E-190

# Environmental Assessment Report

for the Combined Cycle Development at Phumy II, Vietnam

## Executive Summary

Vol. I

August 1995



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Executive Summary

**Volume** 1 **of** 1

**Approved:**

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# EXECUTIVE SUMMARY

## CONTENTS

# EXECUTIVE SUMMARY

## Policy, Legal & Administrative Framework

1.1 This environmental impact assessment report (EIA) addresses the impacts of a project to develop power generating capacity at Phumy in the South of Vietnam. The proposed development will consist of two blocks of combined cycle plant of approximately 800 MW total. Each block will likely consist of gas turbines, waste heat boilers and a steam turbine. This project (Phumy II) is likely to be part funded by the International Bank for Reconstruction and Development (IBRD).

1.2 A separate power development project (Phumy I) consisting of 600 MW of conventional thermal plant is also planned for the site at Phumy and an EIA for this project has already been prepared. For completeness of information this EIA will address the impacts of the complete site development, i.e. Phumy I and Phumy II.

## The Developer

1.3 The Developer of the proposed project is Electricity of Vietnam (EVN), a state owned company which is responsible for supplying power to all of Vietnam. Shortage of adequate base load capacity together with high growth in demand has led EVN to develop this additional power generation capacity. Natural gas from the offshore White Tiger gas field will be available to Phumy in 1997 making it an ideal site for development of combined cycle plant.

## International Bank for Reconstruction and Development (IBRD) Requirements & Guidelines

1.4 This environmental assessment report is prepared for EVN according to the scope and format detailed in IBRD's Operational Directive OD 4.01. It is IBRD policy that all major projects shall be subject to an environmental assessment.

1.5 Environmental Guidelines have been issued by the IBRD to cover a wide range of specific industries. Each guideline contains emission limits as well as permitted ambient levels for all relevant media and likely contaminants. Values are intended as a guideline and mostly relate emissions to units of production. These guidelines are addressed where appropriate in assessing the impacts of the proposed development, and the ones relevant to this proposed project are summarised in Appendix IV. Suitable environmental control technology is also specified in this document. It is IBRD policy that where there exist different limits between its guidelines and national controls, the stricter of the two shall be applied.

**Vietnamese Environment Policy And Regulations**

1.6 A comprehensive environmental plan was adopted by Vietnam in 1991 called "The National Plan for Environmental and Sustainable Development: A Framework for Action". This plan provides the framework for establishing environmental issues. The implementation of this plan rests with the Vietnam State Committee for Science and Technology (SCTC).

1.7 Within this context national regulations and guidelines have been adopted giving permitted levels of contaminants in air, water and soils. These regulations are addressed where appropriate in this report and the relevant guidelines are summarised in Appendix IV. Several provincial centres including Ho Chi Minh City have also issued local environmental guidelines.

1.8 This law extends environmental impact assessment requirements to a broad range of public and private sector development activities, proposes procedures for screening and incorporating of mitigation plans into project design, and explicitly links EIA review to the project approval process.

1.9 The core agency with environmental mandate is the Ministry for Science, Technology and Environment (MSTE) which was formed in 1992 from the State Committee for Science. Within MSTE, the Department of Environment and Natural Resources (DENR) is the environmental arm with the main responsibility for carrying out these environmental functions.

**EIA Review And Approval Process**

1.10 Responsibility for project approval, for projects such as the current one under Vietnam's investment policy is given to the National Project Evaluation Board (NPEB) under the chairmanship of the State Planning Commission (SPC). As a member of the NPEB, the Ministry for Science Technology and Environment has the formal authority to comment on environmental aspects of the project. This function would normally be carried out by the Department of Environment and Natural Resources and a copy of the EIA has been submitted for their approval.

1.11 At the provincial level Environmental Committees also have formal authority to review and comment on environmental aspects of investment applications. The Environmental Committee at Vung Tau is the one of most relevance to the present proposed project and this EIA has been submitted for their approval. A copy has also been made available to the public in the municipality of Phumy where the project is being developed.

1.12 Within the IBRD EIAs are reviewed and assessed within the appropriate divisions. Both the EIA and the EIA summary are made available for public scrutiny.

**Summary of Main Environmental Issues**

1.13 The proposed development has major environmental benefits in the provision of an extra 800MW of combined cycle plant. Combined cycle plant is the most benign of thermal power plants with higher efficiencies and lower emissions per unit of

electricity generated. This extra generation capacity will allow the strengthening of the power supply system, the improvement of living standards and the development of industry and other economic activities in the region.

1.14 The overall development would directly affect 157 families in the Phumy area. A separate Rehabilitation Action Plan (RAP) is being carried out to World Bank (OD 4.30) guidelines.

1.15 The use of natural gas as a fuel and the availability of an extensive body of water for dispersing heat will ensure only minor impacts from stack emissions and cooling water emissions. A variety of mitigating measures will ensure that the impacts of all other emissions from the proposed plant will not be significant.

1.16 It is recommended that monitoring programmes during the construction and operating phases be put in place for the successful implementation of the Project. Recommendations are also made for the establishment of an environmental unit at Phumy as well as that of an environmental co-ordinator within EVN as its thermal program expands with the function of developing environmental policy and ensuring compliance with regulations. This co-ordinator would also liaise with other groups such as a Coastal Zone Management Group in order to promote the protection and sustainable development of the delicate coastal area. It is also stressed in the report that oil spills represent a particular hazard and that strict procedures, must be put in place to minimise this risk.

**Project Description**

1.17 The project is for the development of 800MW of combined cycle plant at Phumy in the South of Vietnam. Combined cycle plant consist of gas turbines which generate electricity directly as well as waste heat boilers which utilise the hot gases exhausted from the gas turbines to raise steam and generate further electricity in the steam turbines. Combined cycle plants have advantages in terms of higher efficiency and lower environmental emissions. Figures 3.1, 3.2, 3.3, 4.2 illustrate the location and layout of the project.

1.18 The plant will burn natural gas which will be available in mid 1997. At this stage the only stack emissions of significance would be NOx (oxides of nitrogen) which will be maintained below a level of 50 ppm by use of low NOx burners. The first two gas turbines will, however, be commissioned in December 1996 and will burn distillate fuel oil for about 6 months until natural gas is available. During this phase emission of NOx will be rather high at about 300 ppm as it is not justifiable to install NOx reduction measures for such a short period.

1.19 A conventional thermal plant called Phumy I as also planned for the site and will consist of 3 x 200MW units. Phumy I will also burn natural gas. Residual fuel oil will be used for emergency standby. For completeness of information this EIA considers total emissions from the site, i.e. Phumy I and II.

1.20 Cooling water for the plants will be taken from the Sao stream at the rate of $60m^3/s$ and will be discharged to the Thivai estuary. Chlorination of the system in order to reduce fouling will be carried out so that the residual chlorine level at the discharge is <0.02 ppm.

1.21 Waste water streams will include water treatment plant waste, sewage, surface drains, boiler washings and other minor sources typical of a power station. They will be treated as appropriate so that the effluents will satisfy IBRD and Vietnamese regulations.

1.22 The plant will require fresh water for boiler make-up and domestic use at a maximum rate of about 2000 $m^3$/day. This will be supplied by wells on site. Gas will be delivered by pipeline and distillate and heavy fuel oil by tanker. A 4km power line will be constructed to join the existing transmission system.

**Baseline Data**

1.23 The Phumy site is located in a rural area about 70km south east of Ho Chi Minh City. The population of the small townlet is about 8000 and the main economic activities are farming and fishing. The average income is low even compared to nearby districts and infrastructure and services such as electrical supply, roads, health services and education are also poor.

1.24 About 157 families in Phumy will be directly affected by the project implementation consisting of:-

- 6 families who live on the site (Phumy I).
- 135 families who own land and farm on the site (47 for Phumy II, 88 for Phumy I).
- 16 families who will have to be rehoused because the construction of a transmission line (Phumy II).

1.25 A survey of these people showed that in general they welcomed the project as a source of jobs for their children, but were worried about the amount of compensation they would receive. A separate Rehabilitation Action Plan (RAP) report is being prepared which will include full details of all these affected people, including land, assets, crops, so that fair and adequate compensation can be agreed.

1.26 Given the rural nature of the site air quality is expected to be good. Limited measurements on the site show that this is so with levels of $NO_2$ of 0 - 0.06 $mg/m^3$ and levels of $SO_2$ of 0.010 - 0.02 $mg/m^3$.

1.27 Noise measurements carried out at 3 locations show levels of about 40 dBA at night and higher levels at day time, probably due to nearby construction activities for a harbour development. For power station design night time levels are the most significant as the permitted noise levels are lowest during night.

1.28 The most significant ecological system is that of the mangrove forest and associated fish, shell fish and other animal species. This appears under threat in this region as it does in many parts of South East Asia due to:-

- Excessive siltation and organic pollution
- Harvesting for firewood and charcoal manufacture
- Operation of shrimp and fish aquaculture enterprises which may involve clearing mangrove areas as well as, depending on the stocking level, water pollution from biocides and other wastes.

1.29 There is evidence of all the above activities near Phumy; however successful replanting of mangroves has also taken place in areas where they were cut down. Development of shrimp aquaculture probably represents the single greatest threat.

1.30 A survey of mangrove trees in the site and nearby study area indicated the presence of 32 species. The distribution depends on submersion and salinity levels as well as impacts of artificial replanting. The survey also found the following numbers of animal species which are largely associated with the mangrove areas;

- 30 species of birds
- 17 species of mammals
- 8 species of amphibians
- 16 species of reptiles

1.31 The site itself, which is 150ha in extent contain, about 20 ha of mangrove area. The rest is mostly cultivated for rice, cashew nut trees, eucalyptus and other crops. Apart from the mangroves there are no significant habitats or wild life areas on the site or in the surrounding area. A study carried out showed the presence of 201 species of plant in the study area of which 101 occurred in the actual site area.

1.32 The Thivai river estuary, which runs by the site, will be utilised to disperse the heat in the cooling water discharged from the plant. It is wide (400m) and deep (15 - 30m) with a tidal variation of about 3m and a large tidal flow (10,000$m^3$/s). Analyses of the water quality of the Thivai estuary indicated the following main features:-

- High salinity levels, particularly in the dry season.
- Some evidence of oil pollution.
- Organic pollution from domestic sources.
- Moderate levels of dissolved oxygen.

1.33 Surveys of the aquatic ecosystem of the Thivai river indicate that it is typical of the nearby large area of delta. It is rich in numbers of species but with some evidence of an impact from organic pollution. The baseline surveys identified the following numbers of species:-

- 72 species of phytoplankton and 31 species of zooplancton.
- 60 species of fish and 22 species of shellfish.
- 42 species of zoobenthos (near site).

1.34 Fish eggs and larvae are considered particularly sensitive to environmental disturbance. A survey of eggs and larvae in the Thivai estuary showed numbers and species composition typical of the delta area. The larvae were found to migrate from surface layer to the bottom depending on the time of day.

**Environmental Impacts**

1.35 The positive impacts of the proposed project are summarised below. The negative impacts are summarised in tables 1, 2, 3, and 4 and described below.

1.36 The proposed project, consisting of combined cycle plant burning natural gas, is the most environmentally benign form of thermal power plant. It has a very high efficiency, close to 50%, and lower air emissions and cooling water requirements per unit of electricity generated than for conventional plant. In particular, when burning natural gas with a low NOx burner as is planned for this project, there are no significant emissions of NOx or $SO_2$ and emissions of carbon dioxide are 50% lower than for conventional plant burning fuel oil or coal.

1.37 A major and positive impact will be the provision of 800MW generating capacity. This will impact on a regional basis by strengthening the electricity supply network and allowing the connection of extra consumers and the development of industry and services in the region. The employment of large number of people during the construction and operation phase will also benefit the local economy.

1.38 The main groups of people directly affected by the overall development include six families, who live on the site, 135 families who own land on the site and 16 families who will be displaced from their homes because of power line construction. A separate RAP report will be carried out to IBRD guidelines which will detail the compensation to be awarded to those people for their land, houses, crops and other assets. The process will ensure that no families will suffer a drop in standard of living as a result of the project.

1.39 While some disturbance will be caused to the townlet of Phumy the overall impact should be positive by the provision of jobs and improvement of infrastructure.

1.40 During the construction phase there will be a permanent loss of 2 ha of mangrove forest due to the construction of a jetty and a loss of about 0.5 ha of mangrove at the cooling water intake. There will be a temporary loss of 1 ha due to construction of the cooling water outlet pipes. As these will be buried the areas can be replanted.

1.41 Dredging of the Thivai river in order to allow berthing of tankers of 10,000 dw tonnage as well as all the cooling water system construction will cause a local and temporary loss of benthnic animals as well as disturbance of fish and other organisms.

1.42 Impacts of other construction activities such as noise, dust, sewage, after taking into account mitigation measures, will be minor.

1.43 The Phumy I and II Power Stations will burn natural gas and the only stack emission of interest will be NOx. A dispersion analysis was carried out for the case of plants on full load and showed that the maximum hourly ground level concentration of $NO_2$ when burning natural gas would be 0.11 mg/m$^3$ while the maximum annual average will be 0.002 mg/m$^3$. These relatively low values will be well below IBRD and Vietnamese air quality regulations and will be of minor significance to air quality in the area.

1.44 For about six months the first two gas turbines to be commissioned will burn distillate until natural gas reaches the site. The rate of emission of NOx will be quite high at 300 ppm as methods of reducing NOx levels such as water injection are not considered feasible for this short period. However as they will be on open cycle for this period the high exit temperature will provide good dispersion characteristics. A dispersion analysis for this case showed that maximum hourly ground level concentrations of $NO_2$ would be 0.100 mg/m$^3$. This level will not break ambient air quality standards nor will it have a significant impact over the short period involved.

1.45 Specification for the proposed plant will be such that noise levels at the site perimeter will not exceed permitted levels for residential areas. This will ensure that no noise nuisance is caused at nearest residences.

1.46 Cooling water discharge will be at a maximum rate of 60m$^3$/s and a temperature rise of 7$^o$C. The discharge will be deep into the Thivai estuary which has a large tidal flow of 10,000 m$^3$/sec. A thermal diffusion study indicates that the physical impact will be minor with, for the worst case, a thermal plume of 1$^o$C extending across the estuary. Beyond the immediate outfall the maximum temperature rise will be 1.5°C.

1.47 Ecological impacts of the thermal plume are not predicted to be significant. However, because it is a deep discharge some scouring will take place at the outfall. No significant impacts will be caused to aquaculture or commercial fishery on the Thivai River.

1.48 Chlorination of the cooling water will take place at a rate that will leave a residual level of <0.02 ppm at the outfall. At this concentration the chlorine should not have any significant impacts beyond the discharge point.

1.49 A large number of organisms including fish eggs and larvae will be entrained by the cooling water system and significant mortality will occur due to pressure, temperature rise and chlorination. This is not predicted to have an overall impact on fish numbers in the area due to the large amount of similar habitat in the region and due to the small ratio of CW flow to overall tidal flow.

1.50 Other waste water streams from the plant include water treatment plant effluent, sewage, surface drains, boiler washes and acid cleans. These will all be treated as appropriate so that the effluents will satisfy Vietnamese regulations and will have no environmental impacts on the receiving water.

1.51 Oil spillage into the sensitive mangrove ecosystem represents a serious menace. In order to minimise this risk strict procedures will be implemented for the delivery, unloading, storage and handling of oil as well as an emergency response plan and clean up procedures.

1.52 Dredging will be required occasionally in order to maintain navigable depth at the jetty. This will create a local and temporary disturbance to biota in the area. The dredged material will be transported for land reclamation to an area not yet designated.

**Summary of Alternatives**

1.53 Alternatives to the proposed project should be seen in the context of a high predicted growth in electricity demand in the South Vietnam area over the next twenty years. This growth is required for economic development and improvement in standard of living. A mixture of thermal and hydroelectric power, which are complimentary to each other, is required to satisfy this demand. Alternative designs and sites were considered.

