Steam Plants

Y-12 Steam Plants

Steam Plant Facts
by S. Wiley

Possible points-of-contact for information:

- o George Banic (retired in Oak Ridge) 4813-8166
- o Bill Butturini (retired in Oak Ridge) 483-0315
- o Merwyn Sanders (retired in Knoxville) 693-4204
- SMJ ✓ o How about E. Choat?

Stacks from 9401-1 were apparently tore down prior to 1969 (per conversation with Ken Delius - Building 9704-1, Ext 6-4965)

I contacted personnel in current Steam Plant (9704-3) who said to contact:

- o Joe L Hart (retired) 921 Grave Ave., Lake City TN 37769
- o Charles Wilson (retired) Route 1, Box 132, Carryville TN 37714

These guys apparently worked in all three plants!

Contact John Skinner (Ext 6-6013) of the Clean Air Program for air emissions from the current Steam Plant (Building 9401-3)

I could not find any information regarding either 9401-1 or 9401-2 at Plant Records/Central Files. Some information on current Steam Plant 9401-3 in Building 9983 (controlled by Cassandra Martin). These box numbers were obtained by Jack Lewis. Boxes are as follows:

78-06-05	79-02-08
78-06-06	79-02-09
	79-02-10

I took a quick look into these boxes.... looks like logbooks on shipments/quality (e.g. sulfur content) of coal coming into the Plant from approximately 1955-1984.

Oak Ridge Reservation Environmental Monitoring Reports (contact Clarence Hill @ 6-7113, Building 9116) if you want to review the following :

- o Y/UB-18 for CY 1982
- o Y/UB-19 for CY 1983
- o ORNL-6209 for CY 1984

Steam Plant Info. from Y-12 Hg Files by S. Wiley

1.	Y-1006	April 1 - June 30, 1954	J8-9	Photos	✓ smd
2.	Y-1007	July 1 - Sept 30, 1954	J6-9	Photos	✓ smd
3.	Y-1009 Y-1005	Jan 1 - March 31, 1955	J5 J8-10	Photos Photos	✓ smd ✓ smd
4.	Y-1010	April 1 - June 30, 1955	J6	Photos	✓ smd
5.	Y-1011	July 1 - Sept 30, 1955	J3	Photos	✓ smd
6.	Y-1014	April 1 - June 30, 1956	J3	Photos	✓ smd
7.	Y-1130	Nov 1956	B6	9401-1 Plating Shop	✓ smd
8.	Y-1012	Oct 1 - Dec 31, 1956	J4-6		
9.	Y-1160	Jan 1957	B10	Disposal of 9401-1 & 9401-2	✓ smd
10.	Y-1161	Feb 1957	B11	Work Orders: B-6206 - Disposal of 9401-1 B-6207 - Disposal of 9401-2	smd
11.	Y-1162	March 1957	B10-11	Disposal of 9401-1 & 9401-2	smd
12.	**Y-1163**	**April 1957**	**B11**	**9401-1 Start 1/7/57 Stop 4/30/57** **9401-2 Start 1/7/57 Stop 5/20/57** **9401-1 to United Iron & Paper Co., Indianapolis** **9401-2 to Sam Walkoff Co., Indianapolis**	
13.	Y-1018	April 1 - June 30, 1957	G54	9401-2 Plating Shop Design	
14.	Y-1165	June 1957	F5	9401-2 Plating Shop Design	
	Y-1166	July 1957		9401-2 Design Criteria # 2-5-2034	
15.	Y-1169	Oct 1957		9401-2 Plating Shop still under design	
16.	Y-1020	Oct - Dec 31, 1957	D6-7		
17.	Y-1221	Jan 1958	Pg 12 B2	9401-2 Plating Shop drawings for construction bids out 2/5/58 contract by 3/15/58 occupy by 9/1/58	

18.	Y-1200	Jan - March 1958	A4 D4 A5 D24	9401-1 Metal Recovery Smelter Proposal # 186 Issued 1/30/58 9401-2 Plating Shop began Construction by Rentenbach Eng Co., Knoxville - to replace Bldg 9744
19.	**Y-1223**	**March 1958**	**B5** **B11**	**9401-1 Eng Drawings Complete** **9401-2 Contract # AT-(40-1)-2105 Rentenbach Eng Co. awarded contract to begin 3/58**
20.	Y-1224	April 1958	B4	9401-1 to be renovated for Metal Recovery Smeltor
21.	Y-1225	May 1958	B12	9401-1 35% Completed
22.	Y-1227	July 1958	B10	9401-2 70% Completed
23.	**Y-1203**	**Oct - Dec 1958**	**A17**	**9401-2 Activated Dec 1958 (now two Plating Shops - 9401-2 and 9744)**
24.	Y-1205	April - June 1959	A18	All ops from 9744 trans to 9401-2
25.	Y-1206	July - Sept 1959	D7	9401-1 Directive # 4-12-172 Due date 6/30/60 for Integrated Salvage Facility
26.	Y-1207	Oct - Dec 1959	D7	9401-1 being installed
27.	Y-1210	July - Sept 1960	D2	9401-1 still working - smelter by Lindberg Industrial Corp.
28.	**Y-1213**	**April - June 1961**	**D2** **F2**	**Start-up of 9401-1 (for Pb and Al)**
29.	Y-1430	July - Sept 1965	D2	9401-3 Air Pollution Control System for control of fly ash (installed 1967)

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OAK RIDGE Y-12 PLANT INFORMATION CONTROL FORM

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Extracted pp. only
Unclassified Title: Y-12 PLANT QUARTERLY REPORT, 3RD QUARTER 1955, PAGES J-5 & J-6 (JANUARY 1 - MARCH 31, 1955)

Author's / Requestor's Name: S. WILEY | Telephone No., Pager No. and Plant Address: 6-0263 BLDG 9106 MS 8023 | Account Number: 23360003

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☐ Invention Disclosure ☐ Journal Article ☐ News Release ☐ Photograph/Visuals ☐ Technical Progress Report
☐ Thesis/Term Paper ☐ Videotape ☐ Other
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R BAYLOR JR (Print Name) R Baylor Jr (Signature) 9/23/96 (Date)
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STEVEN WILEY, HSA COORDINATOR
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Y-12 Plant Quarterly Report
Third Fiscal Quarter, ~~1955~~ 6
January 1 - March 31, 1955
[(pages J-5 & J-6) Y-1009]

Dated April 26, 1955

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R Bayfor Jr 9/23/96
Authorized Signature Date

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Building 9201-4 — The entire complement of absorber trays for this building has been put in place. All major cascade equipment for cascades 7, 8, 9, and 10 has been installed, and piping erection is advanced in cascades 9 and 10. All exchange columns have been fitted with Raschig rings. Completion of this facility was estimated to be 57% at the end of the quarter.

Building 9204-2 — This facility was completed and turned over to operations personnel during the third quarter. Certain outside work, including site improvements, road construction, and a propane storage facility, are not yet finished. No unusual start-up difficulties have been experienced.

STEAM PLANT - Building 9401-3

Boilers 1, 2, and 3 have been completed and put in service, and boiler 4 was nearly finished at the end of the quarter. The steam plant is estimated to be 95% complete.

Although this facility is at an advanced stage of construction, satisfactory operation has not yet been achieved. Major difficulties in combustion control, yet to be overcome, necessitate continual use of fuel oil to supplement coal in order to make safe operation possible.

A compacted-earth retention dam is to be built on the south side of Chestnut Ridge, which lies south of the Y-12 Plant. The resulting pond will collect fly ash and slag from the ash disposal system. These are at present causing a stream pollution problem in the Clinch River.

Figure J-4 shows the fuel piping and the coal bunkers of boiler 1. A view of the steam plant control room is seen in Figure J-5.

PRIMARY POWER SYSTEM

Modifications to the Y-12 primary power system, adapting the system to the new plant conditions, were approaching completion at the end of the quarter. The Elza Number 2 switchyard is shown in Figure J-6. This facility was entirely rebuilt after having been out of service since 1950.

A 50,000 kva power transformer was installed south of Building 9201-5 for use as a reserve unit, and is shown in Figure J-7.

SUNFLOWER EXPANSION - Building 9998

Consistent with other phases of plant expansion, the requirements for normal or depleted uranium weapons components have increased. Production and partial assembly of these components is being done at Y-12. Expanded facilities for doing this work are being provided in the newly constructed Building 9998 adjoining the present A-2 wing of Building 9212.

Construction work being performed by the Rust Engineering Company for Building 9998 is complete furnaces in the foundry. Additional furnaces are being moved by Carbide forces ~~from the pres~~ent foundry in the B-1 wing of Building 9212 to the new foundry. The H-1 foundry may be seen in Figure J-8.

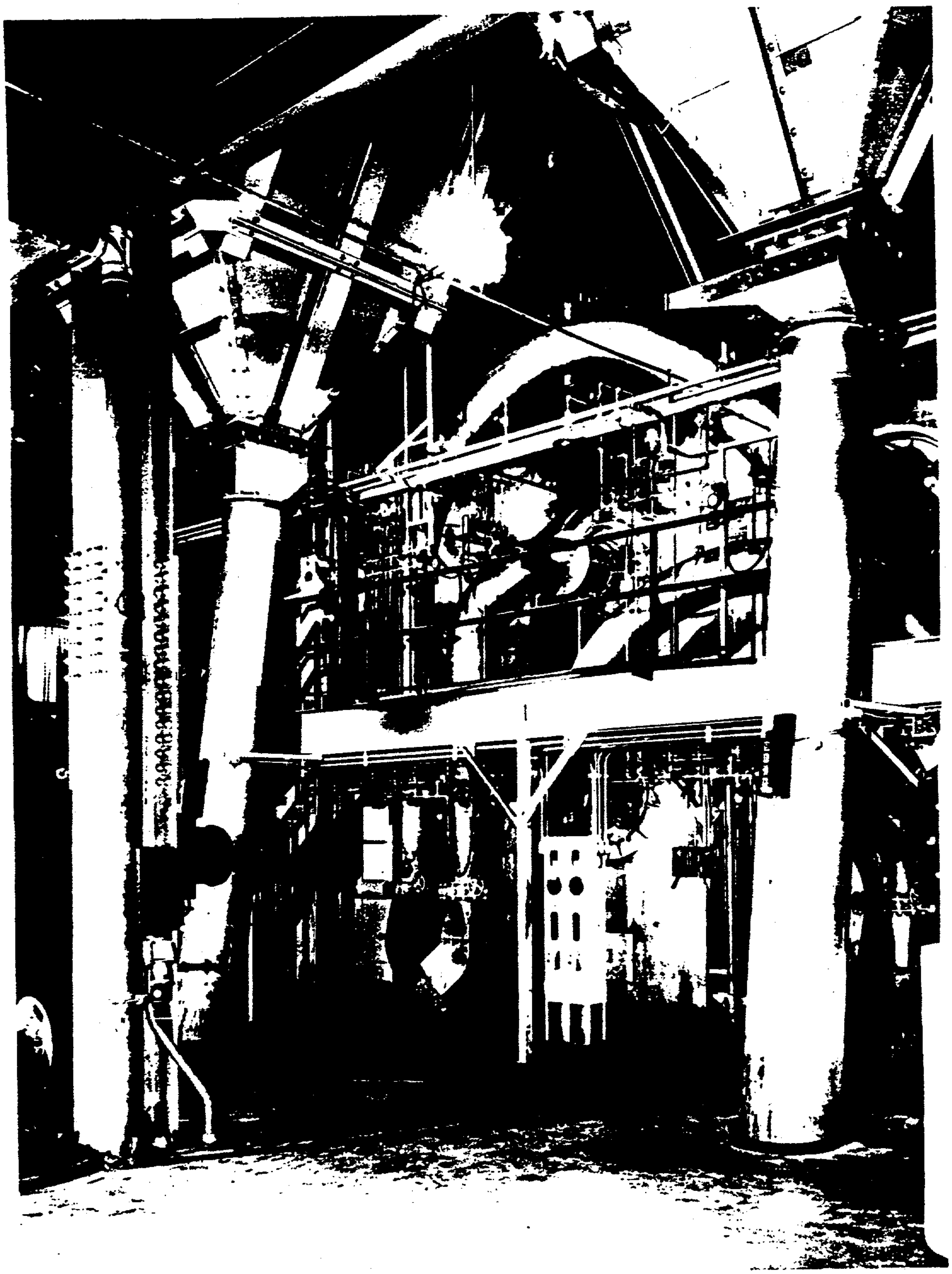

FIGURE J-4

TOOL AND EQUIPMENT FABRICATION FACILITIES - Building 9201-1

The Y-12 machine shop and auxiliary shops with their machine tools and other expensive equipment are presently housed in a temporary type structure that has outlived its usefulness, a

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Telephone No., Pager No. and Plant Address: 6-0263 BLDG 9106 MS 8023
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Y-12 Plant Quarterly Report
Second Fiscal Quarter, 1955
October 1 - December 31, 1955
[(page J-4 & J-6) Y-1012]

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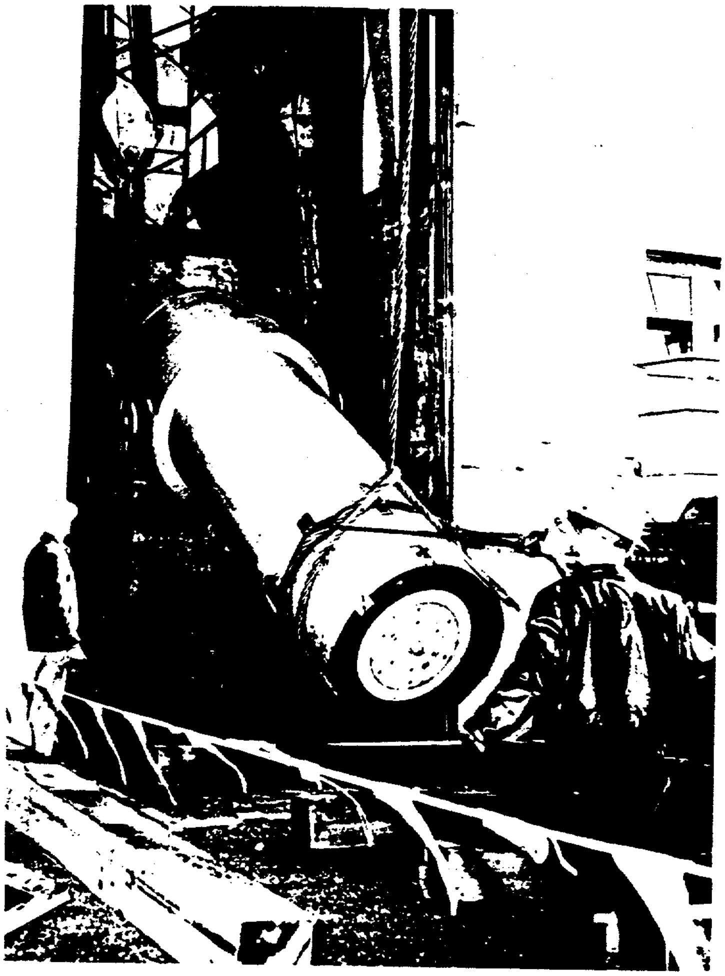

FIGURE J-2

Gas Generating Facility - Building 9805-1

Introduction — A deuterium gas generating facility is under construction southwest of Building 9204-2. The deuterium will be produced by the electrolysis of heavy water.

Present Status — Construction of the installation was complete except for final testing at the end of the quarter. The building as seen from the east is shown in Figure J-3. The large tank at the right is a Wiggins gasholder which will receive the gas from the electrolytic cells. The cells themselves may be seen in Figure J-4.

Steam Plant - Building 9401-3

This facility has been completed except for final acceptance tests. Preliminary tests of boiler operation indicate that the operating characteristics and efficiency do not yet equal the requirements of the design specifications, particularly with respect to fuel loss in stack gases and fly ash. The remedy for this situation had not been determined at the end of the quarter.

A view of the essentially completed steam plant from the south is shown in Figure J-5.

FIGURE J-5

Development Laboratory Facility - Building 9202

Introduction — This phase of the Plant improvement program consists of the installation of a centralized development and engineering test laboratory for performing work leading to the improvement of Plant processes and operations. The installation will include the complete rehabilitation of Building 9202 and the consolidation of certain existing development facilities now at widely separated locations in the Y-12 area.

Present Status — The revisions to Building 9202 were approximately 95% complete at the end of the quarter. Construction by the Malan Construction Company was to have been finished in November, but has been considerably impeded by delays in delivery of electrical gear from the vendor. Essentially all structural changes have been made, as have the piping and ventilation installations.

A view of the east elevation of Building 9202 is shown in Figure J-6.

MISCELLANEOUS FACILITIES

The program of improvement and expansion of employee parking facilities was continued with the modernization and paving of the Central Parking Area. The lot was graded, enlarged to accommodate approximately 500 cars and paved with hot asphaltic concrete. The renovated lot, as viewed from the southwest, may be seen in Figure J-7.

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Y-12 Plant Quarterly Report
Fourth Fiscal Quarter, 195~~6~~5
~~October 1 -December 31, 1956~~ April - June 1956
[(pages J-3) Y-1014]

Dated July 26, 1956

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FIGURE J-2

STEAM PLANT CONVERSION TO GAS

Equipment is being installed in the Building 9401-3 steam plant to permit the use of natural gas as well as pulverized coal. Three of the four boilers are being converted for this purpose. At the end of June installation work was approximately 80% complete.

This conversion will permit the use of "dump" natural gas during the six summer months when that fuel can be obtained at an advantageous price. Conversion is expected to cost about $100,000 but annual savings of $136,000 are anticipated.

A new eight-inch gas pressure reducing station, to regulate fuel to the burners, has been erected and is shown in Figure J-3.

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Author's / Requestor's Name: S. W. Wiley | Telephone No., Pager No. and Plant Address: 6-0263, 417-5417, Bldg. 9106, MS-8023 | Account Number: 2366-0003

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UNION CARBIDE NUCLEAR COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

UCC

POST OFFICE BOX Y
OAK RIDGE, TENNESSEE

Y1286

January 27, 1956

United States Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Subject: Use of Natural Gas at Y-12 Steam Heating Plant
Ref: OPO:EAH

Attention: Mr. R. C. Armstrong, Director
Production Division

Gentlemen:

In accordance with your letter of December 30, 1955, a study was made to determine the economic feasibility of installing the necessary equipment to operate the Y-12 Steam Generating Plant on dump natural gas during the six summer months.

Major work which would be required to accomplish these alterations includes (1) The extension of the 8" natural gas main from the meter station behind Bldg. 9401-2 to the new Steam Plant, Bldg. 9401-3; (2) The installation of the necessary pressure reducing stations to provide gas to the boilers at 10 psig pressure; (3) The installation of stainless steel gas burner rings in each of the existing pulverized coal burners; and (4) The installation of the necessary control valves and instrumentation as required to burn either natural gas or pulverized coal.

Since two boilers are required to carry the estimated summer steam load, it would be necessary to convert an absolute minimum of two boilers to gas firing. However, from the standpoint of providing both an emergency fuel supply and insuring greater flexibility of operation, it would be desirable to convert three boilers to natural gas usage. The cost of extending the gas main to the new steam plant and in making the required alterations to two boilers is estimated to be approximately $79,500. Similar alterations to convert three boilers to natural gas firing is estimated to cost approximately $99,500. The cost of the major alterations, contingencies, and engineering, as required for the conversion of both two and three boilers to gas firing, is detailed on the attached cost estimate sheet.

Based on an estimated gas cost of 20.99¢/1000 cu.ft. of 1055 Btu/cu.ft. natural gas, the saving which is expected to result during a six month summer period over firing with coal presently costing 24.12¢/million Btu, is estimated to be $99,275. However, present indications are that the cost of coal is to increase to 26.17¢/million Btu as of June 30, 1956. At this increased price, an annual operating saving of $135,975 would result. These figures reflect both the saving in cost of fuel and saving in the cost of operating and maintaining coal handling, ash sluicing, and soot blowing equipment. The attached curves and tabulation sheets are submitted to further substantiate the fact that steam production with natural gas at 20.99¢/1000 cu.ft. would result in considerable saving over coal firing at present or expected future coal prices.

In addition to monetary savings, it is considered highly desirable to provide a second fuel source in order to insure continuity of operation of the Y-12 Plant.

If orders for material and equipment could be placed by March 1, 1956, and if the alterations are made by a CPFF Contractor, it is possible that the conversion could be completed by June 30, 1956.

Very truly yours,

UNION CARBIDE NUCLEAR COMPANY

J P Murray
J. P. Murray
Y-12 Plant Superintendent

JPM:JCL:ls

Attachments

cc:	Mr. R. C. Armstrong	(2)
	Mr. C. E. Center	(1)
	Mr. L. B. Emlet	(1)
	Mr. L. H. Jackson	(1)
	Mr. W. C. Moore	(1)
	Mr. D. H. Rader	(2)
	Mr. G. W. Mitchel-Y-12RC	(1)
	Mr. G. B. Lockhart	(1)
	Mr. J. C. Little	(1)
	Mr. E. E. Choat	(1)
	File	(1)

CUMULATIVE FUEL COST

Period	Coal @ 26.62¢ *	Coal @ 26.62¢ * + Gas @ 20.99¢	Coal @ 28.67¢ *	Coal @ 28.67¢ * + Gas @ 20.99¢	Gas @ 29.15¢
6-30-56 to 1-1-57	$ 577,614	$ 511,567	$ 600,554	$ 537,484	$ 612,936
6-30-56 to 6-30-57	1,185,179	1,085,904	1,276,446	1,140,471	1,302,765
6-30-56 to 1-1-58	1,742,793	1,597,471	1,952,338	1,677,955	1,915,701
6-30-56 to 6-30-58	2,370,358	2,171,808	2,552,892	2,280,942	2,605,530
6-30-56 to 1-1-59	2,927,972	2,683,375	3,153,446	2,818,426	3,218,466
6-30-56 to 6-30-59	3,555,537	3,257,712	3,829,338	3,421,413	3,908,295

* Note: Unit fuel costs are given in cents/million Btu, and include handling and preparation charges.

Assumptions:

I. The Y-12 Plant Monthly Steam Requirements, for the three years considered, are assumed to be the same as for F.Y. '57 which are listed below:

Month	Steam Usage M lb.	Total Heat Million Btu Steam M lb. x 1050 $\frac{Btu}{Lb.}$
July	211,226	221,787
Aug.	234,226	245,937
Sept.	249,711	262,197
Oct.	279,876	293,870
Nov.	354,482	372,206
Dec.	424,051	445,254
Jan.	426,328	447,644
Feb.	391,368	410,936
March	352,285	369,899
April	300,248	315,260
May	260,073	273,077
June	243,254	255,417

II. Natural Gas

A.	Dump gas price at K-25	=	20.78¢/M Cu.ft.
	Charges for handling, odorizing, etc. = 1%	=	0.21¢/M Cu.ft.
	Total Dump Gas Cost	=	20.99¢/M Cu.ft.
B.	Yearly average gas cost based on the cost of gas at the K-25 Power Plant	=	29.15¢/M Cu.ft.

6/7/96 ChemRisk - 6/13

DOCUMENT DESCRIPTION (Completed By Requesting Division)

Document No.	Author's Telephone No.	Acct. No.	Date of Request
Y/TS-1525	6-0263	2366000 $	6/6/96

Unclassified Title: SELECTED PAGES FROM HISTORIC BUILDING ASSESSMENT OF THE Y-12 PLANT (DRAFT COPY)

Author(s): Requestor: Steve Wiley

TYPE: ☐ Formal Report ☐ Informal Report ☐ Progress/Status Report ☐ Co-Op Report ☐ Thesis/Term Paper

☐ Oral Presentation (identify meeting, sponsor, location, date):

☐ Journal Article (Identify Journal):

☒ Other (Specify): To Be Released to ChemRisk, Phase II

Document will be published in proceedings ☑ No ☐ Yes

Document will be distributed at meeting ☑ No ☐ Yes

Document has patent or invention significance ☑ No ☐ Yes (Identify)

Document has been previously released ☑ No ☐ Yes (Reference)

DIVISION REVIEW AND APPROVAL (Completed By Requesting Division)

TECHNICAL CLASSIFICATION REVIEW (Divisional Classification Representative)

Title(s): U Abstract: NA

DOCUMENT: Level U Category —

R. J. Fraser 6/6/96
Signature Date

DOCUMENT REQUEST APPROVED (Division or Department)

S. D. Wiley 6/6/96
Signature Date

Signature Date

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Distribution:	UCN-7721B	DOE F-1332.15	Document
Y-12 Central Files	Y-12 RC	Y-12 RC	Y-12 RC
TIO File	L.L. McCauley		
	S.W. Wiley		
	R.M. Keyser		

Distribution Remarks: Unlimited (ChemRisk)

APPROVAL AND RELEASE

Date Received | Date Initiated 6/6/96

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Title(s): U Abstract —
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Y-12 Classification Office Date

☐ Editor Date

☒ Waived / R. McKenney
Patent Office Date

☐ Date

☐ Date

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R. L. McKenney 6/7/96
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Y/TS-1525

Y-12

OAK RIDGE
Y-12
PLANT

MARTIN MARIETTA

Selected Pages from Draft of Historic Building Assessment of the Oak Ridge Y-12 Plant

May 1996

Prepared by:
Thomason and Associates
under subcontract to
Health, Safety, Environment, and Accountability Organization

Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
Managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84-OR21400

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

MARTIN MARIETTA

Internal Correspondence

MARTIN MARIETTA ENERGY SYSTEMS, INC.

Date: November 8, 1995

To: T. R. Butz, C. C. Hill, R. A. Hummel, R. M. Keyser, L. L. McCauley, S. D. Morris, J. D. Peebles, J. E. Powell, J. G. Rogers, R. M. Walton

cc: R. L. Johnson Jr., M. C. Wiest, File-EMD-RC

From: J. L. Webb, 9115, MS-8219 (576-5715) Jennifer L. Webb

Subject: **Draft Y-12 Plant Historic Building Survey**

Enclosed is a copy of the draft Y-12 Historic Building Survey. (Enclosure 1) This survey was conducted to fulfill a committment outlined in Section II of the Programmatic Agreement for the Management of Historical Properties and Cultural Resources at the Oak Ridge Reservation which was signed by DOE, the State Historic Preservation Officer and the Advisory Council on Historic Preservation on May 6, 1994. (Enclosure 2)

To expedite the review process, please red line the enclosed survey with your technical comments and return document to me by Monday, November 20, 1995. Your comments would be greatly appreciated.

This document is being reviewed by the Y-12 Plant Technical Information Office and ,therefore, should not be copied or disseminated.

If you have any questions, please call me at 576-5715.

JLW:alr

Enclosures: As Stated

APPROVED FOR PUBLIC RELEASE

P. L. McKenney 6/7/96

Technical Information Office Date

HISTORIC BUILDING ASSESSMENT OF THE Y-12 PLANT

OAK RIDGE RESERVATION
ANDERSON COUNTY, TENNESSEE

DRAFT COPY

PREPARED BY
THOMASON AND ASSOCIATES
NASHVILLE, TENNESSEE

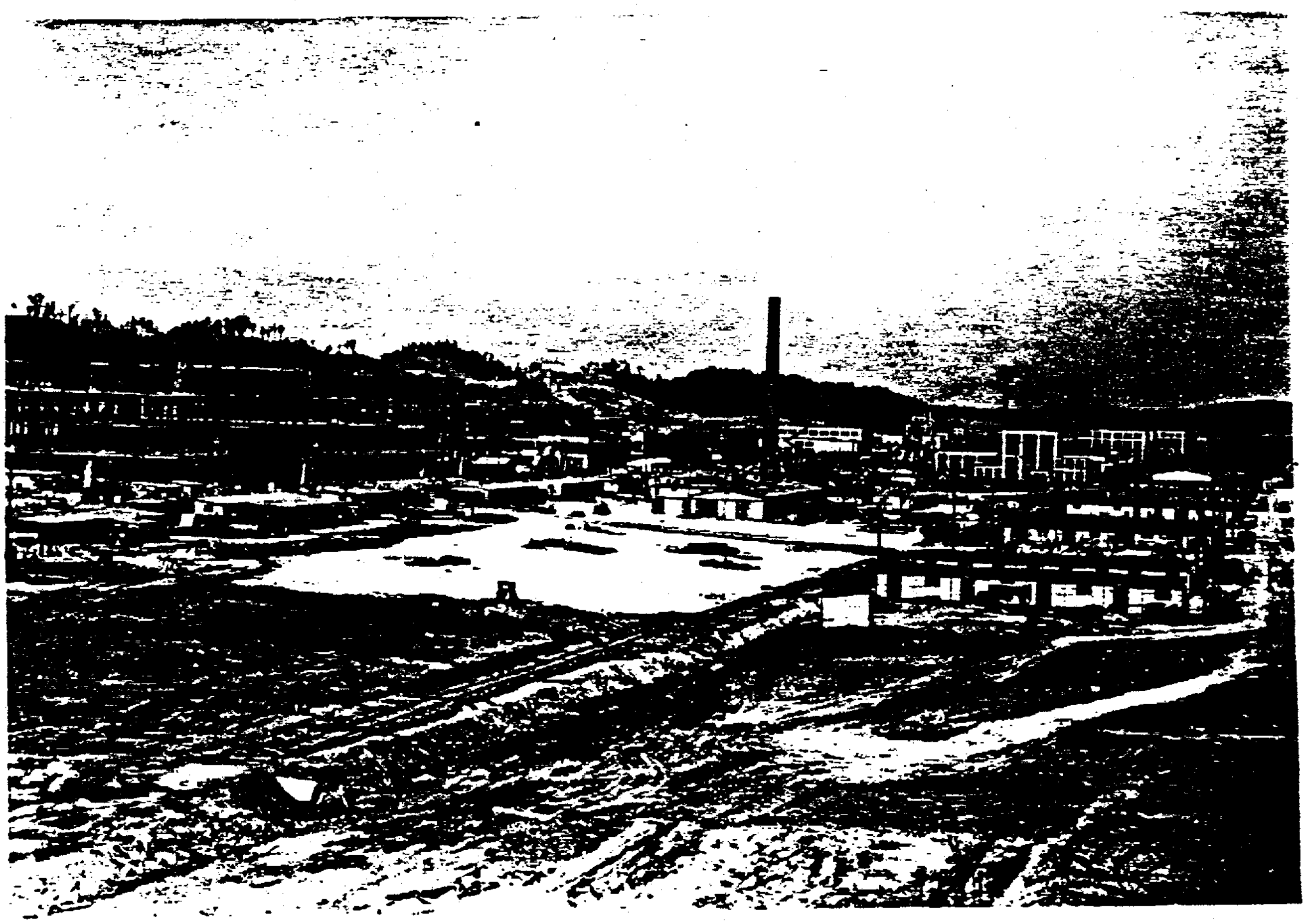


Figure II-XVII:
Y-12 Plant Construction, 1944

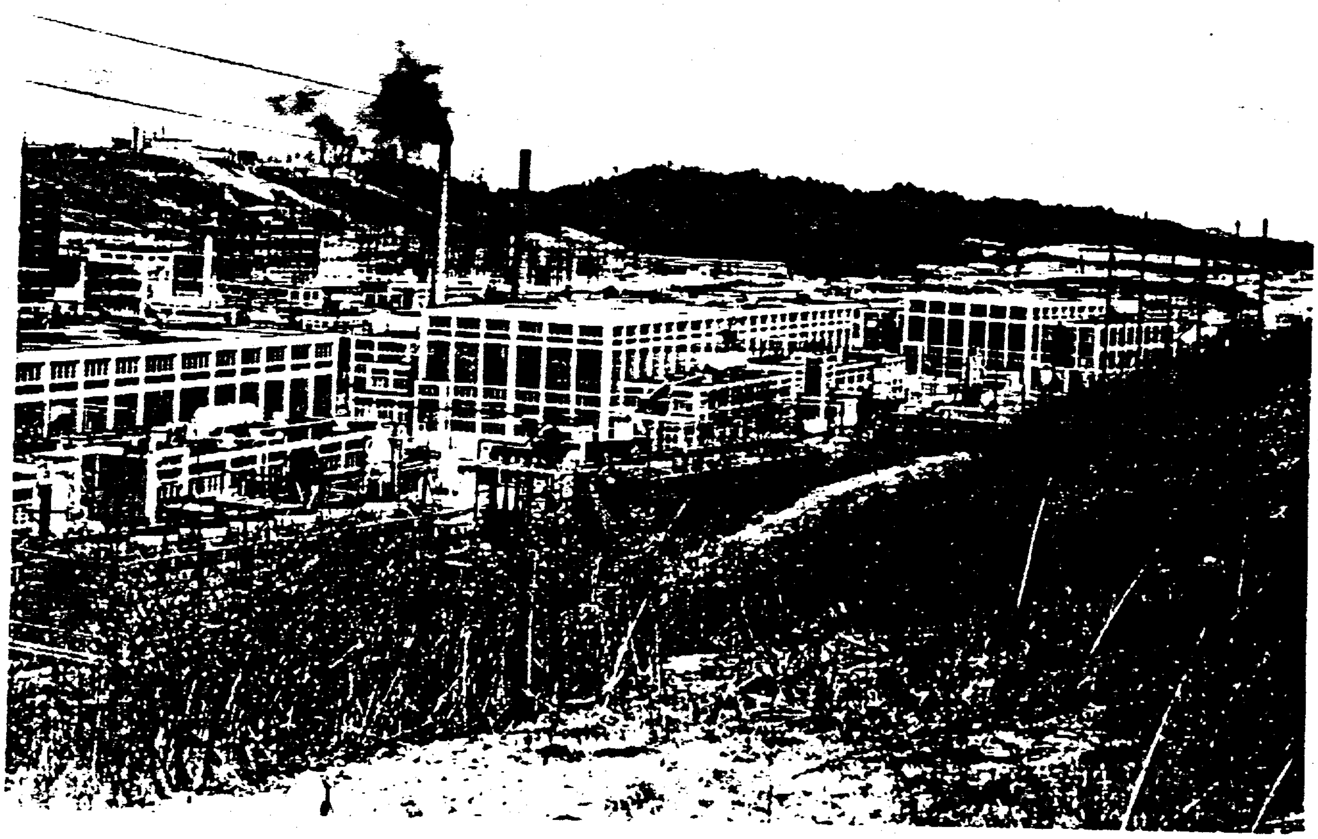


Figure II-XVII:
Y-12 Plant, July 5, 1945

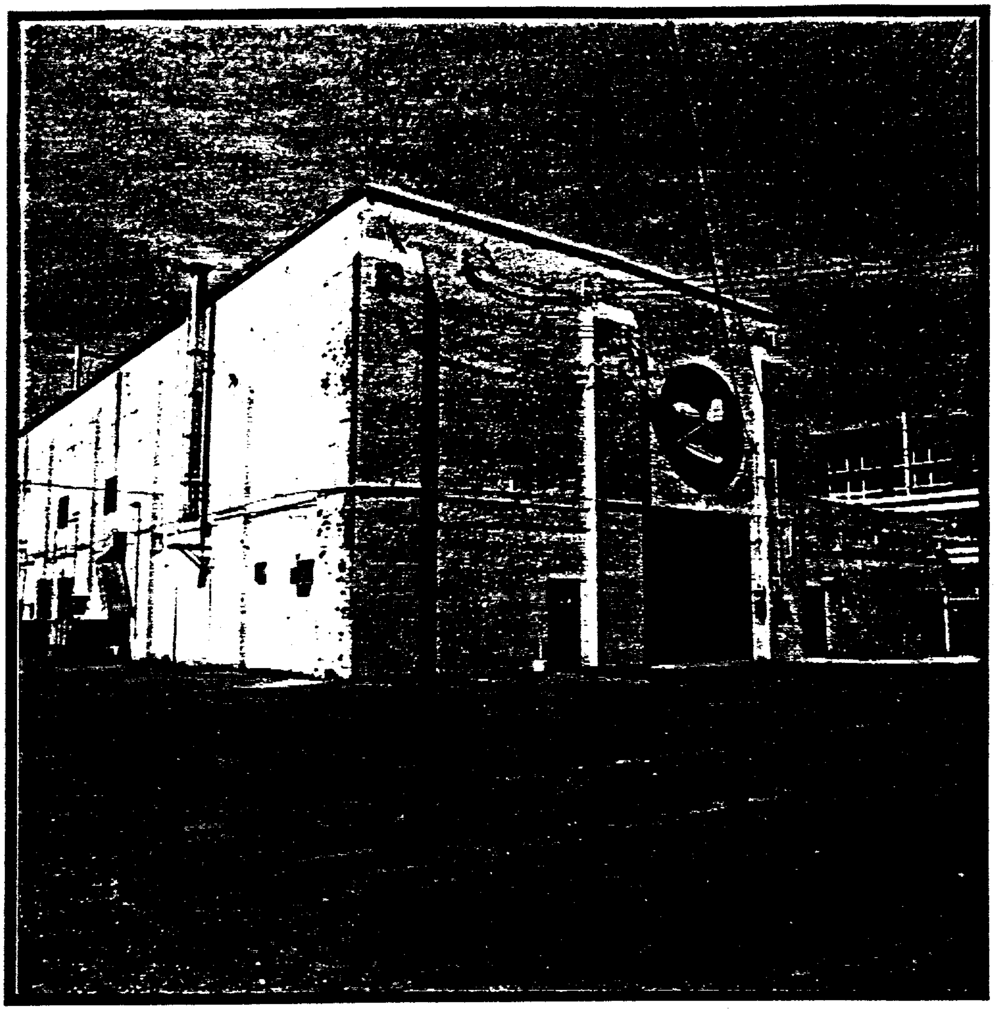


Figure III-XVIII: Building 9401-1 is the oldest remaining brick building

BUILDING 9401-1

ARCHITECTURAL DESCRIPTION:

Constructed of masonry bearing walls (brick) with a precast concrete flat roof system, this two-story, rectangular plan building is the first brick building completed at Y-12. The windowless building features a flat roof and a loading dock on the east facade. Single door entries are located on the east and west facades. The most distinctive feature of the building are the brick pilasters that are located on all the facades of the building. Mechanical vents project from the west and south facades. Mechanical equipment and pipes are located along the north facade. A circular sign reading "Advanced Propulsion Technology Center" is attached to the east facade. One bay of the building on the western end features a raised roof with a metal clad exterior. A small, shed roof addition is located on the northeast corner.

