ที่ วว 0804/ 3607

สำนักงานนโยบายและแผนสิ่งแวดล้อม
ซอยพิบูลวัฒนา 7 ถนนพระรามที่ 6
กรุงเทพฯ 10400

31 พฤษภาคม 2536

เรื่อง ผลการพิจารณารายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม โครงการก่อสร้างโรงแยกก๊าซธรรมชาติ หน่วยที่ 4 อำเภอขนอม จังหวัดนครศรีธรรมราช

เรียน อธิบดีกรมโรงงานอุตสาหกรรม

สิ่งที่ส่งมาด้วย 1. สำเนาหนังสือบริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด ที่ อทอ. 011/36 ลงวันที่ 26 มกราคม 2536
2. สำเนาหนังสือบริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด ที่ อทอ. 103/36 ลงวันที่ 30 เมษายน 2536
3. มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม ที่โครงการก่อสร้างโรงแยกก๊าซธรรมชาติ หน่วยที่ 4 อำเภอขนอม จังหวัดนครศรีธรรมราช ของการปิโตรเลียมแห่งประเทศไทย ต้องยึดถือปฏิบัติ

ตามที่ การปิโตรเลียมแห่งประเทศไทย ได้ดำเนินการเสนอรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม โครงการโรงแยกก๊าซธรรมชาติ หน่วยที่ 4 อำเภอขนอม จังหวัดนครศรีธรรมราช และรายงานชี้แจงรายละเอียดเพิ่มเติม ตามมติของคณะกรรมการผู้ชำนาญการพิจารณารายงานการศึกษาผลกระทบสิ่งแวดล้อมด้านโครงการอุตสาหกรรม ในการประชุมครั้งที่ 1/2536 วันที่ 16 มีนาคม 2536 ดังรายละเอียดในสิ่งที่ส่งมาด้วย 1 และ 2 นั้น

สำนักงานนโยบายและแผนสิ่งแวดล้อม ได้พิจารณาและนำเสนอ คณะกรรมการผู้ชำนาญการพิจารณารายงานการศึกษาผลกระทบสิ่งแวดล้อมด้านโครงการอุตสาหกรรม ในการประชุมครั้งที่ 4/2536 เมื่อวันที่ 20 พฤษภาคม 2536 ซึ่งคณะกรรมการฯ มีมติเห็นชอบในรายงานฯ ดังกล่าว โดยกำหนดมาตรการลดผลกระทบและติดตามตรวจสอบคุณภาพสิ่งแวดล้อม ที่โครงการก่อสร้างโรงแยกก๊าซธรรมชาติ หน่วยที่ 4 อำเภอขนอม จังหวัดนครศรีธรรมราช ของการปิโตรเลียมแห่งประเทศไทย ต้องยึดถือปฏิบัติดังรายละเอียดในสิ่งที่ส่งมาด้วย 3

2/ อนึ่ง....

อนึ่ง เนื่องจากพื้นที่โครงการบางส่วนอยู่ในเขตพื้นที่ป่าอนุรักษ์ ตามมติคณะรัฐมนตรี เมื่อวันที่ 17 มีนาคม 2535 สำนักงานนโยบายและแผนสิ่งแวดล้อม จะได้นำเสนอคณะกรรมการสิ่งแวดล้อมแห่งชาติตามขั้นตอนเกี่ยวกับการขอใช้ประโยชน์ในพื้นที่ป่าอนุรักษ์ดังกล่าว เพื่อให้เป็นไปตามมติคณะรัฐมนตรีและจะแจ้งผลให้ทราบต่อไป ทั้งนี้ สำนักงานฯ ได้สำเนาแจ้งให้การปิโตรเลียมแห่งประเทศไทยทราบด้วยแล้ว

จึงเรียนมาเพื่อโปรดทราบและพิจารณาดำเนินการ

ขอแสดงความนับถือ

(นายศักดิ์สิทธิ์ ตรีเดช)
รองเลขาธิการฯ ปฏิบัติราชการแทน
เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
โทร. 2792792
โทรสาร 2713226

CONSULTING ENGINEERS
KEY DESIGN, CONSTRUCTION SUPERVISION
ENGINEERING ANALYSES, LAB, TESTING
GEOTECHNICAL INVESTIGATION
OFFSHORE BORING, QUALITY CONTROL
HYDROGRAPHIC SURVEY

บริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด
STS ENGINEERING CONSULTANTS CO., LTD.