1.54 A natural gas fired combined cycle plant, such as the present design, has the following major advantage over other types of thermal plant which might be considered :-

- Lower capital cost
- Shorter lead times to power production
- Small land area requirements
- Higher efficiencies
- Lower air emissions per unit of electricity generated
- Lower cooling water requirements per unit of electricity generated.

1.55 A number of alternative sites were considered and evaluated on the following criteria:-

- Proximity to Bach-Ho - Thu Duc gas pipeline
- Distance to transmission lines
- Cooling water availability
- Environmental and socioeconomic issues
- Site area available
- Construction and engineering issues.

The site at Phumy was judged as the optimum available.

**TABLE 1**

**Summary of Environmental Impacts During Construction Phase**

| Source | Environmental Impact | Mitigation Measures | Residual Impact |
|---|---|---|---|
| Site Acquisition | Displacement of people living and owning land on site | Adequate and timely resettlement and/or compensation | Temporary disturbance - no reduction in assets or income |
| Transmission line construction | Displacement of 16 families | Adequate and timely resettlement | Temporary disturbance only |
| Construction of Jetty | Loss of 2ha of Mangrove | None | Local but permanent |
| Construction of C.W. outlet | Loss of 1 ha Mangrove | Pipes are buried and area will be replanted | Temporary |
| Dredging activities | Loss of benthnic fauna | None | Local and Temporary loss |
| Sanitation facilities | Sewage discharge | Effluent will be treated to Vietnamese standards | Minor |
| Noise | Noise during piling and steam purging operations | Restrict piling to day light hours. Notify residents of steam blows | Minor and temporary |
| Dust | Dust generated | Spraying of access roads and truck tyres | Minor |
| Construction Work | Traffic Increase | Road Improvement | Minor |
| Work during construction | Short term employment for over 1000 workers | | Beneficial short term |

## TABLE 2

**Summary of Impacts of Atmospheric Emissions for Phumy I and II When Burning Natural Gas**

| Impact | | Predicted | Vietnamese Regulations | IBRD |
|---|---|---|---|---|
| Nitrogen Oxide ($NO_2$) | | | | |
| Ambient | | | | |
| 1-hour maximum | $\mu g/m^3$ | 110 | 300 | --- |
| 24-hour maximum | $\mu g/m^3$ | | --- | --- |
| Max. annual average | $\mu g/m^3$ | 2 | 80 | 100 |
| Sulphur Dioxide ($SO_2$) (a) | | | | |
| Ambient | | | | |
| 1-hour maximum | $\mu g/m^3$ | 0 | 300 | --- |
| 24-hour maximum | $\mu g/m^3$ | 0 | --- | 500 |
| Max. annual average | $\mu g/m^3$ | 0 | 80 | 100 |
| Carbon Dioxide ($CO_2$) (a) | | | | |
| Emission | | | | |
| Tonnes/annum (total) | | $4.7 \times 10^6$ | --- | --- |
| Noise (dB (A)) | | | | |
| Noise Levels at Boundary fence | | 55 | | 55 (b) |
| Residential Area | | <55 | 55/60 (b) | 55 (b) |
| Particulates | | | | |
| 24-hour maximum | $\mu g/m^3$ | <1 | 200 | 500 |

(a) 100% load factor

(b) Varies with day / night; indoors and outdoors and other factors

## TABLE 3

**Summary of Environmental Impacts**
**During Operation of Plant - Aqueous Emissions of Phumy I and II**

| Source | Environmental Impact | Mitigation Measures | Residual impact |
|---|---|---|---|
| Water Treatment Plant Waste | Contains strong acids and alkalis | Treated in neutralisation tank to pH 6-9. Effluent will comply with waste water standards (Ref.8) | Negligible |
| Oil Contaminated Surface Water | Adverse impact on marine organisms if discharged directly | All surface drains will be routed through oil interceptors. Effluent will comply with waste water standards (Ref.8) | Minor |
| Sewage | High BOD and micro biological pollutants | Sewage will be treated to <20 mg/l BOD before discharge | Minor |
| Boiler Blowdown | Contain very low concentration of contaminants | No treatment necessary | Negligible |
| Boiler Acid Clean | Utilises toxic chemicals. This process arises only rarely. | These will be treated with the waste removed off site for disposal. Effluent discharged will satisfy waste water regulations (Ref.8) | Minor |
| Chemical Spillage | Bulk chemicals stored on site, in particular acid and alkali | Stored bulk chemicals will be bunded so that any spillage will be contained and controlled | Negligible |
| Boiler Washing | If burning residual fuel oil can contain vanadium and other metals | Metals will be precipitated by chemical treatment and removed offsite to land fill | Minor |

**Table 4**

**Summary of Impacts of Cooling Water System Operation for Phumy I and II**

| Source | Environmental Impact | Mitigation Measures | Residual Impact |
|---|---|---|---|
| Intake of 60 $m^3/s$ | Loss of fish eggs and plankton | None | Small in relation to overall abundance in the area |
| Intake screens | Loss of fish through impingement | Optimum measures not yet selected | Minor |
| Discharge of heated water | Impact on sensitive organisms | Discharge designed so that temperature rise will not exceed 1°C | Minor |
| Chlorination of C.W. system | Impact of residual chlorine on ecosystem | Residual chorine levels will be kept to < .02ppm | Negligible |
| Discharge of CW | Scouring of bottom | None | Permanent but local disturbance of area |

**Summary of Mitigation Measures**

1.56 In order to reduce environmental impacts from the proposed development mitigation measures, summarised below, have already been put in hand or are planned. Apart from these, and taking into account the minor residual impacts of the proposed development, no further mitigation measures are considered necessary.

1.57 About 157 families who own land, houses and other assets in the area will be impacted directly by the project. A Rehabilitation Action Plan (RAP) process will be completed to IBRD guidelines to ensure compensation will be given in a fair and timely way. This will ensure that all the people affected, will, at the end of the process, be at least as well off as they were previously.

1.58 Mitigation measures to apply during the construction phase include the following:-

- Provision of housing, clean water, sanitation facilities, health services to the construction workers.

- Sewage treatment.
- Dust suppression control
- Noise control

1.59 During the operation phase air emissions will be controlled by burning natural gas and installing low NOx burners.

1.60 Noise control will be by housing and acoustic cladding of noisy plant to ensure noise levels at the site perimeter are within regulations. Other noise reduction measures such as tree plantations may be used as appropriate.

1.61 Impacts of the cooling water system will be mitigated by:-

- Design of outfall to reduce extent of thermal plumes.
- Maintaining residual chlorine levels at less than 0.02 ppm.
- Measures to reduce impingement of fish at the intake.

1.62 All other waste water streams will be treated so that effluents will satisfy Vietnamese regulations and will not cause any significant impacts.

1.63 In order to avoid risks of ground water pollution or soil contamination all waste materials that will arise at the site will be monitored as to type and quantity and removed offsite for disposal or recycling.

**Consultation with Affected Groups**

1.64 The groups directly affected by the project are:

- 6 families who live on the project site (Phumy I).
- 135 other families who own land and other assets on the site (88 for Phumy I, 47 for Phumy II).
- 16 families who live in houses along the proposed route of the transmission line and who will have to move (Phumy II).

1.65 These people are represented by the Peoples Committee of Phumy who also look after their interests in relation to compensation and resettlement. The company responsible for this project (EVN) have had discussions with the Peoples Committee about plans for the project and compensation issues and the Peoples Committee have informed the families concerned. A representative of EVN has also spoken individually to each of the project affected families.

1.66 As already described in Chapter 4, a survey was carried out of the families affected by the project by Environmental Protection Centre (EPC), H.C.M City. This survey established details of the area of land owned by each family, the type and

quantity of crops grown on each property, the annual income as well as the attitude of the families towards the project and the preferred type of compensation. No objection was voiced to the project as long as proper compensation was agreed.

1.67 On July 15th Dr. C. McMahon of the Consultancy Company, ESBI, visited the Phumy area in order to have independent discussions with the affected groups. In an open discussion with the Peoples Committee the same views as above were expressed i.e. the project is welcome because of the provision of badly needed jobs in the community as well as improvements in infrastructure such as roads and electricity supply. There was an issue about compensation for land, crops and trees. It was felt that the preliminary amount suggested was not sufficient for people to purchase equivalent land elsewhere. Apart from this the only issue raised was that of dust from trucks passing by during construction and a request to hard surface the road. This is already planned.

1.68 Discussions were also held with several individuals who live or own land on the site. These all expressed the view that they were happy with the representation of the Peoples Committee and the way they were kept informed of the project, but were worried about the amount of compensation being talked about for their land, crops and other assets. No firm offers had yet been made. Apart from this they welcomed the project, particularly as regards the likelihood of providing jobs for their children.

1.69 It should be noted that a Rehabilitation Action Plan (RAP) is being finalised by EVN and is being done to World Bank (OD 4.3) criteria and guidelines. The criteria for resettlement/compensation is that overall no affected person should suffer in terms of standard of living and must be given full rights to participate in the RAP process.

**Environmental Management and Training**

1.70 It is recommended that an environmental unit be set up as part of the management structure in the new development at Phumy. The main function of this unit would be the monitoring and control of waste water streams and other emissions from the plant. This function could be combined with the already planned water quality analysis programme at little additional expense.

1.71 It is also recommended that as EVN expands its generation programme, an environmental co-ordinator be established with the function of developing environmental policy, issuing in-house guidelines and establishing compliance with standards and regulations and setting up an environmental management system.

1.72 It is further recommended that this co-ordinator would also liaise with other groups such as a coastal zone management group in order to promote strategies for the protection and sustainable development of the delicate coastal zone.

**Environmental Monitoring**

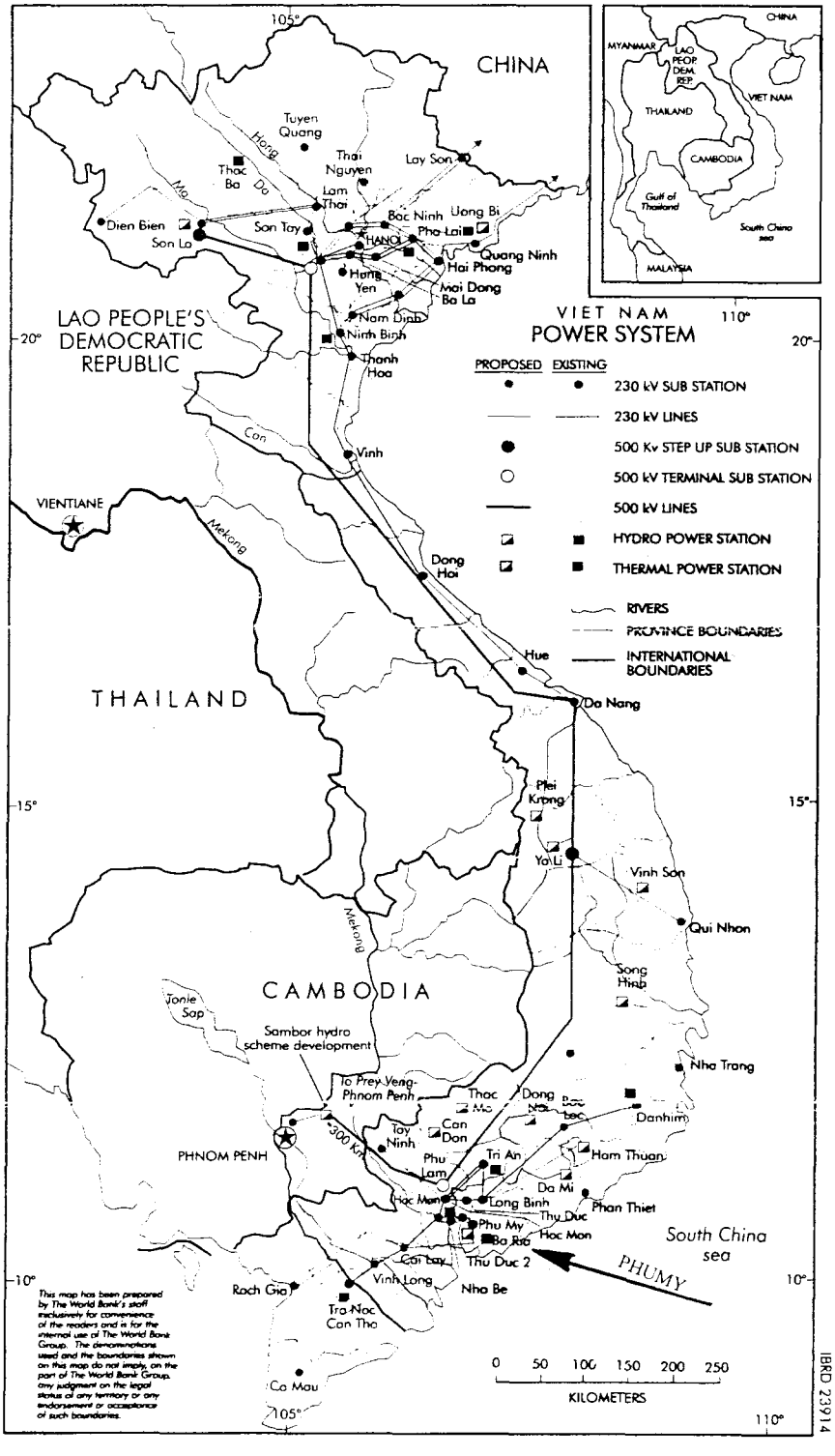
1.73 In order to fully control the implementation of the proposed project, it is recommended that the following monitoring programme be put in place:-

- Monitoring programme of the waste water streams from the new project.
- Extension of the existing air monitoring programme.
- Noise monitoring at the site perimeter.
- Monitoring of waste materials arising on site.
- A review of the baseline ecological study of the Thivai river estuary particularly in the area near the power plant site.

1.74 During the construction phase monitoring for dust levels, noise levels, sewage effluent should be carried out to ensure no nuisance is created.

1.75 Recommendations are made for training programs for management and staff at the proposed plant. Particular attention should be given to staff involved in environmental work, to those handling oil and chemicals and those involved in emergency and safety procedures.

