INNOVATIVE COKE OVEN GAS CLEANING SYSTEM

FOR

RETROFIT APPLICATIONS

ENVIRONMENTAL MONITORING PROGRAM

BASELINE SAMPLING PROGRAM REPORT

VOLUME 1 - SAMPLING PROGRAM REPORT

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LIST OF ACRONYMS AND ABBREVIATIONS

BSC ..... Bethlehem Steel Corporation
DOE ..... U. S. Department of Energy
CCT ..... Clean Coal Technology
EMP ..... Environmental Monitoring Plan
MDE ..... Maryland Department of Environment
OSHA ..... Occupational Safety and Health Administration

NESHAP .... National Emission Standards for Hazardous Air Pollutants
NPDES ..... National Pollutant Discharge Elimination Standards
BRWWTP .... Back River Waste Water Treatment Plant
CPWWTP .... Coke Plant Waste Water Treatment Plant
QA/QC ..... Quality Assurance/Quality Control

MOSHA ..... Maryland Occupational Safety and Health Adminstration
PEL ..... Permissible Exposure Limit
COG ..... Coke Oven Gas
BF ..... Blast Furnace
OBS ..... Observation Number

gpm ..... Gallons per Minute
ppm ..... Parts per Million
mg/l ..... Milligrams per Liter
TSS ..... Total Suspended Solids
TDS ..... Total Dissolved Solids

CO2 ..... Carbon Dioxide
Oxy ..... Oxygen
SO2 ..... Sulfur Dioxide
Cl ..... Chloride
NH3 ..... Ammonia

SO4 ..... Sulfate
H2S ..... Hydrogen Sulfide
NaOH ..... Sodium Hydroxide
NO3-N ..... Nitrate - Nitrogen
NO2-N ..... Nitrite - Nitrogen

NOX ..... all Nitrogen Oxides - expressed as NO2
H2 ..... Hydrogen
Comb ..... Combustables in gas stream measured as a mix of CO and H2 calibrated against a standard flue gas containing 6.4% combustibles(2.9%H2 and 3.5%CO)
ExAir ..... Excess Air

Phenol4AAP. phenol concentration as analyzed by the Standard Analytical Method (510B) which uses 4-AminoAntiPyrine in the procedure
Temp ..... Temperature
pH ..... measure of the acidity of a solution expressed as -log(H) or minus the log of the hydrogen ion concentration

SECTION 1.0 SUMMARY

Bethlehem Steel Corporation (BSC), in conjunction with the Department of Energy (DOE) is conducting a Clean Coal Technology (CCT) project at its Sparrows Point, Maryland Coke Oven Plant. This innovative coke oven gas cleaning system combines several existing technologies into an integrated system for removing impurities from Coke Oven Gas (COG) to make it an acceptable fuel. The agreement requires the conduct of an Environmental Monitoring Plan (EMP) for the purpose of (1) documenting the extent of compliance of monitoring activities activities, (2) confirming the specific impacts predicted in the National Environmental Policy Act documentation, and (3) establishing an information base for the assessment of the environmental performance of the technology demonstrated by the project. The EMP consists of two major monitoring phases. The first phase is a Baseline Environmental Monitoring program conducted during the construction phase of the project prior to startup and operation of the new facility. The second phase will be conducted after successful startup and operation of the new facility. This is a report of the Baseline Environmental Monitoring Program.

The Baseline Environmental Monitoring Plan consists of (1) conducting required air, water, waste management, OSHA*, NESHAP* and other required sampling programs as required by permits or regulations; (2) conducting additional supplemental sampling programs to gather data on activities needed to measure operational or environmental performance, but not required to be measured by permits or regulations.

All of these sampling programs have been completed as required by the approved Environmental Monitoring Plan. The data collected during the monitoring plan and the calculated results and statistics relating to the collected data are contained in the Appendix of this report. The text of this report provides (1) background information about the Innovative Coke Oven Gas Cleaning System that was installed, (2) the purpose and scope of the Environmental Monitoring Plan, and (3) describes details of the samples that were collected and the sampling protocols used.

For the most part, the sampling program was completed successfully. A few minor problems occurred related mostly to the lack of prompt analysis of samples collected during the winter baseline sampling period. This is not considered a serious problem and did not impact the major results of this program.

As a result of Bethlehem Steel's decision to suspend coke making operations at Sparrows Point, the production of coke was stopped in early December, 1991. Thus, the new gas cleaning facility has not been started and therefore the Operational Environmental Monitoring Program has not been conducted and has been deferred indefinitely.

OSHA = Occupational Safety and Health Administration
NESHAP = National Emission Standards for Hazardous Air Pollutants

SECTION 2.0 INTRODUCTION

Bethlehem Steel Corporation (BSC), in conjunction with the Department of Energy (DOE) is conducting a Clean Coal Technology (CCT) project at its Sparrows Point, Maryland Coke Oven Plant. This innovative coke oven gas cleaning system combines several existing technologies into an integrated system for removing impurities from Coke Oven Gas (COG) to make it an acceptable fuel. DOE provided cost-sharing under a Cooperative Agreement with BSC.

This Cooperative Agreement requires BSC to develop and conduct an Environmental Monitoring Plan for the Clean Coal Technology project and to report the status of the EMP on a quarterly basis. It also requires the preparation of a final report on the results of the Baseline Compliance and Supplemental Sampling Programs that are part of the EMP and which were conducted prior to the startup of the innovative coke oven gas cleaning system. This report is the Baseline Sampling Program Report.

2.1 EMP PURPOSE

The EMP describes in detail the environmental monitoring activities to be performed during the project execution. The purpose of the EMP is to: (1) document the extent of compliance of monitoring activities activities, i.e. monitoring required to meet permit requirements, (2) confirm the specific impacts predicted in the National Environmental Policy Act documentation, and (3) establish an information base for the assessment of the environmental performance of the technology demonstrated by the project.

2.2 EMP SCOPE

The EMP as approved by DOE, specifies the streams to be monitored (e.g. clean coke oven gas, ammonia still effluent), and the species to be analyzed (e.g. sulfur compounds, nitrogen compounds, trace elements, etc.). The operation and frequency of the monitoring activities is specified, as well as the timing for the monitoring activities related to project phase (e.g. construction, pre-operational, operational, post-operational). Within the five project's phases, monitoring consists of two types. COMPLIANCE monitoring is that which is or will be required under existing and/or anticipated regulatory requirements or permit conditions. SUPPLEMENTAL monitoring includes data gathering activities deemed important to measure operational or environmental performance, but not required to be measured by permits or regulations. A list of the Compliance and Supplemental sample streams is given in Table 2-1.

2.3 PROJECT DESCRIPTION

The coke plant at the Sparrows Point Plant consists of three coke oven batteries (A, 11 and 12) and two coal chemical plants (A and B). The by-product coke oven gas (COG) consists primarily of hydrogen, methane, carbon monoxide, nitrogen, and contaminants consisting of tars, light oils (benzene, toluene, and xylene) hydrogen sulfide, ammonia, water vapor, and other hydrocarbons. This raw coke oven gas needs to be cleaned of most of its contaminants before it can be used as a fuel at other operations at the Sparrows Point Plant.