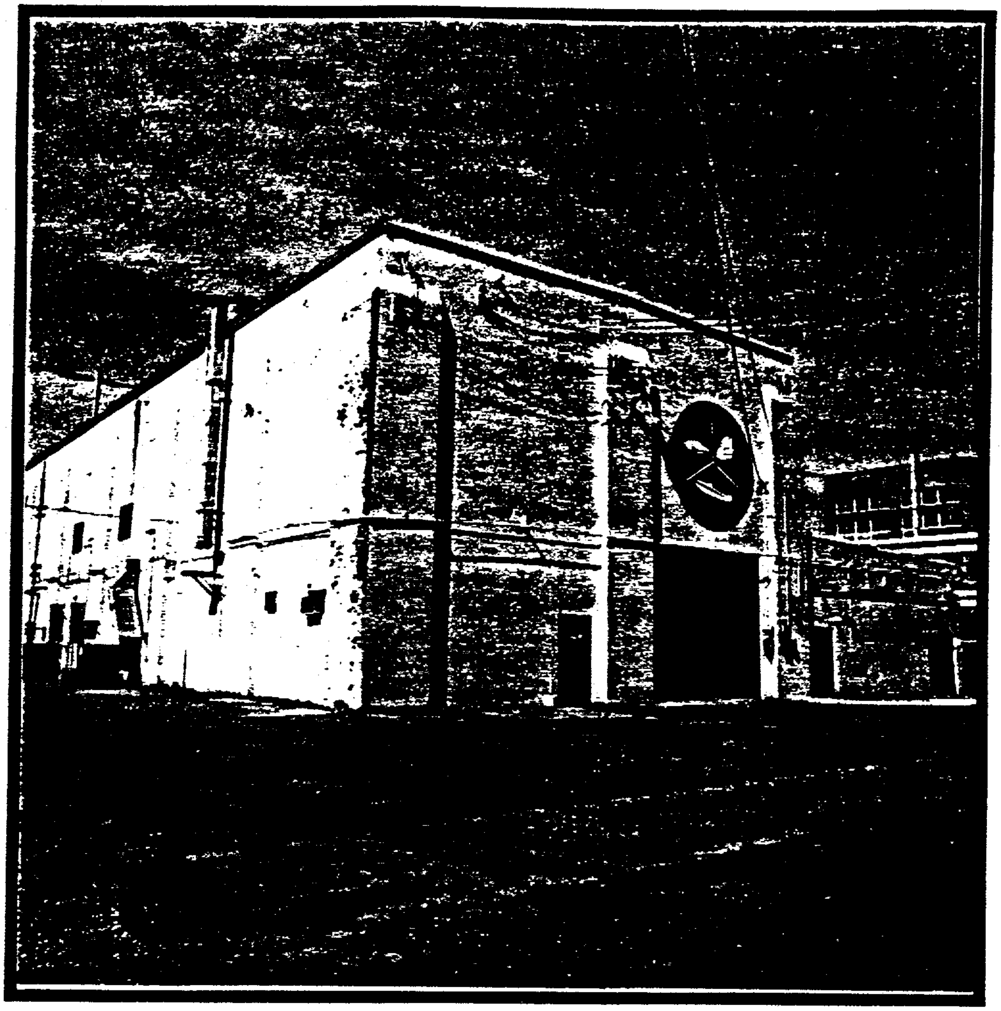
HISTORY:

Completed in June of 1943, this building houses Engine Test Cells and is used for Coal Classification Research. The facility presently houses a component of the United States Navy's "Seawolf" project. The 12,000 square foot facility was constructed by Stone & Webster Engineering Corp.

SIGNIFICANCE:

This building is associated with the development of the Oak Ridge Reservation during World War II. Building 9401-1 functions as an engine cell testing facility. As an ancillary facility, Building 9401-1 furthered Y-12's World War II mission of enriching uranium for the atomic bomb and helped to meet identifed goals throughout the Cold War years. Ancillary facilities - pumphouses, guard posts, warehouses, and utility stations - were vital to the success of missions identified for the Y-12 Plant during World War II and the Cold War years. In terms of the logistics and the support provided Y-12's Alpha and Beta buildings, ancillary facilities contribute to the proposed historic district's sense of time and place. The building retains architectural and historical significance to meet National Register Criteria.

In consultation with the TN-SHPO, the HPS determined that Building 9401-1 is eligible for inclusion in the National Register under Criterion A and is included in the proposed Y-12 Plant National Register Historic District. Under Criterion A, it is eligible for its historical association with World War II and post-World War II government-sponsored scientific movement and early nuclear research.



Building 9401-1.

BUILDING 9401-2

ARCHITECTURAL DESCRIPTION:

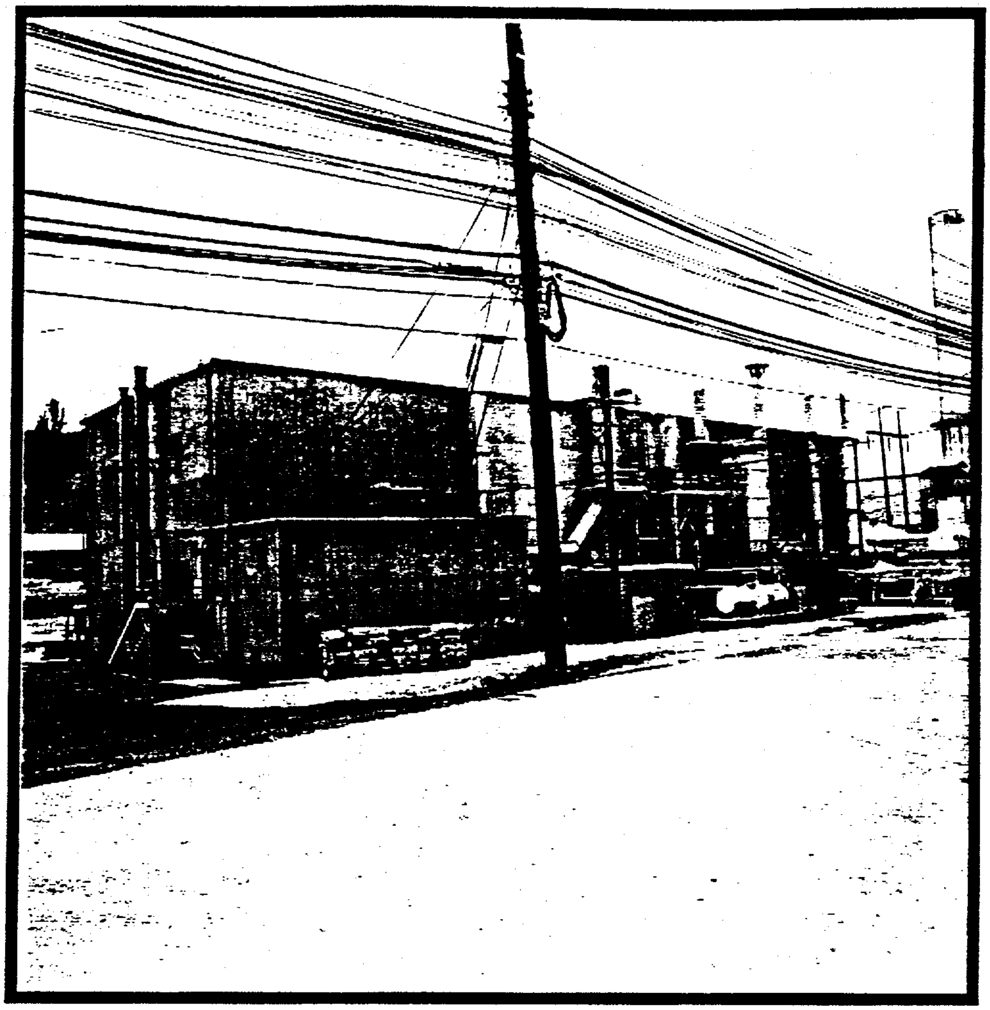
Constructed of steel frame and covered in transite, this rectangular plan, flat roof building features an interior mezzanine and a variety of single story, square and rectangular plan, flat roof additions. Various piping and venting systems are attached directly to the building's face. Poured concrete foundation. Tar and gravel roofing material.

HISTORY:

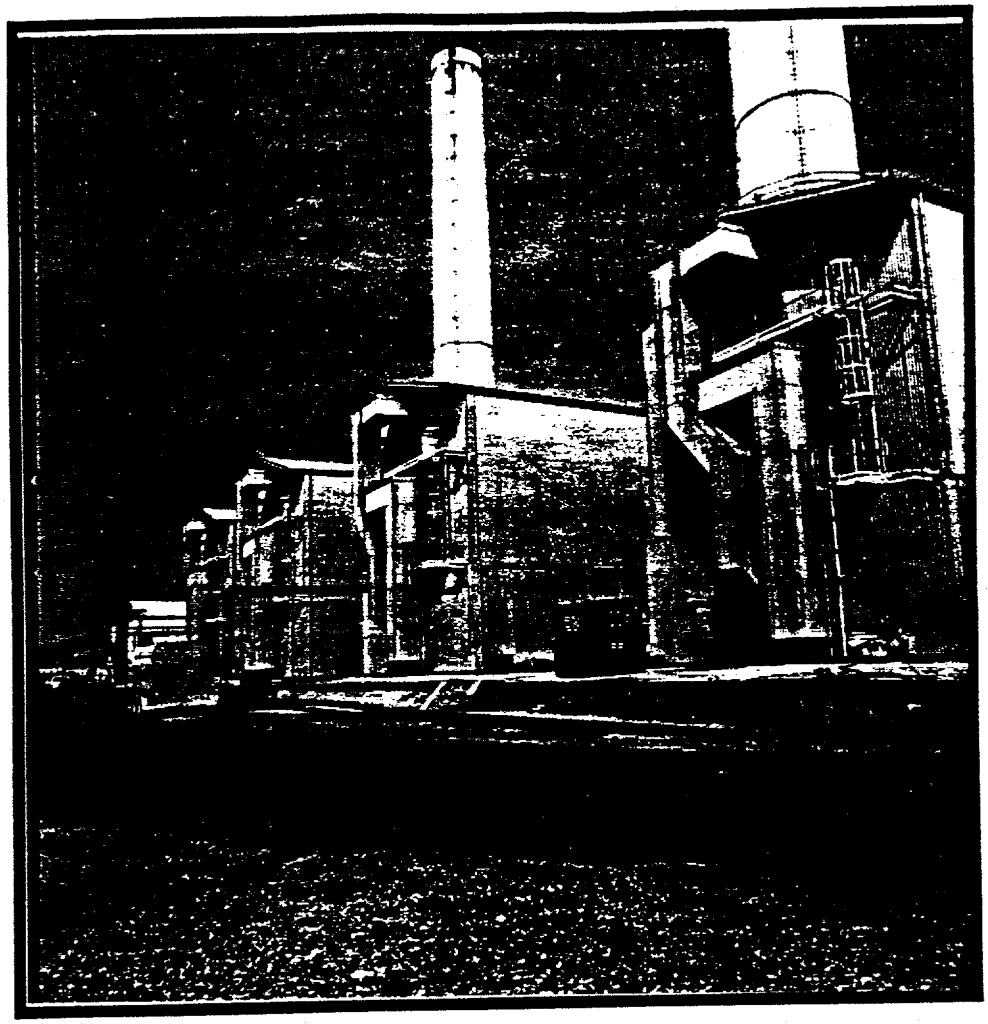
Completed in December of 1943, this 12,900 square foot building houses a Plating Shop and Maintenance facility and was constructed by Stone & Webster Engineering Corp.

SIGNIFICANCE:

This building is associated with the development of the Oak Ridge Reservation during World War II. Building 9401-2 functioned as a plating/maintenance shop and furthered the plant's World War II mission of enriching uranium for the atomic bomb. The building retains architectural and historical significance to meet National Register Criteria. In consultation with the TN-SHPO, the HPS determined that Building 9401-2 is eligible for inclusion in the National Register under Criteria A and C and is included in the proposed Y-12 Plant National Register Historic District. Under Criterion A, the building is eligible for its historical association with the Manhattan Project, the post-World War II government-sponsored scientific movement, and early nuclear research. It is felt to be eligible under Criterion C for engineering merits and for contributions to science and technology.



Building 9401-2.



Building 9401-3 or Steam Plant Complex.

change Excel chart!

~~Exec Sum~~ YEX-21 p.45 229

need Xeroxes SATE n59

Building 9401-3

ARCHITECTURAL DESCRIPTION:

Constructed of structural steel framing, this four-story building is covered with cement-asbestos wall panels, or transite. The irregularly shaped building features flat and shed roofs on the main block. Four identical gable-roofed buildings are located in a linear row along the south facade, adjacent the railroad, which exhibit distinctive, transite enclosed appendages on their south facades. Between the four ancillary buildings and the main block are two cast concrete smokestacks. A small, gable-roof tower, located on the west facade, is elevated four stories by a steel structure and attached to the main block with an elevated, sloping wing. Both the tower and the wing are covered with transite. Small, one-story, metel-clad wings are located on the east and south facades of the main block. A small two-story ancillary building, featuring a gable-roof and transite wall panels, is located to the southeast of the main building complex and adjacent to the expansive coal storage area. This coal storage area, which powers the steam plant, is located to the west of the main building complex and also features small ancillary buildings and conveyors that are included with the Steam Plant Complex.

HISTORY:

Completed in June of 1954 by Burns & McDonald, this 33,725 square foot building houses the Y-12 Plant Steam Plant which features coal conveyors, crusher, pulverizers and water softeners. Powered by coal, the Steam Plant consists of a number of buildings, including two smokestacks and a expansive coal storage area to the west of the complex.

SIGNIFICANCE:

This building is associated with the Y-12 Plant located on the Oak Ridge Reservation, which was originally developed during World War II. Building 9401-3's original and current use has been to generate electricity for the Y-12 Plant. The plant's presence was vital to the success of missions identified for the Y-12 Plant during World War II and the Cold War years. In terms of the logistics and the support provided Y-12's facilities, Building's 9401-3 contributes to the proposed historic district's sense of time and place.

In consultation with the TN-SHPO, the HPS determined that Building 9401-3 is eligible for inclusion in the National Register under Criterion A and is included in the proposed Y-12 Plant National Register Historic District. Under Criterion A, the building is eligible for its historical association with the World War II government sponsored scientific movement and early nuclear research.

ChemRisk 6/13

DOCUMENT DESCRIPTION (Completed By Requesting Division)

Document No.	Author's Telephone No.	Acct. No.	Date of Request
Y/TS-1527	6-0263	2366000 $	6/6/96

Unclassified Title: RCRA CLOSURE PLAN- OLD STEAM PLANT (S-029) - Y-12 PLANT

Author(s) Requestor: Steve Wiley

TYPE: ☐ Formal Report ☐ Informal Report ☐ Progress/Status Report ☐ Co-Op Report ☐ Thesis/Term Paper

☐ Oral Presentation (identify meeting, sponsor, location, date):

☐ Journal Article (Identify Journal):

☒ Other (Specify): To Be Released to ChemRisk, Phase II

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Document will be distributed at meeting ☒ No ☐ Yes

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Document has been previously released ☒ No ☐ Yes (Reference)

DIVISION REVIEW AND APPROVAL (Completed By Requesting Division)

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DOCUMENT: Level U Category —

[signature] Signature 6/6/96 Date

DOCUMENT REQUEST APPROVED (Division or Department)

[signature] Signature 6/6/96 Date

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TIO File L.L. McCauley

S.W. Wiley

R.M. Keyser

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Date Initiated 6/6/96

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Title(s): U Abstract —

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Y-12 Classification Office Date

☐ Editor Date

☒ waived / P. McKenney Patent Office Date

☐ Date

☐ Date

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P. L. McKenney 6/7/96

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Y/TS-216/1R

Y/TS-1527

Y-12

OAK RIDGE
Y-12
PLANT

MARTIN MARIETTA

RCRA CLOSURE PLAN -
OLD STEAM PLANT (S-029) -
Y-12 PLANT (REVISED CLOSURE PLAN)

S. H. Welch

MAY 1986

Health, Safety, Environment,
and Accountability Division

Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84OR21400

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Enclosure 1
Letter, Fee to Spence
May 15, 1986

ARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX Y
OAK RIDGE, TENNESSEE 37831

May 15, 1986

Mr. R. J. Spence
Department of Energy, Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37831

Dear Mr. Spence:

RCRA Closure Plan - Old Steam Plant (S-029) - Y-12 Plant

In response to your letter of April 9 transmitting a Notice of Deficiency (NOD) from the Tennessee Department of Health and Environment, enclosed is a revised closure plan (Enclosure 2), due to TDHE on May 20. Enclosure 1 is a listing of specific comments and our response to each.

Questions should be addressed to S. H. Welch at 6-5706.

Very truly yours,

for R. D. Williams
Gordon G. Fee
Vice President and
Y-12 Plant Manager

GGF:SHWelch:ssh

Enclosures: As Stated

cc/enc: J. K. Bailey
B. J. Davis, DOE-ORO (11)
C. W. Kimbrough
T. P. Perry
T. G. Ramsey
R. J. Spence, DOE-ORO (2)
[redacted] Welch (NoRC)
H. D. Whitehead, Jr.
M. L. Willoughby

cc: T. R. Butz
G. G. Fee
W. F. Furth
C. C. Hill
M. L. Jones
L. L. McCauley
M. E. Mitchell
W. F. Thomas
L. O. Vaughan
L. F. Willis

RESPONSE TO SPECIFIC COMMENTS
OLD STEAM PLANT NOD

1. Comment: Page 3 - "Spent wash and rinse solutions . . . which contain residual hazardous constituents will be disposed of at a permitted facility." To evaluate for "hazardous constituents," all samples would have to be tested for all of the constituents listed in Appendix .02E of the Rules Governing Hazardous Waste Management in Tennessee. This also conflicts with the constituents, listed on page 5, selected to be indicator parameters.

   Response: See response to comment number 3.

2. Comment: Justify the selection of water as the washing/rinsing medium for decontamination.

   Response: This justification is given on page 5 .

3. Comment: Will the facilities used to treat the wash and rinse solutions be RCRA units? If not, testing of those solutions will be necessary to determine the hazardous/nonhazardous status of the rinse waters.

   Response: Page 4 states that spent wash and rinse solutions will be treated at an interim status or permit-by-rule facility. Testing will therefore not be required to determine whether these solutions are hazardous or nonhazardous. However, operating procedures for Y-12's onsite treatment facilities require that all aqueous wastes be tested for a standard set of parameters before they are transported to a treatment facility.

4. Comment: Verification of decontamination—why would taking a wipe sample be adequate as a method of verifying decontamination?

   Response: Verification sampling procedures have been revised from taking wipe samples to taking samples from the concrete floor. Details are given on pages 5 through 8.

5. Comment: Management of clean-up materials and residues, page 5, states that all spent wash and rinse solutions generated as part of the clean-up operation will be collected and disposed of in a permitted disposal facility. Inventory disposal, removal, and decontamination of equipment, page 4, specifies that spent wash and rinse solutions will be collected and disposed of using a suitable treatment technique. Are these conflicting statements?

   Response: All references to management of wash and rinse solutions now state that they will be treated in an interim status or permit-by-rule facility.

6. Comment: Describe decontamination procedures for equipment to be used in clean-up and the procedure to verify that decontamination has been accomplished.

   Response: Page 8 addresses decontamination of cleaning equipment.

7. Comment: Please address the floor drains mentioned in the "Location and Description of Waste Storage Facility" section. Will these need decontamination?

   Response: The "Location and Description of Waste Storage Facility" section has been revised to address the floor drains more fully and justify not decontaminating them.

Enclosure 2
Letter, Fee to Spence
May 15, 1986

CLOSURE PLAN

WASTE STORAGE AREA IN BUILDING 9401-1

OLD STEAM PLANT (S-029)

U.S. DOE Y-12 PLANT

Introduction

This document presents a closure plan for the Old Steam Plant, Building 9401-1 (Facility Number S-029), Y-12 Plant. Thus, this closure plan is limited to a single area out of the numerous hazardous waste management facilities at the plant complex. The location of the Old Steam Plant within Y-12 is shown in Figure 1.

Location and Description of Waste Storage Facility

The nature of the storage area within Building 9401-1 is indicated in Figure 2. The storage area consists of part of the ground floor of an old steam plant and is approximately 50 by 60 feet. This area was used for storage of wastes prior to offsite disposal, beginning in March 1984 and ending in November 1984. The area has a concrete floor in reasonably good condition. Visually the floor appears reasonably clean. There are no dikes, trenches, or sumps. Floor drains are present. A spill of lead fluoborate in hydrofluoric acid occurred during the March to November 1984 time period. The spilled material was cleaned up immediately after observation and did not enter any floor drains. The location of the spill is shown in Figure 2.

The types of wastes stored in this area were principally discarded or partially used laboratory chemicals. None of the hazardous wastes stored in this area had any uranium contamination.

Prior to March 1984, Building 9401-1 was used for a variety of process and development activities which may have resulted in contamination of the building with various materials, including uranium. This closure plan

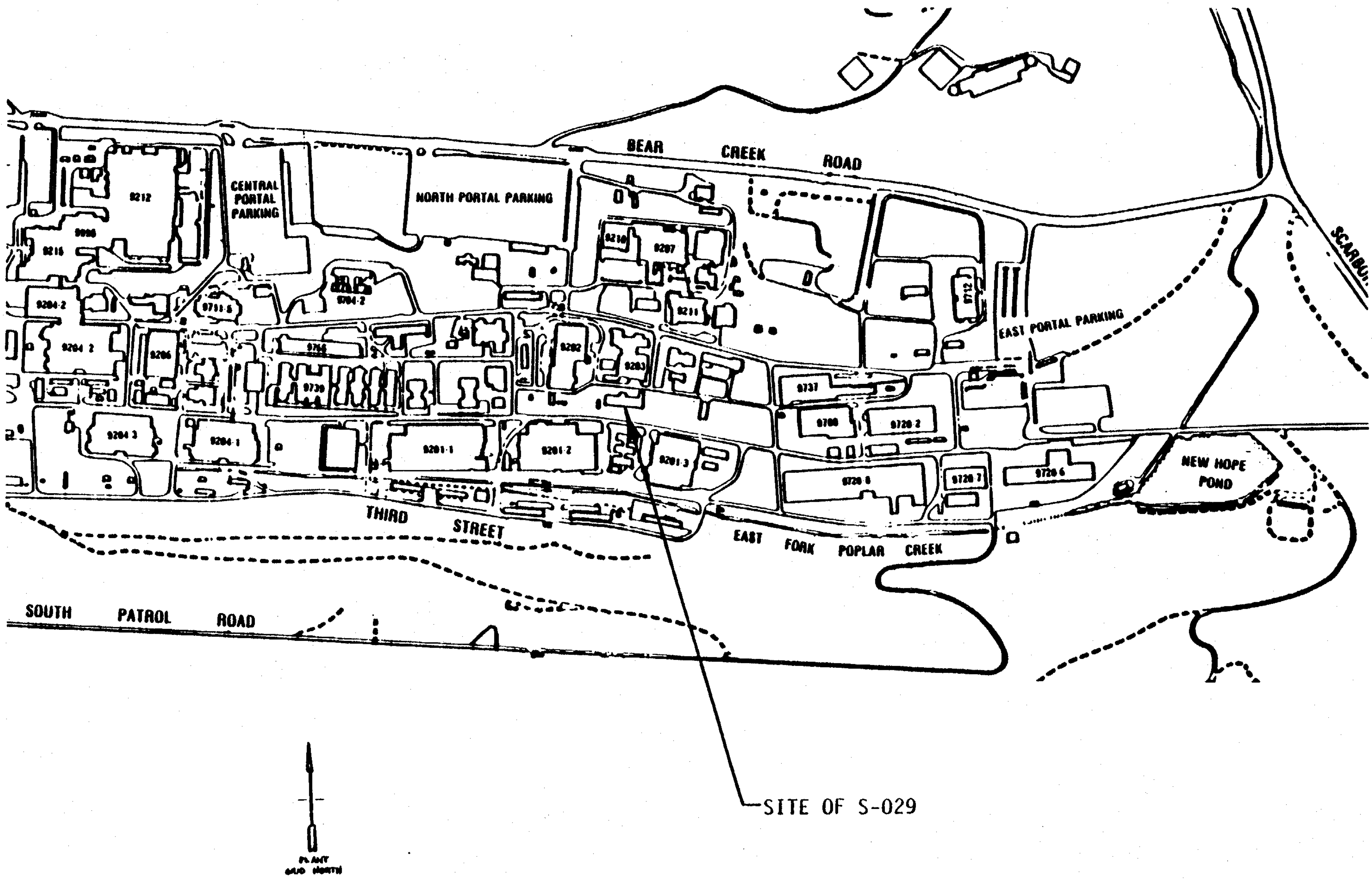
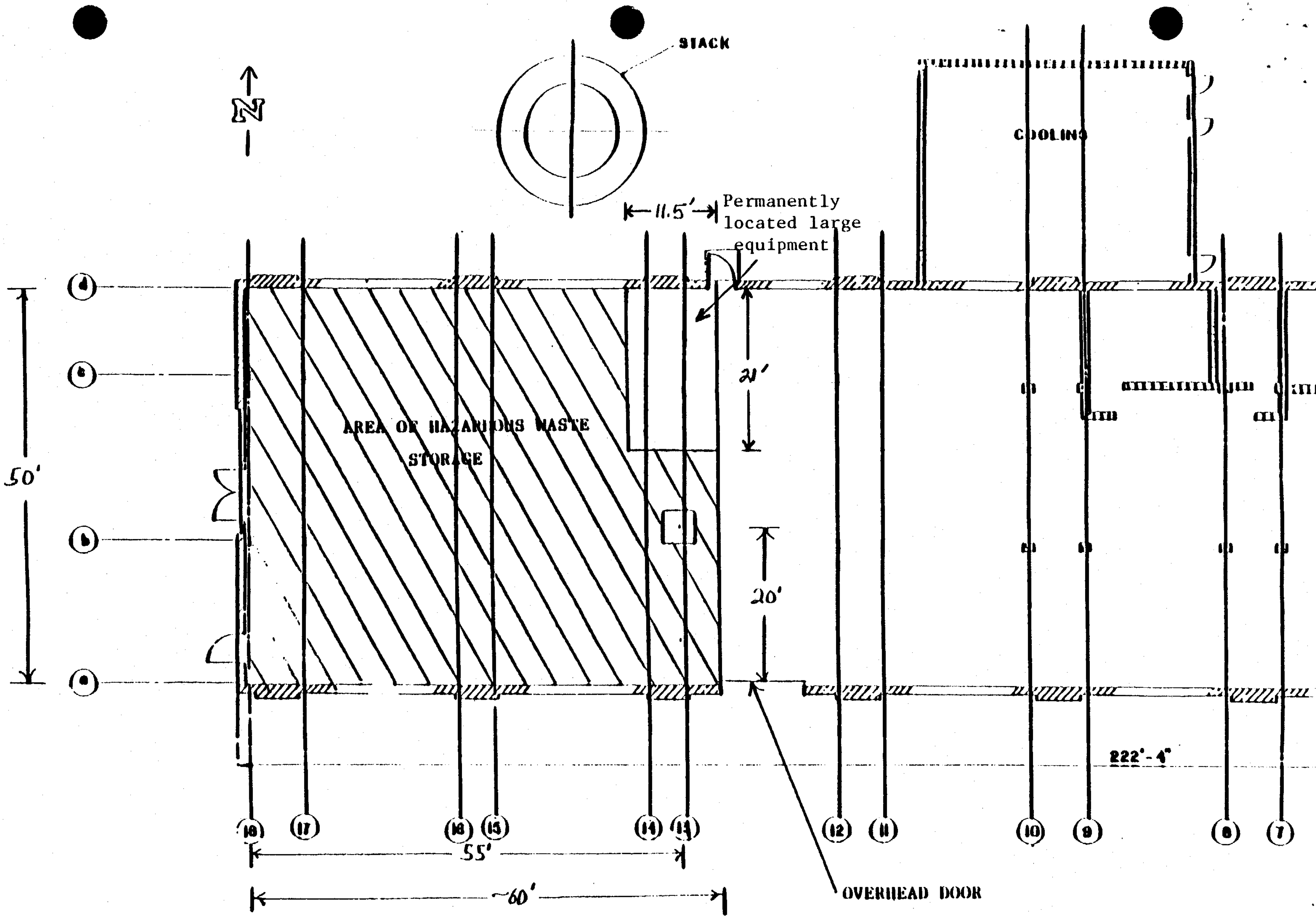


FIGURE 1. LOCATION OF THE OLD STEAM PLANT (S-029).



☐ Lead fluoborate in 10% hydrofluoric acid spill

FIGURE 2. OLD STEAM PLANT (BUILDING 9401-1).
APPROX. SCALE 1″ = 16′

FLOOR PLAN
FL. GR. 9420

addresses only those potential contaminants resulting from the hazardous waste storage activities. The potential presence of residual contaminants from prior activities will be investigated if required under other programs.

All hazardous wastes stored in the building were in individual containers or lab packs. The packaging operations carried out did not provide an opportunity for hazardous wastes to be splashed on the building walls. The only spill that occurred was on the floor, not close to any walls or floor drains. Therefore, decontamination of walls and drains is not addressed in this closure plan.

Closure Plan

Closure Performance Standard

In November 1984, all waste was removed from Building 9401-1 to a permitted commercial hazardous waste disposal facility. At closure, the portion of the building floor that was used for hazardous waste storage will be decontaminated. Spent wash solutions generated during the decontamination procedures will be treated at a RCRA interim status or permit-by-rule facility. Upon completion of these procedures, the building shell will be rededicated to other purposes consistent with the industrial nature of the Y-12 facility. This approach will eliminate the need for post-closure maintenance and controls.

Partial Closure and Final Closure Activities

There will be no partial closure, and final closure will proceed as described below.

Maximum Waste Inventory

The maximum waste inventory for this area was approximately 40 drums (55-gallon size).

Preliminary Sampling

Before beginning closure, three to five shallow concrete samples (concrete chips approximately 1/2-inch deep) will be taken from the facility floor. The sample locations will be selected from the 12 locations indicated in Figure 3, as well as one sample from the area of the spill described in a previous section. The samples will be subjected to the EP Toxicity Test and the Toxicity Characteristic Leaching Procedure (TCLP) and the extracts analyzed for the indicator parameters given in Table 1. If any parameters are above the indicated limits, decontamination will be performed as described in the following section.

Inventory Disposal, Removal, and Decontamination of Equipment

All hazardous waste inventory has been removed from Building 9401-1.

Decontamination Procedures. At closure, the building floor will be detergent washed and double rinsed with water. Water with surfactants will be used as the decontamination solution. Many wastes stored in Building 9401-1 were water soluble. Other wastes which were less water soluble, such as organic solvents, oils, and greases, will be emulsified in the decontamination solution.

Spent wash solutions will be collected and treated in the Central Pollution Control Facility (T-006), West End Treatment Facility (T-007), or Waste Coolant Processing Facility (permit-by-rule). If contamination in excess of allowable limits is detected according to the procedures and standards outlined below, additional decontamination will be performed. Appropriate decontamination methods will be selected, and additional time will be requested for performing the work.

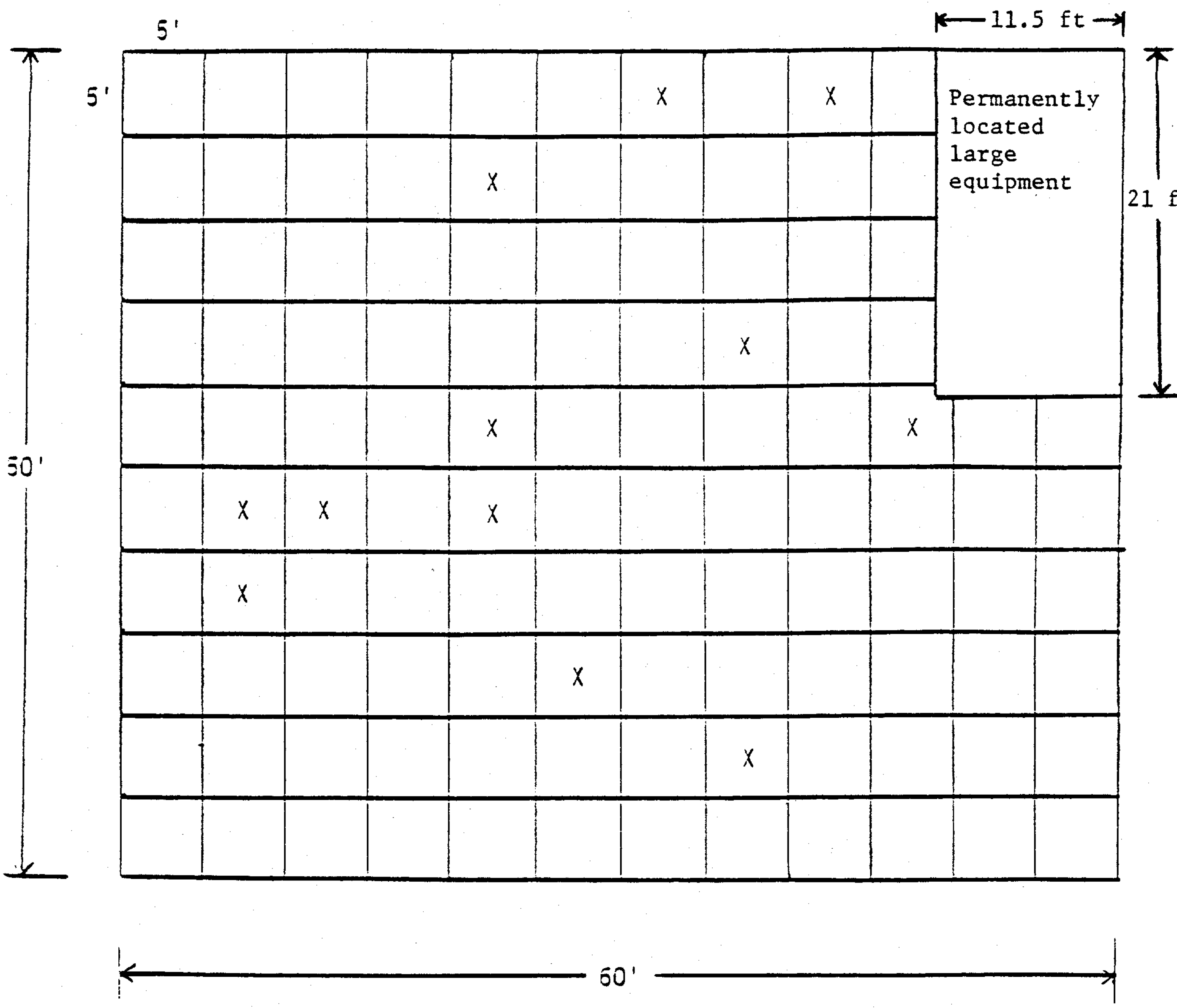


FIGURE 3. SAMPLE LOCATIONS FOR OLD STEAM PLANT

The 12 sample locations shown in this figure are suggested for sampling the hazardous waste storage area in Building 9401-1. The sample is a simple random sample of the 120 grid squares, and is in compliance with EPA Document #SW-846.