Figure 3.1 Vietnam Power Grid



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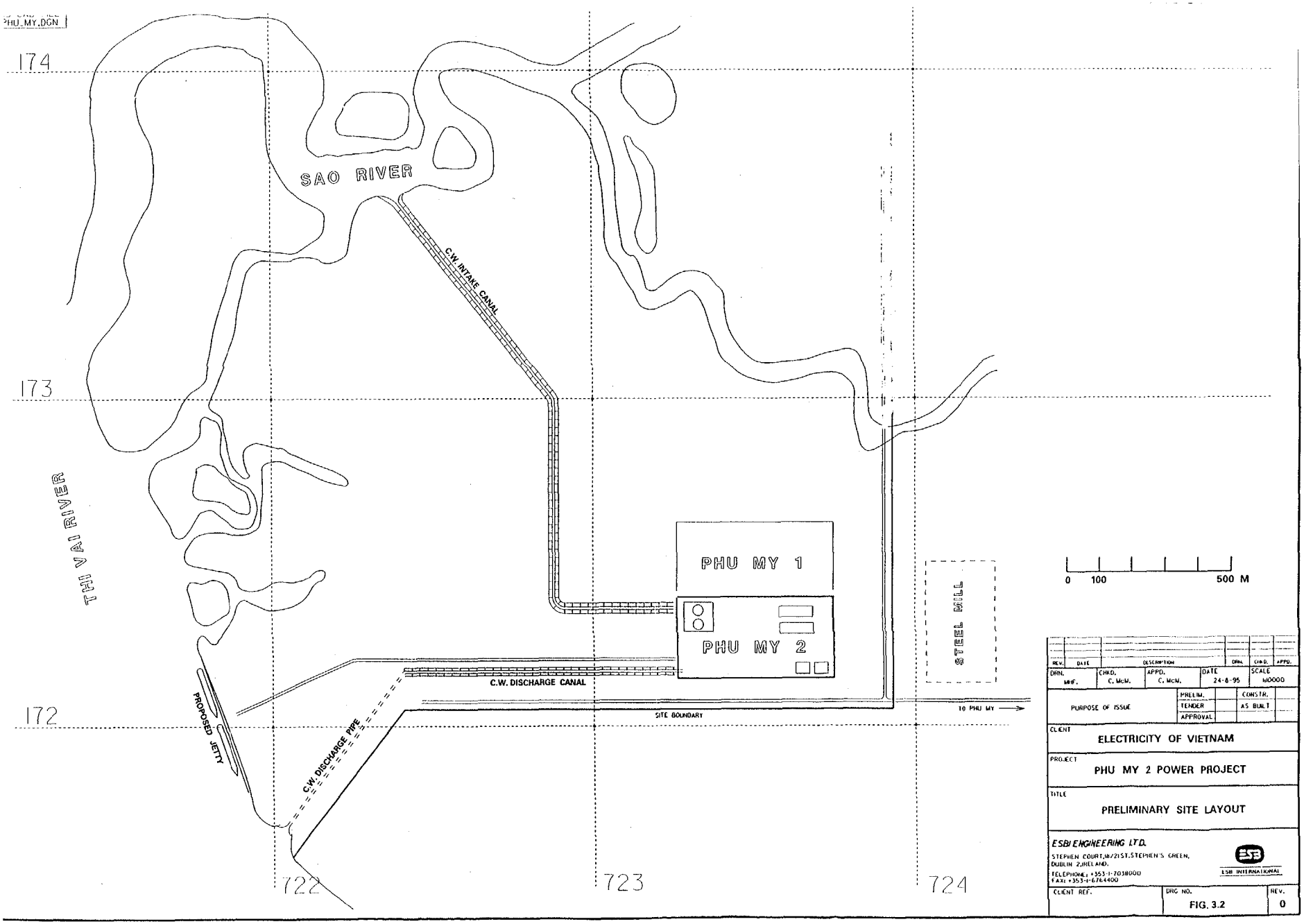


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| PURPOSE OF ISSUE | PRELIM. | | CONSTR. | |
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| | APPROVAL | | | |

CLIENT
ELECTRICITY OF VIETNAM

PROJECT
PHU MY 2 POWER PROJECT

TITLE
PRELIMINARY SITE LAYOUT

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DRG NO. FIG. 3.2

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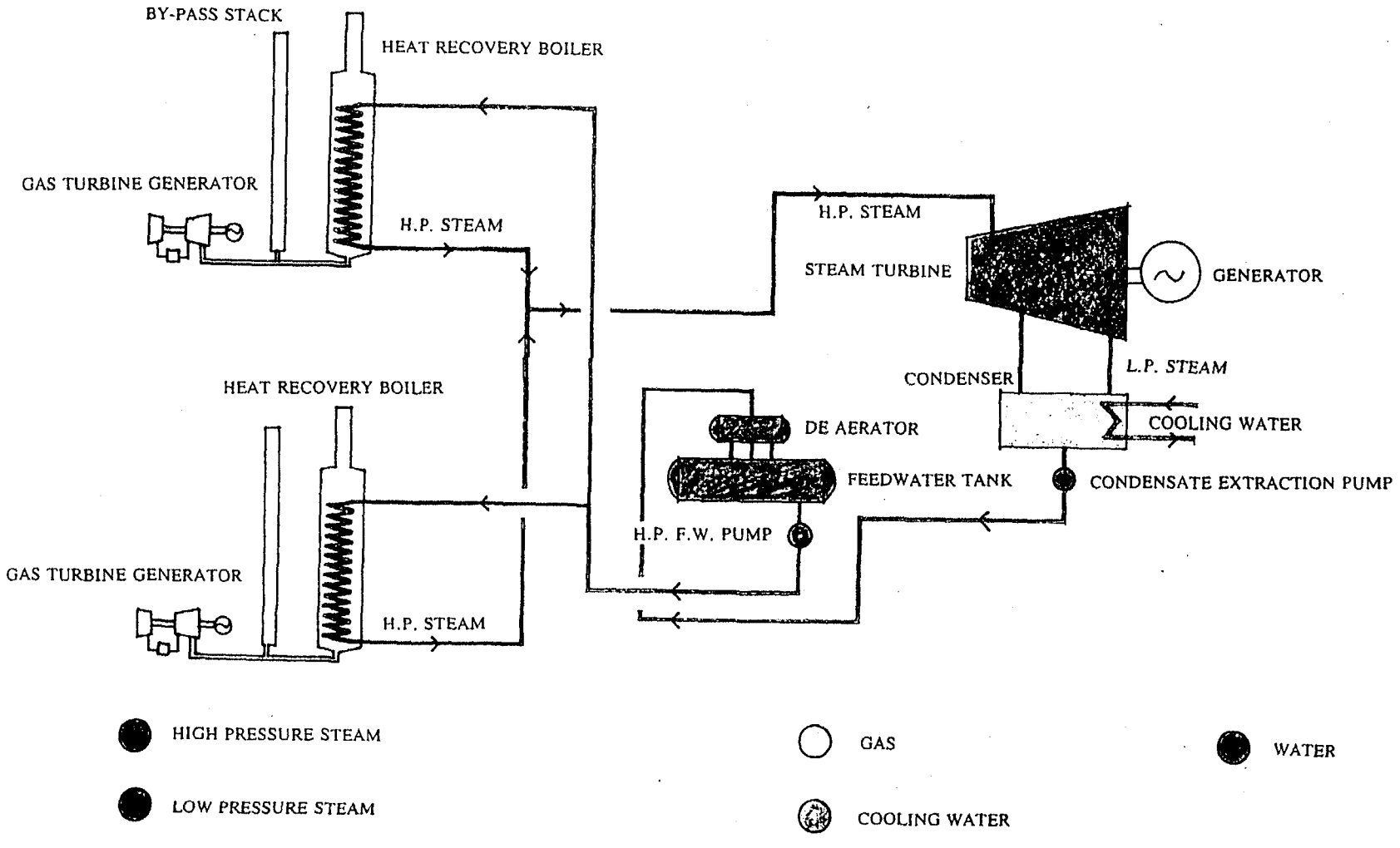


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| ESB International Consultants<br>Stepehn Court, 18/21 St. Stephen's Green,<br>Dublin 2, Ireland.<br>Telephone: +353-1-785155 Fax: +353-1-616600 | CLIENT<br>E.S.B. OPERATIONS | PROJECT<br>Combined Cycle Development | TITLE<br>Typical Combined Cycle Plant<br>- SCHEMATIC | PROJECT ARCHITECT<br>N. Mathews<br>CHKD | DRAWN<br>APPR. |
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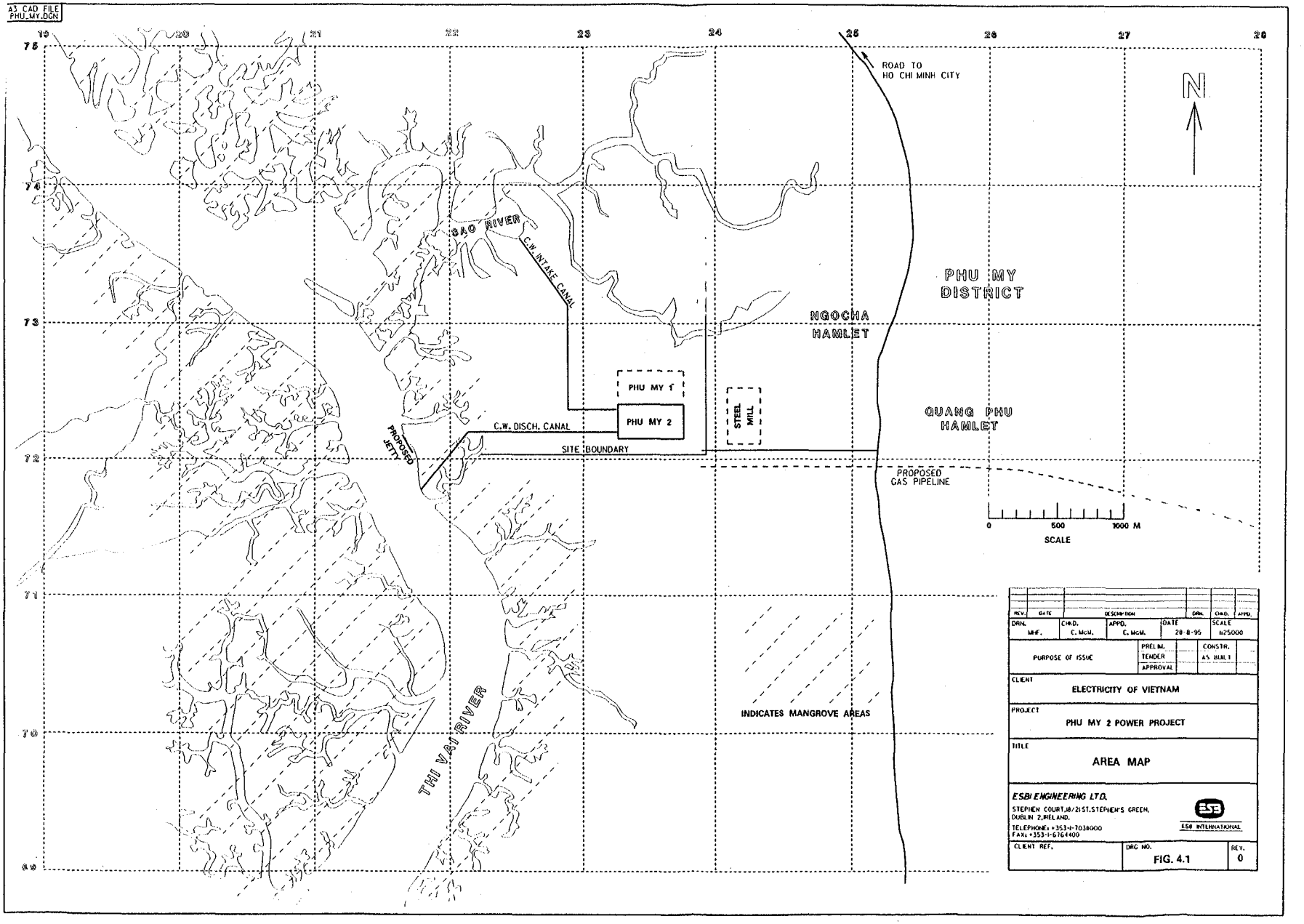
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CLIENT
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TITLE
AREA MAP
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E-190

# Environmental Assessment Report

## for the Combined Cycle Development at Phumy II, Vietnam

**Executive Summary**

Vol. I

August 1995

FILE COPY

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# Environmental Assessment Report

for the Combined Cycle Development at Phumy II, Vietnam

## Executive Summary

August 1995

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**Reference:** PE611-F12-1

**Client:** Electricity of Vietnam (EVN)

**Report No:** PE611-R2

**Report Title:** Environmental Assessment Report for the Combined Cycle Development (Phumy II) at Phumy, Vietnam

Executive Summary

**Volume** 1 **of** 1

**Approved:**

**Date:** 4 September 1995

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# EXECUTIVE SUMMARY

## CONTENTS

# EXECUTIVE SUMMARY

## Policy, Legal & Administrative Framework

1.1 This environmental impact assessment report (EIA) addresses the impacts of a project to develop power generating capacity at Phumy in the South of Vietnam. The proposed development will consist of two blocks of combined cycle plant of approximately 800 MW total. Each block will likely consist of gas turbines, waste heat boilers and a steam turbine. This project (Phumy II) is likely to be part funded by the International Bank for Reconstruction and Development (IBRD).

1.2 A separate power development project (Phumy I) consisting of 600 MW of conventional thermal plant is also planned for the site at Phumy and an EIA for this project has already been prepared. For completeness of information this EIA will address the impacts of the complete site development, i.e. Phumy I and Phumy II.

## The Developer

1.3 The Developer of the proposed project is Electricity of Vietnam (EVN), a state owned company which is responsible for supplying power to all of Vietnam. Shortage of adequate base load capacity together with high growth in demand has led EVN to develop this additional power generation capacity. Natural gas from the offshore White Tiger gas field will be available to Phumy in 1997 making it an ideal site for development of combined cycle plant.

## International Bank for Reconstruction and Development (IBRD) Requirements & Guidelines

1.4 This environmental assessment report is prepared for EVN according to the scope and format detailed in IBRD's Operational Directive OD 4.01. It is IBRD policy that all major projects shall be subject to an environmental assessment.

1.5 Environmental Guidelines have been issued by the IBRD to cover a wide range of specific industries. Each guideline contains emission limits as well as permitted ambient levels for all relevant media and likely contaminants. Values are intended as a guideline and mostly relate emissions to units of production. These guidelines are addressed where appropriate in assessing the impacts of the proposed development, and the ones relevant to this proposed project are summarised in Appendix IV. Suitable environmental control technology is also specified in this document. It is IBRD policy that where there exist different limits between its guidelines and national controls, the stricter of the two shall be applied.

**Vietnamese Environment Policy And Regulations**

1.6 A comprehensive environmental plan was adopted by Vietnam in 1991 called "The National Plan for Environmental and Sustainable Development: A Framework for Action". This plan provides the framework for establishing environmental issues. The implementation of this plan rests with the Vietnam State Committee for Science and Technology (SCTC).

1.7 Within this context national regulations and guidelines have been adopted giving permitted levels of contaminants in air, water and soils. These regulations are addressed where appropriate in this report and the relevant guidelines are summarised in Appendix IV. Several provincial centres including Ho Chi Minh City have also issued local environmental guidelines.

1.8 This law extends environmental impact assessment requirements to a broad range of public and private sector development activities, proposes procedures for screening and incorporating of mitigation plans into project design, and explicitly links EIA review to the project approval process.

1.9 The core agency with environmental mandate is the Ministry for Science, Technology and Environment (MSTE) which was formed in 1992 from the State Committee for Science. Within MSTE, the Department of Environment and Natural Resources (DENR) is the environmental arm with the main responsibility for carrying out these environmental functions.

**EIA Review And Approval Process**

1.10 Responsibility for project approval, for projects such as the current one under Vietnam's investment policy is given to the National Project Evaluation Board (NPEB) under the chairmanship of the State Planning Commission (SPC). As a member of the NPEB, the Ministry for Science Technology and Environment has the formal authority to comment on environmental aspects of the project. This function would normally be carried out by the Department of Environment and Natural Resources and a copy of the EIA has been submitted for their approval.

1.11 At the provincial level Environmental Committees also have formal authority to review and comment on environmental aspects of investment applications. The Environmental Committee at Vung Tau is the one of most relevance to the present proposed project and this EIA has been submitted for their approval. A copy has also been made available to the public in the municipality of Phumy where the project is being developed.

1.12 Within the IBRD EIAs are reviewed and assessed within the appropriate divisions. Both the EIA and the EIA summary are made available for public scrutiny.

**Summary of Main Environmental Issues**

1.13 The proposed development has major environmental benefits in the provision of an extra 800MW of combined cycle plant. Combined cycle plant is the most benign of thermal power plants with higher efficiencies and lower emissions per unit of

electricity generated. This extra generation capacity will allow the strengthening of the power supply system, the improvement of living standards and the development of industry and other economic activities in the region.

1.14 The overall development would directly affect 157 families in the Phumy area. A separate Rehabilitation Action Plan (RAP) is being carried out to World Bank (OD 4.30) guidelines.

1.15 The use of natural gas as a fuel and the availability of an extensive body of water for dispersing heat will ensure only minor impacts from stack emissions and cooling water emissions. A variety of mitigating measures will ensure that the impacts of all other emissions from the proposed plant will not be significant.

1.16 It is recommended that monitoring programmes during the construction and operating phases be put in place for the successful implementation of the Project. Recommendations are also made for the establishment of an environmental unit at Phumy as well as that of an environmental co-ordinator within EVN as its thermal program expands with the function of developing environmental policy and ensuring compliance with regulations. This co-ordinator would also liaise with other groups such as a Coastal Zone Management Group in order to promote the protection and sustainable development of the delicate coastal area. It is also stressed in the report that oil spills represent a particular hazard and that strict procedures, must be put in place to minimise this risk.

