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**ACCEPTANCE OF FEED STREAMS FOR
TREATMENT AT THE LERF/ETF COMPLEX**

Issued by

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for the

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Contents

ABBREVIATIONS AND ACRONYMS	iii
EXECUTIVE SUMMARY	iv
1.0 INTRODUCTION	1
2.0 WASTE TRANSPORTATION, STORAGE, TREATMENT, AND DISPOSAL FACILITIES .	1
4.0 WASTE ACCEPTANCE PROCESS	5
5.0 UPDATES TO THE WASTE ACCEPTANCE PROCESS	7
6.0 REFERENCES	8

LIST OF FIGURES

Liquid Effluent Storage, Treatment, and Disposal Facilities	15
ETF Treatment Train	16
Decision Flowchart for Accepting Wastes into the ETF/LERF Complex	17

LIST OF TABLES

Predicted Decontamination Factors of Organic Chemicals by Group	9
Organics Cited in Delisting Petition	11
Inorganics Cited in Delisting Petition	13

ABBREVIATIONS AND ACRONYMS

2°	secondary
Adj.	adjust
CG	chemical group
Degas.	degassification
DOE	Department of Energy
ETF	Effluent Treatment Facility
LES	Liquid Effluent Services
LERF	Liquid Effluent Retention Facility
min	minute
mR/hr	milliRADS per hour
nCi/g	nanocuries per gram
PAH	polyaromatic hydrocarbons
pg	page
ppm	parts per million
RAD	Radiation Adsorbed Dose
Rad	radiation
RAEP	Radionuclide Air Emission Program
RCRA	Resource Conservation and Recovery Act
Rec.	receiving
RO	reverse osmosis
SALDS	State-Approved Land Disposal Site
SAP	sampling and analysis plan
SAR	safety analysis report
TRU	transuranic
UV	ultraviolet
UV/OX	ultraviolet light oxidation
WAP	waste analysis plan

**ACCEPTANCE OF FEED STREAMS FOR
TREATMENT AT THE LERF/ETF COMPLEX**

EXECUTIVE SUMMARY

A waste acceptance process for treatment of dilute low-level liquid wastes in the Liquid Effluent Retention Facility (LERF)/Effluent Treatment Facility (ETF) complex is established by Liquid Effluent Services (LES) of Westinghouse Hanford Company for the Department of Energy . Once a waste stream is characterized, LES will use the data to determine:

- o If the waste fits within the treatability envelope defined by previous testing,
- o If the secondary waste to be produced as a byproduct of treatment will violate radionuclide inventory limits or transuranic radionuclide concentration limits,
- o If there are any treatment process concerns,
- o If modifications to facility equipment are necessary,
- o If permits need to be revised, and
- o If other documentation, such as procedures, needs to be modified.

ACCEPTANCE OF FEED STREAMS FOR STORAGE AND TREATMENT AT THE LERF/ETF COMPLEX

1.0 INTRODUCTION

Liquid Effluent Services (LES) manages the operation of the Liquid Effluent Retention Facility (LERF) and the 200 Area Effluent Treatment Facility (ETF) for the Department of Energy (DOE) at Hanford. Waste acceptance criteria for these facilities ensure that dilute liquid wastes received at the LERF for temporary storage and subsequent treatment at the ETF can be done efficiently in a safe and environmentally responsible manner and in accordance with permit conditions.

If a generator of dilute liquids intends to have waste treated by the LERF/ETF system, then the Liquid Effluent Advanced Engineering group within LES will guide them through the waste acceptance process, providing coordination and technical services, as necessary. Note that it is mandatory all waste streams be characterized before wastes can be received. Characterization requirements (including quality assurance) will be developed within the RCRA permit for the LERF and ETF. Subsequent to characterization, further steps may or may not be required for waste acceptance.

2.0 WASTE TRANSPORTATION, STORAGE, TREATMENT, AND DISPOSAL FACILITIES

The 200 Area Facilities (Figure 1) managed by LES are available to disposition regulated dilute liquid wastes generated on the Hanford site. Where conveyance is not available by pipeline, transportation is provided by two 5,000 gallon tanker-trailers (Reference 1). Storage will be primarily provided by the three 6.5 million gallon basins (lined and covered surface impoundments) that comprise the LERF. Treatment will be provided by the ETF. Note that the ETF will also have two 10,000 gallon storage tanks to receive tanker-trailer liquid wastes. The treated effluents will be disposed of by a State Approved Land Disposal Site (SALDS) which is a crib located just north of the 200 West Area.

