

**Advisory review of the environmental impact  
assessment of the Ankobra Petrochemical Plant,  
Ghana**

**16 February 2001**

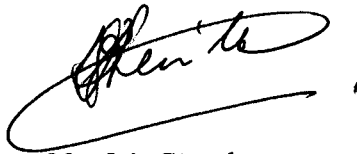
**042-039**

ISBN 90-421-0799-5  
Utrecht, Commissie voor de milieueffectrapportage

**Advisory review of the environmental impact assessment of the  
Ankroba Petrochemical Plant in Ghana**

Advice submitted to the Environmental Protection Agency in Ghana, by a working group of the Commission for Environmental Impact Assessment in the Netherlands.

the technical secretary



Mrs I.A. Steinhauer

the chairman



Mr A. Pijpers

Utrecht, 16 February 2001

## TABLE OF CONTENTS

|  |           |
|--|-----------|
| <b>1. INTRODUCTION.....</b>                                | <b>1</b>  |
| 1.1 Rationale and mandate for this review advice .....     | 1         |
| 1.1.1 Request of the Environmental Protection Agency ..... | 1         |
| 1.1.2 Involvement of the Commission.....                   | 1         |
| 1.2 Justification of the approach .....                    | 2         |
| 1.3 Structure of the report.....                           | 3         |
| <b>2. REVIEW FINDINGS .....</b>                            | <b>3</b>  |
| 2.1 General observations .....                             | 3         |
| 2.2 Specific observations on environmental impacts.....    | 4         |
| 2.2.1 Tanker (un)loading .....                             | 5         |
| 2.2.2 Pipelines to and from the petrochemical complex..... | 6         |
| 2.2.3 The petrochemical complex.....                       | 7         |
| 2.3 Specific observations on social impacts .....          | 11        |
| <b>3. RECOMMENDATIONS .....</b>                            | <b>11</b> |

## APPENDICES

1. Letter from the Environmental Protection Agency dated 26 October 2000 in which the Commission has been asked to submit an advisory review
2. Letter from the Embassy Accra dated 15 December 2000 in which the Embassy endorses the request for advice by EPA
3. Project information
4. Working programme
5. Review framework / guidelines for EIA
6. Map of the area

## ACRONYMS AND ABBREVIATIONS

|                  |  |
|------------------|--|
| BOD              | Biochemical Oxygen Demand  |
| Claus            | Process name for conversion process of H <sub>2</sub> S into sulphur |
| CO               | Carbon Monoxide  |
| COD              | Chemical Oxygen Demand   |
| DAC CRS          | Development Assistance Committee, Creditor Report System             |
| DCMR             | Dienst Centraal Milieubeheer Rijnmond                                |
| EIA              | Environmental Impact Assessment                                      |
| EIS              | Environmental Impact Statement                                       |
| EPA              | Environmental Protection Agency                                      |
| FCCU             | Fluidized Catalytic Cracking Unit                                    |
| H <sub>2</sub> S | Hydrogen Sulfide   |
| HAZOP            | Hazard and Operability Study   |
| HF alkylation    | Hydrogen Fluoride alkylation process                                 |
| ISO              | International Organisation for Standardisation                       |
| LPG              | Liquefied Petroleum Gas  |
| MEST             | Ministry of Mines, Environment, Science & Technology                 |
| MTBE             | Methyl Tertiary Butyl Ether  |
| MW               | Megawatt   |
| NAAQS            | National Ambient Air Quality Standards                               |
| NO <sub>x</sub>  | Nitrogen dioxide   |
| ToR              | Terms of Reference   |
| SPM              | Single Point Mooring   |
| SO <sub>2</sub>  | Sulphur dioxide  |

## **1. INTRODUCTION**

The initiative: construction of the Ankobra petrochemical plant, located in the Sekondi Export Processing Zone, Ghana

The Ankobra Resources Limited project includes a 140,000 barrels per day crude oil refining and petrochemical unit. Petroleum products include diesel, unleaded gasoline, LPG, Jet fuel, fuel oil, bitumen products and methanol. The plant will be constructed in the Sekondi Export Processing Zone, 300 m north of Anoe Village, in the western region of Ghana.