**Project Description**

1.17 The project is for the development of 800MW of combined cycle plant at Phumy in the South of Vietnam. Combined cycle plant consist of gas turbines which generate electricity directly as well as waste heat boilers which utilise the hot gases exhausted from the gas turbines to raise steam and generate further electricity in the steam turbines. Combined cycle plants have advantages in terms of higher efficiency and lower environmental emissions. Figures 3.1, 3.2, 3.3, 4.2 illustrate the location and layout of the project.

1.18 The plant will burn natural gas which will be available in mid 1997. At this stage the only stack emissions of significance would be NOx (oxides of nitrogen) which will be maintained below a level of 50 ppm by use of low NOx burners. The first two gas turbines will, however, be commissioned in December 1996 and will burn distillate fuel oil for about 6 months until natural gas is available. During this phase emission of NOx will be rather high at about 300 ppm as it is not justifiable to install NOx reduction measures for such a short period.

1.19 A conventional thermal plant called Phumy I as also planned for the site and will consist of 3 x 200MW units. Phumy I will also burn natural gas. Residual fuel oil will be used for emergency standby. For completeness of information this EIA considers total emissions from the site, i.e. Phumy I and II.

1.20 Cooling water for the plants will be taken from the Sao stream at the rate of $60m^3/s$ and will be discharged to the Thivai estuary. Chlorination of the system in order to reduce fouling will be carried out so that the residual chlorine level at the discharge is <0.02 ppm.

1.21 Waste water streams will include water treatment plant waste, sewage, surface drains, boiler washings and other minor sources typical of a power station. They will be treated as appropriate so that the effluents will satisfy IBRD and Vietnamese regulations.

1.22 The plant will require fresh water for boiler make-up and domestic use at a maximum rate of about 2000 $m^3$/day. This will be supplied by wells on site. Gas will be delivered by pipeline and distillate and heavy fuel oil by tanker. A 4km power line will be constructed to join the existing transmission system.

**Baseline Data**

1.23 The Phumy site is located in a rural area about 70km south east of Ho Chi Minh City. The population of the small townlet is about 8000 and the main economic activities are farming and fishing. The average income is low even compared to nearby districts and infrastructure and services such as electrical supply, roads, health services and education are also poor.

1.24 About 157 families in Phumy will be directly affected by the project implementation consisting of:-

- 6 families who live on the site (Phumy I).
- 135 families who own land and farm on the site (47 for Phumy II, 88 for Phumy I).
- 16 families who will have to be rehoused because the construction of a transmission line (Phumy II).

1.25 A survey of these people showed that in general they welcomed the project as a source of jobs for their children, but were worried about the amount of compensation they would receive. A separate Rehabilitation Action Plan (RAP) report is being prepared which will include full details of all these affected people, including land, assets, crops, so that fair and adequate compensation can be agreed.

1.26 Given the rural nature of the site air quality is expected to be good. Limited measurements on the site show that this is so with levels of $NO_2$ of 0 - 0.06 $mg/m^3$ and levels of $SO_2$ of 0.010 - 0.02 $mg/m^3$.

1.27 Noise measurements carried out at 3 locations show levels of about 40 dBA at night and higher levels at day time, probably due to nearby construction activities for a harbour development. For power station design night time levels are the most significant as the permitted noise levels are lowest during night.

1.28 The most significant ecological system is that of the mangrove forest and associated fish, shell fish and other animal species. This appears under threat in this region as it does in many parts of South East Asia due to:-

- Excessive siltation and organic pollution
- Harvesting for firewood and charcoal manufacture
- Operation of shrimp and fish aquaculture enterprises which may involve clearing mangrove areas as well as, depending on the stocking level, water pollution from biocides and other wastes.

1.29 There is evidence of all the above activities near Phumy; however successful replanting of mangroves has also taken place in areas where they were cut down. Development of shrimp aquaculture probably represents the single greatest threat.

1.30 A survey of mangrove trees in the site and nearby study area indicated the presence of 32 species. The distribution depends on submersion and salinity levels as well as impacts of artificial replanting. The survey also found the following numbers of animal species which are largely associated with the mangrove areas;

- 30 species of birds
- 17 species of mammals
- 8 species of amphibians
- 16 species of reptiles

1.31 The site itself, which is 150ha in extent contain, about 20 ha of mangrove area. The rest is mostly cultivated for rice, cashew nut trees, eucalyptus and other crops. Apart from the mangroves there are no significant habitats or wild life areas on the site or in the surrounding area. A study carried out showed the presence of 201 species of plant in the study area of which 101 occurred in the actual site area.

1.32 The Thivai river estuary, which runs by the site, will be utilised to disperse the heat in the cooling water discharged from the plant. It is wide (400m) and deep (15 - 30m) with a tidal variation of about 3m and a large tidal flow (10,000$m^3$/s). Analyses of the water quality of the Thivai estuary indicated the following main features:-

- High salinity levels, particularly in the dry season.
- Some evidence of oil pollution.
- Organic pollution from domestic sources.
- Moderate levels of dissolved oxygen.

1.33 Surveys of the aquatic ecosystem of the Thivai river indicate that it is typical of the nearby large area of delta. It is rich in numbers of species but with some evidence of an impact from organic pollution. The baseline surveys identified the following numbers of species:-

- 72 species of phytoplankton and 31 species of zooplancton.
- 60 species of fish and 22 species of shellfish.
- 42 species of zoobenthos (near site).

1.34 Fish eggs and larvae are considered particularly sensitive to environmental disturbance. A survey of eggs and larvae in the Thivai estuary showed numbers and species composition typical of the delta area. The larvae were found to migrate from surface layer to the bottom depending on the time of day.

**Environmental Impacts**

1.35 The positive impacts of the proposed project are summarised below. The negative impacts are summarised in tables 1, 2, 3, and 4 and described below.

1.36 The proposed project, consisting of combined cycle plant burning natural gas, is the most environmentally benign form of thermal power plant. It has a very high efficiency, close to 50%, and lower air emissions and cooling water requirements per unit of electricity generated than for conventional plant. In particular, when burning natural gas with a low NOx burner as is planned for this project, there are no significant emissions of NOx or $SO_2$ and emissions of carbon dioxide are 50% lower than for conventional plant burning fuel oil or coal.

1.37 A major and positive impact will be the provision of 800MW generating capacity. This will impact on a regional basis by strengthening the electricity supply network and allowing the connection of extra consumers and the development of industry and services in the region. The employment of large number of people during the construction and operation phase will also benefit the local economy.

1.38 The main groups of people directly affected by the overall development include six families, who live on the site, 135 families who own land on the site and 16 families who will be displaced from their homes because of power line construction. A separate RAP report will be carried out to IBRD guidelines which will detail the compensation to be awarded to those people for their land, houses, crops and other assets. The process will ensure that no families will suffer a drop in standard of living as a result of the project.

1.39 While some disturbance will be caused to the townlet of Phumy the overall impact should be positive by the provision of jobs and improvement of infrastructure.

1.40 During the construction phase there will be a permanent loss of 2 ha of mangrove forest due to the construction of a jetty and a loss of about 0.5 ha of mangrove at the cooling water intake. There will be a temporary loss of 1 ha due to construction of the cooling water outlet pipes. As these will be buried the areas can be replanted.

1.41 Dredging of the Thivai river in order to allow berthing of tankers of 10,000 dw tonnage as well as all the cooling water system construction will cause a local and temporary loss of benthnic animals as well as disturbance of fish and other organisms.

1.42 Impacts of other construction activities such as noise, dust, sewage, after taking into account mitigation measures, will be minor.

1.43 The Phumy I and II Power Stations will burn natural gas and the only stack emission of interest will be NOx. A dispersion analysis was carried out for the case of plants on full load and showed that the maximum hourly ground level concentration of $NO_2$ when burning natural gas would be 0.11 mg/m$^3$ while the maximum annual average will be 0.002 mg/m$^3$. These relatively low values will be well below IBRD and Vietnamese air quality regulations and will be of minor significance to air quality in the area.

1.44 For about six months the first two gas turbines to be commissioned will burn distillate until natural gas reaches the site. The rate of emission of NOx will be quite high at 300 ppm as methods of reducing NOx levels such as water injection are not considered feasible for this short period. However as they will be on open cycle for this period the high exit temperature will provide good dispersion characteristics. A dispersion analysis for this case showed that maximum hourly ground level concentrations of $NO_2$ would be 0.100 mg/m$^3$. This level will not break ambient air quality standards nor will it have a significant impact over the short period involved.

1.45 Specification for the proposed plant will be such that noise levels at the site perimeter will not exceed permitted levels for residential areas. This will ensure that no noise nuisance is caused at nearest residences.

1.46 Cooling water discharge will be at a maximum rate of 60m$^3$/s and a temperature rise of 7$^o$C. The discharge will be deep into the Thivai estuary which has a large tidal flow of 10,000 m$^3$/sec. A thermal diffusion study indicates that the physical impact will be minor with, for the worst case, a thermal plume of 1$^o$C extending across the estuary. Beyond the immediate outfall the maximum temperature rise will be 1.5°C.

1.47 Ecological impacts of the thermal plume are not predicted to be significant. However, because it is a deep discharge some scouring will take place at the outfall. No significant impacts will be caused to aquaculture or commercial fishery on the Thivai River.

1.48 Chlorination of the cooling water will take place at a rate that will leave a residual level of <0.02 ppm at the outfall. At this concentration the chlorine should not have any significant impacts beyond the discharge point.

1.49 A large number of organisms including fish eggs and larvae will be entrained by the cooling water system and significant mortality will occur due to pressure, temperature rise and chlorination. This is not predicted to have an overall impact on fish numbers in the area due to the large amount of similar habitat in the region and due to the small ratio of CW flow to overall tidal flow.

1.50 Other waste water streams from the plant include water treatment plant effluent, sewage, surface drains, boiler washes and acid cleans. These will all be treated as appropriate so that the effluents will satisfy Vietnamese regulations and will have no environmental impacts on the receiving water.

1.51 Oil spillage into the sensitive mangrove ecosystem represents a serious menace. In order to minimise this risk strict procedures will be implemented for the delivery, unloading, storage and handling of oil as well as an emergency response plan and clean up procedures.

1.52 Dredging will be required occasionally in order to maintain navigable depth at the jetty. This will create a local and temporary disturbance to biota in the area. The dredged material will be transported for land reclamation to an area not yet designated.

**Summary of Alternatives**

1.53 Alternatives to the proposed project should be seen in the context of a high predicted growth in electricity demand in the South Vietnam area over the next twenty years. This growth is required for economic development and improvement in standard of living. A mixture of thermal and hydroelectric power, which are complimentary to each other, is required to satisfy this demand. Alternative designs and sites were considered.

1.54 A natural gas fired combined cycle plant, such as the present design, has the following major advantage over other types of thermal plant which might be considered :-

- Lower capital cost
- Shorter lead times to power production
- Small land area requirements
- Higher efficiencies
- Lower air emissions per unit of electricity generated
- Lower cooling water requirements per unit of electricity generated.

1.55 A number of alternative sites were considered and evaluated on the following criteria:-

- Proximity to Bach-Ho - Thu Duc gas pipeline
- Distance to transmission lines
- Cooling water availability
- Environmental and socioeconomic issues
- Site area available
- Construction and engineering issues.

The site at Phumy was judged as the optimum available.

## TABLE 1

**Summary of Environmental Impacts During Construction Phase**

| Source | Environmental Impact | Mitigation Measures | Residual Impact |
|---|---|---|---|
| Site Acquisition | Displacement of people living and owning land on site | Adequate and timely resettlement and/or compensation | Temporary disturbance - no reduction in assets or income |
| Transmission line construction | Displacement of 16 families | Adequate and timely resettlement | Temporary disturbance only |
| Construction of Jetty | Loss of 2ha of Mangrove | None | Local but permanent |
| Construction of C.W. outlet | Loss of 1 ha Mangrove | Pipes are buried and area will be replanted | Temporary |
| Dredging activities | Loss of benthnic fauna | None | Local and Temporary loss |
| Sanitation facilities | Sewage discharge | Effluent will be treated to Vietnamese standards | Minor |
| Noise | Noise during piling and steam purging operations | Restrict piling to day light hours. Notify residents of steam blows | Minor and temporary |
| Dust | Dust generated | Spraying of access roads and truck tyres | Minor |
| Construction Work | Traffic Increase | Road Improvement | Minor |
| Work during construction | Short term employment for over 1000 workers | | Beneficial short term |

## TABLE 2

**Summary of Impacts of Atmospheric Emissions for Phumy I and II When Burning Natural Gas**

| Impact | | Predicted | Vietnamese Regulations | IBRD |
|---|---|---|---|---|
| Nitrogen Oxide ($NO_2$) | | | | |
| Ambient | | | | |
| 1-hour maximum | $\mu g/m^3$ | 110 | 300 | --- |
| 24-hour maximum | $\mu g/m^3$ | | --- | --- |
| Max. annual average | $\mu g/m^3$ | 2 | 80 | 100 |
| Sulphur Dioxide ($SO_2$) (a) | | | | |
| Ambient | | | | |
| 1-hour maximum | $\mu g/m^3$ | 0 | 300 | --- |
| 24-hour maximum | $\mu g/m^3$ | 0 | --- | 500 |
| Max. annual average | $\mu g/m^3$ | 0 | 80 | 100 |
| Carbon Dioxide ($CO_2$) (a) | | | | |
| Emission | | | | |
| Tonnes/annum (total) | | $4.7 \times 10^6$ | --- | --- |
| Noise (dB (A)) | | | | |
| Noise Levels at Boundary fence | | 55 | | 55 (b) |
| Residential Area | | <55 | 55/60 (b) | 55 (b) |
| Particulates | | | | |
| 24-hour maximum | $\mu g/m^3$ | <1 | 200 | 500 |

(a) 100% load factor

(b) Varies with day / night; indoors and outdoors and other factors

## TABLE 3

**Summary of Environmental Impacts**
**During Operation of Plant - Aqueous Emissions of Phumy I and II**

| Source | Environmental Impact | Mitigation Measures | Residual impact |
|---|---|---|---|
| Water Treatment Plant Waste | Contains strong acids and alkalis | Treated in neutralisation tank to pH 6-9. Effluent will comply with waste water standards (Ref.8) | Negligible |
| Oil Contaminated Surface Water | Adverse impact on marine organisms if discharged directly | All surface drains will be routed through oil interceptors. Effluent will comply with waste water standards (Ref.8) | Minor |
| Sewage | High BOD and micro biological pollutants | Sewage will be treated to <20 mg/l BOD before discharge | Minor |
| Boiler Blowdown | Contain very low concentration of contaminants | No treatment necessary | Negligible |
| Boiler Acid Clean | Utilises toxic chemicals. This process arises only rarely. | These will be treated with the waste removed off site for disposal. Effluent discharged will satisfy waste water regulations (Ref.8) | Minor |
| Chemical Spillage | Bulk chemicals stored on site, in particular acid and alkali | Stored bulk chemicals will be bunded so that any spillage will be contained and controlled | Negligible |
| Boiler Washing | If burning residual fuel oil can contain vanadium and other metals | Metals will be precipitated by chemical treatment and removed offsite to land fill | Minor |

**Table 4**

**Summary of Impacts of Cooling Water System Operation for Phumy I and II**

| Source | Environmental Impact | Mitigation Measures | Residual Impact |
|---|---|---|---|
| Intake of 60 $m^3/s$ | Loss of fish eggs and plankton | None | Small in relation to overall abundance in the area |
| Intake screens | Loss of fish through impingement | Optimum measures not yet selected | Minor |
| Discharge of heated water | Impact on sensitive organisms | Discharge designed so that temperature rise will not exceed 1°C | Minor |
| Chlorination of C.W. system | Impact of residual chlorine on ecosystem | Residual chorine levels will be kept to < .02ppm | Negligible |
| Discharge of CW | Scouring of bottom | None | Permanent but local disturbance of area |

**Summary of Mitigation Measures**

1.56 In order to reduce environmental impacts from the proposed development mitigation measures, summarised below, have already been put in hand or are planned. Apart from these, and taking into account the minor residual impacts of the proposed development, no further mitigation measures are considered necessary.