In response to environmental concerns, BSC decided to replace much of the existing coke oven gas treatment facilities in the two coal chemical plants (A and B) with a group of technologies consisting of;

- o Secondary Cooling of the Coke Oven Gas
- o Hydrogen Sulfide Removal
- o Ammonia Removal
- o Deacification of Acid Gases Removed
- o Ammonia Distillation and Destruction
- o Sulfur Recovery

The installation of this combination of technologies will replace the existing ammonia removal system, the final coolers, hydrogen sulfide removal system and the sulfur recovery system. The existing wastewater treatment, tar recovery and one of the three light oil recovery systems will continue to be used to support the new, innovative combination of COG treatment technologies. Figures 2-1 and 2-2 are simplified block diagrams of the new COG treatment process.

2.4 EMP SAMPLING PROGRAMS

The EMP consists of Baseline and Operational Compliance Monitoring Sampling Programs and Supplemental Monitoring Sampling Programs. The Baseline Compliance Monitoring Sampling Program was conducted during the first eleven months of 1991 during the Pre-Construction/Construction phases of the Project. A similar Operational Compliance Sampling Program will be conducted during the year following the successful Startup and Operational phase of the completed Project.

Compliance monitoring consists of conducting all the sampling and observation programs associated with existing required Federal, State, and Local Regulations, Permits and Orders. These include air, water, and waste monitoring and OSHA and NESHAP monitoring.

A Baseline Supplemental Monitoring Program was also conducted during a summer and a winter baseline periods in 1991 during the Pre-Construction/Construction phases of the Demonstration Facility. A similar Operational Supplemental Sampling Program will be conducted during a summer and a winter period following the successful startup and Operational phase of the completed Facility.

Supplemental Monitoring includes sampling of 27 additional streams that are important to measure operational or environmental performance and impacts of the installation of the new COG treatment facilities.

Collecting Compliance Monitoring data and Supplemental Monitoring data during the Baseline and Operational Phases of the Facility will provide a basis for comparing and estimating the impact of the Demonstration Facility on the compliance streams and important influent and effluent streams of treatment facilities. Figure 2-3 shows the sampling programs scheduled in the Environmental Monitoring Program.

Collecting Compliance monitoring data and Supplemental Monitoring data during summer and winter periods will provide a basis for demonstrating the impact of ambient temperature on the performance of the Demonstration Facility and hence, the impact on the compliance streams. This is important since the solubility of the hydrogen sulfide and ammonia contaminants in the COG are temperature dependent and the performance of the wet surface air cooler equipment at the initial part of the Demonstration Facility will be impacted by the ambient summer and winter temperatures and humidities.

2.5 CONTENTS OF EMP REPORTS

The quarterly and annual EMP reports will present information on the status of planned supplemental and compliance environmental monitoring activities. It will also contain a brief summary of the results of these monitoring activities. The sampling campaign reports will contain all of the data collected during the various sampling campaigns.

2.6 SAMPLING AND LABORATORY CONTRACTORS UTILIZED

The following sampling personnel were employed to collect samples and observations during the compliance and supplemental sampling programs during the Baseline sampling period;

2.6.1 Compliance Sampling Programs

Gaseous Streams

G-1 Battery 'A' Stack Gas
G-2 Battery 11 Stack Gas
G-3 Battery 12 Stack Gas

These exhaust gas stacks are equipped with continuous opacity monitors. No plant or contract personnel were used to conduct visible opacity measurements. The output data from the opacity meters are collected by Sparrows Point Environmental Control personnel.

Aqueous Streams

A-5 Monitoring Point 121
A-6 Outfall 021

These treated wastewater streams were sampled by Bethlehem Steel hourly personnel according to the protocols required by the NPDES permits and the samples delivered to an onsite contract chemical analytical laboratory for analyses. BCM Laboratories of Norristown, PA operates this laboratory at the Sparrows Point Plant. Chain of Custody forms are used for all compliance samples.

Solid Streams

S-4 Sludge Blowdown to BRWWTP

These sludge blowdown samples were sampled by Bethlehem Steel hourly personnel and the samples delivered to a contract chemical analytical laboratory for analyses.

Benzene NESHAP Wastewater Streams (see Table 2-1)

No Benzene NESHAP wastewater streams were sampled during the 1991 Baseline Sampling period. In 1990, samples were collected and analyzed by Bethlehem Steel's contractor - Environmental Resources Management, Inc., Annapolis, Maryland. These data are provided in the Appendix and will serve as the baseline data.

Benzene NESHAP Equipment Monitoring Program

During the year 1991 surveys of equipment in the Coal Chemical Plants were monitored for benzene leaks. This monitoring was done for Sparrows Point by an outside contractor on a monthly, quarterly, semi-annual and annual basis according to prescribed protocol. All required monitoring was completed in 1991.

OSHA Employee Exposure Monitoring

Periodic worker exposure sampling programs are conducted by Bethlehem Steel's Environmental Health and Safety Personnel. The samples collected are submitted for chemical analyses to Bethlehem Steel's contract laboratory - American Medical Laboratories of Fairfax, Virginia.

2.6.2 Supplemental Sampling Program Samples

Gaseous Streams - Battery Stack Gases

G-1 Battery 'A' Stack Gas
G-2 Battery 11 Stack Gas (summer sampling program only)
G-3 Battery 12 Stack Gas (summer sampling program only)

Bethlehem Steel's contractor -

Bradford K. Pease, P.E., CEM
Fuels and Combustion Consultant
2029 E. Columbia Street
Allentown, PA. 18103

sampled and analyzed these exhaust gases using accepted EPA protocols. A description of these protocols and the instrumentation used for the analysis are contained in the contractor's reports in Appendix Section 10.

Gaseous Streams - Battery Fuel Gases

G-5 Blast Furnace Gas to Mixing Station
G-6 Mix Gas to Mixing Station
G-23 Coke Oven Gas to Mixing Station

These samples of these fuel gases were collected by the following personnel ...

1991 Winter Sampling Period Samples were collected by

Bethlehem Steel Corp.
Environmental Technical Programs Group
Bethlehem, PA.

1991 Winter Sampling Period Samples were analyzed by

BCM Laboratories
Norristown, PA.

These samples of fuel gases were grab samples collected in Tedlar sampling bags and delivered to BCM, Laboratories on a daily basis.

1991 Summer Sampling Period Samples were collected and analyzed by Bethlehem Steel's contractor ....

KEYSTONE Environmental Resources
(now Chester Environmental Group)
3000 Tech Center Drive
Monroeville, PA, 15146.

Aqueous Streams

A-24 Composite Feed From Equalization Tank
A-42 Fixed Ammonia Still Wastewater

The samples of these aqueous streams were collected by personnel from Bethlehem Steel's Environmental Technical Program's Group. The chemical analyses of these samples were conducted by the following contract chemical analytical laboratories;

1991 Winter Sampling Period Samples were analyzed by

BCM Laboratories
Norristown, PA.

