hanford connector loads are 2000 lbs resultant force and 2900 ft-lbs resultant moment.

Design Input #2: See attached reference # 2 for Staubli connector drawings. It is recommended to use connector types as shown on drawings S-01162803-A and S-01142503-A for power and signal. Also see sketches provided in this section T.1 for additional design inputs. The Staubli connector force requirement is 400 lbf in any direction.

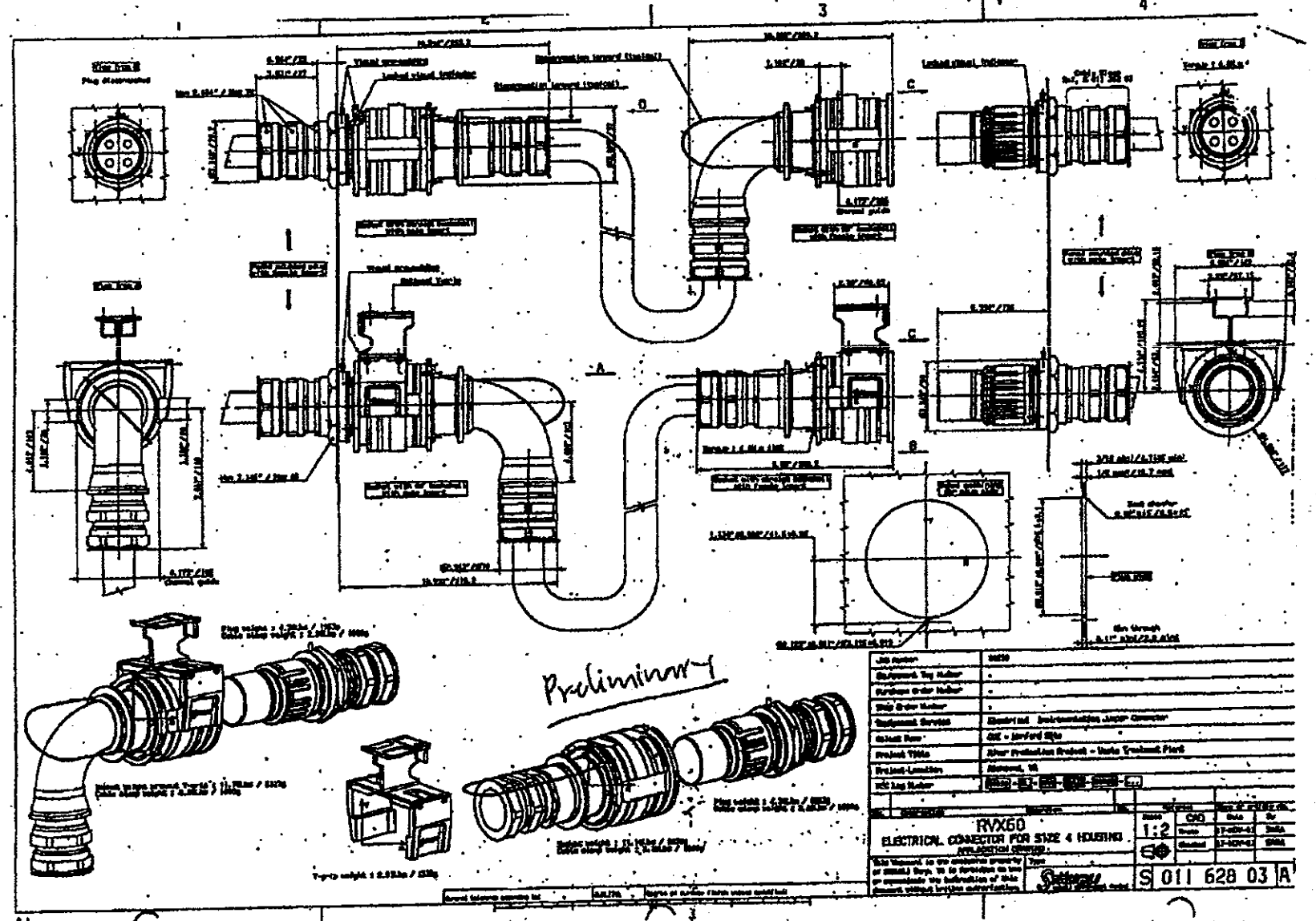
Design Input #3: For seal water and grease connections, the male plug located on the pump seals which has been called out as a Staubli part number RBE 19.6204/IC will change to Staubli part number N 011 612 04. See sketches # S-01249904-F, # S-00122805-A, # S-00119705-B, and S-111610-04-D provided in this section. The Staubli Fluids Connector shall use Keying #35 for for the seal water and grease connection.

