STAATSOLIE MAATSCHAPPIJ SURINAME N.V.
state oil company suriname n.v.

012-11

Environmental Study

Phase II

Suriname Refinery Project

Tout Lui Faut

Lummus Crest B.V.

COMBUSTION ENGINEERING

ENVIRONMENTAL STUDY

PHASE II

SURINAME REFINERY PROJECT

TOUT LUI FAUT

Revision 2
September 12, 1989

INDEX

INDEX (Cont'd)

APPENDICES

1. INTRODUCTION

Staatsolie Maatschappij Suriname N.V. is planning to build a grass roots refinery complex at the left bank of the Suriname River, south of Paramaribo, where already six crude-oil storage tanks and an export terminal are located.

An environmental report has been prepared during the initial period of the basic design of this proposed complex. The purpose of this report is to indicate on a preliminary basis the measures and treating units required to protect the environment in an economic way and to summarize the remaining effluent streams.

To get the required information, an environmental questionnaire has been prepared.

Recommendations for the establishing of environmental background levels and for measurements to define the effluent quantities during operation are also given.

2. CONCEPT FOR THE PROPOSED PROJECT

The proposed project is designed to provide the internal market with LPG, diesel, fuel oil and asphalt. The different products will be produced in sufficient quantities to meet the internal market requirements. The feed to the complex is the crude, produced in Suriname in a proposed quantity of 7,000 bpsd. Because of the heavy nature of the crude, a vacuum unit, a hydrocracker, a visbreaker and the related units are foreseen together with the required utility generation plants and storage and handling facilities. The produced naphtha will be used as feedstock for the hydrogen producing unit.

The plant is located at the left bank of the Suriname River near the Tout Lui Faut Canal, where six crude-oil storage tanks and an export terminal are already located.

Within the facilities the designs will be optimized to conform to the environmental standards. Air cooling will be maximized to reduce the water consumption.

3. <u>FEEDSTOCK CONSUMPTION AND OVERALL PRODUCTION RATES</u>

The feedstock to the unit is the heavy crude, produced in Suriname with a quantity of 7,000 bpsd (357,800 ton/year).

The products (for start of run situation) are as follows:

- LPG 645 barrels/day.
- Premium diesel 2,834 barrels/day.
- Fuel grade diesel 814 barrels/day.
- Heavy fuel oil 2,369 barrels/day.
- Asphalt (as requested) 100 barrels/day.

<u>Note</u>:
- Above figures are valid for start of run conditions.
- During asphalt production the production of heavy fuel will be reduced with approximately the same quantity.

4. PLANT LOCATION AND LAYOUT

The proposed complex shall be located at the Tout Lui Faut site of Staatsolie, where already six crude-oil tanks and an export terminal are located. The site is located approximately 5 miles south of Paramaribo on the left border of the Suriname River.

The following considerations must be taken into account for the setup on the plant layout:

- The access to the existing facilities must neither be hampered by the new units and equipment nor during the construction period.

- To prevent the soil being polluted with oil, areas around equipment must be paved. To minimize the quantity of rainwater polluted with oil, the total paved area must be minimum.

- All units and individual equipment must have easy access for operation and maintenance activities and maintenance equipment.

- Most of the new storage must be located close to the river side to reach short connecting lines.

5. DESCRIPTION OF THE PROPOSED PROJECT

5.1 GENERAL

The complex is designed to produce LPG, diesel in two grades, heavy fuel oil and asphalt from the crude feed.
No refinery by-products are produced.

Because of the heavy nature of the crude, the main units of the complex are a hydrocracker and a visbreaker unit, together with a hydrogen plant and different treating units for feed, intermediate and final products.

The complex will furthermore include utility generation units, storage and handling facilities and effluent treating systems.

The different units are described hereafter.

5.2 DESCRIPTION OF THE INDIVIDUAL UNITS

5.2.1 Preflash Unit Including Crude Preheat

The crude preheat train and preflash unit are designed to prepare the crude feed to the vacuum unit. A desalter will be incorporated to desalt and dry the crude and a preflash tower removes the light gases and water.

5.2.2 Vacuum Unit

The vacuum unit will produce a heavy vacuum residue, while also producing a light vacuum gas oil and a heavy vacuum gas oil. The unit will also produce asphalt.

5.2.3 Visbreaker Unit

The visbreaker unit will be fed with the vacuum residue and will produce a visbroken residue, some light hydrocarbons and naphtha.

5.2.4 Hydrocracker Unit

Under hydrogen pressure, the heavy vacuum gas oil from the vacuum unit will be cracked.

The main product is diesel oil. Other products, but in quantity much lower than diesel oil, are fuel oil and light ends.

2

5.2.5 Hydrogen Plant

The hydrogen generation plant will produce hydrogen for the hydrocracking process. As feedstock naphtha will be used, which is a part of the light end product from the hydrocracker unit.

5.2.6 Light Ends Unit

The light ends unit will be supplied with the light part of the products from the hydrocracker unit. The purpose is to produce LPG as main product. The produced naphtha and gas streams will be used as feedstock for the hydrogen plant and as fuel for the complex.

5.3 DESCRIPTION OF THE STORAGE AND HANDLING FACILITIES

5.3.1 Existing Storage Facilities

There are six (6) existing crude tanks, each with a capacity of 10,000 barrels. These tanks remain in operation.

5.3.2 New Storage Facilities

The following new storage tanks will be located within bund walls close to the jetty:

- Product Tanks
  - Diesel product : Three tanks.
  - Light VGO product : One tank.
  - Fuel-oil product : Three tanks (heated).
- Intermediate Tanks
  - Diesel rundown : Two tanks.
  - Visbreaker feed : Two tanks (heated).
  - Hydrocracker feed : One tank (heated).
  - Hydrogen plant feed : One bullet.

-	Refinery fuel oil	:	One or more tanks (heated).
-	Slop oil	:	Two tanks.
-	Light VGO	:	Two tanks.

Two new heated storage tanks for asphalt and four horizontal LPG pressure vessels will be located close to the truckloading station.

5.3.3 Handling Facilities

The crude oil will be unloaded to the existing crude tanks from barges at the existing jetty or from a future pipeline. New crude-oil transfer pumps will be installed adjacent to the tanks to deliver the crude to the preflash unit.

The LPG product will be pumped via an underground pipeline to a nearby government owned terminal or to an on-plot truckloading station.

The asphalt product will be pumped to an on-plot truckloading station.

The diesel product will be pumped via an underground pipeline to a nearby Shell Oil Co. products terminal and to the jetty for shiploading.

The light VGO will be handled with the diesel product loading system.

The fuel-oil product will be pumped to the jetty for shiploading.

Pumping systems will be provided for the intermediate products.

A truck weigh-scale station will also be provided.

5.4 DESCRIPTION OF THE UTILITY SYSTEMS

The refinery complex will be foreseen of all required utility generation and distribution systems, such as for:

- Steam generation.

- Plant and instrument air.

- Fuel oil and fuel gas.

  △2 The following streams are available for the fuel gas systems:

  - Hydrogen plant PSA gas.
  - Sour fuel gas from the light ends recovery unit.
  - Sour water stripper offgas.
  - LPG in excess of the market consumption.
  - △2 The vacuum ejector(s) vapors.

  For fuel oil the visbreaker fractionator residue will be used.

- Power generation for a part of the requirements, because the complex will be connected to the public grid too.

- Cooling water.

- Sewers and drain systems.

6. ENVIRONMENTAL QUESTIONNAIRE

An environmental questionnaire has been prepared to get the information required to prepare a preliminary survey of all environmental effluent streams and to define a preliminary treating scheme.

In a later stage, when more specific and definitive information becomes available, a final treating scheme must be defined, meeting the environmental requirements.

The environmental questionnaire is given in appendix 1.

7. SURVEY OF EXPECTED EFFLUENT STREAMS FROM THE COMPLEX

A survey of the effluent streams discharged by the units has been prepared.

Because of the early stage of the basic engineering, all information is preliminary. A scheme showing the effluent streams is given in appendix 2.

To protect the environment, a number of measures in the design of the complex can be taken (see chapter 8). Also the installation of treating units will reduce the number of effluent streams, the quantity or will treat the effluent streams up to acceptable qualities.

A survey of the effluent streams discharged to the environment by the complex is presented in appendix 3.

8. MEASURES RECOMMENDED TO PROTECT THE ENVIRONMENT

8.1 GENERAL

Industrial complexes, like the proposed refinery complex will always give a certain level of environmental pollution. To reduce this environmental pollution to a maximum, the optimal solution is to avoid the pollution at all or to minimize the pollution at the source by different design measures. The second best method is to treat the pollution as close to the source as possible, where the volume flows are still minimal and the concentration maximal. This makes the treating as efficient as possible, normally against lower costs.