The Republic of Ghana has a shareholder stake of twenty percent in the consortium which consists of Ebony Enterprises Ltd. in the UK, Antoine Trading International Co and Oil Master Houston (both USA based).

The petrochemical refinery will mainly use West African crude oils, which will be delivered by tankers via a pipeline from the Gulf of Guinea. A desalination unit will be used to provide fresh water for the entire complex.

The project is expected to employ between 220 to 400 individuals including indigenous personnel.

The Ankobra Resources Ltd. project has been proposed to meet the domestic needs of the Republic of Ghana and international needs.

### **1.1 Rationale and mandate for this review advice**

#### **1.1.1 Request of the Environmental Protection Agency**

The Environmental Protection Agency (EPA) in Ghana received and reviewed an Environmental Impact Assessment (EIA) Report on the above mentioned Petrochemical Plant. By letter of 26 October 2000 (see Appendix 1), the assistance of the Netherlands EIA Commission<sup>1</sup> was solicited. In a letter dated 15 December 2000 (Appendix 2), the Netherlands Embassy in Ghana endorsed this request.

#### **1.1.2 Involvement of the Commission**

In further communications on the scope of the request made by EPA, the Commission and EPA agreed on the following:

- The Commission will review the EIA report and will concentrate on (i) shortcomings, (ii) the risks of not providing insight into the effects of these shortcomings and (iii) recommendations to supplement lacking information.

---

<sup>1</sup> The Commission for Environmental Impact Assessment in the Netherlands (henceforth referred to as the Commission)

- The Commission will not perform the usual site visit in Ghana. Instead, two experts from Ghana, who took part in the technical review committee for this project, will come to the Netherlands.

The working group of the Commission thus consists of a chairman, a technical secretary, 2 experts from Ghana, acting as resource persons and 2 experts from the Netherlands. This is advantageous in two ways: first of all for EPA this would offer the possibility to get acquainted with the way independent review is performed in the Netherlands. Secondly, for the Commission the participation of the experts from Ghana is essential as they form the 'eyes and ears' of the working group, able to provide project- and site-specific information. The members of the working group are listed in Appendix 3. The group represents the Commission and comprises expertise in the following disciplines: industrial pollution, oil exploration and exploitation, marine biology and (eco)toxicology.

The preparation of the advice took place in the week of 5-9 February 2001. The working programme is presented in Appendix 4.

## 1.2 Justification of the approach

The aim of the review is to check whether the EIA-report contains sufficient information to guarantee the full integration of environmental and social considerations in decision-making. The EIA-report should be adequate and should not contain inconsistencies. If shortcomings are found, the seriousness of this lack of information for decision-making will be assessed and recommendations will be given for supplementary information.

For this project, the Ghana EIA procedures apply, giving standard references for the elaboration of the EIA-report. No project- and site specific Terms of Reference were made. At the scoping stage, EPA offered to assist the technical staff of the proponent in relating the standard references to the real issues and the practical ground conditions, but the proponent did not make use of this offer. As no ToR are available, the Commission decided to draft a review framework first (= site specific guidelines, see appendix 5), followed by a review based on these guidelines.

During review, the Commission also made use of:

- guidelines of EPA (EIA procedures, June 1995; EIA regulations, 1999, EIS review form);
- advisory guidelines of the Commission on similar projects<sup>2</sup>, both in the Netherlands and abroad;
- Dutch notes on Best Available Technologies for Mineral Oil Refineries, September 1999, drafted to identify the best environmental techniques for

---

<sup>2</sup> Advisory review of the Environmental Impact Statement Oil Refinery Tout Lui Faut, Surinam, July 1994

Advisory review of the Environmental Impact Statements of the hydrocarbon appraisal and development in Camisea, Peru, May 1998

Advisory review of the General Oil Spill Plan, Chad export project, February 2000

Advisory review of the Expansion of the Rotterdam Shell Refinery, 1992

refineries (following the requirements of article 16 of the European Union Council Directive, concerning Integrated Pollution Prevention and Control).