Design Input #4: Remote impact wrench specification on studs

a) Loosen 750 ft-lbs
b) Tighten 400 ± 25 ft-lbs
c) Range 100 - 400 ft-lbs

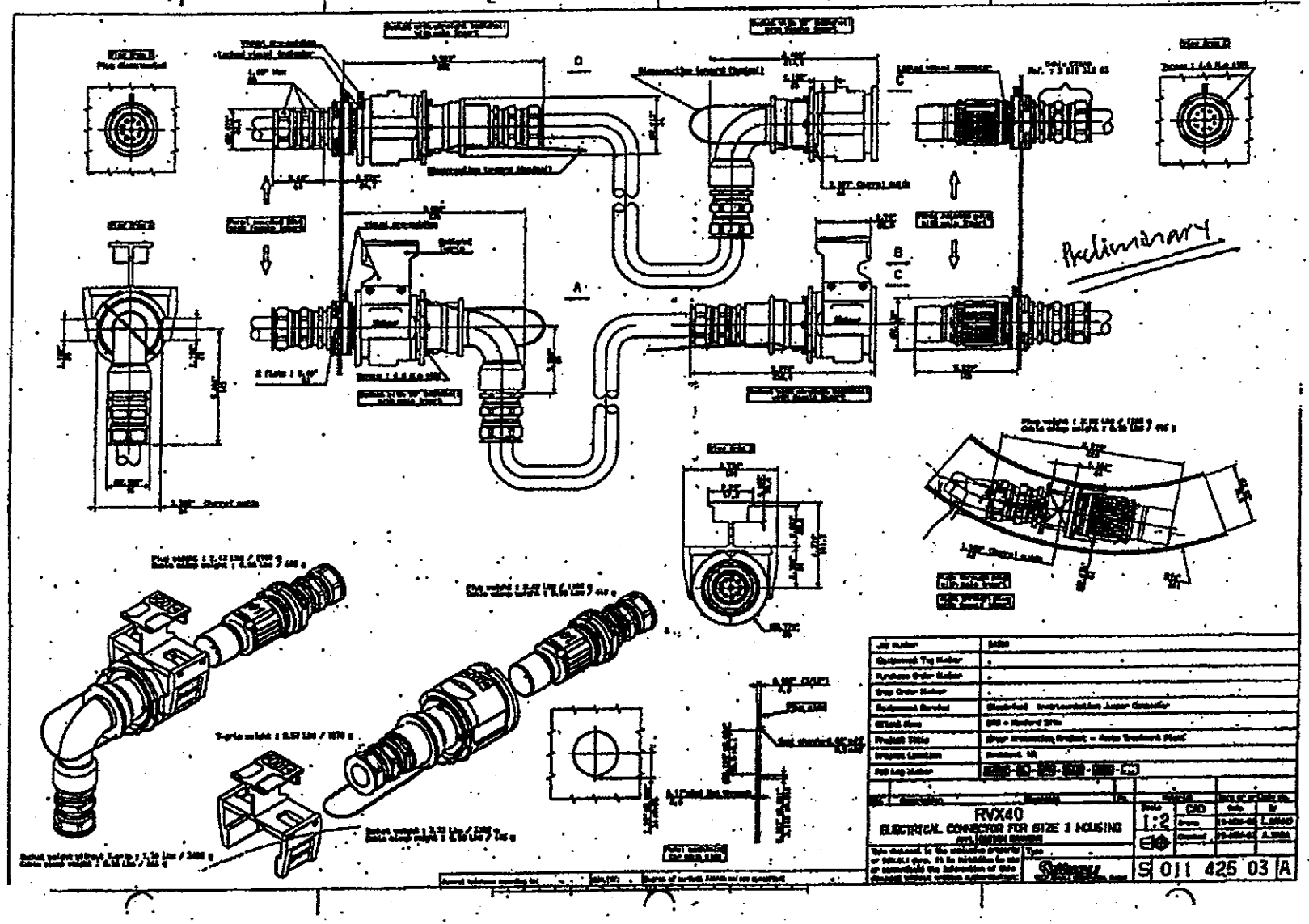
Design Input #5: Recirculation pump shall be designed to incorporate remote grease application to thrust bearing.

for power cable (prefer)



T-3

For signal cable (prefer)