8.2 DESIGN MEASURES

A number of different design measures can be utilized within the process plants and utility generation units to prevent or minimize the environmental pollution.

The following design measures are suggested to be incorporated into the design of the complex:

8.2.1 Measures Dealing With Air Pollution

- To limit the NO_x pollution, low NO_x type burners will be installed and the excess air quantities will be limited as much as possible. This will also result in higher efficiencies, giving lower fuel consumptions and in ratio lower pollution levels of all components.

- All relief valves, discharging hydrogen, hydrocarbons or other flammable gases, will be connected to a closed flare header collecting system discharging into a single emergency flare. Operation will be smokeless during nonemergency venting.

- To minimize the hydrocarbon emission from storage tanks, it is recommended to store hydrocarbon liquids with a vapor pressure above 0.1 bar abs at storage temperature in floating roof tanks. This is in accordance with the American standards. The seal construction of the floating roof must be a double type.

- During draining of hydrocarbons from equipment, vapors will flash from the liquid. When the equipment drains are hooked up to the collecting system via open funnels, these vapors will discharge into the environment. Therefore hydrocarbon drains from equipment should be connected liquid- and vapor tight to the collecting system. The collecting drum should be connected to the flare header system to collect these flashing hydrocarbon vapors.

- Where possible, it is recommended to install vapor return lines at loading/unloading facilities, thus minimizing the vapor losses.

- To minimize small hydrocarbon losses, it is advisable to maximize welded connections, to use mechanical seals on pumps, to cover free surfaces in the treatment facilities where oil layers can be present, etc.

- To prevent storage tanks from overfilling, it is advisable to install overflow protection facilities.

- Design methods to prevent or minimize the generation of noise are described in paragraph 8.4.

8.2.2 Measures Dealing With Water Pollution

- The areas underneath equipment in the process and utility generation areas have to be paved with concrete to minimize the soil and groundwater pollution.

- To minimize the oil-polluted run-off water quantities, it is proposed to install oil-free and oil-contaminated sewer systems. Process plant and utility generation areas are normally considered as oil contaminated. Building roofs, roads and unpaved areas are normally oil free. The diked areas around storage tanks can be connected to both systems, depending on the quality of the collected water.

- The installation of closed hydrocarbon drain systems to avoid spillage on the paved areas, thus preventing or minimizing the pollution of run-off water. The collected hydrocarbon liquid can be reprocessed or can be used as fuel.

- The use of nonchromate type chemicals for the cooling water system to avoid chromate contamination of the effluent water.

- The maximum reuse of water will reduce the effluent water streams and is also saving water make-up quantities.

- The maximum air cooling in the plant reduces the cooling-water requirements, at the same time reducing proportionally the contaminated cooling water blow-down quantities.

- To minimize small hydrocarbon losses contaminating run-off water, it is advisable to maximize welded connections, to use mechanical pump seals, etc.

- Minimizing the spillage of oil during plant operation by proper operator training and housekeeping. Also scheduled and proper maintenance and control techniques are of principal importance.

8.2.3 Measures Dealing With Solid Effluents

- The solid particles in flue gases must be minimized by using the proper combustion systems. Because fuel gas and fuel oil will be used only, there will be a negligible production of these particles, because the ash content of these fuels is very low.

- Spent catalyst charges must be packed properly in accordance vendor's instructions. In most cases these will be returned to vendor for cleaning and regeneration.

- Smoke formation by the flare will only occur during emergency situations in the plant. During normal operation of the facilities, only minor flows will be sent to the flare, which will be burned smokeless with the aid of steam injection in the flare tip.

- Household waste from offices, canteens, etc., must be collected and stored in disposal containers before transferring to the public collection system.

8.3 TREATING SYSTEMS

In spite of all possible measures to prevent pollution, it is unavoidable that for a number of situations polluted streams will be generated, such as flue gas from combustion, oil-polluted rainwater runoff and cooling tower blowdown. The following treating methods are recommended on top of the design measures described in paragraph 8.2:

- Waste water treating facilities to treat all aqueous waste streams, such as:

    - Sanitary waste water.
    - Oil-contaminated run-off water.
    - Cooling water blowdown.
    - Desalter water.
    - Boiler blowdown.

    The waste water treating facilities could consist of the following units:

    - Gravity-type oil separation facilities.
    - Flocculation/flotation unit.
    - Biological treating unit.
    - Sludge thickening facilities.
    - Oil and slops collecting and handling facilities.

- Spent caustic treating facilities to treat spent caustic and sour water streams.

- Noise abatement system is described in paragraph 8.4.

- Incineration facilities to burn waste oils, sludge from the waste water treating facilities, etc.

8.4 NOISE

In-plant and environmental noise can be limited by:

- Using low-noise type equipment.

- Noise attenuation methods.

- A combination of both methods.

It is recommended to use low-noise type equipment where it is feasible and economical.

Commonly used low-noise type equipment is:

- Air coolers.
- Electromotors.
- Control valves.

Attenuation methods are:

- In-line silencers.
- Blow-off silencers.
- Burner muffles.
- Insulation material around pipelines and equipment.
- Noise hoods and shielding.

In most actual situations a combination of the above-mentioned methods is required to match the in-plant and environmental noise criteria.

8.5 GENERAL ASPECTS OF PLOT PLAN LAYOUT

Because of distances to the nearest houses and prevailing wind direction, it is advisable to locate the process units close to the east side of the available area, preferably close to the Suriname River.

Storage tanks have to be grouped together and surrounded by bund walls.

Distances between equipment, units, storage tanks, etc., must be in accordance with a safety code as for instance the refining safety code, issued by the Institute of Petroleum.

9. RECOMMENDATIONS TO DEFINE BACKGROUND LEVELS

To be able to verify the pollution added by the refinery complex, it is required to measure the levels of the requested limitations before and after start-up of the facilities.

Because of the seasonal swings, it is required that the relevant information is available throughout the year. At least average, maximum and minimum values are required.

We recommend to measure the base load of the following parameters:

1. Air

- SO_2/SO_3.
- NO_x.
- CO.
- Particulate.

2. Water

Quality of the Suriname River water:

- pH.
- Temperature.
- Salt.
- Suspended solids.
- BOD.
- Oxygen.
- Other components; when relevant.

For the water in the Tout Lui Faut Canal the available capacity throughout the year is required to decide if this water can be used. When the water will be used the same parameters are required.

3. Noise

The sound pressure level at 1½ m height is required at the plant boundaries per frequency band and in d B(A).

ENVIRONMENTAL-QUESTIONNAIRE

Questionnaire for the ecological influence of the proposed installations (production units and utility generating units).

To be able to prepare a reasonable prediction of the ecological influence of the proposed installations, it is required to get the relevant information in the early stage of the design.

This environmental questionnaire is meant to get this information as quick as possible, however most of the information will be of a preliminary nature.

As soon as the information becomes available, it will be possible to define if additional treating is required and to decide about recommendations for the required treating methods.

I Information about the unit.

Information is required about relevant typicals of the unit. The following is requested :

- Throughput.
- Feeds, products and if applicable by-products.
- General information about the layout and plot requirements with respect to rainwater runoff.
- For storage tanks or (un)loading facilities, incorporated in the unit design, the number, volume, type and contents of each of these tanks and capacities of the (un)loading station.

II Information about the required utilities.

Information is required about the quantities and qualities of the required utilities. All required utilities have to be listed.

For each utility the following information is requested :

- Estimated quantities, when applicable for all different operating cases.
- Required quality or other physical properties, f.i. composition, heating value, in/out going temperature, power consumption, etc.

III Information about treating plants within the units.

The following information about treating plants, when foreseen within the units, is requested :

- Characteristics of the treating units.
- Required chemicals if relevant.
- Required utilities with quantities.

IV Information about the effluent streams.

The effluent streams are normally vent-, flue- and flare gases, liquid effluent streams and solid effluents.

The environmental pollution can be expected from vent- and flue gas stacks, flare stacks, loading and unloading facilities, storage tanks, process water effluents, sanitary sewers, leaking flanges, drain systems, etc.