1991 Summer Sampling Period Samples were analyzed by

Bethlehem Steel Corporation
Homer Research Laboratories
Chemical Analytical Division
Bethlehem, PA

Solid Streams

S-26 Coal Mix Feed To Coke Ovens
S-27 Coke Product

The samples of these solid streams were collected by Sparrows Point's Coke Plant Personnel and delivered to the Sparrows Point's Coke Oven analytical laboratory for physical and chemical analyses.

Benzene NESHAP Equipment Monitoring

Monitoring of equipment in the Coal Chemical Plants for benzene leaks was conducted by Bethlehem Steel's contractor - Environmental Resources Management, Inc., Exton, Pennsylvania.

OSHA Supplemental Employee Exposure Monitoring

Monitoring of worker exposure for benzene, toluene, xylene, total hydrocarbons, hydrogen sulfide and ammonia was conducted by Bethlehem Steel's Environmental Health and Safety personnel. Chemical analyses of the collected samples was performed by Bethlehem Steel's contract laboratory - American Medical Laboratories Fairfax, Virginia.

2.7 EQUIPMENT OPERATIONAL STATUS

Coke Oven Batteries. The major coke oven operating data are contained in tables in Appendix Section 14. The data in these tables show number of ovens operating, coking times, flue temperatures, coke produced, coke oven gas produced and underfiring fuels used for each battery and for each of the sampling periods of the baseline environmental monitoring programs.

Winter Sampling Period - March, 1991

During the winter sampling baseline sampling period the coke oven batteries were operating as follows;

'A' battery was operating at 26 hours coking time and pushed 1788 ovens in March, 1991 During March, 67 of the 80 ovens were operational. The non operating ovens were down for wall repairs and other repairs.

No. 11 Battery was operating at 23 hours coking time and pushed 593 ovens in March, 1991. The battery has a total of 65 ovens, however, only 19 of these ovens were operational. The rest of the ovens were in not able to operate because of their deteriorated condition or they were under repair during the period.

No. 12 Battery was operating at 25 hours coking time and pushed 1536 ovens March. The battery has a total of 65 ovens, however, 12 of these ovens were not operational because of their deteriorated condition or they were under repair during the period.

'A' Battery Oven Walls. The oven walls in 'A' Battery were not in good condition in the spring of 1991. Several of the oven walls had cracks which allowed leakage of coal fines and soot from the oven into the oven wall heating

flues. This wall leakage was the major factor in the very high opacity observations from the 'A' Battery waste heat stack. Throughout 1991, the plant had a major maintenance effort underway which included efforts to repair the oven walls.

Summer Sampling Period - August, 1991

During the summer baseline sampling period the coke oven batteries were operating as follows;

'A' battery was operating at 24.75 hours coking time and pushed 2042 ovens on a Sixty seven of the eighty 80 ovens were operational.

No. 11 Battery was operating at 27 hours coking time and pushed 524 ovens during August. Nineteen of the sixty five ovens were operational.

No. 12 Battery was operating at 27 hours coking time and pushed 1420 ovens during August. Fifty Three of the sixty five ovens were operational.

'A' Battery Oven Walls. The oven walls in 'A' Battery continued to be a major repair effort and improvement was noticed as evident by the somewhat reduced stack opacity observations and reduced sulfur dioxide emissions. Leakage through the oven walls into the heating flues is the major factor in the very high opacity observations from the 'A' Battery waste heat stack.

TABLE 2-1 *ENVIRONMENTAL MONITORING PLAN SAMPLE STREAMS*
List of Compliance and Supplemental Monitoring Streams

A. List of Compliance Streams (Sampled during all Phases of Project)

1. PERMITTED STREAMS

STREAM	STREAM NAME
Gaseous	
G-1	Battery 'A' Stack Gas
G-2	Battery 11 Stack Gas
G-3	Battery 12 Stack Gas
Aqueous	
A-5	Monitoring Point 121-Effluent from Waste Water Treatment Plant
A-6	Outfall 021-Discharge to Patapsco River
Solids	
S-4	Sludge Blowdown to BRWWTP from Waste Water Treatment Plant

2. BENZENE NESHAP WASTEWATER STREAMS

A-7	Tar Sludge Decanter
A-8	'A' Flushing Liquor Strainer
A-9	'B' Secondary Decanter
A-10	Final Cooler Emulsified Oil
A-11	Final Cooler Condensate
A-12	Desulfurizer Blowdown
A-13	Coke Oven Drip Condensate
A-14	Gas Pump Tank Condensate
A-15	Light Oil Still Drainage
A-16	Vapor Oil Exchanger Condensate
A-17	Primary Light Oil Condensate
A-18	Secondary Light Oil Condensate
A-19	'B' Reflux Condensate
A-20	Centrifuge Water
A-21	Vapor Oil Exchanger and Centrifuge Condensate
A-22	Secondary Light Oil Tank Drainage

3. OSHA WORKER EXPOSURE DATA-Quarterly Monitoring of Coke Oven and Coal Chemical Worker Exposure

TABLE 2-1 ENVIRONMENTAL MONITORING PLAN SAMPLE STREAMS
List of Compliance and Supplemental Monitoring Streams - continued

B. List of Supplemental Streams

1. Sampled During Pre-Construction/Construction and Operational Phases

STREAM	STREAM NAME
Gaseous	
G-1,G-7	Battery 'A' Stack Gas
G-2	Battery 11 Stack Gas
G-3	Battery 12 Stack Gas
G-5	Blast Furnace Gas to Mixing Station
G-6	Mix Gas to Coke Oven Underfire Burners
G-23	Coke Oven Gas to Mixing Station
Aqueous	
A-24	Composite Feed from Equalization Tank
A-42	Fixed Ammonia Still Wastewater
Solids	
S-26	Coal Mix Feed to Coke Ovens
S-27	Coke Product

OSHA WORKER EXPOSURE DATA-Quarterly Monitoring of Coke Oven and Coal Chemical Worker Exposure

2. Sampled During Operational Phase of Project

STREAM	STREAM NAME
Gaseous	
G-25	Coke Oven Gas to Secondary Cooler
G-29	Coke Oven Gas to H2S Scrubber
G-41	Coke Oven Gas to Light Oil Scrubber
G-54	Air to Catalytic Oxidizer
G-55	Process Gas to Claus Plant
G-57	Tail Gas to Primary Cooler
Aqueous	
A-28	Flushing Liquor and Tar to Tar Decanter
A-31	Flushing Liquor to Secondary Cooler
A-39	Excess Flushing Liquor to Ammonia Scrubber
A-40	Stripped Liquor from Ammonia Still
A-42	Fixed Ammonia Still Wastewater
A-45	NaOH to Fixed Ammonia Still
Solids	
L-32	Tar to Sump of Secondary Cooler
L-56	Sulfur Product from Claus Plant
S-58	Catalytic Oxidizer Spent Catalyst
S-59	Claus Unit Spent Catalyst

