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OAK RIDGE Y-12 PLANT

MARTIN MARIETTA

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ENGINEERING REPORT
FOR
INTERIM SOLIDS REMOVAL
MODIFICATIONS OF THE
STEAM PLANT WASTEWATER
TREATMENT FACILITY

Process Engineering
Central Engineering Services

April 1995

Prepared by the
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Oak Ridge, Tennessee 37831
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FOR
INTERIM SOLIDS REMOVAL MODIFICATIONS OF THE
STEAM PLANT WASTEWATER TREATMENT FACILITY

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ENGINEERING REPORT

Interim Solids Removal Modifications of the Steam Plant Wastewater Treatment Facility

1.0 INTRODUCTION

The Steam Plant Wastewater Treatment Facility (SPWTF) treats wastewater from the Y-12 Plant coal yard, steam plant, and water demineralizer facility. The facility is required to comply with National Pollutant Discharge Elimination System (NPDES) standards prior to discharge to East Fork Poplar Creek (EFPC). The existing facility was designed to meet Best Available Technology (BAT) standards and has been in operation since 1988. The SPWTF has had intermittent violations of the NPDES permit primarily due to difficulties in complying with the limit for total iron of 1.0 ppm. A FY-1997 Line Item project, SPWTF Upgrades, is planned to improve the capabilities of the SPWTF to eliminate non-compliances with the permit limits. The intent of the Interim Solids Removal Modification project is to improve the SPWTF effluent quality and to provide pilot treatment data to assist in the design and implementation of the SPWTF Upgrades Line Item Project.

2.0 GENERAL DATA

The Y-12 Plant, which is located at the Department of Energy (DOE) Oak Ridge Reservation, lies within the East Tennessee Valley and Ridge Physiographic Province. The location geology, seismology, meteorology and soil characteristics have been studied extensively. For a general overview of these geologic features reference is made to Document Y/TS-730 "Environmental Assessment" published in March 1991. This facility discharges to EFPC which originates in the Y-12 Plant area. The stream flows through Lake Reality, which is located at the east end of the plant, before continuing on through the city of Oak Ridge and entering pasturelands and hardwood forests. The stream first joins Bear Creek, and then Poplar Creek, before discharging into the Clinch River near the K-25 Site. The NPDES permit limits established for the SPWTF are intended to protect this waterway for its downstream uses.

3.0 COLLECTION SYSTEM

The influent to the SPWTF comes from coal yard runoff via a surface drainage system and from the Y-12 Steam Plant and the Demineralizer Facility via piping. The configuration of the coal pile and the adjacent drainage area has been designed to collect all runoff and minimize contact of runoff with coal. All of the influent flows, regardless of source, are collected in a concrete basin divided into two sections. The large section of the basin is used for collecting coal yard runoff and waste streams from the Steam Plant and Demineralizer Facility, including ion exchange regeneration wastewater, boiler blowdown, carbon filter backwash, etc. Combined wastewaters are pumped from the large section of the basin to the smaller section, and the small basin contents are pumped to the SPWTF for treatment and discharge. The small basin is also allowed to overflow to the larger basin to facilitate mixing and homogeneity between the basins.

4.0 WASTEWATER CHARACTERISTICS

The influent wastewater characteristics for this facility have not changed since it began operation in 1988. (See Table A in Appendix). The upgrade will enhance the capability of the facility to consistently meet the NPDES permit. The contaminant of concern is total iron. The SPWTF uses a gravity plate sedimentation unit for solids removal. Since these solids are primarily iron precipitate, any carryover of solids increases the effluent iron concentration. While the solids carryover has caused iron concentration to exceed the iron compliance limit of 1.0 ppm, it has not been large enough to violate the suspended solids limit.

5.0 PILOT PLANT/TREATABILITY STUDIES

A treatability study was conducted by MMES Waste Management. The study examined the removal chemistry and removal mechanisms used in the SPWTF. It concluded that the primary cause of elevated iron concentrations in the SPWTF effluent was carryover of solids. The study concluded that because of fluctuations in wastewater chemistry and flow rates, and operating limitations of the existing sedimentation unit, it is unlikely that desired efficiency could always be maintained using only the existing equipment. An upgrade to the facility is therefore necessary.

