WHC-EP-0342
Addendum 25

# 244-AR Vault Cooling Water Stream-Specific Report

Prepared for the U.S. Department of Energy
Office of Environmental Restoration
and Waste Management

**Westinghouse Hanford Company** Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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# 244-AR Vault Cooling Water Stream-Specific Report

Tank Farms Environmental Engineering

Date Published
August 1990

Prepared for the U.S. Department of Energy
Office of Environmental Restoration
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Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352

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# 244-AR VAULT COOLING WATER STREAM-SPECIFIC REPORT

Tank Farms Environmental Engineering

## ABSTRACT

*The proposed wastestream designation for the 244-AR Vault cooling water wastestream is that this stream is not a dangerous waste, pursuant to the Washington (State) Administration Code (WAC) 173-303,* Dangerous Waste Regulations.* *A combination of process knowledge and sampling data was used to make this determination.*

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**Ecology, 1989,* Dangerous Waste Regulations, *Washington (State) Administrative Code (WAC) 173-303, Washington State Department of Ecology, Olympia, Washington.*

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## EXECUTIVE SUMMARY

The proposed designation for the 244-AR Vault cooling water wastestream, located in the 200 Area of the Hanford Site, is that this stream is not a dangerous waste, pursuant to the Washington (State) Administrative Code (WAC) 173-303, *Dangerous Waste Regulations*.* A combination of process knowledge and present sampling data was used to determine if the effluent contains a listed dangerous waste (WAC 173-303-080). Sampling data alone, is compared to the dangerous waste criteria (WAC 173-303-100) and dangerous waste characteristics (WAC 173-303-090). Process knowledge was based on knowledge of the process configuration and operations in the tank farm facilities (including the chemicals that are utilized). Sample data are based on samples downstream of all process contributors consisting of four random samples taken at one sampling point from October 13, 1989 to February 16, 1990.

*Ecology, 1989, *Dangerous Waste Regulations*, Washington (State) Administrative Code (WAC) 173-303, Washington State Department of Ecology, Olympia, Washington.

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## LIST OF TERMS

| | |
|---|---|
| µS | microsiemens |
| $Al_2(SO_4)_3$ | aluminum sulfate |
| BDL | below detection limit |
| Btu | British thermal unit |
| CASS | computer-automated surveillance system |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| CI | confidence interval |
| DCG | Derived Concentration Guides |
| DOE | U.S. Department of Energy |
| EC | equivalent concentration |
| Ecology | Washington State Department of Ecology |
| EP | extraction procedure |
| EPA | U.S. Environmental Protection Agency |
| GFAA | graphite furnace atomic absorption |
| HCN | hydrocyanide |
| HH | halogenated hydrocarbons |
| HVAC | heating, ventilation, and air conditioning |
| IARC | International Agency for Research on Cancer |
| ICRP | International Committee on Radiological Protection |
| LDL | lower detection limit |
| MCL | maximum concentration level |
| MSDS | Material Safety Data Sheet |
| NCAW | neutralized current acid waste |
| NIC | not in control |
| NR | not recorded |
| PAH | polycyclic aromatic hydrocarbons |
| PCB | polychlorinated biphenyl |
| pCi/L | picocuries per liter |
| ppb | parts per billion |
| ppm | parts per million |
| PUREX | Plutonium-Uranium Extraction (Plant) |
| SARA | *Superfund Amendments and Reauthorization Act* |
| SC | specific carcinogen |
| TK | tank |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |
| TRU | transuranic |
| WAC | Washington Administrative Code |
| Westinghouse Hanford | Westinghouse Hanford Company |

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# 244-AR VAULT COOLING WATER STREAM-SPECIFIC REPORT

## 1.0 INTRODUCTION

### 1.1 BACKGROUND

In response to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989), comments from the public were received about reducing the discharge of liquid effluents into the soil column. As a result, the U.S. Department of Energy (DOE), with concurrence of the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA), committed to assess both waste disposal and health risks of liquid discharges at the Hanford Site (Lawrence 1989).

This assessment is described in the *Draft Liquid Effluent Study Project Plan* (WHC 1990a). A portion of this study consists of characterizing 33 liquid effluent streams. The characterization consists of the process description, sampling data, and dangerous waste regulations on designations contained in the Washington (State) Administrative Code (WAC) 173-303 (Ecology 1989).

The results of the characterization study are documented in 33 separate reports (one report for each wastestream). The complete list of stream-specific reports appears in Table 1-1. This document is one of the 33 reports.

### 1.2 APPROACH

This report characterizes the 200 East Area 244-AR Vault cooling water wastestream in sufficient detail so that a wastestream designation, in accordance with WAC 173-303 *Dangerous Waste Regulations*, can be proposed. This report also provides a means of assessing the relative effluent priorities with regard to the need for treatment and/or alternative disposal practices.

The characterization strategy undertaken in this report (shown in Figure 1-1) is implemented by means of the following steps:

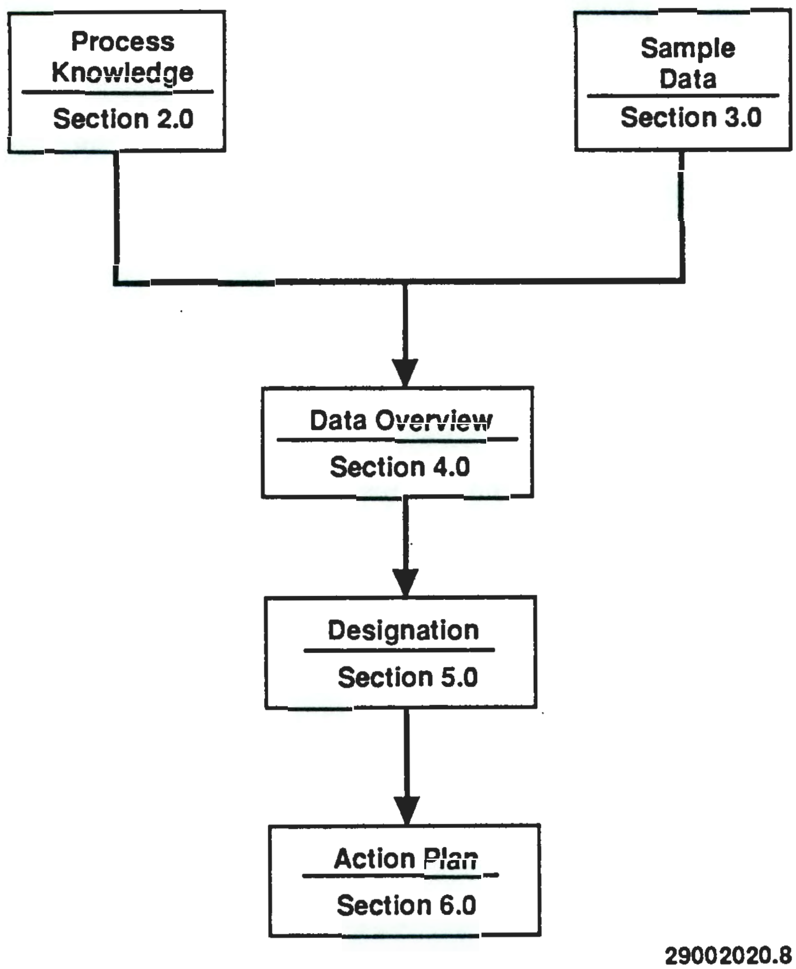
1. Describe the current process based on the knowledge of the system and the chemical/radiological constituents that are known to be present. An historical perspective of the process configuration along with future projects/upgrades has also been presented so that the reader can better understand the current status and current/future disposition of the effluent (Section 2.0).

2. Characterize the wastestream by presenting chemical and radioactive analytical results from samples taken over time in the wastestream (Section 3.0).

Table 1-1. Stream-Specific Characterization Reports.

| | | |
|---|---|---|
| WHC-EP-0342 | Addendum 1 | 300 Area Process Wastewater |
| WHC-EP-0342 | Addendum 2 | PUREX Plant Chemical Sewer |
| WHC-EP-0342 | Addendum 3 | N Reactor Effluent |
| WHC-EP-0342 | Addendum 4 | 163N Demineralization Plant Wastewater |
| WHC-EP-0342 | Addendum 5 | PUREX Plant Steam Condensate |
| WHC-EP-0342 | Addendum 6 | B Plant Chemical Sewer |
| WHC-EP-0342 | Addendum 7 | $UO_3$/U Plant Wastewater |
| WHC-EP-0342 | Addendum 8 | Plutonium Finishing Plant Wastewater |
| WHC-EP-0342 | Addendum 9 | S Plant Wastewater |
| WHC-EP-0342 | Addendum 10 | T Plant Wastewater |
| WHC-EP-0342 | Addendum 11 | 2724-W Laundry Wastewater |
| WHC-EP-0342 | Addendum 12 | PUREX Plant Process Condensate |
| WHC-EP-0342 | Addendum 13 | 222-S Laboratory Wastewater |
| WHC-EP-0342 | Addendum 14 | PUREX Plant Ammonia Scrubber Condensate |
| WHC-EP-0342 | Addendum 15 | 242-A Evaporator Process Condensate |
| WHC-EP-0342 | Addendum 16 | B Plant Steam Condensate |
| WHC-EP-0342 | Addendum 17 | B Plant Process Condensate |
| WHC-EP-0342 | Addendum 18 | 2101-M Laboratory Wastewater |
| WHC-EP-0342 | Addendum 19 | $UO_3$ Plant Process Condensate |
| WHC-EP-0342 | Addendum 20 | PUREX Plant Cooling Water |
| WHC-EP-0342 | Addendum 21 | 242-A Evaporator Cooling Water |
| WHC-EP-0342 | Addendum 22 | B Plant Cooling Water |
| WHC-EP-0342 | Addendum 23 | 241-A Tank Farm Cooling Water |
| WHC-EP-0342 | Addendum 24 | 284-E Powerplant Wastewater |
| WHC-EP-0342 | Addendum 25 | 244-AR Vault Cooling Water |
| WHC-EP-0342 | Addendum 26 | 242-A Evaporator Steam Condensate |
| WHC-EP-0342 | Addendum 27 | 284-W Powerplant Wastewater |
| WHC-EP-0342 | Addendum 28 | 400 Area Secondary Cooling Water |
| WHC-EP-0342 | Addendum 29 | 242-S Evaporator Steam Condensate |
| WHC-EP-0342 | Addendum 30 | 241-AY/AZ Tank Farms Steam Condensate |
| WHC-EP-0342 | Addendum 31 | 209-E Laboratory Reflector Water |
| WHC-EP-0342 | Addendum 32 | T Plant Laboratory Wastewater |
| WHC-EP-0342 | Addendum 33 | 183-D Filter Backwash Wastewater |

Figure 1-1. Characterization Strategy.



3. Compare characterization data obtained through both process knowledge and sampling information. Provide an estimate of stream loadings for radionuclides and chemical constituents based on these factors (Section 4.0).

4. Utilize the process knowledge and sample data to propose a dangerous waste designation (Section 5.0).

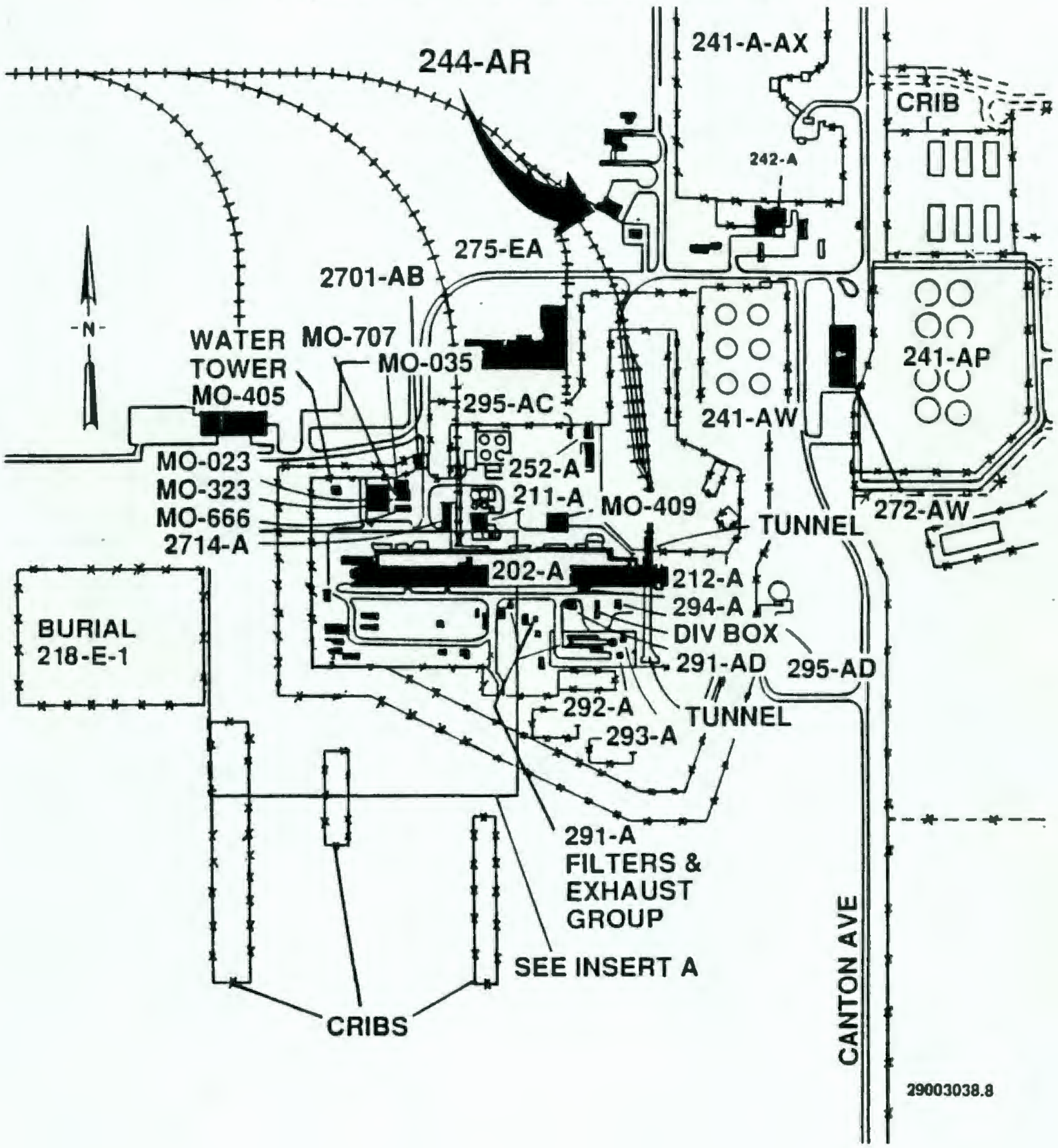
5. Identify new tasks needed to further characterize the wastestream, or to demonstrate continued compliance (Section 6.0).

## 1.3 SCOPE

This scope of this report is a characterization of the current 244-AR Vault cooling water effluents that enter the soil column at the 216-B-3 Pond. The report does not address any other wastestream leaving the 241-A Tank Farm such as solid, gaseous, or sanitary waste.

Historical changes, process campaign changes, and sampling data are considered only if relevant to the characterization of the wastestream as it presently exists. Future configuration/process modifications are addressed only if they will significantly alter the present effluent. The location of the 244-AR Vault is shown in Figure 1-2.

Figure 1-2. 244-AR Vault Area Map.



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# 2.0 PROCESS KNOWLEDGE

This section presents a qualitative and quantitative process knowledge characterization of the chemical and radiological constituents of the 200 East Area 244-AR Vault cooling water wastestream. The process knowledge is discussed in terms of the following factors:

1. Location and physical layout of the process facility
2. The identity of the wastestream contributors
3. A general description of the present, past, and future activities of the process
4. The identity of constituents that are known to be present in each of the contributors.

## 2.1 PHYSICAL LAYOUT

The 244-AR Vault is located north of the Plutonium-Uranium Extraction (PUREX) Plant in the 200 East Area of the Hanford Site. The facility (Figure 2-1) comprises the following:

- Canyon building
- Wind reduction building
- Instrument building
- Closed-loop cooling equipment building
- Control room
- Crane control room
- Changehouse.

## 2.2 CONTRIBUTORS

There are currently two contributors to the 244-AR Vault Cooling Water wastestream as depicted in Figure 2-2. These discharges are:

- Heating, ventilation, and air conditioning (HVAC) system drainage.
- Compressor cooling water.