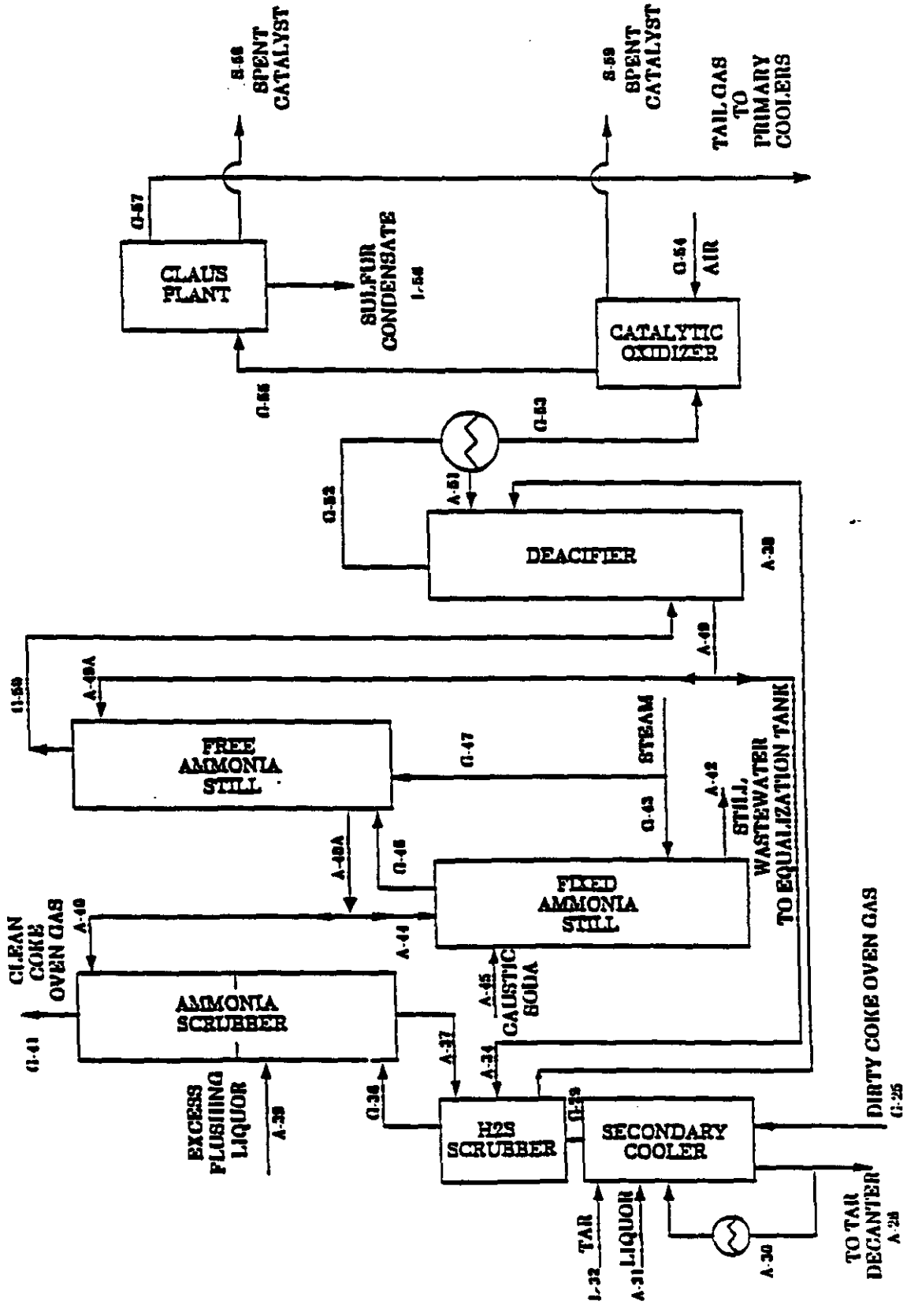


Figure 2-1

Bethlehem Steel's Innovative
Coke Oven Gas Cleaning System

Figure 2-2

Bethlehem Steel's Innovative
Coke Oven Gas Cleaning System
Utilization, Treatment and Disposal of Principal Process Product Streams