At the start of the preparation of this advice, it was agreed that the specific outcome of the review already performed by EPA, would not be available to the Commission, in order to guarantee the review advice prepared in the Netherlands, to be as independent as possible.

It was also agreed that the review would focus on environmental/technical issues, with much less focus on socio-economic issues. Therefore in the next chapter detailed remarks will be made on the environmental part and general observations only on the socio-economic part.

As no site visit took place, the Commission had no chance to take into account the opinions of affected people and a cross-section of stakeholders<sup>3</sup> involved. For the same reason, the Commission was handicapped having only a limited perception of the site characteristics.

### 1.3 Structure of the report

The main review findings are summarized in paragraph 2.1. Chapter 3 gives recommendations on which issues need supplementary information in order to have all relevant information available for environmental sound decision-making. Specific information is given in paragraphs 2.2 and 2.3.

## 2. REVIEW FINDINGS

### 2.1 General observations

The Commission has the opinion that the EIA-report offers relevant information for decision making. Particularly, the following aspects have been well worked out in the document:

- the description on the refinery processes, providing a good insight in the production steps;
- the detailed monitoring plan, including organization, methods and timing (although it appears to be in some cases not specifically tuned to the Ghanaian circumstances);
- the indication to comply with clear safety and environmental standards and targets (for instance p. 9-28 and 9-33), by applying modern techniques.

The Commission is also of the opinion that the EIA-study has shortcomings on a number of relevant issues that can not enable informed decision-making.

---

<sup>3</sup> The EIA-report shows no evidence of public participation; there are for instance no minutes of meetings with potentially affected people. Official stakeholders like the Free Zones Board, the Ministry of Environment, the Energy Commission and the Metropolitan Assembly have been consulted by the proponent.



- No hazards are assessed (spills, explosion, other incidents, etc.).
- Quantitative data on emissions and waste management are hard to find, or may not be up to date. It is stated that impacts will stay below norms, but the report does not provide any information on environmental loads. International standards require a specification on expected emissions/immisions.
- The description of the local environment (base line assessment) is insufficient or lacking. Also clear and relevant maps are lacking.
- Since quantitative data on incidents and emissions is sparsely available, absent or sometimes outdated and the description of the receiving environment is very superficial, a proper risk assessment can not be made. This makes it impossible to assess the seriousness and significance of impacts.
- Inadequate information is given on the social environment and the way this might have consequences for or receive the impacts of the construction and operation of the refinery, the generated transport and the expected workforce.

The Commission recommends that the relevant supplements be made to the EIA-report in order to have sufficient insight in the scope of the environmental and socio-economic impacts (see also chapter 3).

## 2.2 Specific observations on environmental impacts

The realisation of the proposed refinery in Ghana will result in the following key activities:

1. Installation of a single point mooring system (SPM). The EIA-report does not give any information whether dredging will be required in order to allow tankers (16 m depth) entering the Gulf of Guinea to the SPM, nor on the impacts of increased shipping movements.
2. Laying of a (dual use?) pipeline from the SPM to the planned refinery. This consists of a part from the SPM to the shore in the seabed and a part of 20 miles (underground) from the waterfront to the refinery. The EIA-report does not make clear whether a booster station and a storage facility will (need to) be constructed at the waterfront.
3. Building of the refinery consisting of:
  - storage facilities
  - petrochemical processing units
  - waste incineration
  - power generation
  - loading facilities for products in rail and road tankers
  - water treatment facilities
  - surface of 4000 m<sup>2</sup> is claimed (100 acres), total area available 500 acres = 20.000 m<sup>2</sup>
4. Installation of a seawater intake line (1200 meters into sea).
5. Installation of a wastewater discharge line (600 meters into sea).
6. Temporary workforce of 300-350 individuals (construction)

The operation of the refinery will result in the following key components:

1. Operation will require 1 tanker load of 38,000 ton of crude every 31 hrs (maximum available storage capacity of crude oil equals 20 days production).
2. Desalinisation plant (drinking water production) of 85,000 litres per day.
3. Permanent workforce of 350-400 people.
4. Emissions to air.
5. Noise (55 dB(A) design criteria).
6. Continuous light.
7. Increased road traffic.