TABLE 1. INDICATOR CONSTITUENTS FOR WHICH CONCRETE SAMPLES WILL BE ANALYZED AND THEIR MAXIMUM ALLOWABLE LIMIT IN THE WASTE EXTRACT

Contaminant	Maximum limit, (mg/l)
Barium	100.0[a]
Cadmium	1.0[a]
Chromium	5.0[a]
Lead	5.0[a]
Mercury	0.2[a]
Carbon tetrachloride	0.07[b]
Methanol	25.0[b]
Methylene chloride	8.6[b]
Methyl ethyl ketone	7.2[b]
Methyl isobutyl ketone	25.0[b]
Tetrachloroethylene	0.1[b]
Toluene	14.4[b]
1,1,1-Trichloroethane	25.0[b]
Trichloroethylene	0.07[b]
Trichlorofluoromethane	25.0[b]

a Maximum concentration of these contaminants are based on the characteristic of EP Toxicity (40 CFR 261.24, Table 1).

b Maximum concentrations of these contaminants are based on EPA's soon-to-be-proposed TCLP limits.

Criteria for Determining Decontamination. Following the decontamination efforts, a total of 12 shallow concrete samples (concrete chips approximately 1/2-inch deep), indicated in Figure 3, will be taken from the facility floor. The 12 samples will be analyzed for the indicator parameters given in Table 1. If the analytical results are statistically within the limits in Table 1, closure will be certified by DOE and an independent, registered profesional engineer.

Management of Cleaning Materials and Residues. All spent wash solutions generated as part of the cleanup operation will be collected and treated in a interim status or permit-by-rule facility. Solid residues (swabs, wipes, etc.) will be disposed of in an interim status or permitted facility.

The cleaning equipment will be triple steam cleaned to remove any residue from the cleaning operation. Because this procedure is equivalent to or better than triple rinsing, verification sampling is not proposed for the cleaning equipment. However, the equipment will be visually inspected to be sure that no visible residue from the closure activities remains.

Schedule for Closure

A schedule for final closure of the Old Steam Plant is presented in Table 2. The expected date for beginning closure is September 2, 1986. If approval of the closure plan is not received at least 10 days prior to this start date, then a new date for starting closure will be submitted to TDHE.

The schedule presented for the closure of this facility is an estimated schedule. The schedule is subject to unknown factors such as weather conditions, actual boundaries of the contamination, effectiveness of the decontamination procedures, etc. When the schedule progresses faster than anticipated or cannot be met, TDHE will be appropriately notified.

TABLE 2. CLOSURE SCHEDULE FOR THE OLD STEAM PLANT

Action	Days
• Initiate closure	0
• Mobilize and clean floor (Note 1)	25
• Obtain and analyze floor samples and review analytical data	95
• If clean, prepare documentation and certification by independent professional engineer	110
• Closure certification by DOE	130

Note 1: Floor cleaning may be deleted if preliminary sampling indicates the floor is not contaminated.

CC: LOV
CCH
MLW
LLM
TRB

Department of Energy
Oak Ridge Operations
P. O. Box E
Oak Ridge, Tennessee 37831

October 2, 1986

Mr. Gordon G. Fee
Y-12 Plant Manager
Martin Marietta Energy Systems, Inc.
Post Office Box Y
Oak Ridge, Tennessee 37831

Dear Mr. Fee:

RCRA CLOSURE PLAN - OLD STEAM PLANT (S-029) - Y-12 PLANT

Reference is made to your letter, dated May 15, 1986, subject as above, which transmitted a revised closure plan for the subject facility.

Enclosed is a letter from the Tennessee Department of Health and Environment officially approving the closure plan for the Old Steam Plant. Please proceed with the closure as scheduled and keep both myself and our Environmental Protection Division informed of the timing of significant events so that we will be able to certify closure at the completion of the activities.

If you have any questions or require additional information, please contact Mike Travaglini of our Environmental Protection Division at extension 6-0848.

Sincerely,

Robert J. Spence
Deputy Assistant Manager
for Defense Programs

SE-31:Travaglini

Enclosure:
Ltr dtd 9-12-86

cc w/o enclosure:
M. E. Mitchell, 1000, ORNL
T. P. A. Perry, 1000, ORNL
S. H. Welch, 9704-1, Y-12
M. A. Travaglini, SE-31

Chemrisk - 6/13

DOCUMENT DESCRIPTION (Completed By Requesting Division)

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Y/TS-1526	6-0263	2366000 3	6/6/96

Unclassified Title: COMPUTER PRINTOUTS OF DRAWINGS FOR BUILDINGS 9401-1 AND 9401-2

Author(s) Requestor: Steve Wiley

TYPE: ☐ Formal Report ☐ Informal Report ☐ Progress/Status Report ☐ Co-Op Report ☐ Thesis/Term Paper

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Document will be published in proceedings ☑ No ☐ Yes

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Y-12

OAK RIDGE
Y-12
PLANT

MARTIN MARIETTA

Computer Printout of Engineering Drawings for Y-12 Plant Buildings 9401-1 and 9401-2

May 1996

Health, Safety, Environment, and Accountability Organization

Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
Managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84-OR21400

MANAGED BY
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__	V A2E-146405	001	0	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LAB - DEMOLITION FLOOR PLAN & NOTES							
__	V A2E-146406	001	0	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LAB-FL PL, SEC, ROOM FINISH, DOOR SCH&DTLS							
__	V A2E-146407	001	0	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LAB-INTERIOR ELEV WALL SECTION AND DETAILS							
__	V A2E-146408	001	0	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LAB-MEZZANINE & REFLECTED CEILING PLANS							
__	* A2E-940101-A001	001	0	DD	REL	Y-12	9401-1	1
	RESTORE EXTERIOR OF BUILDING PLAN & ELEVATIONS							
__	B-C-21528	001	0	DD	REL	Y-12	9401-1	
	Y-12 INTEGRATED SALVAGE FACILITIES FLOW DIAGRAM							
__	C2E-103926	001	0	DD	REL	Y-12	9401-1	
	FOSSIL ENERGY DEV FENCE							
__	C2E-104566	001	0	DD	REL	Y-12	9401-1	A
	ACCESS PLAN DWG INDEX							
__	V C2E-146404	001	0	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LAB - ACCESS PLAN & DRAWING INDEX							
__	D-A-30977	001	0	DD	REL	Y-12	9401-1	
	MICROWAVE LAB PL SEC & DET							
__	D-A-44160	001	0	DD	REL	Y-12	9401-1	
	PAD & WALKWAY PL & DET							
__	D-CV-39893	001	0	DD	REL	Y-12	9401-1	A
	SIDEWALK-PLAN AND PROFILE							
__	D-CV-43778	001	0	DD	REL	Y-12	9401-1	
	PLAN AND PROFILE							
__	D-S-27909	001	0	DD	REL	Y-12	9401-1	
	INTEGAT SALVAGE FAC BANJO							
__	D-S-27910	001	0	DD	REL	Y-12	9401-1	
	INTEGR SALV FAC BANJO CARR							
__	D-S-27911	001	0	DD	REL	Y-12	9401-1	
	INTEGR SALV FAC BANJO ALT							

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__	D-S-28977 MASKING CURTAIN SUPRT PLAN	001	0	DD	REL	Y-12	9401-1	
__	D-S-29349 INTEGR SALV FAC FURN FLUE	001	0	DD	REL	Y-12	9401-1	
__	D-S-41143 FAN SUPPORT BASE DETAILS	001	0	DD	REL	Y-12	9401-1	1
__	D-S-43254 FAN BASE PLAN AND DETS	001	A	DD	REL	Y-12	9401-1	R
__	D-S-43742 AUTOCLAVE HOISTS PL DET	001	0	DD	REL	Y-12	9401-1	1
__	D-S-44167 CVD FURN NO 2 PL SECT	001	A	DD	REL	Y-12	9401-1	1
__	D-S-52124 EMERG EXIT PL SECT	001	0	DD	REL	Y-12	9401-1	1
__	E-A-72147 PLANS AND DETAILS	001	0	DD	REL	Y-12	9401-1	
__	E-A-72148 ELEVATIONS AND DETAILS	001	0	DD	REL	Y-12	9401-1	
__	E-A-72149 SECTIONS AND DETAILS	001	0	DD	REL	Y-12	9401-1	
__	E-A-72150 MISC DETAILS	001	0	DD	REL	Y-12	9401-1	
__	E-A-72165 SOLVENT STORAGE ROOM	001	B	DD	REL	Y-12	9401-1	1
__	E-A-84007 GEN ENCLOSURE PLAN-DETAILS	001	0	DD	REL	Y-12	9401-1	
__	E-A-85936 AUTOCLAVE ENCL PL SECT	001	0	DD	REL	Y-12	9401-1	1
__	E-B-4401 MASTER BLDG PLAN 1ST FL	001	0	DD	REL	Y-12	9401-1	1
__	E-CV-28657 INTEGRATED SALVAGE FACILI	001	0	DD	REL	Y-12	9401-1	

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__	E-CV-31791	001	A	DD	REL	Y-12	9401-1	
	PAVING SOUTH OF 9401-1							
__	E-CV-62400	001	0	DD	REL	Y-12	9401-1	1
	ACC PL MATERIAL ENG DEVEL							
__	E-CV-72003	001	0	DD	REL	Y-12	9401-1	A
	ACC PL GENERAL VENTILATION							
__	E-C-26607	001	0	DD	REL	Y-12	9401-1	
	Y-12 INTERGRATED SALVAGE							
__	E-MD-86261	001	0	DD	REL	Y-12	9401-1	1
	EMERG PROCEDURE SAF EQPT							
__	E-MD-86261	002	0	DD	REL	Y-12	9401-1	1
	EMERG PROCEDURE SAF EQPT							
__	E-S-27386	001	B	DD	REL	Y-12	9401-1	X
	INTEGRATED SALVAGE FAC							
__	E-S-27387	001	B	DD	REL	Y-12	9401-1	X
	INTEGRATED SALVAGE FAC							
__	E-S-27388	001	A	DD	REL	Y-12	9401-1	X
	INTEGRATED SALVAGE FAC							
__	E-S-27389	001	A	DD	REL	Y-12	9401-1	X
	INTEGRATED SALVAGE FAC							
__	E-S-33817	001	A	DD	REL	Y-12	9401-1	
	INTEGRATED SALVAGE FACILITY FOUNDATION PLAN SECTIONS & DETAILS							
__	E-S--34297	001	D	DD	REL	Y-12	9401-1	1
	PIG CASTER TRENCH							
__	E-S-34766	001	0	DD	REL	Y-12	9401-1	
	SALVAGE FAC. MISC. FRAMING							
__	E-S-37043	001	0	DD	REL	Y-12	9401-1	
	INTEGRATED SALVAGE FACILITY ALUMINUM CAR COVER PLAN, SECTIONS & DETAILS							
__	E-S-37044	001	0	DD	REL	Y-12	9401-1	
	INTEGRATED SALVAGE FACILITY ALUMINUM CAR COVER SUPPORT & MISC DETAILS							
__	E-S-37242	001	0	DD	REL	Y-12	9401-1	
	INTERATED SALVAGE FACILITY ALUMINUM CAR COVER FLUE & SHELF DETAILS							

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__	E-S-41318 TWO 500 LBS CRANES	001	0	DD	REL	Y-12	9401-1	1
__	E-S-54678 ROOF REPLACEMENT	001	A	DD	REL	Y-12	9401-1	R
__	E-S-54679 ROOF REPLACEMENT	001	A	DD	REL	Y-12	9401-1	R
__	E-S-56775 PLANS & DETAILS	001	0	DD	REL	Y-12	9401-1	1
__	E-S-58980 BAILEY PIG CASTER SUPPTS	001	0	DD	REL	Y-12	9401-1	1
__	E-S-63372 CONC PAD AND FENCE	001	0	DD	REL	Y-12	9401-1	1
__	E-S-68780 AUTOCLAVE VENT PLATFORM	001	0	DD	REL	Y-12	9401-1	1
__	E-S-71966 PLAN & DETAILS	001	0	DD	REL	Y-12	9401-1	1
__	E-S-71967 SEDTIONS & DET PITCH IMP	001	0	DD	REL	Y-12	9401-1	1
__	E-S-71975 SECTIONS & DETAILS	001	0	DD	REL	Y-12	9401-1	1
__	E-S-77748 LUCIFER FURN CONT REACTOR	001	0	DD	REL	Y-12	9401-1	
__	E-S-85936 AUTOCLAVE ENCL PL SECT	001	C	DD	REL	Y-12	9401-1	1
__	FS-16272 STRUCT STEEL DETS-ROOF FRM	002	0	DD	REL	Y-12	9401-1	R
__	FS-16273 STRUCTURAL STEEL DETS	003	0	DD	REL	Y-12	9401-1	
__	FS-16289 DEAERATOR SUPPORTS	001	0	DD	REL	Y-12	9401-1	
__	S2D-54202 ROOF LADDER NE CORNER	001	0	DD	REL	Y-12	9401-1	R

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__	* S2E042432SK1	001	B	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LABORATORIES PROPOSED LAYOUT							
__	* S2E0424320SK1	001	A	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LABORATORIES PROPOSED LAYOUT							
__	S2E-104184	001	0	DD	REL	Y-12	9401-1	A
	ACCESS PLAN & DWG INDEX							
__	S2E-105672	001	A	DD	REL	Y-12	9401-1	1
	FOS ENGR LAB CCCTU CONT RM							
__	S2E-146409	001	0	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LAB-FOUNDATION PLAN SECTION & DETAIL							
__	V S2E-146410	001	A	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LABORATORY, BLDG 9401-1 MEZZ FRAMING PLAN							
__	S2E-34457-SK	001	C	DD	REL	Y-12	9401-1	1
	FEDL LAB EQUIP LAYOUT							
__	S2E-42432-SK1	001	0	DD	REL	Y-12	9401-1	1
	ENERGY TECHNOLOGY DEVELOPMENT LABORATORIES PROPOSED LAYOUT							
__	* S2E940101A002	001	0	DD	REL	Y-12	9401-1	R
	REROOF 9401-1 ROOF DETAILS							

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__	V A2E-107173	001	0	DD	REL	Y-12	9401-2	
	ELECTROLESS NICKLE PLATING FAC. LOCATION PLAN & DRAWING INDEX COVER SHT							
__	A2E-113267	001	0	DD	REL	Y-12	9401-2	
	PLATING SHOP DRAWING INDEX							
__	V A2E-113268	001	001	DD	REL	Y-12	9401-2	
	PLATING SHOP FLOOR PLAN AND ELEVATIONS							
__	A2E-113269	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP WALL SECT							
__	A2E-113270	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP ROOF PLAN & DTLS							
__	A2E-113271	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP MISC DETAILS							
__	V A2E-144298	001	0	DD	REL	Y-12	9401-2	
	PAINTING PROJECTS Y-12 PHOTOGRAPHIC VIEWS							
__	A2E-91742	001	0	DD	REL	Y-12	9401-2	M
	OSHA FLOOR LOAD SIGNS							
__	A2E-96716	001	0	DD	REL	Y-12	9401-2	1
	PL ELEV REST RM MODERN							
__	B-A-24941	001	0	DD	REL	Y-12	9401-2	1
	BRIDGE CRANE ACCESS							
__	C2E-129991	001	A	DD	REL	Y-12	9401-2	
	SITE ACCESS PL & DWG INDEX							
__	V C2E-129992	001	0	DD	REL	Y-12	9401-2	
	SITE & GRADING PLAN							
__	C2E-133849-G1	001	0	DD	REL	Y-12	9401-2	
	SITE ACCESS PLAN & DRAWING INDEX (PKG. NO. 1)							
__	C2E-133850-C1	001	0	DD	REL	Y-12	9401-2	
	RAILROAD & SITE WORK PAVING AND GRADING PLAN							
__	C2E-133851-C2	001	0	DD	REL	Y-12	9401-2	
	RAILROAD & SITE WORK TYPICAL SECTIONS & PROFILES							
__	C2E-133852-C4	001	0	DD	REL	Y-12	9401-2	
	PLATING SHOP ADDITION SITE ROUGH GRADING PLAN							

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__	C2E-133853-C5	001	0	DD	REL	Y-12	9401-2	
	PLATING SHOP ADDITION UNDERGROUND UTILITIES							
__	C2E-133854-C6	001	0	DD	REL	Y-12	9401-2	
	PLATING SHOP ADDITION UNDERGROUND UTILITY PROFILE							
__	C2E-133874-G1	001	0	DD	REL	Y-12	9401-2	
	SITE ACCESS PLAN & DRAWING INDEX (PKG. NO. 2)							
__	C2E-133875-G1	001	0	DD	REL	Y-12	9401-2	
	SITE ACCESS PLAN & DRAWING INDEX (OKG. NO. 3)							
__	C2E-133876-G1	001	0	DD	REL	Y-12	9401-2	
	SITE ACCESS PLAN & DRAWING INDEX (PKG. NO. 4)							
__	V C2E-139305	001	0	DD	REL	Y-12	9401-2	
	REPL HCL LINE A PL & D IND							
__	C2E-42624-SK	001	0	DD	REL	Y-12	9401-2	
	PLATING SHOP ADDITION SITE DEMOLITION PLAN							
__	C2E-940102-A001	002	0	DD	REL	Y-12	9401-2	
	PRODUCTION PLATING SHOP NEW PARKING LOT							
__	C2E-940102-SK01	001	0	DD	REL	Y-12	9401-2	X
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION TITLE SHEET							
__	C2E-940102-SK02	001	0	DD	REL	Y-12	9401-2	A
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION SITE ACCESS PLAN							
__	C2E-940102-SK03	001	0	DD	REL	Y-12	9401-2	X
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION SITE GEOMETRY PLAN							
__	C2E-940102-SK04	001	0	DD	REL	Y-12	9401-2	X
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION FINISH GRADE PLAN AND DETAILS							
__	C2E-96715	001	0	DD	REL	Y-12	9401-2	
	ACCESS PLAN DWG INDEX							
__	D-A-32598	001	0	DD	REL	Y-12	9401-2	1
	MTL DOORS							
__	D-A-33460	001	0	DD	REL	Y-12	9401-2	1
	ENT CANOPY SECT & DETS							
__	D-CV-22514	001	B	DD	REL	Y-12	9401-2	
	PLOT PLAN & UNDERGRND LINE							

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	D-CV-27418	001	A	DD	REL	Y-12	9401-2	
	PAVING WALKS & STEPS							
__	D-CV-34560	001	0	DD	REL	Y-12	9401-2	A
	MISC PAVING BLK D-3							
__	D-CV-41164	001	0	DD	REL	Y-12	9401-2	A
	PLAT PRO DEV FAC LOC PLAN							
__	D-SK-26893	001	0	DD	REL	Y-12	9401-2	1
	DUCT AND EQUIP DEMOLITION							
__	D-S-31866	001	0	DD	REL	Y-12	9401-2	A
	FAN SUPPORT							
__	D-S-31924	001	0	DD	REL	Y-12	9401-2	1
	TANK SUPPORT							
__	D-S-33505	001	A	DD	REL	Y-12	9401-2	1
	SPECIAL PLATING DOLLY							
__	D-S-35497	001	0	DD	REL	Y-12	9401-2	1
	4 TON BRIDGE CRANE							
__	D-S-36445	001	0	DD	REL	Y-12	9401-2	R
	ROOM ACCESS LADDER							
__	D-S-41129	001	A	DD	REL	Y-12	9401-2	2
	TANK SUPPORT PLAN AND DET							
__	D-S-44194	001	0	DD	REL	Y-12	9401-2	1
	TANK SUPPORT PLAN & SUPPRT							
__	D-S-47791	001	0	DD	REL	Y-12	9401-2	1
	DRUM SUPPORT PLAN AND DETS							
__	D-S-52128	001	0	DD	REL	Y-12	9401-2	1
	ANODIZER HOOD FAN BASE							
__	D2E-14634	001	C	DD	REL	Y-12	9401-2	
	METER STATION ENCLOSURE							
__	V E-A-23164	001	D	DD	REL	Y-12	9401-2	
	ARCHITECTURAL REPAIR OF THE OUTSIDE SHELL							
__	E-A-23166	001	B	DD	REL	Y-12	9401-2	
	FLOOR PLANS-SECTS & DETS							

----------------------- ABBREVIATED DOCUMENT LISTING - ROW 49 TO 64 OF 208

COMMAND (OPTIONAL):

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	E-A-23167	001	A	DD	REL	Y-12	9401-2	1
	ELECT SHOP PLATFORM TANK S							
__	E-A-23563	001	B	DD	REL	Y-12	9401-2	
	ELECTROPLATING SHOP FL PL							
__	E-A-23564	001	001	DD	REL	Y-12	9401-2	1
	ELECTROPLATING SHOP SECTIONS & DETAILS SH. #1							
__	E-A-23774	001	0	DD	REL	Y-12	9401-2	
	ELECTR SHOP PAINT SCHED							
__	E-A-24903	001	A	DD	REL	Y-12	9401-2	1
	ELECT PLATE - TANK SUPPORT							
__	E-A-52896	001	A	DD	REL	Y-12	9401-2	1
	SILVER PLATING							
__	E-A-56806	001	0	DD	REL	Y-12	9401-2	1
	ANODIZING EQUIPMENT							
__	E-A-64158	001	0	DD	OBS	Y-12	9401-2	1
	PFM PROJECT-PLAT FAC ANNEX							
__	E-A-66757	001	0	DD	REL	Y-12	9401-2	
	EQUIPMENT LAYOUT P							
__	E-A-66913	001	0	DD	REL	Y-12	9401-2	1
	PLAT PRO DEV FAC PLAN							
__	E-A-66914	001	0	DD	REL	Y-12	9401-2	M
	PLAT PRO DEV FAC PL SECT							
__	E-A-67230	001	0	DD	REL	Y-12	9401-2	1
	JOB IC APF EQUIP LAYOUT P							
__	E-A-67241	001	0	DD	REL	Y-12	9401-2	1
	JOB IC DEMOLITION PLAN							
__	E-A-77769	001	B	DD	REL	Y-12	9401-2	1
	REPLACE PLATFORM FL - PLAN							
__	V E-B-4704	001	A	DD	REL	Y-12	9401-2	
	MASTER PLANS - BLDG 9401-2 - FLOOR PLANS							
__	E-CV-23736	001	0	DD	REL	Y-12	9401-2	
	ELECTROPLATING SHOP							

----------------------- ABBREVIATED DOCUMENT LISTING - ROW 65 TO 80 OF 208

COMMAND (OPTIONAL):

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	E-CV-83945 ACCESS PLAN-DWG INDEX	001	0	DD	REL	Y-12	9401-2	A
__	E-CV-83952 LIQUID WASTE SITE	001	B	DD	REL	Y-12	9401-2	
__	E-CV-83953 DRAIN LINE PLAN & PROFILE	001	A	DD	REL	Y-12	9401-2	A
__	E-M-4705 MASTER EQPT PLAN	001	0	DD	REL	Y-12	9401-2	1
__	E-S-23168 BRIDGE CRANE RUNWY&ALTRNS	001	0	DD	REL	Y-12	9401-2	
__	E-S-23480 BLOWER&STACK SUPPRTS SHT 1	001	A	DD	REL	Y-12	9401-2	
__	E-S-23481 BLOWER & STACK SUPPORTS	001	D	DD	REL	Y-12	9401-2	
__	E-S-23482 ELECTROPLATING SHOP HEATER	001	0	DD	REL	Y-12	9401-2	A
__	E-S-23644 ELECTRO SHOP BRIDGE CRANE	001	0	DD	REL	Y-12	9401-2	
__	E-S-23765 ELECTROPLATING SHOP	001	A	DD	REL	Y-12	9401-2	
__	E-S-26712 ELECTROPLATING SHOP PLAT	001	B	DD	REL	Y-12	9401-2	1
__	E-S-26713 ELECTROPLATING SHOP WEST	001	0	DD	REL	Y-12	9401-2	
__	E-S-26714 ELECTROPLATING SHOP WEST	001	0	DD	REL	Y-12	9401-2	A
__	E-S-29169 SAFETY PLATFORMS PL & SEC	001	0	DD	REL	Y-12	9401-2	
__	E-S-29321 PLATING FACILITY	001	C	DD	REL	Y-12	9401-2	
__	E-S-29346 PLATING FACILITY	001	E	DD	REL	Y-12	9401-2	

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	E-S-29407 TANK SUPPORTS	001	C	DD	REL	Y-12	9401-2	
__	E-S-30128 PLATING SHOP EQ PL,SEC&DET	001	0	DD	REL	Y-12	9401-2	
__	E-S-40636 STL FRAMING & CONC	001	0	DD	REL	Y-12	9401-2	R
__	E-S-40637 STL FRAMING - WALLS	001	0	DD	REL	Y-12	9401-2	R
__	E-S-41470 SECTIONS - DETAILS	001	0	DD	REL	Y-12	9401-2	1
__	E-S-44743 STL FRAMING-CONC	001	0	DD	REL	Y-12	9401-2	R
__	E-S-50266 SPECIAL PLATING DOLLY	001	0	DD	REL	Y-12	9401-2	1
__	E-S-50308 EXH SYS IMPROVEMENTS	001	A	DD	REL	Y-12	9401-2	A
__	E-S-50309 EXH SYS IMPROVEMENTS	001	B	DD	REL	Y-12	9401-2	
__	E-S-51946 PLATING TANK DOLLY	001	0	DD	REL	Y-12	9401-2	1
__	E-S-53887 PLATING EQUIPMENT	001	001	DD	REL	Y-12	9401-2	1
__	E-S-53896 PLATING EQUIPMENT	001	004	DD	REL	Y-12	9401-2	1
__	E-S-56807 ANODIZING EQUIPMENT PLAN	001	0	DD	REL	Y-12	9401-2	R
__	E-S-65620 TANK NO 3 SUPPORT	001	0	DD	REL	Y-12	9401-2	1
__	E-S-66933 TANK SUPPORTS & SCHEDULE	001	B	DD	REL	Y-12	9401-2	1
__	E-S-66934 TANK SUPP SECT DETS	001	B	DD	REL	Y-12	9401-2	1

----------------------- ABBREVIATED DOCUMENT LISTING ROW 97 TO 112 OF 208

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	E-S-66952 ALODYNE TANK SUPPORTS	001	0	DD	REL	Y-12	9401-2	1
__	E-S-66953 ALODYNE TANK SUPPORTS	001	0	DD	REL	Y-12	9401-2	1
__	E-S-67242 JOB IC FL SUP STRUCTURE	001	A	DD	REL	Y-12	9401-2	1
__	E-S-67243 JOB IC TANK SUP SECT	001	A	DD	REL	Y-12	9401-2	1
__	E-S-67282 JOB IC EQUIP RM SECT DET	001	0	DD	REL	Y-12	9401-2	1
__	E-S-67298 JOB IC APF HEAD TANK SUP	001	A	DD	REL	Y-12	9401-2	M
__	E-S-68817 JOBIC APF FAN AND STACK	001	0	DD	REL	Y-12	9401-2	A
__	E-S-72146 ACID HD TANK PLAN SECTS	001	0	DD	REL	Y-12	9401-2	M
__	E-S-80741 BLACK MAGIC PLATFORM ALT	001	C	DD	REL	Y-12	9401-2	1
__	E-S-85925 NACN TANK DIKE	001	0	DD	REL	Y-12	9401-2	A
__	E-S-87034 LUNCH AREA IMPROVMENTS	001	0	DD	REL	Y-12	9401-2	2
__	E-S-87035 LUNCH AREA IMPV FRAMING PL	001	0	DD	REL	Y-12	9401-2	2
__	E-S-89143 FILTERATION EQPT SUPPORT	001	A	DD	REL	Y-12	9401-2	1
__	E-S-89195 EQUIP PLAN	001	B	DD	REL	Y-12	9401-2	1
__	E-S-89222 NI TANK INSTALLATION	001	0	DD	REL	Y-12	9401-2	1
__	E-S-89223 NI PLATING EXH FAN STACK	001	A	DD	REL	Y-12	9401-2	1

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	E-S-89257	001	0	DD	REL	Y-12	9401-2	1
	POROSITY TANK INSTAL							
__	E-S-90748	001	0	DD	REL	Y-12	9401-2	1
	FILTERATION EQPT COL T2-6							
__	FR-7129	001	0	DD	REL	Y-12	9401-2	
	COL LOCATION TYP ROOF FRMG							
__	V FR-7156	001	004	DD	REL	Y-12	9401-2	R
	ROOF TILE LAYOUT							
__	FR-7169	001	0	DD	REL	Y-12	9401-2	1
	WALL SECT KEY PLAN							
__	FR-7170	001	006	DD	REL	Y-12	9401-2	
	PLANS AND DETAILS - SUPERSTRUCTURE							
__	FR-7171	001	004	DD	REL	Y-12	9401-2	
	ELEVATIONS & DETAILS							
__	FR-7172	001	0	DD	REL	Y-12	9401-2	
	MISC DETAILS							
__	FR-7297	001	A	DD	REL	Y-12	9401-2	
	ELEV SEC & DETS							
__	FR-7541	001	0	DD	REL	Y-12	9401-2	1
	FOUNDATIONS PLS DET CONC 1							
__	FR-7705	001	0	DD	REL	Y-12	9401-2	
	CONCRETE FOUNDATION DET SH							
__	FR-7707	001	0	DD	REL	Y-12	9401-2	
	CONCRETE BOILER-STOKER FOU							
__	FR-7912	001	0	DD	REL	Y-12	9401-2	1
	GROUND FLOOR PL SEC CONC 1							
__	V FR-8093	001	002	DD	REL	Y-12	9401-2	
	HOPPER & SILO - FOUNDATIONS - CONCRETE - SHEET 1							
__	FR-8150	001	0	DD	REL	Y-12	9401-2	1
	HOPPER-SILO FNDTNS SH2							
__	FT-1455	001	002	DD	REL	Y-12	9401-2	
	FOUND-CINDER COLL SYS-CONC							

---------------------- ABBREVIATED DOCUMENT LISTING ROW 129 TO 144 OF 208
COMMAND (OPTIONAL):

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	FT-1657	001	0	DD	REL	Y-12	9401-2	
	HOPPER & SILO FOUND CONCRE							
__	FT-485	001	0	DD	REL	Y-12	9401-2	1
	ELEV SECT DET WALKWAY FRAM							
__	FT-486	001	A	DD	REL	Y-12	9401-2	R
	ROOF FRMG & FLUE SUPPORTS							
__	FT-486	002	0	DD	REL	Y-12	9401-2	
	COL LOC ROOF FRMG FLUE							
__	FT-493	001	002	DD	REL	Y-12	9401-2	
	PLANS SHEET 2							
__	FT-494	001	002	DD	REL	Y-12	9401-2	
	ELEVATIONS SHEET 2							
__	FT-495	001	0	DD	REL	Y-12	9401-2	R
	ROOF TILE LAYOUT SHT 2							
__	FT-533	001	0	DD	REL	Y-12	9401-2	
	CONCRETE FOUNDATION PL DET							
__	FT-534	001	0	DD	REL	Y-12	9401-2	1
	CONCRETE GROUND FL PL SH 2							
__	S2C-37726	001	0	DD	REL	Y-12	9401-2	1
	SUPPORT PLATFORM 9401-2							
__	S-2-D-54154	001	0	DD	REL	Y-12	9401-2	1
	SPLASH SHIELD							
__	S2E-100028	001	0	DD	REL	Y-12	9401-2	
	FAN DUCT SUPPORT COL B-10							
__	S2E-101492	001	0	DD	REL	Y-12	9401-2	A
	STORAGE TANK PLATFORM							
__	V S2E-105195	001	A	DD	REL	Y-12	9401-2	1
	MONORAIL EXT COL 10							
__	V S2E-107142	001	0	DD	REL	Y-12	9401-2	1
	ELECTROLESS NICKLE PLATING FAC STR PLANS, ELEV.,SECTIONS & DETAILS							
__	V S2E-107143	001	0	DD	REL	Y-12	9401-2	1
	ELECTROLESS NICKKLE PLATING FAC TANK SUPPORT & PLATFORM FRAMING P&E							

----------------------- ABBREVIATED DOCUMENT LISTING ROW 145 TO 160 OF 208

COMMAND (OPTIONAL):

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	S2E-113268	001	A	DD	REL	Y-12	9401-2	
	PLATING SHOP ELECTRICAL DISTRIBUTION SYS - FLOOR PLAN & BUILDING ELEVS							
__	S2E-113273	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP FL FDN ROOF PLAN							
__	S2E-113274	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP CONC SECT & DET							
__	S2E-113275	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP BLDG EL & SECT							
__	S2E-113276	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP STEEL DETAILS							
__	S2E-113277	001	0	DD	REL	Y-12	9401-2	
	PLTG SHOP MISC DETAILS							
__	* S2E-121684-S1	001	0	DD	REL	Y-12	9401-2	1
	VAPOR DEGREASER PLATFORM							
__	V S2E-129993	001	B	DD	REL	Y-12	9401-2	
	FDN PLAN & GENERAL NOTES							
__	V S2E-129994	001	B	DD	REL	Y-12	9401-2	
	SPILL PREVENTION FACILITIES - SECTION AND DETAILS							
__	S2E-133861-S1	001	0	DD	REL	Y-12	9401-2	
	MISCELLANEOUS DETAILS							
__	V S2E-138776	001	A	DD	REL	Y-12	9401-2	1
	SECTION AND DETAILS							
__	V S2E-138777	001	A	DD	REL	Y-12	9401-2	1
	FDN PLAN & GENERAL NOTES							
__	S2E-143988	001	0	DD	REL	Y-12	9401-2	1
	BLACK OXIDE TANK PL & DET							
__	* S2E-145604-S1	001	0	DD	REL	Y-12	9401-2	1
	CYANIDE PLATING DIKE							
__	S2E-35210-SK	001	0	DD	REL	Y-12	9401-2	1
	PLATFORM DEMOLITION							
__	S2E-43318-SK	001	0	DD	REL	Y-12	9401-2	1
	RELOC CYN TANKS PLAN & DET							

ABBREVIATED DOCUMENT LISTING ROW 161 TO 176 OF 208

COMMAND (OPTIONAL):

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	S2E-90783 CORRECT SOUND PROBLEM BLDG 9401-2	001	001	DD	REL	Y-12	9401-2	2
__	S2E-91719 SUP PLATF BLDG 9401-2	001	0	DD	REL	Y-12	9401-2	1
__	S2E-91720 SUP PLATE BLDG 94012	001	0	DD	REL	Y-12	9401-2	1
__	S2E-91721 SUP PLATF BLDG 94012	001	0	DD	REL	Y-12	9401-2	1
__	S2E-92049 MODIFY LAB EXH 9401-2	001	0	DD	REL	Y-12	9401-2	1
__	S2E-92092 TANKS 5A-B 9A 24 60	001	0	DD	REL	Y-12	9401-2	1
__	S2E-93406 SHAFT STRIP COL B-7	001	0	DD	REL	Y-12	9401-2	1
__	S2E-93408 SHAFT STRIP COL B-T2	001	0	DD	REL	Y-12	9401-2	1
__	S2E-93409 8" AFAP PRODUCTION FACILITY ZINC PLATING	001	B	DD	REL	Y-12	9401-2	1
__	S2E-93411 BUILD EXTENSION DETS	001	A	DD	REL	Y-12	9401-2	1
__	S2E-93412 ZN PLTG PLATFORM MOD F 3	001	A	DD	REL	Y-12	9401-2	1
__	S2E-93422 BLOWER SUPP MODIF 94012	001	0	DD	REL	Y-12	9401-2	1
__	S2E-93487 H V ENCLOSURE FDN	001	0	DD	REL	Y-12	9401-2	A
__	S2E-93488 H&V ENCLOSURE FL+FRMG P	002	001	DD	REL	Y-12	9401-2	A
__	S2E-93489 H V ENCLOSURE FRMG DETS	003	B	DD	REL	Y-12	9401-2	A
__	S2E-93491 ZN PLTG PLATFORM MODIF 1	001	A	DD	REL	Y-12	9401-2	1

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	S2E-93497	001	A	DD	REL	Y-12	9401-2	1
	TANK SUPPORTS TANKS 25 26							
__	S2E-93498	001	0	DD	REL	Y-12	9401-2	1
	ZN PLTG PLATFORM MODIF 2							
__	S2E-93499	001	0	DD	REL	Y-12	9401-2	1
	ZINC PLATE WORK TABLES							
__	S2E-93528	001	0	DD	REL	Y-12	9401-2	
	NEW CRANE ACCESS LADDER							
__	V S2E-940102-A001	001	0	DD	REL	Y-12	9401-2	A
	SFTY ACTN ITMS PHSE II Y-12 DIKE NO 9500-0036 LADDER PLAN SECTNS & DETLS							
__	V S2E-940102-SK01	001	0	DD	REL	Y-12	9401-2	A
	DEMOLITION OR LADDER AT SPILL PREVENTION FACILITIES PLANS							
__	S2E-940102-SK01 ~1	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	V S2E-940102-SK02	001	0	DD	REL	Y-12	9401-2	A
	DEMOLITION OR LADDER AT SPILL PREVENTION FACILITIES SECTIONS							
__	S2E-940102-SK02 ~1	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK03	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK04	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK05	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK06	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK07	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK08	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK09	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							

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SELECT CODE	DOCUMENT NUMBER	SHEET NO.	DOCUMENT REVISION	DOCUMENT TYPE	STATUS CODE	PLANT	BUILDING	FLOOR
__	S2E-940102-SK10	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK11	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK12	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK13	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK14	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK15	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK16	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK17	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK18	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	S2E-940102-SK19	001	0	DD	REL	Y-12	9401-2	
	WBS 1.2.4.1 BUILDING 9401-2 DEMOLITION STRUCTURAL							
__	V S2E-940103-A010	001	0	DD	REL	Y-12	9401-2	X
	SAFETY ACTION ITEMS PHASE II TRANSFER TOWER LADDER ELEVATIONS PLANS DETS							
__	S2E-95328	001	0	DD	REL	Y-12	9401-2	1
	NEW CRANE ACCESS LADDER							
__	S2E-95642	001	0	DD	REL	Y-12	9401-2	1
	TANK BASE							
__	S2E-96400	001	A	DD	REL	Y-12	9401-2	
	ELECT SHOP RECTIFIER ACCES							
__	S2E-97020	001	0	DD	REL	Y-12	9401-2	1
	REPLACE FAN PLATF COL B5							
__	S2E-97036	001	0	DD	REL	Y-12	9401-2	1
	FAN SUPPORT COL C2							

Y-12 Coal

Arsenic in Coal burning at Y-12 and K-25 (per Jennifer Cockfort)

1. From 1944-June 1962, a K-25 powerhouse near S-50 burned 5.9 million tons = 5,400 million kg of coal [source is Nick Pesci, who compiled this number from K-25 quarterly reports]. (907 C.F. from tons to kg)

5400 x 10(6) kg / 18.5 yrs = 290,000,000 kg coal /yr for K-25

vs. 70,000 kg coal /yr for Y-12 [p. 11 of Y/TS-574 by R. Turner]

2. It appears that Ralph made an error in his calculation on p. 11.

Y-12:
70,000 kg coal * 0.5 mg Hg /kg coal * 1 kg/10(6) mg = 35,000 x 10(-6) = 0.035 kg = 0.077 lb/yr Hg (we used 77 lb /yr for 10 yrs. 1953-62).