The following information about the nature, composition, toxicological properties and the quantity of the effluents is required :

a Vent gases for each individual source as vents from drain systems, etc.
  - Quantity and frequency
  - Source, composition and temperature
  - Toxicological properties
  - Location of venting points

b Flue gases, for each source.
  - Type of fuel
  - Quantity of the flue gases
  - Composition with respect to SO_2/SO_3-, NO_X-,CO- and particulate content
  - Temperature

c Flare gases, when separate systems are foreseen for each of these systems.
  - Quantities and duration for the possible failure cases
  - Composition or molecular weight
  - Temperature
  - Recommended steam supply for smokeless burning

d Process water.
  - Quantities and duration
  - Composition, pH and temperature

IV Information about the effluent streams (cont'd).

e Domestic waste water.
- Quantity
- Quality as BOD, COD, N-Kjeldahl and pH
- Suspended solids

f Cooling water if required.
- Quantity
- Required temperatures

g Boiler blow-down.
- Quantity
- Quality as pH and suspended solids
- Proposed chemicals

h Solid effluents.
- Quantity
- Nature and composition
- When applicable information about the containment

To be able to give recommendations for collection and further treatment of the effluents the following information is also requested:

- Recommended treating or handling methods for specific effluents.

- Recommended chemicals for treating, if relevant.

- Possibility of reuse or recirculation with or without additional treating.

- When applicable the containment or the proposed disposal method of solid effluents.

V Information about noise levels.

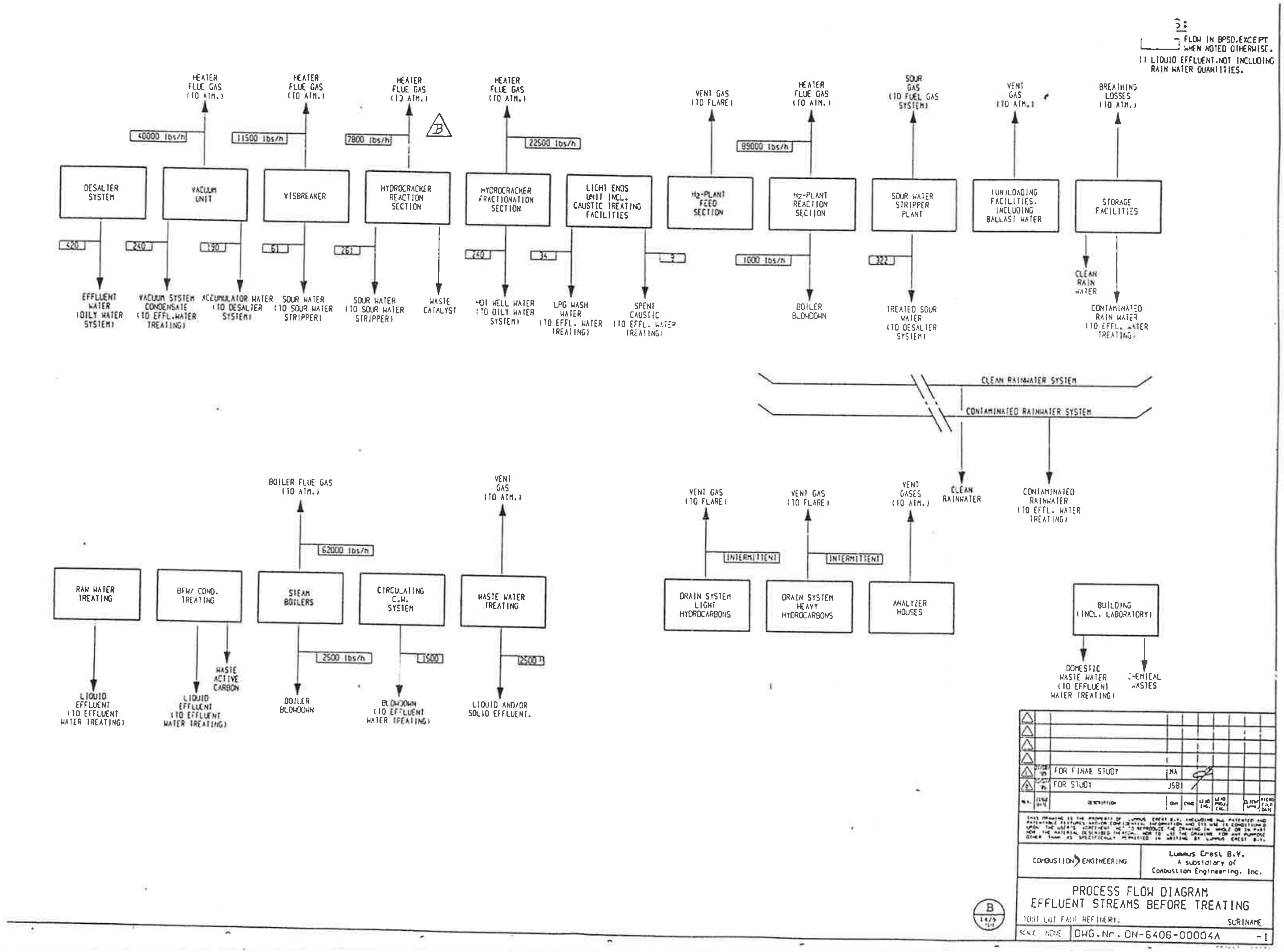
To be able to estimate the in-plant and environmental noise levels the following information is required :

- Estimated sound power level of the entire unit.
- Sound pressure levels of the individual noise sources.
- When applicable information about narrow band noise.
- When applicable information about pulsation noise.

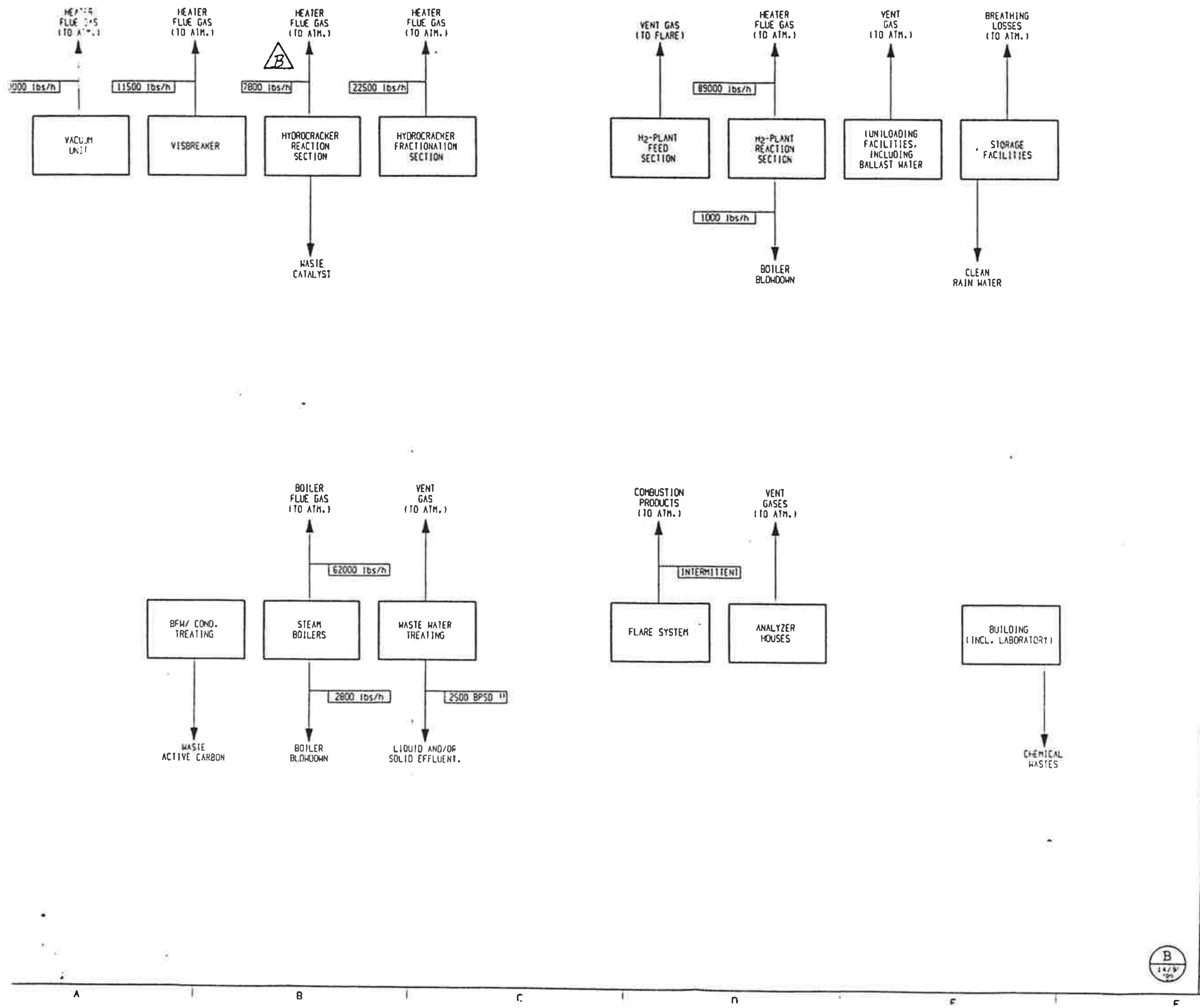
When this information is available, it is possible to give recommendations if noise reducing measures will be required.

