AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

SECRET

DOUGLAS / UNITED NUCLEAR, INC.

DOCUMENT NO.

DUN-7238

Hanford Category C-65

SERIES AND COPY NO.

A 12

DATE _____

SEP 9 1970

~~RESTRICTED DATA~~

THIS DOCUMENT CONTAINS RESTRICTED DATA AS
DEFINED IN THE ATOMIC ENERGY ACT OF 1954.
ITS TRANSMISSION OR THE DISCLOSURE OF ITS
CONTENTS IN ANY MANNER TO AN UNAUTHORIZED

TITLE

LIQUID WASTE DISPOSAL REVIEW

100-K PLANT

~~OTHER OFFICIAL CLASSIFIED INFORMATION~~

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U. S. C., SECS. 793 AND 794, THE TRANSMISSION OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

AUTHOR

G. W. Wells

ISSUING FILE

REFERENCE COPY
REMOVED TO AREA

SEP 10 1970

RETURN TO
DOUGLAS UNITED NUCLEAR, INC.
DOCUMENT CONTROL CENTER

THIS DOCUMENT MUST NOT BE LEFT UNATTENDED OR WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS TO IT. WHEN NOT IN USE, IT MUST BE STORED IN AN APPROVED LOCKED REPOSITORY WITHIN AN APPROVED GUARDED AREA. WHEN OUT OF YOUR POSSESSION AND WHILE YOU HAVE OBTAINED A SIGNED RECEIPT FROM CLASSIFIED FILES, IT IS YOUR RESPONSIBILITY TO RETURN IT AND ITS CONTENTS WITHIN THE LIMITS OF THIS PROJECT AND FROM ANY UNAUTHORIZED PERSON. ITS TRANSMISSION TO, AND STORAGE AT YOUR PLACE OF RESIDENCE IS PROHIBITED. IT IS NOT TO BE DUPLICATED. IF ADDITIONAL COPIES ARE REQUIRED, OBTAIN THEM FROM THE RELATED ISSUING FILE. ALL PERSONS READING THIS DOCUMENT ARE REQUESTED TO SIGN IN THE SPACE PROVIDED BELOW.

**MASTER
DECLASSIFIED**

(CLASSIFICATION)

~~SECRET~~
DECLASSIFIED

-1-

DUN-7238
Hanford Category C-65

~~SECRET~~
~~DECLASSIFIED~~
This document contains restricted data as
of the Atomic Energy Act of 1954.
Its transmittal or the disclosure of its
contents in any manner to an unauthorized
person is prohibited.

This document consists of
32 pages. No. ~~1~~ of
~~1~~ copies. Series ~~1~~

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

LIQUID WASTE DISPOSAL REVIEW

100-K PLANT

Distribution

1. R. G. Clough, Jr.
2. C. D. Corbit
3. J. W. Frymier
4. V. V. Johnson
5. A. P. Larrick
6. P. E. Lindstrom
7. A. R. Maguire
8. R. H. Steach
9. R. K. Wahlen
10. G. W. Wells
11. DUN File
12. DUN Record

Classification Cancelled and Changed To
DECLASSIFIED

By Authority of SG-PR-2

By PL Sullivan 1-17-94

Verified By 1/26/92

Classification reviewed for de-
classification but left unchanged
by Q. E. Lindstrom

Date 5-10-93

Group 1

~~Excluded from Automatic Downgrading
and Declassification~~

This document classified by

Q. E. Lindstrom

DECLASSIFIED

~~SECRET~~
DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DECLASSIFIED

DUN-7238
Page 2

LIQUID WASTE DISPOSAL REVIEW

100-K PLANT

INTRODUCTION

This report presents a review of current 100-K Plant liquid waste disposal practices. The report is divided into two sections with Section I consisting of a general description of the Plant facilities to dispose of liquid wastes by ground disposal or by direct discharge to the Columbia River. Section II further appraises liquid waste disposal practices by examining each material that is used in any significant degree in Plant operations. For ease of presentation in Section II, the materials are grouped into general categories of usage with two primary considerations reviewed for each material, i.e., (a) the storage and supply arrangement with emphasis on provisions or safeguards to prevent accidental discharge and (b) the specific application of the material in the process, manner of usage, and final disposition.

The report should be viewed as only an informal source of data to aid in the future preparation (by others) of a comprehensive environmental control plan document. Suggestions as to refinements, additions, or corrections are solicited.

SECTION I

LIQUID WASTE DISPOSAL FACILITIES

GENERAL

Liquid waste disposal is accomplished by either direct discharge to the Columbia River or by ground disposal.

The majority of the water intake (more than 99 percent) is returned to the 1904-K outfall structure and thence is discharged through two welded 84-inch carbon steel lines discharging under water in the center of the river. These liquid effluents emanate from two different sources and enter the 1904-K outfall structure via three different inlets. The major flow is the KE Reactor coolant effluent that enters the outfall structure via a 66-inch line from the KE Reactor process effluent system. A portion of the KW effluent system can also be utilized for KE Reactor effluent discharge, and this flow enters the outfall structure via a 72-inch line. The second source of water is a process waste stream contained in a 66-inch by 66-inch concrete culvert combining both KE and KW waste discharges. The arrangement of the system and pertinent operating data are further detailed in heading A.

Liquid wastes are also directly discharged to ground for disposal via (a) a main ground disposal trench for retention of certain reactor building process drains plus reactor coolant effluent when appropriate, and (2) numerous dry wells located throughout the area. The facilities for ground disposal are further described under heading B.