9 1 1 2 0 4 7 0 4 1 2

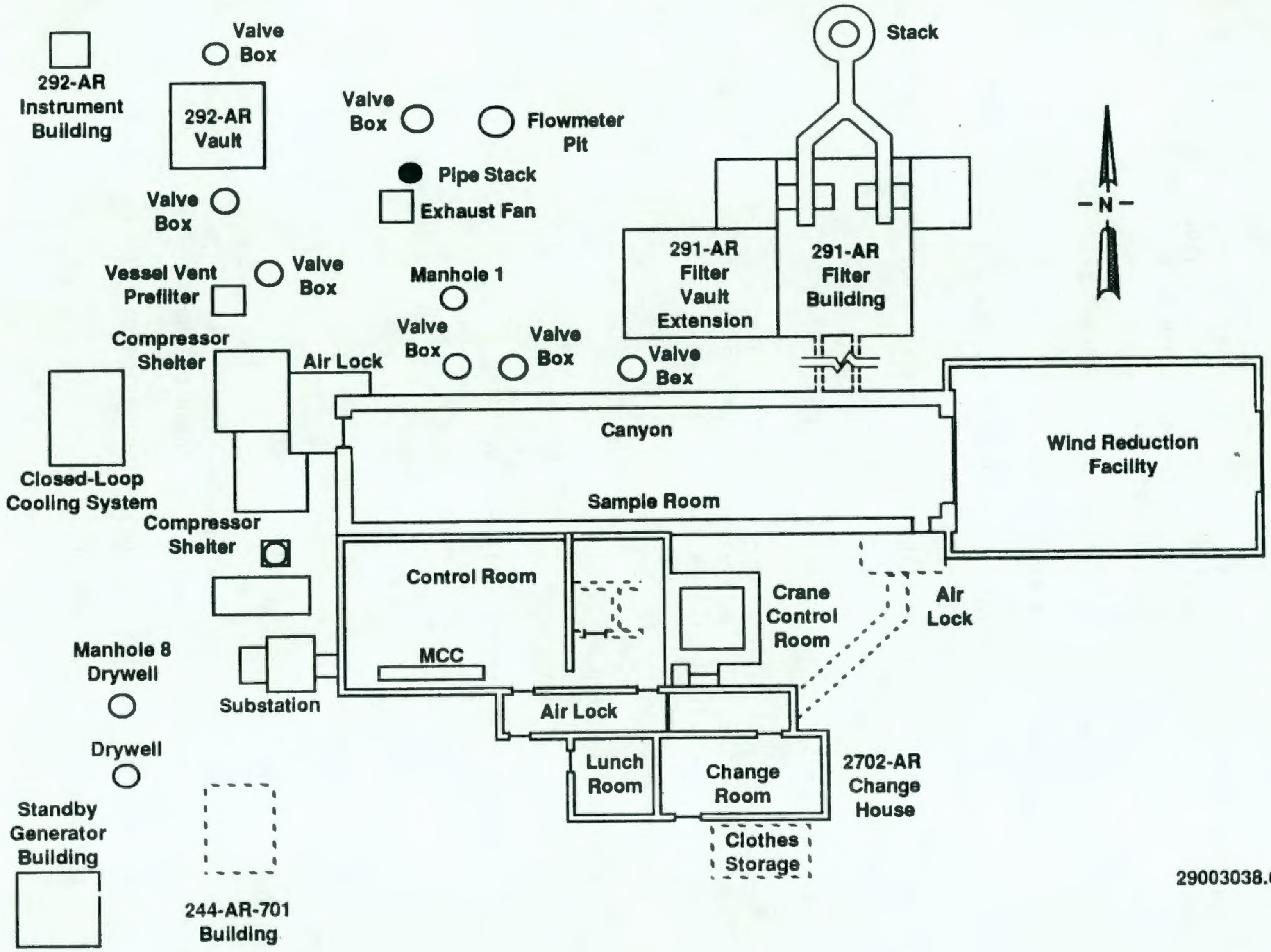
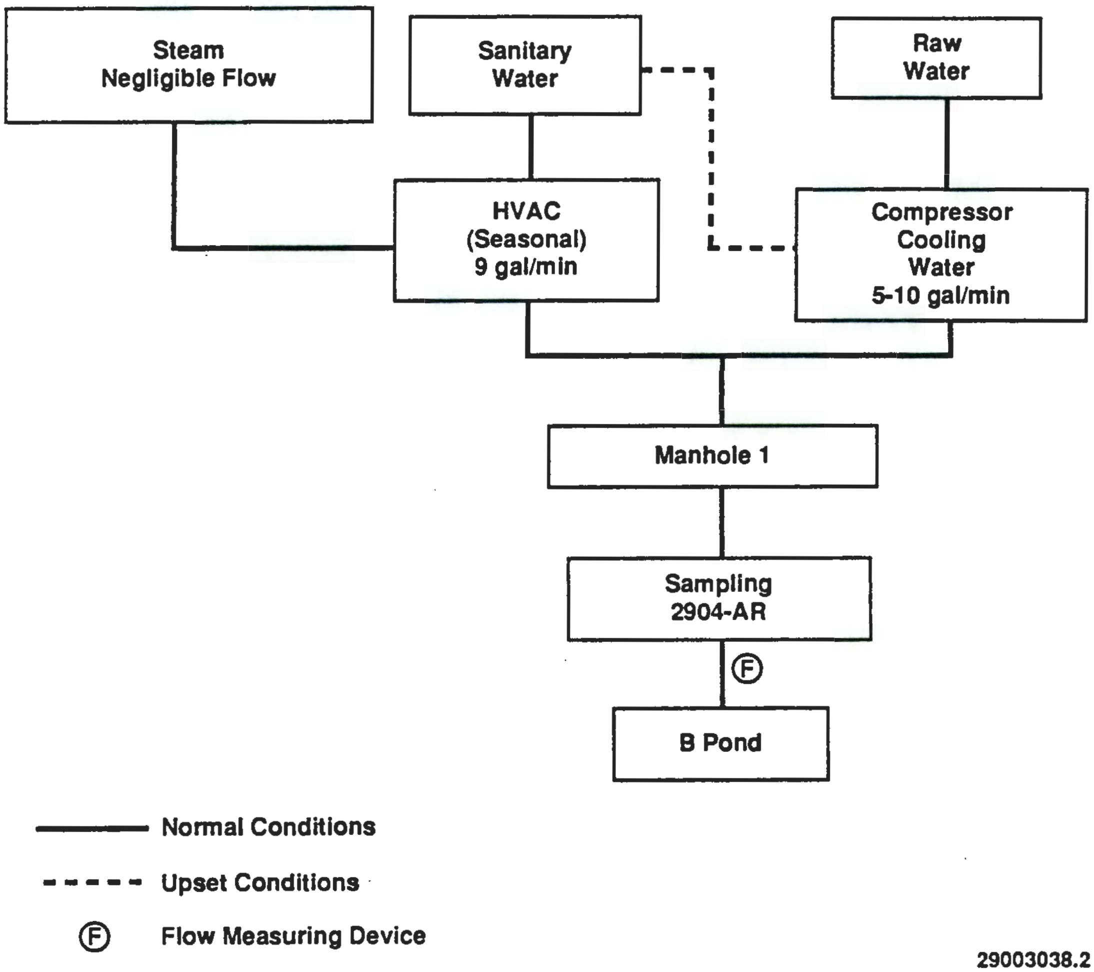



Figure 2-1. The 244-AR Vault Facility Layout.

Figure 2-2. Present 244-AR Vault Cooling Water Effluent Contributions Flow Diagram.



The total flowrate of the wastestream normally ranges from 5 to 45 gal/min. The HVAC contribution is seasonal and varies from negligible flow to 30 gal/min. The compressor cooling water contributes from 5 to 15 gal/min. The overall wastestream flowrate of 42 gal/min used in the stream deposition rates (Section 4.0) is based upon the average flowrate during the time the samples were taken for this report.

## 2.3 PROCESS DESCRIPTION

The 244-AR Vault is currently in standby with no operations in progress. A cooling water wastestream is currently required in order to maintain the facility for future use and meet current operational requirements. Ventilation required for the facility and compressed air for necessary instrumentation are particular operational requirements that must be met.

### 2.3.1 Present Activities

The current process configuration for the 244-AR Vault Cooling Water wastestream is depicted in Figure 2-2. The two major wastestream contributors, HVAC system drainage and compressor cooling water, flow to manhole 1 where they combine. This combined flow then is directed to the 216-B-3 Pond.

The sampling point for this wastestream was the 2904-AR Building, downstream of manhole 1. This sample point was chosen due to it being the first available sample point downstream of all contributors to the wastestream. No record sampler or radioactive material monitoring instruments are present in this wastestream. This is due to the inactive nature of the facility, and the fact that the wastestream is a closed system that has minimal potential for contamination.

A detailed description of the two major contributors is as follows:

**2.3.1.1 The HVAC System Drainage.** The 244-AR Vault HVAC System provides filtered and temperature controlled inlet air to the 244-AR Vault. The temperature control portion of the system is capable of heating or cooling the incoming air depending upon environmental conditions. The cooling portion of the HVAC system uses sanitary water to lower the temperature of the incoming air. The heating portion of the HVAC system uses steam to heat the incoming air.

The cooling portion of the HVAC system involves the use of sanitary water to cool the incoming air when the environmental conditions require. This heat transfer occurs in simple air-cooling water heat exchangers referred to as swamp coolers. The sanitary water is sprayed into the incoming air to reduce the temperature and remove particulates from the incoming air. The cooling water consists of sanitary water with the flowrate depending upon the extent of cooling required for the incoming air. The amount of cooling required is seasonal and varies with the local temperature. A flowrate of up to 9 gal/min can be obtained from this contributor.

The heating portion of the HVAC system involves the use of steam heat exchangers to heat the incoming air. When the air temperature decreases to 35 °F, the steam heaters start. Steam supplied from the 284-E Powerhouse circulates in pipes to heat the air that passes around them. The steam is in an enclosed system and is not exposed to the air. The steam condensate varies from a negligible flow to 2 gal/min depending upon the season.

Both contributors from the HVAC system to the 244-AR Vault cooling water wastestream come from the supply side of the ventilation system. This prevents a potential radiological contamination of the cooling water, as it is upstream of the point where the air contacts the contaminated portion of the facility. Periodic radiological surveys of the K-1 and K-2 inlet air systems are conducted in accordance with established procedures. This is a standard requirement that verifies no contamination is present at the inlet to the HVAC system.

**2.3.1.2 Compressor Cooling Water.** The wastestream effluent contributed from the compressor system is generated in a once-through system that cools the required compressors. These compressors supply the air used for various instrumentation located in the 244-AR Vault Facility. The cooling water removes the excess heat from the compressor block and the lubricating oil that services it. The flowrate from the system varies from 5 to 10 gal/min.

Raw water is normally utilized for the compressor cooling water. Sanitary water can be used in the compressors when raw water is not available. Raw water circulates through the block of the compressor and through a oil cooler. In both situations the cooling water is in a closed system that is not in direct contact with any contamination source. The possibility of contamination from the compressors is low, because the air and oil being cooled are not in direct contact with potential contamination sources.

### 2.3.2 Past Activities

The 244-AR Vault was originally used to process radioactive waste that was being removed ("sluiced") from storage tanks. The waste was eventually transferred to B Plant for removal of cesium and strontium. Since fiscal year 1985, upgrades have been made to 244-AR Vault systems. These enhancements (below) have reduced potential radioactive discharges.

1. Water and steam supplies to failed or leaking storage tank cooling and heating coils were blanked. Remaining coils were pressure tested and leaking coils were blanked. Cooling and heating coils were pressurized with process air at a pressure higher than the tank pressure. Should a leak occur in the coil, leakage would flow from inside the coil toward the liquid waste and prevent contamination of the cooling or heating liquid. The loss of process air would cause an alarm to annunciate in the control room and at the computer automated surveillance system (CASS).

2. The vessel vent steam heater system located outside of the canyon provides a positive pressure on steam coils relative to the tank pressure. Should a leak occur in the steam coils, pressure on the steam condensate would prevent aspiration of tank solution into the coil. As a result, steam condensate would remain nonradioactive.

3. The in-canyon vessel vent steam heater was removed, and a blank spool piece was installed.

4. Pressurizing systems are instrumented, monitored, and tied into the backup utility system. Alarms for the pressurizing system annunciate in the 244-AR Vault control room and the CASS.

5. Floor drains in the vicinity of the jet gang valves are blanked. Should jet gang valves leak or siphon, the contaminated effluents that could drip to the floor would not be a source to B Pond.

6. The condensate from inlet air systems (K-1 and K-2) is surveyed regularly in accordance with established procedures to ensure that steam condensate and water are not contaminated.

7. The liquid effluent sampler has been upgraded to include a detector failure alarm.

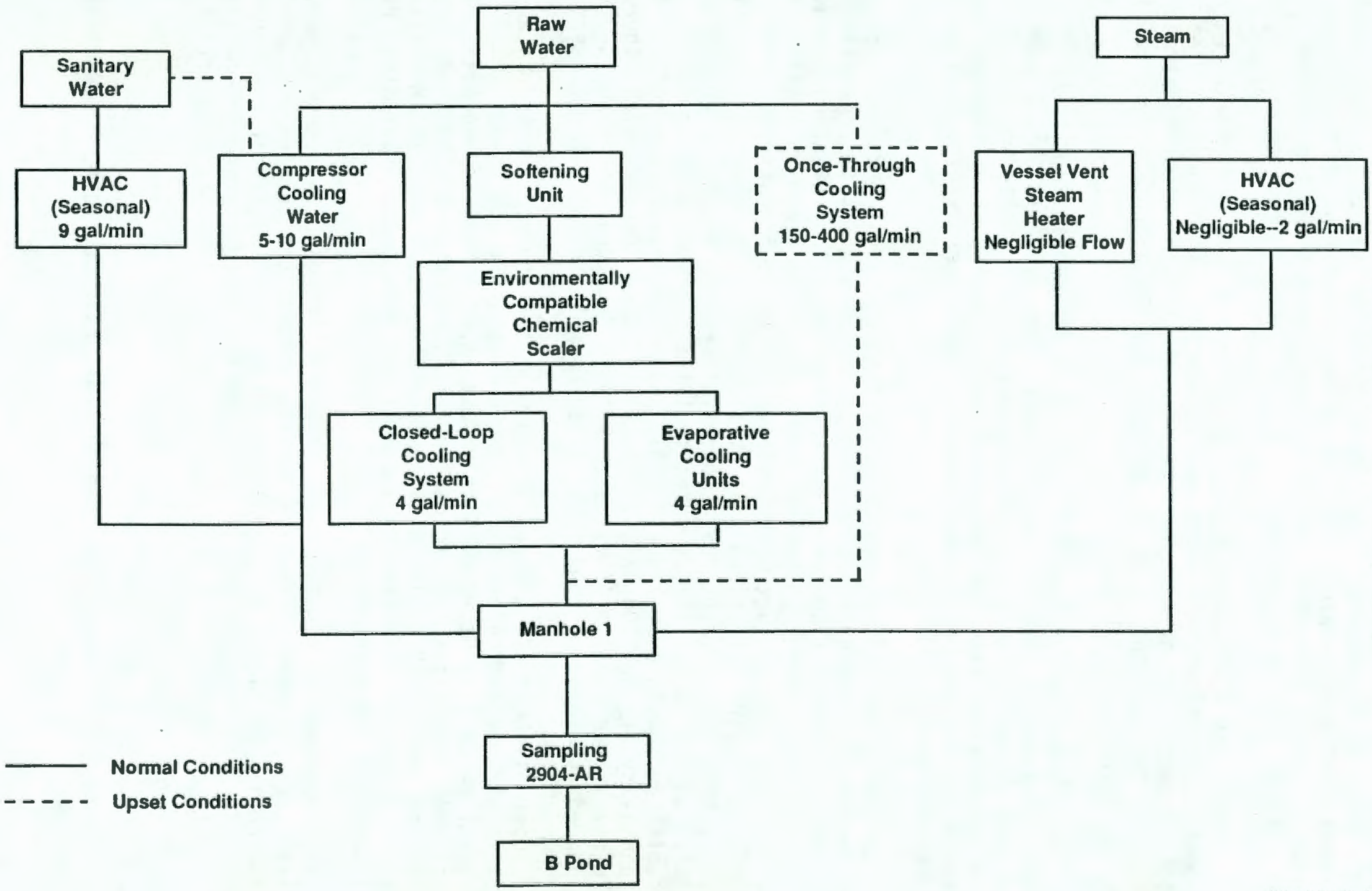
8. Preventive maintenance and plant operating procedures have been implemented to ensure the integrity of the barriers that prevent contamination of liquid effluents.

9. A closed-loop cooling system has been installed to take the place of the once-through cooling system. To date, this system has not been used.

### 2.3.3 Future Activities

Modifications to become a lag storage transfer facility for neutralized current acid waste (NCAW) are tentatively scheduled for completion in 1994. The NCAW will be pumped from aging-waste tanks in the tank farms to the 244-AR Vault. The waste will be stored in the vault in tanks (TK)-001 and -002 until B Plant is ready to receive the waste. The NCAW must be cooled to at least 50 °C in the 244-AR Vault before transfer to B Plant. A closed-loop cooling system is provided to cool waste in all tanks at the 244-AR Vault. B Plant will then separate the NCAW into transuranic (TRU) and non-TRU wastestreams.

Several new contributors to the 244-AR Vault Cooling Water wastestream are proposed as part of these modifications (see Figure 2-3). These contributors will include a bleedoff from the closed-loop cooling system, steam condensate from the vessel vent steam heaters, and bleedoff from evaporative cooling units. A detailed description of these proposed contributors is as follows.




29003038.4

Figure 2-3. Future 244-AR Vault Cooling Water Effluent Contributions Flow Diagram.

**2.3.3.1 Closed-Loop Cooling Water System Bleedoff.** The closed-loop cooling system provides safe cooling of high-level radioactive waste in the 244-AR Vault storage tanks. The closed-loop cooling system will provide for the removal of approximately 1.9 M Btu/h heat load from TK-001, -002, -003, and -004. Should the normal system become inoperative, a once-through cooling capability would be used.

This system will use softened raw water and have a chemical (currently unknown) added to maintain water quality longer. This additive will be an effluent constituent at manhole 1 because of the continuous 4-gal/min bleedoff. The selected chemical additive and the amount to be used will be environmentally compatible.

Also, there is the possibility of an upset condition with the closed-loop cooling system when the 244-AR Vault opens. Should this happen, the once-through cooling system would take over. This system would deliver 150 to 400 gal/min raw water to the 244-AR Vault Cooling Water wastestream, depending on the number of tanks in use. The process will add no chemicals to the raw water.

**2.3.3.2 Vessel Vent Steam Heater Steam Condensate.** The 244-AR Vault vessel vent system is designed to maintain a vacuum within the four process vessels by removing and filtering contaminated offgases. To prevent condensation on the filters, the offgas is heated with steam. The steam is enclosed and does not come into contact with the gas. Heater condensate is routed to manhole 1. Future operations will utilize the existing vessel vent steam heater system, which maintains a positive pressure in the steam system relative to the tank. This ensures that the steam condensate is not contaminated should a leak occur. All steam condensates are monitored for radioactivity at the 2904-AR Building after being combined with other liquid effluents in manhole 1. If radioactivity is detected, the flow is diverted and pumped to a holding pond; otherwise, uncontaminated water flows to B Pond.

Super Filmeen* 14 is added to steam at the power plant and is a potential constituent in steam condensate. However, this product is not an EPA hazardous waste (see Material Safety Data Sheet [MSDS] in Appendix A-1) and the flow is negligible. A proposed project, to be completed before the startup of the 244-AR Vault, will replace the vessel vent steam heater with an electric heater. If this is accomplished, the vessel vent steam heater will not be a contributor.

**2.3.3.3 Evaporative Cooling Units Bleedoff.** Cooling towers will provide greater than 1.9 M Btu/h cooling for the closed-loop cooling system. Evaporation cools the closed-loop cooling system coils located in the cooling tower. This evaporation slowly increases the concentration of constituents in cooling tower fluid. A 4-gal/min bleedoff will maintain an acceptable constituent concentration in the cooling tower water.

*Filmeen is a registered trademark of Grace Dearborn, Hackettstown, New Jersey.

Softened raw water will replace bleedoff evaporated fluids. A scale-preventive chemical may be added to the cooling tower water to maintain acceptable water chemistry. If added, it will be included as a constituent of the effluent flowing to the 216-B-3 Pond via manhole 1. The chemical to be added has not yet been identified, but it will be environmentally compatible.