Figure 2 depicts the unit operations that comprise the ETF. The ETF processes are housed under one building (constructed under project C-018H). The building also houses: office space, a control room, and operations/maintenance related areas. Consisting of primary and secondary treatment trains, the ETF processes will clean waste waters by removing and/or destroying organics, inorganics, radionuclides, ammonia, and undissolved solids.

The primary treatment train consists of:

- o a surge tank used to condition the waste to a pH of 6 and form dissolved ammonium sulfate (from the reaction of ammonia and sulfuric acid),

- o a rough filter nominally rated at 2 microns used to remove suspended solids that might otherwise foul downstream treatment equipment,
- o an ultraviolet light oxidation (UV/OX) treatment (to destroy organics) which uses hydrogen peroxide as the oxidant,
- o a pH adjustment to condition the waste for downstream treatment,
- o a degasser to remove carbon dioxide formed in the organic destruction step,
- o a fine filter nominally rated at 0.5 microns used to remove suspended solids that might otherwise foul downstream treatment equipment,
- o a two-stage reverse osmosis (RO) treatment to remove dissolved solids which include ammonium sulfate, inorganics, radionuclides, and high molecular weight organics,
- o a two-stage ion exchange (IX) treatment to remove residuals that the reverse osmosis step does not remove, and
- o a final pH adjustment to condition the treated effluent.

Prior to discharge, the treated effluent will be sampled and analyzed to verify that it is within permitted parameters. A proportional sampler and three 670,000 gallon tanks are in place to enable this verification to take place. At any one time, a proportional sample is taken as one tank is filling, a second tank is standing by for laboratory analyses to verify successful treatment, and a third tank is discharging to a pipeline that runs 5 miles to the SALDS.

The secondary treatment train receives wastes from the primary treatment train consisting of: backwash from the two filters, concentrate from the reverse osmosis unit, and regenerate from the ion exchange unit. This train consists of: an evaporator which further concentrates the waste and a thin-film dryer which converts the concentrated waste into a powder. Lined 55-gallon drums are used to package the powder.

3.0 WASTE ACCEPTANCE CRITERIA

Before a waste can be accepted for treatment, the acceptance criteria discussed in this section must satisfy requirements and operability parameters established by regulations and design. These criteria along with process knowledge are inputs to a waste acceptance process which begins with characterization. Waste stream constituents and their concentrations must be within the known envelope of treatability. This envelope is currently based on controlled testing of surrogate solutions. The envelope will be re-evaluated and redefined once waste processing commences at the ETF and actual operating data is obtained.

Tables 1, 2, and 3 list the decontamination factors derived from the testing of surrogate wastes. Once the discharge concentrations allowed by the WAC 173-216 Permit are published, the maximum ETF influent concentrations allowable under once-through treatment regimens (i.e., no recycle) will be calculated. As additional testing is completed or Permit modifications are obtained, the calculated maximum ETF influent concentrations allowable will likely change.

It is recognized that recycling within the ETF for additional treatment is an option. If a potential waste stream has higher-than acceptable concentrations of regulated compounds, the waste can be subjected to several passes within the ETF. Alternatively, if the stream is of low volume, it can be metered into a high volume stream prior to treatment.

The three most important acceptance *criteria* are listed below. These criteria are derived from regulatory and facility design requirements. They must be met. They can change in response to modifications of the LERF and ETF and/or their operating permits.

1. The waste stream must be characterized to the degree established in the RCRA Part B Permit. Analytical procedures used must be consistent with RCRA waste analysis plans. Basis: The waste stream cannot be designated without accurate and complete characterization data.
2. Only the waste codes listed in the Delisting Petition and the RCRA permit can be accepted for treatment at the ETF, unless the permit and the Delisting Petition are modified. Basis: The ETF is limited by RCRA regulations to treat only those waste streams containing constituents that have been demonstrated to be treatable. The Delisting Petition to the EPA is the primary document controlling what is considered treatable. This document can be updated to reflect an expansion of the treatment envelope.
3. The absorbed radiation dose to a hypothetical individual at the site boundary cannot increase over permitted levels without a modification to the Radionuclide Air Emission Program (RAEP) permit. Influent concentrations must remain low enough such that this remains true. Radionuclides which have not previously been accounted for, may also force a permit reevaluation. Basis: Washington State Department of Health (DOH) regulations.

Acceptance criteria based on operability *parameters* are listed below. While the following are not necessarily mandatory criteria, each must be considered when determining the acceptability of a waste stream sent to the LERF for storage and the ETF for treatment. These criteria may change in response to modifications made to the LERF and ETF.