A. Direct Discharge of Liquid Wastes to the Columbia River

The 1904-K outfall is a concrete structure that serves as the collection point for all liquid effluent being returned to the Columbia River. The KE Reactor coolant effluent enters the structure through a 66-inch inlet. A portion of the KW Reactor effluent system is still being utilized and this flow enters the structure through a 72-inch inlet. The area process sewer drains also terminate at this location and enter the structure through a 66-inch high by 80-inch wide concrete culvert. The combined flow from these three inlet lines is discharged via two welded 84-inch carbon steel lines that extend approximately 1,400 feet to discharge in the river channel. A concrete overflow spillway is also provided of ten-foot width that extends approximately 200 feet to provide for direct river bank discharge in the event of blockage of the underwater discharge lines or high river elevation. Figure 1 is a schematic presentation of the complete system with the two different sources of water (reactor coolant effluent and area process sewer drains) described in further detail in (1) and (2) below.

DECLASSIFIED .

DECLASSIFIED

DUN-7238

Page 4

FIGURE 1

DIRECT DISCHARGE OF LIQUID WASTES
TO THE COLUMBIA RIVER

(1) Reactor Coolant Effluent

The bulk of the water returned to the Columbia River is KE Reactor process coolant effluent that exits from the reactor through retention basins and thence to the 1904-K outfall structure. The retention basins provide for decay of short-lived radioisotopes and provide a means to detain and isolate flow containing high radioisotope concentrations in the event of fuel element failure. A description of the arrangement of equipment and normal method of operation follows: After passing through the reactor process tubes, the water collects in the rear face downcomer and flows by gravity through an underground 72-inch line to a diversion box. At this diversion box, the line divides into three 72-inch lines with each line supplying one 9-million gallon retention basin. Each line is equipped with a motor-operated shut-off valve. A 72-inch bypass line is also provided around the diversion box. This bypass line ties into the inlet piping of one of the basins (Basin C) downstream of the shutoff valve. During normal operation of the effluent system, flow is restricted in this bypass line by an inverted U bend which extends 30 feet higher than the elevation of the diversion valve station. However, if all valves should become inadvertently closed, the effluent water flows over this inverted U bend and into the basin.

The retention basins are welded carbon steel tanks, 250 feet in diameter and 29 feet high mounted on reinforced concrete foundations. The inlet 72-inch effluent piping runs to the side of a basin and discharges into an inlet chute, which in turn discharges to the bottom of the basin. Water flow discharges from the basin via an overflow at the side of each basin to a 60-inch line. The three 60-inch tank discharge lines tie in to a common 66-inch line that forms one inlet to the 1904 outfall structure.

The normal mode of operation utilizes only two basins (B and C) with Basin A left empty for standby conditions. In addition, by appropriate valving, a water level of approximately 14 inches is maintained in all three 107-KW basins to control contamination. The A basin and the three KW basins are filled to approximately the 8-foot level during outages for better contamination control.

(2) Area Process Sewer Drains

The 183-KE and 165-KE buildings are served by a process sewer consisting of a 30-inch increasing to a 48-inch pipe located in the 183-KE to 165-KE connecting tunnel. At 165-KE this line divides to two 36-inch pipes that discharge into a concrete

DECLASSIFIED

receiver and into a 66-inch by 66-inch covered flume that continues to the 1904-K outfall structure. Additional connections to this concrete flume consist of the 36-inch 105-KE Reactor crossunder drain and a 12-inch drain from the west half of the 105-KE collection box. Prior to termination at the 1904-K outfall, the flume is joined with a similar flume from the KW deactivated facilities.

Numerous floor and service drains are collected in this sewer with the most significant flow from the water plant facilities being the filter backwash water and sedimentation basin sludge drainage. These two flows are discussed in greater detail in Section II of this report. The 36-inch connection from 105-KE is the crossunder line drain and is utilized during reactor outage charge-discharge operations. A common header from the basin overflow weirs also connects to this 36-inch line to permit regulation of a portion of the basin flow to the process sewer system. Four drain lines enter the west half of the 105-KE collection box that also drains into the process sewer via a 12-inch drain connection. These four drains are termed as contaminated drain (bottom thermal shield, relief risers, gamma monitor sample water, etc.), potentially contaminated drain (115 facilities, valve pit, etc.), clean drain (floor drains from miscellaneous storage corridor, electrical equipment room, etc.), and the rod cooling water.

B. Liquid Wastes Discharged to the Ground

Liquid wastes are discharged directly to ground for disposal via (1) a main ground disposal trench for retention of certain reactor building process drains plus reactor coolant effluent when appropriate and (2) numerous dry wells located throughout the area. While disposal to area dry wells and water leakage from water storage facilities are insignificant, disposal to the trench is continuous with the flow being controlled to a range of 0.8 to 1.0 million gallons daily.

Figure 2 is a schematic presentation of the trench supply system. The disposal trench can receive water from two sources, i.e., a 16-inch drain from the east half of the collection box located north of the 105-KE building and a 42-inch drain header from the retention basins. The east half of the 105-KE collection box collects water from four sources--the pluto drain, basin drains, basin overflow drains, and drains from the wash pad area (dummy decontamination). A 36-inch drain line from each retention basin (KE and KW) and a 12-inch drain from the retention basin diversion box are the water sources for the 42-inch drain header.