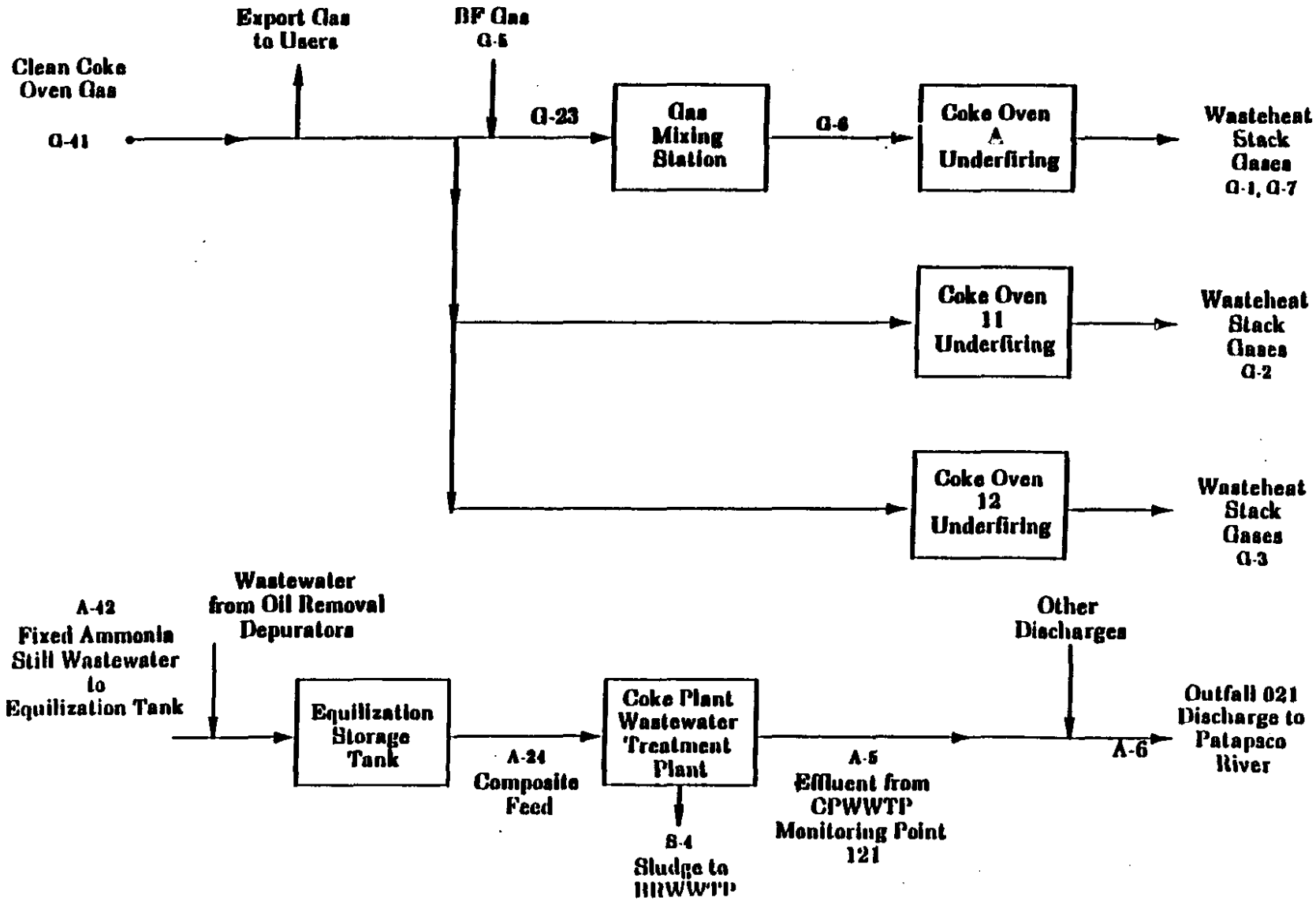
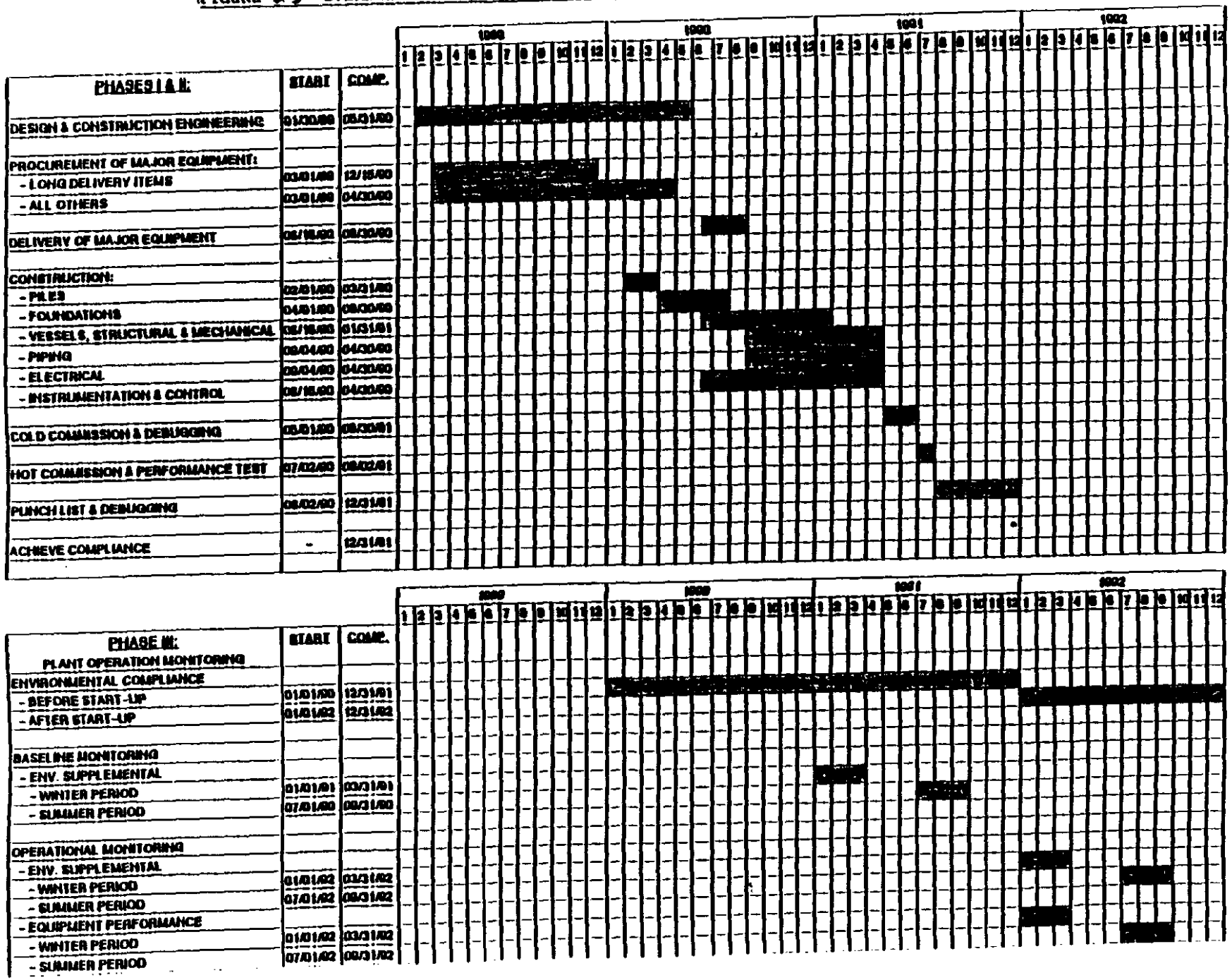


FIGURE 2-3 OVERALL SCHEDULE OF INNOVATIVE COKE OVEN GAS CLEANING PROJECT



SECTION 3.0 PLANT OPERATION CONDITIONS DURING SAMPLING

3.1 DATES OF SAMPLING EVENTS

Compliance Sampling Program. The year 1991 is the baseline period for the Compliance Sampling Programs listed in Table 2-1. All compliance sampling was conducted according to the schedules required. It is noted that no sampling of the BENZENE NESHAP WASTEWATER STREAMS was conducted in 1991. The last sampling and analysis of these wastewaters streams was conducted in 1990 and these data are included in the Appendix Section 6.

Supplemental Sampling Program. The baseline supplemental sampling programs for the supplemental battery stack gas samples (G-1, G-2 and G-3), fuel gas samples(G-5 and G-7) and aqueous samples (A-24 and A-42) were conducted during two periods; A Winter period from March 19, 1991 to April 10, 1991, and a Summer Period from August 19, 1991 to August 28, 1991.

The coal mix feed data (S-26) and Coke Product data(S-27) were collected on daily basis throughout the year 1991.

Supplemental OSHA WORKER EXPOSURE DATA for workers in the Coal Chemical Plants were collected on July 3, 5, 8, 17, and 29 for exposure to Total Hydrocarbons, Benzene, Toluene and Xylene. Exposure to hydrogen sulfide and ammonia were measured on August 7, 8, 9, 14, 15 and 30th.

Significant Events and Comments. There were no major problems or significant events in conjunction with these sampling dates.

3.2 RAW MATERIAL USAGE FOR SAMPLING EVENT PERIOD

The amount of coal used and the chemical analysis of the coal used during the baseline year and during the winter and summer sampling periods are tabulated in Appendix Section 11, Table 11-1.

3.3 PRODUCTION RECORDS FOR SAMPLING EVENT PERIOD

The amount of coke produced and the chemical analysis of the coke produced during the baseline year and during the winter and summer sampling periods are tabulated in Appendix Section 11, Table 11-2.

SECTION 4.0 COMPLIANCE MONITORING

4.1 EFFLUENT AND WASTE STREAMS SAMPLED

4.1.1 Treated Wastewater Outfalls and Monitoring Points

Outfall 021. The effluent waters from this outfall contain mostly cooling waters for several operations in the coke plant and treated wastewaters from monitoring point 121. These effluent waters are sampled on a daily basis for pH, Temperature and Flow Rate; on a weekly basis for Oil and Grease, Ammonia and Phenol; and on a monthly basis for benzene, naphthalene, total nitrogen, nitrate nitrogen and nitrite nitrogen.