## 2.4 PROCESS DATA

The cooling processes used in the HVAC system and compressors do not introduce chemicals to the 244-AR Vault Cooling Water effluent. The once-through operation requires no chemical treatment and is isolated from other fluids. Chemicals expected to be detected in the cooling water stream are those present in raw water, sanitary water, and condensed steam. Some chemicals are expected to be present due to slight corrosion of process piping.

The sanitary water used is expected to contribute calcium hypochlorite and aluminum sulfate ("alum"). Chemical concentrations in sanitary water are maintained at prescribed levels. Alum is added at 5 wt% as a flocculating agent, much of which is filtered out. Chlorine is maintained at 1.5 ppm.

The small amount of steam condensate contributed by the HVAC system potentially contains Super Filmeen 14, which is added to steam at the power plant. This product's not an EPA hazardous waste, according to it's MSDS (Appendix A). Chemicals expected to be detected in the cooling water stream are those present in raw and sanitary water and those that might be contributed by slight corrosion of process piping.

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# 3.0 SAMPLE DATA

This section is intended to characterize the wastestream by presenting chemical and radioactive analytical results from samples taken over time. The discussion identifies the source of the sampling (Section 3.1) and addresses data presentation (Section 3.2).

## 3.1 DATA SOURCE

The chemical data utilized in this report were obtained from four samples taken during the October 13, 1989 to February 16, 1990 time frame. The chemical data samples were taken from the 2904-AR Building downstream of manhole 1. These random samples were taken on October 13, 1989, October 17, 1989, October 24, 1989 and February 16, 1990. The analysis of the samples was performed at the U.S. Testing Laboratory in Richland, Washington. Appendix A presents a complete listing of the analysis performed and the data obtained from these sampling efforts. The EPA sampling and analytical protocols were followed in obtaining this chemical data about the steam condensate.

Chemical data are also in existence for sampling conducted between June 24, 1986 and March 5, 1987. The data from the earlier time frame are not utilized for the designation purposes of this report. Both sets of data are presented in Appendix C in a combined tabular form for completeness of the report.

Process control sampling data are also available for the period from 1976 to 1988. The analysis of these samples was performed at the 222-S Laboratory and was intended for process control rather than environmental sampling. The designation process utilized in this report does not include the 222-S data. The process control data were previously presented in WHC-EP-0287, *Waste Stream Characterization Report* and is referenced here for completeness of this report.

## 3.2 DATA PRESENTATION

A total of nineteen chemical analytes were detected in quantities greater than the minimum detectable concentrations as presented in Table 3-1. Additional analytes presented include alkalinity, alpha activity, beta activity, conductivity, ignitability, pH, reactivity cyanide, reactivity sulfide, total dissolved solids, temperature, total organic carbon, total organic halides, $^{60}Co$, $^{90}Sr$, $^{234}U$, and $^{238}U$.

Table 3-1 is organized to provide for each analyte the mean concentration, standard error, 90% Confidence Interval, and maximum concentration encountered in any of the samples.

Table 3-1. Statistics for 244-AR Vault Cooling Water. (sheet 1 of 2)

| Constituent | N | MDA | Method | Mean | StdErr | 90%CILim | Maximum |
|---|---|---|---|---|---|---|---|
| Arsenic (EP Toxic) | 4 | 4 | n/a | <5.00E+02 | 0.00E+00 | <5.00E+02 | <5.00E+02 |
| Barium | 4 | 0 | n/a | 3.17E+01 | 1.55E+00 | 3.43E+01 | 3.60E+01 |
| Barium (EP Toxic) | 4 | 4 | n/a | <1.00E+03 | 0.00E+00 | <1.00E+03 | <1.00E+03 |
| Boron | 3 | 1 | DL | 1.30E+01 | 1.53E+00 | 1.59E+01 | 1.50E+01 |
| Cadmium (EP Toxic) | 4 | 4 | n/a | <1.00E+02 | 0.00E+00 | <1.00E+02 | <1.00E+02 |
| Calcium | 4 | 0 | n/a | 1.86E+04 | 2.78E+02 | 1.90E+04 | 1.92E+04 |
| Chloride | 4 | 0 | n/a | 1.02E+03 | 6.29E+01 | 1.13E+03 | 1.20E+03 |
| Chromium (EP Toxic) | 4 | 4 | n/a | <5.00E+02 | 0.00E+00 | <5.00E+02 | <5.00E+02 |
| Copper | 4 | 3 | DL | 8.28E+01 | 7.27E+01 | 2.02E+02 | 3.01E+02 |
| Fluoride | 4 | 0 | n/a | 1.54E+02 | 1.00E+01 | 1.71E+02 | 1.75E+02 |
| Iron | 4 | 0 | n/a | 2.15E+02 | 1.49E+02 | 4.59E+02 | 6.58E+02 |
| Lead (EP Toxic) | 4 | 4 | n/a | <5.00E+02 | 0.00E+00 | <5.00E+02 | <5.00E+02 |
| Magnesium | 4 | 0 | n/a | 4.15E+03 | 4.21E+01 | 4.22E+03 | 4.23E+03 |
| Manganese | 4 | 3 | DL | 9.50E+00 | 4.50E+00 | 1.69E+01 | 2.30E+01 |
| Mercury (EP Toxic) | 4 | 4 | n/a | <2.00E+01 | 0.00E+00 | <2.00E+01 | <2.00E+01 |
| Nitrate | 4 | 2 | DL | 5.50E+02 | 2.89E+01 | 5.97E+02 | 6.00E+02 |
| Potassium | 4 | 0 | n/a | 7.58E+02 | 1.53E+01 | 7.83E+02 | 8.00E+02 |
| Selenium (EP Toxic) | 4 | 4 | n/a | <5.00E+02 | 0.00E+00 | <5.00E+02 | <5.00E+02 |
| Silicon | 4 | 0 | n/a | 2.41E+03 | 5.05E+01 | 2.49E+03 | 2.55E+03 |
| Silver (EP Toxic) | 4 | 4 | n/a | <5.00E+02 | 0.00E+00 | <5.00E+02 | <5.00E+02 |
| Sodium | 4 | 0 | n/a | 2.18E+03 | 5.05E+01 | 2.26E+03 | 2.24E+03 |
| Strontium | 4 | 0 | n/a | 9.72E+01 | 3.88E+00 | 1.04E+02 | 1.05E+02 |
| Sulfate | 4 | 0 | n/a | 1.04E+04 | 1.75E+02 | 1.07E+04 | 1.08E+04 |
| Uranium | 3 | 0 | n/a | 5.54E-01 | 2.73E-02 | 6.05E-01 | 5.98E-01 |
| Zinc | 4 | 0 | n/a | 1.65E+01 | 1.02E+01 | 3.32E+01 | 4.70E+01 |
| Ammonia | 4 | 1 | DL | 5.67E+01 | 4.87E+00 | 6.47E+01 | 7.10E+01 |
| 1-Butanol | 1 | 0 | n/a | 5.00E+00 | n/a | n/a | 5.00E+00 |
| Alkalinity (Method B) | 4 | 0 | n/a | 5.85E+04 | 2.89E+02 | 5.90E+04 | 5.90E+04 |
| Alpha Activity (pCi/L) | 3 | 1 | DL | 6.75E-01 | 2.32E-01 | 1.11E+00 | 1.02E+00 |
| Conductivity (µS) | 4 | 0 | n/a | 1.36E+02 | 9.28E+00 | 1.51E+02 | 1.60E+02 |
| Ignitability (°F) | 4 | 0 | n/a | 2.10E+02 | 5.00E-01 | 2.10E+02 | 2.10E+02 |
| pH (dimensionless) | 4 | 0 | n/a | 7.64E+00 | 3.75E-01 | 8.26E+00 | 8.40E+00 |
| Reactivity Cyanide (mg/kg) | 4 | 4 | n/a | <1.00E+02 | 0.00E+00 | <1.00E+02 | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 4 | 4 | n/a | <1.00E+02 | 0.00E+00 | <1.00E+02 | <1.00E+02 |
| TDS | 4 | 0 | n/a | 6.57E+04 | 3.54E+03 | 7.16E+04 | 7.10E+04 |
| Temperature (°C) | 4 | 0 | n/a | 1.87E+01 | 1.52E+00 | 2.12E+01 | 2.26E+01 |
| Total Carbon | 4 | 0 | n/a | 1.58E+04 | 1.65E+02 | 1.60E+04 | 1.60E+04 |
| TOX (as Cl) | 4 | 3 | DL | 7.75E+00 | 1.03E+00 | 9.44E+00 | 1.00E+01 |
| $^{60}$C (pCi/L) | 3 | 2 | DL | 6.60E-01 | 4.68E-01 | 1.54E+00 | 1.59E+00 |
| $^{129}$I (pCi/L) | 1 | 0 | n/a | 9.08E-02 | n/a | n/a | 9.08E-02 |
| $^{239,240}$Pu (pCi/L) | 2 | 0 | n/a | 7.57E-03 | 4.40E-04 | 8.92E-03 | 8.01E-03 |
| Radium Total (pCi/L) | 3 | 1 | DL | 1.67E-01 | 2.70E-02 | 2.18E-01 | 2.08E-01 |
| $^{106}$Ru (pCi/L) | 2 | 1 | DL | 3.06E+00 | 2.00E+00 | 9.24E+00 | 5.07E+00 |
| $^{90}$Sr (pCi/L) | 3 | 1 | DL | 1.75E-01 | 6.44E-02 | 2.96E-01 | 2.70E-01 |
| $^{234}$U (pCi/L) | 3 | 0 | n/a | 2.21E-01 | 1.99E-02 | 2.59E-01 | 2.61E-01 |
| $^{238}$U (pCi/L) | 3 | 0 | n/a | 1.66E-01 | 8.57E-03 | 1.82E-01 | 1.82E-01 |

Table 3-1. Statistics for 244-AR Vault Cooling Water. (sheet 2 of 2)

NOTES:

Mean values, standard errors, confidence interval limits and maxima are in ppb (parts per billion) unless indicated otherwise.

The column headed MDA (Minimum Detectable Amount) is the number of results in each data set below the detection limit.

The column headed Method shows the MDA replacement method used: replacement by the detection limit (DL), replacement of single-valued MDAs by the log-normal plotting position method (LM), or replacement of multiple valued MDAs by the normal plotting position method (MR).

The column headed "90%CILim" (90% Confidence Interval Limit) is the lower limit of the one-tailed 90% confidence interval for all ignitability data sets and pH data sets with mean values below 7.25. For all other data sets it is the upper limit of the one-tailed 90% confidence interval.

The column headed "Maximum" is the minimum value in the data set for ignitability, the value furthest from 7.25 for pH, and the maximum value for all other analytes.

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# 4.0 DATA OVERVIEW

The purpose of this section is to compare the characterization data obtained through both process knowledge and sampling of the wastestream. This section will also provide an estimate of the stream loadings based on radionuclide and chemical constituents.

## 4.1 DATA COMPARISON

Process knowledge indicates that the steam condensate effluent should be similar to the raw water and sanitary water compositions because no chemicals are added to the stream. The 200 East Area raw water and sanitary water data are presented in Appendix B. To confirm this, the sample data results were compared with the raw water background data mean.

To perform an adequate comparison, a ratio of the wastestream mean concentration and the raw water mean concentration has been utilized to determine analytes of interest. This comparison of the wastestream to the raw water is presented in Table 4-1. Two of the analytes, copper and iron, were shown to be present in concentrations significantly above that found in the background mean data.

The definite increases in some of the metallic analytes is explained by corrosion of the piping system. Carbon steels, composed mainly of iron, has been shown to contain up to 0.4% copper (Jastrzebski 1976).

Table 4-2 presents a comparison of average constituent concentrations to various screening criteria. These criteria are not used here for compliance purposes.

## 4.2 STREAM DEPOSITION RATES

Table 4-3 has been included to provide deposition rates using the average data from Table 3-2 adjusted according to flow data from Section 2.0.

Table 4-1. Comparison of Chemical Sample Data to the 200 East Area Raw Water (ppb unless otherwise stated; ratios are dimensionless).

| Analyte | Sample average | Raw water average | Ratio (sample/raw water) |
|---|---|---|---|
| Barium | 31.7 | 28 | 1.13 |
| Boron | 13.0 | - | - |
| Calcium | 18,600 | 18,400 | 1.01 |
| Chloride | 1,020 | 871 | 1.17 |
| Copper | 82.8 | 10.6 | 7.81 |
| Fluoride | 154 | - | - |
| Iron | 215 | 63.6 | 3.38 |
| Magnesium | 4,150 | 4,190 | 0.99 |
| Manganese | 9.5 | 9.8 | 0.97 |
| Nitrate | 550 | 996 | 0.55 |
| Potassium | 758 | 795 | 0.99 |
| Silicon | 2,410 | - | - |
| Sodium | 2,180 | 2,260 | 0.96 |
| Strontium | 97.2 | - | - |
| Sulfate | 10,400 | 10,600 | 0.98 |
| Uranium | 0.554 | 0.726 | 0.76 |
| Zinc | 16.5 | 20.0 | 0.83 |
| Ammonia | 56.7 | - | - |
| 1-butanol | 5.00 | - | - |
| pH | 7.64 | 7.41 | 1.03 |
| Total Carbon(μg/g) | 15,800 | - | - |
| TOX(μg Cl/L) | 7.75 | - | - |
| Radionuclides(pCi/L) | | | |
| Alpha Activity | 0.675 | 0.885 | 0.76 |
| Co-60 | 0.66 | - | - |
| I-129 | 0.0908 | - | - |
| Pu-239/240 | 0.00767 | - | - |
| Radium Total | 0.167 | - | - |
| Ru-106 | 3.06 | - | - |
| Sr-90 | 0.175 | - | - |
| U-234 | 0.221 | - | - |
| U-238 | 0.166 | - | - |

Table 4-2. Evaluation of 244-AR Vault Cooling Water.

| Constituent | Result[a] | SV1[b] | SV2[c] |
|---|---|---|---|
| Barium | 3.2E-02 | 5.0E+00 g | |
| Chloride | 1.0E+00 | 2.5E+02 h | |
| Copper | 8.3E-02 | 1.0E+00 h | |
| Fluoride | 1.5E-01 | 2.0E+00 g | |
| Iron | 2.1E-01 | 3.0E-01 h | |
| Manganese | 9.5E-03 | 5.0E-02 h | |
| Nitrate | 5.5E-01 | 4.5E+01 e | |
| Sulfate | 1.0E+01 | 2.5E+02 h | |
| Zinc | 1.7E-02 | 5.0E+00 h | |
| Alpha Activity (pCi/L)[d] | 6.8E-01 | 1.5E+01 g | 3.0E+01 |
| $^{60}$Co (pCi/L) | 6.6E-01 | 2.0E+02 e | 5.0E+03 |
| $^{129}$I (pCi/L) | 9.1E-02 | 1.0E+02 e | 5.0E+02 |
| $^{239,240}$Pu (pCi/L)[e] | 7.6E-03 | 4.0E+01 e | 3.0E+01 |
| $^{106}$Ru (pCi/L) | 3.1E+00 | 3.0E+02 e | 6.0E+03 |
| $^{90}$Sr (pCi/L) | 1.7E-01 | 5.0E+01 e | 1.0E+03 |
| $^{234}$U (pCi/L) | 2.2E-01 | | 5.0E+02 |
| $^{238}$U (pCi/L) | 1.7E-01 | | 6.0E+02 |
| TDS | 6.6E+01 | 5.0E+02 h | |

[a]Units of results are mg/L unless indicated otherwise. The results are the mean values reported in the Statistics table of Section 3.0.

[b]Screening Value 1 (SV1) lists the value first, basis second and an asterisk (*) third if the result exceeds the regulatory value. The basis is the proposed primary MCL (e), the proposed secondary MCL (f), the primary MCL (g), or the secondary MCL (h). The value is the smaller of two MCLs: the proposed primary MCL (or the primary MCL as a default) or the proposed secondary MCL (or the secondary MCL as a default). See WHC-EP-0342, "Hanford Site Stream-Specific Reports", August 1990.

[c]Screening Value 2 (SV2) lists the value first and an asterisk (*) second if the result exceeds the SV2). These values are derived concentration guides obtained from Appendix A of WHC-CM-7-5, "Environmental Compliance Manual", Revision 1, January 1990.

[d]The SV1 value for $^{239}$Pu is used to evaluate $^{239,240}$Pu.

[e]The SV1 and SV2 values for Gross Alpha are used to evaluate Alpha Activity.

Table 4-3. Deposition Rate for 244-AR Vault Cooling Water.

| Constituent | Kg/L* | Kg/mo* |
|---|---|---|
| Barium | 3.17E-08 | 2.33E-01 |
| Boron | 1.30E-08 | 9.54E-02 |
| Calcium | 1.86E-05 | 1.36E+02 |
| Chloride | 1.02E-06 | 7.48E+00 |
| Copper | 8.28E-08 | 6.08E-01 |
| Fluoride | 1.54E-07 | 1.13E+00 |
| Iron | 2.15E-07 | 1.58E+00 |
| Magnesium | 4.15E-06 | 3.04E+01 |
| Manganese | 9.50E-09 | 6.97E-02 |
| Nitrate | 5.50E-07 | 4.04E+00 |
| Potassium | 7.58E-07 | 5.56E+00 |
| Silicon | 2.41E-06 | 1.77E+01 |
| Sodium | 2.18E-06 | 1.60E+01 |
| Strontium | 9.72E-08 | 7.13E-01 |
| Sulfate | 1.04E-05 | 7.63E+01 |
| Uranium | 5.54E-10 | 4.06E-03 |
| Zinc | 1.65E-08 | 1.21E-01 |
| Ammonia | 5.67E-08 | 4.16E-01 |
| 1-Butanol | 5.00E-09 | 3.67E-02 |
| Alpha Activity * | 6.75E-13 | 4.95E-06 |
| TDS | 6.57E-05 | 4.82E+02 |
| Total Carbon | 1.58E-05 | 1.16E+02 |
| TOX (as Cl) | 7.75E-09 | 5.69E-02 |
| $^{60}Co$ * | 6.60E-13 | 4.84E-06 |
| $^{129}I$ * | 9.08E-14 | 6.66E-07 |
| $^{239,240}Pu$ * | 7.57E-15 | 5.55E-08 |
| Radium Total * | 1.67E-13 | 1.23E-06 |
| $^{106}Ru$ * | 3.06E-12 | 2.25E-05 |
| $^{90}Sr$ * | 1.75E-13 | 1.28E-06 |
| $^{234}U$ * | 2.21E-13 | 1.62E-06 |
| $^{238}U$ * | 1.66E-13 | 1.22E-06 |

NOTES:

Data collected from October 1989 through March 1990.

