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Environmental Radiation Program

STATE OF WASHINGTON DEPARTMENT OF HEALTH

OVERSIGHT AT THE 310 TREATED EFFLUENT DISPOSAL FACILITY (TEDF) 1995 - 1999

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EXECUTIVE SUMMARY

This report summarizes oversight activities conducted by the Washington State Department of Health for the 310 Treated Effluent Disposal Facility (TEDF) as acknowledged in the Aquatic Lands Sewer Outfall Lease No. 20-013357. This agreement, between the Washington Department of Natural Resources (DNR) and the U.S. Department of Energy (USDOE), requires the Department of Health (DOH) to ensure that river and effluent concentrations do not exceed applicable standards for radioactivity.

This lease requires:

- The facility operator to conduct monthly radiological analysis of effluent water and transmit results in the form of a report to the Department of Health.
- The facility operator to split effluent samples with DOH biannually.
- Notification of DOH within 24 hours of gamma scan results that exceed WAC 246-221-290 Table II or gross alpha at 15 pCi/l, gross beta at 50 pCi/l and tritium at 20,000 pCi/l.
- Isotopic analysis of all samples meeting or exceeding reporting requirements.
- Annual sampling and analysis by the facility operator of the receiving water (Columbia River) upstream of the outfall and downstream at the edge of the mixing zone for all radionuclides identified in the Drinking Water Standard, WAC 246-290-310 (8). A report shall be sent to DOH identifying radioactivity with respect to this standard.
- The operator to pay for all associated costs of analysis and verification.

The 310 Treated Effluent Disposal Facility (TEDF) was constructed as part of a Tri-Party Agreement Milestone to cease discharges to the 300 Area Process Trenches under the project number L-045H. The facility began operation in December 1994 and effluent sampling has been conducted by the Department of Health and U.S. Department of Energy contractors since that time.

Reported radiological measurements in all effluent samples analyzed by these programs were less than the drinking water standards during this reporting period.

DEPARTMENT OF HEALTH OVERSIGHT AT THE 310 TREATED EFFLUENT DISPOSAL FACILITY (TEDF) 1995 - 1999

Introduction

The 310 Treated Effluent Disposal Facility (TEDF) was constructed as part of a Tri-Party Agreement Milestone to cease discharges to the 300 Area Process Trenches under the project number L-045H. The facility began operation in December 1994 and effluent sampling has been conducted by the Department of Health and U.S. Department of Energy contractors since that time.

Process Description

The 300 Area TEDF, operated by Fluor Daniel Hanford Company, is located on the northern-most boundary of the 300 Area, adjacent to the Columbia River. The TEDF collects process waste water which is discharged to the 300 Area Process Sewer from approximately forty-five office buildings, research laboratories and support facilities in the 300 Area. The facility removes metals and organic contaminants before the purified water is discharged to the Columbia River. Radioactive material other than tritium is removed during the metals removal cycle.

The process waste water stream consists primarily of potable water, equipment cooling water, steam condensate, water treatment salts, and laboratory and research waste water. The mean daily flow rate is currently in the range of 100 to 250 gallons per minute, with maximum spikes attaining 1200 gallons per minute.

Liquid Treatment Facilities - 300 TEDF

Waste water from buildings connected to the Retention Process Sewer branch of the Process Sewer passes through a beta detector in the building. If radioactivity is detected, water is diverted to the Retention Basins.

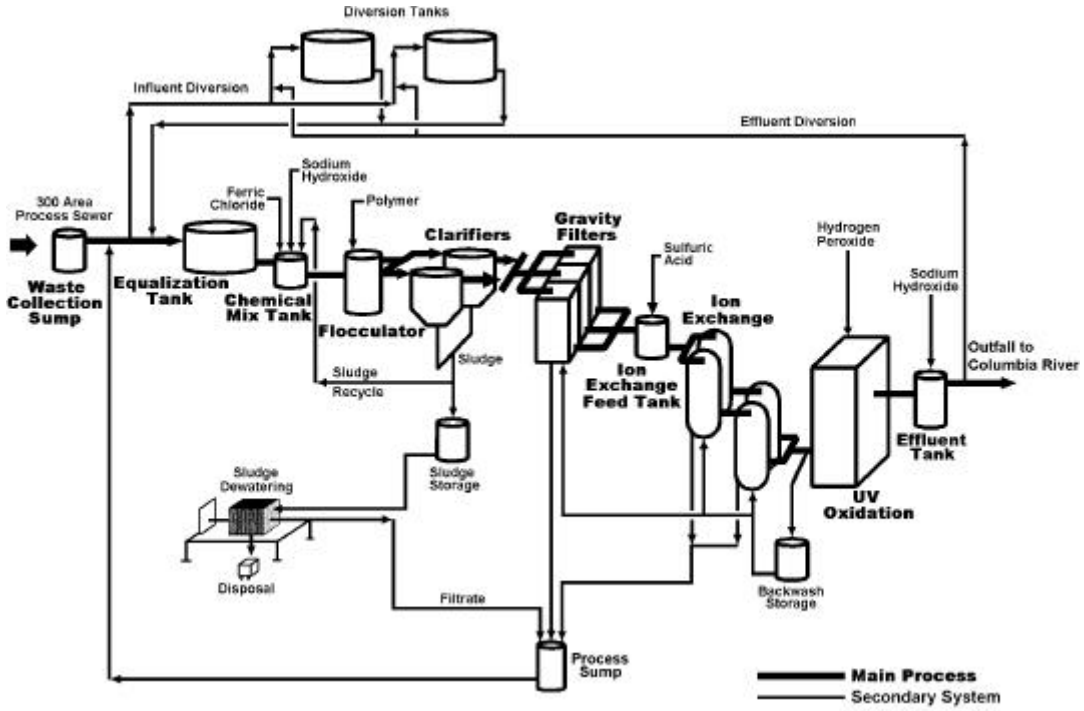
The following processes are employed to purify the TEDF feedstream:

- Chemical Precipitation - Heavy metals form nearly insoluble precipitates under slightly alkaline conditions. Ferric Chloride is added as a co-precipitant, and anionic polymer is added as a flocculent (settling) aid.

- Clarification/filtration - Coagulated solids from the precipitation system are settled and filtered to remove suspended solids from the process stream.

- Ion exchange - Mercury that was not removed in the precipitation process is eliminated with the ion exchange columns.

- UV light/hydrogen peroxide destruction of organics - Organic compounds are destroyed with a process that utilizes UV light.



310 Treated Effluent Disposal Facility Process Diagram

300 Area facility effluent enters the main header at the north end of the 300 Area and is discharged into the waste collection sump. In this 80,000-gallon vessel, waste water is monitored for temperature, pH, and conductivity before it is pumped to the 480,000 gallon equalization tank. This tank provides the "feed water" for the TEDF process and is regulated to maintain a steady influent stream for the process.

The "feed water" is pumped to the chemical mix tank where ferric chloride is added along with sodium hydroxide to control the pH (9-11) as the first step in the iron co-precipitation process.

Under neutral or high pH conditions, many heavy metals form relatively insoluble precipitates. When iron is added as a co-precipitant, it forms well-settling ferric hydroxide flocs that help settle the other metal precipitates by trapping and adsorbing them on the iron flocs.

A flocculent aid polymer is added as the feed water gravity flows from the chemical mix tank to the flocculator tank. The waste stream is gently mixed in the flocculator in order to increase the size and mass of the floc.

The flocculated waste water then flows by gravity to the clarifiers where settling takes place. From the clarifiers, it flows through the gravity filters, which use a dual media bed of charcoal, and sand to remove suspended solids.

The treated water flows by gravity into the ion exchange tank before being pumped into the ion exchange column system. Sulfuric acid is added in the ion exchange feed tank to lower the pH. The water passes through one of the two parallel trains of two ion exchange columns in series. The ion exchange columns are packed with a resin which has an affinity for mercury and other metals that form insoluble metal sulfides.

The water is then pumped through the UV/peroxide system. This destroys organic compounds, sulfide, nitrite, and cyanide by chemical oxidation. Ultraviolet light catalyzes the chemical oxidation reaction by the combined effect on the organic compounds and reaction with the hydrogen peroxide that is fed upstream of the UV reactor. Organics are converted to carbon dioxide and water.

The treated effluent is discharged into the EF-T-10 effluent tank where sodium hydroxide may be added to comply with regulatory pH requirements. A "composite sample" of treated effluent is collected from the effluent discharge line in 100 ml aliquots before the effluent gravity-flows through the outfall pipeline to the Columbia River. Typically, 10 to 12 liters of sample are collected each month and analyzed.

Department of Health Oversight

The Department of Natural Resources' lease requires the Department of Health to collect split samples of effluent semiannually and review monthly data to identify potential impacts to human health and assess water and sediment quality. Each effluent sample

taken by the lessee, or DOH, is analyzed for gross alpha, gross beta and tritium. In addition, each sample is scanned for gamma emitting radionuclides. DOH is notified by the lessee within 24 hours of gamma scan results that exceed WAC 246-221-290 Table II or gross alpha at 15 pCi/l, gross beta at 50 pCi/l and tritium at 20,000 pCi/l. All samples exceeding the standard require characterization of the alpha or beta constituents.

Composite Sample Apparatus at the 310 TEDF

In 1997 the facility reported two instances where the limit for various isotopes of radium were exceeded.

- September 17, 1997 - The downstream annual receiving water sample taken as part of the Receiving Water Quality monitoring requirements of the DNR lease exceeded the combined Radium 226 and 228 limit of 5 pCi/l. Analysis indicated levels of 8.3 pCi/l for Ra-226 and 5.9 pCi/l for Ra-228.

- November and December 1997 - Effluent samples exceed the National Pollutant Discharge Elimination System (NPDES) maximum daily limit (MDL) of 0.4 pCi/l for Ra-228. Levels of Ra-228 for these samples were reported as 0.61 and 0.43 pCi/l respectively.