4. No separable organics. Basis: Physical Limitation of the UV/OX system. The UV/OX system is designed to treat dissolved total organics in concentrations that generally do not exceed 100 to 300 ppm.

5. Minimize colloidal matter to protect filters in the ETF from plugging. Basis: Physical Limitation of the rough and fine filters.
6. Minimize concentrations of scale forming compounds, (e.g., calcium sulfate, calcium phosphate, and metal silicates). Scale formation within the UV/OX unit would block UV radiation from destroying organics. Basis: Physical Limitation of the UV/OX and RO systems. Note that silicate concentrations in excess of 0.001 molar fed to the RO system could foul the membranes. Also, the RO membranes are only capable of handling influent dissolved solid concentrations of up to about 500 ppm. Concentrations in excess of this will likely foul the second stage of the RO membranes.
7. Minimize concentrations of corrosive constituents, such as chloride and fluoride. Basis: Physical Limitation of the ETF evaporator and dryer. In sufficient concentrations, these constituents can corrode the ETF evaporator and dryer.
8. Minimize concentrations of constituents that can absorb UV light to the extent destruction of targeted organics is significantly compromised. Basis: Physical Limitations of the UV/OX system. Nitrate and sulfide are two such constituents. For example, proof-of-principle testing by the Japan Gas Company found hydrogen sulfide forms a milky light-absorbing substance when subjected to ultraviolet light oxidation.
9. Significant concentrations of neutral radionuclide species cannot be accepted by the LERF and ETF without jeopardizing compliance with discharge requirements for radionuclides (0.04 times the Derived Concentration Guidelines) per section 8.4.2.1 of WHC-CM-7-5 (Reference 2). Plutonium and Ruthenium are known to form such neutral species. Basis: Neutral species have lower decontamination factors primarily because the IX system is only effective on ionic species.

Other waste acceptance criteria associated with radioactive content/inventory are listed below. Again, these criteria, must be considered when determining the acceptability of a waste stream sent to the LERF for storage and to the ETF for treatment.

10. Containers (55-gallon drums) filled with secondary waste cannot exceed 100 mR/hr at contact. Basis: The Central Waste Complex is limited by design in what it can accept.
11. Concentrated secondary (powdered) waste cannot exceed 100 nCi/g of transuranic (TRU) radionuclides. Basis: The ETF is not designed to handle TRU wastes. Note that the concentration of TRU in the solid waste is dependent upon the dissolved and undissolved concentrations of TRU and non-TRU solids in the waste water to be treated.
12. Annual tritium releases to the ground shall not exceed 20,000 curies per year. Basis: Section 8.4.2.3.1.e of WHC-CM-7-5 (Reference 2). It is

extremely unlikely this will ever occur however, because there are only an estimated 3300 curies in the tank farm system (Reference 3).

13. The radioactive inventory (total curies) is limited by the facility hazard classification as documented in Reference 4 per the methodology of DOE STD-1027-92.

4.0 WASTE ACCEPTANCE PROCESS

A flow chart (Figure 3) has been prepared that captures the logic LES will follow in evaluating a waste stream for treatment in the LERF/ETF system. The following describes the logic captured in the chart.

Characterize and Designate

The first step is to characterize the waste stream through chemical analyses, followed by a designation based upon process knowledge and analytical results. Analytical procedures used will be consistent with waste analysis plans to be detailed in the RCRA Part B Permit for the LERF and ETF. This data may be sufficient by itself to determine the acceptability of the waste stream. Note that until the waste analysis plans are complete, characterization data should be submitted to LES for a preliminary review. This will facilitate planning for eventual treatment of the waste stream.

Are the Waste Characteristics Within the Existing Treatability Database and the Parameters of the Delisting, RCRA, and 216 Permits?

The following discussion assumes the Delisting Petition and the RCRA Part B Permit will be modified to allow greater flexibility than what currently exists. That is, procedural mechanisms will be written into these regulatory documents to streamline the authorization for treatment of new waste streams.

The next step is to determine if the waste stream constituents are within the known envelope of treatable waste characteristics, and if they are compatible with materials of construction. If they are not, then additional testing may need to be conducted to determine if the treatment process and/or equipment should be modified or supplemented. Quality assurance would be consistent with standards set in the RCRA Part B waste analysis plans. Recommendations from testing might lead to modifications of the LERF, ETF, or the waste generator's facility. Permits would need to be updated to reflect any modifications or additions. If testing shows that the existing facilities can store and treat the waste stream without additions or modifications, then the known envelope of treatable waste characteristics would be expanded and so reflected in modifications to the Delisting Petition and the WAC 173-216 Permit.