1.57 About 157 families who own land, houses and other assets in the area will be impacted directly by the project. A Rehabilitation Action Plan (RAP) process will be completed to IBRD guidelines to ensure compensation will be given in a fair and timely way. This will ensure that all the people affected, will, at the end of the process, be at least as well off as they were previously.

1.58 Mitigation measures to apply during the construction phase include the following:-

- Provision of housing, clean water, sanitation facilities, health services to the construction workers.

- Sewage treatment.
- Dust suppression control
- Noise control

1.59 During the operation phase air emissions will be controlled by burning natural gas and installing low NOx burners.

1.60 Noise control will be by housing and acoustic cladding of noisy plant to ensure noise levels at the site perimeter are within regulations. Other noise reduction measures such as tree plantations may be used as appropriate.

1.61 Impacts of the cooling water system will be mitigated by:-

- Design of outfall to reduce extent of thermal plumes.
- Maintaining residual chlorine levels at less than 0.02 ppm.
- Measures to reduce impingement of fish at the intake.

1.62 All other waste water streams will be treated so that effluents will satisfy Vietnamese regulations and will not cause any significant impacts.

1.63 In order to avoid risks of ground water pollution or soil contamination all waste materials that will arise at the site will be monitored as to type and quantity and removed offsite for disposal or recycling.

**Consultation with Affected Groups**

1.64 The groups directly affected by the project are:

- 6 families who live on the project site (Phumy I).
- 135 other families who own land and other assets on the site (88 for Phumy I, 47 for Phumy II).
- 16 families who live in houses along the proposed route of the transmission line and who will have to move (Phumy II).

1.65 These people are represented by the Peoples Committee of Phumy who also look after their interests in relation to compensation and resettlement. The company responsible for this project (EVN) have had discussions with the Peoples Committee about plans for the project and compensation issues and the Peoples Committee have informed the families concerned. A representative of EVN has also spoken individually to each of the project affected families.

1.66 As already described in Chapter 4, a survey was carried out of the families affected by the project by Environmental Protection Centre (EPC), H.C.M City. This survey established details of the area of land owned by each family, the type and

quantity of crops grown on each property, the annual income as well as the attitude of the families towards the project and the preferred type of compensation. No objection was voiced to the project as long as proper compensation was agreed.

1.67 On July 15th Dr. C. McMahon of the Consultancy Company, ESBI, visited the Phumy area in order to have independent discussions with the affected groups. In an open discussion with the Peoples Committee the same views as above were expressed i.e. the project is welcome because of the provision of badly needed jobs in the community as well as improvements in infrastructure such as roads and electricity supply. There was an issue about compensation for land, crops and trees. It was felt that the preliminary amount suggested was not sufficient for people to purchase equivalent land elsewhere. Apart from this the only issue raised was that of dust from trucks passing by during construction and a request to hard surface the road. This is already planned.

1.68 Discussions were also held with several individuals who live or own land on the site. These all expressed the view that they were happy with the representation of the Peoples Committee and the way they were kept informed of the project, but were worried about the amount of compensation being talked about for their land, crops and other assets. No firm offers had yet been made. Apart from this they welcomed the project, particularly as regards the likelihood of providing jobs for their children.

1.69 It should be noted that a Rehabilitation Action Plan (RAP) is being finalised by EVN and is being done to World Bank (OD 4.3) criteria and guidelines. The criteria for resettlement/compensation is that overall no affected person should suffer in terms of standard of living and must be given full rights to participate in the RAP process.

**Environmental Management and Training**

1.70 It is recommended that an environmental unit be set up as part of the management structure in the new development at Phumy. The main function of this unit would be the monitoring and control of waste water streams and other emissions from the plant. This function could be combined with the already planned water quality analysis programme at little additional expense.

1.71 It is also recommended that as EVN expands its generation programme, an environmental co-ordinator be established with the function of developing environmental policy, issuing in-house guidelines and establishing compliance with standards and regulations and setting up an environmental management system.

1.72 It is further recommended that this co-ordinator would also liaise with other groups such as a coastal zone management group in order to promote strategies for the protection and sustainable development of the delicate coastal zone.

**Environmental Monitoring**

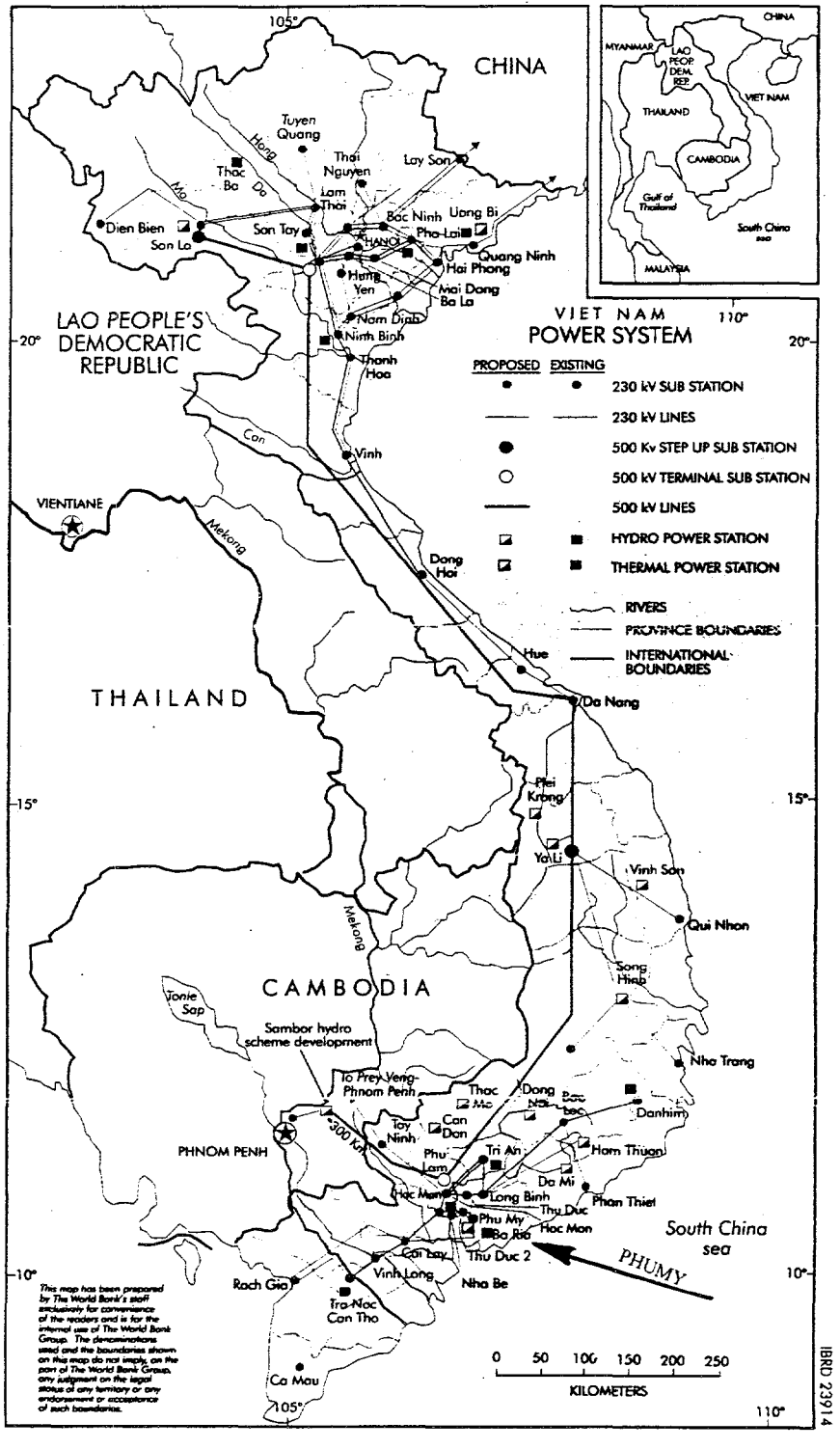
1.73 In order to fully control the implementation of the proposed project, it is recommended that the following monitoring programme be put in place:-

- Monitoring programme of the waste water streams from the new project.
- Extension of the existing air monitoring programme.
- Noise monitoring at the site perimeter.
- Monitoring of waste materials arising on site.
- A review of the baseline ecological study of the Thivai river estuary particularly in the area near the power plant site.

1.74 During the construction phase monitoring for dust levels, noise levels, sewage effluent should be carried out to ensure no nuisance is created.

1.75 Recommendations are made for training programs for management and staff at the proposed plant. Particular attention should be given to staff involved in environmental work, to those handling oil and chemicals and those involved in emergency and safety procedures.

Figure 3.1 Vietnam Power Grid



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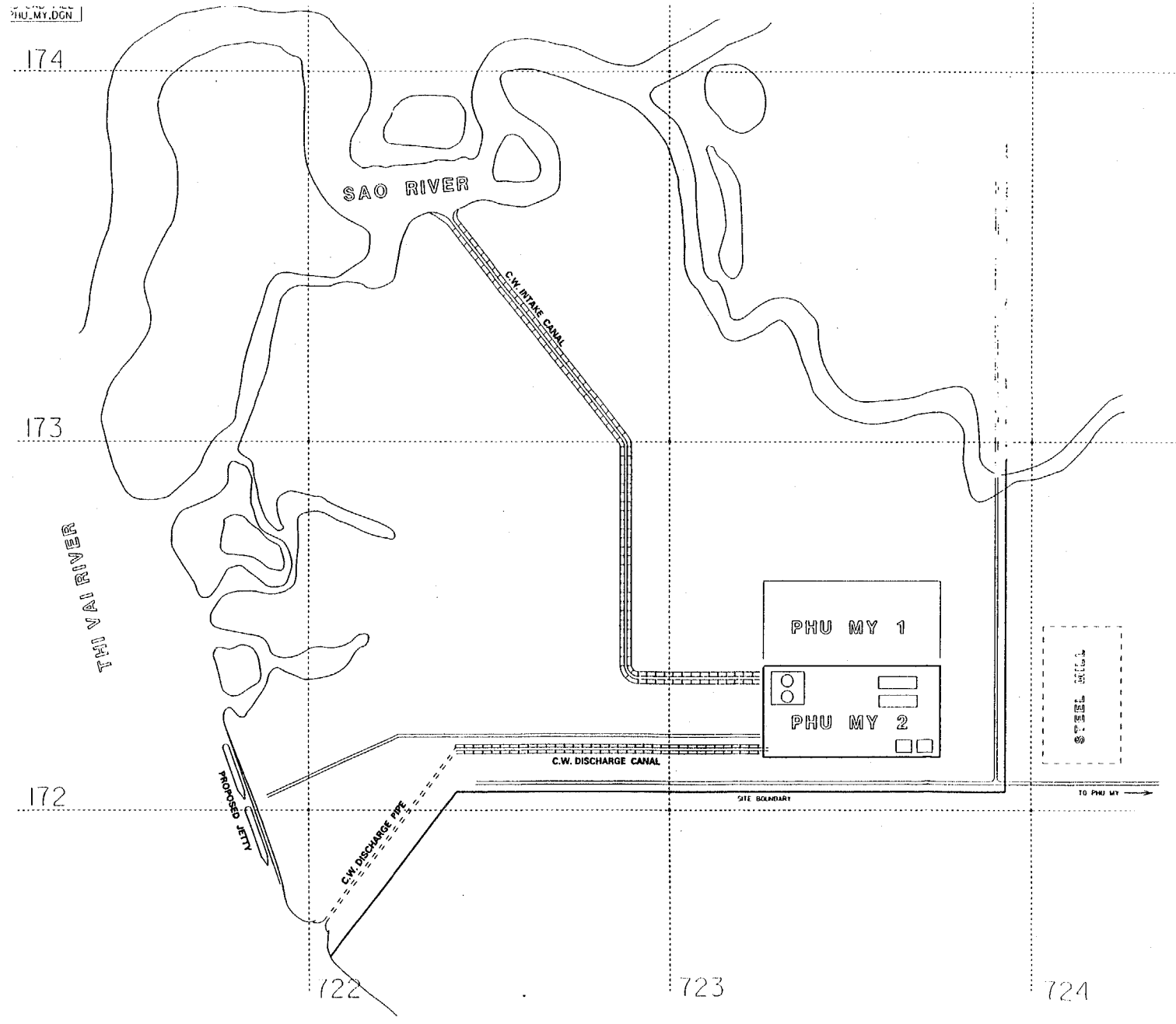


| REV. | DATE | DESCRIPTION | DRN. | CHKD | APPD. |
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| PURPOSE OF ISSUE | PRELIM. | TENDER | APPROVAL | CONSTR. | AS BUILT |
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CLIENT
ELECTRICITY OF VIETNAM

PROJECT
PHU MY 2 POWER PROJECT

TITLE
PRELIMINARY SITE LAYOUT

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CLIENT REF.

DRG. NO. FIG. 3.2

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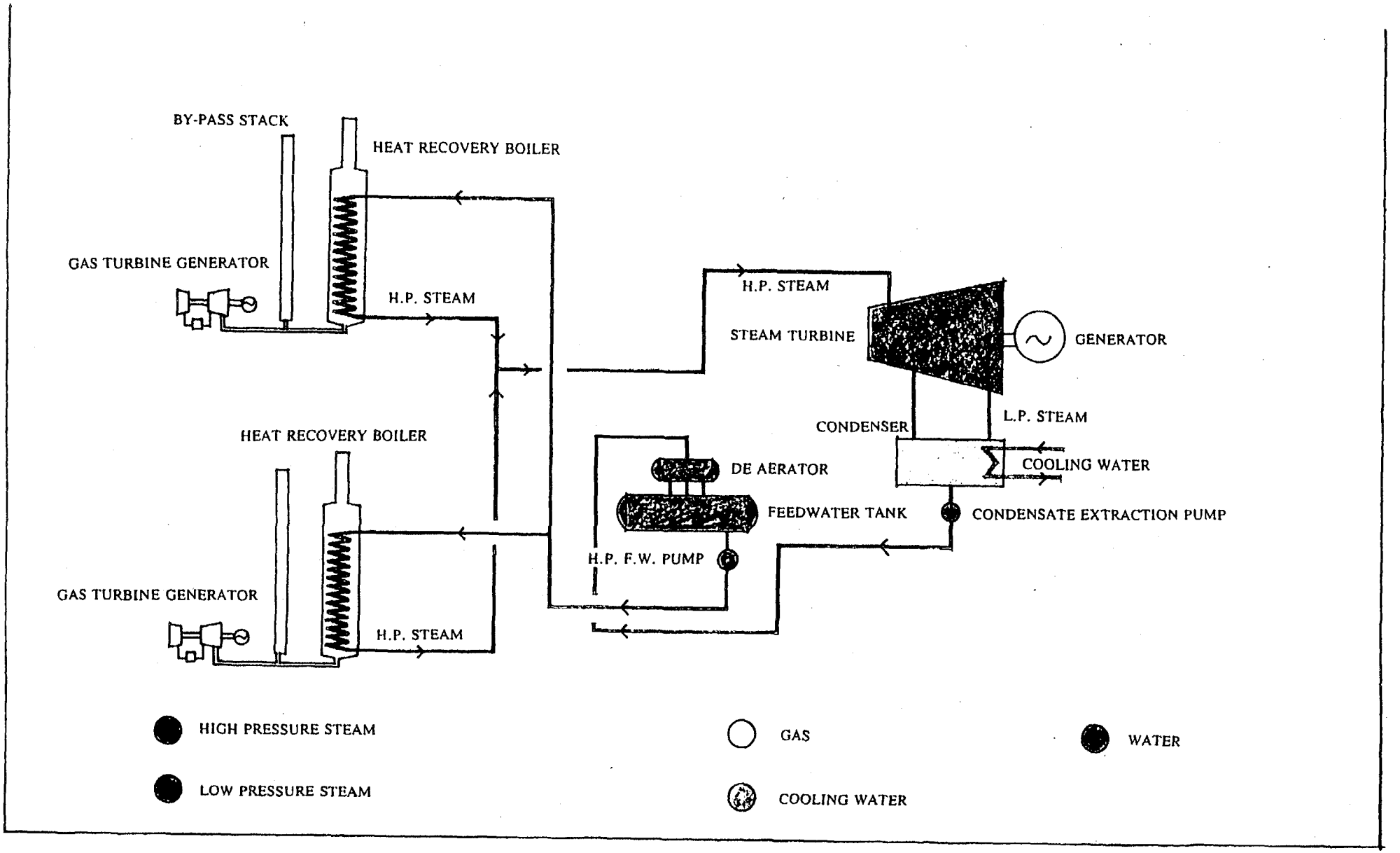