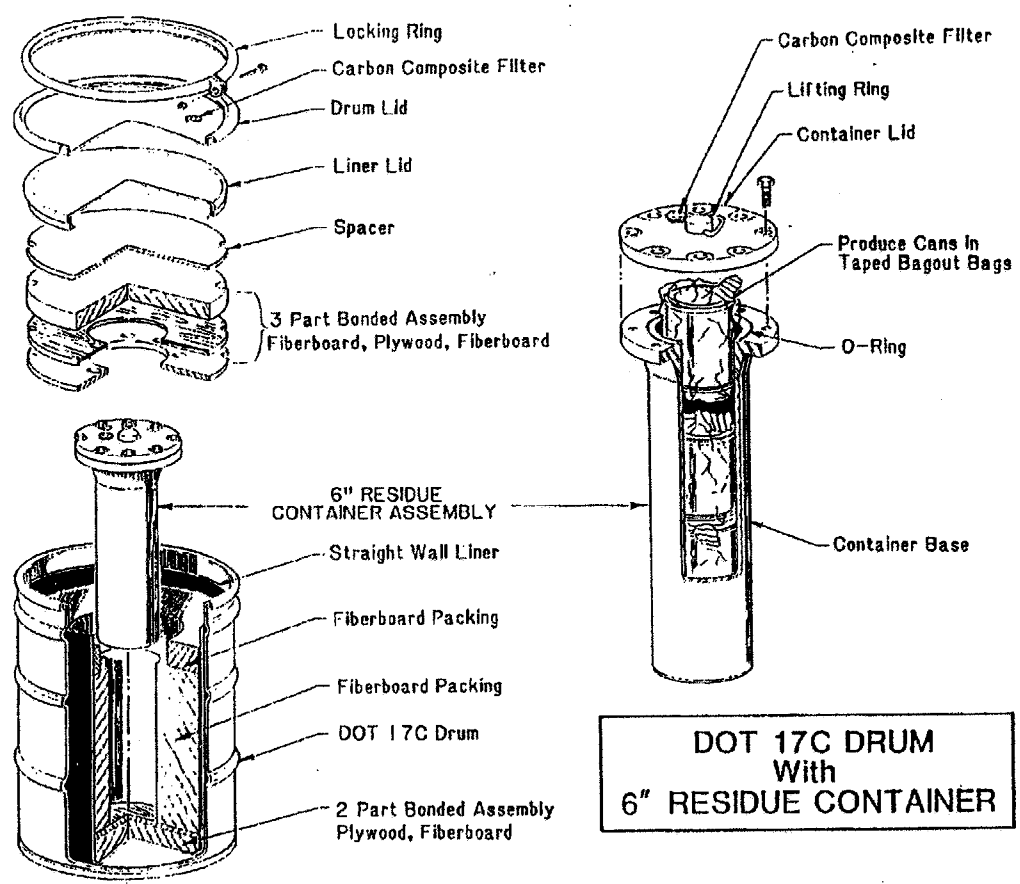
Could everyone look closely at this math and make sure we're right in claiming an error. It's hard to believe that it got in Ralph's document this way and that none of us noticed it before. It could be a typo, but 0.5 GRAM Hg per kg coal instead of 0.5 MILLIGRAM Hg per kg coal seems high (arsenic is 14-25 mg/kg coal). And, I don't think Y-12 could have burned 154 million pounds of coal per year rather than 154,000 pounds of coal. I can't think of any other possibilities.

3. We propose to use the same dilution factor as Jennifer uses for arsenic at K-25 to estimate a Hg air conc. at a K-25 receptor location also determined by Jen. The pounds of mercury to be 'modeled" using the arsenic dilution factor is calculated below. This additional Hg contribution should 'de minimis'ly change our results to date. (Gretchen, please incorporate this somehow into your sections.)

K-25:
2.9 x 10(8) kg coal * 0.5 * 10(-6) = 145 kg Hg/yr = 319 lb Hg/yr for 18.5 yrs. 1944-62. (I used the same modeling years for Hg as before, 1953-62.)

Attached are 2 s'sheets that show the difference between what we did and what this change would be. Botton Line: The air release number increases by 2427 lbs (3% of the total release) when K-25 is included.

Pipe Component



Pipe Size Diameter	*Outside Diameter - inches*	*Inside Diameter - inches*	*-Wall Thickness - inches*	*Inside Height - inches*	*Inside Volume - liters*	*Pipe Wt Empty - lbs*	*Payload Net Wt. - lbs*	*Drum & Liner Wt. - Lbs*	*Fiberboard Wt. - lbs*	*Total Wt. - lbs*
6 inch	**6 1/2**	**6 1/8**	**3/8**	**25 1/8**	**~12**	**88**	**66**	**77**	**97**	**328**
12 inch	**12 7/8**	**12 1/3**	**1/2**	**25 7/8**	**48**	**195**	**167**	**77**	**65**	**504**

3/24/98

Coal Usage tabulation - Coal Usage from Plant Quarterly Progress Reports

1956 - 68,727 (tons)
49,019 (tons)
20,040 (tons)
53,614 (tons

191,400 tons

191,400 tons
$= 3.8\cancel{3}^{28} \times 10^{8}$ lbs   2.205
$1.7\cancel{2} \times 10^{8}$ kg
1.74

1957

60,539 (tons)
2,046 (tons)
0 (tons) gasifying
19,332 (tons)

81,917 tons = $1.64^{38} \times 10^{8}$ lbs
7.38×10^{7} kg
7.43

1958

36,306
3,782
254
15,802

56,144 tons = $1.12^{2} \times 10^{3}$ lbs
5.04×10^{7} kg
5.09

1959

29,015
1,449
0
38,460

68,924 tons = $1.38^{78} \times 10^{8}$ lbs
6.21×10^{7} kg
6.25

Arsenic for each year

1956 $(1.72 \times 10^{8}$ kg$)(47$ mg As/kg coal$)$ = 8084 kg As

1957 $(7.38 \times 10^{7}$ kg$)(47$ mg/kg$)$ = 3469 kg As

1958 $(5.04 \times 10^{7}$ kg$)(47$ mg/kg$)$ = 2,369 kg As

1959 $(6.21 \times 10^{7}$ kg$)(47$ mg/kg$)$ = 2,918 kg As

Quarterly Progress

Y-1013 1/1/56 - 3/31/56 - beryllium - 423 samples this quarter / 0 % above MAC 260 ~~200~~ Last quarter MAC 2 μg/m³ 0 above MAC

other small air sampling programs: ammonia, arsenic, cadmium, fluoride, hydrogen cyanide, hydrogen fluoride, Lithium, NO_2, O_3, Perk, Rhodium, Scandium, Thallium, Trichloroethylene, Yttrium.

Coal Usage: 68,727 tons

Y-1014 4/1 - 6/30/56 - beryllium - 233 samples 0% above MAC

other sampling: ammonia, arsenic, benzene, cadmium, CO, chlorine, dust, fluoride, hydrogen cyanide, hydrogen fluoride, Lithium, NO_2, O_3, Perk, Rhodium, Scandium, Thallium, TCE, Yttrium

Coal Usage - 49,019 tons

Accounting beryllium inventory - "special reactor" "2811" (Account No.)

Y-1015 7/1 - 9/30, 1956 Beryllium 182 samples 2% above MAC

other samples: benzene (18), Cadmium (20), CO (0), Chlorine (0), Chromium (4), dust (0), HCN (34), Lead (6), magnesium (150), ~~[illegible]~~ NO (33), Perk (28), Thallium (246), TCE (14)

Coal Usage 20,040 tons → converted to Natural gas for the Summer beginning July 11

Y-1017 1/1 - 3/31 1957 Beryllium (423 samples)

Other samples: Cadmium (21), CO (0), Chlorine (12), Fluorine (14), HCN (23), Lead (8), Perk (27), Thallium (0), TCE (41), Zinc (7)

Coal Usage 60,539 tons, previous quarter 53,614 tons

Changed to Coal fuel after Oct 11.

Partial gas firing after March 12

Quarterly Reports

Y-1018 4/1-6/30, 1957 Beryllium (562) 1.6% above MAC
Othersamples: Cadmium (6), CO(0), Chlorine(0), Fluorine(0), HCN(13)
Lead (20), Perk (235 6.4% above MAC-200ppm, Thallium(0)
TCE (343), (18.4% above MAC 300ppm) Zinc (8) - 25% above MAC 15mg/m³

Coal Usage 2,046 tons → steam Plant on Gas firing
"In response to a letter from Sapirie to Center a survey and design Study has been made of facilities required at Y-12 for an anticipated Be metal components production schedule. It appears that the present equipment and space will be adequate through July 1958. With the installation of larger facilities in Bldg 9204-4, any future requirements could be met (Page G-50)
Notes: (Still working in 9766) ~~might move~~ trying to decide either upgrade 9766 or move all (if enough money) to 9204-4.
Requirements outlined in ORO 85046

Y-1019 7/1-9/30, 1957 Samples → Be (543) 0.0 above MAC
Other Samples: Boron (10), (MAC 0.2mg/m³ 40% above) Cadmium (28) (28.6% Above MAC 100ug/m³), CO(0), Chlorine(0), Fluorine(0)
HCN (0), Lead (33) (-24.2% Above MAC 0.2mg/m³), Perk (422) - 19.9% above MAC 200ppm
TCE (0), Zinc Oxide (6).
Coal Usage 0 tons - *Steam Plant on gas firing

Y-1020 10/1-12/31, 1957 Coal Usage 19,332 tons
Beryllium samples 706 0% above MAC 2ug/m³
other Boron (11) 72.7% above MAC, Cadmium (0), CO(7), HCN(36), Lead (86) 2.3% above MAC,
Perk (232) 25% above MAC, TCE(0),
Beryllium work still in 9766

Quarterly Reports

Y-1201 4/1-6/30, 1958 Beryllium (1,849) 0% above MAC

Other samples: CO (3), Chromic Acid (15), HCN (32), Lead (100) 12% above MAC @ 200 μg/m³,
Methyl Chloroform (4), PCE (118) 29.6 above 200 ppm

Coal Usage 3,782 tons previous quarter 36,806 tons

Y-1202 7/1-9/30, 1959 - Beryllium oxide mentioned (G-49) in regard to nuclear weapons components
- produce dense BeO bodies used (1) Isostatic pressing followed by ~~bat~~ sintering and (2) hot pressing

Air Beryllium 3,195 samples 0% above MAC

other samples: CO (12), Chromic Acid (15), HCN (22), Lead (5), Methyl Chloroform (4)
Perk (73) 8.2% above MAC

Coal 254 tons (Steam Plant on gas firing)

were adding Mettalurgy

Pg. G-47 → Added 5% wt. Pb to a powder to alleviate problems with Hot pressing.

Y-1203 10/1-12/31, 1958 - pg. (G-54)
- BeO machining - "A program has been initiated to develop methods of machining pieces made of BeO and to determine the best methods of handling this material to prevent the creation of H&S hazards. An area in Bldg. 9202 has been obtained for work w/ this material. Two machine tools, a surface grinders & a 17-inch lathe, have been acquired for experimental work and are to be installed as soon as maintenance services become available.

Pg. G-44 - BeO Program mentioned

Beryllium Air Samping (3,248) 0.3% above MAC

CO (68), Chromic Acid (10), HCN (29), Lead (12) 41.7% above MAC, Methyl Chloroform (16)
Perk (89) 9.0% above MAC

Coal Usage 15,802 tons

Quarterly Reports

1204 1/1-3/31, 1959 Routine air samples

Beryllium (14,156) 0.05% above MAC, CO (43), Chromic Acid (12)
HCN (22), Lead (0), Methyl Chloroform (12), Perk (47) 14.9% above MAC

Beryllium mentioned under Ceramics G-23,
Metallurgy G-29
G-40 - Beryllium Air Monitor obtained from ORNL

Coal Usage 29,015 tons

Y-1205 4/1-6/30, 1959

Coal Usage ~~1,449 tons~~

Beryllium mentioned Metallurgy G-21, G-26; G-55-Ceramics, G-66 (Continuous Be Air Monitor)
Beryllium Air 8,806 samples 0.2% above MAC
Beryllium Smear 3,584 6.1% above MAC
Other CO (0), Chromic Acid (5), HCN (12), Lead (32), Methyl Chloroform (0)
Perk (44) 20.5% above MAC

Y-1206 7/1-9/30, 1959

Be air samples 9,462 (0.08% above MAC)
Be smear 3,516 (5.9% above MAC 25 μg/12 in²)
Other samples: Be air (164)
Be water (3)
CO (7), Chromic Acid (16), HCN (30), Lead (13), Perk (18) 22.2% above MAC

Coal Usage - 0 tons

Be mentioned pg. G-4 "kg batches of Uranium-loaded BeO were prepared"
pg. G-14 - Ceramics - "fuel tubes"
pg. G-20 - Metallurgy

Quarterly Progress Reports

Y-1207 ~~10/1/59-12/31/59~~ Format of Quarterly Report Changed - ~~[illegible]~~ less detail

Be air samples 6,787 (0.02% above MAC)

Be smear samples 4,014 (7.8% above MAC)

Carbon Monoxide (11), Chromic Acid (12), HCN (56), Lead (0), PerC (57) 31.6% above MAC
TCE (10)

Coal Usage 38,460 tons

Y-1209 - Jack has H & S activities

4/1/60 - 6/30/60 Coal Usage 16,054 tons

Pg. F-6 bldg 9201-3 → Approx 3,600 ft² on the 1st floor, SW corner of this building was enclosed w/ light-weight concrete block for a beryllium facility.

request pg. F-21 if Jack does not have

Beryllium air sampling G-5, & G-6

Be Procedure for Certification (Purity etc.) G-6

Y-1210 7/1-9/30, 1960

Lead in urine samples FY 1960 (17) 4th Qtr FY 1960 (112) Third Qtr FY 1960 (64) 2nd Qtr FY 1960 (102)

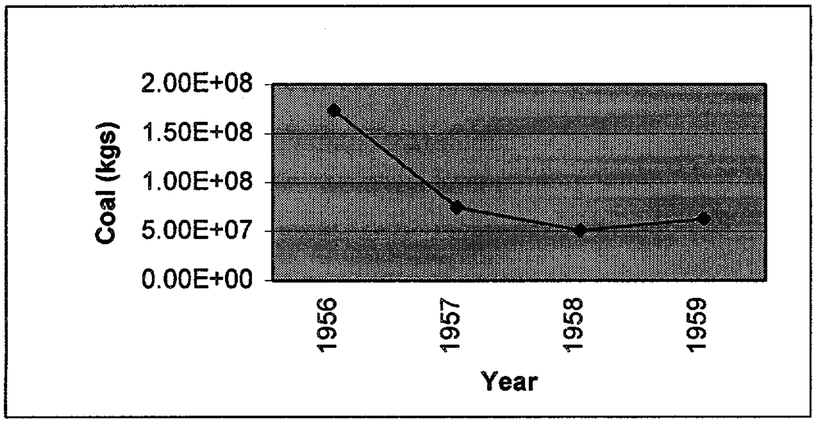
Be air 9,203 (0.57%) above MAC

Be smear 4,222 (3.88%) above MAC

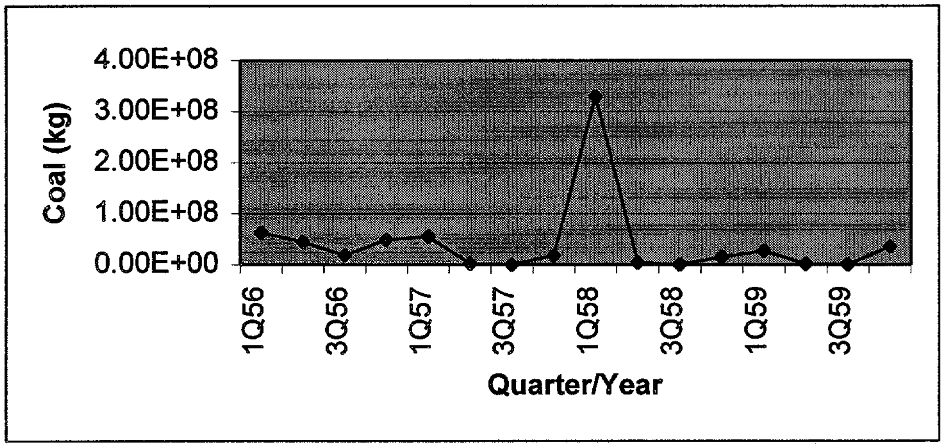
other CO

Request Section F-16 to end of section

Coal (kg)	Year
1.74E+08	1956
7.43E+07	1957
5.09E+07	1958
6.25E+07	1959
9.04E+07	annual avg
5.65E+07	SD



Coal (kg)	Quarter	
6.23E+07	1Q56	
4.45E+07	2Q56	
1.82E+07	3Q56	
4.86E+07	4Q56	
5.49E+07	1Q57	
1.86E+06	2Q57	
0.00E+00	3Q57	
1.75E+07	4Q57	
3.29E+08	1Q58	
3.43E+06	2Q58	
2.30E+05	3Q58	
1.43E+07	4Q58	
2.63E+07	1Q59	
1.31E+06	2Q59	
0.00E+00	3Q59	
3.49E+07	4Q59	
4.11E+07	qtrly avg	1.64E+08
7.98E+07	SD	



Coal (Tons)	Coal (kg)
6.87E+04	6.23E+07
4.90E+04	4.45E+07
2.00E+04	1.82E+07
5.36E+04	4.86E+07
6.05E+04	5.49E+07
2.05E+03	1.86E+06
0	0.00E+00
1.93E+04	1.75E+07
3.63E+05	3.29E+08
3.78E+03	3.43E+06
2.54E+02	2.30E+05
1.58E+04	1.43E+07
2.90E+04	2.63E+07
1.45E+03	1.31E+06
0	0.00E+00
3.85E+04	3.49E+07

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OAK RIDGE Y-12 PLANT INFORMATION CONTROL FORM

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Y-12 Site DRC

OAK RIDGE
Y-12
PLANT

MARTIN MARIETTA

ASSESSMENT OF COAL STORAGE

AND

STEAM PLANT MANAGEMENT PLANS

Prepared by
UCC-ND Engineering and
Utilities Administration Department

Y-12 PLANT
OAK RIDGE, TENNESSEE
UNITED STATES DEPARTMENT OF ENERGY

CLEARED FOR PUBLIC RELEASE

JULY 29, 1983

Y-12 Technical Information Officer 1/28/93 Date

Prepared for the U.S. Department of Energy
Under U. S. Government Contract W-7405-eng-26

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

EXECUTIVE SUMMARY

Three waste streams originating at the Y-12 Steam Plant have been found to be of concern with respect to adverse environmental impacts. These are coal pile runoff (low pH, suspended solids, high metal concentrations), hydrogen ion exchange regeneration waste (low pH), and boiler blowdown/boiler drain (high pH, high temperature). A fourth waste stream, flyash/bottoms ash sluiced with water, has a high suspended solids content but is currently treated by sedimentation in Rogers Quarry.

Short range partial corrective actions have been determined for two of the three waste streams identified above as causing adverse environmental impacts. As a short range measure for lessening impact of coal yard runoff, the coal pile will be reshaped in order to minimize leaching of coal and silt screens will be installed to decrease the quantity of suspended coal fines reaching Upper East Fork Poplar Creek (UEFPC). An interim neutralization process for hydrogen ion exchange waste is currently expected to be operational by October 1, 1983. No interim measures are identified for the boiler blowdown/boiler drain waste.

The long range plan proposes a central facility for treating coal yard runoff, hydrogen ion exchange regeneration waste, and boiler blowdown/boiler drain waste. The facility will include a coal yard runoff collection system, equalization/sedimentation basin, and equipment for neutralization and solid-liquid separation and will cost $4.4 million as an FY-1986 Congressional Line Item. The project construction will be completed 27 months after funding is received. As an interim phase to the long range plan, should alternate funding be available, the coal yard runoff collection system and equalization/sedimentation basin could potentially be constructed To provide partial treatment (removal of coal fines) of coal yard runoff.

The interim project would cost $1.2 million dollars and would be completed in 12 months after receipt of funding.

An evaluation of the condition of the classified parts waste material buried under the coal pile is being undertaken. The possibilities of relocating the material or capping the trench will be studied. It is expected that the study will be completed by February 1984.

Funding for control of coal pile runoff was originally requested as a part of the proposed Control of Effluents and Pollutants, Phase II Line Item for FY-1984. This request was made in December 1981.

Table of Contents

1.0 INTRODUCTION

The Y-12 Steam Plant and associated coal yard are potential contributors to the pollution of Upper East Fork Poplar Creek (UEFPC) through the discharge of several wastewater streams. This report addresses the characterization of the Steam Plant waste streams and their possible impact upon the aqueous environment. Short-range and long-range management plans for the control and treatment of the waste streams are presented. Tennessee Effluent Limitations and Standards, Rule 1200-4-5, and EPA Standards, Title 40 Part 423 - Steam Electric Power Generating Point Source Category, were referred to for the assessment and plans.

2.0 GENERAL DATA

2.1 Geology, Seismology and Soils

The Y-12 Plant, which is located at the Department of Energy (DOE) Oak Ridge Reservation, lies within the Valley and Ridge Physiographic Province. Its geology, seismology, and soil characteristics have been studied extensively. For a general overview of these geologic features, reference is made to document DOE/EA-0182, "Environmental Assessment, Y-12 Plant Site".

2.2 Drainage System

The Oak Ridge area is drained by the Clinch River and some of its tributary streams. Figure 1 shows the river and stream system near the Plant.

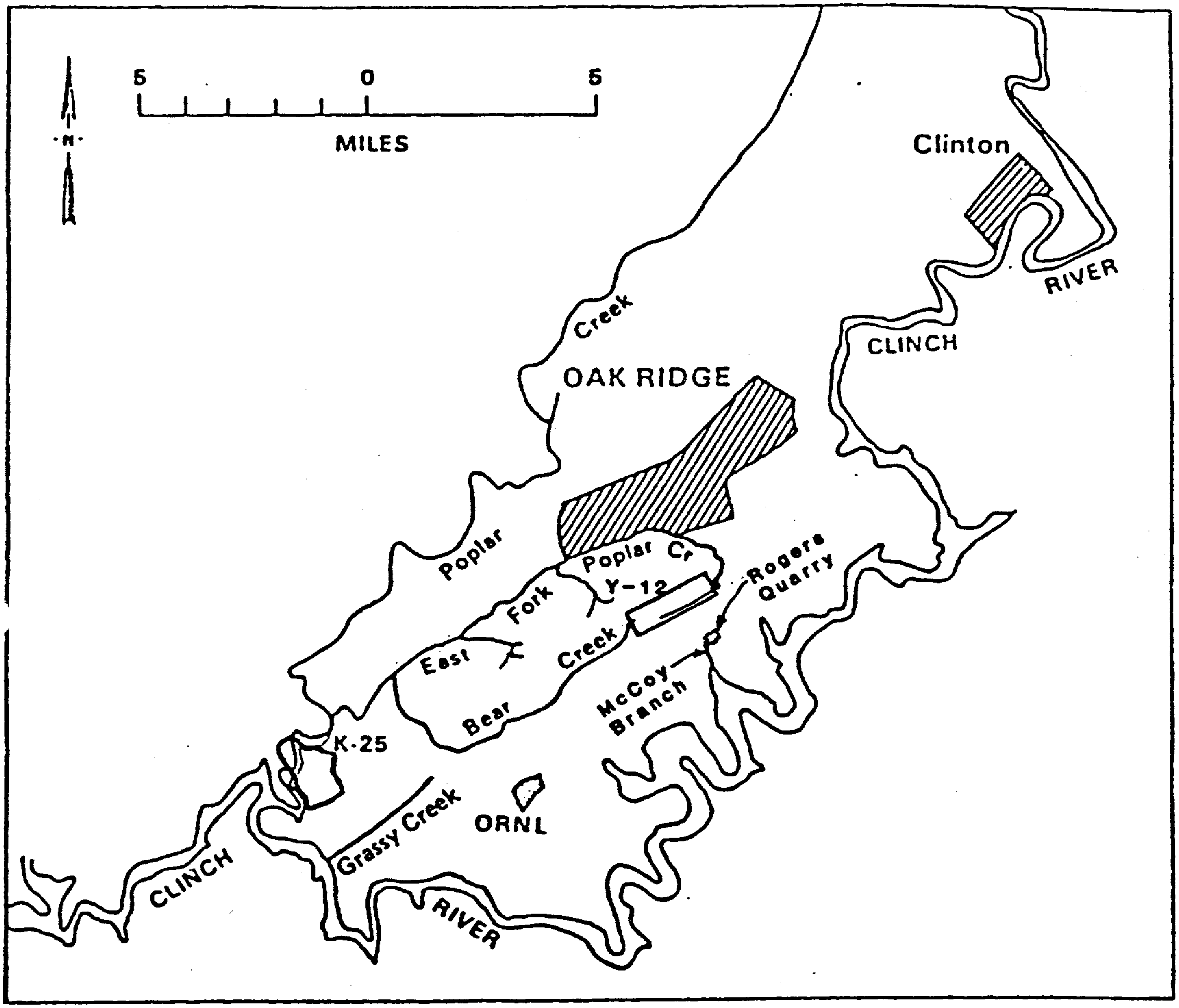

Figure 1. Rivers and Streams near Y-12 Plant.

2.2.1 Bear Creek

The headwaters of Bear Creek originate within the western boundary of the Y-12 Plant. Bear Creek flows in a southwest direction from the Plant through hardwood and softwood forests. None of the wastes generated at the Steam Plant discharge into Bear Creek.

2.2.2 East Fork Poplar Creek

The headwaters of East Fork Poplar Creek originate in the Y-12 Plant area. The upper portion of the creek that flows along the south side of the Y-12 Plant is commonly referred to as Upper East Fork Poplar Creek (UEFPC). UEFPC flows into New Hope Pond, which is located at the east end of the Plant. After leaving the pond, East Fork Poplar Creek flows northwest before changing to an approximate southwest course. The creek flows through the City of Oak Ridge before entering pasture lands and hardwood forests. The stream joins first Bear Creek and then Poplar Creek before discharging into the Clinch River near the Oak Ridge Gaseous Diffusion Plant (ORGDP).

All streams emanating from the Y-12 Steam Plant, with the exception of the flyash/bottom ash stream (discharged to Rogers Quarry), discharge into UEFPC.

2.2.3 McCoy Branch

The source of McCoy Branch is Rogers Quarry, an abandoned water-filled quarry located south of the Y-12 Plant and Chestnut Ridge and on the north side of Bethel Valley Road. Rogers Quarry is fed by groundwater and surface water from the south slope of Chestnut Ridge. McCoy Branch flows south and discharges to Melton Hill Lake which is part of the Clinch River System.

2.3 Meteorology

According to the United States Department of Commerce, mean rainfall at the Oak Ridge area is 52.60 inches/year; mean snowfall is 10.0 inches/year; and mean yearly temperature is 57.8 degrees Fahrenheit. Detailed meteorological information, including wind patterns and frequency of severe storms, can be found in document DOE/EA-0182.

2.4 Type of Industry

The Oak Ridge Y-12 Plant is one of the installations operated by Union Carbide Corporation-Nuclear Division (UCC-ND) for the United States Department of Energy (DOE). The plant site occupies an area of 811 acres located on the DOE Reservation adjacent to the City of Oak Ridge. The plant site can be divided into two sections: the western area devoted to DOE weapons manufacturing operations, and an eastern area which is occupied mainly by several major organizations which are part of the Oak Ridge National Laboratory (ORNL). The four major responsibilities of the Y-12 Plant are:

1. Producing nuclear weapons components and supporting DOE's

weapons design laboratories,

2. Processing special materials,
3. Supporting other DOE installations, and
4. Supporting other government agencies.

ORNL organizations housed within the Y-12 Plant site include:

1. Fusion Energy Division,
2. Engineerng Technology Division,
3. Biology Division, and
4. Operational Division

Other facilities located at the site are:

1. DOE Transportation Safeguards Division
2. RUST Engineering Company

Plant facilities consist of 233 buildings, including machine shops, chemical processing buildings, laboratories, maintenance buildings, changehouses, and other plant support installations.

2.5 Water Supply and Wastewater Disposal

Potable water supply to the Y-12 plant is provided by the water treatment plant serving the City of Oak Ridge and ORNL. This water plant is owned by DOE and operated by RUST Engineering Company. Sanitary liquid waste is discharged into the public sewerage system and treated at the sewage treatment plant serving the City of Oak Ridge.

3.0 DESCRIPTION OF STEAM PLANT

The Y-12 Steam Plant, designated Building 9401-3, was constructed during 1954-1956 (See Figure 2 for location of Steam Plant). It has four boilers of the two-drum, bent tube design. Each boiler is designed for 250,000 lb/hr continuous steam generation at 250 psig and 500^{O}F at the superheader outlet. The boilers will be derated to 200,000 lb/hr with the addition of baghouse dust collectors in 1985. Two boilers have the capability to fire with natural gas for emergency purposes only, but all four boilers are presently firing pulverized coal. Steam loads vary from 150,000 lb/hr in summer to 600,000 lb/hr peak in winter. Each boiler is equipped with the usual auxiliaries, including an air preheater, electrostatic precipitator, forced draft fan, and induced draft fan. The electrostatic precipitators were constructed in 1967.

Steam is distributed at 235 psig and 500^{O}F to the Y-12 buildings with pressure reduction at each building. Normal building usage is 15 to 30 psig. Heating, ventilation, and air conditioning condensate is returned from the major buildings to the steam plant for boiler feedwater. From 25 to 50 percent of the condensate is recovered. The remaining boiler feedwater is obtained by treatment of filtered water from the Oak Ridge Water Treatment Plant. The steam plant water treatment equipment consists of parallel sodium zeolite and hydrogen zeolite ion exchange columns which supply blended makeup water to a degasifier. The makeup water combines with the returned condensate downstream of the degasifier where caustic is added. The feedwater is then pumped through deaerators to the boilers. Phosphate and sodium

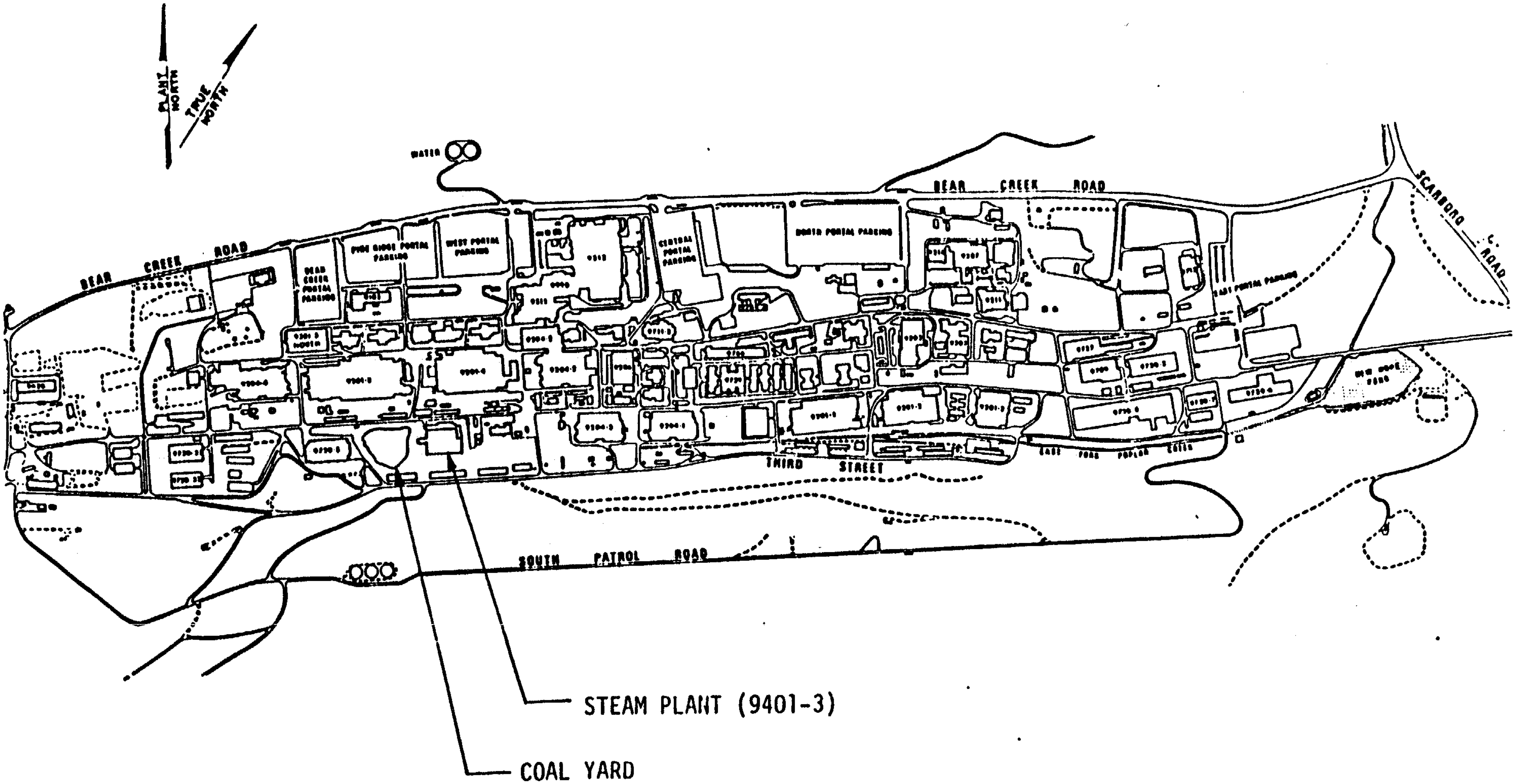

Figure 2. Location of Y-12 Steam Plant and Coal Yard

sulfite are injected into the feedwater as it enters the boilers. Boiler blowdown is collected in a flash tank where the pressure is reduced to 5 psig; the flash steam generated is used to deaerate the feedwater.