Monitoring Point 121. The waters at this monitoring point are the effluent from the biological wastewater treatment facility for all of the coke oven wastewaters generated by the coke plant at Sparrows Point. These treated wastewaters are a tributary to Outfall 021 and are monitored separately on a daily basis for flow and phenol; twice a week for total suspended solids, oil & grease, total cyanide and ammonia and pH; and on a monthly basis for benzene, naphthalene and benzo-a-pyrene.

4.1.2 Gaseous Effluents

'A' Coke Oven Battery Stack. Compliance monitoring of 'A' battery stack consist of continuous opacity monitoring.

No. 11 Coke Oven Battery Stack. Compliance monitoring of No. 11 battery stack consist of continuous opacity monitoring.

No. 12 Coke Oven Battery Stack. Compliance monitoring of No. 12 battery stack consist of continuous opacity monitoring.

4.1.3 Spills

All spills of materials in the coke plant area are treated as though they exceed the reportable quantity of the hazardous components contained in the material spilled. Thus, if there is a spill of a material in the coke plant area it is reported to the Maryland Department of Environment(MDE), National Response Center and the U. S. Coast Guard.

4.2 SIGNIFICANT FINDINGS OF FIELD TEAMS

The field teams collecting the compliance samples did not report any unusual problems or events during the baseline sampling year.

4.3 COMPLIANCE MONITORING RESULTS

4.3.1 Treated Wastewater Outfalls and Monitoring Points

Outfall 021 Monitoring Results (Stream A-6). The compliance monitoring data collected during 1991 for Outfall 021 is provided in the Appendix Section 1, Tables 1-1, 1-2 and 1-3. It is noted that only eleven months of 1991 are included in the baseline data base since the coke plant were shut down in early December and discharges from Outfall 021 during December were not representative of the operating ovens.

Table 1-1 contains the raw data collected during the year 1991 and compares it with the Daily Compliance Limits for this outfall. In the baseline year there were seven incidences when the discharges contained greater than the effluent limits including one for benzene, one for naphthalene and five for Low pH.

Table 1-2 contains the calculated monthly average compliance data for Outfall 021 and compares it with the Monthly Average Compliance Limits for this outfall. In the baseline year there were no exceedances of the monthly compliance limits.

Table 1-3 contains calculated statistics for the effluent parameters for Outfall 021. Included are averages, standard deviations, and percentile levels based on the daily compliance monitoring data.

Monitoring Point 121 Monitoring Results (Stream A-5). The compliance monitoring data collected during 1991 for Monitoring Point 121 as provided in the Appendix Section 2, Tables 2-1, 2-2, 2-3 and 2-4. It is noted that only eleven months of 1991 are included in the baseline data base since the coke plant were shut down in early December and discharges from Outfall 021 during December were not representative of the operating ovens.

Table 2-1 contains the raw data collected during the year 1991.

Table 2-2 contains the calculated daily mass discharge data, the various compliance parameters for Monitoring Point 121 and compares them with the daily compliance parameters.

Table 2-3 contains the calculated monthly average mass discharges for the various monthly average compliance parameters for Monitoring Point 121 and compares it with the Monthly Average Compliance Limits for this monitoring point.

In the baseline year there were ten occasions when the effluent contained discharges of limited parameters greater than the daily compliance limits. These included three monthly averages for ammonia, one monthly average for phenol, one daily limit for suspended solids and five daily limits for ammonia.

Table 2-4 contains calculated statistics for the effluent parameters for Monitoring Point 121. Included are the annual averages, standard deviations, and percentile levels based on the daily compliance monitoring data.

Monitoring Point 121 Effluent Emission Factors. This monitoring point is the treated discharge from the phenol biological wastewater treatment plant that is used to treat all coke oven wastewaters from the Sparrows Point Coke Plant.

Table 2-5 provides the calculated daily effluent emission factors for the compliance parameters for this monitoring point. These factors in Table 2-5 were calculated by calculating the mass discharge for a given parameter and dividing it by the amount of Run-of-Oven Coke produced by the coke plant for that day. (Run-of-Oven coke is all of the coke that comes out of the oven. It consist of the Furnace Coke, which is properly sized for use in the blast furnace and Coke Breeze which is fine coke not suitable for use the blast furnace. At Sparrows Point the coke breeze is typically less than one percent of the Run of Oven coke.) Table 2-6 provides calculated statistics for these effluent emission factors for the 1991 baseline period.

4.3.2 Gaseous Effluents

'A' Coke Oven Battery Stack. The compliance continuous opacity monitoring data collected during 1991 for 'A' Battery Stack is provided in Appendix Section 3.

Table 3-1 shows the monthly average opacity readings for the year 1991 for 'A' Battery and continues with the daily readings for each month of 1991. The structural problems with the interior oven walls for many of the ovens in 'A' Battery caused opacity observations in excess of 90% opacity throughout the year 1991.

No. 11 Coke Oven Battery Stack. The compliance continuous opacity monitoring data collected during 1991 for No. 11 Battery Stack is provided in Appendix Section 3. Table 3-2 shows the monthly average opacity readings for the year 1991 for No. 11 Battery and continues with the daily readings for each month of 1991.

No. 12 Coke Oven Battery Stack. The compliance continuous opacity monitoring data collected during 1991 for No. 12 Battery Stack is provided in Appendix Section 3. Table 3-3 shows the monthly average opacity readings for the year 1991 for No. 12 Battery and continues with the daily readings for each month of 1991.

4.3.3 Spills

Table 4-1 in Appendix Section 4 shows a complete listing of the spills that occurred in the coke plant area in 1991 and which were reported to the agencies. The installation of this innovative coke oven gas cleaning system and the associated ancillary facilities should result in a reduction of the number of spills.

4.3.4 Sludge to BRWWTP from Waste Water Treatment Plant

Sparrows Point operates a biological wastewater treatment plant to treat coke oven wastewaters. The sludge from this treatment plant is discharged to Baltimore City's Back River Waste Water Treatment Plant. Bethlehem is required to sample and analyze this sludge twice a year. Copies of the reports transmitting these analyses to the regulating authority are provided in Appendix Section 5.

4.3.5 Benzene NESHAP Monitoring

Wastewater Streams. No sampling of the BENZENE NESHAP WASTEWATER STREAMS was conducted in 1991. The last sampling and analysis of these wastewaters streams was conducted in 1990. These data are included in the Appendix Section 6 in the report "Initial Annual Report - June 5, 1990, NESHAP Benzene Waste Operations, Coke By-Product Recovery Plant, Sparrows Point, MD.

Equipment Monitoring. BENZENE NESHAP EQUIPMENT Monitoring was conducted as required in 1991 and the reports of the results of this monitoring are contained in Appendix Section 6. During the year 1991 a total of 11 benzene leaks were identified; 8 valves, 1 pump and 1 exhauster. These data are summarized in Appendix Section 6, Table 6-1.