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|---|---|
| CLIENT | E.S.B. OPERATIONS |
| PROJECT | Combined Cycle Development |
| TITLE | Typical Combined Cycle Plant - SCHEMATIC |
| PROJECT ARCHITECT | N. Matthews |
| DRAWN | |
| CHKD | |
| APPR. | |
| SCALE | |
| DATE | June '94 |
| REV | |
| JOB NO | 4Y003C |
| DRWG NO | Figure 3.3 |

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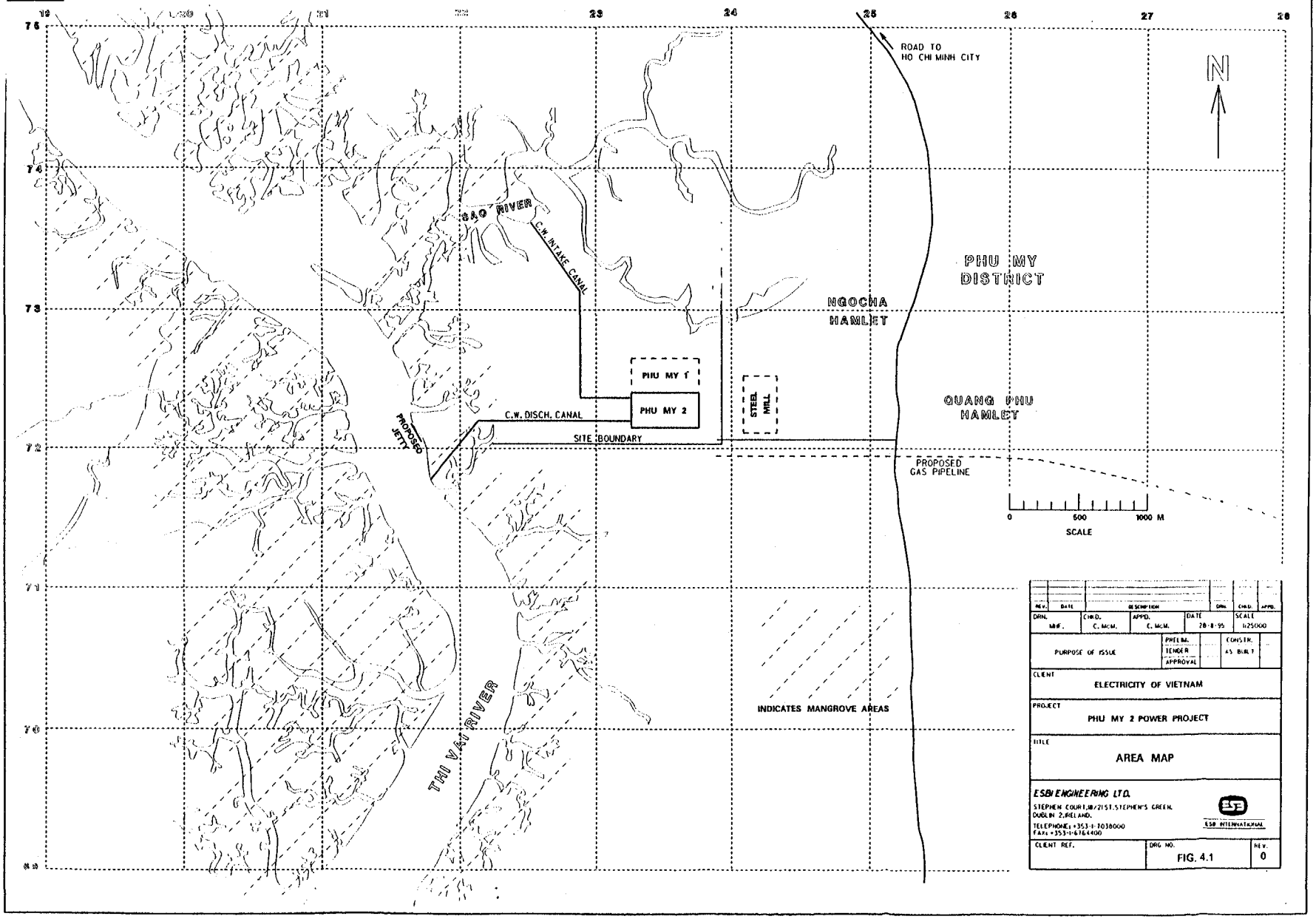

E-190

# Environmental Assessment Report

## for the Combined Cycle Development at Phumy II, Vietnam

**Executive Summary**

Vol. I

August 1995

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# Environmental Assessment Report

for the Combined Cycle Development at Phumy II, Vietnam

## Executive Summary

August 1995

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**Reference:** PE611-F12-1

**Client:** Electricity of Vietnam (EVN)

**Report No:** PE611-R2

**Report Title:** Environmental Assessment Report for the Combined Cycle Development (Phumy II) at Phumy, Vietnam

Executive Summary

**Volume** 1 **of** 1

**Approved:**

**Date:** 4 September 1995

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# EXECUTIVE SUMMARY

## CONTENTS

# EXECUTIVE SUMMARY

## Policy, Legal & Administrative Framework

1.1 This environmental impact assessment report (EIA) addresses the impacts of a project to develop power generating capacity at Phumy in the South of Vietnam. The proposed development will consist of two blocks of combined cycle plant of approximately 800 MW total. Each block will likely consist of gas turbines, waste heat boilers and a steam turbine. This project (Phumy II) is likely to be part funded by the International Bank for Reconstruction and Development (IBRD).

1.2 A separate power development project (Phumy I) consisting of 600 MW of conventional thermal plant is also planned for the site at Phumy and an EIA for this project has already been prepared. For completeness of information this EIA will address the impacts of the complete site development, i.e. Phumy I and Phumy II.

## The Developer

1.3 The Developer of the proposed project is Electricity of Vietnam (EVN), a state owned company which is responsible for supplying power to all of Vietnam. Shortage of adequate base load capacity together with high growth in demand has led EVN to develop this additional power generation capacity. Natural gas from the offshore White Tiger gas field will be available to Phumy in 1997 making it an ideal site for development of combined cycle plant.

## International Bank for Reconstruction and Development (IBRD) Requirements & Guidelines

1.4 This environmental assessment report is prepared for EVN according to the scope and format detailed in IBRD's Operational Directive OD 4.01. It is IBRD policy that all major projects shall be subject to an environmental assessment.

1.5 Environmental Guidelines have been issued by the IBRD to cover a wide range of specific industries. Each guideline contains emission limits as well as permitted ambient levels for all relevant media and likely contaminants. Values are intended as a guideline and mostly relate emissions to units of production. These guidelines are addressed where appropriate in assessing the impacts of the proposed development, and the ones relevant to this proposed project are summarised in Appendix IV. Suitable environmental control technology is also specified in this document. It is IBRD policy that where there exist different limits between its guidelines and national controls, the stricter of the two shall be applied.

**Vietnamese Environment Policy And Regulations**

1.6 A comprehensive environmental plan was adopted by Vietnam in 1991 called "The National Plan for Environmental and Sustainable Development: A Framework for Action". This plan provides the framework for establishing environmental issues. The implementation of this plan rests with the Vietnam State Committee for Science and Technology (SCTC).

1.7 Within this context national regulations and guidelines have been adopted giving permitted levels of contaminants in air, water and soils. These regulations are addressed where appropriate in this report and the relevant guidelines are summarised in Appendix IV. Several provincial centres including Ho Chi Minh City have also issued local environmental guidelines.

1.8 This law extends environmental impact assessment requirements to a broad range of public and private sector development activities, proposes procedures for screening and incorporating of mitigation plans into project design, and explicitly links EIA review to the project approval process.

1.9 The core agency with environmental mandate is the Ministry for Science, Technology and Environment (MSTE) which was formed in 1992 from the State Committee for Science. Within MSTE, the Department of Environment and Natural Resources (DENR) is the environmental arm with the main responsibility for carrying out these environmental functions.

**EIA Review And Approval Process**

1.10 Responsibility for project approval, for projects such as the current one under Vietnam's investment policy is given to the National Project Evaluation Board (NPEB) under the chairmanship of the State Planning Commission (SPC). As a member of the NPEB, the Ministry for Science Technology and Environment has the formal authority to comment on environmental aspects of the project. This function would normally be carried out by the Department of Environment and Natural Resources and a copy of the EIA has been submitted for their approval.

1.11 At the provincial level Environmental Committees also have formal authority to review and comment on environmental aspects of investment applications. The Environmental Committee at Vung Tau is the one of most relevance to the present proposed project and this EIA has been submitted for their approval. A copy has also been made available to the public in the municipality of Phumy where the project is being developed.

1.12 Within the IBRD EIAs are reviewed and assessed within the appropriate divisions. Both the EIA and the EIA summary are made available for public scrutiny.

**Summary of Main Environmental Issues**

1.13 The proposed development has major environmental benefits in the provision of an extra 800MW of combined cycle plant. Combined cycle plant is the most benign of thermal power plants with higher efficiencies and lower emissions per unit of

electricity generated. This extra generation capacity will allow the strengthening of the power supply system, the improvement of living standards and the development of industry and other economic activities in the region.

1.14 The overall development would directly affect 157 families in the Phumy area. A separate Rehabilitation Action Plan (RAP) is being carried out to World Bank (OD 4.30) guidelines.

1.15 The use of natural gas as a fuel and the availability of an extensive body of water for dispersing heat will ensure only minor impacts from stack emissions and cooling water emissions. A variety of mitigating measures will ensure that the impacts of all other emissions from the proposed plant will not be significant.

1.16 It is recommended that monitoring programmes during the construction and operating phases be put in place for the successful implementation of the Project. Recommendations are also made for the establishment of an environmental unit at Phumy as well as that of an environmental co-ordinator within EVN as its thermal program expands with the function of developing environmental policy and ensuring compliance with regulations. This co-ordinator would also liaise with other groups such as a Coastal Zone Management Group in order to promote the protection and sustainable development of the delicate coastal area. It is also stressed in the report that oil spills represent a particular hazard and that strict procedures, must be put in place to minimise this risk.

**Project Description**

1.17 The project is for the development of 800MW of combined cycle plant at Phumy in the South of Vietnam. Combined cycle plant consist of gas turbines which generate electricity directly as well as waste heat boilers which utilise the hot gases exhausted from the gas turbines to raise steam and generate further electricity in the steam turbines. Combined cycle plants have advantages in terms of higher efficiency and lower environmental emissions. Figures 3.1, 3.2, 3.3, 4.2 illustrate the location and layout of the project.

1.18 The plant will burn natural gas which will be available in mid 1997. At this stage the only stack emissions of significance would be NOx (oxides of nitrogen) which will be maintained below a level of 50 ppm by use of low NOx burners. The first two gas turbines will, however, be commissioned in December 1996 and will burn distillate fuel oil for about 6 months until natural gas is available. During this phase emission of NOx will be rather high at about 300 ppm as it is not justifiable to install NOx reduction measures for such a short period.

1.19 A conventional thermal plant called Phumy I as also planned for the site and will consist of 3 x 200MW units. Phumy I will also burn natural gas. Residual fuel oil will be used for emergency standby. For completeness of information this EIA considers total emissions from the site, i.e. Phumy I and II.

1.20 Cooling water for the plants will be taken from the Sao stream at the rate of $60m^3/s$ and will be discharged to the Thivai estuary. Chlorination of the system in order to reduce fouling will be carried out so that the residual chlorine level at the discharge is <0.02 ppm.

1.21 Waste water streams will include water treatment plant waste, sewage, surface drains, boiler washings and other minor sources typical of a power station. They will be treated as appropriate so that the effluents will satisfy IBRD and Vietnamese regulations.

1.22 The plant will require fresh water for boiler make-up and domestic use at a maximum rate of about 2000 $m^3$/day. This will be supplied by wells on site. Gas will be delivered by pipeline and distillate and heavy fuel oil by tanker. A 4km power line will be constructed to join the existing transmission system.

**Baseline Data**

1.23 The Phumy site is located in a rural area about 70km south east of Ho Chi Minh City. The population of the small townlet is about 8000 and the main economic activities are farming and fishing. The average income is low even compared to nearby districts and infrastructure and services such as electrical supply, roads, health services and education are also poor.

1.24 About 157 families in Phumy will be directly affected by the project implementation consisting of:-

- 6 families who live on the site (Phumy I).
- 135 families who own land and farm on the site (47 for Phumy II, 88 for Phumy I).
- 16 families who will have to be rehoused because the construction of a transmission line (Phumy II).

1.25 A survey of these people showed that in general they welcomed the project as a source of jobs for their children, but were worried about the amount of compensation they would receive. A separate Rehabilitation Action Plan (RAP) report is being prepared which will include full details of all these affected people, including land, assets, crops, so that fair and adequate compensation can be agreed.

1.26 Given the rural nature of the site air quality is expected to be good. Limited measurements on the site show that this is so with levels of $NO_2$ of 0 - 0.06 $mg/m^3$ and levels of $SO_2$ of 0.010 - 0.02 $mg/m^3$.

1.27 Noise measurements carried out at 3 locations show levels of about 40 dBA at night and higher levels at day time, probably due to nearby construction activities for a harbour development. For power station design night time levels are the most significant as the permitted noise levels are lowest during night.

1.28 The most significant ecological system is that of the mangrove forest and associated fish, shell fish and other animal species. This appears under threat in this region as it does in many parts of South East Asia due to:-

- Excessive siltation and organic pollution
- Harvesting for firewood and charcoal manufacture
- Operation of shrimp and fish aquaculture enterprises which may involve clearing mangrove areas as well as, depending on the stocking level, water pollution from biocides and other wastes.

1.29 There is evidence of all the above activities near Phumy; however successful replanting of mangroves has also taken place in areas where they were cut down. Development of shrimp aquaculture probably represents the single greatest threat.

1.30 A survey of mangrove trees in the site and nearby study area indicated the presence of 32 species. The distribution depends on submersion and salinity levels as well as impacts of artificial replanting. The survey also found the following numbers of animal species which are largely associated with the mangrove areas;

- 30 species of birds
- 17 species of mammals
- 8 species of amphibians
- 16 species of reptiles

1.31 The site itself, which is 150ha in extent contain, about 20 ha of mangrove area. The rest is mostly cultivated for rice, cashew nut trees, eucalyptus and other crops. Apart from the mangroves there are no significant habitats or wild life areas on the site or in the surrounding area. A study carried out showed the presence of 201 species of plant in the study area of which 101 occurred in the actual site area.

1.32 The Thivai river estuary, which runs by the site, will be utilised to disperse the heat in the cooling water discharged from the plant. It is wide (400m) and deep (15 - 30m) with a tidal variation of about 3m and a large tidal flow (10,000$m^3$/s). Analyses of the water quality of the Thivai estuary indicated the following main features:-

- High salinity levels, particularly in the dry season.
- Some evidence of oil pollution.
- Organic pollution from domestic sources.
- Moderate levels of dissolved oxygen.

1.33 Surveys of the aquatic ecosystem of the Thivai river indicate that it is typical of the nearby large area of delta. It is rich in numbers of species but with some evidence of an impact from organic pollution. The baseline surveys identified the following numbers of species:-

- 72 species of phytoplankton and 31 species of zooplancton.
- 60 species of fish and 22 species of shellfish.
- 42 species of zoobenthos (near site).