For the review, the Commission distinguished three main components: the tanker (un)loading, the pipelines to and from the petrochemical complex and the petrochemical complex itself. The shortcomings on each component will be listed below.

#### **2.2.1 Tanker (un)loading**

This component consists of the unloading of West-African (Nigerian light) crudes from 40,000 ton tankers via SPM (single point mooring) and a sub-sea pipeline and loading of 70 % of the petroleum products produced in the refinery. The way of construction of the SPM and pipeline is unclear. SPM's are known to be associated with incidental oil spills.

The Commission notes that relevant information is lacking on:

- location, design, operation and safeguarding (the EIA-study mentions a double hosing at SPM as an EPA requirement, but no insight is given on the actual application of this requirement);
- the evaluation of alternative locations and designs;
- the implications of the 1990 Environmental Action Plan and Coastal Zone Management Plan for the proposed activities;
- oil spill scenario's, on Oil Spill Contingency and Response Planning, on regional co-operation and abatement capabilities (in fact there is only the statement that a marine vessel will be present at the SPM during (un)loading). The maximum spill scenario should include a stranded tanker<sup>4</sup>;
- discharge of contaminated ballast water from tankers;
- chemicals used for anti-fouling and pressure testing.

---

<sup>4</sup> Reference is made to the advisory review made by the Commission on the General Oil Spill Plan for the Chad/Cameroon oil pipeline, February 2000

### *Marine ecosystem*

The description on the marine ecosystem is practically non-existing in the EIA-report. The information should be adequate in order to assess the risks related to incidents and continuous operational discharges. The information is also relevant to assess the social impacts. The area is used by fishermen and is important as a protein source. Any change (for instance in abundance or taste) in (commercially) marketed fish species therefore has to be described. According to the report, the SPM is located about 1 km downstream of an assumed spawning area (in a diurnal tidal situation and currents up to 1 m/s the range that pollutants may travel is 9-36 km per tidal cycle; page 4-6 versus 3-5).

Abiotic information has to be provided on:

- depth contours, proper maps with scale
- current rosette in area of discharge and proper tidal data
- sediment composition
- information on wind direction and wind speed
- description of coastline (in relation to potential oil spill)
- nutrient balance (state of eutrophication)

Biotic information (the information should concentrate on species that have importance for the local fishermen or are regarded rare or endangered species that should be protected) should include:

- benthos (including shellfish and shrimp<sup>5</sup>).
- fish, describing the species that are brought to the local markets and are of value for nutrition to supplement the protein diet.
- wildlife, focussing on species that are key species in case of an oil spill and worth protecting, like migratory waderbirds, pelicans and sea turtles.
- information on seasonal variation (spawning, bird migration) in order to assess the most and least vulnerable season.

### **2.2.2 Pipelines to and from the petrochemical complex**

This component includes the transport of crude oil, petroleum products, wastewater and seawater over a distance of 20 miles between the complex and the waterfront. A description of the pipeline transect is restricted to Anoe village and claimed to be under and along public roads. However, a clear description on the beach crossing and route of the pipeline between the coast and the site is not given. The EIA-report states that the pipeline will be made of poly-propylene<sup>6</sup>.

The Commission is of the opinion that the following points are not or insufficiently addressed:

---

<sup>5</sup> Shellfish and shrimp show specific sensitivities to toxicants. Some species of shellfish (like oyster species) are indifferent for copper, but very sensitive to TBT (tributyltin). This is often applied in ship (tankers included) anti-fouling paint. Shrimp on the other hand are sensitive to biocides (including quaternary ammonium based) corrosion inhibitors).

<sup>6</sup> This material, however, is permeable for aromatics and may cause severe groundwater pollution or even pollution of the incoming seawater line, also used to produce fresh (drinking) water. Normal practice is steel and a corrosion inhibitor or frequent replacement (10 years lifetime).