6.0 ALTERNATIVES

The alternatives considered were:

1. Make no facility changes but increase operational control
2. Expand the sedimentation capacity
3. Add filtration after sedimentation

Alternative #1 relies on the ability to conduct frequent operational monitoring tests and determine changes in chemical types and dosages quickly in order to respond to changes in wastewater chemistry and/or flowrates. While this is conceptually possible and is utilized in some facilities, it does not assure that fine solids might not escape from the system at some point during the transition in operating parameters.

Alternative #2 would solve the problem if the particles are always of sufficient size to settle during the retention time provided. This alternative, like alternative #1, relies on the ability to always make changes to chemistry quickly enough to keep the particle formation at or near optimum otherwise the sedimentation expansion would have to be oversized to provide a factor of safety. This adds both cost and space considerations to the decision.

Alternative #3 takes advantage of the predictable particle removal characteristics of filtration systems. They can be designed to remove down to submicron sized particles efficiently and reliably.

Alternative #3 was chosen as the preferred alternative because it is easier to operate and more reliable than alternatives #1 and #2 and it requires less space than alternative #2. Alternative #3 would provide a system that is compatible with the existing facility equipment and operations.

7.0 TREATMENT FACILITIES

The existing SPWTF has a hydraulic flow capacity of 350 gpm and consists of wastewater collection/equalization basins; neutralization and precipitation tanks fed with hydrated lime; coagulation/flocculation tanks fed with polymer; gravity plate settler for solids sedimentation and holding; and final pH adjustment tank fed with sulfuric acid. The upgrade provides for the addition of a filter and associated piping prior to effluent discharge. The new flowsheet is shown in Figure 1.

Excessive amounts of iron in the effluent is partly due to carryover of iron solids from the existing gravity settler. A build up of solids on the plates of the settler is adversely affecting the flow characteristics. Solids buildup is restricting the flow, increasing the flow through velocity, and reducing the retention time for solids settling. This produces a condition which can lead to excessive solids carryover. The plates of the clarifier are sprayed weekly with water to dislodge solids. However, over a long period of time, solids have hardened on to the plates and are not removed by this water spray. Replacement of the plates is being performed as a maintenance activity. Once the new plates are replaced, solids carryover will decrease, and installation and operation of the new filter unit will be optimized.

The new filter unit will remove solids carryover from the gravity settler. The filter unit will be either a duplex cartridge or bag filter capable of handling the maximum flow. Various particle size cartridges or bags (e.g. 5 or 10 micron) will be used for optimum filter performance and operation. The cartridges or bags will be changed out intermittently, and the resulting waste will be disposed of in accordance with Y-12 Plant and Tennessee Solid Waste regulations.

Existing recirculation pumps will be used to provide the head to pump the wastewater through the piping and filter. The ability to bypass the filter will be maintained so that the pilot performance of the filter can be tested and evaluated. Capabilities to recirculate filtered wastewater will also be provided by this project. All construction activities, excluding tie-ins to existing piping, will be performed while the facility is on-line. Tie-ins to the existing piping should take no more than 4 to 6 hrs and can be accomplished during regularly scheduled down time.

8.0 SCHEDULE

Design will be performed by Energy Systems Engineering with installation by either MMES Maintenance, MK-F Direct Hire or MK-F/Contractor. The duration of design, procurement, and construction is as follows:

<u>Activity</u>	<u>Duration</u>
Design completion	2 wks.
Sole-source procurement	3 wks.
Equipment delivery	4 wks.
Field work	7 wks.

Total	16 wks.

FIGURE 1 ADDITION OF PILOT FILTRATION EQUIPMENT TO SPWTF

Activities listed above will begin when TDEC approval of the Engineering Report is received.

9.0 RECEIVING STREAM

The final effluent will be discharged to the EFPC through the existing NPDES monitoring station, Outfall 503.

10.0 LIQUID EFFLUENT STANDARDS

The NPDES permit for Outfall 503 is currently in the renewal process. The existing Y-12 NPDES permit for outfall 503 is shown in Table 1. The reliability of the facility meeting these permit limits will be improved by making the proposed modifications.