The disposal trench itself is divided into three sections by two earth-filled dams. The first section, "A", is 900 feet long and is covered with wire to prevent the entrance of wildlife. This is the section routinely in use and has a percolation capacity of less than 850 gpm (reference: K Processing O.P. 1.2). Water flow is regulated to maintain maximum capacity by regulation

DECLASSIFIED

DECLASSIFIED

FIGURE 2

DISPOSAL TRENCH SUPPLY SYSTEM

of the reactor basin overflow drain to the collection box. A quantity of 1,200 pounds of copper sulfate was added to this trench section early in 1970 for control of algae growth, and future additions of this chemical will be introduced as required. The "B" section of the trench is 1,500 feet long and is filled only if the capacity of the "A" trench is not sufficient with water overflowing through a 36-inch pipe into "B" section. The "C" section is also 1,500 feet long and would be used only if the "B" section does not have capacity to handle a very unusual requirement.

DECLASSIFIED

DECLASSIFIED

DUN-7238
Page 9

SECTION II

K PLANT MATERIALS

GENERAL

A significant quantity of materials (mainly chemicals) are stored, utilized, and/or consumed in the operation of the K Plant facilities. Certain materials are of primary interest in that they are direct additives and alter the chemical structure of the waste water being returned either to the Columbia River or to the ground. Other materials are of concern in this review only insofar as insuring that safeguards are adequate to prevent their entrainment in liquid waste discharges through accidental discharge from storage or material handling facilities.

For review, the materials have been grouped into three general categories as (A) water treatment chemicals, (B) fuels, and (C) miscellaneous materials. Each material is then further reviewed as to the general arrangement of the storage facilities, normal and maximum quantity of material in storage, manner of material supply to point of consumption, and safeguards to prevent accidental discharge. Reference is also made to specific actions that have been taken to provide added protection against accidental discharge. For materials that are direct additives, the specific application and chemical reactions that occur are described with the eventual contribution to the waste stream defined.

SECTION II
K PLANT MATERIALS

INDEX

A. Water Treatment Chemicals

1. Aluminum Sulfate
2. Bauxite
3. Chlorine
4. Polyacrylamide Filter Aid
5. Sodium Dichromate
6. Sulfuric Acid

B. Fuels

1. No. 6 Fuel Oil
2. No. 2 Diesel Fuel

C. Miscellaneous Materials

1. Ethylene Glycol
2. Nitric Acid and/or Phoenix 33 (Dummy Decontamination)
3. Turco (Rear Face Decontamination)

DECLASSIFIED

A. Water Treatment Chemicals

The water treatment process involves the addition of aluminum sulfate as a coagulant (either purchased liquid alum or that formed from the reaction of sulfuric acid and bauxite), chlorine for algae control, sulfuric acid for plant production of aluminum sulfate and/or for pH control, a polyacrylamide as a filter aid, and sodium dichromate as a corrosion inhibitor. These chemicals all eventually discharge to the Columbia River as summarized in Table 1 below either as soluble additions in the main reactor effluent discharge or as insolubles removed in the water treatment process and discharged to the Columbia River via the area waste system.

TABLE 1

Disposition of Daily Water Treatment Chemical Usage

<u>Material</u>	<u>Quantity</u>	<u>Forms</u>	<u>Disposition</u>
Bauxite	12,000 lbs.	1,800 lbs. insolubles	Periodic discharge to river (basin discharge) at average concentration of 7.5 ppm.
		10,000 lbs. aluminum hydroxide	Periodic discharge to river of 6 ppm average concentration (basin discharge) and 11 ppm average concentration (backwash).
Sulfuric Acid	58,000 lbs.	57,000 lbs. sulfate	Continuous 22 ppm SO ₄ in total effluent.
Chlorine	2,200 lbs.	2,200 lbs.	Continuous 0.86 ppm chlorides in total effluent.
Poly-acrylamides	70 lbs.	70 lbs.	Periodic discharge to river (backwash) at 0.1 ppm concentration.
Sodium Dichromate	1,200 lbs.	185 lbs. sodium	Continuous 0.075 ppm sodium in total effluent.
		430 lbs. chromium	Continuous 0.175 ppm chromium in total effluent.

1. Aluminum Sulfate

The liquid aluminum sulfate for plant use is stored in two above-ground and outside storage tanks immediately south of the 183-K water treatment facility. These tanks of 185,650-gallon capacity each are located at a distance of approximately 3,400 feet from the river. The material is received in an approximate 50 percent solution (containing about 8 percent Al_2O_3) with the total available storage capacity of 371,300 gallons representing 1,911,500 pounds of 17 percent Al_2O_3 content aluminum sulfate (normal commercial alum). This year the month-end inventory quantity has varied from a low of 798,000 pounds to a high of 1,508,980 pounds with the average being 1,225,000 pounds.

Figure 3 shows the storage and feed system. The material flows by gravity from the tanks through two 3-inch suction lines to alum injection pumps located in the 183-KE head house. These suction lines along with additional recirculation lines not shown (to enable heating to prevent criptallization) are contained in a pipe trench. The material from the alum injection pumps is introduced to the two raw water headers supplying the 183-KE water treatment facility. Modifications previously implemented to prevent accidental discharge of material to the process waste sewer and thence to the river are noted on Figure 3. This has included (a) the installation of barriers in the trench and (b) blanking of tank drain lines with the overflow line repiped to serve now as only an equalizing line between tanks.