VI Recommendations for treating or prevention.

Recommendations are requested, when there are special treating methods required or for possibilities to prevent one or more of the effluents.



FLOW IN BPSD. EXCEPT WHEN NOTED OTHERWISE.
1) LIQUID EFFLUENT. NOT INCLUDING RAIN WATER QUANTITIES.
DESALTER SYSTEM
VACUUM UNIT
VISBREAKER
HYDROCRACKER REACTION SECTION
HYDROCRACKER FRACTIONATION SECTION
LIGHT ENDS UNIT INCL. CAUSTIC TREATING FACILITIES
H2-PLANT FEED SECTION
H2-PLANT REACTION SECTION
SOUR WATER STRIPPER PLANT
(UN)LOADING FACILITIES. INCLUDING BALLAST WATER
STORAGE FACILITIES
HEATER FLUE GAS (TO ATM.)
40000 lbs/h
11500 lbs/h
7800 lbs/h
22500 lbs/h
VENT GAS (TO FLARE)
89000 lbs/h
SOUR GAS (TO FUEL GAS SYSTEM)
VENT GAS (TO ATM.)
BREATHING LOSSES (TO ATM.)
420
240
190
61
261
240
34
3
1000 lbs/h
322
EFFLUENT WATER (OILY WATER SYSTEM)
VACUUM SYSTEM CONDENSATE (TO EFFL. WATER TREATING)
ACCUMULATOR WATER (TO DESALTER SYSTEM)
SOUR WATER (TO SOUR WATER STRIPPER)
WASTE CATALYST
HOT WELL WATER (TO OILY WATER SYSTEM)
LPG WASH WATER (TO EFFL. WATER TREATING)
SPENT CAUSTIC (TO EFFL. WATER TREATING)
BOILER BLOWDOWN
TREATED SOUR WATER (TO DESALTER SYSTEM)
CLEAN RAIN WATER
CONTAMINATED RAIN WATER (TO EFFL. WATER TREATING)
CLEAN RAINWATER SYSTEM
CONTAMINATED RAINWATER SYSTEM
CLEAN RAINWATER
CONTAMINATED RAINWATER (TO EFFL. WATER TREATING)
BOILER FLUE GAS (TO ATM.)
62000 lbs/h
VENT GAS (TO ATM.)
RAW WATER TREATING
BFW/ COND. TREATING
STEAM BOILERS
CIRCULATING C.W. SYSTEM
WASTE WATER TREATING
2500 lbs/h
1500
2500 1)
LIQUID EFFLUENT (TO EFFLUENT WATER TREATING)
WASTE ACTIVE CARBON
BOILER BLOWDOWN
BLOWDOWN (TO EFFLUENT WATER TREATING)
LIQUID AND/OR SOLID EFFLUENT.
VENT GAS (TO FLARE)
INTERMITTENT
DRAIN SYSTEM LIGHT HYDROCARBONS
DRAIN SYSTEM HEAVY HYDROCARBONS
ANALYZER HOUSES
VENT GASES (TO ATM.)
BUILDING (INCL. LABORATORY)
DOMESTIC WASTE WATER (TO EFFLUENT WATER TREATING)
CHEMICAL WASTES
FOR FINAL STUDY
MA
FOR STUDY
JSBI
DESCRIPTION
COMBUSTION ENGINEERING
Lummus Crest B.V.
A subsidiary of Combustion Engineering, Inc.
PROCESS FLOW DIAGRAM
EFFLUENT STREAMS BEFORE TREATING
SURINAME
SCALE NONE
DWG. Nr. ON-6406-00004A
-1



NOTES:

1) LIQUID EFFLUENT, NOT INCLUDING RAIN WATER QUANTITIES.

REV.	ISSUE DATE	DESCRIPTION	DN	CHKD	LEAD ENG.	LEAD PROJ. ENG.	CLIENT APPR.
B		FOR FINAL STUDY	MK				
A		FOR STUDY	JSB				

COMBUSTION ENGINEERING

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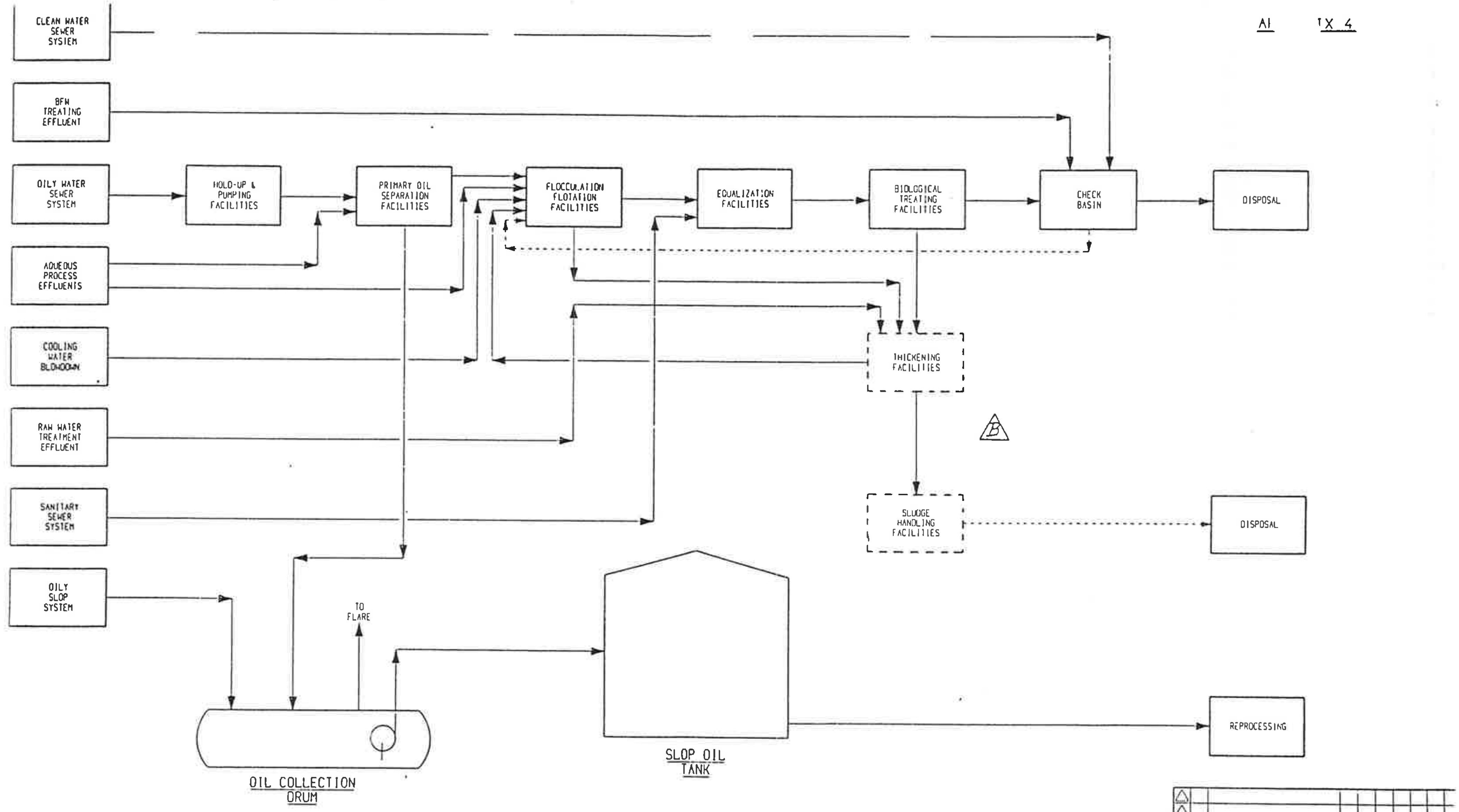
PROCESS FLOW DIAGRAM
ENVIRONMENTAL POLLUTION STREAMS