4.3.6 OSHA Worker Exposure Data

During the baseline year 1991 the Environmental Health & Safety Department of the Sparrows Point Plant conducted a benzene exposure survey in "A" Coal Chemical Plant. There were no over exposures during this survey. A copy of the results of this survey, dated April 10, 1991, is included in Appendix Section 7. Also included in Appendix Section 7 are copies of the results of benzene exposure surveys conducted in 1990.

4.4 SUPPLEMENTAL MONITORING RESULTS

Supplemental monitoring is included in the EMP to demonstrate the effectiveness of the project by providing environmental and process data not available from compliance monitoring. Two main objectives of the supplemental monitoring program are to provide sufficient data to demonstrate the effectiveness of the individual unit processes and to demonstrate the effectiveness of the combined process.

To obtain a basis for comparison, various process streams of existing units were analyzed to develop a baseline standard of performance. Table 2-1B of this report lists the process and material streams that were sampled during the supplemental baseline sampling periods. Data collection is directed toward the determination of baseline sulfur content and ammonia content of the clean coke gas prior to use and volatile organic carbon emissions from the existing process.

4.4.1 Wastewater Streams

Composite Feed from Equalization Tank. This is the combined coke oven pre-treated wastewater stream that is the feed to the phenol biological wastewater treatment plant. Winter and Summer supplemental sampling programs were conducted in 1991 and the results of the analyses of the samples collected during these periods are provided in Appendix Section 8, Tables 8-1, 8-2 and 8-3. Table 8-1 provides the raw data collected during the sampling periods. Table 8-2 provides the calculated mass rates of the various parameters and Table 8-4 provides the calculated mass emission factors per 1000 tons of coke produced.

Fixed Ammonia Still Wastewater. This flow is the aqueous discharge from the existing ammonia still before it is sent to the million gallon composite feed

tank. Winter and Summer supplemental sampling programs were conducted in 1991 and the results of the analyses of the samples collected during these periods are provided in Appendix Section 9, Tables 9-1, 9-2 and 9-3. Table 9-1 provides the raw data collected during the sampling periods. Table 9-2 provides the calculated mass rates of the various parameters and Table 9-3 provides the calculated mass emission factors per 1000 tons of coke produced.

4.4.2 Gaseous Streams

Appendix Section 10 contains the results of the Supplemental sampling program for the coke oven stack gases and the gaseous fuels used to heat the coke oven batteries; i.e., blast furnace gas and coke oven gas. It also contains the estimated sulfur dioxide emission factors for these batteries during the summer and winter sampling periods.

All stack gas measurements were conducted only during the battery heating cycle when fuel was being burned and did not include a 'reversal' period when fuel is not being burned.

'A' Coke Oven Battery Stack Gas Analyses. Table 10-1 contains the raw data collected daily during the baseline summer and winter sampling periods. The data collected includes the concentrations of oxygen, combustibles, nitrogen oxides, sulfur dioxides, the percent excess air and the temperature. A report of the 'A' Battery Stack test procedures and results by the consultant performing the analyses is also included at the end of Appendix Section 10. Table 10-2 provides the daily average analysis for each of these analytes.

No. 11 Coke Oven Battery Stack Gas Analyses. Table 10-3 contains the raw data collected during the baseline summer sampling period. No sampling of No. 11 Stack was conducted during the winter sampling period. Table 10-4 provides daily average analysis for each of the measurements for No. 11 Battery.

No. 12 Coke Oven Battery Stack Gas Analyses. Table 10-5 contains the raw data collected during the baseline summer sampling period. No sampling of No. 12 Stack was conducted during the winter sampling period. Table 10-6 provides daily average analysis for each of the measurements for No. 12 battery.

Blast Furnace Gas Analyses. Appendix Section 10 Table 10-7 shows the results of the analyses of the Blast Furnace Gas that is mixed with coke oven gas prior to for use in underfiring 'A' Battery coke ovens.

Coke Oven Gas Analyses. Appendix Section 10 Table 10-8 shows the results of the analyses of the coke oven gas is used to underfire all the coke batteries.

Mixed Gas to Coke Oven Underfire Burners. Appendix Section 10 Table 10-9 shows the results of the analyses of the blend of blast furnace and coke oven gas that is for use in underfiring 'A' Battery coke ovens. 'A' Battery uses a blend of blast furnace gas and coke oven gas for underfiring while No. 11 and No. 12 use only coke oven gas for underfiring.

Fuel Gas Flows. Appendix Section 10, Table 10-10 shows the amount of underfiring fuel gases used for No. 11, No. 12 and 'A' coke batteries during the baseline sampling periods.

Sulfur Dioxide Emissions from Battery Stacks. Tables 10-11, 10-12 and 10-13 show the underfiring fuel rates used, the calculated exhaust gas flow rates from each of the battery stacks and the estimated sulfur dioxide emissions for each of the sampling days for each of the sampling periods. It is noted that the coke oven gas desulfurization system was not operable during the 1991 baseline period.

These sulfur dioxide emissions were calculated from the sulfur dioxide analysis of the exhaust gases from each battery and the exhaust gas emission rates calculated from the amount of fuels used to underfire each oven. The sulfur dioxide concentration used in these estimates is the average twenty four hour concentration (24hrSO2). This twenty four hour concentration is twenty percent less than the actual measured concentration since during a heating cycle on an oven there is a four minute period in each cycle to reverse the side of the ovens being heated. During this 'reversal' there is no burning of the fuel gases. There are 12 minutes of 'reversal' each hour or twenty percent of the time with no burning of fuels.

Sulfur Dioxide Emission Factors. Table 10-14 shows the estimated sulfur dioxide emission factors per ton of coke produced during the sampling periods. It is noted that there is a drop in the sulfur dioxide emission factor from the winter sampling period to the summer sampling period. This is due to a combination of events including slightly reduced sulfur in the coals used and improved integrity of the oven walls following a major wall repair effort to reduce the amount of leakage of coke oven gases through the walls into the heating chambers.

4.4.3 Solid Streams

Appendix Section 11 contains tables showing the coal usage rate and coal analyses and the coke production rate and coke analyses for each day of the 1991 baseline period. These data were used in the calculation of various emission factors.

Coal Mix Feed to Coke Ovens. Appendix Section 11, Table 11-1 contains the coal usage rate and coal analyses.

Coke Product. Appendix Section 11, Table 11-2 contains the coke production rate and coke analyses.

4.4.4 Supplemental OSHA Exposure Monitoring

The results of supplemental OSHA Exposure Monitoring are contained in Appendix Section 12. The report dated August 13, 1991, contains the results of the survey of employee exposures to benzene, toluene, xylene and total hydrocarbons. Two over exposures to benzene were detected. Historically, there have been very few over exposures detected during routine OSHA personnel exposure monitoring in the coke oven - coal chemical plants. These particular exposures occurred in July and they may have been the result of leaking valves or other equipment in the coal chemical plant. The results of NESHAP-Benzene- leak detection

surveys(see Appendix 6) show a leaking valve in July. Repair work on all leaking equipment in these areas is done promptly to maintain exposure levels well below acceptable levels. The new coke oven gas cleaning system being installed under this DOE agreement will replace or eliminate much of the older equipment now in place and result in substantially reduced concentrations of benzene in this area.