Aluminum sulfate is used as a coagulant in the water treatment process with the liquid aluminum sulfate used primarily as a backup source for aluminum sulfate produced on plant from the reaction of bauxite ore and sulfuric acid. The following is applicable to either source of aluminum sulfate.

It is added as a coagulant in the water treatment process with the rate of feed adjusted to secure a zero zeta potential (electrophoretic mobility) of the colloid particles contained in raw water. The rate is quite uniform throughout the year varying from about 13 ppm to 20 ppm with the average being 16 ppm. On addition of aluminum sulfate to the incoming raw water, the aluminum sulfate reacts with the natural alkalinity to form the desired aluminum hydroxide precipitate. The growth of this precipitate (termed "floc") captures the turbidity and silt with a portion (perhaps 10 to 20 percent) settling in the sedimentation basins with the balance being captured at the filters and removed during the filter backwash process. Although numerous chemical reactions are involved, the major one is the reaction with calcium bicarbonate contained in the raw water. This formula is:

DECLASSIFIED

DECLASSIFIED

DUM-7238

Page 13

FIGURE 3

LIQUID ALUM STORAGE AND SUPPLY
183-KE WATER TREATMENT

NOTES:

- ① Barriers installed to isolate trench from Building drains.
- ② Blanks installed in Tank drain lines, overflows disconnected from drain system with overflow line now serving as equalizing line between tanks

The aluminum sulfate as shown with 14 waters of crystallization is normal commercial filter alum (containing 17 percent Al_2O_3 content) and all DUN inventory and feed values are in equivalent amounts of this material. At a feed rate of 16 ppm and an average water treated quantity of 31 million gallons daily, the aluminum sulfate requirements are about 40,000 pounds. From the formula shown above, this will produce about 10,000 pounds of aluminum hydroxide. Of this total about 1,500 pounds will settle out in the sedimentation basins while the remaining 8,500 pounds will be retained at the filters. Enmeshed in this amount of aluminum hydroxide is the silt and turbidity removed in the water treatment process. When the aluminum sulfate is being produced on plant, the basin discharges will also contain the insolubles contained in the bauxite as described under that heading.

Figure 4 illustrates the manner in which this material (from the sedimentation basins and filters) is introduced to the process sewer for return to the Columbia River. Each sedimentation basin (six total) is equipped with two imbedded sludge collecting hoppers at the south end of each basin. Each basin is equipped with monorakes which serve to transport the sludge to the sludge hoppers. When the monorakes are in operation, the sludge hoppers are discharged to the waste system by automatic opening of the discharge valve when the monorake approaches the sludge hopper. Although each sludge hopper is also equipped with an open bypass to provide continual flow, the sludge removal in this line would be minimal. The only significant estimate is the 1,500 pounds daily accumulation. Calculations as to actual concentrations at point of discharge to the river become quite nebulous and highly variable. As an example, the current operating schedule for the monorakes is an 8-hour period of operation three days per week. The travel rate of the monorakes yields about three complete sweeps in an 8-hour period with the hopper open and discharging about 20 minutes at the culmination of each sweep. The total discharge time for one basin would be 60 minutes each operating day or a total of 180 minutes per week. As a basin is accumulating about 250 pounds of aluminum hydroxide daily, the 1,750 pounds weekly would indicate an average removal rate of 10 pounds per minute. This waste stream receives additional dilution in the process sewer and again at the 1904 outfall with the minimum total flow to the river being about 20,000 gpm (reactor outage). The 10 pounds per minute aluminum hydroxide sludge would accordingly yield a concentration of 60 ppm aluminum hydroxide or 21 ppm aluminum. During reactor operation, the concentration at point of discharge would be a factor of 10 less. Much higher concentrations, no doubt, occur at initial period of sludge hopper opening and during the initial operation following a period when the monorakes have not been operated.

DECLASSIFIED

DECLASSIFIED

DUN-7238

Page 15

FIGURE 4

WASTE DRAIN SYSTEM FROM WATER TREATMENT PROCESS

The major quantity of aluminum hydroxide is retained at the filters and removed during the filter backwash operation. The filter backwash water will also contain the polyacrylamide filter conditioner as further described under that heading. This discharge at each filter backwash enters the 48-inch main waste line from the 36-inch waste flume drain as shown in Figure 4. A filter backwash at 183-KE is normally of 12-minute duration utilizing 204,000 gallons water with an average of 36 filter backwashes occurring daily. A filter backwash would remove an average accumulation of 240 pounds aluminum hydroxide or an average concentration of 140 ppm (50 ppm aluminum) in the backwash water. The minimum flow at point of discharge would again be 20,000 gpm (reactor outage) plus the 17,000 gpm average backwash flow rate to yield an indicated 65 ppm aluminum hydroxide or 23 ppm aluminum. During reactor operation, the concentration at point of discharge would be a factor of 6 less. Much higher concentrations, however, would occur at initiation of the backwash cycle than this average indicates.

The sulfate radical (SO_4) added with the aluminum sulfate is not altered in the water treatment process. This addition is described under the discussion of sulfuric acid, the major source of SO_4 to the effluent stream.