TOUT LUI FAUT REFINERY. SURINAME

SCALE NONE DWG.Nr. DN-6406-00004B



	TOTAL STUDIE	JSB					
REV.	DESCRIPTION	DR	DWG				

COMBUSTION ENGINEERING

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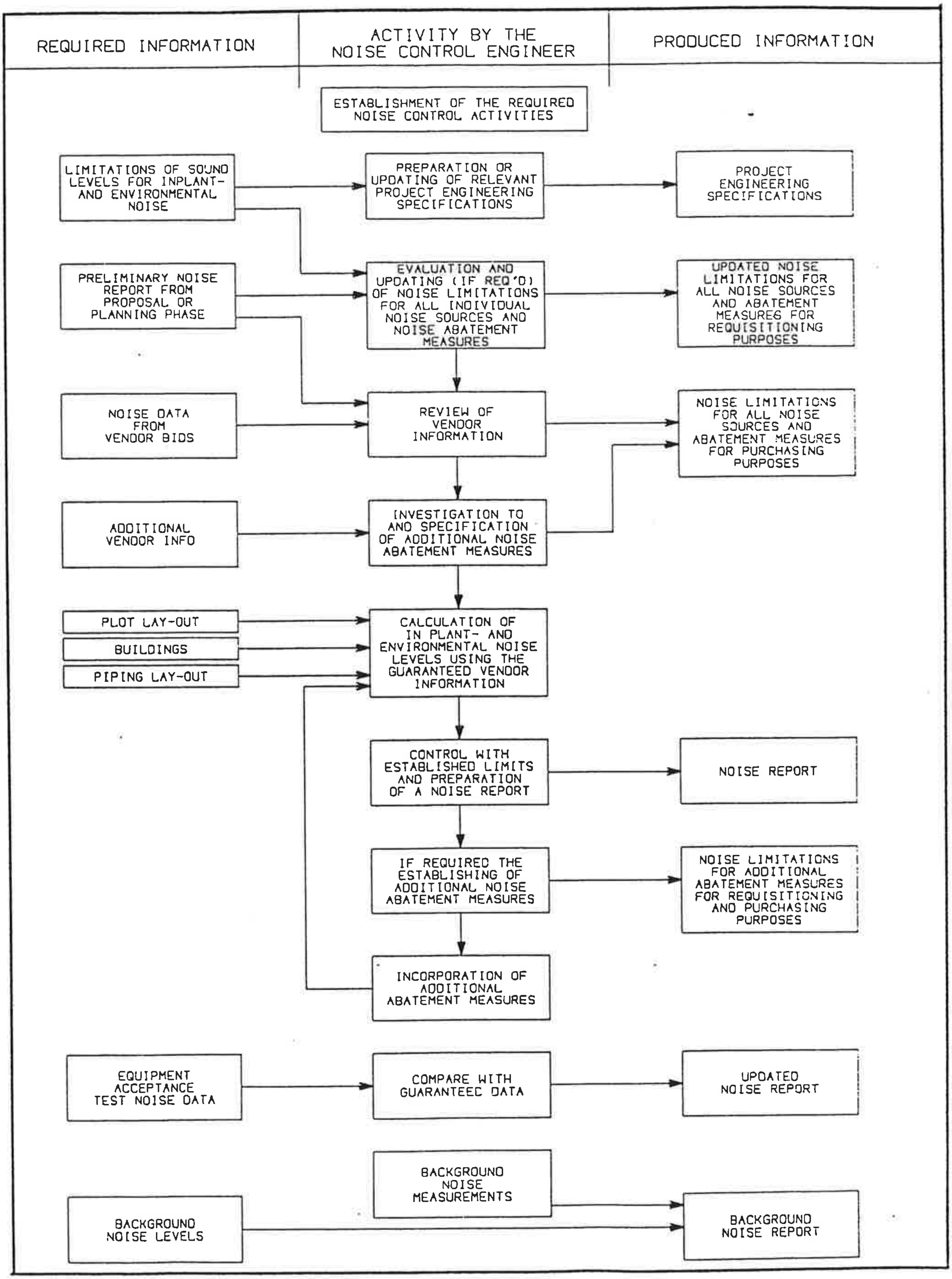
PROCESS FLOW DIAGRAM
EFFLUENT TREATING

TOUT LUI FAUT REFINERY. SURINAME

DWG. Nr. DN-6406-00004C -0

LOGINNR. 3356


REQUIRED INFORMATION
ACTIVITY BY THE NOISE CONTROL ENGINEER
PRODUCED INFORMATION
ESTABLISHMENT OF THE REQUIRED NOISE CONTROL ACTIVITIES
LIMITATIONS OF SOUND LEVELS FOR INPLANT- AND ENVIRONMENTAL NOISE
PREPARATION OR UPDATING OF RELEVANT PROJECT ENGINEERING SPECIFICATIONS
PROJECT ENGINEERING SPECIFICATIONS
PRELIMINARY NOISE REPORT FROM PROPOSAL OR PLANNING PHASE
EVALUATION AND UPDATING (IF REQ'D) OF NOISE LIMITATIONS FOR ALL INDIVIDUAL NOISE SOURCES AND NOISE ABATEMENT MEASURES
UPDATED NOISE LIMITATIONS FOR ALL NOISE SOURCES AND ABATEMENT MEASURES FOR REQUISITIONING PURPOSES
NOISE DATA FROM VENDOR BIDS
REVIEW OF VENDOR INFORMATION
NOISE LIMITATIONS FOR ALL NOISE SOURCES AND ABATEMENT MEASURES FOR PURCHASING PURPOSES
ADDITIONAL VENDOR INFO
INVESTIGATION TO AND SPECIFICATION OF ADDITIONAL NOISE ABATEMENT MEASURES
PLOT LAY-OUT
BUILDINGS
PIPING LAY-OUT
CALCULATION OF IN PLANT- AND ENVIRONMENTAL NOISE LEVELS USING THE GUARANTEED VENDOR INFORMATION
CONTROL WITH ESTABLISHED LIMITS AND PREPARATION OF A NOISE REPORT
NOISE REPORT
IF REQUIRED THE ESTABLISHING OF ADDITIONAL NOISE ABATEMENT MEASURES
NOISE LIMITATIONS FOR ADDITIONAL ABATEMENT MEASURES FOR REQUISITIONING AND PURCHASING PURPOSES
INCORPORATION OF ADDITIONAL ABATEMENT MEASURES
EQUIPMENT ACCEPTANCE TEST NOISE DATA
COMPARE WITH GUARANTEED DATA
UPDATED NOISE REPORT
BACKGROUND NOISE MEASUREMENTS
BACKGROUND NOISE LEVELS
BACKGROUND NOISE REPORT

Main Office: P. O. Box 956. Tyler, Texas 75710-0956 Phone: 214/597-0311 Cable: HOWBACO Telex: 735450

July 7, 1989

Howe-Baker Engineers, Inc.

Staatsolie Maatschappij Surimname N.V.
C/O Howe-Baker Engineers, Inc.
P.O. Box 956
Tyler, Texas 75710

Attention: Mr. Marc Waaldijk
Project Manager

Reference: STAATSOLIE SURINAME REFINERY
HBE Project J-1317

Letter No. HB/SUR-034

Subject: ENVIRONMENTAL INFORMATION

Gentlemen:

Staatsolie has requested that Howe-Baker furnish certain information to be used to ascertain the ecological influence of the proposed Staatsolie Suriname Refinery. Specifically, Howe-Baker has been asked to respond to an Environmental Questionnaire submitted by Staatsolie. In responding to this questionnaire, Howe-Baker has been asked to submit our specific scheme for handling gaseous, liquid, and/or solid emissions or wastes.

Additionally, Staatsolie submitted to Howe-Baker a document entitled "Preliminary Environmental Standards for Staatsolie Suriname Refinery". Howe-Baker was asked to perform calculations for heater stack emission quality and ground level ambient air quality for the scheme which we will propose. The purpose of these calculations is to ascertain that our stack emission levels and ground level concentrations are in general agreement with certain preliminary environmental standards before submitting our proposed scheme. The purpose of this letter is to report our findings, make recommendations, and briefly describe our specific scheme.

Since sulfur emission levels appear to be reasonable and probably acceptable, Howe-Baker suggests that sulfur recovery processes be avoided; this will avoid considerable capital investment and also eliminate the problem of elemental sulfur disposal. Additionally, Howe-Baker suggests that the installation of an amine unit be avoided; this eliminates capital investment and since our plan is to burn sour gas in certain process heaters, concentration of hydrogen sulfide is neither required nor desirable.

The following streams are available as fuel sources:

1. Hydrogen plant PSA gas
2. Sour fuel gas from the light ends recovery unit
3. Sour water stripper off-gas
4. LPG in excess of the market consumption
5. Visbreaker fractionator residuum (fuel oil)

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A Subsidiary of Process Systems International, Inc.