1.34 Fish eggs and larvae are considered particularly sensitive to environmental disturbance. A survey of eggs and larvae in the Thivai estuary showed numbers and species composition typical of the delta area. The larvae were found to migrate from surface layer to the bottom depending on the time of day.

**Environmental Impacts**

1.35 The positive impacts of the proposed project are summarised below. The negative impacts are summarised in tables 1, 2, 3, and 4 and described below.

1.36 The proposed project, consisting of combined cycle plant burning natural gas, is the most environmentally benign form of thermal power plant. It has a very high efficiency, close to 50%, and lower air emissions and cooling water requirements per unit of electricity generated than for conventional plant. In particular, when burning natural gas with a low NOx burner as is planned for this project, there are no significant emissions of NOx or $SO_2$ and emissions of carbon dioxide are 50% lower than for conventional plant burning fuel oil or coal.

1.37 A major and positive impact will be the provision of 800MW generating capacity. This will impact on a regional basis by strengthening the electricity supply network and allowing the connection of extra consumers and the development of industry and services in the region. The employment of large number of people during the construction and operation phase will also benefit the local economy.

1.38 The main groups of people directly affected by the overall development include six families, who live on the site, 135 families who own land on the site and 16 families who will be displaced from their homes because of power line construction. A separate RAP report will be carried out to IBRD guidelines which will detail the compensation to be awarded to those people for their land, houses, crops and other assets. The process will ensure that no families will suffer a drop in standard of living as a result of the project.

1.39 While some disturbance will be caused to the townlet of Phumy the overall impact should be positive by the provision of jobs and improvement of infrastructure.

1.40 During the construction phase there will be a permanent loss of 2 ha of mangrove forest due to the construction of a jetty and a loss of about 0.5 ha of mangrove at the cooling water intake. There will be a temporary loss of 1 ha due to construction of the cooling water outlet pipes. As these will be buried the areas can be replanted.

1.41 Dredging of the Thivai river in order to allow berthing of tankers of 10,000 dw tonnage as well as all the cooling water system construction will cause a local and temporary loss of benthnic animals as well as disturbance of fish and other organisms.

1.42 Impacts of other construction activities such as noise, dust, sewage, after taking into account mitigation measures, will be minor.

1.43 The Phumy I and II Power Stations will burn natural gas and the only stack emission of interest will be NOx. A dispersion analysis was carried out for the case of plants on full load and showed that the maximum hourly ground level concentration of $NO_2$ when burning natural gas would be 0.11 mg/m$^3$ while the maximum annual average will be 0.002 mg/m$^3$. These relatively low values will be well below IBRD and Vietnamese air quality regulations and will be of minor significance to air quality in the area.

1.44 For about six months the first two gas turbines to be commissioned will burn distillate until natural gas reaches the site. The rate of emission of NOx will be quite high at 300 ppm as methods of reducing NOx levels such as water injection are not considered feasible for this short period. However as they will be on open cycle for this period the high exit temperature will provide good dispersion characteristics. A dispersion analysis for this case showed that maximum hourly ground level concentrations of $NO_2$ would be 0.100 mg/m$^3$. This level will not break ambient air quality standards nor will it have a significant impact over the short period involved.

1.45 Specification for the proposed plant will be such that noise levels at the site perimeter will not exceed permitted levels for residential areas. This will ensure that no noise nuisance is caused at nearest residences.

1.46 Cooling water discharge will be at a maximum rate of 60m$^3$/s and a temperature rise of 7$^o$C. The discharge will be deep into the Thivai estuary which has a large tidal flow of 10,000 m$^3$/sec. A thermal diffusion study indicates that the physical impact will be minor with, for the worst case, a thermal plume of 1$^o$C extending across the estuary. Beyond the immediate outfall the maximum temperature rise will be 1.5°C.

1.47 Ecological impacts of the thermal plume are not predicted to be significant. However, because it is a deep discharge some scouring will take place at the outfall. No significant impacts will be caused to aquaculture or commercial fishery on the Thivai River.

1.48 Chlorination of the cooling water will take place at a rate that will leave a residual level of <0.02 ppm at the outfall. At this concentration the chlorine should not have any significant impacts beyond the discharge point.

1.49 A large number of organisms including fish eggs and larvae will be entrained by the cooling water system and significant mortality will occur due to pressure, temperature rise and chlorination. This is not predicted to have an overall impact on fish numbers in the area due to the large amount of similar habitat in the region and due to the small ratio of CW flow to overall tidal flow.

1.50 Other waste water streams from the plant include water treatment plant effluent, sewage, surface drains, boiler washes and acid cleans. These will all be treated as appropriate so that the effluents will satisfy Vietnamese regulations and will have no environmental impacts on the receiving water.

1.51 Oil spillage into the sensitive mangrove ecosystem represents a serious menace. In order to minimise this risk strict procedures will be implemented for the delivery, unloading, storage and handling of oil as well as an emergency response plan and clean up procedures.

1.52 Dredging will be required occasionally in order to maintain navigable depth at the jetty. This will create a local and temporary disturbance to biota in the area. The dredged material will be transported for land reclamation to an area not yet designated.

**Summary of Alternatives**

1.53 Alternatives to the proposed project should be seen in the context of a high predicted growth in electricity demand in the South Vietnam area over the next twenty years. This growth is required for economic development and improvement in standard of living. A mixture of thermal and hydroelectric power, which are complimentary to each other, is required to satisfy this demand. Alternative designs and sites were considered.

1.54 A natural gas fired combined cycle plant, such as the present design, has the following major advantage over other types of thermal plant which might be considered :-

- Lower capital cost
- Shorter lead times to power production
- Small land area requirements
- Higher efficiencies
- Lower air emissions per unit of electricity generated
- Lower cooling water requirements per unit of electricity generated.

1.55 A number of alternative sites were considered and evaluated on the following criteria:-

- Proximity to Bach-Ho - Thu Duc gas pipeline
- Distance to transmission lines
- Cooling water availability
- Environmental and socioeconomic issues
- Site area available
- Construction and engineering issues.

The site at Phumy was judged as the optimum available.

## TABLE 1

**Summary of Environmental Impacts During Construction Phase**

| Source | Environmental Impact | Mitigation Measures | Residual Impact |
|---|---|---|---|
| Site Acquisition | Displacement of people living and owning land on site | Adequate and timely resettlement and/or compensation | Temporary disturbance - no reduction in assets or income |
| Transmission line construction | Displacement of 16 families | Adequate and timely resettlement | Temporary disturbance only |
| Construction of Jetty | Loss of 2ha of Mangrove | None | Local but permanent |
| Construction of C.W. outlet | Loss of 1 ha Mangrove | Pipes are buried and area will be replanted | Temporary |
| Dredging activities | Loss of benthnic fauna | None | Local and Temporary loss |
| Sanitation facilities | Sewage discharge | Effluent will be treated to Vietnamese standards | Minor |
| Noise | Noise during piling and steam purging operations | Restrict piling to day light hours. Notify residents of steam blows | Minor and temporary |
| Dust | Dust generated | Spraying of access roads and truck tyres | Minor |
| Construction Work | Traffic Increase | Road Improvement | Minor |
| Work during construction | Short term employment for over 1000 workers | | Beneficial short term |

## TABLE 2

**Summary of Impacts of Atmospheric Emissions for Phumy I and II When Burning Natural Gas**

| Impact | | Predicted | Vietnamese Regulations | IBRD |
|---|---|---|---|---|
| Nitrogen Oxide ($NO_2$) | | | | |
| Ambient | | | | |
| 1-hour maximum | $\mu g/m^3$ | 110 | 300 | --- |
| 24-hour maximum | $\mu g/m^3$ | | --- | --- |
| Max. annual average | $\mu g/m^3$ | 2 | 80 | 100 |
| Sulphur Dioxide ($SO_2$) (a) | | | | |
| Ambient | | | | |
| 1-hour maximum | $\mu g/m^3$ | 0 | 300 | --- |
| 24-hour maximum | $\mu g/m^3$ | 0 | --- | 500 |
| Max. annual average | $\mu g/m^3$ | 0 | 80 | 100 |
| Carbon Dioxide ($CO_2$) (a) | | | | |
| Emission | | | | |
| Tonnes/annum (total) | | $4.7 \times 10^6$ | --- | --- |
| Noise (dB (A)) | | | | |
| Noise Levels at Boundary fence | | 55 | | 55 (b) |
| Residential Area | | <55 | 55/60 (b) | 55 (b) |
| Particulates | | | | |
| 24-hour maximum | $\mu g/m^3$ | <1 | 200 | 500 |

(a) 100% load factor

(b) Varies with day / night; indoors and outdoors and other factors

## TABLE 3

**Summary of Environmental Impacts**
**During Operation of Plant - Aqueous Emissions of Phumy I and II**

| Source | Environmental Impact | Mitigation Measures | Residual impact |
|---|---|---|---|
| Water Treatment Plant Waste | Contains strong acids and alkalis | Treated in neutralisation tank to pH 6-9. Effluent will comply with waste water standards (Ref.8) | Negligible |
| Oil Contaminated Surface Water | Adverse impact on marine organisms if discharged directly | All surface drains will be routed through oil interceptors. Effluent will comply with waste water standards (Ref.8) | Minor |
| Sewage | High BOD and micro biological pollutants | Sewage will be treated to <20 mg/l BOD before discharge | Minor |
| Boiler Blowdown | Contain very low concentration of contaminants | No treatment necessary | Negligible |
| Boiler Acid Clean | Utilises toxic chemicals. This process arises only rarely. | These will be treated with the waste removed off site for disposal. Effluent discharged will satisfy waste water regulations (Ref.8) | Minor |
| Chemical Spillage | Bulk chemicals stored on site, in particular acid and alkali | Stored bulk chemicals will be bunded so that any spillage will be contained and controlled | Negligible |
| Boiler Washing | If burning residual fuel oil can contain vanadium and other metals | Metals will be precipitated by chemical treatment and removed offsite to land fill | Minor |

**Table 4**

**Summary of Impacts of Cooling Water System Operation for Phumy I and II**

| Source | Environmental Impact | Mitigation Measures | Residual Impact |
|---|---|---|---|
| Intake of 60 $m^3/s$ | Loss of fish eggs and plankton | None | Small in relation to overall abundance in the area |
| Intake screens | Loss of fish through impingement | Optimum measures not yet selected | Minor |
| Discharge of heated water | Impact on sensitive organisms | Discharge designed so that temperature rise will not exceed 1°C | Minor |
| Chlorination of C.W. system | Impact of residual chlorine on ecosystem | Residual chorine levels will be kept to < .02ppm | Negligible |
| Discharge of CW | Scouring of bottom | None | Permanent but local disturbance of area |

**Summary of Mitigation Measures**

1.56 In order to reduce environmental impacts from the proposed development mitigation measures, summarised below, have already been put in hand or are planned. Apart from these, and taking into account the minor residual impacts of the proposed development, no further mitigation measures are considered necessary.

1.57 About 157 families who own land, houses and other assets in the area will be impacted directly by the project. A Rehabilitation Action Plan (RAP) process will be completed to IBRD guidelines to ensure compensation will be given in a fair and timely way. This will ensure that all the people affected, will, at the end of the process, be at least as well off as they were previously.

1.58 Mitigation measures to apply during the construction phase include the following:-

- Provision of housing, clean water, sanitation facilities, health services to the construction workers.

- Sewage treatment.
- Dust suppression control
- Noise control

1.59 During the operation phase air emissions will be controlled by burning natural gas and installing low NOx burners.

1.60 Noise control will be by housing and acoustic cladding of noisy plant to ensure noise levels at the site perimeter are within regulations. Other noise reduction measures such as tree plantations may be used as appropriate.

1.61 Impacts of the cooling water system will be mitigated by:-

- Design of outfall to reduce extent of thermal plumes.
- Maintaining residual chlorine levels at less than 0.02 ppm.
- Measures to reduce impingement of fish at the intake.

1.62 All other waste water streams will be treated so that effluents will satisfy Vietnamese regulations and will not cause any significant impacts.

1.63 In order to avoid risks of ground water pollution or soil contamination all waste materials that will arise at the site will be monitored as to type and quantity and removed offsite for disposal or recycling.

**Consultation with Affected Groups**

1.64 The groups directly affected by the project are:

- 6 families who live on the project site (Phumy I).
- 135 other families who own land and other assets on the site (88 for Phumy I, 47 for Phumy II).
- 16 families who live in houses along the proposed route of the transmission line and who will have to move (Phumy II).

1.65 These people are represented by the Peoples Committee of Phumy who also look after their interests in relation to compensation and resettlement. The company responsible for this project (EVN) have had discussions with the Peoples Committee about plans for the project and compensation issues and the Peoples Committee have informed the families concerned. A representative of EVN has also spoken individually to each of the project affected families.

1.66 As already described in Chapter 4, a survey was carried out of the families affected by the project by Environmental Protection Centre (EPC), H.C.M City. This survey established details of the area of land owned by each family, the type and

quantity of crops grown on each property, the annual income as well as the attitude of the families towards the project and the preferred type of compensation. No objection was voiced to the project as long as proper compensation was agreed.

1.67 On July 15th Dr. C. McMahon of the Consultancy Company, ESBI, visited the Phumy area in order to have independent discussions with the affected groups. In an open discussion with the Peoples Committee the same views as above were expressed i.e. the project is welcome because of the provision of badly needed jobs in the community as well as improvements in infrastructure such as roads and electricity supply. There was an issue about compensation for land, crops and trees. It was felt that the preliminary amount suggested was not sufficient for people to purchase equivalent land elsewhere. Apart from this the only issue raised was that of dust from trucks passing by during construction and a request to hard surface the road. This is already planned.

1.68 Discussions were also held with several individuals who live or own land on the site. These all expressed the view that they were happy with the representation of the Peoples Committee and the way they were kept informed of the project, but were worried about the amount of compensation being talked about for their land, crops and other assets. No firm offers had yet been made. Apart from this they welcomed the project, particularly as regards the likelihood of providing jobs for their children.

1.69 It should be noted that a Rehabilitation Action Plan (RAP) is being finalised by EVN and is being done to World Bank (OD 4.3) criteria and guidelines. The criteria for resettlement/compensation is that overall no affected person should suffer in terms of standard of living and must be given full rights to participate in the RAP process.

**Environmental Management and Training**

1.70 It is recommended that an environmental unit be set up as part of the management structure in the new development at Phumy. The main function of this unit would be the monitoring and control of waste water streams and other emissions from the plant. This function could be combined with the already planned water quality analysis programme at little additional expense.

1.71 It is also recommended that as EVN expands its generation programme, an environmental co-ordinator be established with the function of developing environmental policy, issuing in-house guidelines and establishing compliance with standards and regulations and setting up an environmental management system.

1.72 It is further recommended that this co-ordinator would also liaise with other groups such as a coastal zone management group in order to promote strategies for the protection and sustainable development of the delicate coastal zone.