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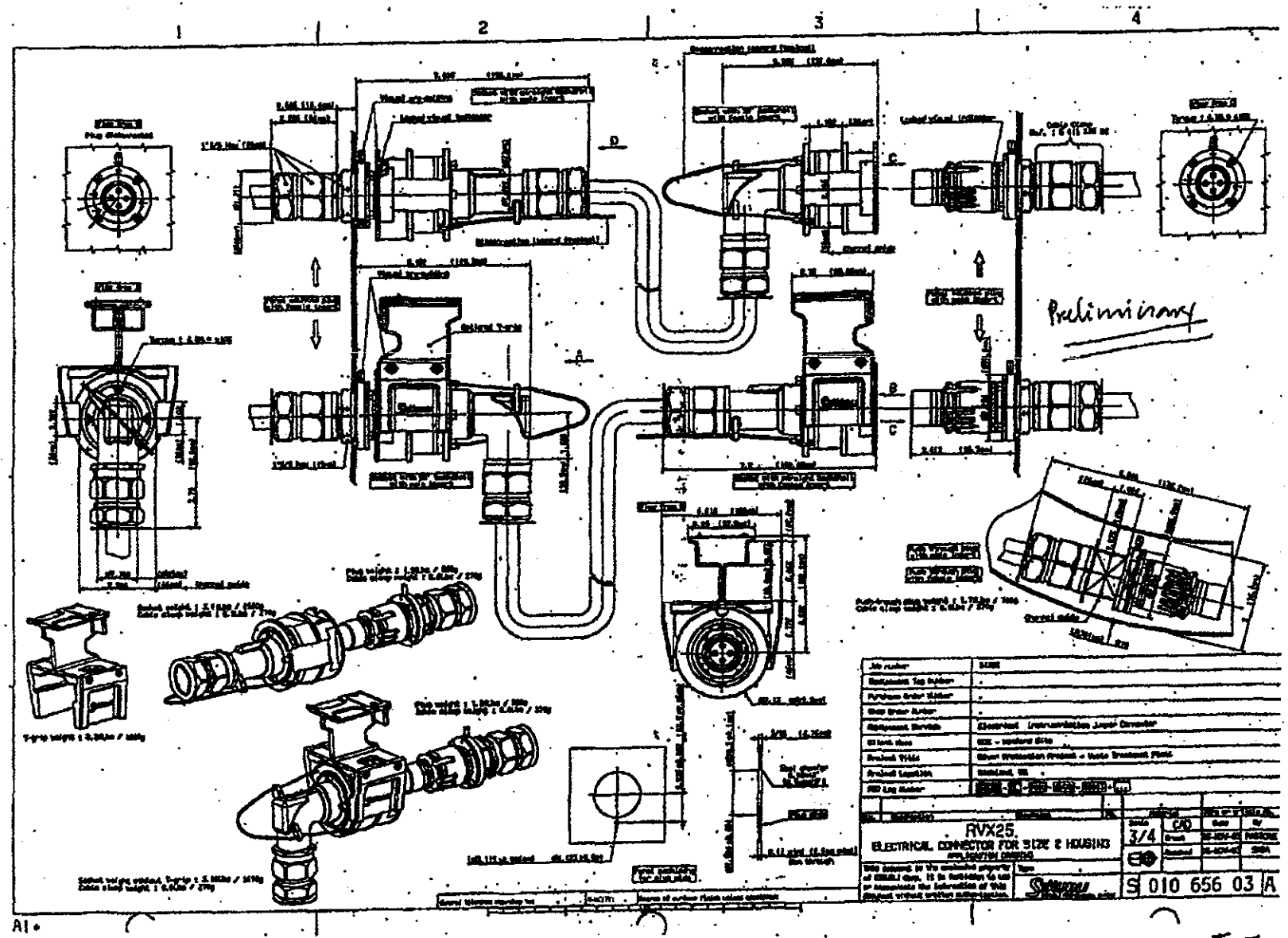
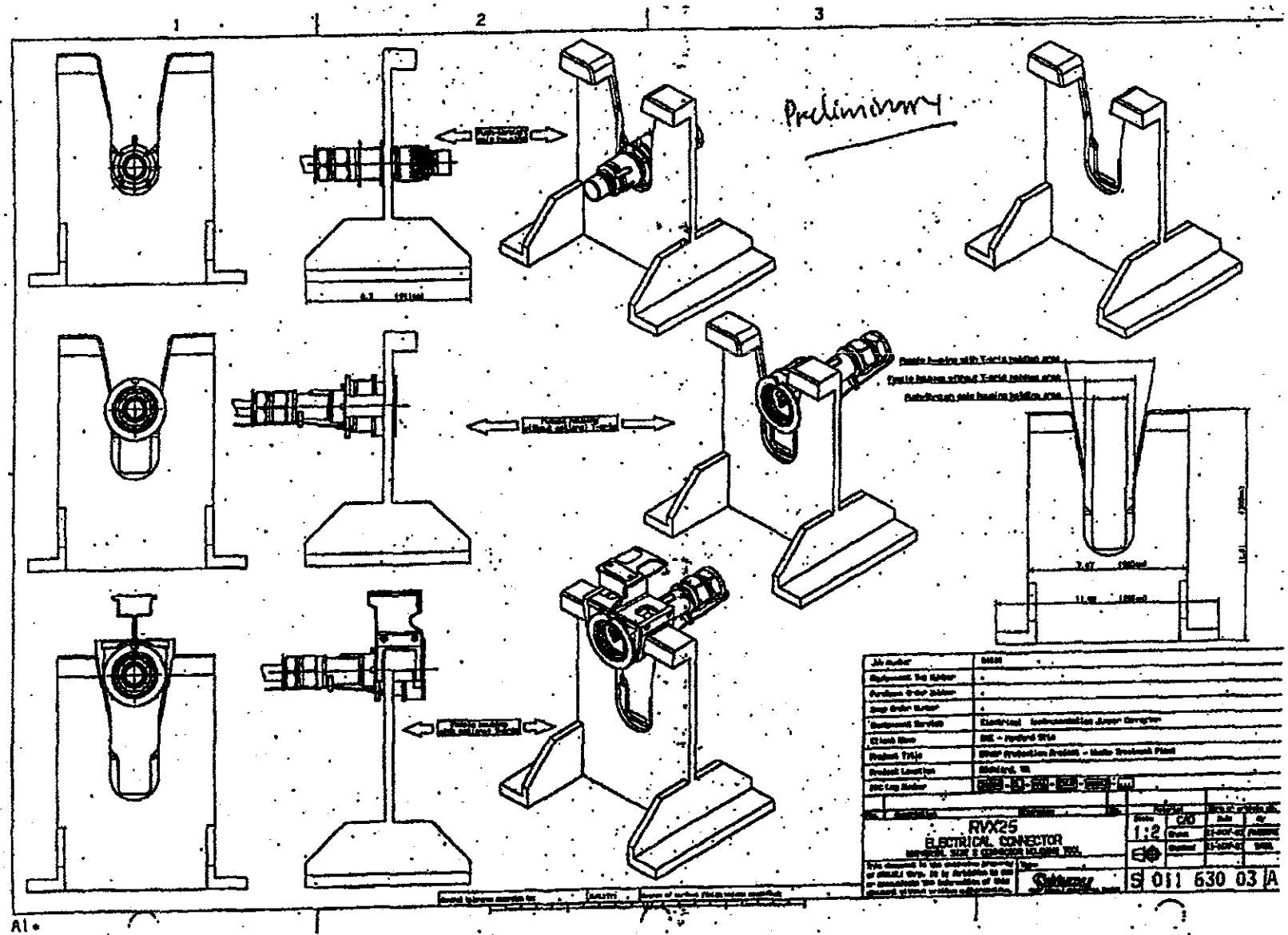
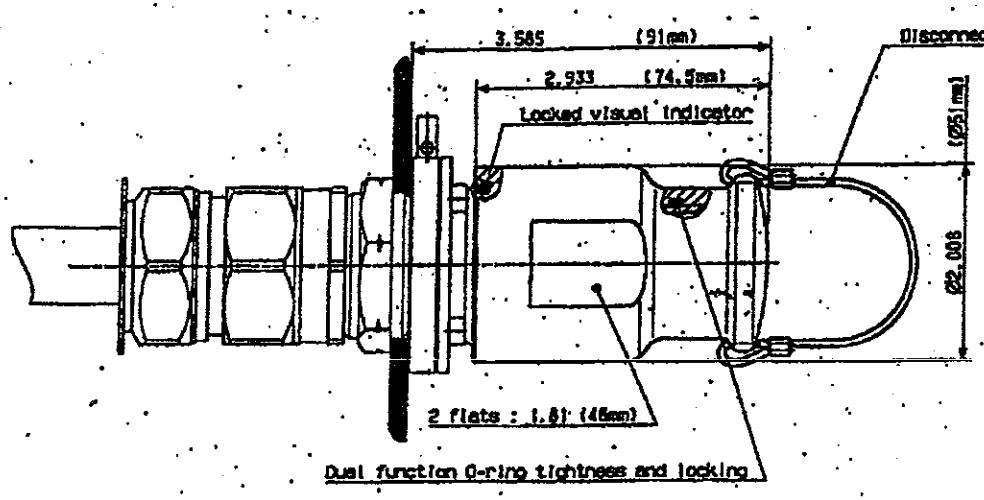