Flow rate is the average of rates from Section 2.0.

Constituent concentrations are average values from the Statistics Report in Section 3.0.

Concentration units of flagged (*) constituents are reported as curies per liter.

Deposition rate units of flagged (*) constituents are reported as curies per month.

# 5.0 DESIGNATION

The purpose of this section is to utilize process knowledge and sampling data to propose a designation of the wastestream in accordance with the requirements of the Dangerous Waste Regulations (WAC 173-303).

The evaluation of the 244-AR Vault Cooling Water wastestream performed to compose this report indicates that the wastestream should not be designated as a dangerous waste. This proposed designation uses data from both the process knowledge and sampling data (Sections 2.0 through 4.0) and complies with the designation requirements of WAC 173-303-070 (Ecology 1989).

- Dangerous Waste Lists (WAC 173-303-080)
- Dangerous Waste Criteria (WAC 173-303-100)
- Dangerous Waste Characteristics (WAC 173-303-090).

The proposed designation is based upon the sample data collected between October 13, 1989 to February 16, 1990. The designation strategy is shown in Figure 5-1.

## 5.1 DANGEROUS WASTE LISTS

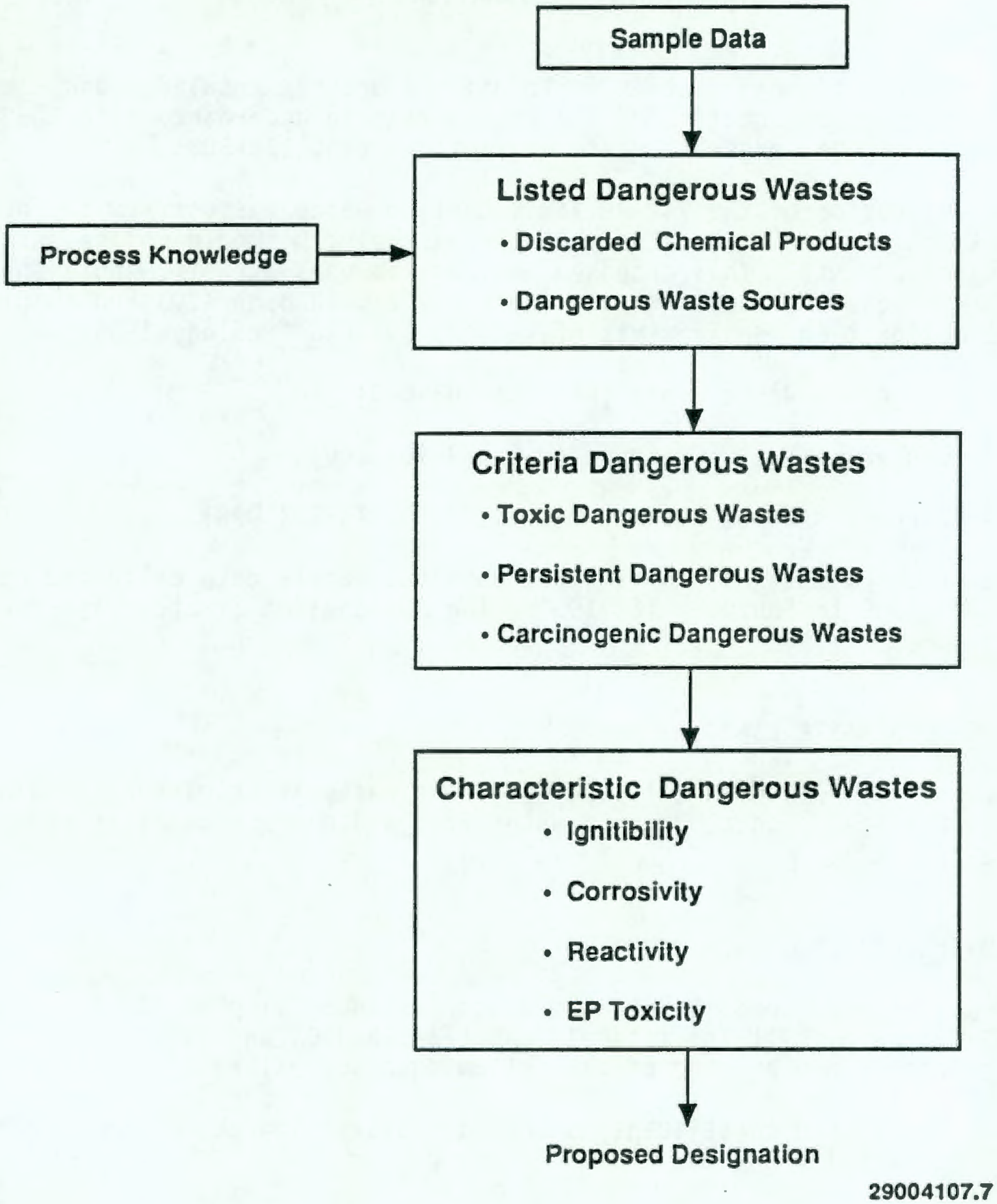
A waste is considered a listed dangerous waste if it either contains a discarded chemical product or originates from a dangerous waste source (WAC 173-303-082).

### 5.1.1 Discarded Chemical Products

A wastestream constituent is a discarded chemical product (WAC 173-303-081) if it is listed in WAC 173-303-9903 and is characterized by one or more of the following descriptions.

- The listed constituent is the sole active ingredient in a commercial chemical.
- The constituent results from a spill of unused commercial chemical products. (A spill of a discarded chemical product would cause a wastestream to be designated during the time that the discharge is occurring. The approach taken is that the current wastestream would not be designated unless a review of past spill events indicates that the spills are predictable, systematic events that are ongoing or are reasonably anticipated to occur in the future. In this report, the evaluation of this criterion is based on a review of spill data reported in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).)

Figure 5-1. Designation Strategy.



- The constituent is discarded in the form of a residue resulting from cleanup of a spill of an unused chemical on the discarded chemical products list. (A chemical product that is used in a process and then released to the wastestream is not a discarded chemical product. Off-specification, unused chemicals, and chemicals that have exceeded a shelf life but have not been used are considered discarded chemical products.)

### 5.1.2 Dangerous Waste Sources

A list of dangerous waste sources is contained in WAC 173-303-9904, pursuant to WAC 173-303-082. There are three major categories of sources in WAC 173-303-9904. The first is nonspecific sources from routine operations occurring at many industries. The second is specific sources (e.g., wastes from ink formulation, etc.). The third is state sources, which is limited to PCB-contaminated transformers and capacitors resulting from salvaging, rebuilding, or discarding activities.

## 5.2 LISTED WASTE DATA CONSIDERATIONS

The proposed designation of the wastestream described in this report is based on an evaluation of process and sampling data. The following sections describe the types of information used in this designation.

### 5.2.1 Process Evaluation

The process evaluation begins with a thorough review of the processes contributing to the wastestream. Processes must be reviewed and compared with the discarded chemical products list and the dangerous waste source list. This process evaluation is necessary because the stream is a listed waste, in accordance with the mixture rule, if a listed waste is known to have been added at any upstream location, even though a listed constituent cannot be detected at the sample point. The process evaluation typically includes a review of the following information sources:

- MSDSs
- Superfund Amendments and Reauthorization Act (SARA) Title III Inventory reports
- Operating procedures
- Process chemical inventories
- Physical inspections, where possible.

If a listed chemical is identified, the specific use of the chemical is evaluated to determine if such use results in the generation of a listed waste.

### 5.2.2 Sampling Data

Sampling data are used as screening tools to enhance and support the results of the process evaluation. This step compares the results of the sampling data to the WAC 173-303-9903 and 9904 lists. If a constituent is cited on one or both of these lists, an engineering evaluation is performed to determine if the constituent has entered the wastestream as a discarded chemical product or comes from a dangerous waste source.

Screening organic constituents is a relatively simple procedure because analytical data for organic constituents are reported as substances and easily are compared to the WAC 173-303-9903 and -9904 lists. It is not as simple to screen inorganic analytical data because inorganic data are reported as ions or elements rather than as chemical substances. For example, an analysis may show that a wastestream contains the cations sodium and calcium along with the anions chloride and nitrate. The possible combinations of substances include: sodium chloride, sodium nitrate, calcium chloride, and calcium nitrate. In a situation with many cations and anions, however, the list of possible combinations is extensive.

A procedure was developed for combining the inorganic constituents into substances. This screening procedure is intended to be a tool in the evaluation of a wastestream. The listing of the inorganic substances developed by this screening procedure is not intended to be an indication that the substance was discharged to the wastestream, only that the necessary cations and anions are present and an investigation should be conducted to determine how they entered the wastestream.

Table 5-1 documents how ion analytes from the sample data were assigned to neutral substances that are required for designation. The table accounts for charge balancing the ion assemblage from Table 3-2 and the subsequent formulation of neutral substances. A detailed discussion can be found in WHC (1990). Table 5-2 summarizes designation data for the 244-AR Vault Cooling Water stream.

## 5.3 PROPOSED LISTED WASTE DESIGNATION

A process evaluation, along with a review of sampling data, indicates that the 244-AR Vault Cooling Water stream does not contain a discarded chemical product or a listed waste source. The following sections discuss the evaluation that was conducted to substantiate this conclusion.

### 5.3.1 Discarded Chemical Products

As discussed in Section 5.2, a process evaluation of the contributors to the 244-AR Vault Cooling Water was conducted. This evaluation included a review of MSDSs at the plant and chemical inventories compiled for compliance with the SARA Title III requirements for possible listed waste contributors.

Table 5-1. Inorganic Chemistry for 244-AR Vault Cooling Water.
(sheet 1 of 2)

| Constituent | ppb | Ion | Eq/g | Normalized |
|---|---|---|---|---|
| Charge normalization: | | | | |
| Barium | 3.43E+01 | Ba+2 | 4.99E-10 | |
| Boron | 1.59E+01 | B407-2 | 7.35E-10 | 2.35E-09 |
| Calcium | 1.90E+04 | Ca+2 | 9.50E-07 | |
| Chloride | 1.13E+03 | Cl-1 | 3.18E-08 | 1.02E-07 |
| Copper | 2.02E+02 | Cu+2 | 6.36E-09 | |
| Fluoride | 1.71E+02 | F-1 | 8.98E-09 | 2.88E-08 |
| Iron | 4.59E+02 | Fe+3 | 2.47E-08 | |
| Magnesium | 4.22E+03 | Mg+2 | 3.47E-07 | |
| Manganese | 1.69E+01 | Mn+2 | 6.14E-10 | |
| Nitrate | 5.97E+02 | NO3-1 | 9.63E-09 | 3.09E-08 |
| Potassium | 7.83E+02 | K+1 | 2.00E-08 | |
| Silicon | 2.49E+03 | SiO3-2 | 1.78E-07 | 5.69E-07 |
| Sodium | 2.26E+03 | Na+1 | 9.84E-08 | |
| Strontium | 1.04E+02 | Sr+2 | 2.36E-09 | |
| Sulfate | 1.07E+04 | SO4-2 | 2.22E-07 | 7.12E-07 |
| Uranium | 6.05E-01 | UO2+2 | 5.08E-12 | |
| Zinc | 3.32E+01 | Zn+2 | 1.01E-09 | |
| Hydrogen Ion (from pH 8.3) | | H+ | (5.50E-12) | |
| Hydroxide Ion (from pH) | | OH- | (1.82E-09) | |
| Cation total | | | 1.45E-06 | |
| Anion total | | | 4.53E-07 | |
| Anion normalization factor: | 3.206 | | | |

Substance Formation:

| Substance | % | Cation Out | Anion Out |
|---|---|---|---|
| Copper(II) chloride | 4.27E-05 | 0.00E+00 | 9.57E-08 |
| Uranyl nitrate | 1.00E-07 | 0.00E+00 | 3.09E-08 |
| Iron(III) fluoride | 9.28E-05 | 0.00E+00 | 4.12E-09 |
| Potassium fluoride | 2.40E-05 | 1.59E-08 | 0.00E+00 |
| Barium chloride | 5.20E-06 | 0.00E+00 | 9.52E-08 |
| Zinc nitrate | 9.61E-06 | 0.00E+00 | 2.99E-08 |
| Magnesium chloride | 4.53E-04 | 2.52E-07 | 0.00E+00 |
| Magnesium nitrate | 2.35E-04 | 2.22E-07 | 0.00E+00 |
| Calcium tetraborate | 2.30E-05 | 9.47E-07 | 0.00E+00 |
| Magnesium sulfate | 1.34E-03 | 0.00E+00 | 4.90E-07 |
| Sodium metasilicate | 6.01E-04 | 0.00E+00 | 4.71E-07 |
| Potassium metasilicate | 1.23E-04 | 0.00E+00 | 4.55E-07 |
| Manganese(II) metasilicate | 4.02E-06 | 0.00E+00 | 4.54E-07 |
| Strontium sulfate | 2.17E-05 | 0.00E+00 | 4.87E-07 |
| Calcium sulfate | 3.32E-03 | 4.60E-07 | 0.00E+00 |

Table 5-1. Inorganic Chemistry for 244-AR Vault Cooling Water.
(sheet 2 of 2)

NOTES:

Statistics based on a single datum are noted by an asterisk (*). With the exception of hydrogen ion and hydroxide, others report the upper limit of the one-tailed 90% confidence interval.

Hydrogen ion is based on the lower limit of the one-tailed 90% confidence interval for pH sets with mean values below 7.25 and on the upper limit of the one-tailed 90% confidence interval for pH data sets with mean values of 7.25 or higher. The hydroxide magnitude is equal to 1.00E-20 (Eq/g)**2 divided by the hydrogen ion value equivalents per gram (in Eq/g).

Ion concentrations in Eq/g are based on the statistic. Conversions include scale (ppb to g/g), molecular weight (constituent form to ionic form), and equivalents (charges per ion). The column headed "Normalized" shows normalized concentrations (also in Eq/g) calculated by increasing concentrations of cations, excluding Hydrogen ion, or anions, excluding hydroxide, by the normalization factor. The normalization factor is the larger of the cation total, including Hydrogen ion, or anion total, including hydroxide, divided by the smaller total.

Substance names may include MB (monobasic), DB (dibasic), TB (tribasic) to identify the equivalents of hydrogen ion that have been neutralized from polycrotic weak acids to form their conjugate bases.

Substances are formulated in the order listed. The column headed "%" is the percent of the substance in the waste (gms/100gms). Substances formulated with oxygen are based on the residual concentration of the counterion. Other substance concentrations are based on the limiting residual concentration of the cation or anion. The columns headed "Cation Out" and "Anion Out" indicate the residual concentrations (in Eq/g) of each ion after a substance concentration has been calculated.

Table 5-2. Dangerous Waste Data Designation Report for 244-AR Vault Cooling Water. (sheet 1 of 2)

Dangerous Waste Data Designation Report for 244-AR Vault Cooling Water

Finding: Undesignated

Discarded Chemical Products - WAC 173-303-081

| Substance | Review Number | Status | DW Number |
|---|---|---|---|
| Hydrogen fluoride | U134(DW) | Not Discarded | Undesignated |
| *1-Butanol | U031(DW) | Not Discarded | Undesignated |

Dangerous Waste Sources - WAC 173-303-082

| Substance | Review Number | Status | DW Number |
|---|---|---|---|
| *1-Butanol | F003 | Unlisted Source | Undesignated |

Infectous Dangerous Waste - WAC 173-303-083

No regulatory guidance

Dangerous Waste Mixtures - WAC 173-303-084

| | Toxic | Persistant | | Carcinogenic |
|---|---|---|---|---|
| Substance | EC% | HH% | PAH% | Total% |
| Barium chloride | 5.20E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Calcium tetraborate | 2.30E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Copper(II) chloride | 4.27E-06 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Iron(III) fluoride | 9.28E-07 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Magnesium chloride | 4.53E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Magnesium nitrate | 2.35E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Magnesium sulfate | 1.34E-07 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Potassium fluoride | 2.40E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Sodium metasilicate | 6.01E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Uranyl nitrate | 1.00E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Zinc nitrate | 9.61E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Ammonia | 6.47E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| *1-Butanol | 5.00E-11 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Total | 5.57E-06 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| DW Number | Undesignated | Undesignated | Undesignated | Undesignated |

Dangerous Waste Characteristics - WAC 173-303-090

| Characteristic | Value | DW Number |
|---|---|---|
| Ignitability (Degrees F) | >209 | Undesignated |
| Corrosivity-pH | 8.26 | Undesignated |
| Reactivity Cyanide (mg/kg) | <1.00E+02 | Undesignated |
| Reactivity Sulfide (mg/kg) | <1.00E+02 | Undesignated |
| EP Toxic Arsenic (mg/L) | <5.00E-01 | Undesignated |
| EP Toxic Barium (mg/L) | <1.00E+00 | Undesignated |
| EP Toxic Cadmium (mg/L) | <1.00E-01 | Undesignated |
| EP Toxic Chromium (mg/L) | <5.00E-01 | Undesignated |
| EP Toxic Lead (mg/L) | <5.00E-01 | Undesignated |
| EP Toxic Mercury (mg/L) | <2.00E-02 | Undesignated |
| EP Toxic Selenium (mg/L) | <5.00E-01 | Undesignated |
| EP Toxic Silver (mg/L) | <5.00E-01 | Undesignated |

Dangerous Waste Criteria - WAC 173-303-100

| | Toxic | Persistant | | Carcinogenic | |
|---|---|---|---|---|---|
| Substance | EC% | HH% | PAH% | Total% | DW Number-Positive |
| Barium chloride | 5.20E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Calcium tetraborate | 2.30E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Copper(II) chloride | 4.27E-06 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |

Table 5-2. Dangerous Waste Data Designation Report for 244-AR Vault Cooling Water. (sheet 2 of 2)

Dangerous Waste Data Designation Report for 244-AR Vault Cooling Water

Dangerous Waste Criteria - WAC 173-303-100 - Continued

| Substance | Toxic EC% | Persistant HH% | Persistant PAH% | Carcinogenic Total% | DW Number-Positive |
|---|---|---|---|---|---|
| Iron(III) fluoride | 9.28E-07 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Magnesium chloride | 4.53E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Magnesium nitrate | 2.35E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Magnesium sulfate | 1.34E-07 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Potassium fluoride | 2.40E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Sodium metasilicate | 6.01E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Uranyl nitrate | 1.00E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Zinc nitrate | 9.61E-09 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Ammonia | 6.47E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| *1-Butanol | 5.00E-11 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| Total | 5.57E-06 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| DW Number | Undesignated | Undesignated | Undesignated | Undesignated | |

Dangerous Waste Constituents - WAC 173-303-9905

Substance
Hydrogen fluoride
Barium and compounds,NOS

Substance names may include MB (monobasic), DB (dibasic), or TB (tribasic) to identify the equivalence of hydrogen ion that have been nutralized from polyprotic weak acids to form their conjugate bases.