Is the Secondary Waste (a Byproduct of Treating the Waste Stream at the ETF) Within DOE Defined Safety Limits?

This step determines if the waste stream can be treated without exceeding safety limits associated with accumulating radioactive waste. Since the ETF secondary waste treatment train concentrates radioactive constituents from the waste stream, the solid waste produced by the ETF dryer is the most radiologically significant waste accumulated at the ETF. The maximum possible inventory of radionuclides in radioactive waste accumulated within the ETF must be investigated to see if hazard category 3 limits, as calculated in WHC-SD-C018H-HC-002, can be exceeded with the introduction of a new source term. If limits can be exceeded, then the generator may need to pretreat the waste stream. In cases where the potential accumulation exceeds the inventory limits by a relatively small amount, administrative controls can be used to limit the amount of solid waste allowed to accumulate in the drum storage area of the ETF.

Does the Waste Stream Pose Any Process Concerns for the ETF?

For this decision block, engineering judgement must be used to decide if there are potential process related problems with respect to treating the waste stream. For example, there may be a fouling problem requiring a chemical and/or equipment solution. Engineering judgement will be based upon process and/or analytical knowledge. If there is sufficient reason to suspect process difficulties, then testing is performed. Based upon test results, a recommendation may be made to modify the treatment process. All affected permits would then be modified.

Has Anything Changed to Warrant Modifying the Air Permits?

For this decision block, a determination is made on the effect processing a new waste stream may have on existing air permits. For example, a waste stream may contain volatile radionuclides which are not presently taken into account. Note that per previous decisions represented on this flow chart, the air permits may have already changed under "modify all facility permits, as necessary." However, it is possible that a modification at the generator's facility has somehow changed the nature of the waste stream such that processing the stream in the ETF now affects the air permits. If the air permits need modification, there may be a need to add or modify air effluent treatment equipment. This would be reflected in modified air permits.

Modify Subtier Documentation, as Necessary

Before the waste stream can be transported for subsequent treatment at the ETF, subtier documentation must be revised, such as the: Safety Analysis Report, Waste Analysis Plans, Sampling Analysis Plans, Procedures, Training Plans, and Operations and Maintenance Manuals.

5.0 UPDATES TO THE WASTE ACCEPTANCE PROCESS

The waste acceptance process will be revised as controlling documentation is added, modified and/or finalized. As of this revision, several important activities are anticipated to be completed over the next 12 months. These include:

- o ETF construction (including mandatory modifications identified as outside of the original construction contract),
- o Permitting (including the RCRA Part B Permit and its associated waste analysis plan, the WAC 173-216 permit, and the Delisting Petition), and
- o 9090 Testing of polymeric materials from the LERF/ETF system (including the LERF liner, LERF piping, and tanker-trailer unloading system piping).

The latter activity will be conducted to insure that the polymeric materials are chemically compatible with all anticipated waste streams to be treated in the LERF/ETF system.

6.0 REFERENCES

1. Drawings H-9-203, sheets 1 through 4.
2. Environmental Compliance Manual, REV 1, WHC-CM-7-5, January 21, 1991, and updates through Release 63, July 1994.
3. Letter, J.D. Williams to J.M. Hennig, Correspondence No. 9356882, "Tritium Concentrations in the Effluent from the 200 Area Effluent Treatment Facility (Project C-018H), dated August 16, 1994.
4. F.H. Bourger, "Hazard Categorization Report for the 200 Area Effluent Treatment Facility," WHC-SD-C018H-HC-002, January 1994.

Table 1. Predicted Decontamination Factors of Organic Chemicals by Group

CG	Chemical Group Name	Decon Factor (Retention Time = 2.08 min)
1	Phenols	7.4
2	Substituted phenols	311.3
3	Low molecular weight aromatic	5.9
4	High molecular weight PAH (1)	6,223
5	Chlorinated Aromatic Hydrocarbons	see 5a
5 a	Chlorinated benzenes	61.5
6	Chlorinated aliphatic hydrocarbons	see 6a & b
6 a	Halogenated alkanes	1.2
6 b	Halogenated alkenes	1.9
7	Halogenated ethers	see 6a & b
7 a	Halogenated alkyl ether	31.6
7 b	Halogenated aryl ether (1)	1,388,869
8	Phthalates	2.3
9	Miscellaneous oxygenated compounds	see 9a
9 a	Alcohols	19.2
10	Organonitrogen compounds	see 10a thru f
10 a	Amines	132.7
10 b	Anilines	38.1
10 c	Nitriles	132.7
10 d	Nitroaromatics	170.3
10 e	Nitrosoamines	360.1
10 f	Pyridines	132.7
11	Pesticides	2.3