1.3×10^5 / 2×10^3 2.4×10^8 lbs/yr vs. 3.07×10^8 lbs/yr

Approximately 120,000 tons of mine-run coal are burned each year at the Y-12 Steam Plant. The coal is procured from local mines and is delivered by truck. The coal yard is immediately west of the steam plant and has a capacity of approximately 80,000 tons. Coal is procured in the spring and again in the fall. A minimum inventory of approximately 50,000 tons is maintained. Coal is transferred to the steam plant bunkers by a series of three conveyor belts. Coal preparation equipment consists of two bowl mill pulverizers on each boiler. Furnaces burn the coal with ignition and boiler warm-up accomplished by fuel oil. A pneumatic combustion control system is used to control the combustion process. A conventional flame monitoring system supervises the safety aspects of boiler operation.

The ash-handling equipment consists of a raw water booster pump, water sluice jets in the bottom ash hoppers, a jet vacuum for removing dry ash from the hoppers, ash transfer pumps, and a sluice water recycle system.

The electrical power distribution system for the steam plant consists of four 13.8 kV feeder lines, two double-ended 480V substations, and one double-ended 2300V substation. Emergency power is provided only for lights and safety systems.

4.0 CHARACTERIZATION OF WASTE STREAMS

Waste streams resulting from Y-12 Steam Plant operations include coal yard runoff, ion exchange regeneration wastes, boiler blowdown/boiler drain, flyash/bottoms ash, cooling process water, and miscellaneous low volume waste streams. These waste streams are described in subsequent sections. Figure 3 illustrates the source of each waste stream with respect to steam plant operations; Table 1 presents a summary waste characterization.

A description of a filled burial trench containing classified uranium parts underneath the coal pile can be found in Section 4.7.

4.1 Coal Yard Runoff

Coal yard runoff is generated during and after rainfall. Generally, the coal pile is compacted and sloped resulting in a top surface that slows the penetration of stormwater. Because of the limited penetration, stormwater that contacts this top layer will have a short contact time with the coal and thus a limited amount of leaching should occur. However, sampling of rainfall in this area indicates that precipitation has an average pH of approximately 4.3[1]. Thus, even though little leaching may occur, this runoff will still have a low pH; in fact, samples obtained of direct surface runoff from the Y-12 coal pile during a storm on April 5, 1983, were measured to have a pH of approximately 3.0.

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[1] National Atmospheric Deposition Program Data Report of Precipitation Chemistry for Samples taken at the Walker Branch Watershet, DOE Oak Ridge Reservation, Oak Ridge, Tennessee, October-December 1980.

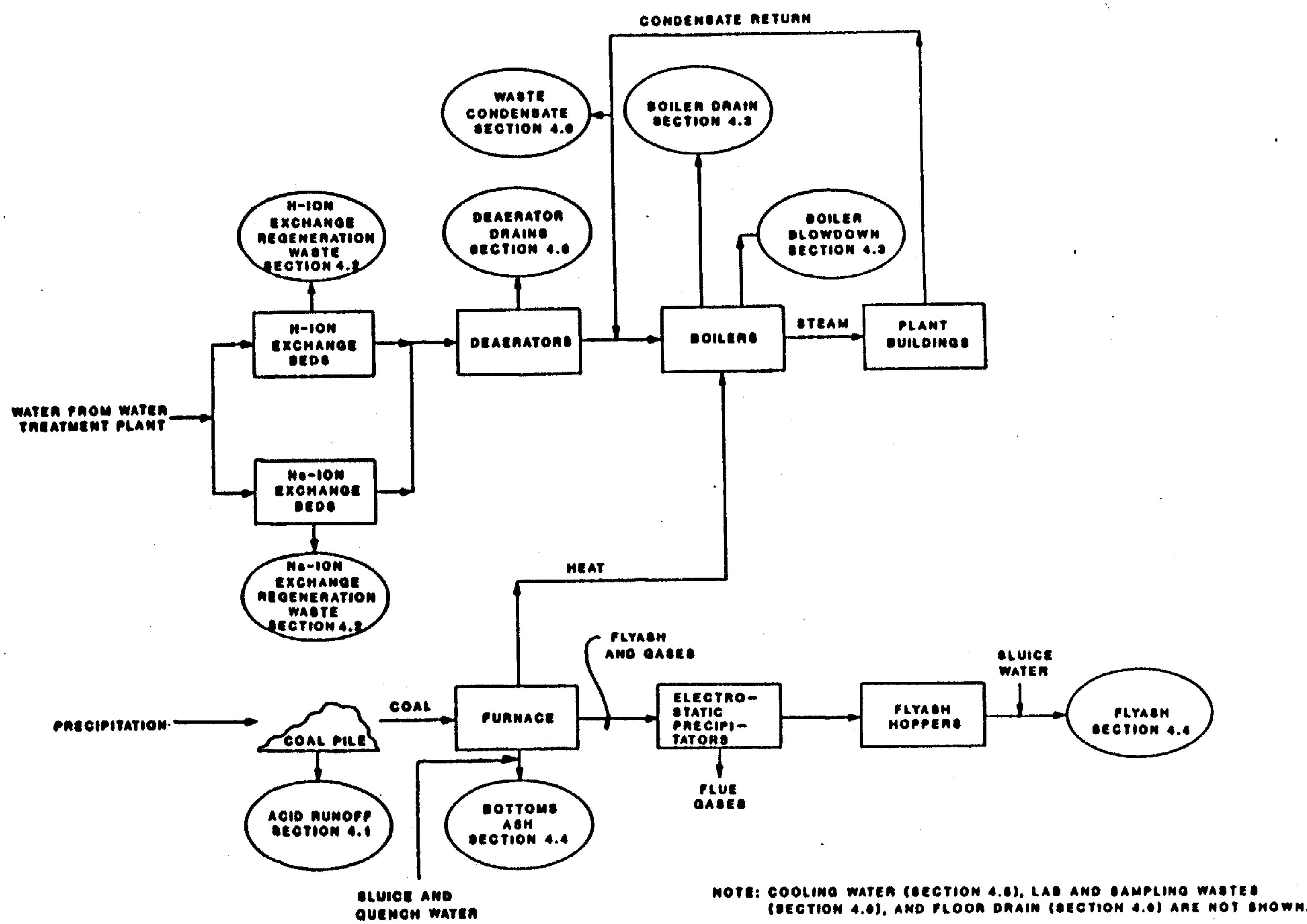

Figure 3. Waste Streams Generated from Y-12 Steam Plant Operations

TABLE I

SUMMARY CHARACTERIZATION OF WASTES FROM Y-12 STEAM PLANT OPERATIONS

WASTE STREAM	ENVIRONMENTAL CONCERNS	ANNUAL DISCHARGE (GAL/YR)	DISCHARGE FREQUENCY	CURRENT HANDLING
Coal Yard Runoff	Suspended solids (coal fines) low pH (2 to 3) high metal concentrations (Fe, As, Cu, Ni, Mn) high sulfate concentration	3×10^6	Intermittent	Released to UEFPC
Hydrogen Ion Exchange Regeneration Waste	low pH (1.5 to 6) high sulfate concentration	17.5×10^6	Daily	Fed through limestone bed and released to UEFPC
Sodium Ion Exchange Regeneration Waste	None	2.5×10^6	Daily	Fed through limestone bed and released to UEFPC
Boiler Blowdown	high pH (~11) high temperature (~212°F)	18.5×10^6	Continuous	Released to UEFPC
Boiler Drain	high pH (~11) high temperature (~212°F)	2.0×10^6	Intermittent	Released to UEFPC
Flyash/Bottoms Ash	Suspended solids (ash)	180×10^6 (includes 20,000 tons of ash)	3 X/Day	Discharged to Roger's Quarry for sedimentati
Process Cooling Water	None	26×10^6	Continuous	Released to UEFPC
Low Volume Wastes -Lab and Sampling Streams	None	150	Intermittent	Discharged to Sanitary Sewer
-Floor Drains	None	20,000	Intermittent	Discharged to UEFPC
-Deaerator Drains	None	40,000	Intermittent	Discharged to UEFPC
-Waste Condensate	None	100,000	Intermittent	Discharged to UEFPC

Consequently, this direct surface runoff will not only require sedimentation to remove suspended solids but will also require treatment prior to discharge. Still, leachate with greater acidity (pH of approximately 2) is generated from the coal pile. The primary sources of this leachate are theorized to be rainfall that percolates through the uncompacted sides of the coal pile and surface runoff that flows through the base of the pile. Stormwater from these sources has a longer contact time with the coal and consequently has the potential for decreasing the pH as well as the potential for leaching As, SO_4, Fe, Cu, Ni, and Mn from coal.

Table 2 presents the inorganic elemental composition of coal used by the Y-12 Steam Plant. Approximately 10 samples were obtained and analyzed over a fifteen month period in 1976 and 1977.

4.2 Ion Exchange Regeneration Wastes

The Y-12 Steam Plant water softening system consists of three (3) hydrogen ion exchange units and four (4) sodium ion exchange units. There are three processing steps in the regeneration of these units. These steps are backwashing with water, washing with sulfuric acid (H ion units) or sodium chloride (Na ion units), and rinsing with water. A typical sample was obtained of effluent from each step of the regeneration process and analyzed. Data for the hydrogen ion exchange regeneration waste and the sodium ion exchange regeneration waste are shown in Tables 3 and 4, respectively.

TABLE 2

INORGANIC ELEMENTAL COMPOSITION OF Y-12 STEAM PLANT COAL

ELEMENT	Mean (ug/g)	Minimum Value (ug/g)	Maximum Value (ug/g)
Al	27600	18500	66000
As[1]	39	15	58
As[2]	47	22	65
Ba[1]	180	140	300
Ba[2]	160	110	220
Br	9.7	5.30	16
Ca	1460	1000	2210
Cd	0.3	0.1	1
Ce	32	24	65
Cl	920	500	1240
Cr[1]	28	21	59
Cr[2]	23	13	41
Co	8.2	5.3	12
Cs	2.1	1.2	5.4
Cu	20	12	42
Eu	0.7	0.4	1.2
Fe	14900	12000	19400
Ga	7.0	4.9	15
Hf	1.0	0.70	1.8
Hg	.2	0.1	0.4
I	1.8	1.4	2
In	0.5	0.1	1
La	15	11	32

Table 2 (Continued)

Element	Mean (ug/g)	Minimum Value (ug/g)	Maximum Value (ug/g)
K	5480	3300	14000
Mg	3960	2410	9920
Mn	64	33	137
Mo	1.7	0.8	4.8
Na	420	280	750
Ni	19	10	32
Pb	9	5	13
Rb	42	25	100
S	17000	13000	22000
Sb	1.6	0.8	2.6
Sc	6.2	4.5	12
Se	3.5	2.4	4.7
Sm	3.1	2	5.8
Sr[1]	120	80	185
Sr[2]	110	75	170
Ta	.4	0.2	0.6
Th	5	3	13
Ti	1200	866	2960
Tl	0.8	0.3	1.6
U	2.4	1.3	8.7
V	48	33	100
Zn	33	20	50

[1] Instrumental neutron activation analysis

[2] Isotope dilution spark source mass spectometry

TABLE 3

H-ION REGENERATION WASTE COMPOSITION

Component/ Stream Concentrations (mg/1)*	Backwash With Water	Sulfuric Acid Regeneration	Rinse With Water
pH	6.0	2.0	6.0
Alkalinity ($CaCO_3$)	15	11	<2
Chlorides	7	6	6
SO_4	27	24	3900
Ag	<0.1	<.01	<.01
Al	<.05	<.05	0.05
As	<.06	<.06	<.06
Ba	<.2	<.2	<.2
Be	<.0005	<.0005	<.0005
Ca	9.4	8.4	170
Cd	<.002	<.002	<.002
Ce	<.03	<.03	<.03
Co	<.002	<.002	<.002
Cr	<.01	<.01	<.01
Cu	<.004	.004	.009
Fe	.10	0.08	1.4
Ga	<.04	<.04	<.04
K	0.8	0.7	-
La	<.01	<.01	<.01
Li	<.01	<.01	0.05
Mg	2.6	2.3	130
Mn	<.01	<.01	0.02
Mo	<.1	<.1	<.1
Na	5.0	4.5	60
Nb	<.02	<.02	<.02
Ni	<.01	<.01	<.01
P	0.22	<.03	0.26
Pb	<.01	0.23	<.01
Sc	<.001	<.001	<.001
Sr	0.023	0.020	0.37
Th	<.02	<.02	<.02
Ti	<.001	<.001	<.001
V	<.003	<.003	0.005
Y	<.001	<.001	<.001
Zn	<.02	<.02	0.28
Zr	.001	<0.001	<.001

*Except pH Data

TABLE 4

Na-Ion Regeneration Waste Composition

Component/ Stream Conclusion (mg/l)*	Backwash With Water	Na Regeneration	Rinse With Water
pH	7.2	8.0	7.4
$CaCO_3$	78	110	120
Chlorides	6	**	5700
SO_4	30	**	98
Ag	<.01	<.01	<.01
Al	<.05	<.05	0.05
As	<.06	<.06	<.06
Ba	<0.2	<0.2	<0.7
Be	<.0005	<.0005	<.0005
Ca	11	7.1	1200
Cd	<.002	<.002	<.002
Ce	<.03	<.03	<.03
Co	<.002	<.002	<.002
Cr	<.01	<.01	<.01
Cu	<.004	<.004	0.006
Fe	0.09	0.06	<.06
Ga	<.04	<.04	<.04
K	1.0	1.0	22
La	<.01	<.01	<.01
Li	<.01	0.01	0.08
Mg	3.3	2.0	270
Mn	<.01	<.01	<.01
Mo	<.1	<.1	<.1
Na	32	57	2300
Nb	<.02	<.02	0.02
Ni	<.01	<.01	<.01
P	0.22	0.19	0.21
Pb	<.01	<.01	<.01
Sc	<.001	<.001	<.001
Sr	0.025	0.025	2.2
Th	<.02	<.02	<.02
Ti	<.001	<.001	<.001
V	<.003	<.003	<.003
Y	<.001	<.001	<.001
Zn	<.02	<.02	1.2
Zr	<.001	<.001	<.001

*Except pH Data
**Data not available

4.3 Boiler Blowdown/Boiler Drain

In order to keep mineral levels in the boiler water from becoming too concentrated, a stream is continuously discharged from the operating boilers through a flash tank. Approximately 30% of the waste stream collected in a flash tank is used to deaerate feedwater; the rest is released untreated to Upper East Fork Poplar Creek. Also, the boilers are drained as needed for maintenance purposes, which results in another waste stream of similar chemical characteristics. Analytical data are presented in Table 5 for a sample typical of boiler blowdown.

4.4 Flyash/Bottoms Ash

Flyash collected by the precipitators and ash removed from the boiler furnace bottoms are mixed with water. This stream is combined with waste streams generated from the cleaning of boiler furnaces and preheaters as necessary during maintenance work. This combined slurry stream is presently pumped to Rogers Quarry for sedimentation. Typical data for flyash are shown in Table 6.

4.5 Process Cooling Water

Potable water passed through a backflow prevention device is used for cooling auxiliary equipment within the Steam Plant. Approximately 50 gpm of the cooling water is discharged continuously to UEFPC.

TABLE 5

Boiler Blowdown Waste Composition

Components	Concentration (mg/l)*
pH	11
Alkalinity ($CaCO_3$)	480
Chlorides	150
SO_4	630
Ag	<.01
Al	0.17
As	<.06
Ba	<.2
Be	<0.0005
Ca	2.0
Cd	<.002
Ce	<.03
Co	<.002
Cr	<.01
Cu	0.09
Fe	1.1
Ga	<.04
K	4.8
La	<.01
Li	0.02
Mg	0.3
Mn	0.02
Mo	<.01
Na	580
Nb	<0.02
Ni	0.01
P	11
Pb	<.01
Sc	<.001
Sr	<.001
Th	<.02
Ti	<.001
V	<.003
Y	<.001
Zn	<.02
Zr	<.001

*Except pH Data

TABLE 6

FLYASH COMPOSITION

Constituents	Ash as a Whole, Percent
Iron as Fe_2O_3	9.10
Carbon as C	10.64
Magnesium as MgO	0.83
Calcium as CaO	2.33
Aluminum as Al_2O_3	26.90
Sulphur as SO_3	1.20
Titanium as TiO_2	1.35
Carbonate as CO_3	0.01
Silicon as SiO_2	45.93
Phosphorus as P_2O_3	Trace
Undetermined	1.58
	100.00

4.6 Low Volume Wastes

4.6.1 Lab and Sampling Streams

Samples of the boiler water and the water softening ion exchange unit streams are taken once during each work shift at the Y-12 Steam Plant. These samples are analyzed at the Steam Plant Lab and then discharged daily through sink drains to the sanitary sewer.

4.6.2 Floor Drains

Water from leaks from piping and pumps and water used for cleaning accidental chemical spill, (sodium hydroxide, sodium sulfite, and tri-sodium phosphate), are periodically released through floor drains that discharge to UEFPC via storm sewers.

4.6.3 Deaerator Drains

The deaerators are drained of water periodicaly for maintenance purposes. The water is released to drains that eventually discharge to UEFPC.

4.6.4 Waste Condensate

Return condensate is inadvertently mixed with potable water at various buildings supplied with steam and cannot be recycled to boilers as normally occurs. The waste condensate is instead released to storm sewers that discharge to UEFPC. It is to be noted that the discharge water quality of the condensate - potable water mixture will generally be improved over that of potable water alone.

4.7 Classified Parts Waste

During 1965 and 1966, classified parts were buried in the coal yard area and are now underneath the Y-12 coal pile. Available information indicates that disposal took place in a pit 161 feet long, 14.5 feet wide and 15 feet deep. The centerline of the pit is located approximately 85 feet south of the center of Second Street, with the eastern end of the pit located approximately 130 feet from the west end of 9401-3. The long axis of the pit parallels Second Street (See Figure 4).

The majority of the material buried consists of weapons parts manufactured from depleted uranium and depleted uranium alloys. Non-uranium weapon parts were also buried in the coal yard pit. The estimated total of the buried material is in the 2,000,000 kg range, with an estimated being depleted uranium or depleted uranium alloys.

5.0 WATER QUALITY IMPACTS

5.1 Coal Pile Runoff

The Y-12 Plant coal pile is located just west of the Steam Plant. A minimum inventory of 50,000 tons of coal is maintained throughout the year, and at maximum capacity the pile contains 80,000 tons. The pile is compacted and sloped resulting in a top surface that slows the penetration of rainwater into the body of the pile. The direct surface runoff constitutes most of the runoff, with some leachate percolating through the uncompacted sides of the pile.

At present, runoff is removed from the coal pile area through storm drains discharging directly into UEFPC. The main impacts upon receiving waters (UEFPC) resulting from the coal pile runoff are suspended solids (coal fines), low pH, and metallic and sulfate ions. Currently no treatment is being given to this waste stream.

5.2 Ion Exchange Regeneration Wastes

Currently, the combined ion exchange regeneration wastes are treated in an abandoned cooling tower basin filled with limestone rock and released to UEFPC. The waste streams are distributed through a perforated pipe and allowed to flow by gravity through the limestone bed in order to raise the low pH. However, the pH, at best, has been raised to 5; this treatment method is less than satisfactory.

The hydrogen ion exchange regeneration waste is noted for its low pH deriving from the use of sulfuric acid as regeneration fluid for the ion exchange resin units. This stream presents pH and sulfate concerns similar to those seen in the coal yard runoff; however, it is discharged on a regular basis.

The sodium ion exchange waste stream is pH neutral and contains sodium chloride. The environmental impact of this stream is minimal.

5.3 Boiler Blowdown/Boiler Drain

The main impact upon UEFPC from boiler blowdown/boiler drain results from the elevated pH of the predominantly water discharge. The high temperature of the blowdown may affect the receiving stream through the introduction of thermal pollution. Sulfates in this waste stream may also be detrimental to UEFPC.

5.4 Flyash/Bottom Ash

The Y-12 Steam Plant ash streams are currently pumped over the crest of Chestnut Ridge where the pipeline empties into a wet weather creek. From that point on, the stream flows by gravity through a filled ash impoundment, past a spillway in the ash impoundment, and through a wet weather stream that empties into the northwest corner of Rogers Quarry. The quarry is used as a sedimentation basin.

A National Pollutant Discharge Elimination System (NPDES) permit point exists at the outlet of Rogers Quarry. Solid-liquid separation, generally through plain sedimentation, has been proven effective in controlling suspended solids at the permit point. The conditions (e.g. suspended solids, pH) of the permit are being met at present.

5.5 Process Cooling Water

The cooling water contains few impurities and, as such, has an insignificant impact upon UEFPC.

5.6 Low Volume Wastes

These wastes include floor drain and deaerator drainage, condensate, and lab and sampling wastes. These streams are very small in quantity and as such do not present a significant threat to the environment.

5.7 Classified Parts Waste

An estimated 2,000,000 kg of material is buried in a trench under the coal pile. Approximately 1,750,000 kg of the above is depleted uranium and depleted uranium alloys. No waste stream from the trench has been identified and no environmental injury resulting therefrom has been noted. It is, however, possible to describe several scenarios of what may be happening or might happen in the future to the buried waste.

5.7.1 Dry Trench

If it is assumed that the groundwater table never (or seldom) reaches the waste in the trench, and if it is further assumed that the coal pile is impervious at that point, then it may be surmised that the material in the trench is relatively intact. No environmental effects will occur as the uranium will not be solubilized by the coal-derived acid leachate and consequently will not migrate.

5.7.2 Trench Subject to Groundwater Table Variations

In this case, it is assumed that the top of the ground water table reaches the trench during wet periods. It is further assumed that the pile is relatively impervious and thus no leachate will reach the uranium. Under those conditions, some surface oxidation would have probably taken place, but the material is still essentially in its original form. Very little migration through the water table would be taking place; environmental impact in this situation would be minimal, but would perhaps tend to be more pronounced with time as uranium is leached out and carried underground to the ULFPC.

This situation is considered to be the most probable because the existing pile is quite impervious and may effectively isolate leachate from the pit. In all probability, the material is still in the pit, either in metallic or alloy form and coated with oxides of uranium.

5.7.3 Trench Subject to High Groundwater Table and to Infiltration

In this case, it is assumed that, in addition to the water from the groundwater table reaching the trench, acid infiltration also penetrates and contacts uranium. Under this set of conditions, soluble uranium salts (e.g. uranyl sulfate) will migrate with the groundwater flow and will show up in the lower reaches of ULFPC and New Hope Pond. Environmental impact will be maximized in this case, as eventually most uranium will reach the environment through this route.

6.0 CORRECTIVE MEASURES

Short-term and long-term corrective measures are presented in this section.

6.1 Coal Pile Runoff

6.1.1 Short Range Plan

The short range plans has two components: the shaping of the coal pile and the screening of storm sewer drains. The coal pile will be sloped to allow runoff to flow in a southwestern direction. The top slope will be compacted to a density of 70-80 lbs/cu ft to prevent runoff from flowing down through the coal pile and thus minimizing leaching of coal. Flow shall be directed by berms constructed along the top perimeter to prevent stormwater from channeling down the uncompacted coal on the sides of the pile. Screens will be provided on storm sewer inlets to reduce the amount of coal fines entering UEFPC.

Implementation of this plan will require procurement of a scraper for moving coal from the pile to the conveyor belt and procurement of silt separation screening. The scraper is expected to be on site by January 1984 with reshaping of the pile and installation of the screening completed by March 1984.

6.1.2 Interim Plan

Proposed is the construction of concrete lined ditches and a 400,000 gallon collection/sedimentation basin located south of the existing 54 inch double storm sewers and north of the south coal yard boundary fence (See Figure

5). The basin will equalize storm flows and settle coal fines. The basin is to be designed to allow access by equipment required to periodically dredge the settled fines.

The interim plan would be completed 12 months after receipt of approximately $1.2 million funding,

6.1.3 Long Term Plan

The long term plan will provide treatment following the the sedimentation and equalization basin and will involve neutralization, solid-liquid separation, and sludge dewatering. The system will consist of a neutralization tank, a reactor-clarifier, chemical addition equipment, and a centrifuge. It is proposed to use the same system to treat the boiler blowdown/boiler drain streams and the hydrogen ion exchange waste. This can be accommodated because of the similarities in the waste streams and the need for similar treatment equipment as indicated in Table 7.

Figure 4 presents a flow chart of the proposed waste treatment facility designed to treat coal pile runoff, boiler blowdown, and hydrogen ion exchange regeneration waste. A general site layout of the project is given in Figure 5.

Full implementation of this plan (including runoff collec-

TABLE 7 STEAM PLANT WASTE SIMILARITIES

WASTE STREAM	PROBLEMS	TREATMENT PROCESSES REQUIRED
(1) Coal Yard Runoff	Coal fines, low pH, high metal concentration high sulfate concentration	Equalization, Sedimentation, Neutralization, Solid-Liquid Separation
(2) Hydrogen Ion Exchange Waste	low pH high sulfate concentration	Equalization, Neutralization, Solid-Liquid Separation
(3) Boiler Blowdown/ Boiler Drain	High Temperature, High pH	Neutralization, Solid-Liquid Separation

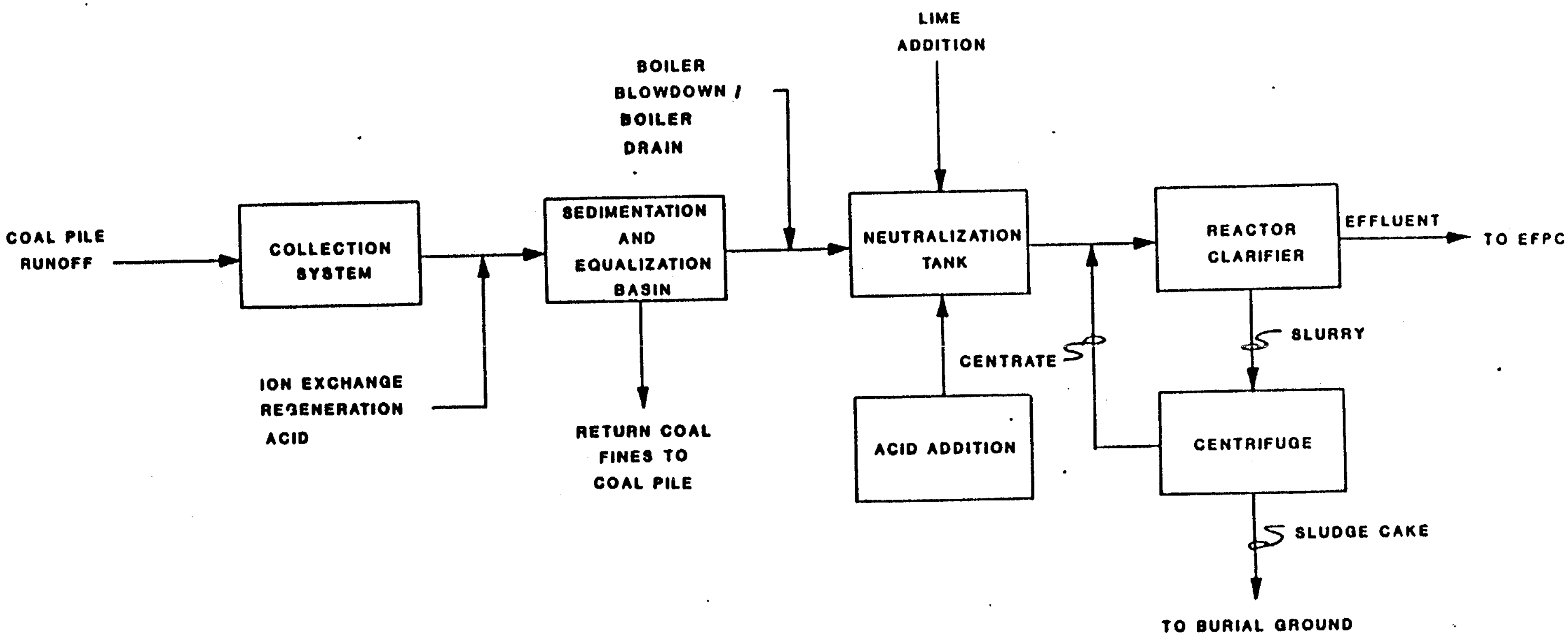

FIGURE 4 PROPOSED STEAM PLANT WASTE TREATMENT FACILITY

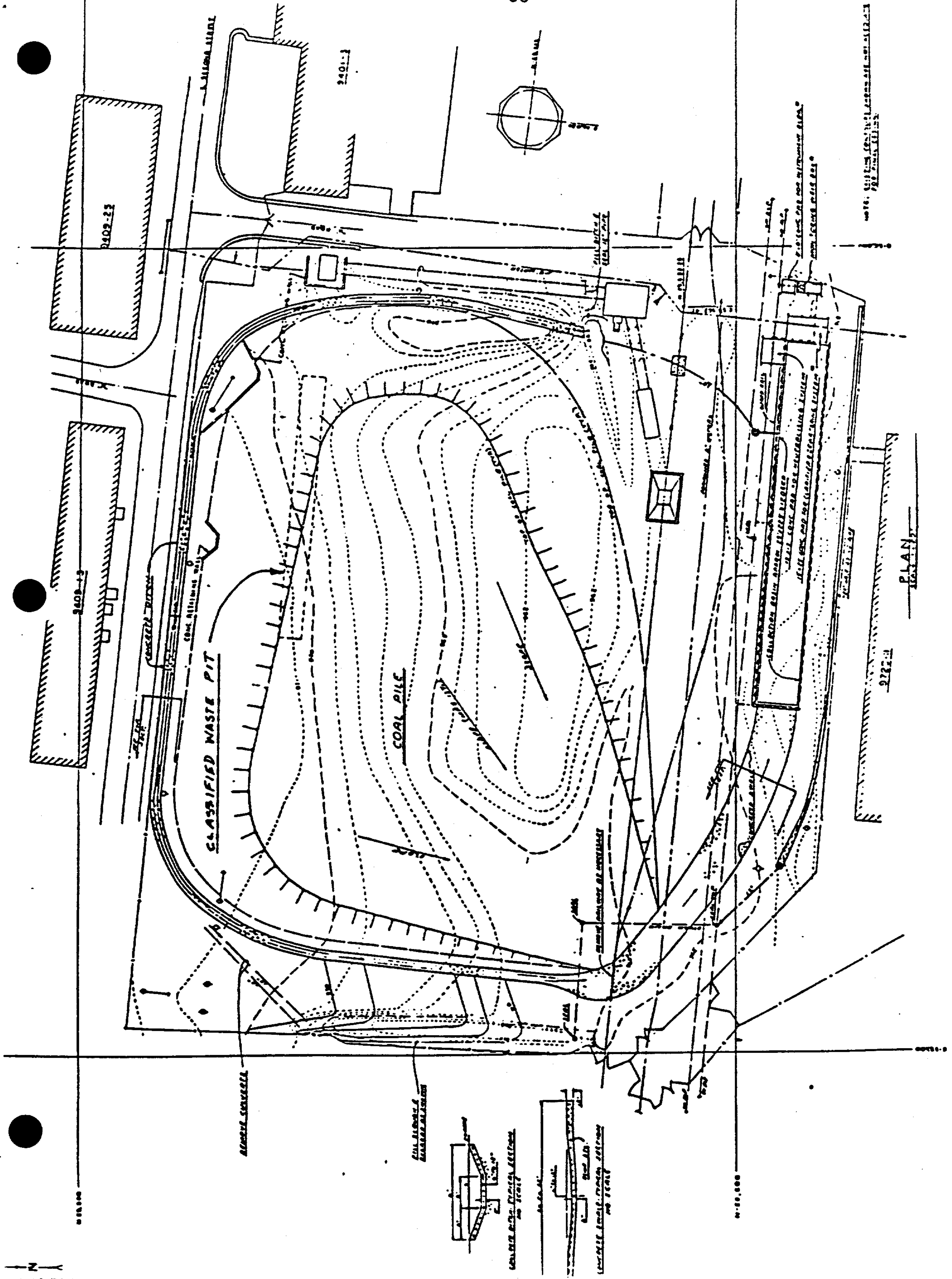

FIGURE 5 SITE LAYOUT

tion system and sedimentation basin) will require a Congressional Line Item which is scheduled for FY-1986 at a total estimated cost of $4.4 million dollars. Engineering design and construction would be completed 27 months after receipt of funding.

6.2 Ion Exchange Regeneration Wastes

6.2.1 Hydrogen Ion Regeneration Waste Stream

Complete, long-range treatment for this stream has been discussed in section 6.1.3 above. Short range corrective measures involve the injection of sodium hydroxide into the acid stream prior to discharge to ULFPC. This process is intended to bring the pH of the stream closer to neutral but will be incapable of effectively dewatering precipitated sludge so that it can be disposed of.

Development of the sodium hydroxide injection neutralization process has been underway for approximately 6 months. It is expected to be fully operational by October 1, 1983 at a cost of approximately $10,000.

6.2.2 Sodium Ion Regeneration Waste Stream

No treatment is needed for this stream.

6.3 Boiler Blowdown/Boiler Drain

Complete (long-range) treatment plans for the boiler blowdown/boiler drain waste stream are discussed in section 6.1.3 above. There are no plans available at this time for short-range corrective measures related to boiler blowdown/boiler drain streams.

6.4 Flyash/Bottom Ash

This stream does not contribute to any known environmental problem at Rogers Quarry and McCoy Branch; consequently, no corrective measures are proposed.

6.5 Process Cooling Water

No treatment is needed for this stream.

6.6 Low Volume Wastes

No treatment is required for lab and sampling wastes, floor drain and deaerator drainage, and condensate streams. Administrative measures are being implemented to prevent contamination of these streams as much as feasible.

6.7 Classified Parts Waste

The location of a classified waste pit under the coal pile may present environmental problems because of (1) its proximity to an acid waste source and (2) its probable location below the groundwater table. UCC-ND plans to continue to evaluate the classified waste pit to determine the condition of the uranium waste and its impact on the surrounding earth and groundwater. The possibility of recovering the material and disposing it in another site or capping the disposal pit area are also being evaluated. It is expected the study will be completed by February, 1984.

7.0 DISCHARGE POINTS

7.1 Coal Pile

Presently, coal pile runoff is discharged into two 54" pipes that convey whatever flow UFFPC carries at this point. The discharge takes place through three storm drains located immediately south of the pile.

Once the runoff project progresses to the point where a new ditching system is provided and the equalization and sedimentation chamber is constructed, all coal pile runoff will be collected at a single point, as indicated in Figure 5. Sampling and monitoring at this point will be simplified and representative samples may more easily be collected at the single discharge point.

7.2 Complete Treatment

Ultimately, treatment of boiler blowdown/boiler drain, hydrogen ion exchange regeneration waste, and coal yard runoff wastes is proposed to be done jointly. There will then be a unique discharge point for all three streams which should be given a single discharge permit.

7.3 Other Discharge Points

The three streams indicated in Section 7.2 above are the only ones that are considered to be of a quality that would require a discharge point permit (other than the flyash stream). At present, all streams from the steam plant discharging into UFFPC do so through storm sewers as follows:

1. A 12" line running south from the steam plant.
2. A 12" line running west on the north side of the steam plant and joining a 36" line running north-south into UEFPC.
3. A 36" line located east of the steam plant and running north-south.

At present, monitoring points would be needed for the boiler blowdown and ion exchange regeneration streams prior to reaching the main storm sewer.

7.4 Flyash Stream

It is proposed that the discharge point remain at the outlet point of Rogers Quarry.

8.0 BUDGET HISTORY

Concern about high metal concentrations entering UEFPC in 1980 prompted further study of the Y-12 Steam Plant coal storage pile. As a result of these concerns, a Conceptual Design Report (CDR) was completed by Lockwood-Greene in February 1982 and included coal yard run-off collection and treatment. This CDR addressed a variety of environmental problems as indicated by its title, Control of Effluents and Pollutants, Phase II. A corresponding budget request was made for a FY-1984 Congressional Line Item in December 1981. The request was included in the February 1982 budget submittal. The project was not supported as an FY-1984 Line Item. Consequently, the project was divided into subprojects in order to fund whatever possible as GPP projects (e.g Biodenitrification Sludge Dewatering, Waste Oil Storage). The coal yard runoff project, which exceeds GPP Funding limitations, has been submitted as an FY-1986 Line Item.