2. Bauxite

This material (ground bauxite ore) is procured and stored in a 600,000 pound storage silo and a 38,000 pound feed bin for a total available capacity of 638,000 pounds. This year the month-end inventory quantity has varied from a low of 60,000 pounds to a high of 481,300 pounds with the average being 304,330 pounds. This dry material is used to produce aluminum sulfate on reaction with sulfuric acid. A typical analysis of the material currently in use (Alabama Bauxite) is as follows:

Al_2O_3	-	57%
SiO_2	-	12%
Fe_2O_3	-	1%
TiO_2	-	2%
H_2O	-	28%

Figure 5 shows the storage and feed system with pneumatic conveying of the material from the storage silo to the roof-mounted feed bin. From the feed bin the material flows by gravity to dry feeders, thence to a bauxite water slurry tank, and then to the reaction vessel. The aluminum sulfate produced is injected into the raw water headers and functions as previously described under the aluminum sulfate heading.

The chemical formula for this reaction is:

DECLASSIFIED

DECLASSIFIED

DUN-7238
Page 17

FIGURE 5

BAUXITE STORAGE AND SUPPLY
183-KE WATER TREATMENT

Therefore, to produce one pound of aluminum sulfate will require 0.17 pounds of Al_2O_3 . As the bauxite ore contains about 57% Al_2O_3 , the pounds of bauxite required would be 0.3 pounds. As noted earlier (under discussion of aluminum sulfate) about 40,000 pounds of aluminum sulfate are required daily. When produced by the bauxite reaction process, the amount of bauxite required is therefore $40,000 \times 0.3$ or 12,000 pounds. The bauxite contains roughly 15% insolubles (largely hydrated aluminum silicates) so about $12,000 \times 0.15$ or 1,800 pounds of insoluble material will be formed daily and settle in the sedimentation basins. Utilizing again the same assumptions for sludge hopper discharge frequency and minimum total flow at point of discharge (reference page 14), the discharge would contain about 75 ppm of insolubles from the bauxite process in addition to the previously calculated 60 ppm of aluminum hydroxide. Again, this value would be reduced by a factor of 10 during reactor operation and subject to considerable fluctuation as previously described.

3. Chlorine

This material is received and used directly from liquid tank cars housed in a bomb-resistant concrete shelter building. Although the shelter contains space for four cars, the normal practice involves one car in service with a replacement car placed in standby when the car in service has about 25% capacity remaining. Although smaller chlorine rail cars have been utilized, 55-ton (110,000 pound) rail cars are generally employed. This year the month-end inventory quantity has varied from a low of 13,332 pounds to a high of 198,396 pounds with the average being 128,475 pounds.

Figure 6 shows the storage and feed system. Each of the four car storage spaces has its own chlorine line running separately through a trench to the chlorine room in the 183-KE head house. At that point the lines are manifolded to serve the chlorine evaporator.

Chlorine is fed continuously to the raw water entering the 183-KE water treatment facility with the rate adjusted to maintain a free residual chlorine content of 0 to 0.20 ppm in the final plant effluent. In the past year, the monthly average feed rates varied from a low of 0.47 ppm to a high of 1.31 ppm with the average being 0.86 ppm. Under normal flow conditions, the average feed rate represents 2,200 pounds daily usage which essentially all discharge to the Columbia River in the form of chlorides.

4. Polyacrylamide Filter Aid

The two materials currently approved for use are Purifloc NP-10 produced by Dow Chemical Company and Magnifloc 990 produced by the American Cyanamid Company. These high-molecular weight, synthetic organic polymers are received and stored as bagged material. This year the month-end inventory has varied from a low of 4,100 pounds to a high of 10,900 pounds with the average being 7,150 pounds. The material is

DECLASSIFIED

DECLASSIFIED

DUN-7238
Page 19

FIGURE 6

CHLORINE STORAGE AND SUPPLY
183-KE WATER TREATMENT

prepared for use by dissolving either 25 or 50 pounds in 7,500 gallons of water. The solution concentration is therefore either 0.04 or 0.08 percent, depending on feed requirements. Two tanks are utilized in this process with one serving as a mix tank with material prepared as required and pumped to a feed tank.

The material is pumped through rotameters to the water inlet of each filter. The material serves to aid in retention of floc (aluminum hydroxide) in the filters and is regulated solely on requirements. In the past year, the monthly average feed rates varied from a low of 0.020 ppm to a high of 0.037 ppm with the average being 0.027 ppm. This material is all retained at the filters and discharged to the Columbia River during filter backwashing. The average feed of 70 pounds daily represents only the discharge of 2 pounds per backwash with the concentration at point of discharge to the river being an average of 0.6 ppm at minimum flow conditions (reactor outage) and a factor of 6 less during reactor operation.

It is pertinent to note that polyacrylamide materials are finding increased application in water treatment systems. Where plants are producing potable water, the usage must be restricted to those specifically approved as potable grade. Although the KE Plant produces no potable water (area sanitary needs supplied by separate system), only those materials approved for potable water use have been purchased in recognition of the fact that although extremely minor quantities are used, the material does return to the Columbia River.

5. Sodium Dichromate

The liquid sodium dichromate for plant use is stored in an above-ground and outside storage tank adjacent to the 183-KE water treatment facility. This tank of 42,000-gallon capacity is located at a distance of approximately 3,400 feet from the river. The material is normally received at 75% concentration but diluted to 60% for storage and use, with the available storage capacity representing 328,500 pounds as 100% $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$. This year the month-end inventory quantity has averaged 206,282 pounds with a variation from 131,000 pounds to 282,010 pounds.