Results based on a single datum are noted by an asterisk (*). Others are based on the lower limit of the one-tailed 90% confidence interval for pH data sets with mean values below 7.25 or by the upper limit of the one-tailed 90% confidence interval for all other data sets.

EP Toxic contaminants, ignitability, and reactivity are reported by standard methods when available. In the absence of EP Toxicity data, total contaminant concentrations are evaluated. In lieu of closed cup ignition results, ignitability is estimated from the sum of the contributions of all substances that are ignitable when pure. A waste is flagged as dangerous if sum of the ignitable substances exceeds one percent. Reactivity is by SW-846: 250 mg of cyanide as hydrogen cyanide per kg of waste or 500 mg of sulfide as hydrogen sulfide per kg of waste. Total cyanide and total sulfide are used in lieu of amenable cyanide and amenable sulfide.

Inorganic substances are fomulated and their possible concentrations calculated for designation purposes only. The actual existance in the waste of these substances is not implied and should not be infered.

Two potential discarded chemical products were identified from sampling data (using the screening procedure described in Section 5.2) as shown in Table 5-2. They are hydrogen fluoride and 1-butanol. Each of these will be discussed in the following sections.

Based on the considerations and data presented in the previous sections, it is concluded that the wastestream does not contain any discarded chemical products.

**5.3.1.1 Hydrogen Fluoride.** A review of Tank Farms chemical inventory data did not show hydrogen fluoride to be present in any chemical compound used within Tank Farms.

Fluoride appeared in all four samples taken of the wastewater stream. The presence of the fluoride ion in the wastestream indicated that discarded hydrogen fluoride was a potential source of the fluoride. The actual compound hydrogen fluoride was not detected in the wastestream.

The concentration of fluoride in the four samples of the wastewater ranged from 128 to 175 ppb. The average concentration of fluoride in this wastestream was 154 ppb. The rejection criterion for fluoride based on sanitary water supplied to Tank Farms is 143 ppb as presented in Section 5.2. Although the concentration of fluoride seen in three of the four samples is greater than this rejection criterion, this constituent must be attributed to the incoming sanitary water supply. No fluoride or hydrogen fluoride is added to the wastestream as part of the current process configuration. The presence of the fluoride ion is certainly not the result of mixing with waste hydrogen fluoride, as none is utilized at the Tank Farms.

**5.3.1.2 1-butanol.** 1-butanol appeared in one of the four samples taken of the wastewater stream. The concentration of 1-butanol in that particular sample was the minimum detectable amount (5 ppb). The rejection criterion for 1-butanol based on blank analysis is 33 ppb as presented in Section 5.2. As the concentration of 1-butanol seen in all four samples is less than this rejection criterion, this constituent must be attributed to sample contamination.

### 5.3.2 Dangerous Waste Sources

The process evaluation (see Section 5.2) also was used to determine if the wastestream included any specific waste sources (K and W wastes) or any nonspecific waste sources (F wastes) in the Dangerous Waste Source List WAC 173-303-9904.

Sampling data identified 1-butanol as a potential listed source. As described in Section 5.3.1, 1-butanol is not used in the process, was a contaminant in sample blanks, and does not qualify as detected.

Based on the discussion and data presented above, this wastestream does not have a dangerous waste source.

## 5.4 DANGEROUS WASTE CRITERIA

A waste is considered a dangerous waste if it meets any of the following criteria categories (WAC 173-303-100): toxic dangerous waste, persistent dangerous waste, or carcinogenic dangerous waste. A description of the methods used to test the sampling data against the criteria is contained in *Wastestream Designation for Liquid Analytical Data* (Jungfleisch 1990). Summaries of the methods, along with the results, are contained in the following sections.

### 5.4.1 Toxic Dangerous Wastes

The procedure for determining if a wastestream is a toxic dangerous waste is as follows (WAC 173-303-101).

- Collect and analyze multiple samples from the wastestream.
- Calculate the upper limit of one-sided 90%CI for each analyte in the wastestream.
- Formulate substances from the analytical data. NOTE: This step is only required for inorganic analytes since it is not possible to complete the evaluation based on the concentrations of cations and anions. This methodology is based on an evaluation of the most toxic substances that can exist in an aqueous environment under normal temperatures and pressures (WHC 1990b).
- Assign toxic categories to the substances formulated for the wastestream.
- Calculate the contribution of each substance to the percent equivalent concentration (EC%).
- Calculate the EC% by summing the contributions of each substance.
- Designate the wastestream as a toxic dangerous waste if the EC% is greater than 0.001%, in accordance with WAC 173-303-9906.

Thirteen substances potentially present in the 244-AR Vault Cooling Water stream were determined to have toxic categories associated with them. These substances are listed in Table 5-2 along with their toxic categories. The individual and sum EC% values for these chemical compounds are listed in Table 5-2. Since the EC% sum is 5.57 E-06%, which is less than the designation limit of 1.0 E-03 (i.e., 0.001%), the wastestream is not a toxic dangerous waste.

### 5.4.2 Persistent Dangerous Wastes

The procedure for determining if a wastestream is a persistent dangerous waste is as follows (WAC 173-303-102).

- Collect multiple grab samples of the wastestream.
- Determine which substances in the wastestream are halogenated hydrocarbons (HH) and which are polycyclic aromatic hydrocarbons (PAH).
- Determine the upper limit of the one-sided 90%CI for the substances of interest.
- Calculate the weight percent contribution of each HH and PAH.
- Sum the resulting HH% and PAH% contributions, separately.
- Designate the wastestream as persistent if the HH% concentration is greater than 0.01% or if the PAH% concentration is greater than 1.0%, in accordance with WAC 173-303-9907.

No substances potentially present in the 244-AR Vault Cooling Water stream were determined to be HH and no chemical compounds were determined to be PAH. Consequently, this wastestream is not a persistent dangerous waste.

### 5.4.3 Carcinogenic Dangerous Wastes

The procedure for determining if a wastestream is a carcinogenic dangerous waste is as follows (WAC 173-303-103).

- Collect multiple grab samples of the wastestream.
- Determine the upper limit of the one-sided 90%CI for the substances of interest.
- Formulate neutral substances from the analytical data. NOTE: This step is only required for inorganic analytes since it is not possible to complete the evaluation based on the concentrations of cations and anions. This methodology is based on an evaluation of the carcinogenic substances that exist in an aqueous environment under normal temperatures and pressures (WHC 1990b).
- Determine which substances in the wastestream are human or animal carcinogens according to the International Agency for Research on Cancer (IARC).
- Calculate the weight percent concentration for each carcinogen.
- Sum the resulting weight percent contributions.

- Designate the wastestream as carcinogenic if any of the positive carcinogens are above 0.01% or if the total concentration for positive and suspected carcinogens is above 1.0%.

No substances potentially present in the 244-AR Vault Cooling Water stream were determined to be carcinogenic chemical compounds. Consequently, this wastestream is not a carcinogenic dangerous waste.

## 5.5 DANGEROUS WASTE CHARACTERISTICS

A waste is considered a dangerous waste if it is ignitable, corrosive, reactive, or extraction procedure (EP) toxic (WAC 173-303-090). A description of the methods used to evaluate the data in terms of these characteristics is contained in WHC (1990). Summaries of the methods, along with the results, are contained in the following sections.

### 5.5.1 Ignitability

As shown in Table 5-2, the flashpoint of this waste is above 209 °F. This is greater than the limit of 140 °F at which temperature wastes are determined to be ignitable. Therefore, the 244-AR Vault Cooling Water stream is not an ignitable waste.

### 5.5.2 Corrosivity

A waste is a corrosive dangerous waste if the stream exhibited a pH of $\leq$2.0 or $\geq$12.5. The comparison of this characteristic was based on the lower limit of the one-sided 90%CI for a stream with a mean value of pH <7.25 and the upper limit of the one-sided 90%CI for a stream with a mean value of pH >7.25.

The 90% CI value of the pH measurements for the 244-AR Vault Cooling Water stream is 8.26. The wastestream is not a corrosive dangerous waste [WAC 173-303-090(6)].

### 5.5.3 Reactivity

An aqueous waste is reactive if the waste contains an amount of cyanide or sulfide under conditions sufficient to threaten human health or the environment [WAC 173-303-090(7)]. A recent revision to *Test Methods for Evaluating Solid Waste* (EPA 1986) provides more quantitative indicator levels for cyanide and sulfide. It states that levels of (equivalent) hydrocyanide (as HCN) below 250 mg/kg or of (equivalent) sulfide (as $H_2S$) below 500 mg/kg would not be considered reactive.

Sample results indicate that the equivalent HCN concentration and the equivalent $H_2S$ concentration are both below the minimum detectable amount (100 mg/kg). Therefore, this wastestream is not a reactive dangerous waste.

### 5.5.4 Extraction Procedure Toxicity

A waste is an EP toxic dangerous waste if individual chemical analytes exceed limits of WAC 173-303-090(8)(c). Extraction procedure toxicity tests detected no EP toxic metals above regulated limits, as shown in Table 5-2. Based on these results, the 244-AR Vault cooling water is not an EP toxic dangerous waste.

## 5.6 PROPOSED DESIGNATION

Because the 244-AR Vault Cooling Water stream does not contain any dangerous waste, as defined in WAC 173-303-070, it is proposed that the wastestream not be designated a dangerous waste.

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# 6.0 ACTION PLAN

This chapter addresses recommendations for future waste characterization tasks for the liquid effluents that are within the scope of the Liquid Effluent Study (Lawrence 1989). The final extent of and schedule for any recommended tasks are subject to negotiation between Ecology, the EPA, and the DOE. An implementation schedule for the completion of these tasks will consider other compliance actions already underway as part of the Tri-Party Agreement (Ecology et al. 1989) and the availability of funding. All effluent monitoring and sampling will be conducted according to DOE Order 5400.1 (DOE 1988).

## 6.1 FUTURE SAMPLING

The random sampling conducted during the October 1989 to February 1990 period addressed the current process configuration for this wastestream. No additional sampling is warranted or recommended.

## 6.2 TECHNICAL ISSUES

As described in Section 2.0, the effluent was sampled at manhole 1 at the 2904-AR Building. This sample point was chosen because it is a common, accessible location downstream of all the contributing wastestreams.

The samples collected at this point are considered to be representative of the types of constituents present in the contributing wastestreams. As a result, the characterization data presented in this report are considered to be representative of the effluent stream.

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## 7.0 REFERENCES


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WHC, 1988b, *Preliminary Evaluation of Hanford Liquid Discharges to the Ground*, WHC-EP-0052, Westinghouse Hanford Company, Richland, Washington.

# APPENDIX A

## THE 244-AR VAULT COOLING WATER SAMPLE DATA

Taken from *Waste Stream Characterization Report*
WHC-EP-0287, Volumes 1 through 4,
Westinghouse Hanford Company,
Richland, Washington (1989).

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**Raw Analytical Data** (sheet 1 of 6)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Arsenic (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Arsenic (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Arsenic (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Arsenic (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Barium | 50685 | 10/13/89 | ICP | 3.60E+01 |
| Barium | 50693 | 10/17/89 | ICP | 3.20E+01 |
| Barium | 50717 | 10/24/89 | ICP | 3.00E+01 |
| Barium | 50947 | 2/16/90 | ICP | 2.90E+01 |
| Barium (EP Toxic) | 50685E | 10/13/89 | ICP | <1.00E+03 |
| Barium (EP Toxic) | 50693E | 10/17/89 | ICP | <1.00E+03 |
| Barium (EP Toxic) | 50717E | 10/24/89 | ICP | <1.00E+03 |
| Barium (EP Toxic) | 50947E | 2/16/90 | ICP | <1.00E+03 |
| Boron | 50685 | 10/13/89 | ICP | 1.50E+01 |
| Boron | 50693 | 10/17/89 | ICP | <1.00E+01 |
| Boron | 50717 | 10/24/89 | ICP | 1.40E+01 |
| Boron | 50947 | 2/16/90 | ICP | <2.20E+01 |
| Cadmium (EP Toxic) | 50685E | 10/13/89 | ICP | <1.00E+02 |
| Cadmium (EP Toxic) | 50693E | 10/17/89 | ICP | <1.00E+02 |
| Cadmium (EP Toxic) | 50717E | 10/24/89 | ICP | <1.00E+02 |
| Cadmium (EP Toxic) | 50947E | 2/16/90 | ICP | <1.00E+02 |
| Calcium | 50685 | 10/13/89 | ICP | 1.84E+04 |
| Calcium | 50693 | 10/17/89 | ICP | 1.92E+04 |
| Calcium | 50717 | 10/24/89 | ICP | 1.88E+04 |
| Calcium | 50947 | 2/16/90 | ICP | 1.79E+04 |
| Chloride | 50685 | 10/13/89 | IC | 1.00E+03 |
| Chloride | 50693 | 10/17/89 | IC | 1.00E+03 |
| Chloride | 50717 | 10/24/89 | IC | 1.20E+03 |
| Chloride | 50947 | 2/16/90 | IC | 9.00E+02 |
| Chromium (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Chromium (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Chromium (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Chromium (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Copper | 50685 | 10/13/89 | ICP | <1.00E+01 |
| Copper | 50693 | 10/17/89 | ICP | <1.00E+01 |
| Copper | 50717 | 10/24/89 | ICP | <1.00E+01 |
| Copper | 50947 | 2/16/90 | ICP | 3.01E+02 |
| Fluoride | 50685 | 10/13/89 | IC | <5.00E+02 |
| Fluoride | 50685 | 10/13/89 | ISE | 1.75E+02 |
| Fluoride | 50693 | 10/17/89 | IC | <5.00E+02 |
| Fluoride | 50693 | 10/17/89 | ISE | 1.51E+02 |
| Fluoride | 50717 | 10/24/89 | IC | <5.00E+02 |
| Fluoride | 50717 | 10/24/89 | ISE | 1.63E+02 |
| Fluoride | 50947 | 2/16/90 | IC | <5.00E+02 |
| Fluoride | 50947 | 2/16/90 | ISE | 1.28E+02 |
| Iron | 50685 | 10/13/89 | ICP | 1.28E+02 |
| Iron | 50693 | 10/17/89 | ICP | 4.20E+01 |
| Iron | 50717 | 10/24/89 | ICP | 3.20E+01 |
| Iron | 50947 | 2/16/90 | ICP | 6.58E+02 |

**Raw Analytical Data** (sheet 2 of 6)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Lead (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Lead (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Lead (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Lead (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Magnesium | 50685 | 10/13/89 | ICP | 4.17E+03 |
| Magnesium | 50693 | 10/17/89 | ICP | 4.16E+03 |
| Magnesium | 50717 | 10/24/89 | ICP | 4.03E+03 |
| Magnesium | 50947 | 2/16/90 | ICP | 4.23E+03 |
| Manganese | 50685 | 10/13/89 | ICP | <5.00E+00 |
| Manganese | 50693 | 10/17/89 | ICP | <5.00E+00 |
| Manganese | 50717 | 10/24/89 | ICP | <5.00E+00 |
| Manganese | 50947 | 2/16/90 | ICP | 2.30E+01 |
| Mercury (EP Toxic) | 50685E | 10/13/89 | CVAA/M | <2.00E+01 |
| Mercury (EP Toxic) | 50693E | 10/17/89 | CVAA/M | <2.00E+01 |
| Mercury (EP Toxic) | 50717E | 10/24/89 | CVAA/M | <2.00E+01 |
| Mercury (EP Toxic) | 50947E | 2/16/90 | CVAA/M | <2.00E+01 |
| Nitrate | 50685 | 10/13/89 | IC | <5.00E+02 |
| Nitrate | 50693 | 10/17/89 | IC | <5.00E+02 |
| Nitrate | 50717 | 10/24/89 | IC | 6.00E+02 |
| Nitrate | 50947 | 2/16/90 | IC | 6.00E+02 |
| Potassium | 50685 | 10/13/89 | ICP | 8.00E+02 |
| Potassium | 50693 | 10/17/89 | ICP | 7.27E+02 |
| Potassium | 50717 | 10/24/89 | ICP | 7.54E+02 |
| Potassium | 50947 | 2/16/90 | ICP | 7.50E+02 |
| Selenium (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Selenium (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Selenium (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Selenium (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Silicon | 50685 | 10/13/89 | ICP | 2.38E+03 |
| Silicon | 50693 | 10/17/89 | ICP | 2.31E+03 |
| Silicon | 50717 | 10/24/89 | ICP | 2.40E+03 |
| Silicon | 50947 | 2/16/90 | ICP | 2.55E+03 |
| Silver (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Silver (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Silver (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Silver (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Sodium | 50685 | 10/13/89 | ICP | 2.24E+03 |
| Sodium | 50693 | 10/17/89 | ICP | 2.21E+03 |
| Sodium | 50717 | 10/24/89 | ICP | 2.24E+03 |
| Sodium | 50947 | 2/16/90 | ICP | 2.03E+03 |
| Strontium | 50685 | 10/13/89 | ICP | 1.05E+02 |
| Strontium | 50693 | 10/17/89 | ICP | 1.01E+02 |
| Strontium | 50717 | 10/24/89 | ICP | 9.60E+01 |
| Strontium | 50947 | 2/16/90 | ICP | 8.70E+01 |
| Sulfate | 50685 | 10/13/89 | IC | 1.02E+04 |
| Sulfate | 50693 | 10/17/89 | IC | 1.05E+04 |
| Sulfate | 50717 | 10/24/89 | IC | 1.08E+04 |
| Sulfate | 50947 | 2/16/90 | IC | 1.00E+04 |