Preliminary
RVX25
ELECTRICAL CONNECTOR FOR SIZE 2 HOUSING
3/4
S 010 656 03 A

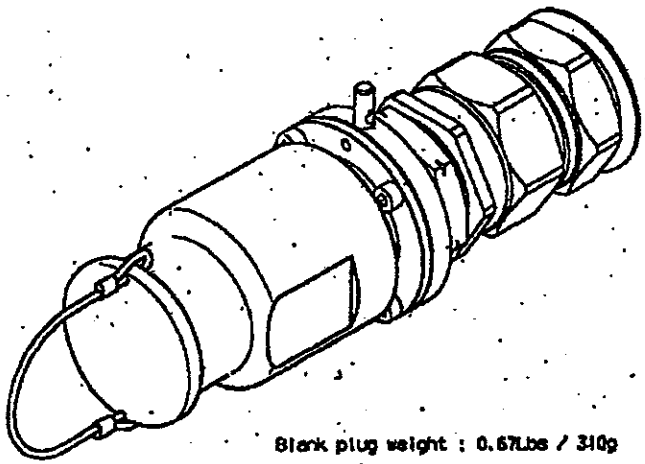
T-5


1
2
3
Preliminary
RVX25
ELECTRICAL CONNECTOR
1:2
CAD
S 011 630 03 A
A1

T-6



Preliminary



Blank plug weight : 0.67Lbs / 310g

Job number	24590.
Equipement Tag Number	.
Purchase Order Number	.
Shop Order Number	.
Equipement Service	Electrical Instrumentation Jumper Connector
Client Name	DOE - Hanford Site
Project Title	River Protection Project - Waste Treatment Plant
Project Location	Richland, WA
POC Log Number	24590 - QL - MRA - EVUO - 00003 - ...

REV.	Description	Operation	No.	Material	Name or article no.

RVX25
ELECTRICAL CONNECTOR BLANK PLUG FOR SIZE 2 HOUSING
APPLICATION DRAWING

Scale	CAD	Date	By
1	Drawn	19-NOV-03	MASTORE
	Checked	19-NOV-03	SABA

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Type: Saturn

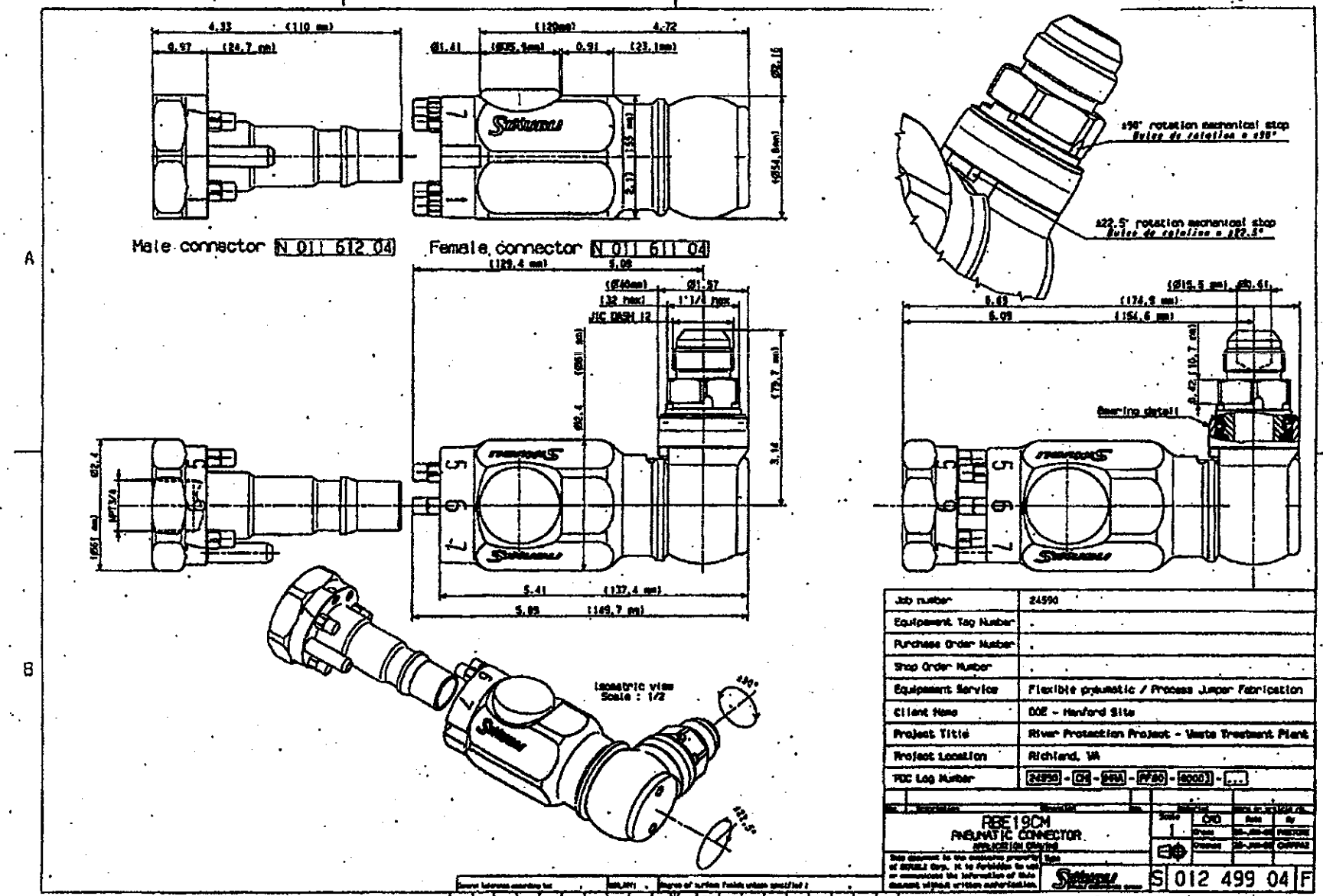
S 011 494 03 A

General tolerance according to: QUALITY: Degree of surface finish unless specified :