INTERNAL DISTRIBUTION

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2. A. K. Lee (2)
3. ER Document Management Center (2)
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1. Scott Surovchak, DOE Field Office, Savannah River, Environmental Restoration Division

3172

Date Issued: April 20, 1970

Document Y-1713

Rep. No. 3172

UNION CARBIDE CORPORATION
Nuclear Division

OAK RIDGE Y-12 PLANT

Operated under Contract W-7405-eng-26
With the US Atomic Energy Commission

SURVEY OF THE FLY-ASH DISPOSAL SYSTEM AT THE OAK RIDGE Y-12 PLANT

C. R. Schmitt

80,000 T capacity
50,000 T stored

Y-12 7-83: 1,200,000 kg/yr
'91: 70,000 kg/yr

K-25 290,000,000 kg/yr

Oak Ridge, Tennessee

130857

Figure 6. ACROSS-POND VIEW OF THE OUTLET FOR THE WATER-FILLED QUARRY. (Note Fly-Ash Scum Near the Inlet to the Quarry)

discharge channel, lined with gray fly-ash solids at the south side of the retention basin, is seen in Figure 13.

The Y-12 Steam Plant generates approximately 100,000 pounds of steam per hour in the summer and approximately 600,000 pounds per hour in the winter.(4) At the winter steam rate, assuming that one pound of coal is required per ten pounds of steam generated and that there is an average ash content of 15 percent for the coal, it may be calculated that 1,500 pounds of fly ash per hour or approximately 0.75 ton per hour will accumulate. Thus, at the winter rate:

is this correct?

$$\frac{600{,}000 \text{ lbs steam}}{\text{hour}} \times \frac{\boxed{1 \text{ lb coal}}}{10 \text{ lbs steam}} \times \frac{15 \text{ lbs fly ash}}{100 \text{ lbs coal}} = 9{,}000 \text{ lbs fly ash/hr or } 4.5 \text{ tons/hr, or}$$

coal per yea

$$4.5 \text{ tons/hr} \times 24 \text{ hrs} = 108 \text{ tons/day.}$$

Similarly, it may be calculated that at the summer steam rate of 100,000 pounds of steam per hour, 18 tons of fly ash per day will accumulate for disposal.

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(7) Nature, 223, pp 762-763; August 16, 1969.

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Hg in Coal

S

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Collection, chemical analysis, and evaluation of coal samples in 1975

By

Vernon E. Swanson, Jack H. Medlin, Joseph R. Hatch, S. Lynn Coleman, Gordon H. Wood, Jr., Scott D. Woodruff, and Ricky T. Hildebrand

Open-file report 76-468
1976

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

Table 7C.--Arithmetic mean, observed range, geometric mean, and geometric deviation of 36 elements in 331 Appalachian region coal samples (whole-coal basis). For comparison average shale values are listed (Turekian and Wedepohl, 1961)

[As, F, Hg, Sb, Se, Th, and U values used to calculate the statistics were determined directly on whole-coal. All other values used were calculated from determinations made on coal ash. L means less than the value shown, and G means greater than the value shown]

Element	Arithmetic mean (abundance)	Observed range Minimum	Observed range Maximum	Geometric mean (expected value)	Geometric deviation	Average shale
Si %	2.7	0.22	25.0	1.2	2.2	7.3
Al %	1.6	.19	10.5	1.3	2.0	8.0
Ca %	.12	.023L	2.0	.093	2.0	2.21
Mg %	.068	.007	1.10	.052	2.0	1.55
Na %	.032	.025	.242	.025	2.0	.96
K %	.23	.008	2.4	.13	2.8	2.66
Fe %	1.9	.059	9.3	1.0	3.0	4.72
Mn ppm	620	3.9 L	1,000	200	4.6	850
Ti %	.09	.011	.49	.074	2.1	.4
As ppm	27	.5	357	11	3.8	13
Cd ppm	.7	.03 L	6.8	.3	3.6	.3
Cu ppm	24	1.2	911	16.0	2.4	45
F ppm	80	20 L	586	60	2.1	740
Hg ppm	.24	.01	3.30	.14	2.7	.4
Li ppm	27.6	1.8	150	18.8	2.4	66
Pb ppm	15.3	1	69.9	10.9	2.3	20
Sb ppm	1.2	.1	34.6	.8	2.4	1.5
Se ppm	4.7	.1 L	150	3.5	2.2	.6
Th ppm	4.9	2.2	47.8	2.8	2.8	12
U ppm	1.4	.2 L	10.5	1.0	2.3	3.7
Zn ppm	20.0	1.5	1,072	12.8	2.6	95
B ppm	30	1	100 G	20	3.0	100
Ba ppm	100	7	700	70	3.2	580
Be ppm	2	.3	7	2	1.9	3
Co ppm	7	.5	300 G	5	2.2	19
Cr ppm	20	.5 L	70	15	2.2	90
Ga ppm	7	.7	30	7	2.0	19
Mo ppm	3	.2 L	30	2	2.6	2.6
Nb ppm	5	.2	20	3	2.3	11
Ni ppm	15	1.5	300 G	15	2.1	68
Sc ppm	5	.7	15	3	2.0	13
Sr ppm	100	7	700 G	70	2.3	300
V ppm	20	2	150	20	2.0	130
Y ppm	10	2	70	7	1.8	26
Yb ppm	1	.15	5	.7	1.8	2.
Zr ppm	50	2	300	30	2.8	160

EPA-650/2-74-054

OCCURRENCE AND DISTRIBUTION OF POTENTIALLY VOLATILE TRACE ELEMENTS IN COAL

by

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Contract No. 68-02-0246

Program Element No. 1AB013

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July 1974

OCCURRENCE AND DISTRIBUTION OF POTENTIALLY VOLATILE TRACE ELEMENTS IN COAL:

A Final Report

R. R. Ruch, H. J. Gluskoter, and N. F. Shimp

With Contributions From

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ABSTRACT

Chemical analyses of 101 whole coal samples and of 32 separate fractions of four laboratory-prepared (washed) coals have been made in the laboratories of the Illinois State Geological Survey. The four laboratory-prepared coals and eighty-two of the 101 whole coals are from the Illinois Basin. The remaining 19 coal samples were collected from other parts of the United States.

Trace elements determined were antimony (Sb), arsenic (As), beryllium (Be), boron (B), bromine (Br), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), fluorine (F), gallium (Ga), germanium (Ge), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), mercury (Hg), phosphorus (P), selenium (Se), tin (Sn), vanadium (V), zinc (Zn), and zirconium (Zr). Major and minor elements determined were aluminum (Al), calcium (Ca), chlorine (Cl), iron (Fe), magnesium (Mg), potassium (K), silicon (Si), sodium (Na), sulfur (S), and titanium (Ti). Procedures for the analytical methods used—neutron activation, optical emission, atomic absorption, X-ray fluorescence, and ion-selective electrode—are given in detail.

Wherever practical, accuracy was evaluated by comparing results obtained by the various methods from splits of the same coal samples. Further comparisons were made by analyzing whole coal and its low- and high-temperature ashes, thus permitting a thorough evaluation of trace-element losses resulting from volatilization during sampl preparation.

In general, results from the various analytical procedures compared favorably, although exceptions are noted, e.g., from V and from F. Certain techniques have been chosen as preferred methods for determining specific elements because they are more accurate, their precision is superior, or they take less time for analysis.

Statistical analyses of the large amounts of data generated on the 101 whole coal samples have resulted in several preliminary findings:

1. The elements Al, Fe, F, Ga, Br, B, Be, Cr, Cu, K, Ni, Si, Ti, Se, and V display a more or less normal distribution of analytical values with small standard deviations and ranges. A second group is composed of Cd, Zn, P, As, Sb, Pb, Sn, Cl, Ge, and Hg, each of which exhibits highly skewed distributions with large ranges and standard deviations.

2. The highest positive correlation coefficient (r) for any two chemical elements in coal is that between Zn and Cd ($r = 0.93$) Other significant positive correlations were found between the elements within the following groups: As, Co, Cu, Ni, Pb, and Sb; Si, Al, Ti, and K; Mn and Ca; and Na and Cl.

3. The average concentration of an element in the earth's crust (the clarke value) was compared to the mean value of that element in coal. Only three elements were found to be enriched in coals by at least one order of magnitude: Cd, B, and Se. Similarly, only three elements, F, Mn, and P, were found to be depleted in the coals by at least one order of magnitude.

The data from the analytical determinations on the washed coals are plotted as washability curves and as histograms. These data allow the elements to be classified into four groups. The elements in the first group (Ge, Be, and B) have the greatest organic affinity and tend to be concentrated in the clean coal fractions. The elements in the second group (Hg, Zr, Zn, Cd, As, Pb, Mn, and Mo) are those found concentrated in the mineral matter in coal and have the least organic affinity. A third group (P, Ga, Ti, Sb, and V) contains elements which are apparently associated both organically and inorganically in coals but are more closely allied to the elements with the highest organic affinities. The last group contains those elements (Co, Ni, Cr, Se, and Cu) which are also found in both modes of combination but which tend to be more inorganically associated. The washability studies (analyses of specific gravity fractions of coals) indicate the potential effective removal of major portions of several trace elements, e.g., Zn, Cd, and Pb, from raw coals by conventional specific gravity methods of separation.

Several trace and minor elements have been identified as occurring in discrete mineral phases in the coals. Among these are Zn and Cd in sphalerite (ZnS), Pb in galena (PbS), and P and F in apatite [$Ca_5(PO_4)_3(F,CO_3)$].

INTRODUCTION

Because huge tonnages of coal are burned each year for electric power generation, volatile materials, such as sulfur oxides, and the fine particulate matter emitted into the atmosphere during coal combustion are considered to be potential environmental hazards. Further, it has been clear for some time that the major chemical constituents retained in fly ash, bottom ash, and other coal combustion products may constitute long-term disposal hazards if they become soluble and enter ground- or surface-water systems. However, it has only recently become evident that the growing concern over environmental pollution will ultimately require a thorough knowledge of the elements present in coal in only trace amounts. These so-called trace elements have come under scrutiny because they are known to occur in coal (Goldschmidt, 1935, 1937) and because of the general knowledge that such elements as As, Be, Cd, Hg, and Pb are toxic to plant and animal life at relatively low concentrations. Many trace elements are now being considered not only as potential environmental pollutants, but also as poisons of costly catalysts in certain of the proposed coal gasification and liquefaction schemes.

It has therefore become imperative to develop accurate and reliable data on the amount of these elements present in coal, on their distribution and mode of occurrence, and on their volatility during combustion of the coal. Only with the development of a sufficiently large fund of such data will the general public and the agencies with the responsibility of protecting the environment be in a position to make intelligent decisions concerning utilization of coal.

The chemical nature of coal ash has been amply summarized in recent review articles (Francis, 1961; Ode, 1963; Nicholls, 1968; Watt, 1968; and Magee, Hall, and Varga, 1973), which deal in part with trace elements. However, research on trace elements in coal ash has not been extensive because until now they have been of little more than academic interest and because they occur in such small amounts that their determination is both costly and difficult.

Trace element investigations in coal prior to 1970 were based on analyses of high-temperature coal ash (Deul and Annell, 1956; Zubovic, Stadnichenko, and Sheffey, 1961, 1964, 1966; Zubovic, Sheffey, and Stadnichenko, 1967; Abernethy, Peterson, and Gibson, 1969), which measure the oxides of the elements in the altered mineral matter. Although such investigations are valuable for estimating concentrations of refractory constituents, or elements of low volatility, they do not reliably measure total amounts of volatile trace elements in whole coal. In this study, we have determined not only the amounts of the trace elements present in the coals but also their volatility when the coals were ashed at both high (up to 700° C) and low (< 150° C) temperatures

Ruch, Gluskoter, and Kennedy (1971) published whole coal Hg values for Illinois coals, and O'Gorman and Walker (1972) determined a number of trace elements in low-temperature ashes from United States coals. Ruch, Gluskoter, and Shimp (1973) reported major, minor, and trace element concentrations in 25 coals, most of them from Illinois, in which results from high- and low-temperature ashes were compared with those obtained from the whole coal.

Many of their results were verified by comparing determinations obtained by analyzing the coals by two or more independent methods.

The need for verification of trace element results has recently been emphasized (von Lehmden, Jungers, and Lee, 1974) in an EPA-NBS interlaboratory comparison study, which included both a coal sample and a fly ash sample. A wide range of values was obtained for many of the trace elements, and an urgent need for better standard samples and analytical methods was indicated.

Reports of investigations of trace element fallout from power plants (Oak Ridge, 1973; and Klein and Russell, 1973), fate of trace elements during coal gasification (Attari, 1973; and Forney et al., 1974), trace element beneficiation of coal (Capes et al., 1974), trace element concentration in fly ash (Natusch, Wallace, and Evans, 1974), and mercury mass balance in a coal-fired power plant (Kalb and Baldeck, 1973) have all appeared within the past year and are indicative of the mounting interest in trace element research.

This report contains the results of analyses for major, minor, and trace elements of 101 coals, most of them from within Illinois; however, a significant number of eastern and western coals were analyzed for comparative purposes.

The following trace elements are reported in these coals: antimony (Sb), arsenic (As), beryllium (Be), boron (B), bromine (Br), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), fluorine (F), gallium (Ga), germanium (Ge), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), mercury (Hg), phosphorus (P), selenium (Se), tin (Sn), vanadium (V), zinc (Zn), and zirconium (Zr). In addition, the major and minor elements aluminum (Al), calcium (Ca), chlorine (Cl), iron (Fe), magnesium (Mg), potassium (K), silicon (Si), sodium (Na), sulfur (S), and titanium (Ti) are reported.

The techniques used to prepare the samples for chemical analyses and the analytical methods developed for determination of many of the trace elements in coal are discussed in detail in the appendix. The appendix also includes a discussion of the results obtained by two or more analytical methods for the same element and compares the determinations for a single element on samples prepared at different ashing temperatures. As a result of such cross-checking, a high degree of confidence can be placed in the "recommended" or "best" values reported.

A partial statistical analysis of the chemical analytical data has been done, and the arithmetic mean, standard deviation, and range for each element are given. The data have also been tested for the relationships of the elements to each other, and a matrix of correlation coefficients has been generated. Many of the better correlations between elements are those to be expected from most types of geologic samples.

A second set of analytical values was determined on a series of "washed" coal samples. These samples were separated into specific gravity fractions and each fraction was analyzed for most of the same major, minor, and trace elements as were the whole coal samples. The results of the analyses of these samples are of special value for two purposes. First, they demonstrate which of the elements can be removed from the coals by specific gravity techniques and the amount of each element that can be so removed. The second use for such data is to indicate the mode of occurrence of an element in the coal—to indicate whether it is in organic or inorganic combination and, if in inorganic combination, to suggest with which group of minerals it is most likely to be associated.

The total amount of data reported here is very large, and the complete geologic interpretation of these data requires more time than is available before the publication of this report. The areal and stratigraphic distributions of the trace elements in Illinois coals and the paleoenvironmental and diagenetic significances of these distributions will be reported in the near future.

The Illinois State Geological Survey expects to continue investigations of trace elements in coal, extending the closely spaced sample grid into that part of the Illinois Basin which lies in Indiana and Kentucky, and including more samples from the eastern and western United States.

Acknowledgment

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TYPE AND SOURCE OF COAL SAMPLES

Chemical analyses of 101 whole coal samples were made for this study. Seventy-six of the samples were composite face-channel samples collected in coal mines by Illinois State Geological Survey personnel. Each face-channel sample was cut by hand with a pick and represented the full height of the coal seam, excluding only mineral bands, partings, or nodules more than three-eighths of an inch thick. This procedure follows a long-standing practice at the Illinois State Geological Survey and is based on a technique described by Holmes (1918) in which mineral bands greater than three-eighths inch in thickness were excluded. Generally, three face-channel samples were collected in each mine, but in some mines only two could be collected. The face-channel samples were crushed to pass a one-eighth-inch screen, combined into a composite sample, and then riffled to the desired quantity.

The coal sample was comminuted further to 20 mesh (740 μm), 60 mesh (250 μm), 100 mesh (149 μm), or finer, depending on the analytical technique to be applied. In all cases, the sample was subdivided into aliquots by riffle-type sample splitters or by quartering the sample. The parts are thus considered representative of the original coal sample.

Of the 25 coal samples that were not face-channel samples, four (C-13324, C-13433, C-15943, and C-15944) were drill cores. The first two drill cores are from the Herrin (No. 6) Coal Member, and the last two are from the Davis and DeKoven Coal Members, respectively. The drill cores were treated much like a face-channel sample (omitting mineral bands more than three-eighths of an inch thick). The following 14 samples represent production from individual mines and were provided by coal companies or state or federal agencies: C-17095 and C-17243 (Belmont County, Ohio), C-17046 and C-17047 (Montana), C-17045 (Arizona), C-17098 (Cambria, Pennsylvania), C-17092 (Coshocton County, Ohio), C-17096 (Utah), C-17244 (Harrison County, Ohio), C-17099 (Marion, Pennsylvania), C-17305 (Muhlenberg, Kentucky), C-17309 (Arizona), C-17054 (Colorado), and C-17097 (Colorado). Samples C-17970 and C-18009, National Bureau of Standards (NBS) samples SRM-1632 and SRM-1630, respectively, are combinations of several West Virginia coals. Four samples, C-17304 (Clay County, Indiana), C-17307 (Henry County, Missouri), C-17245 (Jefferson County, Ohio), C-17246 (Kanawha County, West Virginia), and C-17303 (Washington County, Pennsylvania), are not raw coal samples but represent commercially washed coal from the mines. The samples were obtained by other agencies and sent to the Survey.

RESULTS OF ANALYSES OF WHOLE COAL

The results of the chemical analyses of the 101 coal samples investigated are given in tables 1 through 4. All analyses in this report are given on the "whole coal" basis and not as a percentage of ash. Table 1 lists the results of the analyses for 23 trace elements, all reported in parts per million (ppm). Table 2 consists of the major and minor element determinations on the same coals. The standard coal analyses, proximate, ultimate, and heating value, are given in table 3. In addition, table 3 contains the low-temperature ash values as well as the high-temperature ash values for each coal. Table 4 contains the results of the analyses for varieties of sulfur and two total sulfur determinations, one by the standard ASTM method and the other by X-ray fluorescence.

In all four of the tables the first 82 samples are from the Illinois Basin (Illinois, Indiana, and western Kentucky), and the last 19 are from other states. The 82 samples from the Illinois Basin are listed in stratigraphic order beginning with the oldest coal seam. Coals from Illinois are identified with the following symbols: Reynoldsburg Member (Rb), coal in Abbott Formation (AF), Delwood Member (DW), Murphysboro Member (MU), Davis Member (DV), DeKoven Member (DK), coal in Mattoon Formation (MF), and the numbers 1, 2, 4, 5, 6, and 7 for the following coal members: Rock Island (No. 1), Colchester (No. 2), Summum (No. 4), Springfield or Harrisburg (No. 5), Herrin (No. 6), and Danville (No. 7). Coals from states other than Illinois are identified by a two-letter state abbreviation. The last two samples listed are National Bureau of Standards (NBS) samples 1630 (our sample Number C-18009) and 1632 (our sample Number C-17970).

TABLE 5—MEAN ANALYTICAL VALUES FOR ALL 101 COALS

CONSTITUENT	MEAN		STD	MIN	MAX
AS	14.02	PPM	17.70	0.50	93.00
B	102.21	PPM	54.65	5.00	224.00
BE	1.61	PPM	0.82	0.20	4.30
BR	15.42	PPM	5.92	4.00	52.00
CD	2.52	PPM	7.60	0.10	65.00
CO	9.57	PPM	7.20	1.00	43.00
CR	13.75	PPM	7.20	4.00	54.00
CU	15.16	PPM	6.12	5.00	61.00
F	60.94	PPM	20.99	25.00	143.00
GA	3.12	PPM	1.06	1.10	7.50
GE	6.59	PPM	6.71	1.00	43.00
HG	0.20	PPM	0.20	0.02	1.60
MN	49.40	PPM	40.15	6.00	181.00
MO	7.54	PPM	5.96	1.00	30.00
NI	21.07	PPM	12.35	3.00	80.00
P	71.10	PPM	72.01	5.00	400.00
PB	34.78	PPM	43.69	4.00	218.00
SB	1.26	PPM	1.32	0.20	6.90
SE	2.08	PPM	1.10	0.45	7.70
SN	4.79	PPM	6.19	1.03	51.00
V	32.71	PPM	12.03	11.00	78.00
ZN	272.29	PPM	694.23	6.00	5350.00
ZR	72.46	PPM	57.78	8.00	133.00
AL	1.29	%	0.45	0.43	3.04
CA	0.77	%	0.55	0.05	2.67
CL	0.14	%	0.14	0.01	0.54
FE	1.92	%	0.79	0.34	4.32
K	0.16	%	0.06	0.02	0.43
MG	0.05	%	0.04	0.01	0.29
NA	0.05	%	0.04	0.00	0.20
SI	2.49	%	0.80	0.58	6.09
TI	0.07	%	0.02	0.02	0.15
ORS	1.01	%	0.65	0.31	3.09
PYS	1.76	%	0.86	0.06	3.78
SUS	0.10	%	0.19	0.01	1.06
TOS	3.27	%	1.35	0.42	6.47
SXRF	2.91	%	1.20	0.54	5.40
ADL	7.70	%	3.47	1.00	16.70
MOIS	9.05	%	5.05	0.01	20.70
VOL	39.70	%	4.27	18.90	52.70
FIXC	48.82	%	4.95	34.60	65.40
ASH	11.44	%	2.89	2.20	25.80
BTU/LB	12748.91		464.30	11562.00	14362.00
C	70.28	%	3.87	55.23	80.14
H	4.95	%	0.31	4.03	5.79
N	1.30	%	0.22	0.78	1.84
O	8.68	%	2.44	4.15	16.03
HTA	11.41	%	2.95	3.20	25.85
LTA	15.28	%	4.04	3.82	31.70

Note: Abbreviations other than standard chemical symbols: organic sulfur (ORS), pyritic sulfur (PYS), sulfate sulfur (SUS), total sulfur (TOS), sulfur by X-ray fluorescence (SXRF), air-dry loss (ADL), moisture (MOIS), volatile matter (VOL), fixed carbon (FIXC), high-temperature ash (HTA), low-temperature ash (LTA).

TABLE 6—MEAN ANALYTICAL VALUES FOR 82 COALS FROM THE ILLINOIS BASIN

CONSTITUENT	MEAN		STD	MIN	MAX
AS	14,91	PPM	18,94	1,70	93,00
B	113,79	PPM	51,72	12,00	224,00
BE	1,72	PPM	0,83	0,50	4,00
BR	15,27	PPM	5,60	6,00	32,00
CD	2,09	PPM	8,32	0,10	65,00
CO	9,15	PPM	5,76	2,00	34,00
CR	14,10	PPM	7,88	4,00	54,00
CU	14,09	PPM	6,78	5,00	44,00
F	59,30	PPM	19,79	30,00	143,00
GA	3,04	PPM	1,03	1,60	7,50
GE	7,51	PPM	7,08	1,00	43,00
HG	0,21	PPM	0,22	0,03	1,60
MN	53,16	PPM	40,98	6,00	181,00
MO	7,96	PPM	5,68	1,00	29,00
NI	2[illegible],35	PPM	10,81	8,00	68,00
P	62,77	PPM	65,66	5,00	339,00
PB	39,83	PPM	45,94	4,00	218,00
SB	1,35	PPM	1,42	0,20	8,90
SE	1,99	PPM	0,93	0,45	7,70
SN	4,56	PPM	6,64	1,00	51,00
V	33,13	PPM	11,63	16,00	78,00
ZN	313,04	PPM	769,92	10,00	5350,00
ZR	72,10	PPM	58,01	12,00	133,00
AL	1,22	%	0,37	0,43	3,04
CA	0,74	%	0,49	0,05	2,67
CL	0,15	%	0,15	0,01	0,54
FE	2,06	%	0,71	0,46	4,32
K	0,16	%	0,06	0,04	0,30
MG	0,05	%	0,02	0,01	0,17
NA	0,05	%	0,04	0,00	0,19
SI	2,39	%	0,62	0,58	4,63
TI	0,06	%	0,02	0,02	0,15
ORS	1,54	%	0,62	0,37	3,09
PYS	1,88	%	0,74	0,29	3,78
SUS	0,09	%	0,18	0,01	1,06
TOS	3,51	%	1,12	0,85	5,59
SXRF	3,19	%	1,06	0,79	5,40
ADL	7,70	%	3,47	1,40	16,70
MOIS	10,02	%	4,23	1,60	18,20
VOL	39,60	%	3,17	31,90	46,40
FIXC	48,98	%	3,92	41,30	61,00
ASH	11,28	%	1,98	8,60	16,00
BTU/LB	12748,91		465,50	11568,00	14362,00
C	70,69	%	3,11	62,49	79,94
H	4,98	%	0,26	4,19	5,76
N	1,35	%	0,20	0,93	1,84
O	8,19	%	1,84	4,15	14,36
HTA	11,18	%	2,17	3,28	16,04
LTA	15,22	%	3,28	3,82	23,53

Note: Abbreviations other than standard chemical symbols: organic sulfur (ORS), pyritic sulfur (PYS), sulfate sulfur (SUS), total sulfur (TOS), sulfur by X-ray fluorescence (SXRF), air-dry loss (ADL), moisture (MOIS), volatile matter (VOL), fixed carbon (FIXC), high-temperature ash (HTA), low-temperature ash (LTA).

S

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Collection, chemical analysis, and evaluation of coal samples in 1975

By

Vernon E. Swanson, Jack H. Medlin, Joseph R. Hatch, S. Lynn Coleman, Gordon H. Wood, Jr., Scott D. Woodruff, and Ricky T. Hildebrand

Open-file report 76-468
1976

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

PB89-194229

United States
Environmental Protection
Agency

Office of Air Quality
Planning And Standards
Research Triangle Park, NC 27711

EPA-450/2-89-001
April 1989

AIR

EPA

ESTIMATING AIR TOXICS EMISSIONS FROM COAL AND OIL COMBUSTION SOURCES

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2211107	37.41

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BOULDER CO 80301

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higher than for residual oil may be that there is a lack of representative data to adequately characterize distillate oil. In general, distillate oil will have lower trace metal contents than residual oil.

Some data were available with which to compare the copper concentration in foreign and domestic crude oils (Table 3-29). Based on this limited set of data, domestic oils have a higher concentration of copper than do foreign oils.

<u>Mercury in Fuels</u>

Mercury in Coal-

Table 3-30 presents the mean concentration of mercury in coal by coal type. Bituminous and anthracite coals have the highest mean mercury concentration, 0.21 ppm and 0.23 ppm, respectively. The standard deviation of each mean either approaches or exceeds the mean, indicating strong variations in the data. Table 3-31 shows the ranges of mercury concentration in each of the four coal types. Subbituminous coals have the greatest reported range of mercury concentrations (0.01-8.0 ppm). The means reported by White et al. (1984) in Table 3-30 may be regarded as typical values for mercury concentration in coals because the data were based on the NCRDS, the most comprehensive data set available at this time.

The concentration of mercury in coal also varies by the geographic region from which the coal is obtained. As shown in Table 3-32, coals from the Appalachian and Gulf Provinces have the highest mean mercury concentration, 0.24 ppm for both regions. The lowest mean concentration is found in coals from the Alaska region. The greatest range of mercury concentrations is found in coals from the Alaska region with a reported range of 0.02 ppm to 63 ppm. The means reported by White et al. (1984) may be regarded as typical concentrations of mercury in coals from each geographic region.

Mercury in Oil-

The concentration of mercury in oil depends on the type of oil. As shown in Table 3-33, some reported values for the mean mercury concentration in crude oil are higher than those reported for residual oil. The reported

PAGE : 1

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	SUSAN M FLACK						
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	PAGES SENT	18					
	PAGE RECALL	4					
10/22/96	CONNECT FEES					25.00	25.00
10/22/96	NATIONWIDE NOW CONNECT FEE					10.00	10.00
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	STATE TAX						1.23

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7/96

TABLE 3-30. CONCENTRATION OF MERCURY IN COAL BY COAL TYPE[a]

Coal Type	Number of Samples	Mercury Concentration (ppm) Mean	Standard Deviation
Bituminous	3527	0.21	0.42
Subbituminous	640	0.10	0.11
Anthracite	52	0.23	0.27
Lignite	183	0.15	0.14

[a]Data presented in White et al., (1984); based on data in the USGS National Coal Resources Data System (NCRDS) as of 1982. Arithmetic means from this study may be used as typical values for arsenic content of these types of coals.

TABLE 3-31. RANGES OF MERCURY CONCENTRATION IN COALS BY COAL TYPE

Coal Type	Mercury Concentration Range (ppm)[a]
Bituminous	<0.01-3.3
Subbituminous	0.01-8.0
Anthracite	0.16-0.30
Lignite	0.03-1.0

[a]Lowest and highest values reported in any of the literature reviewed. Note: The White et al., (1984) study does not list the range of values in the NCRDS. The Swanson et al., (1976) study, which is a subset of the NCRDS describing about 800 coal samples does include ranges for bituminous and lignite coals from certain geographical regions. Valkovic, 1983a lists ranges of mercury concentrations in subbituminous coals.

dinner
2/19

2204384801 50000 14

FEB 19, 97 235 20

SUSAN M FLACK
[redacted]
VISA

SALE

104437

FOOD AND BEVERAGE

BASE AMOUNT $56.20

TIP AMOUNT 8.00

TOTAL $64.20

X Susan M Flack
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lunch 2/22

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3012 AIRPORT HWY
ALCOA, TN

gas - rental car

02/21/97 22:18
STATION ID 42437442

ALCOA , TN

VISA
[redacted]
INV #: 2218300000
REF #: 4000028038
APPROVAL#: 022150 5

PUMP # 06 UNLD
GALLONS: 9.421
PRICE/GAL: $ 1.199
FUEL SALE: $ 11.30
TOTAL SALE $ 11.30

supplies
2/20

dinner
2/21

DATE: 02/21/97 TIME: 21:04

MCSCROUGES
307 N PETERS RD
KNOXVILLE, TN 379220000
(615)691-6443

CLERK ID

QUAN	DESCRIPTION	AMT
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TIP ______
REF NO 56000950 TAX ______
AUTH NO 554387
TRAN TYPE SALE TOTAL 27.45
ACCOUNT # EXP
[redacted] 1297

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SALES TAX 1 0.29
TOTAL 3.76
CASH TEND 20.01
CHANGE DUE 16.25

TC# 038030310677297
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02/20/97 19:03:52

supplies
2/21

TABLE 3-32. MERCURY CONCENTRATION IN COAL BY REGION

Region	Number of Samples	Mercury Concentration (ppm) Range	Arithmetic Mean	Standard Deviation	Reference
Appalachian	2749	---	0.24[a]	0.47	White et al., 1984, NCRDS[b]
	331	<0.01-3.3	0.24	---	Swanson et al., 1976[c]
Interior	592	---	0.14[a]	0.14	White et al., 1984, NCRDS
	155	0.01-0.83	0.14	---	Swanson et al., 1976
	---	0.01-1.5	0.15	---	Valkovic, 1983a
Illinois Basin[d]	82	0.03-1.6	0.21	0.22	Ruch, 1974
	---	0.16-1.91	---	---	PedCo, 1982
Gulf Province	38	---	0.24[d]	0.19	White et al., 1984, NCRDS
	34	0.03-1.0	0.18	---	Swanson et al., 1976
Northern Plains	371	---	0.11[a]	0.10	White et al., 1984, NCRDS
	490	0.01-3.8	0.11	---	Hatch and Swanson, 1977
Rocky Mountains	184	---	0.09[a]	0.12	White et al., 1984, NCRDS
	124	0.01-1.48	0.06	---	Swanson et al., 1976
	---	0.01-8.0	0.11	---	Valkovic, 1983a

▸ **To install a Novell NetWare client with no previous networking**

1. Run the Novell-supplied installation program to install a NetWare client.
2. In the Network option in Control Panel, click Add, and then double-click Client in the Select Network Component Type dialog box.
3. In the Select Network Client dialog box, click Novell in the Manufacturers list, and click the workstation shell that you want (NETX orVLM) in the Network Clients list. Then click OK.

TABLE 3-32. MERCURY CONCENTRATION IN COAL BY REGION (Continued)

Region	Number of Samples	Mercury Concentration (ppm)			Reference
		Range	Arithmetic Mean	Standard Deviation	
Alaska	107	---	0.08[a]	0.07	White et al., 1984, NCRDS
	18	0.02-63	4.4	---	Swanson et al., 1976

[a]Values are based on the most comprehensive data set currently available and may be used as typical values for mercury in coal from these regions.

[b]NCRDS = National Coal Resource Data System maintained by USGS.

[c]Data from the Swanson et al. (1976) study are included in the NCRDS. Arithmetic means from the entire NCRDS are more representative than means from Swanson, since the NCRDS contains many more coal samples. The Swanson data are included here to give an idea of the range of values for mercury content in individual coal samples from each region.

[d]Eastern section of Interior Province.

Installing Windows 95 with a Novell NetWare Client

This section presents the procedures for installing Windows 95 to run with a Novell-supplied client, depending on various installation situations:

- Installing Novell-supplied NetWare client support during Windows 95 Setup
- Installing Client for Microsoft Networks in addition to a Novell-supplied NetWare client
- Installing a Novell-supplied NetWare client after installing Windows 95 with no network support

> **Note** The method for installing VLM support is different if VLM support was not installed previously under Windows 3.x, as described in VLM Technical Notes.
>
> Also notice that, if the NetWare client software is not running at the time Windows 95 is installed, you must configure Windows 95 manually after Setup to work in conjunction with the NetWare client software.

By default, Windows 95 Setup automatically installs Microsoft Client for NetWare Networks if it detects NetWare software, except in the cases described in Setting Up Windows 95 for NetWare Networks: An Overview. You can select the Custom Setup type and specify that the Novell-supplied software be retained during Setup. In this case, Windows 95 will use the existing networking configuration specified in NET.CFG for protocols, adapter drivers, and other values.

▸ To select the Novell-supplied NETX client support during Windows 95 Setup

1. Start the computer as usual, making sure that the Novell-supplied network software is running. Then run Windows 95 Setup, and select Custom as the Setup type.
2. When the Network Configuration dialog box appears, select Client for NetWare Networks in the list of components, and then click Remove.
3. Click Add, and then double-click Client in the Select Network Component Type dialog box.
4. In the Select Network Client dialog box, click Novell in the Manufacturers list, and click Workstation Shell 3.X [NETX] in the Network Clients list. Then click OK.

   If you also want to use Client for Microsoft Networks, follow the steps in the next procedure.
5. Click the Next button in the Network Configuration dialog box.

   If you want to use only the NETX client, you do not need to specify settings for your network adapter driver or protocols. Setup automatically adds support for the ODI adapter and IPXODI (or for IPX.COM) by reading NET.CFG.
6. Continue with Windows 95 Setup.

> **Note** You cannot install Client for Microsoft Networks as an additional network client if you are installing Windows 95 to run with an IPX monolithic configuration.

▸ To install Client for Microsoft Networks with a Novell NetWare client

1. In the Network Configuration dialog box, click Add, and then double-click Client.
2. In the Select Network Client dialog box, click Microsoft in the Manufacturers list, and click Client for Microsoft Networks in the Network Clients list. Then click OK.

▸ To determine whether the correct adapter driver is installed

1. In the Network option in Control Panel, double-click the network adapter (or IPX Monolithic) in the list of components.
2. In the properties for the network adapter, click the Driver Type tab.
3. Make sure the Real Mode (16 bit) ODI driver is selected.

emit from 67 to 148 $lb/10^{12}$ Btu. Overfeed stokers would emit from 148 to 204 $lb/10^{12}$ Btu.

Subbituminous Coal-Fired Boilers. The available emissions test data for subbituminous coal combustion are presented in Tables 4-78 and 4-81. Many studies do not distinguish between bituminous and subbituminous coal. Emission factors specific to subbituminous coal are not presented, but based on the typical copper content of subbituminous and bituminous coals, emission factors for the two types of coal should be similar.

Lignite and Anthracite Coal-Fired Boilers. Emission factors for lignite-fired boilers are summarized in Table 4-79. Testing of three anthracite-fired stoker boilers is summarized in Table 4-82. There are too few data to derive representative emission factors. Emission factors for lignite and anthracite combustion may be derived from the summarized bituminous coal emission factors presented in Table 4-76. The bituminous coal emission factors are multiplied by ratios to account for the differing copper contents and heating values of the three types of coal. Typical copper contents of the coals are shown in Table 3-24, and heating values are summarized in Appendix B. The calculated emission factors are presented in Table 4-76. Calculated lignite and anthracite copper emission factors are higher than bituminous coal emission factors.