Table 1. Predicted Decontamination Factors of Organic Chemicals by Group

CG	Chemical Group Name	Decon Factor (Retention Time = 2.08 min)
12	Polychlorinated biphenyls (1)	11,614
13	Volatile halogenated alkanes	2.3
14	Volatile halogenated alkenes	1.9
15	Volatile aromatic hydrocarbons	
15 a	Low molecular weight polycyclic aromatic hydrocarbons	14.0
16	Volatile chlorinated aromatic hydrocarbons	61.5
17	Volatile unsaturated carbonyl compounds	see 17a
17 a	Aldehyde compounds	26.7
18	Volatile ethers	see 18a
18 a	Cyclic ethers	124.7
19	Volatile ketones	6.1
25	Miscellaneous semivolatile compounds	see 25a & b
25 a	Alkyl phosphates	45.0
25 b	Long chain alkanes	1.5
(1) Based on Peroxidation Systems, Inc. oxidation data base.		

Table 2. Organics Cited in Delisting Petition

CG	Constituent Name	Decon Factor (Retention Time = 2.08 min)
1	Phenol	7.4
2	Pentachlorophenol	311.8
3	Benzene	11.5
3	Naphthalene	5.9
4	Pyrene (1)	6,223
5 a	1,4-dichlorobenzene	61.5
6 a	Hexachloroethane	1.2
7 a	Bis(2-chloroethyl) ether	31.6
7 b	4-Chlorophenyl phenyl ether (1)	1,388,869
8	Bis (2-ethylhexyl) phthalate	2.4
9 a	n-Butanol	19.2
10 b	Aniline	38.4
10 c	Acetonitrile (2)	133.5
10 d	Nitrobenzene	170.1
10 e	N-nitroso-di-n-propylamine	363.8
10 f	Pyridine (2)	133.5
11	gamma-BHC	2.3
12	4,4'-Dichlorobiphenyl (1)	11,614
13	Carbon tetrachloride	1.5
13	Chloroform	2.2
13	1,1,1-Trichloroethane	2.2
13	1,1,2-Trichloroethane	1.4
14	Tetrachloroethylene	2.0
15 a	Toluene	14.0
17 a	Acrolein	26.7

Table 2. Organics Cited in Delisting Petition

CG	Constituent Name	Decon Factor (Retention Time = 2.08 min)
18 a	Tetrahydrofuran	125.2
19	Acetone	1.3
19	Methyl ethyl ketone	4.2
19	Methyl isobutyl ketone	12.7
25 a	Tributyl phosphate	44.7
25 b	Tridecane	1.5
(1) Based on Peroxidation Systems, Inc. oxidation data base. (2) Oxidation rate based on other CG 10 constituents.		

Table 3. Inorganics Cited in Delisting Petition

Constituent Name	Decon Factor
Aluminum	25.0
Ammonium	500.0
Arsenic	333.3
Barium	7.9
Beryllium	76.9
Cadmium	200.0
Cesium	29.4
Chromium	250.0
Copper	250.0
Iron	2.1
Lead	13.5
Mercury	83.3
Nickel	76.9
Ruthenium	1.4
Selenium	200.0
Silicon	21.7
Silver	6.9
Sodium	55.6
Strontium	62.5
Vanadium	11.8
Zinc	66.7
Carbonate	NA
Chloride	1000.0
Cyanide	71.4
Fluoride	32.3
Nitrate	1000.0
Nitrite	166.7

Table 3. Inorganics Cited in Delisting Petition

Constituent Name	Decon Factor
Phosphate	27.0
Sulfate	> 1000.0
Lithium (1)	15.2
Potassium (1)	15.2
Thallium (1)	15.2
Calcium (1)	52.6
Cobalt (1)	52.6
Magnesium (1)	52.6
Manganese (1)	52.6
Antimony (1)	62.5
Tin (1)	40.0
Titanium (1)	40.0
Valance of 5 (1)	11.8
(1) Estimated removal efficiency based on average removal for metals with similar most stable oxidation state. NA Not available due to lack of data.	

Figure 1. Liquid Effluent Storage, Treatment, and Disposal Facilities

WMC-SD-ETF-WAC-001 Rev. 0
Figure 2. ETF Treatment Train

Figure 3. Decision Flowchart for Accepting Wastes into the ETF/LERF