A3

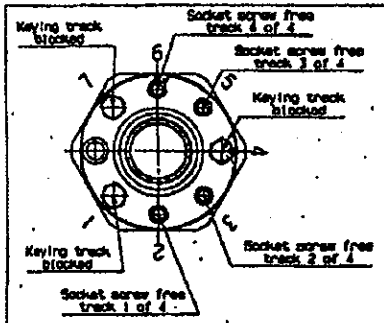
T-7

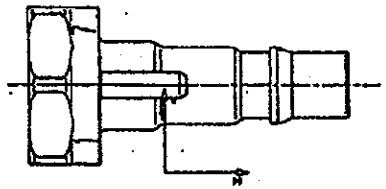
24590-PTF-3PS-MEVV-TP001, Rev 2
Forced Circulation Vacuum Evaporator System



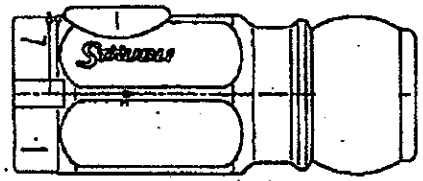
Job number	24590
Equipment Tag Number	-
Purchase Order Number	-
Shop Order Number	-
Equipment Service	Flexible pneumatic / Process Jumper Fabrication
Client Name	DOE - Hanford Site
Project Title	River Protection Project - Waste Treatment Plant
Project Location	Richland, WA
TOC Log Number	24590 - CH - 94A - PF80 - 00003 - [...]

T-8

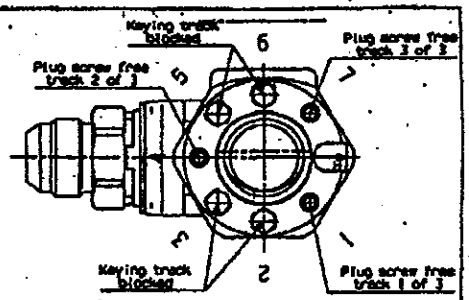


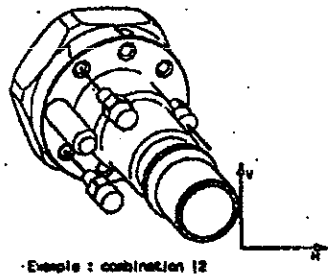


Plug

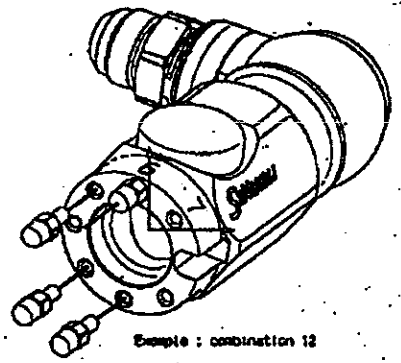


Socket





Example : combination 12



Example : combination 12

* For each combination the 7 screws must be installed.
* Screws thread lock : Loctite F2432
* Torque : 9.5 N.m

Comb.	Screw 1	Screw 2	Screw 3
01	Track 1	Track 2	Track 3
02	Track 1	Track 2	Track 4
03	Track 1	Track 2	Track 5
04	Track 1	Track 2	Track 6
05	Track 1	Track 2	Track 7
06	Track 1	Track 3	Track 4
07	Track 1	Track 3	Track 5
08	Track 1	Track 3	Track 6
09	Track 1	Track 3	Track 7
10	Track 1	Track 4	Track 5
11	Track 1	Track 4	Track 6
12	Track 1	Track 4	Track 7
13	Track 1	Track 5	Track 6
14	Track 1	Track 5	Track 7
15	Track 1	Track 6	Track 7
16	Track 2	Track 3	Track 4
17	Track 2	Track 3	Track 5
18	Track 2	Track 3	Track 6
19	Track 2	Track 3	Track 7
20	Track 2	Track 4	Track 5
21	Track 2	Track 4	Track 6
22	Track 2	Track 4	Track 7
23	Track 2	Track 5	Track 6
24	Track 2	Track 5	Track 7
25	Track 2	Track 6	Track 7
26	Track 3	Track 4	Track 5
27	Track 3	Track 4	Track 6
28	Track 3	Track 4	Track 7
29	Track 3	Track 5	Track 6
30	Track 3	Track 5	Track 7
31	Track 3	Track 6	Track 7
32	Track 4	Track 5	Track 6
33	Track 4	Track 6	Track 7
34	Track 4	Track 6	Track 7
35	Track 5	Track 6	Track 7