Howe-Baker Engineers, Inc.

It is recommended that fuel sources be utilized as follows:

A. All PSA gas will be utilized in the hydrogen plant reforming furnaces. Sour fuel gas will furnish the remainder of the combustion requirement. Fuel oil will neither be utilized nor piped to these furnaces due to tube metallurgy considerations. Vaporized LPG will be piped as a back-up fuel. The estimated SOx emission level from these furnaces is a maximum of 1.1 G/M Joule.

B. All of the sour water stripper off-gas will be burned in the preflash/vacuum unit heater, along with the sour fuel gas. It is important that all of the sour water stripper gas be burned in one furnace since this piping must be steam traced and insulated and a burner of special design must be utilized in order to combust this gas. Fuel oil and LPG will also serve as fuels to this heater. Assuming that no LPG is burned routinely in this heater, this heater would have an SOx emission level of approximately 5.7 G/M Joule SOR and 6.9 G/M Joule EOR. Substitution of LPG for fuel oil would cut the emission level somewhat.

C. Fuel oil and LPG will be burned in all of the other heaters. Assuming that fuel oil is burned entirely, these furnaces would have an SOx emission level of approximately 0.43 G/M Joule.

The above system would yield an overall plant SOx emission level of approximately 1.5 G/M Joule. This number is based upon firing no LPG. Should 200 BPSD of LPG be burned, the SOx emission level could be reduced to approximately 1.4 G/M Joule. The sour water stripper off-gas and sour fuel gas are the primary SOx contributors.

Utilizing the recommended fuel distribution and firing system, the NOx emission levels calculate to be 120-160 mg/M Joule for the individual heaters utilizing standard burners at 250 vppm NOx in the stack effluent. Use of low NOx burners would reduce the numbers significantly. It is viewed that particulates would consist entirely of ash from fuel oil firing. If ash formation is considered to be 0.001 weight fraction of fuel oil fired, considered to be an acceptable number, then no heater would have a particulate emission of more than approximately 50 mg/m3 of stack gas.

It may be seen from this discussion that the only emission of question as concerns the preliminary environmental standards is SOx emission. Even so, a requirement for 50 foot minimum stack height for any heater should yield a ground level concentration of approximately 100 micrograms/m3 SOx. If it is stipulated that the preflash/vacuum unit heater, the main contributor, be furnished with a 75-100 foot stack, the aforesaid value should be easily met.

The above is considered to be a viable design, and on this basis we will now proceed to respond to the Environmental Questionnaire. Should you have any reservations, please notify us immediately.

Yours very truly,
Howe-Baker Engineers, Inc.

Dan McDonald

DGM:RLG
cc: RDB, DRD, PLC

April 19, 1990

Staatsolie Suriname Refinery
7,000 BPSD Refinery
Howe-Baker Project J-1317

Corrections to Letter HB/SUR-037 - Environmental Questionnaire Response

Since the submittal of the aforementioned letter on July 14, 1990, several changes have been made to the refinery design.

Below are the necessary revisions to the letter that follows, as well as corrections to the "Attachments" list required in order to reference the lastest information:

Section 3. INFORMATION ABOUT TREATING PLANTS WITHIN THE UNITS
The third and last sentence of this section should read as follows:
"Spent caustic will be routed to the oily water disposal system."

Appendix A: Process Block Flow Diagram - see Volume I, Refinery Balances
Appendix B: Utilities Block Flow Diagram - see Volume I, Refinery Balances
Appendix C: PARC Suriname Crude Assay - see Volume I, Basic Engineering Design Criteria (Attachment B)
Appendix D: Properties of Refinery Products - see Volume I, Refinery Balances
Appendix E: Refinery Yield Structure - see Volume I, Refinery Balances
Appendix F: Utility Consumptions - see Volume I, Refinery Balances
Appendix H: Furnace Fuel Requirements - Retitled "Fired Heaters - Fuel Summary"

Main Office: P. O. Box 956, Tyler, Texas 75710-0956 Phone: 214/597-0311 Cable: HOWBACO Telex: 735450

Howe-Baker Engineers, Inc.

July 14, 1989

Staatsolie Maatschappij Surimname N.V.
C/O Howe-Baker Engineers, Inc.
P.O. Box 956
Tyler, Texas 75710

Attention: Mr. Marc Waaldijk
Project Manager

Reference: STAATSOLIE SURINAME REFINERY
HBE Project J-1317

Letter No. HB/SUR-037

Subject: ENVIRONMENTAL QUESTIONNAIRE RESPONSE

Gentlemen:

Attached, you will find four copies of our response to the environmental questionnaire issued with your letter no. SUR/HB-030 dated June 14, 1989.

Please let us know if additional information is required.

Yours very truly,
Howe-Baker Engineers, Inc.

Dan McDonald

Dan McDonald

cc: RDB, DRD, PLC

STAATSOLIE SURINAME REFINERY

HBE PROJECT J-1317

ENVIRONMENTAL QUESTIONNAIRE RESPONSE

1. INFORMATION ABOUT THE UNIT

State Oil Company Suriname, N.V., proposes to install a 7,000 BPSD refinery to be located at Tout Lui Faut, Suriname. The charge stock will be Suriname crude. The primarily desired product is diesel fuel, and the goal of maximizing diesel production determined the basic refinery configuration. The proposed refinery configuration is shown on the appended Process Block Flow Diagram, Dwg. 1317-DF-001, attached as Appendix A. The required utilities support systems are shown on the attached Utilities Block Flow Diagram, Dwg. 1317-DF-002, included as Appendix B.

Two viable sources of crude oil assay information were available for design purposes. These were:

1. E. W. Saybolt & Co., Inc. assay of September, 1986, included in Howe-Baker Feasibility Study J-1203-2.
2. Pittsburgh Applied Research Corporation assay accompanying transmittal letter of April 11, 1988, to F. H. James Consulting Engineer, Inc.

Although both assay sources were utilized to develop a crude oil TBP curve and crude oil gravity, the PARC assay was utilized for determination of all distillate and heavier fraction physical properties. The PARC assay is attached as Appendix C.

The final refinery products are as follows:

1. LPG
2. Premium Diesel
3. Fuel Grade Diesel
4. Heavy Fuel Oil (primary grade and alternate grade)
5. Asphalt (alternate operation)

No refinery by-products are produced. The properties of the refinery products are attached as Appendix D. The refinery yield structure is attached as Appendix E. Due to the types of process units included in the refinery, start of run and end of run conditions will exist. Yields and utility consumptions are provided for both cases.

All rainwater runoff within the refinery will be collected in one of two systems: the Oily Water Sewer System or the Non Contaminated Surface Drainage System. Rainwater falling within the battery limits of process units will be considered contaminated and will be routed to the oily water sewer. Rainwater falling within the dikes containing storage tanks will be routed to the oily water sewer, however the capability will be provided for an operator to divert this water to the non contaminated surface drainage system after an initial period of rainfall. All other rainwater falling outside the process units and the storage areas will be routed by open ditches to the non contaminated surface drainage retention pond.

STAATSOLIE SURINAME REFINERY

HBE PROJECT J-1317

ENVIRONMENTAL QUESTIONNAIRE RESPONSE

1. INFORMATION ABOUT THE UNIT - continued

The refinery will include the following tankage and product handling facilities:

Crude oil will be unloaded from barge at the existing jetty or from a future pipeline at 80 deg F. min. and stored in six existing 10,000 barrel tanks. Crude oil transfer pumps will be installed adjacent to the crude tanks and deliver crude to the preflash unit battery limits at 40 psig.

LPG product storage will consist of four 1,000 bbl. horizontal pressure vessels. LPG product will be delivered by underground pipeline to the nearby government owned terminal at a nominal rate of 300 GPM and delivered over a single spot refinery LPG loading rack with two loading stations at a nominal rate of 300 GPM.

Diesel product storage will consist of three 25,000 bbl. tanks. Diesel product will be delivered by underground piping to the nearby Shell Oil Co. products terminal at a nominal rate of 400 GPM and delivered over the jetty at a nominal rate of 1200 GPM.

LVGO product storage will consist of one 10,000 bbl. product storage tank. LVGO product loading will be handled with the diesel loading system.

Fuel oil product will consist of three 10-12,000 bbl. heated tanks. Fuel oil will be loaded out across the jetty at a nominal rate of 1200 GPM.