**Environmental Monitoring**

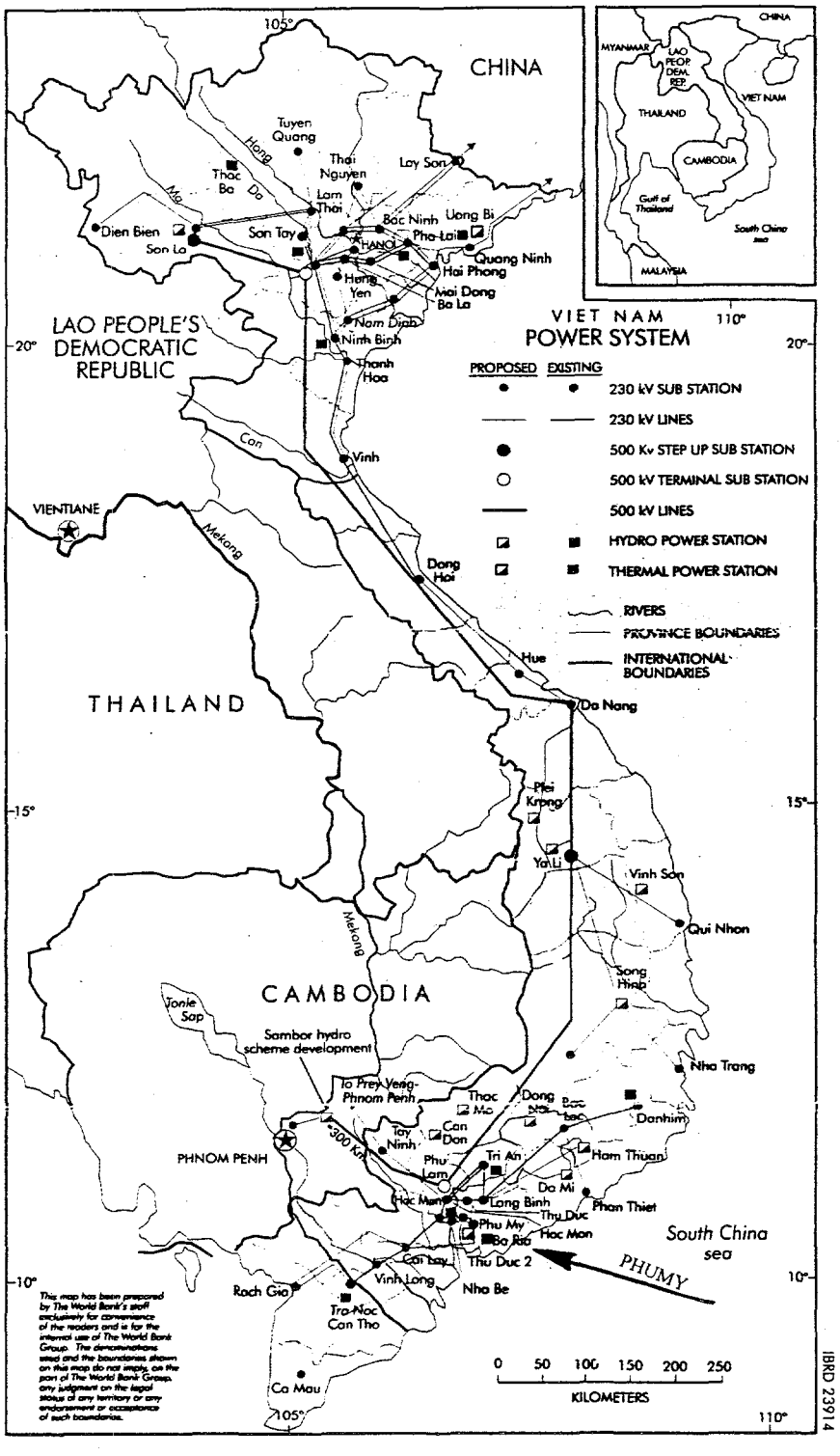
1.73 In order to fully control the implementation of the proposed project, it is recommended that the following monitoring programme be put in place:-

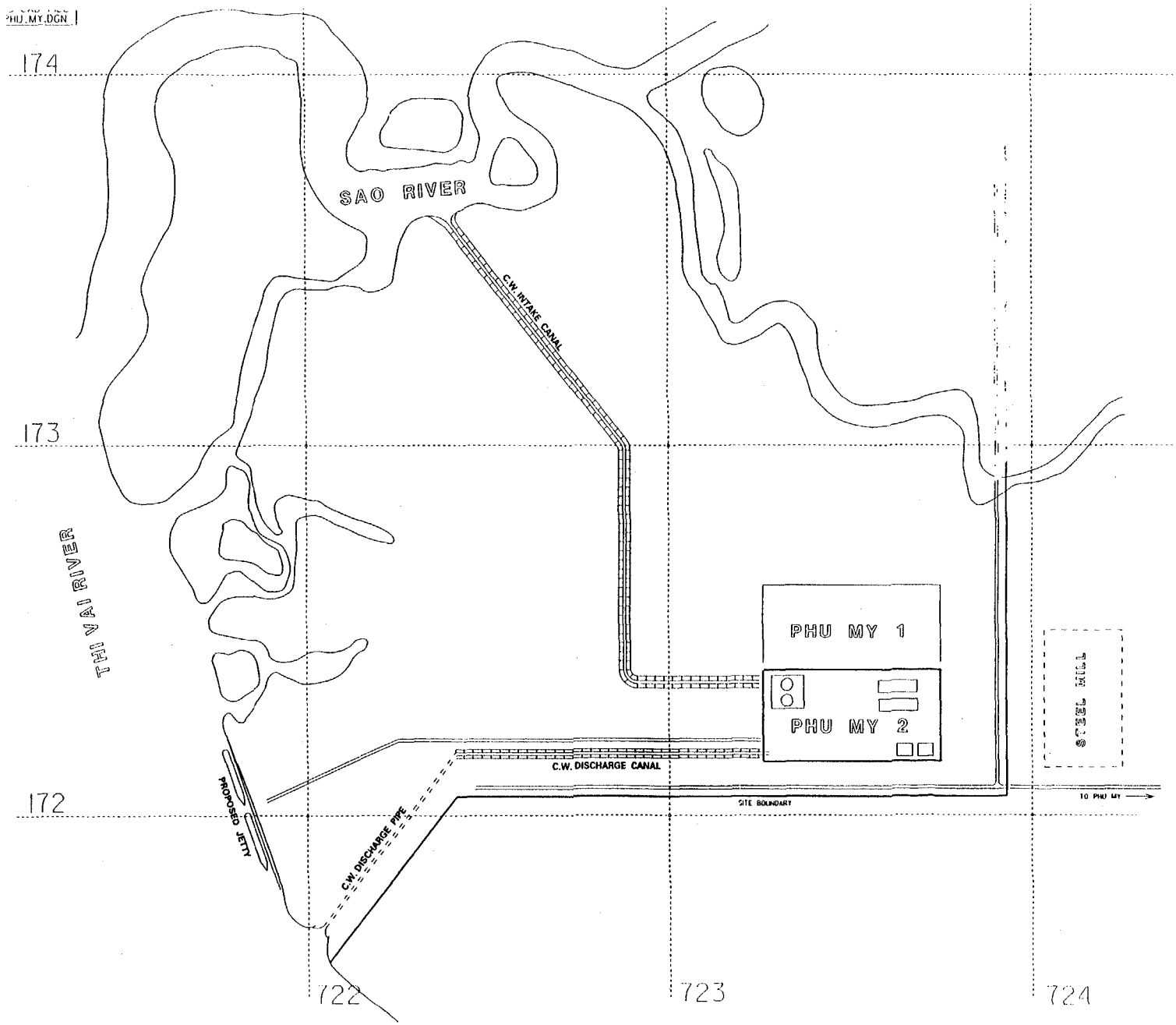
- Monitoring programme of the waste water streams from the new project.
- Extension of the existing air monitoring programme.
- Noise monitoring at the site perimeter.
- Monitoring of waste materials arising on site.
- A review of the baseline ecological study of the Thivai river estuary particularly in the area near the power plant site.

1.74 During the construction phase monitoring for dust levels, noise levels, sewage effluent should be carried out to ensure no nuisance is created.

1.75 Recommendations are made for training programs for management and staff at the proposed plant. Particular attention should be given to staff involved in environmental work, to those handling oil and chemicals and those involved in emergency and safety procedures.

Figure 3.1 Vietnam Power Grid



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CLIENT
ELECTRICITY OF VIETNAM

PROJECT
PHU MY 2 POWER PROJECT

TITLE
PRELIMINARY SITE LAYOUT

ESB ENGINEERING LTD.
STEPHEN COURT, 18/21 ST. STEPHEN'S GREEN,
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ESB INTERNATIONAL

CLIENT REF.

DRG. NO. FIG. 3.2

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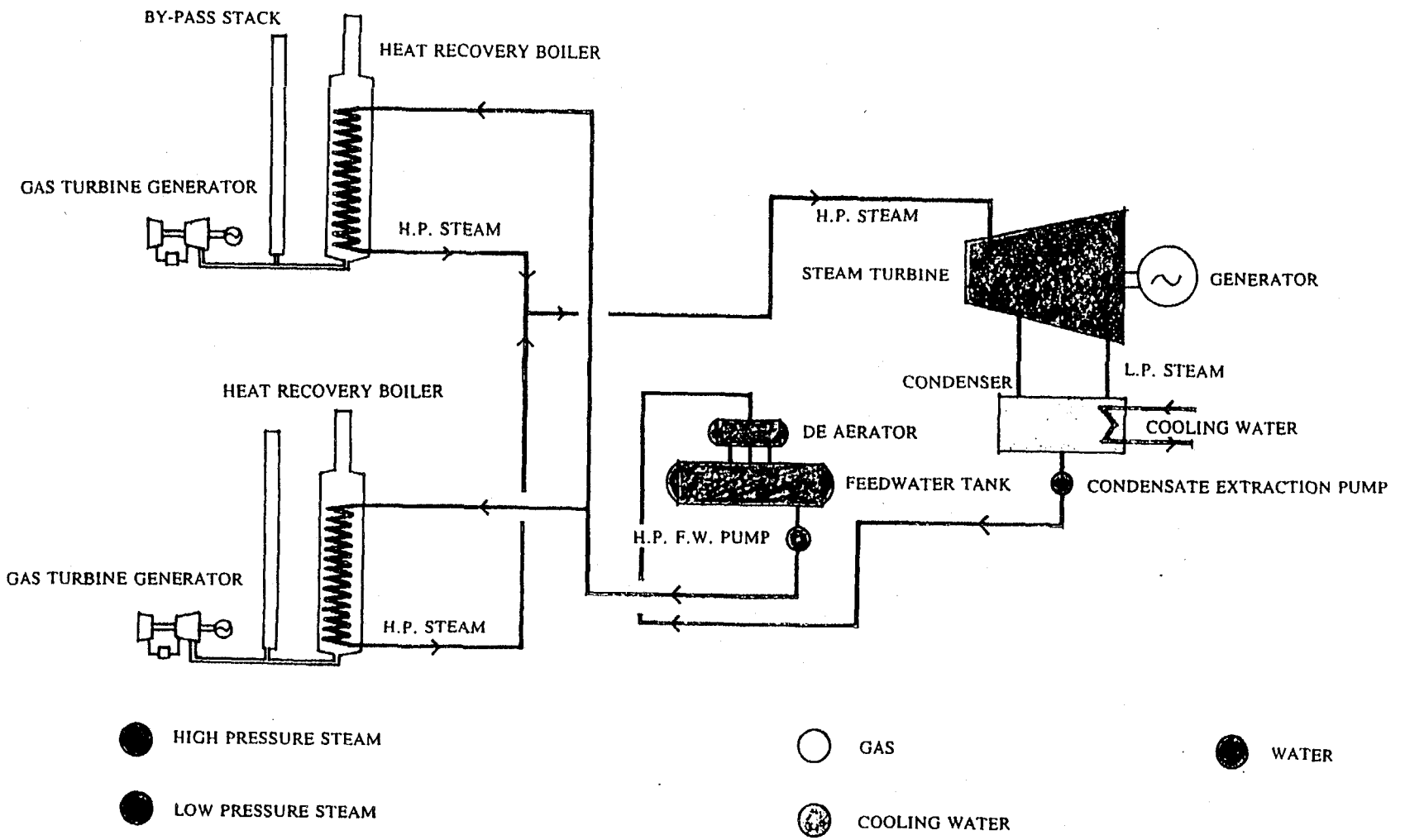


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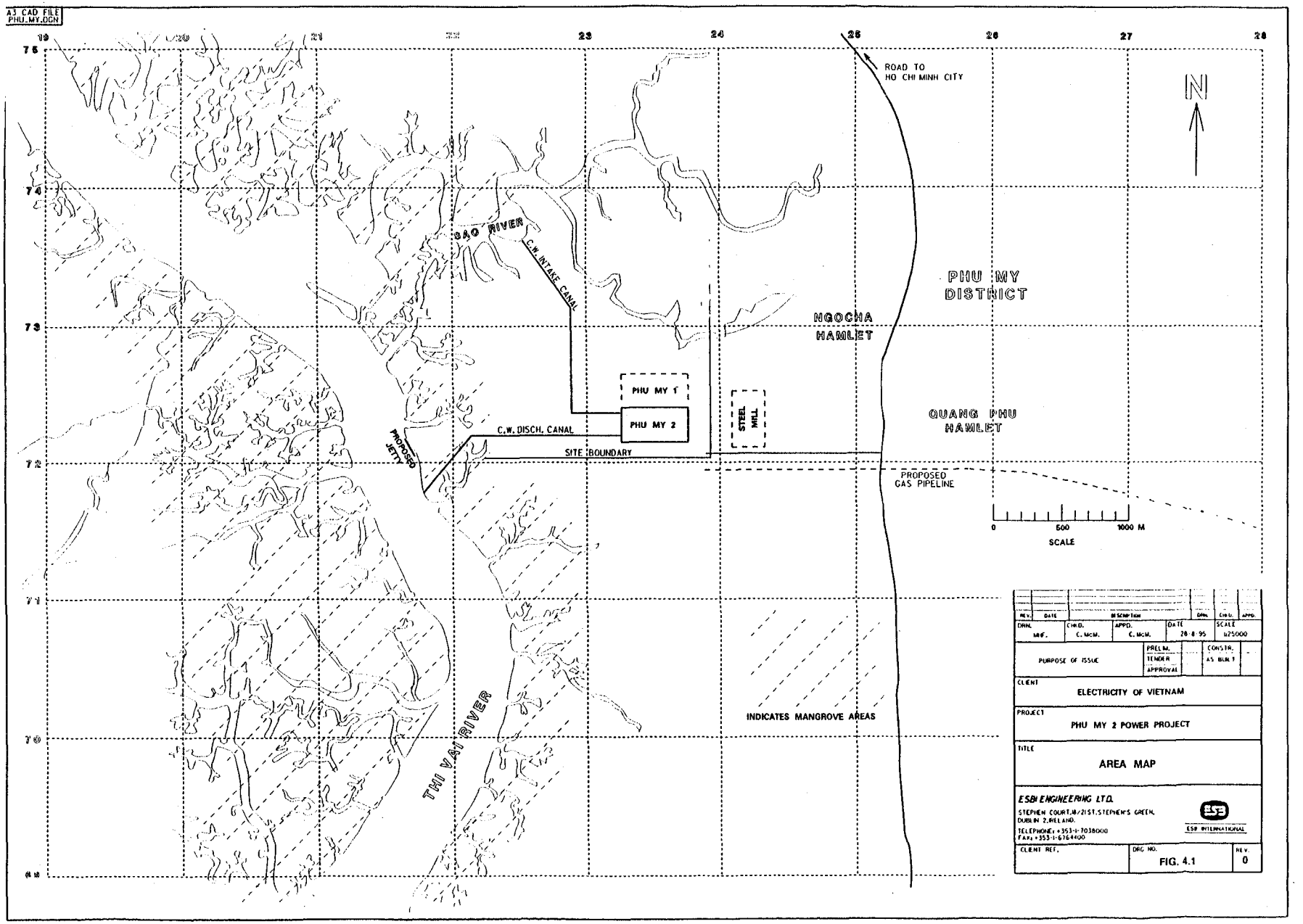
| CLIENT | E.S.B. OPERATIONS |
| PROJECT | Combined Cycle Development |
| TITLE | Typical Combined Cycle Plant - SCHEMATIC |
| PROJECT ARCHITECT | N. Matthews |
| DRAWN | |
| CHKD | |
| APPR. | |
| SCALE | |
| DATE | June '94 |
| REV | |
| JOB NO | 4Y003C |
| DRWG NO | Figure 3.3 |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DATE
28-8-95
SCALE
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PURPOSE OF ISSUE
PRELIM.
TENDER
APPROVAL
CONSTR.
AS BUILT
CLIENT
ELECTRICITY OF VIETNAM
PROJECT
PHU MY 2 POWER PROJECT
TITLE
AREA MAP
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FIG. 4.1
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