In both instances, the facility was unable to identify through influent sampling a source of radium that would have been introduced into the facility process. The reported

non-compliance issues for radium results can be attributed to their laboratory methods for detecting total radium. The facility has requested the laboratory detection limit be lowered to minimize counting error as a contributor to a non-compliant result.

DOH has access to the results of all pertinent internal audits and periodically audits the facility sampling program and analytical laboratory. The facility was inspected by DOH Environmental Radiation Section staff in May 1998 as part of a USEPA "multi-media inspection". These types of comprehensive inspections are routinely conducted in conjunction with state agencies to examine facilities with a variety of waste streams that have the potential for significant environmental contamination. The 300 Area TEDF was inspected to ensure compliance with a full array of federal and state environmental laws.

Analytical Results

The results of all samples split at the facility are listed in Table 1. Radioactivity is reported in units of pico-curies per liter with an associated error that results from the randomness of decay. In general, analytical results near or less than the LLD and MDA and reported error are considered to be non-detectable; detection is questionable for results greater than 2 sigma but less than 3 sigma.

Tritium was the most prevalent radionuclide detected in split facility samples. Tritium values were within the range of minimum and maximum results for riverbank springs discharged to the Columbia River during the reporting period. Tritium is a radioactive form of hydrogen that can become part of a water molecule. There is no proven cost effective treatment technology that would remove tritium before water is discharged.

Generally, gross alpha and beta measurements were less than detectable. Results of all split sample analyses are less than all applicable lease conditions or drinking water standards. Continuous ingestion of water for one year at the drinking water standard concentration would result in a dose of 4 millirem.

Conclusion

Analytical techniques utilized by each program are based on standard methods. Rigorous quality control protocols are employed to assure that data collected and the resultant conclusions are traceable to the source of the data.

The cooperation between Fluor Daniel Hanford Company and DOH environmental monitoring programs enables verification of results as well as characterization and quantification of radioactive contaminants discharged to the Columbia River. Program deficiencies are identified and quickly resolved. It is evident that the current monitoring program is effective for detecting and tracking radioactive pollutants before they become a problem.

Table 1 - Analytical Results for Split Effluent Samples from the 300 Area TEDF 1995-1999					
Date	**Test**	**Department of Health pCi/l ± 2 Sigma Counting Error**	**LLD**	**Waste Management Federal Services of Hanford pCi/l ± % Counting Error**	**MDA**
2-23-95	Gross Alpha	-0.2±2.9	4	<2.0	2.00
	Gross Beta	1.3±0.7	1	<2.0	2.00
	Tritium	237±29	50	<377	
10-25-95	Gross Alpha	0.6±3.5	4	0.63±64%	0.60
	Gross Beta	3±1	1	1.90±20%	0.43
	Tritium	89±31	50	<583	
2-28-96	Gross Alpha	0±3	4	<0.53	0.53
	Gross Beta	2±1	1	0.69±40%	0.37
	Tritium	119±43	50	<190	
8-21-96	Gross Alpha	1±3	4	<1.06±1000%	1.06
	Gross Beta	1.5±0.7	1	<0.72±76%	0.82
	Tritium	156±51	50	<218±78%	
2-27-97	Gross Alpha	1±3	4	<-0.64±160%	2.10
	Gross Beta	2±4	1	<0.38±210%	1.30
	Tritium	-15±62	50	<-110±120%	
8-28-97	Gross Alpha	0±3	4	<0.44±220%	1.60
	Gross Beta	3±4	1	<0.86±100%	1.40
	Tritium	178±42	50	190.00±40%	
2-22-98	Gross Alpha	-1±2	4	<1.5±80%	1.55
	Gross Beta	2±1	1	2.30±30%	0.90
	Tritium	130±40	50	<110±60%	
5-13-98	Gross Alpha	1±3	4	<-0.45±170%	1.60
	Gross Beta	1±4	1	<0.77±120%	1.50
	Tritium	354±35	50	310.00±50%	
8-31-98	Gross Alpha	0±2	4	<0.31±142%	0.73
	Gross Beta	3±3	1	1.10±60%	1.00
	Tritium	300±50	50	430.00±40%	
2-25-99	Gross Alpha	3.8±1.2	4	4.9±61%	4.20
	Gross Beta	3.67±1.01	1	<1.6±120%	3.00
	Tritium	74±47	50	<84±62%	
9-21-99	Gross Alpha	-0.8 ± 0.9	4	1.6±60%	1.00
	Gross Beta	0.7 ± 1.4	1	0.00±135%	2.10
	Tritium	1790 ± 95*	50	1800.00±22%	

LLD - Lower Limit of Detection
MDA - Minimum Detectable Activity

Regulatory Limits - pCi/l
Gross Alpha - 15
Gross Beta - 50
Tritium - 20,000

*This result is under investigation. It is still less than applicable lease conditions and drinking water standards.

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