Figure 7 shows the storage and feed system. The material flows by gravity from the tank through a two-inch supply to eight sodium dichromate injection pumps located in the 183-KE head house. The line from the tank to the building is contained in a pipe trench. Each injection pump (six plus two spares) has a separate 1/2" discharge line that extends through the raw water tunnel to the 190-KE pump room where the solution is fed into the discharge of each 190-KE low lift pump. Modifications previously implemented to prevent accidental discharge of material to the process sewer system and thence to the river are noted in Figure 7. This has included the installation of a barrier

DECLASSIFIED

DECLASSIFIED

DUN-7238
Page 21

FIGURE 7

SODIUM DICHROMATE STORAGE AND SUPPLY
183-KE WATER TREATMENT

NOTES:

- ① BLANKS INSTALLED ON BOTH OVERFLOW AND DRAIN LINES
- ② BARRIER INSTALLED TO ISOLATE TRENCH FROM BUILDING DRAINS
- ③ PRESSURE SENSING SYSTEM INSTALLED TO PROVIDE ANNUNCIATION IN EVENT OF LINE RUPTURES.

in the trench at the building wall, installation of blanks in both the overflow and drain line, and a pressure sensing system to annunciate in event of a rupture of the long pump injection discharge lines.

Sodium dichromate is added to the process water as a corrosion inhibitor. It is fed at a constant rate currently of 0.5 ppm of 100% $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$. This feed rate would yield about 0.075 ppm sodium and 0.175 ppm chromium discharged continually to the Columbia River.

6. Sulfuric Acid

Sulfuric acid is stored in four above-ground and outside storage tanks south of the 183-KE facility. Two tanks are of 10,880-gallon capacity each and two are of 20,360-gallon capacity each all located a distance of approximately 3,400 feet from the river. The material is purchased as commercial grade containing a minimum of 93% H_2SO_4 with inventory and feed quantities all corrected to represent equivalent 100% H_2SO_4 . A small head feed tank of 370-gallon capacity is also included in the system with the total capacity of all five tanks being 62,850 gallons or 896,000 pounds of 100% H_2SO_4 . This year the month-end inventory quantity has averaged 615,346 pounds with a variation from 440,160 to 784,780 pounds.

Figure 8 shows the storage and feed system. The acid is pumped from main storage to the roof-mounted head tank periodically as required. The supply line is one inch contained in a pipe trench. The flow of acid is from the head tank to one of two bauxite reaction vessels. Modifications previously implemented to prevent accidental discharge of material to the process sewer and thence to the river are noted in Figure 8. These have included the installation of barriers in the trench and discontinuance of original plant neutralization pits that connect to the process sewer system.

Although sulfuric acid is used both in the production of aluminum sulfate and to reduce process water pH, the feed requirements are dictated solely by pH requirements. When the bauxite reactor vessels are in service for aluminum sulfate production, a portion of this acid will react initially with the bauxite. When purchased liquid alum is being used, acid is still fed through the bauxite reaction vessels but at a somewhat lower rate. The sulfate radical (SO_4) is not altered by the water treatment process and would be contained in treated water discharged to the Columbia River. Although the required feed rates will vary somewhat as dependent on incoming raw water pH, the feed is quite uniform and represents an average of 22 ppm sulfate addition to the process water or 57,000 pounds daily under normal flow conditions.

DECLASSIFIED

FIGURE 8.

SULFURIC ACID STORAGE AND SUPPLY
183-KE WATER TREATMENT

WASTE MANAGEMENT MODIFICATIONS

- ① BARRIERS INSTALLED TO LOCATE TRENCH FROM BUILDING AND BUILDING TRENCH.
- ② NEUTRALIZATION PIT CONNECTED TO AREA WASTE SYSTEM ADJUSTED TANK OPERATION AND DESIGN LINES AND OPERATIONS TO A HIGH LEVEL FILLER WITH LINGERING CHIPS.
- ③ NEUTRALIZATION PIT CONNECTED TO AREA WASTE SYSTEM ADJUSTED HEAD TANK DESIGN, OVERFLOW, etc. PLAN FOR HOURS TO GROUND.

DECLASSIFIED

DECLASSIFIED

DUN-7238
Page 24

B. Fuels

Two types of fuel oil are consumed at the K Plant--Number 6 oil as a boiler fuel and Number 2 oil to power critical diesel engine drives.

1. Number 6 Fuel Oil

The combustion fuel for the three boilers at the KE Plant is No. 6 fuel oil. The oil pumping and storage area is known as the 166 building and is located adjacent to the west side of the 165-KE building. Storage consists of two underground concrete oil tanks of 800,000-gallon capacity each and two smaller day tanks (also underground and concrete) of 49,000-gallon capacity each. These tanks are located at a distance of approximately 2,200 feet from the river. The total available storage capacity is approximately 1,700,000 gallons. This year the month-end inventory quantity has averaged 1,049,769 gallons with a variation from 669,730 to 1,348,910 gallons. Process Standards, Water Plant, specify a minimum availability at all times of 200,000 gallons.

The arrangement of these facilities is shown in Figure 9. The oil is unloaded to storage at the north end of the tanks with provision for receipt of oil by either rail or tank truck. In unloading, oil flows by gravity through two 6-inch dump lines for each storage tank. Oil is then transferred from main storage to day storage by pumping with transfer performed daily to maintain day storage tanks at essentially full level. These transfer pumps are located in a below-grade pump room positioned between the two day storage tanks. The floor of this pump room has a trench leading to a sump pit. High liquid level in the sump annunciates in the 165-KE boiler room and starts a sump pump with the waste discharging through a 4-inch line into a drywell located west of the No. 2 day storage tank. Transfer of oil to each operating boiler consists of gravity flow from the day storage tank to a fuel table where the oil is pumped to the boiler with a percentage of the flow continually recirculating back to the day storage tank.