- description of capacities, type of products (LPG as well?), pipeline dimensions, pipeline routes (clear maps, indicating potential vulnerable crossings etc. are lacking), where (above/beneath ground), design (polypropylene for crude?), safeguarding (leak-detection) and surveillance;
- way of operation<sup>7</sup>;
- the evaluation of alternative routes and designs;
- oil spill scenarios and soil remediation;
- fire/explosion risk assessment along pipeline routes;
- anti fouling measures of intake;
- dispersion calculations for operational discharges.

#### *Onshore transect description*

Information is lacking on the following aspects:

- description of land ecosystem with spatial description of the transect up to 50 meter on both sides;
- soil (sensitivity for erosion);
- groundwater (composition, direction, recharge);
- elevation in relation to sea level (storm conditions) and water runoff.

### **2.2.3**

#### **The petrochemical complex**

The third component of the proposed activity is the full scale refinery, including catalytic (platinum) reforming, catalytic cracking, HF alkylation and methanol (MTBE?) production; power generation with 45 MW export; storage facilities including LPG; railcar and road-car loading for inland distribution.

The Commission observes that essential information is lacking on:

#### *Site location*

The selection of the site is briefly addressed in the EIA-report. No alternative sites were mentioned nor a justification for the site selection from an environmental point of view. The ecological description is very superficial. Surveys of flora and fauna are presented in appendix 2 as baseline data, but consequences of the activity on flora and fauna are not addressed in the main text.

#### *Energy use by fossil fuels (CO<sub>2</sub> emissions)*

- energy efficiency in power generation and process furnaces in order to limit fuel consumption is not addressed (Solomon benchmark<sup>8</sup>);
- it is not clear whether heat integration/pinch analysis is included in the design;

---

<sup>7</sup> It is known that loads of crude are intended for different customers and will need to be stored in separate tanks. Sometimes the same line is also used in reversed way, to transport the product to the ship. In these cases, the different loads are separated by a spacer. It is common practice to use seawater. At the petrochemical plant the seawater needs to be disposed of. If the same line is used to transport products to the ship, this seawater can not be discharged in the sea without treatment.

<sup>8</sup> Solomon Associates Limited, Windsor, UK monitors world wide many parameters on the operation of oil refineries. The performance on energy (the energy intensity index) is one of these benchmarks.

- an alternative for higher electricity export to the national grid is not addressed.

#### *Air pollution*

In pages 9-28 and 9-33 the air quality standards and targets are formulated based on Ghana/EPA, NAAQS and US EPA. Furthermore it is stated that modern pollution abatement equipment is designed to meet these standards. Mentioned are a scrubber at the incinerator, deSO<sub>x</sub>/deNO<sub>x</sub> at power generation and an electrostatic precipitator (FCCU?) for particle emission reduction. Monitoring both in the complex and in Anoe village (SO<sub>2</sub>/NO<sub>x</sub>) is mentioned to control compliance. No reference is made to stack heights in order to reduce immission levels at nearby communities. Table 2.5 provides information on stack heights from a plant in Tennessee, but it is not clear how this information relates to the plant in Ghana. Also dispersion and ground level calculations are lacking.

A quantification of SO<sub>2</sub>, NO<sub>x</sub>, hydrocarbons, H<sub>2</sub>S, fluorides, particles emissions etc. is not given, nor the expected quantities to be flared. The EIA-report does not provide insight in emissions from process installations, power generation, storage facilities, loading of rail/road-cars, loading of ships, water treatment, waste water incineration and flares.

#### SO<sub>2</sub>/H<sub>2</sub>S:

- nr 2 (low S%) fuel is mentioned for the power generation, but the type (S%) fuels that will be used in process furnaces is not indicated. The possibilities to reduce the sulphur % of these fuels are not mentioned;
- sulphur recovery capability is not mentioned. Modern refineries have >99% recovery by implementing efficient redundant Claus conversion in combination with tail gas treating and incineration (to limit H<sub>2</sub>S exhaust < 10ppm);
- the flaring of H<sub>2</sub>S is not addressed.