**Raw Analytical Data** (sheet 3 of 6)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Uranium | 50685 | 10/13/89 | FLUOR | 5.04E-01 |
| Uranium | 50693 | 10/17/89 | FLUOR | 5.59E-01 |
| Uranium | 50717 | 10/24/89 | FLUOR | 5.98E-01 |
| Zinc | 50685 | 10/13/89 | ICP | 7.00E+00 |
| Zinc | 50693 | 10/17/89 | ICP | 7.00E+00 |
| Zinc | 50717 | 10/24/89 | ICP | 5.00E+00 |
| Zinc | 50947 | 2/16/90 | ICP | 4.70E+01 |
| Ammonia | 50685 | 10/13/89 | ISE | 5.50E+01 |
| Ammonia | 50693 | 10/17/89 | ISE | 7.10E+01 |
| Ammonia | 50717 | 10/24/89 | ISE | 5.10E+01 |
| Ammonia | 50947 | 2/16/90 | ISE | <5.00E+01 |
| 1-Butanol | 50685 | 10/13/89 | DIGC | <1.00E+04 |
| 1-Butanol | 50693 | 10/17/89 | DIGC | <1.00E+04 |
| 1-Butanol | 50717 | 10/24/89 | DIGC | <1.00E+04 |
| 1-Butanol | 50947 | 2/16/90 | VOA | 5.00E+00 |
| 1-Butanol | 50947 | 2/16/90 | DIGC | <1.00E+04 |
| 2-Butanone | 50685 | 10/13/89 | VOA | <1.00E+01 |
| 2-Butanone | 50685B | 10/13/89 | VOA | <1.00E+01 |
| 2-Butanone | 50685T | 10/13/89 | VOA | <1.00E+01 |
| 2-Butanone | 50693 | 10/17/89 | VOA | <1.00E+01 |
| 2-Butanone | 50693B | 10/17/89 | VOA | <1.00E+01 |
| 2-Butanone | 50693T | 10/17/89 | VOA | <5.00E+00 |
| 2-Butanone | 50717 | 10/24/89 | VOA | <1.00E+01 |
| 2-Butanone | 50717B | 10/24/89 | VOA | 1.30E+01 |
| 2-Butanone | 50717T | 10/24/89 | VOA | <1.00E+01 |
| 2-Butanone | 50947 | 2/16/90 | VOA | <1.00E+01 |
| 2-Butanone | 50947B | 2/16/90 | VOA | <1.00E+01 |
| 2-Butanone | 50947T | 2/16/90 | VOA | <5.00E+00 |
| Dichloromethane | 50685 | 10/13/89 | VOA | <5.00E+00 |
| Dichloromethane | 50685B | 10/13/89 | VOA | 3.90E+02 |
| Dichloromethane | 50685T | 10/13/89 | VOA | 3.70E+02 |
| Dichloromethane | 50693 | 10/17/89 | VOA | <5.00E+00 |
| Dichloromethane | 50693B | 10/17/89 | VOA | <3.00E+00 |
| Dichloromethane | 50693T | 10/17/89 | VOA | 1.40E+01 |
| Dichloromethane | 50717 | 10/24/89 | VOA | <5.00E+00 |
| Dichloromethane | 50717B | 10/24/89 | VOA | 5.00E+00 |
| Dichloromethane | 50717T | 10/24/89 | VOA | 6.10E+01 |
| Dichloromethane | 50947 | 2/16/90 | VOA | <5.00E+00 |
| Dichloromethane | 50947B | 2/16/90 | VOA | <5.00E+00 |
| Dichloromethane | 50947T | 2/16/90 | VOA | <5.00E+00 |
| Tetrahydrofuran | 50685 | 10/13/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50685B | 10/13/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50685T | 10/13/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50693 | 10/17/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50693B | 10/17/89 | VOA | 1.30E+01 |
| Tetrahydrofuran | 50693T | 10/17/89 | VOA | 1.30E+01 |
| Tetrahydrofuran | 50717 | 10/24/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50717B | 10/24/89 | VOA | 2.10E+01 |

**Raw Analytical Data (shee 4 of 6)**

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Tetrahydrofuran | 50717T | 10/24/89 | VOA | <7.00E+00 |
| Tetrahydrofuran | 50947 | 2/16/90 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50947B | 2/16/90 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50947T | 2/16/90 | VOA | <5.00E+00 |
| Alkalinity (Method B) | 50685 | 10/13/89 | TITRA | 5.80E+04 |
| Alkalinity (Method B) | 50693 | 10/17/89 | TITRA | 5.90E+04 |
| Alkalinity (Method B) | 50717 | 10/24/89 | TITRA | 5.80E+04 |
| Alkalinity (Method B) | 50947 | 2/16/90 | TITRA | 5.90E+04 |
| Alpha Activity (pCi/L) | 50685 | 10/13/89 | Alpha | 1.02E+00 |
| Alpha Activity (pCi/L) | 50693 | 10/17/89 | Alpha | <2.34E-01 |
| Alpha Activity (pCi/L) | 50717 | 10/24/89 | Alpha | 7.71E-01 |
| Conductivity (µS) | 50685 | 10/13/89 | COND-Fld | 1.40E+02 |
| Conductivity (µS) | 50693 | 10/17/89 | COND-Fld | 1.27E+02 |
| Conductivity (µS) | 50717 | 10/24/89 | COND-Fld | 1.17E+02 |
| Conductivity (µS) | 50947 | 2/16/90 | COND-Fld | 1.60E+02 |
| Ignitability (°F) | 50685E | 10/13/89 | IGNIT | 2.12E+02 |
| Ignitability (°F) | 50693E | 10/17/89 | IGNIT | 2.10E+02 |
| Ignitability (°F) | 50717E | 10/24/89 | IGNIT | 2.10E+02 |
| Ignitability (°F) | 50947E | 2/16/90 | IGNIT | 2.10E+02 |
| pH (dimensionless) | 50685 | 10/13/89 | PH-Fld | 7.00E+00 |
| pH (dimensionless) | 50693 | 10/17/89 | PH-Fld | 8.18E+00 |
| pH (dimensionless) | 50717 | 10/24/89 | PH-Fld | 8.40E+00 |
| pH (dimensionless) | 50947 | 2/16/90 | PH-Fld | 7.00E+00 |
| Reactivity Cyanide (mg/kg) | 50685E | 10/13/89 | DSPEC | <1.00E+02 |
| Reactivity Cyanide (mg/kg) | 50693E | 10/17/89 | DSPEC | <1.00E+02 |
| Reactivity Cyanide (mg/kg) | 50717E | 10/24/89 | DSPEC | <1.00E+02 |
| Reactivity Cyanide (mg/kg) | 50947E | 2/16/90 | DSPEC | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50685E | 10/13/89 | DTITRA | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50693E | 10/17/89 | DTITRA | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50717E | 10/24/89 | DTITRA | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50947E | 2/16/90 | DTITRA | <1.00E+02 |
| TDS | 50685 | 10/13/89 | TDS | 7.10E+04 |
| TDS | 50693 | 10/17/89 | TDS | 6.50E+04 |
| TDS | 50717 | 10/24/89 | TDS | 7.10E+04 |
| TDS | 50947 | 2/16/90 | TDS | 5.60E+04 |
| Temperature (°C) | 50685 | 10/13/89 | TEMP-Fld | 1.92E+01 |
| Temperature (°C) | 50693 | 10/17/89 | TEMP-Fld | 1.75E+01 |
| Temperature (°C) | 50717 | 10/24/89 | TEMP-Fld | 1.54E+01 |
| Temperature (°C) | 50947 | 2/16/90 | TEMP-Fld | 2.26E+01 |
| Total Carbon | 50685 | 10/13/89 | TC | 1.60E+04 |
| Total Carbon | 50693 | 10/17/89 | TC | 1.60E+04 |
| Total Carbon | 50717 | 10/24/89 | TC | 1.58E+04 |
| Total Carbon | 50947 | 2/16/90 | TC | 1.53E+04 |
| TOX (as Cl) | 50685 | 10/13/89 | LTOX | <8.00E+00 |
| TOX (as Cl) | 50693 | 10/17/89 | LTOX | <5.00E+00 |
| TOX (as Cl) | 50717 | 10/24/89 | LTOX | 1.00E+01 |
| TOX (as Cl) | 50947 | 2/16/90 | LTOX | <8.00E+00 |

**Raw Analytical Data** (sheet 5 of 6)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| $^{60}$Co (pCi/L) | 50685 | 10/13/89 | GEA | <2.89E-01 |
| $^{60}$Co (pCi/L) | 50693 | 10/17/89 | GEA | <1.01E-01 |
| $^{60}$Co (pCi/L) | 50717 | 10/24/89 | GEA | 1.59E+00 |
| $^{129}$I (pCi/L) | 50685 | 10/13/89 | LEPD | 9.08E-02 |
| $^{239,240}$Pu (pCi/L) | 50685 | 10/13/89 | AEA | 7.13E-03 |
| $^{239,240}$Pu (pCi/L) | 50693 | 10/17/89 | AEA | 8.01E-03 |
| Radium Total (pCi/L) | 50685 | 10/13/89 | Alpha-Ra | <1.16E-01 |
| Radium Total (pCi/L) | 50693 | 10/17/89 | Alpha-Ra | 2.08E-01 |
| Radium Total (pCi/L) | 50717 | 10/24/89 | Alpha-Ra | 1.77E-01 |
| $^{106}$Ru (pCi/L) | 50685 | 10/13/89 | GEA | <1.06E+00 |
| $^{106}$Ru (pCi/L) | 50693 | 10/17/89 | GEA | 5.07E+00 |
| $^{90}$Sr (pCi/L) | 50685 | 10/13/89 | Beta | <5.20E-02 |
| $^{90}$Sr (pCi/L) | 50693 | 10/17/89 | Beta | 2.02E-01 |
| $^{90}$Sr (pCi/L) | 50717 | 10/24/89 | Beta | 2.70E-01 |
| $^{234}$U (pCi/L) | 50685 | 10/13/89 | AEA | 1.99E-01 |
| $^{234}$U (pCi/L) | 50693 | 10/17/89 | AEA | 2.04E-01 |
| $^{234}$U (pCi/L) | 50717 | 10/24/89 | AEA | 2.61E-01 |
| $^{238}$U (pCi/L) | 50685 | 10/13/89 | AEA | 1.53E-01 |
| $^{238}$U (pCi/L) | 50693 | 10/17/89 | AEA | 1.62E-01 |
| $^{238}$U (pCi/L) | 50717 | 10/24/89 | AEA | 1.82E-01 |

The following lists the methods that are coded in the method column.

| Code | Analytical Method | Reference |
|---|---|---|
| ABN | Semivolatile Organics (GC/MS) | USEPA-8270 |
| AEA | $^{241}$Am | UST-20Am01 |
| AEA | Curium Isotopes | UST-20Am/Cm01 |
| AEA | Plutonium Isotopes | UST-20Pu01 |
| AEA | Uranium Isotopes | UST-20U01 |
| ALPHA | Alpha Counting | EPA-680/4-75/1 |
| ALPHA-Ra | Total Radium Alpha Counting | ASTM-D2460 |
| BETA | Beta Counting | EPA-680/4-75/1 |
| BETA | $^{90}$Sr | UST-20Sr02 |
| COLIF | Coliform Bacteria | USEPA-9131 |
| COLIFMF | Coliform Bacteria (Membrane Filter) | USEPA-9132 |
| COND-Fld | Conductivity-Field | ASTM-D1125A |
| COND-Lab | Conductivity-Laboratory | ASTM-D1125A |
| CVAA | Mercury | USEPA-7470 |
| CVAA/M | Mercury-Mixed Matrix | USEPA-7470 |
| DIGC | Direct Aqueous Injection (GC) | UST-70DIGC |
| DIMS | Direct Aqueous Injection (GC/MS) | "USEPA-8240" |
| DSPEC | Reactive Cyanide (Distillation, Spectroscopy) | USEPA-CHAPTER 7 |
| DTITRA | Reactive Sulfide (Distillation, Titration) | USEPA-CHAPTER 7 |
| FLUOR | Uranium (Fluorometry) | ASTM-D2907-83 |
| GEA | Gamma Energy Analysis Spectroscopy | ASTM-D3649-85 |
| GFAA | Arsenic (AA, Furnace Technique) | USEPA-7060 |
| GFAA | Lead (AA, Furnace Technique) | USEPA-7421 |

**Raw Analytical Data** (sheet 6 of 6)

| | | |
|---|---|---|
| GFAA | Selenium (AA, Furnace Technique) | USEPA-7740 |
| GFAA | Thallium (AA, Furnace Technique) | USEPA-7841 |
| IC | Ion Chromatography | EPA-600/4-84-01 |
| ICP | Atomic Emission Spectroscopy (ICP) | USEPA-6010 |
| ICP/M | Atomic Emission Spectroscopy (ICP)-Mixed Matrix | USEPA-6010 |
| IGNIT | Pensky-Martens Closed-Cup Ignitability | USEPA-1010 |
| ISE | Fluoride-Low Detection Limit | ASTM-D1179-80-B |
| ISE | Ammonium Ion | ASTM-D1426-D |
| LALPHA | Alpha Activity-Low Detection Limit | EPA-680/4-75/1 |
| LEPD | $^{129}I$ | UST-20I02 |
| LSC | $^{14}C$ | UST-20C01 |
| LSC | Tritium | UST-20H03 |
| LTOX | Total Organic Halides-Low Detection Limit | USEPA-9020 |
| PH-Fld | pH-Field | USEPA-9040 |
| PH-Lab | pH-Laboratory | USEPA-9040 |
| SPEC | Total and Amenable Cyanide (Spectroscopy) | USEPA-9010 |
| SPEC | Hydrazine-Low Detection Limit (Spectroscopy) | ASTM-D1385 |
| SSOLID | Suspended Solids | SM-208D |
| TC | Total Carbon | USEPA-9060 |
| TDS | Total Dissolved Solids | SM-208B |
| TEMP-Fld | Temperature-Field | Local |
| TITRA | Alkalinity-Method B (Titration) | ASTM-D1067B |
| TITRA | Sulfides (Titration) | USEPA-9030 |
| TOC | Total Organic Carbon | USEPA-9060 |
| TOX | Total Organic Halides | USEPA-9020 |
| VOA | Volatile Organics (GC/MS) | USEPA-8240 |

NOTES:

Sample# is the number of the sample. See Section 3.0 for corresponding chain-of-custody number.

Date is the sampling date.

Results are in ppb (parts per billion) unless otherwise indicated.

Analytical Method Acronyms:

AA = atomic absorption spectroscopy.
GC = gas chromatography.
MS = mass spectrometry.
ICP = inductively-coupled plasma spectroscopy.

References:

ASTM--"1986 Annual Book of ASTM Standards", American Society for Testing and Materials, Philadelphia, Pennsylvania.

EPA--Various methods of the U.S. Environmental Protection Agency, Washington, D.C.

UST--Methods of the United States Testing Company, Incorporated, Richland, Washington.

SM--"Standard Methods for the Examination of Water and Wastewater", 16th ed., American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, D.C.

USEPA--"Test Methods for Evaluating Solid Waste Physical/Chemical Methods", 3rd ed., SW-846, U.S. Environmental Protection Agency, Washington, D.C.

# APPENDIX B

## RAW AND SANITARY WATER BACKGROUND DATA

Taken from *Waste Stream Characterization Report*,
WHC-EP-0287, Volumes 1 through 4,
Westinghouse Hanford Company,
Richland, Washington (1989).

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Table B-1. Summary of 200 East Area Raw Water and Sanitary Water Data (1985-1988).
(sheet 1 of 2)

| Constituent/Parameter [all ppb, exceptions noted] | Raw Water[a] (1986-1987) | | | Sanitary Water[b] (1985-1988) | | |
|---|---|---|---|---|---|---|
| | N[c] | AVG | STD DEV | N | AVG | STD DEV |
| Arsenic | | | | 4 | <5.00E+00 | NA |
| Barium | 5 | 2.80E+01 | 3.40E+00 | 4 | *1.05E+02 | 1.00E+01 |
| Cadmium | 5 | 2.40E+00 | 8.94E-01 | 4 | <5.00E-01 | NA |
| Calcium | 5 | 1.84E+04 | 1.47E+03 | | | |
| Chromium | | | | 4 | <1.00E+01 | NA |
| Chloride | 5 | 8.71E+02 | 2.37E+02 | 4 | 3.05E+03 | 6.76E+02 |
| Conductivity-field (μS) | 5 | 9.32E+01 | 4.61E+01 | | | |
| Copper | 5 | 1.06E+01 | 1.34E+00 | 4 | *2.50E+01 | 1.00E+01 |
| Color (units) | | | | 4 | <5.00E+00 | NA |
| Iron | 5 | 6.36E+01 | 2.57E+01 | 4 | *8.25E+01 | 5.19E+01 |
| Fluoride | | | | 4 | *1.13E+02 | 2.50E+01 |
| Lead | | | | 4 | <5.00E+00 | NA |
| Magnesium | 5 | 4.19E+03 | 4.83E+02 | | | |
| Manganese | 5 | 9.80E+00 | 3.49E+00 | 4 | <1.00E+01 | NA |
| Mercury | | | | 4 | <5.00E-01 | NA |
| Nickel | 5 | 1.04E+01 | 8.94E-01 | | | |
| Nitrate (as N) | 5 | 9.96E+02 | 8.79E+02 | 4 | *3.72E+02 | 5.44E+02 |
| pH (dimensionless) | 5 | 7.41E+00 | 1.18E+00 | | | |
| Potassium | 5 | 7.95E+02 | 6.24E+01 | | | |
| Selenium | | | | 4 | <5.00E+00 | NA |
| Silver | | | | 4 | <1.00E+01 | NA |
| Sodium | 5 | 2.26E+03 | 2.42E+02 | 4 | 2.28E+03 | 1.26E+02 |
| Sulfate | 5 | 1.06E+04 | 9.97E+02 | 4 | 1.68E+04 | 3.37E+03 |
| Temperature-field (C) | 5 | 1.64E+01 | 5.84E+00 | | | |
| TOC (μg/g) | 5 | 1.36E+03 | 2.53E+02 | | | |
| TDS (mg/L) | | | | 4 | 8.10E+01 | 1.69E+01 |
| Trichloromethane | 5 | 1.18E+01 | 4.02E+00 | | | |
| Uranium | 4 | 7.26E-01 | 2.22E-01 | | | |
| Zinc | 5 | 2.00E+01 | 2.12E+01 | 4 | <1.00E+02 | NA |
| Radionuclides (pCi/L) | | | | | | |
| Alpha Activity | 4 | 8.85E-01 | 5.30E-01 | | | |
| Beta Activity | 4 | 4.47E+00 | 1.76E+00 | | | |

NOTES: Averages denoted by an asterisk include a mix of above- and below-detection limit in computations when the actual values are below the detection limit.

See companion table for inorganic detection limits as compiled from Hanford Environmental Health Foundation.