The concrete underground tanks are designed to be bomb-resistant and have 15-inch thick concrete walls and roof. Any failure of oil transfer piping would discharge oil to the sump with operating personnel alerted on level annunciation. Failure of piping from day storage to boilers could permit access of oil to building floor drains and thence to the process sewer system. Failure in these lines, however, would be readily apparent in boiler operation and consequent annunciation or by odor developed in this constantly manned facility.

2. No. 2 Diesel Fuel

Diesel fuel is required at two different locations in the K Plant, i.e., the 182-K coolant backup diesels and the 105-KE Reactor confinement diesels.

FIGURE 9

NO. 6 FUEL OIL STORAGE AND SUPPLY 166-KE

DECLASSIFIED

DECLASSIFIED

DUN-7238
Page 26

a. 182-K Coolant Backup

The diesel storage facilities for the 182-K coolant backup system consist of two underground tanks of 17,500-gallon capacity each. In addition to these main storage tanks, three small head tanks (one for each diesel drive) of 250-gallon capacity each are provided in the 182-K pump station. Total available storage capacity is 33,750 gallons with Process Standards, Water Plant, requiring a minimum of 12,000 gallons available at all times. The arrangement of this diesel fuel system is shown on Figure 10.

The tanks are underground and located at a distance of approximately 2,200 feet from the river. All building drains discharge to a crib located west of the pump station. In the event of oil line failure, diesel fuel would have access only to this crib.

b. 105-KE Reactor Confinement Diesels

The diesel storage facilities for the 105-KE Reactor confinement system diesels consist of two underground tanks of 2,000-gallon capacity each. Two small head tanks (one for each diesel drive) are provided in 105-KE proper. Available storage capacity is 4,000 gallons with Process Standards, Reactor, requiring a five-day supply or about 3,000 gallons available at all times. The arrangement of this diesel fuel system is shown on Figure 11.

The tanks are underground and located at a distance of approximately 2,000 feet from the river. Diesel fuel within the building is insignificant (head tanks are fabricated from 8-inch pipe 24-inches long) with pumping to these tanks occurring only during diesel engine operation.

FIGURE 10

DIESEL FUEL STORAGE AND SUPPLY
100-K COOLANT BACKUP

NOTE: TANKS ARE BURIED WITH ALL BUILDING
DRAINS DISCHARGING TO A SEPARATE
ROCK CRIB

DECLASSIFIED

DECLASSIFIED

DIESEL FUEL STORAGE AND SUPPLY
105-KE REACTOR CONFINEMENT DIESEL SUPPLY

FIGURE 11

C. Miscellaneous Material

Many other materials are utilized in the operation of the K Plant facilities. This portion of the report includes, however, only those materials that are of concern from the standpoint of quantity consumed, quantity stored, or material toxicity. The three materials that are of concern are detailed below.

1. Ethylene Glycol

Ethylene glycol $C_2H_4(OH)_2$, is used at the K Plant as the heating medium for the area's heating and ventilating units. The ethylene glycol circulating system is a closed system under positive pressure by circulating pumps with the solution being heated by either warm reactor coolant effluent (building 150 heat exchanger) or by an auxiliary steam heat exchanger. The system for the KE and KW Plant is intertied and essentially one system with the system facilities in the two plants being identical. The deactivation of KW Reactor has altered the system only in that the KW heat exchangers (reactor coolant effluent and auxiliary steam) have been isolated from the system along with certain circulation system laterals where heating is no longer required. The medium in the circulating system is a 33 percent by weight solution of ethylene glycol. Proper volume of solution in the circulating system is maintained by a 230-gallon capacity day tank at each 165-KE and 165-KW augmented by several pressurized expansion tanks at system high points.

The main solution storage for the system consists of four horizontal underground storage tanks. Two of these tanks are located immediately north of the 165-KE building and two are located immediately north of the 165-KW building. These tanks are all of 10,000-gallon capacity and all located at a distance of approximately 2,200 feet from the river. The arrangement of the two tanks at each location (165-KE and 165-KW) is identical. At each location one tank is used for storage of 100 percent ethylene glycol and receives its supply direct from railroad tank cars. The other tank is ethylene glycol that has been diluted to 33 percent (by weight) ready for use. The 250-gallon capacity day tank connects to this tank with solution exchange occurring (in and out) as system demands require.

The ethylene glycol as procured is uninhibited anti-freeze type. Additions, on plant, are made of potassium phosphate (corrosion inhibitor) and Red Rotamine, B extra (coloring dye). Potassium hydroxide is also added as required to maintain the pH within the desired range of 7.0 to 9.0. The total maximum system inventory of 100 percent equivalent ethylene glycol is estimated at 60,000 gallons as follows:

DECLASSIFIED

DECLASSIFIED

DUN-7238

Page 30

Circulating System--estimated at 100,000 gals. ¹	or 33,000 gals. (100%)
Two 33% solution tanks at 10,000 gals. each	or 7,000 gals. (100%)
Two 33% storage tanks at 10,000 gals. each	or <u>20,000</u> gals. (100%)
Total	60,000 gals. (100%)

The storage tanks are located underground with pumping required for solution removal. Transfer of solution from either concentrated to dilute storage or dilute storage to circulating system is a manual pumping operation requiring operator attendance. The system is in operation approximately eight months of the year. The circulatory system is extensive and some loss of material is unavoidable through pump packing glands, valve leakage, etc. This source of loss has access to the process sewer system through floor drains but is readily discernible for prompt corrective action by the red dye coloring of the solution. More extensive losses have occurred through the heat exchangers. The recording of storage tank levels (both concentrated and diluted) each shift, however, provides a continual assessment of inventory quantity to detect evidence of substantial loss.