Mercury Emission Factors.

Mercury is the most volatile of the trace elements studied (see Section 3). Essentially 100 percent of the mercury contained in the coal feed is volatilized during combustion and emitted to the atmosphere (Baig et al., 1981). Much of the mercury is emitted in vapor form, although some mercury condenses in the stack and is associated with the fine particulate fractions of the fly ash (Klein et al., 1975b). The literature indicates that the majority of mercury is emitted in the vapor phase, however, the proportion of mercury measured in particulate versus vapor phase varies greatly between tests, and often mass balances do not close well. The form of mercury present in the flue gas is dependent on temperature and on fly

Setting Up Windows 95 for NetWare Networks: An Overview

If you are administering a NetWare network, the move to Windows 95 will involve incremental planning, testing, and gradual implementation of Windows 95 on many computers on the network. Typically, the administrator will take awhile to complete the following tasks:

1. Install Windows 95 on a single workstation, and experiment with various configuration alternatives, including the following:
   - Windows 95 protected-mode network client vs. Novell real-mode client
   - Protected-mode NDIS 3.1-compliant network adapter drivers vs. real-mode Open Datalink Interface (ODI) drivers
   - Protected-mode IPX/SPX-compatible protocol vs. existing IPX
   - Using a sole client vs. adding Client for Microsoft Networks

   This task includes experimenting with the typical applications used at your site and working over the network to assess the performance, reliability, and robustness available under Windows 95.
2. Prepare an implementation strategy, as summarized in Deployment Planning Basics.
3. Test the selected configuration of network clients, protocols, and drivers on a small network. This could include any combinations of the following:
   - Windows 95 installed over an existing 16-bit, Novell-supplied workstation client, using ODI drivers
   - Windows 95 added to an existing Windows 3.x-and-NetWare installation, using Client for NetWare Networks and protected-mode network components
   - Windows 95 as a new installation using all protected-mode components, including both Client for NetWare Networks and Client for Microsoft Networks, plus peer resource sharing support
4. Create default user profiles, system policies, and setup scripts, and perform other customization tasks for automatic installation and configuration, based on the inventory and implementation strategy.
5. Test automatic installation on a small network.
6. Prepare and implement the strategy for rollout on the larger network.

To support Novell NetWare integration with Windows 95, any computer on which you are installing Windows 95 should be connected to a NetWare server when you start Windows 95 Setup. This requires that the computer be configured with either an ODI driver (recommended) or the monolithic IPX driver, in addition to either NETX or VLM to access resources on a NetWare server.

Windows 95 Setup detects whether a Novell NetWare workstation shell is running on the computer. If Setup finds at least version 3.26 of NET*.COM, it automatically configures networking for NetWare networks. During the detection phase, Windows 95 Setup also tries to determine whether the computer is using real-mode TSRs that cannot be replaced (such as DOSNP.COM, TCP/IP client software, or 3720 emulators).

After detection is complete, Windows 95 Setup prepares to install protected-mode networking support based on Client for NetWare Networks, unless detection has found incompatible software components or the user specifies that network support should be based on Novell-supplied components. The new Windows 95 protected-mode components are not installed automatically if detection finds the following:

- The computer is using VLM with NetWare 4.x NDS. In this case, Setup leaves all existing networking components in place.
- Certain TSRs are present that require ODI. In this case, Setup installs Client for NetWare Networks, but configures it to run over ODI.
- Certain TSRs are present that are not compatible with the protected-mode client, but can use the new implementation of the IPX/SPX-compatible protocol. In this case, the real-mode network client and adapter drivers are left in place, but Setup installs the new protocol.
- Certain TSRs are present that are not compatible with Client for NetWare Networks or other protected-mode components. In this case, Setup leaves all existing real-mode networking

ash characteristics. Some literature references also indicate that there have been large margins of error in sample collection and analysis of vapor phase mercury. These factors account for some of the differences in measured mercury emissions between tests.

The distribution of mercury between the vapor and particulate phases determines whether particulate control devices will be effective for mercury control. The available test data indicated in some tests that ESPs resulted in an average of about 50 percent mercury control; however, some tests indicated no, or very little, reduction in mercury emissions. Many of the tests reporting higher mercury control efficiencies for ESPs are suspect due to mass balance closure of less than 50 percent around the boiler and/or control device. It is likely that mercury in the vapor phase escaped detection in some of these tests. There were no test data on the mercury removal efficiency of multiclones, but since multiclones are less efficient than ESPs at small particle collection, very little mercury control would be expected. Two scrubbers tested resulted in 54 and 94 percent mercury control. Scrubbing reduces stack gas temperatures from about 150°C (300°F) to about 52°C (125°F), causing mercury to condense and be removed more effectively (Baig et al., 1981).

Summary mercury emission factors are presented in Table 4-85. These are derived from measured emissions tests and from calculations based on the mercury content of typical coals. Tests of mercury emissions are summarized in Tables 4-86 through 4-91, and previously calculated emission factors are summarized in Table 4-92. Appendix C (Tables C-50 through C-59) contains more information on mercury emissions test results.

Bituminous Coal-Fired Boilers. Bituminous coal contains an average of about 0.21 ppm mercury. Assuming all mercury is volatilized during combustion and emitted, an uncontrolled emission factor of 16 $lb/10^{12}$ Btu would be expected. Since mercury is highly volatile and leaves the boiler in vapor phase, boiler design would have little effect on the expected mercury emissions. As discussed previously, multiclones would not significantly reduce mercury emissions. Thus the 16 $lb/10^{12}$ Btu emission factor would apply to multiclone-controlled as well as uncontrolled boilers. As

Windows 95 Networking: The Basics

The Windows 95 operating system includes built-in networking support with a wide range of improvements over earlier versions of Windows. This includes built-in support for popular networks, plus an open, extensible networking architecture.

For supported networks other than Microsoft networking, the computer must already have the networking software from another vendor installed. Windows 95 Setup adds only the client or protocols required to work with Windows 95. The following networks are supported:

- Artisoft® LANtastic® version 5.0 and greater
- Banyan® VINES® version 5.52 and greater
- DEC™ PATHWORKS™ (installed as a protocol)
- Microsoft networking — Microsoft LAN Manager, Windows for Workgroups 3.x, and Windows NT
- Novell® NetWare® version 3.11 and greater
- SunSoft™ PC-NFS® version 5.0 and greater

The built-in networking components include support for a wide range of network transports (such as TCP/IP and IPX/SPX), industry-wide communications protocols (such as RPC, NetBIOS, and named pipes), and existing network device standards (such as NDIS and ODI). Because of the extensible architecture, other network vendors can add network connectivity enhancements and application support, and you can mix and match components at every layer. For information, see Windows 95 Network Architecture.

The following list summarizes the benefits of networking features in Windows 95.

Robust networking components using no conventional memory.
The protected-mode clients provided with Windows 95 — Microsoft Client for NetWare Networks and Client for Microsoft Networks — use only 32-bit, protected-mode protocols, drivers, and supporting files. On large block transfers over the network, these protected-mode clients are up to twice as fast as real-mode clients under Windows 3.x. Windows 95 includes new 32-bit drivers for network protocols and adapters, plus a new implementation of TCP/IP.

Easy, graphical configuration for all networking components.
All network clients, adapter drivers, protocols, and services are installed and configured by using the Network option in Control Panel rather than by editing configuration files manually. All configuration values for protected-mode components are stored in the Registry.

Automatic setup of Windows 95 on network workstations.
For both Windows-based and MS-DOS-based computers, Setup upgrades the network software whenever possible to a Windows 95 protected-mode client and supporting protected-mode components, based on information detected about existing networking components. Setup also supports automated installation and customization during installation from setup scripts, plus installing Windows 95 to run from a local hard disk or from a shared network copy. For information, see Server-Based Setup for Windows 95, and Custom, Automated, and Push Installations.

Peer resource sharing with protected-mode network clients.
Any computer running the protected-mode Microsoft Client for NetWare Networks or Client for Microsoft Networks can be set up to serve as a file and print server for other computers on the network. Resources can be protected with user-level security on NetWare or Windows NT networks using existing user account databases. On Microsoft networks, resources can also be protected with share-level security.

Simultaneous connection to multiple networks on a computer.
The number of network connections allowed on a computer running Windows 95 depends only on the limits of your networking software. (Windows 3.x supported connection to only one network. Windows for Workgroups 3.11 allowed simultaneous connection to only two networks.) For information, see Windows 95 Network Architecture.

TABLE 4-85. SUMMARIZED MERCURY EMISSION FACTORS FOR COAL-FIRED BOILERS

Boiler Type/Control Status	Emission Factor (lb/10^{12} Btu) by Coal Type		
	Bituminous	Lignite	Anthracite
All Types of Boilers[a]:			
Uncontrolled	16	21	18
Multiclone	16	21	18
ESP	8-16	10-21	9-18
Scrubber	0.96-7.4	1.2-9.6	1.1-8.3

[a] Boiler types include pulverized coal-fired, cyclone-fired, and stoker boilers.

Plug and Play networking support.
You can insert or remove a PCMCIA network adapter while the computer is running, and Windows 95 assigns the required resources automatically and makes or removes the network connection. For any network adapter that uses an NDIS 3.1 driver, you can remove a docking unit without turning off the computer. If you disconnect the network cable from a computer running Windows 95 with Plug and Play components, the system continues to function. With most real-mode network clients, this causes the system to stall. For more information, see <u>Plug and Play Networking Overview.</u>

Unified logon, login script processing, and resource browsing.
You can use the Windows 95 unified user logon and password caching to log on to Windows NT, Novell NetWare, and other networks. Automatic login script processing is provided for Microsoft and NetWare networks. Users can access network resources by using Network Neighborhood or common dialog boxes, such as the Open or Save As dialog boxes. For more information, see <u>Logon, Browsing, and Resource Sharing.</u>

Automatic reconnection for lost server connections.
When servers are available again after the loss of a network connection, Windows 95 reconnects automatically and rebuilds the user's environment, including connection status, drive mappings, and printer connections.

Client-side caching of network data with protected-mode clients.
A protected-mode network client is a file system driver that uses the same 32-bit cache (VCACHE) used by all Windows 95 file system drivers, so it can cache network data for quick access. Files read across the network are copied to the RAM cache and made available to applications much faster than they would by rereading the file across the network. For a given file request, the cache is checked for the needed data before checking the network. This feature is available when running Client for NetWare Networks or Client for Microsoft Networks. For more information, see <u>Disks and File Systems.</u>

Long filenames for network resources.
Computers running Windows 95 can recognize and use long filenames on other computers running Windows 95, on Windows NT servers, and on NetWare 3.x and 4.x volumes that have been configured to use the OS/2® name space. For more information, see <u>Disks and File Systems.</u>

Support for the Win32 WinNet interface.
This is an API that allows developers to create applications that run unmodified on different networks. The Win32 WinNet interface in Windows 95 supports 16-bit and 32-bit applications (as opposed to the WinNet interface in Windows 3.x, which supports only 16-bit applications). For information, see <u>Windows 95 Network Architecture.</u>

User profiles and system policies for automatic configuration.
To take advantage of system policies, the computer must be running a protected-mode network client such as Microsoft Client for NetWare Networks or Client for Microsoft Networks. For information, see <u>User Profiles and System Policies.</u>

Agents for network backup and remote management.
Windows 95 includes backup agents for Cheyenne® ARCserve and Arcada® Backup Exec. Agents for Simple Network Management Protocols (SNMP) and Microsoft Network Monitor are available in the ADMIN\NETTOOLS directory of the Windows 95 compact disc. When the correct system management agent is installed on client computers, you can use a service such as HP® Open View or Microsoft Systems Management Server to manage workstations remotely. For information about remote administration, see <u>Remote Administration.</u>

Dial-up networking for remote access.
Windows 95 supports multiple protocols for remote access, including TCP/IP, IPX/SPX and the industry standard, Point-to-Point Protocol (PPP). For information about remote access protocols and connection types, see <u>Dial-Up Networking and Mobile Computing.</u>

TABLE 4-86. SUMMARY OF MEASURED MERCURY EMISSION FACTORS FOR BITUMINOUS COAL-FIRED UTILITY BOILERS

Boiler Type Control Status	Emission Factor ($lb/10^{12}$ Btu) Average[a]	Emission Factor ($lb/10^{12}$ Btu) Range	Number of Boilers	Number of Data Points
Pulverized Dry Bottom:				
Uncontrolled	35	3.9-308	3	12
Mechanical Ppt.	8.5	3.7-21.2	1	7
ESP or Mech. Ppt/ESP	11.0	0.41-22.3	13	42
2 ESPs in Series	0.20	0.011-0.56	1	5
Scrubber	ND[b]	---	1	1
Pulverized Wet Bottom:				
ESP or Mech. Ppt/ESP	4.7	2.6-6.3	5	5
Scrubber	0.16	---	1	1
Cyclone:				
Uncontrolled	10	---	1	1
ESP	8.5	3.95-17.7	5	5
Scrubber	4.9	---	1	1
Stoker:				
Mech. Ppt. or Multiclone	14.2	2.5-26	2	2
Fabric Filter	4.6	---	1	1

[a]Each boiler tested was weighted equally in determining this average. An arithmetic mean value was calculated for each boiler and then a mean of these means was calculated.

[b]Not detectable.

Windows 95 Networking: The Issues

If the real-mode network is running when you start Windows 95 Setup, the appropriate network client is installed automatically. This is the recommended method for installing networking support in all cases. When Setup detects existing network components, it installs the appropriate supporting software automatically and moves the configuration settings to the Registry, wherever possible.

If Windows 95 Setup detects that NetWare networking components are present, it installs the new protected-mode client, Microsoft Client for NetWare Networks, plus the supporting protected-mode protocol and adapter drivers. Client for NetWare Networks is not installed automatically, however, if Setup detects VLM running with NDS support. To maintain the existing real-mode client and support configuration, you must run Setup in Custom mode and manually select the NetWare client. For more information, see Windows 95 on NetWare Networks.

Microsoft recommends using the 32-bit, protected-mode networking components wherever possible. With protected-mode networking components, all configuration settings are stored in the Registry, so you do not have to maintain configuration files such as AUTOEXEC.BAT, PROTOCOL.INI, or NET.CFG. The protected-mode networking components also allow you to take advantage of the many related benefits such as:

- Performance and reliability
- Peer resource sharing capabilities
- Use of system policies for administrative control, remote administration of the Registry, and use of the network agents, such as Network Monitor and Remote Registry service, available in the ADMIN\NETTOOLS directory on the Windows 95 compact disc

If you must run a real-mode client, networking settings are required in AUTOEXEC.BAT, plus a NETSTART.BAT file might be required to start the network during system startup. Configuration

TABLE 4-87. SUMMARY OF MEASURED MERCURY EMISSION FACTORS FOR SUBBITUMINOUS COAL-FIRED UTILITY BOILERS

Boiler Type/ Control Status	Emission Factor ($lb/10^{12}$ Btu)		Number of Boilers	Number of Data Points
	Average[a]	Range		
<u>Pulverized Coal Fired</u>:				
ESP	4.1	---	1	1
Scrubber	11	---	1	1
<u>Cyclone</u>:				
Uncontrolled	81	---	1	1
Scrubber	4.9	---	1	1
<u>Unspecified Boiler Type</u>:				
ESP	1.8	1.7-2.0	2	2

[a]Each boiler tested was weighted equally in determining this average. An arithmetic mean value was calculated for each boiler, and then a mean of these means was calculated.

1. Start Microsoft Windows.

2. Insert the Graphics Filters Disk in drive A or drive B.

3. From the File Manager, search for and copy the file or files a
ssociated with each filter you
want to install to C:\WINDOWS\MSAPPS\GRPHFLT, assuming your Window
s directory is C:\WINDOWS.

If you do find the directory MSAPPS but do not find GRPHFLT, use F
ile Manager to create this
directory and then copy the file or files to this directory.

If you do not find the directory MSAPPS, use File Manager to creat
e the directory MSAPPS under
your WINDOWS directory. Then create the directory GRPHFLT under y
our MSAPPS directory. Assuming
your Windows directory is C:\WINDOWS, the full path to your graphi
cs filters directory will be
C:\WINDOWS\MSAPPS\GRPHFLT. Copy the file or files associated with
each filter you want to
install to this directory.

Note: The MSAPPS\GRPHFLT directory can be shared with other Micro
soft applications so you may
find this directory on your hard disk even if you have not previou
sly installed graphics filters
for Microsoft Excel.

>Adding Graphics Filters entries to WIN.INI
----

1. Using Windows Notepad or other text editor, open WIN.INI. WIN.
INI is located in your Windows
directory, for example, C:\WINDOWS.

2. Search for [MS Graphic Import Filters].

3. If you find this section, find the line below which corresponds
to the filter or filters you
want to install and add it to the [MS Graphic Import Filters] sect
ion:

[MS Graphic Import Filters]

TABLE 4-88. SUMMARY OF MEASURED MERCURY EMISSION FACTORS FOR LIGNITE COAL-FIRED UTILITY BOILERS

Boiler Type/ Control Status	Emission Factor ($lb/10^{12}$ Btu) Average	Range	Number of Boilers	Number of Data Points
Pulverized Dry Bottom:				
Multiclone	5.4	4.4-6.5	2	2
ESP	<0.23	---	1	1
Cyclone Boilers:				
Cyclone	22	---	1	1
ESP	0.46	---	1	1
Spreader Stoker:				
Multiclone	5.6	---	1	1
ESP	0.53	---	1	1

(To get the best on-screen view in Windows Notepad, maximize the N
otepad window and turn on word
wrap if it is not already on -- from the Edit menu, choose Word Wr
ap. For best printed results,
open this document in Windows Write, Microsoft Word, or another wo
rd processor, select the entire
document and format the text in 10 point Courier before printing.)

Installing Graphics Filters for Use with Microsoft Excel 5.0

Contents

Note: To move directly to step-by-step instructions, search for t
he right-angle bracket
character (>).

Introduction

The files included on this disk allow you to import graphics files
in the following file formats
into a Microsoft Excel document without leaving Microsoft Excel.

Note: The graphics filters contained on this disk are identical to
the graphics filters shipped
with Microsoft Office for Windows version 4.2. If you have alread
y installed Office version 4.2,
it is not necessary to install the files on this disk.

This disk contains the following:

Microsoft Graphics Import Filter   Filenames   File Versi
on Number

TABLE 4-89. SUMMARY OF MERCURY EMISSION FACTORS FOR BITUMINOUS COAL-FIRED INDUSTRIAL BOILERS

Boiler Type/ Control Status	Emission Factor ($lb/10^{12}$ Btu) Average[a]	Range	Number of Boilers	Number of Data Points
<u>Pulverized Dry Bottom</u>:				
Multiclone	180	---	1	1
ESP	4.25	4.2-4.4	4	4
Multiclone/Scrubber	86	---	1	1
<u>Pulverized Wet Bottom</u>:				
Multiclone	6.7	---	1	1
<u>Spreader Stoker</u>:				
Uncontrolled	3.4	0.76-12	7	14
Multiclone	15.4	5.8-25.1	2	2
ESP	2.95	1.0-4.2	2	3
<u>Overfeed Stoker</u>:				
Uncontrolled	1.3	0.011-2.1	4	5
Economizer/Dust Collector	0.8	0.39-1.2	1	2

[a] Each boiler was weighted equally in determining this average. An arithmetic mean value was calculated for each boiler, and then a mean of these means was calculated.

15-APR-97 TUE 04:07 PM MCLAREN HART/CHEMRISK FAX NO. 2077748263 P.12/17

Shears (3) [Photo shear.tif]:

- Capacities: 1" mild steel, 5' bed; $^5/_8$" mild steel, 90" bed; ½" mild steel, 48" bed
- All shears recently have been operational testing by shearing various thickness of stainless steel

Furnace [Photo rotary.tif]:

- Lindberg rotary design
- Two zone control
- 2350° F continuous, 2500° F intermittent
- Variable speed hearth

Furnaces (2):

- Lindberg Inline design, located along rolling mill table
- 47 ½" x 100" x 40" heat zones
- 2000° F maximum temperature
- Solid state programmable controllers
- Recently used to anneal stainless steel, aluminum; preheat of stainless steel for extruding

TABLE 4-90. SUMMARY OF MEASURED MERCURY EMISSION FACTORS FOR SUBBITUMINOUS COAL-FIRED INDUSTRIAL BOILERS

Boiler Type/ Control Status	Emission Factor ($lb/10^{12}$ Btu)		Number of Boilers	Number of Data Points
	Average[a]	Range		
Spreader Stoker:				
Uncontrolled	4.8	0.64-17	2	4
Mechanical Ppt/ESP	0.50	0.37-0.64	1	2

[a]Each boiler tested was weighted equally in determining this average. An arithmetic mean value was calculated for each boiler, and then a mean of these means was calculated.

Equipment Summary

Rolling Mills (2) [Photo rollmill.tif]:

- Loewy 4 high design
- One mill has been retrofitted with direct drive 500 hp motor
- 48" diameter backup rolls, 12" work rolls
- Maximum sheet width: 42"
- 5,000,000 pound separating force
- Recently used to roll 3" stainless steel plate into sheet approx 0.75" thick

Hydraulic Presses (2) [Photo press.tif; press2.tif]:

- Hydraulic Press Manufacture (HPM) design
- 2000 ton capacity with 500 ton booster
- Normally used for Marforming (28" rubber die)
- Can be converted to metal punch and die configuration
- 5' x 5' bed, 38" stroke
- Recently used to back extrude stainless 6" steel blanks, 1700 tons pressure

Hydraulic Presses (2) [Photo clearing.tif]:

- USI Clearing design
- 150 - 300 ton capacity
- Single / Double action
- 5' x 5' bed, 64" stroke

Hydraulic Press:

- Erie press design
- 300 ton capacity
- 5' x 5' bed, 48" stroke
- Recently used for size reduction (crushing) operations of light gage steel

Hydraulic Press:

- HydraForm design
- 15,000 psi capacity
- 12" maximum blank size, 7' draw depth

Roll Grinder [Photo rolgrind.tif]:
- Cincinnati design
- Setup for grinding rolling mill work rolls
- Bed length: 8", 20" maximum diameter

TABLE 4-91. SUMMARY OF MEASURED MERCURY EMISSION FACTORS FOR COMMERCIAL/INSTITUTIONAL COAL-FIRED BOILERS

Coal Type/ Boiler Type	Control Status	Emission Factor ($lb/10^{12}$ Btu) Average	Emission Factor ($lb/10^{12}$ Btu) Range	Number of Boilers	Number of Data Points
Bituminous Coal:					
Pulverized Dry Bottom	Uncontrolled	5.8	---	1	1
	Multiclone/Scubber	1.1	---	1	1
Underfeed Stoker	Uncontrolled	0.42	---	1	1
Spreader Stoker	Mechanical Ppt.	1.4	---	1	1
Overfeed Stoker	Mechanical Ppt.	13.0	---	1	1
Anthracite Coal:					
Stoker	Uncontrolled	5.3	3.5-7.0	3	3

- Bed length: 8", 20" maximum diameter

Shears (3) [Photo shear.tif]:

- Capacities: 1" mild steel, 5' bed; $^{5}/_{8}$ " mild steel, 90" bed; ½" mild steel, 48" bed
- All shears recently have been operational testing by shearing various thickness of stainless steel

Furnace [Photo rotary.tif]:

- Lindberg rotary design
- Two zone control
- 2350° F continuous, 2500° F intermittent
- Variable speed hearth

Furnaces (2):

- Lindberg Inline design, located along rolling mill table
- 47 ½" x 100" x 40" heat zones
- 2000° F maximum temperature
- Solid state programmable controllers
- Recently used to anneal stainless steel, aluminum; preheat of stainless steel for extruding

TABLE 4-92. CALCULATED MERCURY EMISSION FACTORS FOR COAL COMBUSTION

Coal Type	Boiler Type	Control Status	Sectors[a]	Emission Factor ($lb/10^{12}$ Btu)	Reference
Bituminous	All Types (Pulverized Dry Bottom, Pulverized Wet Bottom, Cyclone, Stoker, Residential Furnaces)	Uncontrolled	U, I, C, R	16	Baig et al., 1981; Shih et al., 1980b; Suprenant et al., 1980a; Suprenant et al., 1980b; DeAngelis and Reznik, 1979
		Mechanical Ppt.	U, I, C	16	
		ESP	U, I	16	
		Wet Scrubber	U	3.3	
Lignite	Pulverized Dry Bottom or Stoker	Uncontrolled	U, I, C	9.0-26	Baig et al., 1981
Lignite	Pulverized Dry Bottom or Stoker	Multiclone	U, I, C	2.3	Baig et al., 1981
Lignite	Cyclone	Uncontrolled	U	7.6-26	Baig et al., 1981
Lignite	Pulverized Dry Bottom or Cyclone	Multiclone, ESP, or Wet Scrubber	U	23	Shih et al., 1980b
Lignite	Automatic Coal-Fired Furnace	Uncontrolled	R	14	DeAngelis and Reznik, 1979
Anthracite	Pulverized Dry Bottom	Uncontrolled	U, I, C	9-11	Baig et al., 1981
Anthracite	Stoker	Uncontrolled	U, I, C	0.53-11	Baig et al., 1981
Anthracite	Stoker	Uncontrolled	C	4.6	Suprenant et al., 1980b
Anthracite	Automatic Coal-Fired Furnace	Uncontrolled	R	16	DeAngelis and Reznik, 1979

[a]U = Utility, I = Industrial, C = Commercial/Institutional, R = Residential

Task 5 Document Search

Conclusions

- Storage and retrieval by box number is purpose of center, not box contents
- Database is main tool for locating relevant boxes
- Most boxes are 'not' relevant
- Submitting department can withdraw box at any time!

discussed in previous paragraphs, ESPs may result in up to 50 percent mercury control. Therefore, the emission factor for ESP-controlled boilers is expressed as a range, from 8 to 16 lb/10^{12} Btu. Scrubbers were shown to result in 54 to 94 percent mercury control, so emission factors for scrubber-controlled boilers would range from 0.96 to 7.4 lb/10^{12} Btu.

In general, measured bituminous coal emission factors summarized in Tables 4-86, 4-89, and 4-91 support the calculated values. Average emission factors for uncontrolled and multiclone-controlled boilers of various designs range from 1.3 to 35 lb/10^{12} Btu. (One industrial boiler and one utility boiler tested emitted over 180 lb/10^{12} Btu, but these appear to be outliers. The mercury content of the coals for these two tests were not reported, so mass balance calculations are not possible.) The data show no significant differences in mercury emissions between different boiler types or different combustion sectors. The average measured emission factors for various types of ESP-controlled boilers range from 2.9 to 11 lb/10^{12} Btu, and emission factors for scrubber controlled boilers ranged from undetectable amounts to 4.9 lb/10^{12} Btu. (There was one scrubber-controlled boiler emitting 86 lb/10^{12} Btu, but this is an outlier. The mercury content of the coal feed was not reported.) These measured values are in general agreement with the calculated values shown in Table 4-85.

Subbituminous Coal-Fired Boilers. Emission factors for subbituminous coal-fired boilers were not calculated because much of the literature does not distinguish between bituminous and subbituminous coals. Based on mercury content and heating values of the two coals, it would be expected that emission factors for subbituminous coal would be slightly lower than for bituminous coal. The available test data for subbituminous coal combustion are summarized in Tables 4-87 and 4-90.

Lignite and Anthracite Coal-Fired Boilers. Lignite contains about 0.15 ppm and anthracite about 0.23 ppm mercury. Emission factors for lignite and anthracite combustion are presented in Table 4-85. These were calculated using the same procedures that were used to calculate bituminous coal emission factors. The lignite and anthracite emission factors are slightly

Task 5 Document Search

Relevance

- Most documents are not relevant
- Examples:
  - Weapons parts x-rays
  - Medical x-rays
  - Weapons assembly QA files

Task 5 Document Search

'HSEATECH'

- Subset of about 1000 boxes
- Includes Health Physics, Radiation Safety, Industrial Hygiene, Medical, Technical departments
- Review of HSEATECH completed
- U, Hg, Be, Cr, 3H documents identified

Oak Ridge Health Studies Dose Reconstruction

higher than bituminous coal emission factors. Measured emission factors derived from the available test data on lignite and anthracite fired combustion sources are summarized in Tables 4-88 and 4-91.

Manganese Emission Factors.

Summarized manganese emission factors for coal-fired boilers are presented in Table 4-93. These are based on measurements of manganese emissions and on theoretical calculations. They are applicable to utility, industrial, and commercial/institutional boilers. Tables 4-94 through 4-99 summarize the available manganese emissions data. For the various combustion sector/coal type/boiler design/control technology scenarios, the average and range of measured manganese emission factors are presented. Tables C-60 through C-69, in Appendix C, provide additional information on each emissions test, including references. Previously calculated manganese emission factors are listed in Table 4-100.

Bituminous Coal-Fired Pulverized Dry Bottom Boilers. Six uncontrolled, pulverized dry bottom boilers were tested. Measured emission factors are summarized in Tables 4-94 and 4-99. The average emission factor, weighting each boiler equally is 2,980 lb/10^{12} Btu. This emission factor is similar to previously calculated emission factors listed in Table 4-100.

Data on boilers controlled with multiclones, summarized in Tables 4-94 and 4-97, are highly variable. According to the emissions tests reviewed, multiclones remove about 54.3 percent of the manganese present in the flue gas. Applying this control efficiency to the summary uncontrolled emission factor yields the emission factor of 1,390 lb/10^{12} Btu for bituminous coal-fired pulverized dry bottom boilers controlled with multiclones.

Measured emission factors for 11 pulverized utility boilers and 4 industrial boilers controlled with ESPs are summarized in Tables 4-94 and 4-97. The average emission factor, weighting each boiler equally, is 642 lb/10^{12} Btu. This is the summary emission factor given in Table 4-93.

A total of five pulverized dry bottom boilers controlled with scrubbers were tested. These include utility, industrial, and commercial/institutional boilers. The average emission factor from these tests is 36 lb/10^{12} Btu.

Task 5 Document Search

Update on Y-12 Records Center

by
Susan Flack

Oak Ridge Health Studies Dose Reconstruction

Task 5 Document Search

Databases

- 22,000 boxes and 1000 shelved documents
- Index for shelf documents is complete and validated
- No single entry in box database has all fields completed
- Had to create a group of boxes using clues from relevant boxes

Oak Ridge Health Studies Dose Reconstruction

PB86-200666

EPA-600/7-84-066
June 1984

FINAL REPORT:

CORRELATION OF COAL PROPERTIES WITH
ENVIRONMENTAL CONTROL TECHNOLOGY NEEDS
FOR SULFUR AND TRACE ELEMENTS

by

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INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

TABLE 7. SULFUR, ASH, AND TRACE ELEMENTS IN U.S. COALS BY RANK[a]

	Units	Anthracite	Bituminous	Subbituminous	Lignite	Clarkes[b]
Number of samples		52	3527	640	183	
Sulfur (S), total	%	0.86 ±0.80	2.31 ±2.08	0.59 ±0.67	1.08 ±1.01	0.026
Sulfur (S), sulfate	%	0.02 ±0.02	0.14 ±0.27	0.05 ±0.10	0.22 ±0.67	—
Sulfur (S), pyritic	%	0.37 ±0.78	1.50 ±1.82	0.19 ±0.41	0.36 ±0.64	—
Sulfur (S), organic	%	0.49 ±0.16	0.92 ±0.63	0.37 ±0.30	0.57 ±0.38	—
Ash	%	15.0 ±8.94	12.6 ±9.26	14.0 ±23.7	21.5 ±22.9	—
Silicon (Si)	%	6.56 ±1.41	5.25 ±1.51	5.21 ±2.11	6.73 ±4.62	28.15
Aluminum (Al)	%	4.73 ±0.77	2.87 ±0.92	2.47 ±0.85	2.77 ±1.46	8.23
Calcium (Ca)	%	0.20 ±0.24	0.42 ±0.59	1.72 ±1.16	3.31 ±2.28	4.15
Magnesium (Mg)	%	0.15 ±0.21	0.11 ±0.10	0.42 ±0.33	1.01 ±0.74	2.33
Sodium (Na)	%	0.07 ±0.13	0.06 ±0.07	0.25 ±0.33	0.3[illegible] ±0.53	2.36
Potassium (K)	%	0.30 ±0.13	0.22 ±0.97	0.10 ±0.09	0.19 ±0.24	2.09
Iron (Fe)	%	0.87 ±0.85	2.37 ±1.86	0.95 ±0.92	1.51 ±1.41	5.63
Manganese (Mn)	%	0.01 ±0.02	0.01 ±0.01	0.01 ±0.02	0.03 ±0.02	0.10
Titanium (Ti)	%	0.29 ±0.11	0.14 ±0.07	0.13 ±0.06	0.20 ±0.12	0.57
Phosphorus (P)	%	0.07 ±0.10	0.05 ±0.09	0.13 ±0.14	0.18 ±0.28	0.11
Antimony (Sb)	ppm	1.12 ±1.84	1.22 ±2.27	0.85 ±1.40	1.01 ±2.23	0.2
X Arsenic (As)	ppm	7.67 ±19.6	20.3 ±41.8	6.17 ±15.5	22.8 ±138	1.8
Barium (Ba)	ppm	102 ±61.7	84.4 ±132	447 ±924	415 ±531	425
Beryllium (Be)	ppm	1.32 ±0.85	2.22 ±1.66	1.30 ±1.77	1.98 ±2.71	2.8
Boron (B)	ppm	11.8 ±10.5	37.6 ±41.7	52.6 ±38.5	114 ±75.2	10
Cadmium (Cd)	ppm	0.22 ±0.30	0.91 ±7.30	0.38 ±0.47	0.55 ±0.61	0.2
Chromium (Cr)	ppm	47.2 ±60.9	20.5 ±27.5	14.9 ±25.6	13.5 ±18.2	100
Cobalt (Co)	ppm	7.27 ±9.42	9.74 ±24.5	6.63 ±18.3	6.46 ±15.1	25
Copper (Cu)	ppm	18.9 ±16.4	17.8 ±17.8	14.1 ±14.3	17.2 ±21.2	55
Fluorine (F)	ppm	103 ±93.5	88.5 ±103	83.0 ±92.7	191 ±360	625
Gallium (Ga)	ppm	6.26 ±3.82	5.99 ±4.72	4.97 ±5.76	6.64 ±8.66	15
Germanium (Ge)	ppm	1.71 ±2.17	6.33 ±10.2	5.93 ±6.55	10.7 ±11.1	1.5

(Continued)

TABLE 7. (Continued)

	Units	Anthracite	Bituminous	Subbituminous	Lignite	Clarkes[b]
Lanthanum (La)	ppm	14.0 ±7.68	10.7 ±8.32	13.0 ±12.2	20.5 ±23.7	30
Lead (Pb)	ppm	7.32 ±6.92	14.3 ±27.5	6.35 ±5.47	6.90 ±7.88	12.5
Lithium (Li)	ppm	26.0 ±28.9	10.3 ±26.3	9.24 ±11.9	11.6 ±18.5	20
Mercury (Hg)	ppm	0.23 ±0.27	0.21 ±0.42	0.10 ±0.11	0.15 ±0.14	0.08
Molybdenum (Mo)	ppm	2.68 ±2.44	3.28 ±4.13	2.19 ±2.82	5.99 ±26.3	1.5
Nickel (Ni)	ppm	28.5 ±32.0	16.9 ±19.2	7.02 ±8.44	8.35 ±19.7	75
Scandium (Sc)	ppm	6.04 ±5.85	3.79 ±2.73	2.84 ±2.84	4.64 ±4.73	22
Selenium (Se)	ppm	3.11 ±2.58	3.39 ±4.00	1.44 ±1.42	2.70 ±3.67	0.05
Silver (Ag)	ppm	0.13 ±0.10	0.08 ±0.15	0.61 ±1.54	0.20 ±0.07	0.07
Strontium (Sr)	ppm	73.7 ±77.0	88.1 ±95.0	171 ±184	309 ±258	375
Thorium (Th)	ppm	6.09 ±2.92	3.03 ±3.15	5.13 ±4.64	7.13 ±5.70	9.6
Uranium (U)	ppm	1.94 ±3.38	1.85 ±2.71	2.13 ±3.84	3.39 ±10.3	2.7
Vanadium (V)	ppm	37.8 ±33.1	22.3 ±19.7	23.9 ±30.6	29.1 ±37.3	135
Ytterbium (Yb)	ppm	1.00 ±0.67	0.94 ±0.65	0.77 ±0.85	1.43 ±1.92	3
Yttrium (Y)	ppm	10.3 ±5.24	8.35 ±6.36	7.73 ±7.97	12.8 ±16.5	33
Zinc (Zn)	ppm	12.6 ±14.5	92.4 ±689	17.4 ±21.1	22.5 ±79.8	70
Zirconium (Zr)	ppm	39.1 ±23.6	24.7 ±16.5	25.7 ±27.4	42.1 ±62.1	165

[a]Whole-coal basis; mean ± standard deviation.
[b]Average elemental concentration in crustal rocks, Reference 2, Section 1.