[a]Compiled from "Substance Toxicity Evaluation of Waste Data Base," provided by F. M. Jungfleisch (this data is an update of the data presented in WHC 1988, Preliminary Evaluation of Hanford Liquid Discharges to Ground, Westinghouse Hanford Company, Richland, Washington.

[b]Compiled from HEHF 1986, Hanford Sanitary Water Quality Surveillance, CY 1985, HEHF-55, Hanford Environmental Health Foundation, Environmental Health Sciences, April 1986, and HEHF-59; HEHF-71; and HEHF-74 (corresponding reports for CY 1986, 1987, and 1988).

[c]N is defined as the number of test results available for a particular analyte. N may reflect both single and multiple data sets.

ppb = parts per billion.
pCi/L = picoCuries/liter.
TOC = total organic carbon.
TOX = total organic halides.
TDS = Total Dissolved Solids.
μS = microsiemen.
μg = microgram.

Table B-1. Summary of 200 East Area Raw Water and Sanitary Water Data (1985-1988). (sheet 2 of 2)

| Constituent/Parameter [all ppb, exceptions noted] | 200 East[b] | | |
|---|---|---|---|
| | N[c] | AVG | STD DEV |
| 1,1,1-Trichloroethane | 1 | <DL[c] | NA |
| 1,1 Dichloroethylene | 1 | <DL | NA |
| 1,2,-Dichloroethane | 1 | <DL | NA |
| 1,3,5-Trimethylbenzene | 1 | <DL | NA |
| Benzene | 1 | <DL | NA |
| Bromodichloromethane | 5 | 1.76E+00 | 6.68E-01 |
| Bromoform | 5 | <DL | NA |
| Carbon Tetrachloride | 1 | <DL | NA |
| Chlorodibromomethane | 5 | <DL | NA |
| Chloroform | 5 | 2.65E+01 | 1.27E+01 |
| Difluorodichloromethane | 2 | <DL | NA |
| Ethlylbenzene | 1 | <DL | NA |
| o-Xylene | 1 | <DL | NA |
| p-Chlorotoluene | 1 | <DL | NA |
| p-Dichlorobenzene | 1 | <DL | NA |
| Tetrachloroethylene | 1 | <DL | NA |
| Toluene | 1 | <DL | NA |
| Trichloroethylene | 1 | <DL | NA |
| Vinyl Chloride | 1 | <DL | NA |

[a]The data given in this table were compiled by Hanford Environmental Health Foundation (HEHF). Data sets included first quarter 1987 and quarterly 1988 data. The total trihalomethane concentration for the 200 and 300 Areas appear in the HEHF, 1989, *Hanford Water Quality Surveillance Report for CY 1988*, HEHF-74, HEHF, Environmental Health Sciences, Richland, Washington, and the *Hanford Water Quality Surveillance Report for CY 1989*.

[b]N is defined as the number of test results available for a particular analyte; N may reflect both single and multiple data sets. For N = 1 the sole available data entry is listed as "avg."

[c]See companion table for organic detection limits as compiled from HEHF data.

DL = detection limit

ppb = parts per billion.

# APPENDIX C

## CHEMICAL/RADIOLOGICAL DATA FROM PREVIOUS AND CURRENT SAMPLING EFFORTS

Taken from *Waste Stream Characterization Report*,
WHC-EP-0287, Volumes 1 through 4,
Westinghouse Hanford Company,
Richland, Washington (1989).

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Data for 244-AR Vault Cooling Water. (sheet 1 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Aluminum | 50075 | 6/24/86 | ICP | <1.50E+02 |
| Aluminum | 50137 | 9/23/86 | ICP | 1.83E+02 |
| Aluminum | 50147 | 10/03/86 | ICP | <1.50E+02 |
| Aluminum | 50248 | 3/05/87 | ICP | <1.50E+02 |
| Aluminum | 50685 | 10/13/89 | ICP | <1.50E+02 |
| Aluminum | 50693 | 10/17/89 | ICP | <1.50E+02 |
| Aluminum | 50717 | 10/24/89 | ICP | <1.50E+02 |
| Aluminum | 50947 | 2/16/90 | ICP | <1.50E+02 |
| Arsenic (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Arsenic (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Arsenic (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Arsenic (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Barium | 50075 | 6/24/86 | ICP | 2.60E+01 |
| Barium | 50137 | 9/23/86 | ICP | 3.00E+01 |
| Barium | 50147 | 10/03/86 | ICP | 2.80E+01 |
| Barium | 50248 | 3/05/87 | ICP | 2.50E+01 |
| Barium | 50685 | 10/13/89 | ICP | 3.60E+01 |
| Barium | 50693 | 10/17/89 | ICP | 3.20E+01 |
| Barium | 50717 | 10/24/89 | ICP | 3.00E+01 |
| Barium | 50947 | 2/16/90 | ICP | 2.90E+01 |
| Barium (EP Toxic) | 50685E | 10/13/89 | ICP | <1.00E+03 |
| Barium (EP Toxic) | 50693E | 10/17/89 | ICP | <1.00E+03 |
| Barium (EP Toxic) | 50717E | 10/24/89 | ICP | <1.00E+03 |
| Barium (EP Toxic) | 50947E | 2/16/90 | ICP | <1.00E+03 |
| Boron | 50685 | 10/13/89 | ICP | 1.50E+01 |
| Boron | 50693 | 10/17/89 | ICP | <1.00E+01 |
| Boron | 50717 | 10/24/89 | ICP | 1.40E+01 |
| Boron | 50947 | 2/16/90 | ICP | <2.20E+01 |
| Cadmium (EP Toxic) | 50685E | 10/13/89 | ICP | <1.00E+02 |
| Cadmium (EP Toxic) | 50693E | 10/17/89 | ICP | <1.00E+02 |
| Cadmium (EP Toxic) | 50717E | 10/24/89 | ICP | <1.00E+02 |
| Cadmium (EP Toxic) | 50947E | 2/16/90 | ICP | <1.00E+02 |
| Calcium | 50075 | 6/24/86 | ICP | 1.71E+04 |
| Calcium | 50137 | 9/23/86 | ICP | 1.94E+04 |
| Calcium | 50147 | 10/03/86 | ICP | 1.93E+04 |
| Calcium | 50248 | 3/05/87 | ICP | 1.89E+04 |
| Calcium | 50685 | 10/13/89 | ICP | 1.84E+04 |
| Calcium | 50693 | 10/17/89 | ICP | 1.92E+04 |
| Calcium | 50717 | 10/24/89 | ICP | 1.88E+04 |
| Calcium | 50947 | 2/16/90 | ICP | 1.79E+04 |
| Chloride | 50075 | 6/24/86 | IC | <5.00E+02 |
| Chloride | 50137 | 9/23/86 | IC | 8.35E+02 |
| Chloride | 50147 | 10/03/86 | IC | 7.68E+02 |
| Chloride | 50248 | 3/05/87 | IC | 1.09E+03 |
| Chloride | 50685 | 10/13/89 | IC | 1.00E+03 |
| Chloride | 50693 | 10/17/89 | IC | 1.00E+03 |
| Chloride | 50717 | 10/24/89 | IC | 1.20E+03 |
| Chloride | 50947 | 2/16/90 | IC | 9.00E+02 |

Data for 244-AR Vault Cooling Water. (sheet 2 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Chromium (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Chromium (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Chromium (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Chromium (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Copper | 50075 | 6/24/86 | ICP | <1.00E+01 |
| Copper | 50137 | 9/23/86 | ICP | 1.80E+01 |
| Copper | 50147 | 10/03/86 | ICP | 4.60E+01 |
| Copper | 50248 | 3/05/87 | ICP | <1.00E+01 |
| Copper | 50685 | 10/13/89 | ICP | <1.00E+01 |
| Copper | 50693 | 10/17/89 | ICP | <1.00E+01 |
| Copper | 50717 | 10/24/89 | ICP | <1.00E+01 |
| Copper | 50947 | 2/16/90 | ICP | 3.01E+02 |
| Fluoride | 50075 | 6/24/86 | IC | <5.00E+02 |
| Fluoride | 50137 | 9/23/86 | IC | <5.00E+02 |
| Fluoride | 50147 | 10/03/86 | IC | <5.00E+02 |
| Fluoride | 50248 | 3/05/87 | IC | <5.00E+02 |
| Fluoride | 50685 | 10/13/89 | IC | <5.00E+02 |
| Fluoride | 50685 | 10/13/89 | ISE | 1.75E+02 |
| Fluoride | 50693 | 10/17/89 | IC | <5.00E+02 |
| Fluoride | 50693 | 10/17/89 | ISE | 1.51E+02 |
| Fluoride | 50717 | 10/24/89 | IC | <5.00E+02 |
| Fluoride | 50717 | 10/24/89 | ISE | 1.63E+02 |
| Fluoride | 50947 | 2/16/90 | IC | <5.00E+02 |
| Fluoride | 50947 | 2/16/90 | ISE | 1.28E+02 |
| Iron | 50075 | 6/24/86 | ICP | <5.00E+01 |
| Iron | 50137 | 9/23/86 | ICP | 2.96E+02 |
| Iron | 50147 | 10/03/86 | ICP | 3.05E+02 |
| Iron | 50248 | 3/05/87 | ICP | 1.72E+02 |
| Iron | 50685 | 10/13/89 | ICP | 1.28E+02 |
| Iron | 50693 | 10/17/89 | ICP | 4.20E+01 |
| Iron | 50717 | 10/24/89 | ICP | 3.20E+01 |
| Iron | 50947 | 2/16/90 | ICP | 6.58E+02 |
| Lead | 50137 | 9/23/86 | GFAA | 6.80E+00 |
| Lead | 50147 | 10/03/86 | GFAA | <5.00E+00 |
| Lead | 50248 | 3/05/87 | GFAA | <5.00E+00 |
| Lead | 50685 | 10/13/89 | GFAA | <5.00E+00 |
| Lead | 50693 | 10/17/89 | GFAA | <5.00E+00 |
| Lead | 50717 | 10/24/89 | GFAA | <5.00E+00 |
| Lead | 50947 | 2/16/90 | GFAA | <5.00E+00 |
| Lead (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Lead (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Lead (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Lead (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Magnesium | 50075 | 6/24/86 | ICP | 3.76E+03 |
| Magnesium | 50137 | 9/23/86 | ICP | 4.25E+03 |
| Magnesium | 50147 | 10/03/86 | ICP | 4.23E+03 |
| Magnesium | 50248 | 3/05/87 | ICP | 4.35E+03 |
| Magnesium | 50685 | 10/13/89 | ICP | 4.17E+03 |

Data for 244-AR Vault Cooling Water. (sheet 3 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Magnesium | 50693 | 10/17/89 | ICP | 4.16E+03 |
| Magnesium | 50717 | 10/24/89 | ICP | 4.03E+03 |
| Magnesium | 50947 | 2/16/90 | ICP | 4.23E+03 |
| Manganese | 50075 | 6/24/86 | ICP | <5.00E+00 |
| Manganese | 50137 | 9/23/86 | ICP | 4.60E+01 |
| Manganese | 50147 | 10/03/86 | ICP | 3.50E+01 |
| Manganese | 50248 | 3/05/87 | ICP | <5.00E+00 |
| Manganese | 50685 | 10/13/89 | ICP | <5.00E+00 |
| Manganese | 50693 | 10/17/89 | ICP | <5.00E+00 |
| Manganese | 50717 | 10/24/89 | ICP | <5.00E+00 |
| Manganese | 50947 | 2/16/90 | ICP | 2.30E+01 |
| Mercury (EP Toxic) | 50685E | 10/13/89 | CVAA/M | <2.00E+01 |
| Mercury (EP Toxic) | 50693E | 10/17/89 | CVAA/M | <2.00E+01 |
| Mercury (EP Toxic) | 50717E | 10/24/89 | CVAA/M | <2.00E+01 |
| Mercury (EP Toxic) | 50947E | 2/16/90 | CVAA/M | <2.00E+01 |
| Nitrate | 50075 | 6/24/86 | IC | <5.00E+02 |
| Nitrate | 50137 | 9/23/86 | IC | <5.00E+02 |
| Nitrate | 50147 | 10/03/86 | IC | 5.40E+02 |
| Nitrate | 50248 | 3/05/87 | IC | <5.00E+02 |
| Nitrate | 50685 | 10/13/89 | IC | <5.00E+02 |
| Nitrate | 50693 | 10/17/89 | IC | <5.00E+02 |
| Nitrate | 50717 | 10/24/89 | IC | 6.00E+02 |
| Nitrate | 50947 | 2/16/90 | IC | 6.00E+02 |
| Potassium | 50075 | 6/24/86 | ICP | 7.19E+02 |
| Potassium | 50137 | 9/23/86 | ICP | 9.42E+02 |
| Potassium | 50147 | 10/03/86 | ICP | 8.46E+02 |
| Potassium | 50248 | 3/05/87 | ICP | 7.26E+02 |
| Potassium | 50685 | 10/13/89 | ICP | 8.00E+02 |
| Potassium | 50693 | 10/17/89 | ICP | 7.27E+02 |
| Potassium | 50717 | 10/24/89 | ICP | 7.54E+02 |
| Potassium | 50947 | 2/16/90 | ICP | 7.50E+02 |
| Selenium (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Selenium (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Selenium (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Selenium (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Silicon | 50685 | 10/13/89 | ICP | 2.38E+03 |
| Silicon | 50693 | 10/17/89 | ICP | 2.31E+03 |
| Silicon | 50717 | 10/24/89 | ICP | 2.40E+03 |
| Silicon | 50947 | 2/16/90 | ICP | 2.55E+03 |
| Silver (EP Toxic) | 50685E | 10/13/89 | ICP | <5.00E+02 |
| Silver (EP Toxic) | 50693E | 10/17/89 | ICP | <5.00E+02 |
| Silver (EP Toxic) | 50717E | 10/24/89 | ICP | <5.00E+02 |
| Silver (EP Toxic) | 50947E | 2/16/90 | ICP | <5.00E+02 |
| Sodium | 50075 | 6/24/86 | ICP | 2.22E+03 |
| Sodium | 50137 | 9/23/86 | ICP | 2.62E+03 |
| Sodium | 50147 | 10/03/86 | ICP | 2.50E+03 |
| Sodium | 50248 | 3/05/87 | ICP | 1.89E+03 |
| Sodium | 50685 | 10/13/89 | ICP | 2.24E+03 |

Data for 244-AR Vault Cooling Water. (sheet 4 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Sodium | 50693 | 10/17/89 | ICP | 2.21E+03 |
| Sodium | 50717 | 10/24/89 | ICP | 2.24E+03 |
| Sodium | 50947 | 2/16/90 | ICP | 2.03E+03 |
| Strontium | 50075 | 6/24/86 | ICP | <3.00E+02 |
| Strontium | 50137 | 9/23/86 | ICP | <3.00E+02 |
| Strontium | 50147 | 10/03/86 | ICP | <3.00E+02 |
| Strontium | 50248 | 3/05/87 | ICP | <3.00E+02 |
| Strontium | 50685 | 10/13/89 | ICP | 1.05E+02 |
| Strontium | 50693 | 10/17/89 | ICP | 1.01E+02 |
| Strontium | 50717 | 10/24/89 | ICP | 9.60E+01 |
| Strontium | 50947 | 2/16/90 | ICP | 8.70E+01 |
| Sulfate | 50075 | 6/24/86 | IC | 9.41E+03 |
| Sulfate | 50137 | 9/23/86 | IC | 9.37E+03 |
| Sulfate | 50147 | 10/03/86 | IC | 9.42E+03 |
| Sulfate | 50248 | 3/05/87 | IC | 1.18E+04 |
| Sulfate | 50685 | 10/13/89 | IC | 1.02E+04 |
| Sulfate | 50693 | 10/17/89 | IC | 1.05E+04 |
| Sulfate | 50717 | 10/24/89 | IC | 1.08E+04 |
| Sulfate | 50947 | 2/16/90 | IC | 1.00E+04 |
| Uranium | 50075 | 6/24/86 | FLUOR | 3.08E-01 |
| Uranium | 50137 | 9/23/86 | FLUOR | 1.13E+00 |
| Uranium | 50147 | 10/03/86 | FLUOR | 5.20E-01 |
| Uranium | 50248 | 3/05/87 | FLUOR | 4.87E-01 |
| Uranium | 50685 | 10/13/89 | FLUOR | 5.04E-01 |
| Uranium | 50693 | 10/17/89 | FLUOR | 5.59E-01 |
| Uranium | 50717 | 10/24/89 | FLUOR | 5.98E-01 |
| Zinc | 50075 | 6/24/86 | ICP | 2.60E+01 |
| Zinc | 50137 | 9/23/86 | ICP | 2.70E+01 |
| Zinc | 50147 | 10/03/86 | ICP | 2.10E+01 |
| Zinc | 50248 | 3/05/87 | ICP | 1.70E+01 |
| Zinc | 50685 | 10/13/89 | ICP | 7.00E+00 |
| Zinc | 50693 | 10/17/89 | ICP | 7.00E+00 |
| Zinc | 50717 | 10/24/89 | ICP | 5.00E+00 |
| Zinc | 50947 | 2/16/90 | ICP | 4.70E+01 |
| Ammonia | 50075 | 6/24/86 | ISE | <5.00E+01 |
| Ammonia | 50137 | 9/23/86 | ISE | 5.40E+01 |
| Ammonia | 50147 | 10/03/86 | ISE | <5.00E+01 |
| Ammonia | 50248 | 3/05/87 | ISE | <5.00E+01 |
| Ammonia | 50685 | 10/13/89 | ISE | 5.50E+01 |
| Ammonia | 50693 | 10/17/89 | ISE | 7.10E+01 |
| Ammonia | 50717 | 10/24/89 | ISE | 5.10E+01 |
| Ammonia | 50947 | 2/16/90 | ISE | <5.00E+01 |
| 1-Butanol | 50685 | 10/13/89 | DIGC | <1.00E+04 |
| 1-Butanol | 50693 | 10/17/89 | DIGC | <1.00E+04 |
| 1-Butanol | 50717 | 10/24/89 | DIGC | <1.00E+04 |
| 1-Butanol | 50947 | 2/16/90 | VOA | 5.00E+00 |
| 1-Butanol | 50947 | 2/16/90 | DIGC | <1.00E+04 |
| 2-Butanone | 50075 | 6/24/86 | VOA | <1.00E+01 |