#### NO<sub>x</sub>:

Measures to reduce NO<sub>x</sub> are not mentioned, such as low NO<sub>x</sub> technology (burners, gas turbines) or deNO<sub>x</sub> at FCCU regenerator.

#### Hydrocarbons:

- emissions from process installations are not indicated;
- process water strippers to remove hydrocarbons from process water by open steam stripping are not mentioned (which are to be considered as an essential reduction technique);
- reduction of emissions from storage tanks is not mentioned (for instance (inner) floating roofs or vapour recovery);
- vapours from railcar-loading are vented to the atmosphere (page 7-7), alternative vapour return –or recovery is not addressed;
- flaring scenarios and emissions are not indicated (would flare gas recovery be possible?);
- it is not clear whether benzene production is an issue (benzene - carcinogenic component- is mentioned in page 7-6).

#### Particles:

- Electrostatic Precipitator at FCCU regenerator?;
- the composition is not indicated (PM10: particulate matter (dust) with size smaller than 10 micron, metals, etc.);
- fluorides (ex HF alkylolation/incineration)?

#### *Water pollution*

Wastewater is to be discharged to the sea after treatment, mainly in case of "over capacity". A clear description of the treatment facility (except fig 30, before 5-18) is lacking. Information is insufficient or lacking on:

- a description of concrete slabs in the process area and storm water buffer (10.000 m<sup>3</sup> of rain?);
- discharge at sea, eutrophication risk;
- composition and impacts of wastewater to be incinerated;
- temperature requirement for wastewater discharge (if fresh, increase above ambient should be no problem).

#### *Noise*

The information presented in the report on sources and criteria is rather outdated (1977 = 20 years) and reflects the past conditions in a western industrial society. Moreover, it includes standards for housing with proper isolation and windows. This may not be the case for Anoe Village.

The EIA-report lacks background noise information (tropical ecosystems can be noisy). As data is outdated and reference information is lacking, this data should be updated and the predicted noise contours should be mapped in relation to the village and in relation to the background (night and day).

#### *Light*

Light is not mentioned as such. It may attract lots of insects and birds. It may result in nuisance. Description of this phenomenon and mitigation measures are lacking and should be addressed.

In addition, flares may occasionally come in. They produce an enormous amount of candles and put the village in light. These flares may also attract vast numbers of insects, bats and birds with fatal result<sup>9</sup>. The description of the flare stacks is poor and the alternative ground flare is not mentioned.

#### *Waste*

Waste impact description should include the waste treatment of the 350-400 permanent staff if they are intended to become residents. The justification for wastewater incineration is unclear. If this would also include the incineration of HF containing water, the HF is set to the atmosphere. Fluoride is a known toxicant to plant species that may cause damage to foliage and interfere with

---

<sup>9</sup> In many (most tropical and subtropical) countries specific attention is given to screen off chimneys, stacks, safety pressure controls to prevent nesting of birds and insects.

agriculture activities. If the water contains chloride, burning of hydrocarbons may result in the formation of highly toxic dioxines and dibenzofuranes.

The information on on-site waste management is insufficient. A landfill has been mentioned, but it is unclear which quantities are going to be disposed of this way. It is also not clear whether waste is going to be separated and what (sub)contractors are going to be involved in handling and disposal.

#### *Odour/ stench*

A table with threshold levels in air is provided in table 14.8, but an impact assessment and possible mitigation measures to reduce odour are lacking.

#### *Soil*

Soil pollution is one of the greatest hazards of a refinery. Therefore consequences of incidental soil pollution should be described in far more detail with emphasis on the risk to groundwater contamination. Prevention of soil pollution should be described as separate issue.

#### *External Safety*

This aspect is not sufficiently addressed. Quantitative risk assessments for similar refineries in the Netherlands show attention is needed for accidental releases of HF, H<sub>2</sub>S and hydrocarbons. In this respect the EIA does not address safeguarding of HF storage, transport and handling and the safeguarding of the LPG storage facilities. Transport of highly toxic HF, and also LPG deserves special attention. It is unclear how it will be transported and what safety and mitigation measures will be taken.