Asphalt product will consist of two - 1,000 bbl. heated tanks near the loading rack and will be loaded across a single spot refinery loading rack with two loading stations at a nominal rate of 250 GPM. There will also be one 5,000 bbl. tank within the plant.

Intermediate tankage will consist of the following:

Diesel Rundown - two 5,000 bbl. tanks
Visbreaker Feed Tank - two 10,000 bbl. heated tanks
Hydrocracker Feed Tank - one 20,000 bbl heated tank
Hydrogen Plant Feed Tank - one 1,000 bbl. bullet
Refinery Fuel Oil Tank - one or two 600 bbl. heated tanks
Slop Oil Tanks - two 5,000 bbl tanks
LVGO Rundown/Storage - two 5,000 bbl. tanks

A truck weigh scale station will be required to weigh both bob tail and tractor trailer trucks.

STAATSOLIE SURINAME REFINERY

HBE PROJECT J-1317

ENVIRONMENTAL QUESTIONNAIRE RESPONSE

2. INFORMATION ABOUT THE REQUIRED UTILITIES

Estimated utility consumptions for the refinery are attached as Appendix F. The required qualities and/or physical properties of the various utilities are attached as Appendix G.

The following streams are available as fuel sources:

1. Hydrogen plant PSA gas
2. Sour fuel gas from the light ends recovery unit
3. Sour water stripper off-gas
4. LPG in excess of the market consumption
5. Visbreaker fractionator residuum (fuel oil)

It is planned that fuel sources be utilized as follows:

A. All PSA gas will be utilized in the hydrogen plant reforming furnaces. Sour fuel gas will furnish the remainder of the combustion requirement. Fuel oil will neither be utilized nor piped to these furnaces due to tube metallurgy considerations. Vaporized LPG will be piped as a back-up fuel. The estimated SOx emission level from these furnaces is a maximum of 1.1 G/M Joule.

B. All of the sour water stripper off-gas will be burned in the preflash/vacuum unit heater, along with the sour fuel gas. It is important that all of the sour water stripper gas be burned in one furnace since this piping must be steam traced and insulated and a burner of special design must be utilized in order to combust this gas. Fuel oil and LPG will also serve as fuels to this heater. Assuming that no LPG is burned routinely in this heater, this heater would have an SOx emission level of approximately 5.7 G/M Joule SOR and 6.9 G/M Joule EOR. Substitution of LPG for fuel oil would cut the emission level somewhat.

C. Fuel oil and LPG will be burned in all of the other heaters. Assuming that fuel oil is burned entirely, these furnaces would have an SOx emission level of approximately 0.43 G/M Joule.

The above system would yield an overall plant SOx emission level of approximately 1.5 G/M Joule. This number is based upon firing no LPG. Should 200 BPSD of LPG be burned, the SOx emission level could be reduced to approximately 1.4 G/M Joule. The sour water stripper off-gas and sour fuel gas are the primary SOx contributors.

STAATSOLIE SURINAME REFINERY

HBE PROJECT J-1317

ENVIRONMENTAL QUESTIONNAIRE RESPONSE

3. INFORMATION ABOUT TREATING PLANTS WITHIN THE UNITS

The only product treating unit within the plant is a caustic treating unit on LPG product. Fresh caustic make-up is expected to be 0.25 GPM of 2-4 weight percent sodium hydroxide. Spent caustic will be oxidized with steam to sodium sulfate.

4. INFORMATION ABOUT THE EFFLUENT STREAMS

a. No gases will be vented as a part of normal plant operational procedures. Minimal quantities of fractionation column overhead vapors may be released to flare as part of the tower pressure control system; however, this would be minimal and intermittent. Any continuously venting stream will be routed to a heater firebox, for example, the vacuum ejector(s) vapors, sour water stripper off-gas, and hydrogen plant PSA gas will all be routed to heater fireboxes.

b. Heater and boiler flue gases will be discharged to atmosphere. Heater thermal efficiency will be a minimum of 80%. Low NOx burners will be supplied if required to meet final emission requirements.

c. A single emergency flare will be provided. Operation will be smokeless during non-emergency venting.

d. Sour process water from the visbreaker and hydrocracker units will be routed to a sour water stripper. Stripped sour water is expected to contain 1 wppm hydrogen sulfide and 14 wppm ammonia. This stripped water, along with amine neutralized preflash/vacuum unit hot well water, is collected and used for crude oil desalting. Desalter effluent water, along with hydrocracker vacuum fractionation column hot well water, sulfur free, is routed to oily water sewer. Process water disposition is summarized in attached Appendix J.

e. The Sanitary Sewer system will consist of a packaged treatment unit. The liquid waste from this unit will be routed to the inlet of the waste water treatment and the solids or sludge will be periodically pumped out and trucked off.

This system will serve approximately 150 people within the refinery. Distribution of these 150 people will be as follows:

90 - people on the day shift
30 - people on the evening shift
30 - people on the night shift

4. INFORMATION ABOUT THE EFFLUENT STREAMS - continued

f. The cooling water for the refinery will be a circulating system; no once-through cooling water will be used. The circulation rate on the cooling water system will be 10,834 gpm with a supply temperature of 90 deg. F and a maximum return temperature of 120 deg. F.

g. The estimated boiler blow down for the total refinery will be approximately 3800#/hr. The pH will be approximately 10.5 and the suspended solids in the blow down will be a maximum of 150 ppm. Chemical additions in the boiler have not yet been defined, but are expected to be typical chemical additions for prevention of scale and corrosion.

h. Hydrocracker catalyst will be removed and regenerated outside of Suriname. Small quantities of coke particles will be collected during furnace decoking in a decoking drum and disposed of locally.

5. INFORMATION ABOUT NOISE LEVELS

The purchased equipment and final plant design will be governed by the noise level exposure limitations of the Occupational Safety and Health Administration (OSHA) as follows:

Duration per day (hours)	Sound Level 3 ft (dBA, slow response)
8	90
4	95
2	100
1	105
1/2	110
1/4 or less	115

6. RECOMMENDATIONS FOR TREATING OR PREVENTION

Air cooling has been maximized as feasible in order to minimize cooling water requirements.

STAATSOLIE SURINAME REFINERY

HBE PROJECT J-1317

ENVIRONMENTAL QUESTIONNAIRE RESPONSE

ATTACHMENTS

Appendix A	:	Process Block Flow Diagram
Appendix B	:	Utilities Block Flow Diagram
Appendix C	:	Pittsburgh Applied Research Corporation Suriname Crude Oil Assay
Appendix D	:	Properties of Refinery Products LPG Premium Diesel Fuel Grade Diesel Heavy Fuel Oil Asphalt
Appendix E	:	Refinery Yield Structure
Appendix F	:	Utility Consumptions
Appendix G	:	Utility Qualities and/or Physical Properties
Appendix H	:	Furnace Fuel Requirements and Fuel Breakdown
Appendix I	:	Furnace Flue Gas Information
Appendix J	:	Process Water Disposition

STAATSOLIE SURINAME REFINERY

APPENDIX G

UTILITY QUALITIES AND/OR PHYSICAL PROPERTIES

FUELS

1. Hydrogen Plant PSA Gas

Component	SOR, Vol%	EOR, Vol%
CH_4	4.86	10.56
CO	0.74	1.57
H_2	36.36	33.50
H_2O	0.72	0.68
CO_2	57.32	53.69

2. Sour Fuel Gas

	SOR	EOR
Mols/Hour	145.96	160.58
Mol Wt	15.24	16.50
H_2S, Vol%	2.27	2.07
LHV, BTU/SCF	876	939

3. Sour Water Stripper Off-Gas

Component	Mols/Hour
H_2O	37.55
NH_3	5.73
H_2S	5.81

4. LPG

Quantity : As required
LHV, BTU/SCF: 2,826
Mol Wt : 54.45

5. Visbreaker Fractionator Residuum

Quantity	: As required
Specific Gravity	: 1.039
Viscosity at 212 deg F	: 1700 cs
CCR, Wt%	: 25
Sulfur, Wt%	: 0.9
Vanadium, wppm	: 24
Sodium, wppm	: 28

STEAM

Produced steam will be 150 psig saturated and 600 psig superheated to 750 deg F.

POWER

Electrical power will be generated at 4160 V, 3 phase, 60 Hertz. A parallel and back-up supply will be from the national grid. Motors from 250-2500 HP will operate at 4160 volts and 1-200 HP motors will operate at 480 volts. Fractional HP motors can operate on single phase power.