TABLE 1 Existing Y-12 NPDES Permit For Outfall 503

	<u>EFFLUENT CHARACTERISTICS</u>		<u>DISCHARGE LIMITATIONS</u>		<u>MONITORING REQUIREMENTS</u>		
	<u>kg/day (lbs/day)</u>		<u>Other Units (mg/l)</u>		<u>Measurement Frequency</u>	<u>Sample Type</u>	<u>Sampling Point</u>
	<u>Daily Avg.</u>	<u>Daily Max</u>	<u>Daily Avg.</u>	<u>Daily Max</u>			
Flow, m ³ /Day (MGD) ----	----	----	----	----	Daily	Continuous	Effluent
Chromium, Total	0.38(0.83)	0.38(0.83)	0.20	0.20	3/Week	Composite	Effluent
Copper, Total	1.89(4.17)	1.89(4.17)	1.0	1.0	3/Week	Composite	Effluent
Iron, Total	1.89(4.17)	1.89(4.17)	1.0	1.0	3/Week	Composite	Effluent
Zinc, Total	1.89(4.17)	1.89(4.17)	1.0	1.0	3/Week	Composite	Effluent
Oil and Grease	28.4(62.6)	37.9(83.4)	15.0	20.0	3/Week	Grab	Effluent
Total Suspended Solids	57.0(125)	189(417)	30.0	100.0	3/Week	Composite	Effluent
Temperature, (°F)(°C) ----	----	----	----	86.9(30.5)	3/Week	Grab	Effluent

APPENDIX

TABLE A. Characterization of Effluent Waste Streams to be Treated in Wastewater Facility

Element	Steam Plant Effluent Boiler Blowdown (BB)	Demineralizer Effluent Carbon Filter Backwash (CFB)	Steam Plant Effluent IX Regeneration (H*)	Steam Plant Effluent IX Regeneration (Na)	Demineralizer Effluent Demineralize Regeneration Waste (DRW)	Coal Pile Runoff (CPR)
pH	11.34	3.38	1.85	7.3	7.4	2.7
TSS (mg/L)	19	47	20	44	30	1019
TDS (mg/L)	1634	43.5	5234	7815	4837	4065
Settling rate (ML/L/hr)	0	0	0	0		9.0
TOC (unfiltered)	28	14.6	8.9	8.2		
TOC (filtered)	28	4.5	4.6	8.7		6.5
COD (unfiltered)	63	22	21	Trace		1090
COD (filtered)	61	7	9	137		106
AQ (mg/L)	<0.018	<0.018	<0.018	<0.488	<0.108	<0.108
Al	0.148	<0.068	0.807	2.05	1.17	55
As	<0.84	<0.84	<3.84	<18.8	<3.84	<3.84
B	0.187	0.0835	<0.458	<1.98	<0.458	<0.458
Ba	0.0124	0.0238	0.214	1.18	0.0988	0.108
Be	<0.0013	<0.0013	<0.0078	<0.0338	<0.0078	0.0131
Ca	<4.0	<4.0	385	1420	34.8	233
Cd	<0.0082	<0.0082	0.113	<0.238	<0.0652	<0.0652
Co	<0.013	<0.013	<0.078	<0.338	<0.078	0.318
Cu	<0.023	<0.023	<0.138	<0.598	6.45	0.211
Cr	0.0388	0.322	<0.182	<0.832	<0.138	<0.138
Fe	0.228	2.82	0.883	<0.52	2.38	681
Ga	<0.07	<0.07	<0.42	<1.82	<0.42	<0.42
HI	<0.04	<0.04	<0.24	<1.04	<0.24	0.328
K	47	<4.0	30.4	<104	<54	<24
Li	0.427	<0.1	0.844	<2.8	3.4	0.8
Mg	0.587	0.0541	108	518	10.1	114
Mn	<0.001	<0.001	<0.008	<0.028	0.622	12.3
Mo	<0.27	<0.027	<0.182	<0.702	<0.182	<0.182
Na	682	1.31	480	442	1890	19.8
Ni	<0.11	<0.11	<0.88	<2.88	3.22	0.951
P	18.8	<0.33	<1.98	<8.58	<1.98	<1.98
Pb	<0.28	<0.28	<1.58	<6.78	<1.58	<1.58
Sb	<0.2	<0.2	<1.2	<5.2	<1.2	<1.2
Se	<0.43	<0.43	<2.58	<11.2	<2.58	<2.58
Si	22.1	0.458	<0.72	<3.12	9.18	8.81
Sn	<0.5	<0.5	<3.0	<13		
Sr	<0.018	<0.018	0.83	3.65	0.388	0.28
Ti	0.0808	0.0683	0.352	1.45	0.357	0.438
V	<0.016	<0.016	<0.09	<0.39	<0.09	<0.09
Zn	0.0347	0.0704	1.43	5.73	2.39	3.35
Zr	<0.018	<0.018	<0.018	<0.488	<0.108	<0.108

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