Data for 244-AR Vault Cooling Water. (sheet 5 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| 2-Butanone | 50075B | 6/24/86 | VOA | <1.00E+01 |
| 2-Butanone | 50137 | 9/23/86 | VOA | <1.00E+01 |
| 2-Butanone | 50137B | 9/23/86 | VOA | <1.00E+01 |
| 2-Butanone | 50147 | 10/03/86 | VOA | <1.00E+01 |
| 2-Butanone | 50147B | 10/03/86 | VOA | <1.00E+01 |
| 2-Butanone | 50248 | 3/05/87 | VOA | <1.00E+01 |
| 2-Butanone | 50248B | 3/05/87 | VOA | <1.00E+01 |
| 2-Butanone | 50685 | 10/13/89 | VOA | <1.00E+01 |
| 2-Butanone | 50685B | 10/13/89 | VOA | <1.00E+01 |
| 2-Butanone | 50685T | 10/13/89 | VOA | <1.00E+01 |
| 2-Butanone | 50693 | 10/17/89 | VOA | <1.00E+01 |
| 2-Butanone | 50693B | 10/17/89 | VOA | <1.00E+01 |
| 2-Butanone | 50693T | 10/17/89 | VOA | <5.00E+00 |
| 2-Butanone | 50717 | 10/24/89 | VOA | <1.00E+01 |
| 2-Butanone | 50717B | 10/24/89 | VOA | 1.30E+01 |
| 2-Butanone | 50717T | 10/24/89 | VOA | <1.00E+01 |
| 2-Butanone | 50947 | 2/16/90 | VOA | <1.00E+01 |
| 2-Butanone | 50947B | 2/16/90 | VOA | <1.00E+01 |
| 2-Butanone | 50947T | 2/16/90 | VOA | <5.00E+00 |
| Dichloromethane | 50075 | 6/24/86 | VOA | <1.00E+01 |
| Dichloromethane | 50075B | 6/24/86 | VOA | 1.86E+02 |
| Dichloromethane | 50137 | 9/23/86 | VOA | <1.00E+01 |
| Dichloromethane | 50137B | 9/23/86 | VOA | 1.30E+02 |
| Dichloromethane | 50147 | 10/03/86 | VOA | <1.00E+01 |
| Dichloromethane | 50147B | 10/03/86 | VOA | 1.10E+02 |
| Dichloromethane | 50248 | 3/05/87 | VOA | <1.00E+01 |
| Dichloromethane | 50248B | 3/05/87 | VOA | 4.60E+01 |
| Dichloromethane | 50685 | 10/13/89 | VOA | <5.00E+00 |
| Dichloromethane | 50685B | 10/13/89 | VOA | 3.90E+02 |
| Dichloromethane | 50685T | 10/13/89 | VOA | 3.70E+02 |
| Dichloromethane | 50693 | 10/17/89 | VOA | <5.00E+00 |
| Dichloromethane | 50693B | 10/17/89 | VOA | <3.00E+00 |
| Dichloromethane | 50693T | 10/17/89 | VOA | 1.40E+01 |
| Dichloromethane | 50717 | 10/24/89 | VOA | <5.00E+00 |
| Dichloromethane | 50717B | 10/24/89 | VOA | 5.00E+00 |
| Dichloromethane | 50717T | 10/24/89 | VOA | 6.10E+01 |
| Dichloromethane | 50947 | 2/16/90 | VOA | <5.00E+00 |
| Dichloromethane | 50947B | 2/16/90 | VOA | <5.00E+00 |
| Dichloromethane | 50947T | 2/16/90 | VOA | <5.00E+00 |
| Tetrahydrofuran | 50685 | 10/13/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50685B | 10/13/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50685T | 10/13/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50693 | 10/17/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50693B | 10/17/89 | VOA | 1.30E+01 |
| Tetrahydrofuran | 50693T | 10/17/89 | VOA | 1.30E+01 |
| Tetrahydrofuran | 50717 | 10/24/89 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50717B | 10/24/89 | VOA | 2.10E+01 |
| Tetrahydrofuran | 50717T | 10/24/89 | VOA | <7.00E+00 |

Data for 244-AR Vault Cooling Water. (sheet 6 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| Tetrahydrofuran | 50947 | 2/16/90 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50947B | 2/16/90 | VOA | <1.00E+01 |
| Tetrahydrofuran | 50947T | 2/16/90 | VOA | <5.00E+00 |
| Alkalinity (Method B) | 50685 | 10/13/89 | TITRA | 5.80E+04 |
| Alkalinity (Method B) | 50693 | 10/17/89 | TITRA | 5.90E+04 |
| Alkalinity (Method B) | 50717 | 10/24/89 | TITRA | 5.80E+04 |
| Alkalinity (Method B) | 50947 | 2/16/90 | TITRA | 5.90E+04 |
| Alpha Activity (pCi/L) | 50075 | 6/24/86 | Alpha | 3.01E-01 |
| Alpha Activity (pCi/L) | 50137 | 9/23/86 | Alpha | 1.31E+00 |
| Alpha Activity (pCi/L) | 50147 | 10/03/86 | Alpha | 6.71E-01 |
| Alpha Activity (pCi/L) | 50248 | 3/05/87 | Alpha | 4.36E-01 |
| Alpha Activity (pCi/L) | 50685 | 10/13/89 | Alpha | 1.02E+00 |
| Alpha Activity (pCi/L) | 50693 | 10/17/89 | Alpha | <2.34E-01 |
| Alpha Activity (pCi/L) | 50717 | 10/24/89 | Alpha | 7.71E-01 |
| Beta Activity (pCi/L) | 50075 | 6/24/86 | Beta | 6.48E+00 |
| Beta Activity (pCi/L) | 50137 | 9/23/86 | Beta | 7.07E+00 |
| Beta Activity (pCi/L) | 50147 | 10/03/86 | Beta | 3.25E+00 |
| Beta Activity (pCi/L) | 50248 | 3/05/87 | Beta | 1.39E+00 |
| Beta Activity (pCi/L) | 50685 | 10/13/89 | Beta | <1.08E+00 |
| Beta Activity (pCi/L) | 50693 | 10/17/89 | Beta | <1.31E+00 |
| Beta Activity (pCi/L) | 50717 | 10/24/89 | Beta | <8.69E-01 |
| Conductivity (μS) | 50075 | 6/24/86 | COND-Fld | 1.75E+02 |
| Conductivity (μS) | 50137 | 9/23/86 | COND-Fld | 1.29E+02 |
| Conductivity (μS) | 50147 | 10/03/86 | COND-Fld | 1.25E+02 |
| Conductivity (μS) | 50248 | 3/05/87 | COND-Fld | 1.43E+02 |
| Conductivity (μS) | 50685 | 10/13/89 | COND-Fld | 1.40E+02 |
| Conductivity (μS) | 50693 | 10/17/89 | COND-Fld | 1.27E+02 |
| Conductivity (μS) | 50717 | 10/24/89 | COND-Fld | 1.17E+02 |
| Conductivity (μS) | 50947 | 2/16/90 | COND-Fld | 1.60E+02 |
| Ignitability (°F) | 50685E | 10/13/89 | IGNIT | 2.12E+02 |
| Ignitability (°F) | 50693E | 10/17/89 | IGNIT | 2.10E+02 |
| Ignitability (°F) | 50717E | 10/24/89 | IGNIT | 2.10E+02 |
| Ignitability (°F) | 50947E | 2/16/90 | IGNIT | 2.10E+02 |
| pH (dimensionless) | 50075 | 6/24/86 | PH-Fld | 6.20E+00 |
| pH (dimensionless) | 50137 | 9/23/86 | PH-Fld | 7.80E+00 |
| pH (dimensionless) | 50147 | 10/03/86 | PH-Fld | 7.47E+00 |
| pH (dimensionless) | 50248 | 3/05/87 | PH-Fld | 5.58E+00 |
| pH (dimensionless) | 50685 | 10/13/89 | PH-Fld | 7.00E+00 |
| pH (dimensionless) | 50693 | 10/17/89 | PH-Fld | 8.18E+00 |
| pH (dimensionless) | 50717 | 10/24/89 | PH-Fld | 8.40E+00 |
| pH (dimensionless) | 50947 | 2/16/90 | PH-Fld | 7.00E+00 |
| Reactivity Cyanide (mg/kg) | 50685E | 10/13/89 | DSPEC | <1.00E+02 |
| Reactivity Cyanide (mg/kg) | 50693E | 10/17/89 | DSPEC | <1.00E+02 |
| Reactivity Cyanide (mg/kg) | 50717E | 10/24/89 | DSPEC | <1.00E+02 |
| Reactivity Cyanide (mg/kg) | 50947E | 2/16/90 | DSPEC | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50685E | 10/13/89 | DTITRA | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50693E | 10/17/89 | DTITRA | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50717E | 10/24/89 | DTITRA | <1.00E+02 |
| Reactivity Sulfide (mg/kg) | 50947E | 2/16/90 | DTITRA | <1.00E+02 |

Data for 244-AR Vault Cooling Water. (sheet 7 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| TDS | 50685 | 10/13/89 | TDS | 7.10E+04 |
| TDS | 50693 | 10/17/89 | TDS | 6.50E+04 |
| TDS | 50717 | 10/24/89 | TDS | 7.10E+04 |
| TDS | 50947 | 2/16/90 | TDS | 5.60E+04 |
| Temperature (°C) | 50137 | 9/23/86 | TEMP-Fld | 1.77E+01 |
| Temperature (°C) | 50147 | 10/03/86 | TEMP-Fld | 1.70E+01 |
| Temperature (°C) | 50248 | 3/05/87 | TEMP-Fld | 2.64E+01 |
| Temperature (°C) | 50685 | 10/13/89 | TEMP-Fld | 1.92E+01 |
| Temperature (°C) | 50693 | 10/17/89 | TEMP-Fld | 1.75E+01 |
| Temperature (°C) | 50717 | 10/24/89 | TEMP-Fld | 1.54E+01 |
| Temperature (°C) | 50947 | 2/16/90 | TEMP-Fld | 2.26E+01 |
| TOC | 50075 | 6/24/86 | TOC | 2.01E+03 |
| TOC | 50137 | 9/23/86 | TOC | 1.75E+03 |
| TOC | 50147 | 10/03/86 | TOC | <9.97E+02 |
| TOC | 50248 | 3/05/87 | TOC | 1.10E+03 |
| TOC | 50685 | 10/13/89 | TOC | <1.50E+03 |
| TOC | 50693 | 10/17/89 | TOC | <1.60E+03 |
| TOC | 50717 | 10/24/89 | TOC | <1.40E+03 |
| TOC | 50947 | 2/16/90 | TOC | <1.30E+03 |
| Total Carbon | 50685 | 10/13/89 | TC | 1.60E+04 |
| Total Carbon | 50693 | 10/17/89 | TC | 1.60E+04 |
| Total Carbon | 50717 | 10/24/89 | TC | 1.58E+04 |
| Total Carbon | 50947 | 2/16/90 | TC | 1.53E+04 |
| TOX (as Cl) | 50075 | 6/24/86 | TOX | <1.65E+01 |
| TOX (as Cl) | 50137 | 9/23/86 | TOX | <8.00E+00 |
| TOX (as Cl) | 50147 | 10/03/86 | TOX | <1.00E+02 |
| TOX (as Cl) | 50248 | 3/05/87 | LTOX | <2.00E+01 |
| TOX (as Cl) | 50685 | 10/13/89 | LTOX | <8.00E+00 |
| TOX (as Cl) | 50693 | 10/17/89 | LTOX | <5.00E+00 |
| TOX (as Cl) | 50717 | 10/24/89 | LTOX | 1.00E+01 |
| TOX (as Cl) | 50947 | 2/16/90 | LTOX | <8.00E+00 |
| $^{60}$Co (pCi/L) | 50685 | 10/13/89 | GEA | <2.89E-01 |
| $^{60}$Co (pCi/L) | 50693 | 10/17/89 | GEA | <1.01E-01 |
| $^{60}$Co (pCi/L) | 50717 | 10/24/89 | GEA | 1.59E+00 |
| $^{129}$I (pCi/L) | 50685 | 10/13/89 | LEPD | 9.08E-02 |
| $^{239,240}$Pu (pCi/L) | 50685 | 10/13/89 | AEA | 7.13E-03 |
| $^{239,240}$Pu (pCi/L) | 50693 | 10/17/89 | AEA | 8.01E-03 |
| Radium Total (pCi/L) | 50685 | 10/13/89 | Alpha-Ra | <1.16E-01 |
| Radium Total (pCi/L) | 50693 | 10/17/89 | Alpha-Ra | 2.08E-01 |
| Radium Total (pCi/L) | 50717 | 10/24/89 | Alpha-Ra | 1.77E-01 |
| $^{106}$Ru (pCi/L) | 50685 | 10/13/89 | GEA | <1.06E+00 |
| $^{106}$Ru (pCi/L) | 50693 | 10/17/89 | GEA | 5.07E+00 |
| $^{90}$Sr (pCi/L) | 50685 | 10/13/89 | Beta | <5.20E-02 |
| $^{90}$Sr (pCi/L) | 50693 | 10/17/89 | Beta | 2.02E-01 |
| $^{90}$Sr (pCi/L) | 50717 | 10/24/89 | Beta | 2.70E-01 |
| $^{234}$U (pCi/L) | 50685 | 10/13/89 | AEA | 1.99E-01 |
| $^{234}$U (pCi/L) | 50693 | 10/17/89 | AEA | 2.04E-01 |
| $^{234}$U (pCi/L) | 50717 | 10/24/89 | AEA | 2.61E-01 |

Data for 244-AR Vault Cooling Water. (sheet 8 of 9)

| Constituent | Sample # | Date | Method | Result |
|---|---|---|---|---|
| $^{238}U$ (pCi/L) | 50685 | 10/13/89 | AEA | 1.53E-01 |
| $^{238}U$ (pCi/L) | 50693 | 10/17/89 | AEA | 1.62E-01 |
| $^{238}U$ (pCi/L) | 50717 | 10/24/89 | AEA | 1.82E-01 |

The following table lists the methods that are coded in the method column.

| Code | Analytical Method | Reference |
|---|---|---|
| ABN | Semivolatile Organics (GC/MS) | USEPA-8270 |
| AEA | $^{241}Am$ | UST-20Am01 |
| AEA | Curium Isotopes | UST-20Am/Cm01 |
| AEA | Plutonium Isotopes | UST-20Pu01 |
| AEA | Uranium Isotopes | UST-20U01 |
| ALPHA | Alpha Counting | EPA-680/4-75/1 |
| ALPHA-Ra | Total Radium Alpha Counting | ASTM-D2460 |
| BETA | Beta Counting | EPA-680/4-75/1 |
| BETA | $^{90}Sr$ | UST-20Sr02 |
| COLIF | Coliform Bacteria | USEPA-9131 |
| COLIFMF | Coliform Bacteria (Membrane Filter) | USEPA-9132 |
| COND-Fld | Conductivity-Field | ASTM-D1125A |
| COND-Lab | Conductivity-Laboratory | ASTM-D1125A |
| CVAA | Mercury | USEPA-7470 |
| CVAA/M | Mercury-Mixed Matrix | USEPA-7470 |
| DIGC | Direct Aqueous Injection (GC) | UST-70DIGC |
| DIMS | Direct Aqueous Injection (GC/MS) | "USEPA-8240" |
| DSPEC | Reactive Cyanide (Distillation, Spectroscopy) | USEPA-CHAPTER 7 |
| DTITRA | Reactive Sulfide (Distillation, Titration) | USEPA-CHAPTER 7 |
| FLUOR | Uranium (Fluorometry) | ASTM-D2907-83 |
| GEA | Gamma Energy Analysis Spectroscopy | ASTM-D3649-85 |
| GFAA | Arsenic (AA, Furnace Technique) | USEPA-7060 |
| GFAA | Lead (AA, Furnace Technique) | USEPA-7421 |
| GFAA | Selenium (AA, Furnace Technique) | USEPA-7740 |
| GFAA | Thallium (AA, Furnace Technique) | USEPA-7841 |
| IC | Ion Chromatography | EPA-600/4-84-01 |
| ICP | Atomic Emission Spectroscopy (ICP) | USEPA-6010 |
| ICP/M | Atomic Emission Spectroscopy (ICP)-Mixed Matrix | USEPA-6010 |
| IGNIT | Pensky-Martens Closed-Cup Ignitability | USEPA-1010 |
| ISE | Fluoride-Low Detection Limit | ASTM-D1179-80-B |
| ISE | Ammonium Ion | ASTM-D1426-D |
| LALPHA | Alpha Activity-Low Detection Limit | EPA-680/4-75/1 |
| LEPD | $^{129}I$ | UST-20I02 |
| LSC | $^{14}C$ | UST-20C01 |

Data for 244-AR Vault Cooling Water. (sheet 9 of 9)

| Code | Analytical Method | Reference |
|---|---|---|
| LSC | Tritium | UST-20H03 |
| LTOX | Total Organic Halides-Low Detection Limit | USEPA-9020 |
| PH-Fld | pH-Field | USEPA-9040 |
| PH-Lab | pH-Laboratory | USEPA-9040 |
| SPEC | Total and Amenable Cyanide (Spectroscopy) | USEPA-9010 |
| SPEC | Hydrazine-Low Detection Limit (Spectroscopy) | ASTM-D1385 |
| SSOLID | Suspended Solids | SM-208D |
| TC | Total Carbon | USEPA-9060 |
| TDS | Total Dissolved Solids | SM-208B |
| TEMP-Fld | Temperature-Field | Local |
| TITRA | Alkalinity-Method B (Titration) | ASTM-D1067B |
| TITRA | Sulfides (Titration) | USEPA-9030 |
| TOC | Total Organic Carbon | USEPA-9060 |
| TOX | Total Organic Halides | USEPA-9020 |
| VOA | Volatile Organics (GC/MS) | USEPA-8240 |

NOTES:

Sample# is the number of the sample. See Section 3.0 for corresponding chain-of-custody number.

Date is the sampling date.

Results are in ppb (parts per billion) unless otherwise indicated.

Analytical Method Acronyms:

AA = atomic absorption spectroscopy.
GC = gas chromatography.
MS = mass spectrometry.
ICP = inductively-coupled plasma spectroscopy.

References:

ASTM--"1986 Annual Book of ASTM Standards", American Society for Testing and Materials, Philadelphia, Pennsylvania.

EPA--Various methods of the U.S. Environmental Protection Agency, Washington, D.C.

UST--Methods of the United States Testing Company, Incorporated, Richland, Washington.

SM--"Standard Methods for the Examination of Water and Wastewater", 16th ed., American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, D.C.

USEPA--"Test Methods for Evaluating Solid Waste Physical/Chemical Methods", 3rd ed., SW-846, U.S. Environmental Protection Agency, Washington, D.C.

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