APPENDIX H

STAATSOLIE

19-APR-1990 | FIRED HEATERS - FUEL SUMMARY | J-1317

HEATER	DUTY, MM BTU/HR ABS'D	FIRED	FUEL OIL	FUEL GAS	LPG	OTHER	REMARKS
H-101	24.379	30.474	28.898	1.576	—	—	SOR CRUDE HEATER
	24.379	30.474	6.514	23.960	—	—	EOR CRUDE HEATER
H-201	8.800	11.000	11.000	—	—	—	SOR VB FEED HEATER
	8.800	11.000	11.000	—	—	—	EOR VB FEED HEATER
H-301	4.366	5.458	—	—	5.458	—	SOR H2 HEATER
	4.955	6.194	—	—	6.194	—	EOR H2 HEATER
H-302	1.060	1.325	—	—	1.325	—	SOR H2 HEATER
	1.480	1.850	—	—	1.850	—	EOR H2 HEATER
H-351	7.660	9.575	9.575	—	—	—	SOR STAB. REBOILER
	7.284	9.105	9.105	—	—	—	EOR STAB. REBOILER
H-352	5.269	6.586	6.586	—	—	—	SOR SPLIT. REBOILER
	6.052	7.565	7.565	—	—	—	EOR SPLIT. REBOILER
H-353	4.160	5.200	5.200	—	—	—	SOR VAC. REBOILER
	3.981	4.976	4.976	—	—	—	EOR VAC. REBOILER
H-501A&B	32.798	78.080	—	46.954	—	31.126	SOR H2 REFORMER
	30.984	75.130	—	29.660	—	45.470	EOR H2 REFORMER
B-801	76.240	95.300	95.300	—	—	—	SOR 600 PSIG BOILER
	76.240	95.300	95.300	—	—	—	EOR 600 PSIG BOILER
TOTAL	164.732	242.998	156.559	48.530	6.783	31.126	SOR
	164.155	241.594	134.460	53.620	8.044	45.470	EOR
BPSD			605		43		SOR
			519		51		EOR

NOTES

1. HEATER FIRED DUTIES BASED ON 80% HEATER EFFICIENCY.
2. FUEL OIL BASED ON 17,020 BTU/LB, 1.043 S.G. (STRAIGHT VB RESIDUE BEFORE BLENDED).
3. LPG BASED ON 19,600 BTU/LB, 0.555 S.G.

STAATSOLIE SURINAME REFINERY

APPENDIX I

FURNACE FLUE GAS INFORMATION

H-501A&B, Hydrogen Plant Reforming Furnaces (SOR Controlling)

Flue gas from sour fuel gas,SOR: 46,589 lbs/hour at 27.84 mol wt
Flue gas from PSA gas, SOR : 42,497 lbs/hour at 30.28 mol wt
Total lbs/hour SO2 formed, SOR : 205.63

H-101, Preflash/Vacuum Unit Heater (EOR Controlling)

Flue gas from SWS gas, EOR : 4,070 lbs/hour at 26.66 mol wt
Flue gas from sour fuel gas,EOR: 23,793 lbs/hour at 27.84 mol wt
Flue gas from fuel oil : 12,117 lbs/hour at 26.59 mol wt
Total lbs/hour SO2 formed, EOR : 486.40

Note: Above two cases do not occur simultaneously, but are worst case scenarios per heater.

All Heaters on Total Fuel Oil Firing

Per MMBTU/Hour fired duty : 1,860 lbs/hour flue gas, 26.59 mol wt, 1.20 lbs/hour SO2

STAATSOLIE SURINAME REFINERY

APPENDIX J

PROCESS WATER DISPOSITION

Stream	Quantity and Disposition
Desalter Effluent Water	420 BPSD to oily water disposal
Crude/Preflash Vacuum Hot Well Water	240 BPSD to oily water disposal
Crude/Preflash Accumulator Water	190 BPSD to desalter water surge drum
Visbreaker Accumulator Water	61 BPSD to sour water stripper
Hydrocracker Separator Water	261 BPSD to sour water stripper
Light Ends Unit Water	Less than 1 BPSD to sour water stripper
Hydrocracker Fractionation Vacuum Hot Well Water	240 BPSD to oily water disposal
Sour Water Stripper	322 BPSD to desalter water surge drum
Miscellaneous	Intermittent occasional draining of small quantities of water

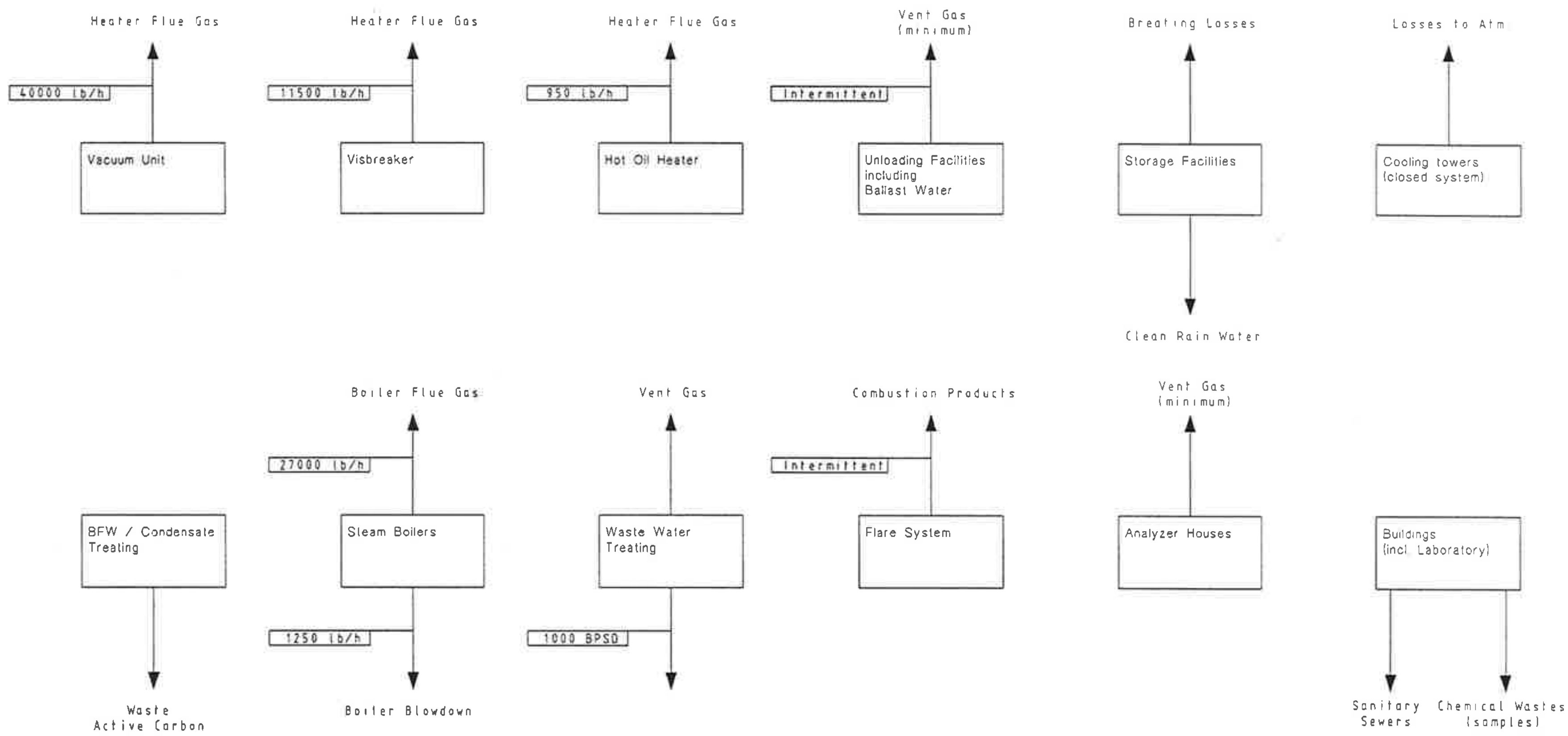
NOTE: Above represents water from process units only.

Client : Staatsolie Suriname | Plant : Tout Lui Faut

Remarks

1 Rain water qualities not included

2 Waste water composed of 650 BPSD Desalter water and Sour Water Stripper bottoms and 350 BPSD (estimate) oily water from sewers.



Refinery Phase 1 - Effluent Scheme

Rev	Date	Revision Description	Init.	Sign.	Init.	Sign.	Init.	Sign.
0	94/04/29	Concept	TJL		JGC			
			Prepared		Checked		Approved	

**REFINERY PHASE 1
EFFLUENT SCHEME**

Document Identification Number

Dept.	Job	Tag No.	Rev.
N07 —	33022 —	ENVIRON1 —	0

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