Comb.	Screw 1	Screw 2	Screw 3	Screw 4
01	Track 4	Track 5	Track 6	Track 7
02	Track 3	Track 5	Track 6	Track 7
03	Track 3	Track 4	Track 6	Track 7
04	Track 3	Track 4	Track 5	Track 7
05	Track 3	Track 4	Track 5	Track 6
06	Track 2	Track 5	Track 6	Track 7
07	Track 2	Track 4	Track 6	Track 7
08	Track 2	Track 4	Track 5	Track 7
09	Track 2	Track 4	Track 5	Track 6
10	Track 2	Track 3	Track 5	Track 7
11	Track 2	Track 3	Track 5	Track 7
12	Track 2	Track 3	Track 5	Track 6
13	Track 2	Track 3	Track 4	Track 7
14	Track 2	Track 3	Track 4	Track 6
15	Track 2	Track 3	Track 4	Track 5
16	Track 1	Track 5	Track 6	Track 7
17	Track 1	Track 4	Track 6	Track 7
18	Track 1	Track 4	Track 5	Track 7
19	Track 1	Track 4	Track 5	Track 6
20	Track 1	Track 3	Track 5	Track 7
21	Track 1	Track 3	Track 5	Track 7
22	Track 1	Track 3	Track 5	Track 6
23	Track 1	Track 3	Track 4	Track 7
24	Track 1	Track 3	Track 4	Track 6
25	Track 1	Track 3	Track 4	Track 5
26	Track 1	Track 2	Track 6	Track 7
27	Track 1	Track 2	Track 5	Track 7
28	Track 1	Track 2	Track 5	Track 6
29	Track 1	Track 2	Track 4	Track 7
30	Track 1	Track 2	Track 4	Track 6
31	Track 1	Track 2	Track 4	Track 5
32	Track 1	Track 2	Track 3	Track 7
33	Track 1	Track 2	Track 3	Track 6
34	Track 1	Track 2	Track 3	Track 5
35	Track 1	Track 2	Track 3	Track 4

Job number	24590
Equipment Tag Number	.
Purchase Order Number	.
Shop Order Number	.
Equipment Service	Flexible pneumatic / Process Jumper Fabrication
Client Name	DOE - Hanford Site
Project Title	River Protection Project - Waste Treatment Plant
Project Location	Richland, WA
PDC Log Number	24590 - CH - MPA - RF00 - 00003 - ...

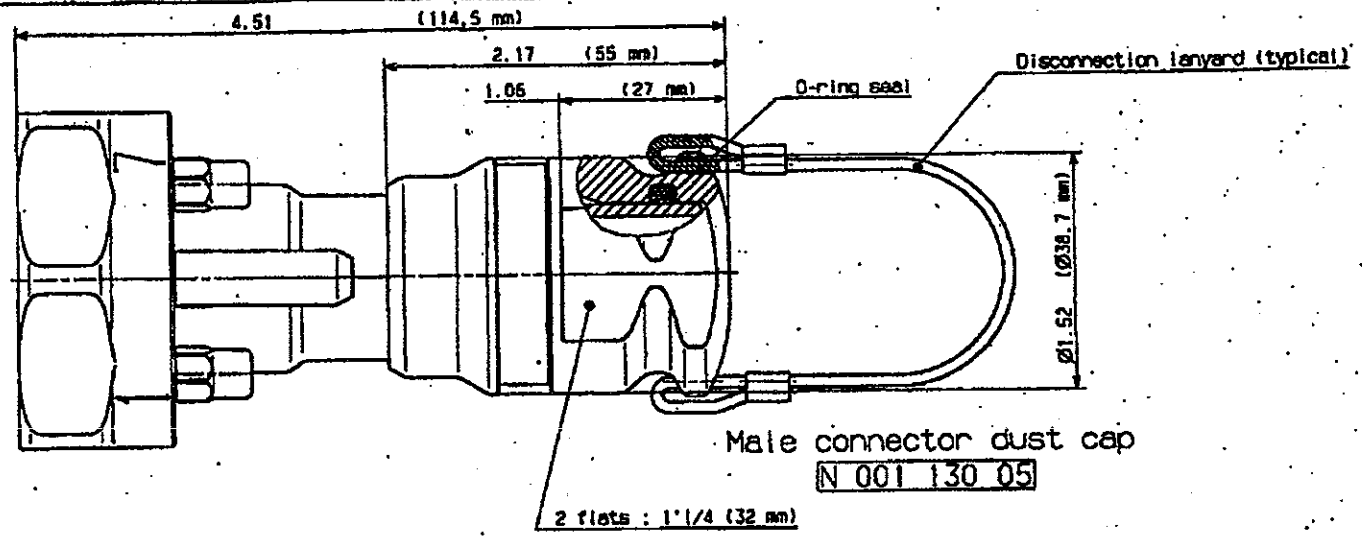
RBE19CM

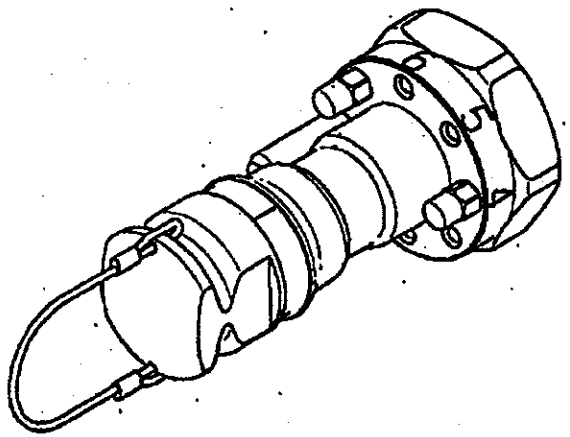
Key combination sheet and assembly instructions

Sheet 1. CAD Date Time

S 001 228 05 A

T-1





Job number	24590
Equipement Tag Number	.
Purchase Order Number	.
Shop Order Number	.
Equipement Service	Flexible pneumatic / Process Jumper Fabrication
Client Name	DOE - Hanford Site
Project Title	River Protection Project - Waste Treatment Plant
Project Location	Richland, WA
PDC Log Number	24590 - CH - MRA - PF00 - 00003 - ...

Qty.	Description	Designation	No.	Material	Name or article no.

RBE19CM
PNEUMATIC CONNECTOR DUST CAP
APPLICATION DRAWING

Scale	CAD	Date	By
1	Drawn	28-JAN-05	PASTORE
	Checked	28-JAN-05	CHAPPAZ

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Type

STAUBLI

S 001 197 05 B

General tolerances according to: QUALITY: Degree of surface finish unless specified :

A3

T-10

T-11

[redacted]

APPLICATION

Remotely operated fluid connector for radioactive environment designed to allow a high number of keying possibilities set on site.