2. Nitric Acid and/or Phoenix 33 (Dummy Decontamination)

Both nitric acid and Phoenix 33 are used in decontaminating anodized dummies while nitric acid only is used in decontaminating nonanodized dummies and perfs. This decontamination operation is a batch-type operation with the facility placed in operation as dependent on production needs and operator availability.

The nitric acid (60 percent by weight) for the decontamination operation is stored in an approximate 450-gallon outside storage tank with material received by tank truck deliveries. The material is transferred by gravity flow to the No. 1 nitric acid decontamination tank (inside building in wash pad area) for use. The required acid strength is about 35 percent (by weight) or about 55 gallons (375 pounds 100% equivalent) to 45 gallons water. This acid solution is utilized until exhausted as indicated by decontaminating performance, then neutralized with flake caustic before discharging to waste. The flake caustic required for neutralization would be about 225 pounds.

Phoenix 33 (principally a buffered and inhibited oxalic acid) is received and stored as a dry material. It is prepared for use by dissolving 32 pounds in water to achieve an 8-ounce-per-gallon concentration. The Phoenix solution is utilized until exhausted as indicated by decontamination performance and then discharged to waste. No neutralization of this buffered solution is required prior to discharge.

¹Quantity previously estimated by J. W. Frymier, K Power.

Drainage for the nitric acid, Phoenix, and rinse tanks along with floor drain in the wash pad area all drain via the No. 8 line (reference Figure 2) and then to the trench. The outside nitric acid storage tank is equipped with an overflow line extending from the top of the tank connected to the drain gutter in the unloading ramp near the tank. Overflow of material through the top float connection (most likely route) would also reach this drain gutter. This drain gutter connects to the No. 2 drain line (reference Figure 1) and thence to the process waste sewer to the river. Review of tank shipments indicates some receipts have been in excess of 375 gallons, thus the danger of tank overflow is present. Engineering action to revise the unloading ramp drain gutter such that it will also tie into the No. 8 drain line is in progress.

The frequency of material usage is highly variable. In FY 1970, the nitric acid procurement totaled 21,520 pounds (as 100%). In the same period, only 1,000 pounds of flake caustic was procured indicating little neutralization was actually performed. The quantity of Phoenix 33 procured totaled 4,000 pounds.

3. Turco (Reactor Rear Face Decontamination)

Turco 4306-C or 4306-D is a dry material normally received in 125-pound containers. It is a proprietary product manufactured by Turco Products Company and is a sulfamic acid-base with 4306-C containing a higher percentage of oxallic acid. A somewhat similar product, Wyandatte 5061, is also approved for decontamination use (reference Standard F-010, Process Standards - Water Plant) but has been generally superseded by the Turco products. The frequency of decontamination and quantity of material utilized at each decontamination is dependent on many variables. During the past three years, two decontamination operations have been performed--in March, 1969, using 90,000 pounds and again in February, 1970, using 51,375 pounds.

Decontamination is an operation to reduce the radiation exposure levels on the rear face. It is prepared for use by initially dissolving the dry material in an outside preparation tank with the solution slurried to a feed tank located in the basement of 105-KE. In this feed tank, the mixture is further diluted to the required feed concentration (normally 5 or 6 ounces per gallon), agitated, and heated. The material is then pumped to the rear relief riser using either a batch process or a continuous process. From the relief riser the solution passes through the crossheaders into the rear connectors, through the rear nozzles and down the rear face.

During the decontamination process, the spent material is confined to the pickup chute area by prior closing of the pickup chute gates. Whirly pumps are then utilized to transfer this spent turco solution to the transfer area pit. The transfer area pit gates are closed

DECLASSIFIED

DECLASSIFIED

DUN-7238

Page 32

with the solution draining through the floor drains to the east collection box and thence to the trench. As an added precaution, the storage basin water level during the decontamination process is maintained below the normal overflow weir with all water flow from the storage basin also routed to the trench via adjustment of floor drains.

The supply tank is normally filled to the 18,000-gallon capacity level and would contain 5,625 pounds (5 ounces/gallon concentration) or 6,750 pounds (6 ounces/gallon) of Turco material. The tank is equipped with a tank drain and tank overflow which discharge to an open gutter in this purge equipment room. Failure of the tank or piping would also discharge material to the gutter. The gutter drains into the No. 2 line through the west collection box and thence to the river. The nature of the operation is such, however, that constant operator attendance and close surveillance are required, thus making inadvertent loss through the drain or overflow difficult to perceive. Loss of material on complete tank failure would be limited to 6,750 pounds.

ACKNOWLEDGEMENTS

The aid of many K Plant Section personnel was required in deriving the information for this report. Their assistance is gratefully acknowledged. J. W. Frymier of K Power and R. H. Steach of KE Processing were particularly helpful in this task.

Glen W. Wells

G. W. Wells, Senior Engineer
K Plant Engineering

GWG:gd

**DATE
FILMED**

11/2/94

END