TABLE 8. SULFUR, ASH, AND TRACE ELEMENTS IN U.S. COALS BY PROVINCE[a]

	Units	Appalacian	Interior	Gulf	Northern Great Plains	Rocky Mountain	Alaska
No. of Samples		2749	592	38	371	512	107
Sulfur (S), total	%	2.13 ±1.90	3.83 ±2.42	0.88 ±0.42	0.83 ±0.88	0.58 ±0.47	0.44 ±0.79
Sulfur (S), sulfate	%	0.08 ±0.18	0.39 ±0.40	0.09 ±0.14	0.07 ±0.14	0.03 ±0.07	0.02 ±0.0[illegible]
Sulfur (S), pyritic	%	1.45 ±1.75	2.12 ±2.0[illegible]	0.14 ±0.14	0.38 ±0.69	0.12 ±0.15	0.09 ±0.14
Sulfur (S), organic	%	0.84 ±0.58	1.33 ±0.63	0.74 ±0.26	0.43 ±0.38	0.42 ±0.20	0.30 ±0.28
Ash	%	12.5 ±9.50	12.8 ±7.27	17.9 ±10.5	11.4 ±12.5	16.6 ±16.0	15.5 ±12.5
Silicon (Si)	%	5.46 ±1.33	4.06 ±1.57	7.07 ±2.63	3.03 ±1.60	7.57 ±2.37	5.75 ±2.08
Aluminum (Al)	%	3.10 ±0.76	1.89 ±0.87	3.31 ±0.98	1.51 ±0.56	3.26 ±1.14	3.13 ±0.90
Calcium (Ca)	%	0.26 ±0.30	0.88 ±0.90	1.56 ±1.00	2.01 ±0.97	1.45 ±1.21	1.86 ±1.22
Magnesium (Mg)	%	0.10 ±0.06	0.12 ±0.13	0.37 ±0.23	0.57 ±0.32	0.31 ±0.28	0.42 ±0.26
Sodium (Na)	%	0.06 ±0.05	0.06 ±0.07	0.06 ±0.05	0.32 ±0.35	0.15 ±0.19	0.20 ±0.24
Potassium (K)	%	0.24 ±0.12	0.19 ±0.09	0.09 ±0.08	0.06 ±0.06	0.11 ±0.11	0.22 ±0.17
Iron (Fe)	%	2.24 ±1.79	3.49 ±1.89	1.13 ±1.07	0.89 ±0.92	0.99 ±0.76	0.91 ±0.54
Manganese (Mn)	%	0.01 ±0.01	0.01 ±0.03	0.03 ±0.01	0.01 ±0.01	0.01 ±0.02	0.02 ±0.02
Titanium (Ti)	%	0.15 ±0.0[illegible]	0.09 ±0.04	0.25 ±0.11	0.10 ±0.05	0.16 ±0.06	0.18 ±0.14
Phosphorus (P)	%	0.04 ±0.07	0.05 ±0.07	0.03 ±0.01	0.10 ±0.11	0.18 ±0.23	0.22 ±0.20
Antimony (Sb)	ppm	1.19 ±2.34	1.58 ±2.20	1.05 ±0.86	0.55 ±0.71	0.79 ±1.47	1.24 ±1.39
Arsenic (As)	ppm	22.2 ±45.5	16.3 ±23.0	4.74 ±3.53	6.33 ±[illegible]5.3	4.72 ±12.3	5.25 ±4.45
Barium (Ba)	ppm	74.5 ±66.6	70.0 ±232	161 ±132	443 ±427	353 ±1019	534 ±292
Beryllium (Be)	ppm	2.27 ±1.68	2.29 ±1.60	2.05 ±2.85	1.23 ±1.86	1.37 ±1.72	0.78 ±0.74
Boron (B)	ppm	29.1 ±31.1	78.1 ±60.4	151 ±85.6	70.5 ±54.0	60.1 ±48.6	39.7 ±31.1
Cadmium (Cd)	ppm	0.13 ±0.21	5.47 ±18.5	0.50 ±0.49	0.30 ±0.48	0.35 ±0.39	0.28 ±0.59
Chromium (Cr)	ppm	18.2 ±13.6	27.2 ±54.1	21.2 ±10.9	7.53 ±12.9	19.7 ±27.4	39.7 ±46.9
Cobalt (Co)	ppm	7.52 ±19.7	16.7 ±37.8	5.57 ±6.02	3.13 ±5.17	11.1 ±23.8	19.1 ±29.8
Copper (Cu)	ppm	18.2 ±18.2	17.5 ±14.6	26.5 ±16.1	9.82 ±10.2	13.8 ±16.0	20.1 ±16.6
Fluorine (F)	ppm	89.9 ±108	77.4 ±74.6	67.8 ±50.4	76.2 ±123	123 ±205	84.4 ±72.9
Gallium (Ga)	ppm	6.27 ±4.56	4.99 ±3.45	9.52 ±5.57	3.37 ±5.22	5.95 ±6.50	5.15 ±4.76
Germanium (Ge)	ppm	3.98 ±6.30	17.1 ±16.1	7.81 ±7.75	4.89 ±3.79	7.11 ±8.60	6.24 ±6.05

(Continued)

TABLE 8. (Continued)

	Units	Appalacian	Interior	Gulf	Northern Great Plains	Rocky Mountain	Alaska
Lanthanum (La)	ppm	10.8 ±8.0	10.2 ±11.7	36.4 ±27.9	10.7 ±10.6	13.8 ±13.1	12.7 ±8.3
Lead (Pb)	ppm	8.93 ±9.42	10.5 ±18.9	14.4 ±13.0	6.39 ±10.1	11.8 ±12.8	13.7 ±24.1
Mercury (Hg)	ppm	0.24 ±0.47	0.14 ±0.14	0.24 ±0.19	0.11 ±0.10	0.09 ±0.12	0.08 ±0.07
Molybdenum (Mo)	ppm	3.03 ±3.51	4.97 ±6.15	3.24 ±2.04	2.70 ±15.3	2.09 ±2.53	2.75 ±4.66
Nickel (Ni)	ppm	15.4 ±14.7	26.7 ±32.6	14.0 ±13.0	5.33 ±9.67	6.71 ±8.19	11.2 ±8.8
Scandium (Sc)	ppm	4.00 ±2.77	3.09 ±2.42	6.58 ±2.54	2.06 ±2.27	2.96 ±2.88	4.57 ±3.56
Selenium (Se)	ppm	3.56 ±4.03	3.37 ±4.33	8.14 ±3.49	0.98 ±1.25	1.73 ±1.20	0.96 ±1.43
Silver (Ag)	ppm	0.06 ±0.06	0.20 ±0.32	0.18 ±0.07	0.32 ±0.24	1.02 ±1.45	0.90 ±2.18
Strontium (Sr)	ppm	93.2 ±92.3	44.0 ±78.6	119 ±113	242 ±196	154 ±208	169 ±103
Thorium (Th)	ppm	2.98 ±2.33	3.73 ±6.60	8.96 ±6.33	4.30 ±3.74	5.13 ±4.65	3.49 ±2.54
Uranium (U)	ppm	1.66 ±1.87	2.98 ±5.07	3.07 ±2.64	1.59 ±2.24	2.40 ±4.40	1.28 ±1.43
Vanadium (V)	ppm	22.4 ±18.0	22.8 ±22.2	48.8 ±25.8	14.8 ±26.9	20.7 ±23.3	50.3 ±47.1
Ytterbium (Yb)	ppm	0.96 ±0.63	0.83 ±0.80	1.67 ±0.94	0.61 ±0.97	0.89 ±1.09	0.98 ±0.79
Yttrium (Y)	ppm	8.22 ±5.83	8.76 ±7.87	16.2 ±11.1	6.07 ±8.37	9.41 ±10.2	8.95 ±6.99
Zinc (Zn)	ppm	22.9 ±43.6	442 ±1638	18.7 ±32.3	15.9 ±20.7	16.0 ±21.1	17.5 ±24.4
Zirconium (Zr)	ppm	25.6 ±27.7	18.5 ±17.9	49.3 ±46.0	17.7 ±23.7	34.9 ±40.8	29.0 ±27.5

*Whole-coal basis; mean ± standard deviation.

TABLE 9. SULFUR, ASH, AND TRACE ELEMENTS IN U.S. BITUMINOUS COAL BY FORMATION/REGION*

	Units	Pottsville Group	Allegheny Formation	Monongahela Formation	Illinois Basin	Western Interior	Rocky Mountain
No. of Samples		1111	1005	341	275	305	184
Sulfur (S), total	%	1.19 ±0.96	2.64 ±2.28	3.09 ±1.38	3.21 ±1.53	4.40 ±2.85	0.66 ±0.61
Sulfur (S), sulfate	%	0.04 ±0.07	0.11 ±0.23	0.10 ±0.13	0.33 ±0.32	0.45 ±0.44	0.03 ±0.04
Sulfur (S), pyritic	%	0.64 ±0.87	1.80 ±2.13	1.89 ±1.15	1.48 ±1.15	2.66 ±2.45	0.12 ±0.17
Sulfur (S), organic	%	0.65 ±0.28	0.88 ±0.69	1.21 ±0.60	1.41 ±0.70	1.28 ±0.70	0.47 ±0.19
Ash	%	9.39 ±6.72	14.7 ±11.8	12.9 ±6.74	10.9 ±5.76	14.3 ±7.27	11.8 ±7.17
Silicon (Si)	%	4.34 ±0.95	6.13 ±1.58	5.41 ±1.26	4.13 ±1.18	3.72 ±1.53	5.34 ±1.47
Aluminum (Al)	%	2.51 ±0.52	3.57 ±0.88	2.67 ±0.56	1.94 ±0.64	1.69 ±0.89	2.32 ±0.81
Calcium (Ca)	%	0.21 ±0.23	0.30 ±0.34	0.32 ±0.37	0.46 ±0.52	1.35 ±1.12	1.09 ±0.64
Magnesium (Mg)	%	0.09 ±0.04	0.10 ±0.04	0.11 ±0.11	0.08 ±0.03	0.17 ±0.20	0.20 ±0.16
Sodium (Na)	%	0.06 ±0.05	0.05 ±0.04	0.05 ±0.03	0.06 ±0.06	0.05 ±0.06	0.13 ±0.16
Potassium (K)	%	0.19 ±0.10	0.28 ±0.14	0.23 ±0.08	0.18 ±0.08	0.19 ±0.09	0.07 ±0.06
Iron (Fe)	%	1.15 ±1.07	3.18 ±2.24	3.10 ±1.50	2.65 ±1.59	4.35 ±2.06	0.68 ±0.45
Manganese (Mn)	%	0.01 ±0.01	0.01 ±0.01	0.01 ±0.01	0.01 ±0.01	0.02 ±0.05	0.01 ±0.01
Titanium (Ti)	%	0.13 ±0.05	0.17 ±0.07	0.13 ±0.03	0.09 ±0.03	0.08 ±0.04	0.11 ±0.05
Phosphorus (P)	%	0.03 ±0.06	0.05 ±0.09	0.05 ±0.06	0.03 ±0.05	0.10 ±0.08	0.14 ±0.17
Antimony (Sb)	ppm	1.19 ±1.59	1.44 ±3.28	0.58 ±0.56	1.29 ±1.55	1.87 ±2.68	0.43 ±.71
Arsenic (As)	ppm	16.7 ±29.9	29.2 ±63.9	20.7 ±28.7	11.9 ±13.6	20.3 ±28.9	1.82 ±5.08
Barium (Ba)	ppm	85.8 ±73.5	61.2 ±59.3	66.9 ±50.0	73.7 ±242	67.1 ±225	183 ±156
Beryllium (Be)	ppm	2.49 ±2.02	2.33 ±1.44	1.51 ±0.98	2.82 ±1.66	1.78 ±1.29	0.95 ±0.85
Boron (B)	ppm	18.9 ±17.7	31.0 ±33.2	50.1 ±29.4	123 ±56.4	66.6 ±56.1	64.1 ±56.4
Cadmium (Cd)	ppm	0.11 ±0.12	0.15 ±0.20	0.10 ±0.13	1.35 ±7.17	11.8 ±26.8	0.18 ±0.15
Chromium (Cr)	ppm	14.2 ±10.6	21.1 ±14.5	16.6 ±10.3	15.2 ±16.3	36.9 ±70.8	25.7 ±37.1
Cobalt (Co)	ppm	7.07 ±4.88	7.69 ±11.8	4.53 ±5.29	5.89 ±5.37	25.1 ±47.2	14.8 ±22.2
Copper (Cu)	ppm	21.1 ±17.2	19.2 ±20.7	8.41 ±11.0	12.9 ±10.1	21.4 ±16.4	8.54 ±5.60
Fluorine (F)	ppm	80.1 ±119	97.9 ±106	93.6 ±101	57.8 ±49.9	75.9 ±55.7	102 ±109
Gallium (Ga)	ppm	5.16 ±3.88	7.38 ±5.09	5.13 ±3.30	4.43 ±2.43	5.55 ±3.75	4.21 ±3.34
Germanium (Ge)	ppm	2.63 ±3.86	5.24 ±8.05	3.63 ±4.56	13.6 ±12.7	20.4 ±18.1	4.19 ±4.45

(Continued)

TABLE 9. (Continued)

	Units	Pottsville Group	Allegheny Formation	Monongahela Formation	Illinois Basin	Western Interior	Rocky Mountain
Lanthanum (La)	ppm	10.2 ±7.17	11.7 ±9.04	7.94 ±5.11	7.41 ±7.55	19.4 ±13.6	19.4 ±13.6
Lead (Pb)	ppm	7.12 ±6.33	11.6 ±12.4	6.13 ±5.70	21.0 ±38.2	61.4 ±63.8	5.57 ±6.63
Lithium (Li)	ppm	18.6 ±20.1	26.5 ±33.2	18.2 ±16.7	11.5 ±23.2	8.79 ±9.87	10.3 ±9.86
Mercury (Hg)	ppm	0.14 ±0.16	0.36 ±0.71	0.19 ±0.15	0.11 ±0.09	0.17 ±0.16	0.06 ±0.09
Molybdenum (Mo)	ppm	2.39 ±3.22	3.78 ±3.70	2.38 ±2.58	4.49 ±5.89	5.51 ±6.41	1.12 ±0.67
Nickel (Ni)	ppm	13.3 ±12.5	18.8 ±18.1	10.9 ±8.41	23.4 ±34.9	29.0 ±28.5	6.09 ±9.21
Scandium (Sc)	ppm	3.38 ±2.23	4.65 ±3.18	3.23 ±2.08	2.91 ±1.67	3.15 ±2.24	2.13 ±1.70
Selenium (Se)	ppm	3.16 ±2.03	4.23 ±5.70	2.17 ±1.37	2.72 ±1.92	4.01 ±5.75	1.56 ±0.93
Silver (Ag)	ppm	0.05 ±0.05	0.07 ±0.07	0.04 ±0.04	0.09 ±0.12	0.36 ±0.44	1.29 ±1.58
Strontium (Sr)	ppm	98.0 ±88.5	88.0 ±90.0	85.0 ±88.8	37.3 ±47.4	50.0 ±98.7	127 ±115
Thorium (Th)	ppm	2.85 ±2.25	3.21 ±2.57	2.19 ±1.38	2.18 ±2.22	5.76 ±9.67	3.06 ±2.22
Uranium (U)	ppm	1.65 ±1.69	1.73 ±2.01	1.50 ±2.09	1.98 ±2.91	3.76 ±6.20	1.32 ±3.23
Vanadium (V)	ppm	19.8 ±15.6	24.6 ±20.3	18.5 ±13.1	19.9 ±15.9	24.9 ±25.3	12.2 ±10.2
Ytterbium (Yb)	ppm	0.87 ±0.56	1.11 ±0.70	0.69 ±0.46	0.66 ±0.46	1.05 ±0.74	0.66 ±0.56
Yttrium (Y)	ppm	7.80 ±5.58	9.03 ±6.36	5.93 ±3.87	6.50 ±4.41	10.4 ±7.83	7.62 ±8.18
Zinc (Zn)	ppm	13.6 ±20.2	34.4 ±55.4	16.3 ±14.5	130 ±561	731 ±2172	11.0 ±14.7
Zirconium (Zr)	ppm	20.4 ±20.9	27.3 ±30.5	27.5 ±30.3	23.9 ±21.8	13.4 ±10.2	26.0 ±18.6

[a]whole coal basis

K-25 Coal

for Jennifer L. C.
0-571-1547
From Milton S.
423-576-6475
p. 1 of 6

DJ-27

"Pesce" ref for Section 3
Nick 1995

Pesce 1995.
Pesci 1996 (App A)
Nick Pesce.

HISTORICAL INVESTIGATION
SPECIAL REPORT S/R 7

TABULATION OF LIFETIME COAL CONSUMPTION
K-701 Power Station / Boiler House

INTRODUCTION:

The K-25 Environmental Restoration Department (Mr. Milton Stanley) requested a search of documents that would record the lifetime coal consumption by the K-701 Boiler House operations. The period of concern spans from May, 1944 (start of operations) through October, 1962 (shutdown of Power Station). An easy request turned out to require more time to answer than first expected. Former employees having knowledge of the power station operations all stated that continuing records of coal consumption and coal analyses were maintained in the power station administrative offices. However, after the power station shutdown, the records may have been stored in another depository or could have been destroyed, but no definitive answer could be found.

Eventually, with the help of John Arrowood and Gentry Hunt, equivalent data were found in the K-25 Plant monthly and quarterly reports, which are to be found in the K-1034 Plant Records Vault and in the K-1002 Library.

DISCUSSION:

The K-25 Environmental Restoration Division requested data related to the lifetime consumption of coal used in the K-701 Power Production / Boiler House facility. The subject facility operated from May 1944 through its shutdown on October 31, 1962. Thereafter, the TVA supplied power to the K-25 complex.

The requested data were found in monthly and quarterly reports prepared by the Oak Ridge Gaseous Diffusion Plant operations, and which are detailed on the attached summation.

CONTACTS/INFORMATION RESOURCES:

John Arrowood, K-25 Central Library, K-1002, 4-9696
Retrieved quarterly and monthly reports retained in the Library.

Gentry Hunt, K-25 Information Services, K-1001, 4-8263
Retrieved monthly reports retained in the K-1034 Records Vault.

Mary Ross, Manager, Central Accounting, 4-9471
Identified Bill Watson as a good information source.

Bill Watson, retired, Powell, TN 947-7658
Former member of Central Accounting. Bill deciphered the Users Code that appears in the referenced reports.

Coal Consumption, S/R 7

Doug Janney, Electrical Engineering Specialist, 4-9448

One time manager of Power Station / Electrical Operations. Provided general information regarding power generation operations and usage of different fuels. He recounted the periods of partial shutdown of the power plant for scheduled routine equipment maintenance. Suggested contacts with J. C. Elrod and T. C. Wilson.

J. C. Elrod, retired, Oak Ridge, TN, 483-5509

Formerly associated with Power Operations (1944 - 1962). Transferred to X-10 in 1963, in charge of Utilities Operations. He remembered when the power station converted to gas operation in conjunction with the East Tennessee Natural Gas Co. (ETNG) -- 20-year contract with the government. The government's contract flow rate of approximately 85,000 MCF/day was about 90% of ETNG system flow. Elrod recalled that records of power station operations were maintained in Bldg. K-703. When the station was shut down, the records were probably relocated. He has no idea where they may be, if they still exist. Elrod suggested contact with T. C. Wilson.

Jim Dalton, Power and Utilities, 4-3003

Jim is not aware of the existence of the coal consumption records. He offered to check with his staff. Jim suggested contacts with J. C. Elrod and T. C. Wilson.

T. C. Wilson, retired, Farragut, TN, 671-2500

Mechanical Engineer, graduate of Clemson University. Lifetime associate of power station operations on the mechanical side of the house. T. C. Wilson displayed a fountain of knowledge with regard to the power station operations, fuel usage, problems and solutions. T. C. has a very engaging personality, and shows an in-depth knowledge of general power operations and problem solving. T. C. Wilson stated he has served as an expert witness in court cases involving power production operations. His recall of the K-25 Power Station operations with focus on specific problems and their resolution is most impressive. T. C. is a very good information resource.

TABULATION OF LIFETIME COAL CONSUMPTION

K-701 POWER STATION / BOILER HOUSE (1)

REPORT NUMBER	PERIOD COVERED	TONS USED DURING PERIOD (2)	CUMULATIVE CONSUMPTION	OTHER FUELS USED (3) REMARKS
KZ-6822, PT 1	Jan. 1944	0.00	0.00	
KZ-6822, PT 2	Feb. 1944	0.00	0.00	
KZ-6822, PT3	Mar. 1944	0.00	0.00	
KZ-6822, PT 4	Apr. 1944	0.00	0.00	
KZ-6822, PT 5	May. 1944	3071.74	3,071.74	#3 Fuel Oil - 143076 gal.
KZ-6822, PT 6	Jun. 1944	6906.26	9,978.00	#3 Fuel Oil - 173300 gal.
KZ-6822, PT 7	Jul. 1944	9271.06	19,249.06	#3 Fuel Oil - 158684 gal.
KZ-6822, PT 8	Aug. 1944	13111.60	32,360.66	#3 Fuel Oil - 35040 gal.
KZ-6822, PT 9	Sep. 1944	14202.10	46,562.76	#3 Fuel Oil - 69961 gal.
KZ-6822, PT 10	Oct. 1944	19644.14	66,206.90	#3 Fuel Oil - 27352 gal.
KZ-6822, PT 11	Nov. 1944	31999.18	98,206.08	#3 Fuel Oil - 28802 gal.
KZ-6822, PT 12	Dec. 1944	34706.30	132,912.38	#3 Fuel Oil - 25581 gal.
KZ-6823, PT 1	Jan. 1945	37167.71	170,080.09	#3 Fuel Oil - 49209 gal.
KZ-6823, PT 2	Feb. 1945	51418.39	221,498.48	#3 Fuel Oil - 9860 gal.
KZ-6823, PT 3	Mar. 1945	57918.62	279,417.10	#3 Fuel Oil - 16790 gal.
KZ-6823, PT 4	Apr. 1945	64808.66	344,225.76	#3 Fuel Oil - 19650 gal.
KZ-6823, PT 5	May. 1945	64260.24	408,486.00	#3 Fuel Oil - 13660 gal.
KZ-6823, PT 6	Jun. 1945	72962.23	481,448.23	#3 Fuel Oil - 2950 gal.
KZ-6823, PT 7	Jul. 1945	54713.04	536,161.27	#3 Fuel Oil - 19603 gal.
KZ-6823, PT 8	Aug. 1945	73922.51	610,083.78	#3 Fuel Oil - 17100 gal.
KZ-6823, PT 9	Sep. 1945	62194.05	672,277.83	#3 Fuel Oil - 0 gal.
KZ-6823, PT 10	Oct. 1945	52088.00	724,365.83	#3 Fuel Oil - 16192 gal.
KZ-6823, PT 11	Nov. 1945	61530.00	785,895.83	#3 Fuel Oil - 3375 gal.
KZ-6823, PT 12	Dec. 1945	62002.00	847,897.83	#3 Fuel Oil - 5500 gal.
KZ-6824, PT 1	Jan. 1946	52467.40	900,365.23	#3 Fuel Oil - 22670 gal.
KZ-6824, PT 2	Feb. 1946	46054.90	946,420.13	#3 Fuel Oil - 22550 gal.
KZ-6824, PT 3	Mar. 1946	48831.60	995,251.73	#3 Fuel Oil - 10700 gal.
KZ-6824, PT 4	Apr. 1946	49843.20	1,045,094.93	#3 Fuel Oil - 39935 gal.
KZ-6824, PT 5	May. 1946	49192.60	1,094,287.53	#3 Fuel Oil - 6890 gal.
KZ-6824, PT 6	Jun. 1946	40820.20	1,135,107.73	#3 Fuel Oil - 12800 gal.
KZ-6824, PT 7	Jul. 1946	51238.90	1,186,346.63	#3 Fuel Oil - 7100 gal.
KZ-6824, PT 8	Aug. 1946	57140.00	1,243,486.63	#3 Fuel Oil - 6178 gal.
KZ-6824, PT 9	Sep. 1946	53607.70	1,297,094.33	#3 Fuel Oil - 4650 gal., Bunker C oil - 730580 gal.

(1) Tabulated data obtained from plant monthly and/or quarterly reports

User Code: MR

Stores Symbol: S2R

(2) Coal classification -- Bituminous. Average ash content about 20%

(3) Oil data presented for information only - not essential part of subject tabulation. Oil data provides partial explanation for variations in coal consumption. Bunker C oil supplemented coal and gas as a boiler fuel. #3 Fuel Oil served primarily as an ignition fuel, and when needed, subsidized the burning of coal. Other factors are scheduled equipment unit shutdowns for maintenance operations.

KZ-6824, PT 10	Oct. 1946	52896.80	1,349,991.13	#3 Fuel Oil - 3700 gal., Bunker C oil - 0
KZ-6824, PT 11	Nov. 1946	51284.70	1,401,275.83	#3 Fuel Oil - 8200 gal., Bunker C oil - 0
KZ-6824, PT 12	Dec. 1946	50572.80	1,451,848.63	#3 Fuel Oil - 7000 gal. , Bunker C oil - 10722 gal.
KZ-6825, PT 1	Jan. 1947	54438.50	1,506,287.13	#3 Fuel Oil - 8500 gal., Bunker C oil - 4703 gal.
KZ-6825, PT 2	Feb. 1947	45910.40	1,552,197.53	#3 Fuel Oil - 0 gal., Bunker C oil - 25273 gal.
KZ-6825, PT 3	Mar. 1947	55507.40	1,607,704.93	#3 Fuel Oil - 21300 gal., Bunker C oil - 1700 gal.
KZ-6825, PT 4	Apr. 1947	56416.50	1,664,121.43	#3 Fuel Oil - 3800 gal., Bunker C oil - 35325 gal.
KZ-6825, PT 5	May. 1947	51419.10	1,715,540.53	#3 Fuel Oil - 1100 gal., Bunker C oil - 3000 gal.
KZ-6825, PT 6	Jun. 1947	49374.10	1,764,914.63	#3 Fuel Oil - 9400 gal., Bunker C oil - 101390 gal.
KZ-6825, PT 7	Jul. 1947	58051.80	1,822,966.43	#3 Fuel Oil - 17800 gal., Bunker C oil - 0
KZ-6825, PT 8	Aug. 1947	68864.30	1,891,830.73	#3 Fuel Oil - 3050 gal., Bunker C oil - 0
K-10, Part 1	Sep. 1947	59914.10	1,951,744.83	#3 Fuel Oil - 1550 gal., Bunker C oil - 0
K-10, Part 2	Oct. 1947	49472.53	2,001,217.36	#3 Fuel Oil - 4500 gal., Bunker C oil - 177185 gal.
K-10, Part 3	Nov. 1947	70288.20	2,071,505.56	#3 Fuel Oil - 0 gal., Bunker C oil - 0 gal., Coal for TVA 20982 tons.
K-10, Part 4	Dec. 1947	30107.80	2,101,613.36	#3 Fuel Oil - 0 gal., Bunker C oil - 0, Coal for TVA 1497.1 tons
K-10, Part 5	Jan. 1948	58724.99	2,160,338.35	#3 Fuel Oil - 300 gal., Bunker C oil - 0, coal for TVA 8596.01 tons
K-158, Part 2	Feb. 1948	65008.80	2,225,347.15	#3 Fuel Oil - 5000 gal., Bunker C oil - 124183 gal.
K-158, Part 3	Mar. 1948	52993.90	2,278,341.05	#3 Fuel Oil - 0 gal.
K-158, Part 4	Apr. 1948	53597.90	2,331,938.95	#3 Fuel Oil - 21200 gal., Bunker C oil - 11400 gal.
K-158, Part 5	May. 1948	50420.50	2,382,359.45	#3 Fuel Oil - 12800 gal., Bunker C oil - 170400 gal.
K-158, Part 6	Jun. 1948	61180.90	2,443,540.35	#3 Fuel Oil - 8050 gal., Bunker C oil - 0
K-252, Part 1	Jul. 1948	71464.50	2,515,004.85	#3 Fuel Oil - 0 gal., Bunker C oil - 0
K-252, Part 2	Aug. 1948	59666.20	2,574,671.05	#3 Fuel Oil - 9050 gal., Bunker C oil - 0
K-252, Part 4	Sep. 1948	64384.30	2,639,055.35	#3 Fuel Oil - 0 gal., Bunker C oil - 0
K-384	10/1/48 – 12/31/48	185691.00	2,824,746.35	Bunker C Oil = 92,800 gal.

K-384	1/1/49 – 3/31/49	184122.00	3,008,868.35	Bunker C Oil = 23,000 gal.
K-464	4/1/49 – 6/30/49	163490.00	3,172,358.35	#3 Fuel Oil , Bunker C oil = 20,600 gal
K-520	7/1/49 – 9/30/49	166315.00	3,338,673.35	#3 Fuel Oil = 25,700 gal.
K-560	10/1/49 – 12/31/49	116064.00	3,454,737.35	#3 Fuel Oil = 17,400 gal. Installation of gas consumption equipment completed during December.
K-600	1/1/50 – 3/31/50	17035.00	3,471,772.35	Boiler fuel changed to gas. Partial operation with pulverized coal due to gas supply problems; gas line strainer screens became plugged.
K-636	4/1/50 – 6/30/50	569.00	3,472,341.35	#3 Fuel Oil= 9000 gal.
K-638	7/1/50 – 9/30/50	240.00	3,472,581.35	#3 Fuel Oil= 41,100 gal.
K-638	10/1/50 – 12/31/50	27428.00	3,500,009.35	#3 Fuel Oil = 0 gal.
K-639	1/1/51 – 3/31/51	59841.00	3,559,850.35	#3 Fuel Oil = 0 gal.
K-640	4/1/51 – 6/30/51	33320.00	3,593,170.35	#3 Fuel Oil = 24,300 gal.
K-800	7/1/51 – 9/30/51	24199.00	3,617,369.35	#3 Fuel Oil = 14,400 gal.
K-801	10/1/51 – 12/31/51	11606.00	3,628,975.35	#3 Fuel Oil = 6,150 gal.
K-802	1/1/52 – 3/31/52	9533.00	3,638,508.35	#3 Fuel Oil = 3,100 gal.
K-803	4/1/52 – 6/30/52	1347.00	3,639,855.35	#3 Fuel Oil = 2,450 gal.
K-958	7/1/52 – 9/30/52	0.00	3,639,855.35	#3 Fuel oil - 0 gal.
K-959	10/1/52 – 12/31/52	0.00	3,639,855.35	#3 Fuel Oil = 10,800 gal.
K-960	1/1/53 – 3/31/53	44930.00	3,684,785.35	#3 Fuel Oil = 6,200 gal.
K-961	4/1/53 – 6/30/53	9383.00	3,694,168.35	#3 Fuel Oil = 1,450 gal. Bunker C oil - 315,313: supply depleted
K-1050	7/1/53 – 9/30/53	0.00	3,694,168.35	#3 Fuel Oil - 0 gal.
K-1051	10/1/53 – 12/31/53	41839.00	3,736,007.35	#3 Fuel Oil = 1,300 gal.
K-1052	1/1/54 – 3/31/54	65378.00	3,801,385.35	#3 Fuel Oil = 0 gal.
K-1053	4/1/54 – 6/30/54	7601.00	3,808,986.35	#3 Fuel Oil = 0 gal.
K-1150	7/1/54 – 9/30/54	419.00	3,809,405.35	#3 Fuel Oil = 0 gal.
K-1151	10/1/54 – 12/31/54	56860.00	3,866,265.35	#3 Fuel Oil = 0 gal.
K-1152	1/1/55 – 3/31/55	56294.00	3,922,559.35	#3 Fuel Oil = 0 gal.
K-1153	4/1/55 – 6/30/55	3294.00	3,925,853.35	#3 Fuel Oil = 0 gal.
K-1250	7/1/55 – 9/30/55	41.00	3,925,894.35	#3 Fuel Oil = 0 gal.
K-1251	10/1/55 – 12/31/55	68666.00	3,994,560.35	#3 Fuel Oil = 0 gal.
K-1252	1/1/56 – 3/31/56	49540.00	4,044,100.35	#3 Fuel Oil = 0 gal.
K-1253	4/1/56 – 6/30/56	0.00	4,044,100.35	#3 Fuel Oil = 0 gal.
K-1350	7/1/56 – 9/30/56	0.00	4,044,100.35	#3 Fuel Oil = 0 gal.
K-1351	10/1/56 – 12/31/56	41222.00	4,085,322.35	#3 Fuel Oil = 0 gal.
K-1352	1/1/57 – 3/31/57	84674.00	4,169,996.35	#3 Fuel Oil = 0 gal.
K-1353	4/1/57 – 6/30/57	9413.00	4,179,409.35	#3 Fuel Oil = 0 gal.
K-1360	7/1/57 – 9/30/57	39.00	4,179,448.35	#3 Fuel Oil = 0 gal.
K-1361	10/1/57 – 12/31/57	13778.00	4,193,226.35	#3 Fuel Oil = 0 gal. Gas usage significantly dropped.
K-1362	1/1/58 – 3/31/58	66323.00	4,259,549.35	#3 Fuel Oil = 0 gal.
K-1363	4/1/58 – 6/30/58	13116.00	4,272,665.35	#3 Fuel Oil = 0 gal.
K-1410	7/1/58 – 9/30/58	4393.00	4,277,058.35	#3 Fuel Oil = 0 gal.

K-1411	10/1/58 – 12/31/58	146841.00	4,423,899.35	#3 Fuel Oil = 0 gal.
K-1412	1/1/59 – 3/31/59	195267.00	4,619,166.35	#3 Fuel Oil = 0 gal.
K-1413	4/1/59 – 6/30/59	101293.00	4,720,459.35	#3 Fuel Oil = 0 gal.
K-1450	7/1/59 – 9/30/59	90489.00	4,810,948.35	#3 Fuel Oil = 0 gal.
K-1451	10/1/59 – 12/31/59	168780.00	4,979,728.35	#3 Fuel Oil = 0 gal.
K-1452	1/1/60 – 3/31/60	213018.00	5,192,746.35	#3 Fuel Oil = 0 gal. Gas consumption drastically reduced.
K-1453	4/1/60 – 6/30/60	100526.00	5,293,272.35	#3 Fuel Oil = 0 gal. Electric facility transferred to city of Oak Ridge.
K-1500	7/1/60 – 9/30/60	61175.00	5,354,447.35	#3 Fuel Oil = 0 gal. Gas consumption drastically reduced.
K-1501	10/1/60 – 12/31/60	170940.00	5,525,387.35	#3 Fuel Oil = 0 gal.
K-1502	1/1/61 – 3/31/61	201344.00	5,726,731.35	#3 Fuel Oil = 0 gal.
K-1503	4/1/61 – 6/30/61	88350.00	5,815,081.35	#3 Fuel Oil = 0 gal.
K-1504	7/1/61 – 9/30/61	0.00	5,815,081.35	#3 Fuel Oil = 0 gal. Natural gas usage low.
K-1505	10/1/61 – 12/31/61	58145.00	5,873,226.35	#3 Fuel Oil = 0 gal. Operated at one boiler level
K-1506	1/1/62 – 3/31/62	82616.00	5,955,842.35	#3 Fuel Oil = 0 gal.
K-1507	4/1/62 – 6/30/62	9341.00	5,965,183.35	#3 Fuel Oil = 0 gal.
K-1600	7/1/62 – 9/30/62	0.00		One boiler on natural gas entirely.
K-1601	10/1/62 – 12/31/62			#3 Fuel Oil = 0 gal. Scheduled shutdown of power station at 11:30 pm, Oct. 31, 1962. One boiler on natural gas. Thereafter, all power, regular or emergency, supplied by TVA.
		TOTAL, IN TONS	5,965,183.35	

May 1944 → June 1962
5.97 million tons of coal burned