CONNECTION:

1. The three sets of opposed flats on the female housing allow the manipulator jaws to grab and index the connector during operation.
2. The staged guiding helps in addressing the misalignment between the male and female connector.
3. The visual pre-guiding helps the operator to position the indexation.
4. The indexation operates before the safety keys.
5. The safety keying will then allow connection only if the female connector configuration matches the male one. (*picture* **2** : safety keying, *picture* **3** : purple screw unmatches the gray one)
6. The connection can now be completed by the automatic locking mechanism (no need to operate the locking mechanism during connection). Once the indexing is made the connectors can be pushed using the flat area located on the elbow.

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T-12

DISCONNECTION:

Directly push the release button for disconnection.

KEYING:

The connector will supply a total number of 35 non-interchangeable keys. The operator assembling the male and female connector sets all keys on site.

- **Male connector** (plug) setting is described on ***picture 1 and 3.*** 3 screws take place among 7 possible locations (location number engraved on the body).
- **Female connector** (socket) setting works the opposite way using screws taking place in the remaining locations (location number engraved on the body).

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T-13

FITTINGS AND MOUNTING:

- **Female connector** (socket) has a male JIC DASH12 threaded end fitting. A rotating 90° backshell assembly allows a free angular positionning according to the 2 rotations axis (See *picture 4)*
- **Male connector** (plug) has a female threaded connection with a 3/4" NPT.

DUST CAP:

Disconnected plug will be protected with a dust cap.

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MATERIALS:

Mechanical connector is 316L stainless steel with ethylene propylene soft O-ring seals.

TECHNICAL FEATURES

• Working temperature	-25°C + 150°C (-4°F up to 302°F)
• Socket valving	unvalved
• Plug valving	unvalved (straight through bore)
• Seals lubrication	STÄUBLI G 0 lubricant (validated for use in nuclear environment by E.D.F)
• Plug weight	0.550 Kg (1.25 Lb)
• Socket weight	1.800Kg (3.97 Lb)
• Dust cap weight	0.300 Kg (0.66 Lb)
• Connection strength	80N (without pressure)
• Disconnection strength	90N (without pressure)
• Identification	Manufacturer's name, part number and week and year of manufacturing engraved on male and female connectors
• Packaging	Single unit in sealed plastic bag.

PARTNUMBERS

Part number	Description
N 011 611 04	Female connector
N 011 612 04	Male connector
N 001 130 05	Male connector dust cap

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STÄUBLI S 111 610 04 D

T.2 Reboiler Grayloc Backing Plate

Design Input: It is acceptable design that the Grayloc backing plates for the 24" diameter process inlet of the reboilers FEP-RBLR-00001A/1B and TLP-RBLR-00001 can be installed after reboiler has after reboiler has been transported through airlock (inside hotcell). Furthermore, the Grayloc backing plate for the 18" diameter steam inlet of the reboiler TLP-RBLR-00001 can also be installed after the TLP reboiler has been through airlock.

T.3 Floor loading

Design Input: The uniform load is defined as floor loading transmitted by the skid to the floor without spreading of the load out through the supporting concrete slab. The floor loadings listed in the table below has been determined to be acceptable.

Allowable Uniform Floor Loading Directly Under Skid Footprint

Equipment	Location	Weight (Operating + Skid) (lbs)	Skid Foot Print Floor Area (ft^2)	Uniform Load (Operating) (lbs/ft^2)
FEP-SEP-00001A	J : 8-9 (0'-0")	134,500	400	**336**
FEP-SEP-00001B	J : 10-11 (0'-0")	134,500	400	**336**
TLP-SEP-00001	D : 18 (0'-0")	134,500	400	**336**
FEP Condenser Skid A	K-L : 8 (56'-0")	70,000	179	**391**
FEP Condenser Skid B	K-L : 10-11 (56'-0")	70,000	179	**391**
TLP Condenser Skid	D-E : 19-20 (56'-0")	70,000	179	**391**
FEP-VSL-00005	M : 7-8 (0'-0")	45,100	66	**683**
TLP-VSL-00002	B : 24-25 (0'-0")	24,000/4	1	**6000**
AFR-TK-00001	G-H : 9-10 (77'-0")	24,000	40	**600**
AFR Pump Skid	G-H : 9-10 (77'-0")	415	12	**35**

Note: Uniform load (lbs/ft^2) = Total Equipment Weight (lbs) / Foot Print Area (ft^2)

T.4 Surface Finish for Equipment in the Hot Cell

Design Input #1: A surface finish of 125 micro-inches is required for non-rotating parts such as reboiler, support stands, recirculation pump, recirculation piping, and lifting yokes. The surface finish of 125 micro inches shall be applied to machined surfaces not all surfaces

Design Input #2: A surface finish of 63 micro-inches is required for rotating parts such as pump shaft and impeller.

T.5 Manipulator Capability for Separator Vessel Head Crane

Design Input: There will be no manipulator capability for the crane on the 56-ft elevation for separator vessel head removal. The current plan is to install a monorail and hoist when there is a need to replace separator demister pads.

T.6 Axial Flow Pump ASDs

Design Input: The ASDs for FEP-PMP-00009A/9B will be installed in the MCC room P-417 on the 77'-0" elevation and the ASD for TLP-PMP-00009 will be installed in the MCC room P-0315 on the 56'-0" elevation. These MCC rooms are designed as R2/C2 as shown on the drawings 24590-PTF-P01T-00003 and 24590-PTF-P01T-00004. The temperature range for these MCC rooms is between 59-113 °F and the humidity range of 5 - 85 %.

T.7 Instrumentation

Design Input #1 - Final Instrument Location Drawings:

Seller is no longer required to provide instrument location and mounting information on the datasheet. Instrument location and mounting information will be completed by Buyer as required on the data sheets.

Design Input #2 - BNI Instrument Details:

Seller is no longer required to provide loop drawings that include schematic and wiring information. BNI will use Set Route and Intools for wiring information. For the 60% design stage, Seller is not required to provide environmental criteria, manufacturer or manufacturer's model number since they will be addressed at the 90% design milestone. Seller shall provide the following I&C information at 60% design:

1) An Instrument Index that includes the type of instrument, service description, calibration range, tag number, signal type, P&ID number and data sheet number.