In cases of over exposure it is recommended that full facepiece respirators be worn during procedures with potential overexposure and that employees in these areas be given annual training.

The report dated September 12, 1991 contains the results of the survey of employee exposures to hydrogen sulfide and ammonia. No over exposures were detected in this survey.

SECTION 5.0 POLLUTION CONTROL EQUIPMENT PERFORMANCE

5.1 WASTEWATER TREATMENT PLANT

The coke oven wastewater treatment plant is a biological wastewater treatment process designed to remove phenols from pretreated coke oven wastewaters. Some cyanide removal is also removed during the process. It is the final step in the treatment of wastewaters from the coke plant. After the oils and most of the cyanides and ammonia have been removed from coke oven waters, these waters are sent to a 1 million gallon equalization tank. From this tank the waters are sent to the biological treatment plant. The composite feed to this treatment plant is Stream A-24. The treated effluent from this treatment plant is Stream A-5 or Compliance Monitoring Point 121.

Appendix Section 8 contains the results of an analysis of the performance of this treatment plant during the baseline sampling periods. Table 8-4 shows the estimated percent removals of phenol and cyanides. The system was performing well during these baseline periods with over 99.9 percent removal of phenol and about 56 percent removal of cyanide. This is typical performance for this system.

5.2 AMMONIA STILL

The principal coke oven wastewater is flushing liquor blowdown or weak ammonia liquor. This liquor is treated with lime to increase the pH and "free" the ammonia so it can be steam stripped from the water in the ammonia still. Samples of the treated waters discharged from the ammonia still were collected during the baseline periods (Stream A-42). The results of this sampling program are shown in Appendix Section 9, Tables 9-1, 9-2 and 9-3. These data show that the effluent from the ammonia still during the winter sampling period was very high; 401 to 3298 parts per million(ppm) This indicated that during this period the pre-limer/ammonia still process was not operating well. Based on historical performance the ammonia discharges should have been less than 200 ppm. During the summer sampling period the ammonia still was operating normally with effluent ammonia concentrations in the range of 30 to 128 ppm.

5.3 COKE OVEN GAS DESULFURIZATION PLANT

The coke oven gas desulfurization system at the Sparrows Point plant was not operating for mechanical reasons during the baseline year 1991 and no performance data was taken on the system.

SECTION 6.0 COKE OVEN OPERATING CHARACTERISTICS

Tables 14-1, 14-2, 14-3, 14-4 and 14-5 in Appendix Section 14 provide monthly average summaries for 1991 of the major operating parameters for all of the coke ovens batteries including coal and coke productions, oven pushing times, number of ovens pushed, flue temperatures, coke oven gas produced and coke oven undefiring fuels used.

SECTION 7.0 QUALITY ASSURANCE AND QUALITY CONTROL

7.1 CHAIN OF CUSTODY PROCEDURES

Compliance Sampling Program. Chain of Custody forms are normally used to verify sample integrity for all NPDES compliance samples collected at Sparrows Point and they were used during the baseline year 1991. Chain of Custody forms are kept onsite at the contract laboratory for inspection.

Supplemental Sampling Programs. Aqueous samples collected during the supplemental sampling program were delivered to the contract laboratories by Bethlehem Personnel. Chain of custody forms were used to log in all samples by the laboratories used. A sample chain of custody form is included in Appendix Section 13.

Gaseous samples delivered by Bethlehem personnel to off site contract laboratories were also logged in using chain of custody forms. Gaseous samples collected by non-Bethlehem personnel during the Summer sampling program were analyzed on site. No chain of custody forms were used. Bethlehem personnel did spot monitor the collection and delivery of samples by the contractor. No monitoring reports were prepared.

7.2 LABORATORY QA/QC PROGRAMS

Aqueous Samples. Each of the laboratories used for chemical analysis of compliance and supplemental samples has standard QA/QC procedures inplace including periodic testing of spiked samples, multiple runs on the same sample and simultaneous side by side samples. The results of these QA/QC procedures are kept on file for inspection at the various contract laboratories. Laboratory QA/QC reports were not requested of the contract laboratories by the Environmental Monitoring Plan Team during the baseline year.

Visible Emission Observations. The visible emissions observations used to monitor the opacity of the coke oven stacks are done by continuous emission monitors. These monitors are automatically calibrated and checked every day. Sparrows Point instrument technicians checked the system daily and in the event of a calibration failure the instrumentation was repaired promptly. Maintenance records for the calibration failures are kept on file at the Sparrows Point Plant.

7.3 LABORATORY AUDITS

The Environmental Monitoring Plan team did not conduct audits of the contract laboratories during the baseline year 1991 primarily due to the need to complete other programs. However, auditing of contract laboratories will be a priority activity during the planned environmental monitoring programs associated with the operational phase of the Environmental Monitoring Plan.

SECTION 8.0 CONCLUSIONS AND RECOMMENDATIONS

Bethlehem Steel Corporation (BSC), in conjunction with the Department of Energy (DOE) is conducting a Clean Coal Technology (CCT) project at its Sparrows Point, Maryland Coke Oven Plant. This new facility is installed at Sparrows Point.

As required by the agreement between BSC and the DOE, BSC developed an Environmental Monitoring Plan (EMP) for the Clean Coal Technology project. This EMP required conducting Baseline Compliance and Supplemental sampling programs that would document the compliance of monitoring activities, confirm the specific impacts predicted to be achieved by the installation of this facility, and establish an information base for the assessment of the environmental performance of the technology demonstrated by the project.

All of the planned Compliance and Supplemental monitoring activities required by the Baseline Phase of the approved Environmental Monitoring Plan was completed. These data and the resulting statistical analyses and calculation of results are presented in this report. These results describe the emissions from the operating coke oven batteries and coke oven gas treatment facilities at the Sparrows Point Plant during the 1991 baseline period. These results can be used as a comparison to those to be measured during the operational phase of the new coke oven gas treatment facility.

The raw data and the results developed from the data, i.e., average performances, emission factors, compliance statistics, are provided in tabular and report form in the Appendix.

In review of these monitoring programs a few incidences have been identified that could have been improved. First, the contract chemical analytical laboratories retained to conduct the analyses required by the program were not audited. This should have been done early in the program. One of the laboratories retained did not complete the sample analyses promptly and as a result some of the samples delivered to the laboratory were not analyzed within the sample holding time prescribed. These were not critical analyses and did not bias the results. Prompt follow-up audits of the laboratory may have helped avoid this problem.

In addition to audits of the laboratory, follow-up checks of the QA/QC procedures of the chemical analytical laboratories should also have been done. While each of the laboratories have inplace adequate QA/AC procedures, the inclusion of appropriate field blanks and duplicate samples should have been included as part of the sampling and testing protocol.

As a result of the shutdown of the coke oven batteries at the Sparrows Point plant in December, 1991 the Innovative Coke Oven Gas Cleaning facility was not hot commissioned. Mothballing of the facilities was completed to preserve them. As of July, 1993 there were no operating coke ovens at Sparrows Point. Thus, the planned environmental monitoring associated with the operational phase of the Environmental Monitoring Plan continues to be deferred.