Containment in case of mineral oil storage failure of 10% (4-8) is not sufficient.

The fire-fighting system is not described. Does this include a storage facility for freshwater or is seawater going to be used? In the latter case, how is supply secured and how is this water going to be discharged?

#### *Environmental management*

ISO 14000 is mentioned (9-49), but the capacity of involved Ghanaian authorities to ensure compliance is unclear.

In case of an accident, costs may be extremely high. Depending on the outcome of the external safety assessment and the marine spill assessment, it is recommended to discuss provisions to combat accidents and compensate potential victims. Such provisions are also applied to guarantee proper decommissioning in case of refinery closure.

#### *Transport*

Railcars are said to be used for inland transport of products. To the knowledge of the Commission, the railcar infrastructure in Ghana is not equipped for this purpose. In rough terms, the total production may result in a few hundred truckloads a day. No information on impacts is provided, e.g.

accidents, noise and pollution, spills related to loading (vapour) and risks associated with the transport of dangerous substances.

No information is given to which countries products for export are targeted nor which means of transport will be used (only ships or also road/train?).

### 2.3 Specific observations on social impacts

The site is situated at 300 meter from an existing village, Anoe that is based on a traditional lifestyle (page 3-8). Other villages are not mentioned. The village consists of 387 inhabitants. The data through the report are inconsistent, but it can be assumed that this concerns about 50 families. Relation with information on page 3-9 is unclear.

It is unclear:

- what their water and protein sources are and whether they will be impacted by spill or soil contamination;
- what the impact will be from 300-350 temporary construction workers (normally males housed in camps) on social life and market goods;
- what the impact will be from 350-400 permanent workforce (normally bringing wives and children);
- whether the 70-80 percentage of indigenous employees is realistic. The running of an oil refinery complex needs highly skilled and specially trained workforce;
- where malaria comes from if there is no open water as stated in the report;
- if respiratory infection is a problem (3-9) it should have consequences for the dust emission (it is not believed that foliage is problem as mentioned on page 3-12, if so there must be a seasonal trend);
- sabotage prevention is a recurring issue in many projects and is not addressed.

## 3. RECOMMENDATIONS

The previous chapter listed shortcomings that must be supplemented for well-informed decision-making. The degree of importance of respective shortcomings, however varies in terms of their contribution to relevant decision making. Therefor, in this chapter the Commission highlights the most important of these shortcomings, which are essential for decision-making. If no supplementary information on these issues is provided, these could be considered as significant (but perhaps calculated) risks.

In general, the Commission is of the opinion that the most significant environmental risks are associated with the tanker (un)loading component and the pipeline component. At the petrochemical complex itself, a number of mitigation measures can be applied in order to achieve a more environmentally friendly performance, and only a limited amount of serious environmental constraints is expected.

The Commission recommends to supplement the EIA-report, paying special attention to:



### *The receptors of potential impacts*

- a proper and accurate description of the environment, including the marine environment and the onshore environment along the pipeline and at the site (guidelines are provided on page 6 and 7).
- an adequate description of the socio-economic environment (points of attention are described on page 12).

### *The sources of potential impacts*

- Quantitative data on emissions of the petrochemical complex, including (hazardous) waste and waste water.
- An assessment of hazards like spills, explosions and incidents.
- A detailed description of the SPM and pipelines, how they are constructed and operated.

### *Impact assessment*

Having the above mentioned information available, the significance of impacts can then be determined in the EIA-report, especially on:

- oil spills in the range of 10-40.000 tons and how these are treated (oil spill contingency planning);
- discharge of waste water (including modelling of the dispersion of organic load);
- interference with fishing;
- routing and operation of the pipeline;
- emissions to the air (SO<sub>2</sub>, NO<sub>x</sub>, hydrocarbons, H<sub>2</sub>S, fluorides and particulate);
- nuisances like noise, light and odour;
- external safety;
- inland transport;
- the increase in temporary and permanent workforce.

The Commission recommends the need to explore the use of Oil Spill Contingency and Response Plans of (Ghana?) and neighbouring countries, while drafting a supplementary EIA-report.