2) Data Sheets as supplied with the contract package completed with as much information as is available, including tag numbers, calibration range, instrument range and specific process parameters, etc.

3) Logic diagrams which complement the system description.

T.8 Off-gas piping Condenser Intra-Skid Piping

Design Input: No insulation is required for off-gas piping and condenser intra-skid piping. These pipes are in restrictive rooms where no personnel enter during evaporator system operations.

T.9 Separator Vessels

Design Input #1: Separator Vessel Lower Frame:

No internal components are allowed except the use of Nelson studs on the lower ten inches of the inside surface. Seller shall provide minimum amount of grouting requirements to provide adequate stiffness for the lower frame of solid ring of 18-inches high and 19-feet square

Design Input #2: External Ring for Spray Nozzles:

Seller shall design and provide external rings for both the upper and lower demister pad spray nozzles. These external rings shall be connected together to provide an accessible connection at approximately 48'-0" plant elevation.

T.10 FEP Condensate vessel

Design Input: Seller shall provide a separate FEP condensate vessel support ring plate to interface properly with floor embeds. The ring plate will be field welded to embedded plates on both sides. Vessel skirt will be filed welded to ring plate at exterior face only with partial penetration and fillet welds.

T.11 Equivalent Lengths for Centrifugal Pumps

The piping equivalent length is provided on the table below for pump sizing calculation. Please be advised that the bounding values have incorporated the line size changes. However, the flow resistance due to flow restriction orifice, backpressure control valve, discharge spray nozzle has not incorporated into the bounding values because they are to be sized by Seller. Seller shall include these flow resistance in their pump sizing calculation.

For discharge lines from pumps TLP-PMP-00002A/B to separator vessel (TLP-SEP-00001) and from pumps FEP-PMP-00006A/B, FANP shall also add a flow resistance of 5 psi due to Millipore filter in the calculation. For discharge line from TLP-PMP-00005A/B to sampler, Seller shall also include sample delivery pressure of 5 psig.

	Description	From	To	Straight Runs	Elevation Change	Elbows (LR 90)	Eq. Length	Tees	Eq. Length	Valves	Eq. Length	Exits	Eq. Length	Entrances	Eq. Length	Other	Totals (ft) (EQ.L.)	Totals (ft) (AEL.)	Bounding Values (ft) (EQ.L.)	Bounding Values (ft) (AEL.)	Notes
TLP-PMP-00002A/B	Suction	TLP-VSL-00002	Pump	30	2	5	83	1	20	4	30	0	0	1	9	0	112	2	160	2	
	Discharge	Pump	TLP-VSL-00002	40	15	5	33	2	30	4	15	1	13	0	0	60	173	15	258	20	1
			RLD-TK-00008A/B	280	60	25	125	4	60	4	30	1	13	0	0	50	528	60	625	65	2
			TLP-VSL-00008A/B	250	60	25	125	4	60	4	30	1	13	0	0	50	528	60	625	65	2
			TLP-SEP-00001	250	60	25	125	3	45	10	35	0	0	0	0	50	508	60	600	65	3, 4
TLP-PMP-00011A/B	Suction	TLP-SEP-00001	Pump	100	8	5	25	1	15	3	11	0	0	1	7	0	158	8	250	5	
	Discharge	Pump	TCP-VSL-00002	300	60	15	56	1	15	3	8	1	9	0	0	0	376	60	450	65	
TLP-PMP-00005A/B	Suction	TLP-VSL-00009A/B	Pump	80	-4	5	40	2	30	5	13	0	0	1	7	0	189	4	300	4	
	Discharge	Pump	TLP-SEP-00001	125	15	15	38	3	22.5	2	4	1	7	0	0	0	195	10	350	15	
			SAMPLER	100	70	15	50	2	30	3	9	0	9	0	0	0	209	70	300	70	5
FEP-PMP-00006A/B	Suction	FEP-VSL-00005	Pump	15	2	5	33	1	20	2	18	0	0	1	8	0	92	2	125	3	
	Discharge	Pump	FEP-VSL-00005	25	20	7	35	2	30	5	15	1	13	0	0	50	172	20	250	25	1
			RLD-TK-00005A/B	1100	60	50	250	8	90	8	30	1	13	0	0	50	1633	60	1750	65	2
			FEP-VSL-00017A/B	550	60	35	175	4	60	8	33	1	13	0	0	50	871	60	1000	65	2
			FEP-SEP-00001A/B	550	60	35	175	3	45	10	38	0	0	0	0	50	908	60	1100	65	3, 4

Notes: Framatome Needs to also consider flow resistances due to...
1. Flow Restriction Orifice (sized by FANP)
2. Back Pressure Control valve (sized by FANP)
3. Mill-pore filter (max dP = 5 psi)
4. Discharge spray nozzle pressure (specified by FANP)
5. Sample Delivery pressure of 5 psig.

T.12 Equivalent Lengths for Roth Transfer Station Pump

The equivalent length is provided in the table below:

Description	From	To	Bounding values (ft)	
			EQ. L	ΔEL
Discharge	FEP A SKID 9A Pump	SCW Storage Tank	2200	60
Discharge	FEP A SKID 9A Pump	Steam Cond. Skid 6A	600	80
Discharge	FEP B SKID 9B Pump	SCW Storage Tank	2000	60
Discharge	FEP B SKID 9A Pump	Steam Cond. Skid 6B	700	80
Discharge	TLP SKID Pump	SCW Storage Tank	720	60
Discharge	FEP B SKID 9A Pump	Steam Cond. Skid 8	1130	100

T.13 Standard Kick-Off Plate

Design Input: Buyer will provide Seller 2" and 4" PUREX nozzle with square standard kick-off plate per drawing 24590-WTP-M61-P23T-00040 for FEP/TLP reboilers.