196/10-12 ซอยกิ่งจินดา ถนนประดิพัทธ์ กรุงเทพฯ 10400
196/10-12 SOI KINGCHINDA PRADIPAT RD., BANGKOK 10400 ☎ 279-1375, 270-1306
TELEX 20590 STS TH ☎ 279-7065, 270-1856
FAX: 271-0020, 270-1306 279-8881

ที่ อทอ. 103/36

เรื่อง ส่งรายงานเกี่ยวกับการศึกษาและมาตรการป้องกันและแก้ไขผลกระทบกระเทือนต่อคุณภาพสิ่งแวดล้อม (รายละเอียดเพิ่มเติม ครั้งที่ 1) โครงการก่อสร้างโรงแยกก๊าซฯ หน่วยที่ 4

เรียน เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

สิ่งที่ส่งมาด้วย รายงานเกี่ยวกับการศึกษาและมาตรการป้องกันและแก้ไขผลกระทบกระเทือนต่อคุณภาพสิ่งแวดล้อม (รายละเอียดเพิ่มเติม ครั้งที่ 1) 15 ฉบับ

ตามที่สำนักงานนโยบายและแผนสิ่งแวดล้อมได้จัดประชุมคณะกรรมการผู้ชำนาญการเพื่อพิจารณารายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมด้านโครงการอุตสาหกรรมครั้งที่ 1/2536 เมื่อวันที่ 16 มีนาคม 2536 ผลการประชุมพิจารณาโครงการก่อสร้างโรงแยกก๊าซธรรมชาติ หน่วยที่ 4 อำเภอขนอม จังหวัดนครศรีธรรมราช ของการปิโตรเลียมแห่งประเทศไทย มีมติไม่เห็นชอบในรายงานฯ และให้มีการปรับปรุงแก้ไขและเสนอรายละเอียดเพิ่มเติมนั้น

บริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด ในฐานะนิติบุคคลที่ได้รับมอบหมายให้จัดทำรายงานฯ และรับมอบอำนาจจากการปิโตรเลียมแห่งประเทศไทยให้กระทำการเสนอรายงานฯ ตามหนังสือมอบอำนาจ ลงวันที่ 18 มกราคม 2536 จึงได้ทำการปรับปรุงแก้ไขและชี้แจงรายละเอียดเพิ่มเติมตามประเด็นที่สำนักงานฯ และคณะกรรมการเสนอและขอส่งรายงานฯ ฉบับแก้ไข (รายละเอียดเพิ่มเติมครั้งที่ 1) ดังกล่าวจำนวน 15 ฉบับ เพื่อให้ท่านพิจารณาต่อไป

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ
บริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด

(นายสมเจต ทรงไพบูลย์)
กรรมการผู้จัดการ

สท/วก

(สิ่งที่ส่งมาด้วย 1)

CONSULTING ENGINEERS
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ENGINEERING ANALYSES, LAB, TESTING
GEOTECHNICAL INVESTIGATION
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HYDROGRAPHIC SURVEY

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279-7065, 270-1856
279-8881

สำนักงานนโยบายและแผนสิ่งแวดล้อม
รับที่ ๒๐(๕๔๗) วันที่ ๒๖ ม.ค. ๓๖
เวลา ๑๕.๑๐ ผู้รับ

ที่ อทอ. 011/36 26 มกราคม 2536

เรื่อง ขอส่งรายงานการศึกษาผลกระทบสิ่งแวดล้อมโครงการก่อสร้างโรงแยกก๊าซฯ หน่วยที่ 4 และโครงการท่าเทียบเรือขนอม

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
รับที่ 42 ลงวันที่ ๒๗ ม.ค. ๓๖
เวลา 9.15 น. ผู้รับ

เรียน เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

สิ่งที่ส่งมาด้วย 1. หนังสือมอบอำนาจ
2. รายงานการศึกษาผลกระทบสิ่งแวดล้อมโครงการก่อสร้างโรงแยกก๊าซฯ หน่วยที่ 4 รายงานหลัก จำนวน 15 เล่ม รายงานสรุปย่อจำนวน 15 เล่ม และโครงการท่าเทียบเรือขนอม รายงานหลัก จำนวน 15 เล่ม รายงานสรุปย่อจำนวน 15 เล่ม

เนื่องจาก การปิโตรเลียมแห่งประเทศไทย โดย นายเลื่อน กฤษณกรี ผู้ว่าการ-การปิโตรเลียมแห่งประเทศไทย ได้มอบอำนาจให้ บริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด เป็นผู้มีอำนาจกระทำการเสนอรายงานเกี่ยวกับการศึกษาและมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อมโครงการก่อสร้างโรงแยกก๊าซฯ หน่วยที่ 4 และโครงการท่าเทียบเรือขนอม ดังนั้น ทางบริษัทฯ จึงขอส่งรายงานการศึกษาฯ ดังกล่าวเสนอต่อสำนักงานนโยบายและแผนสิ่งแวดล้อมเพื่อพิจารณาต่อไป

จึงเรียนมาเพื่อทราบและโปรดพิจารณาอนุเคราะห์ให้เป็นไปตามความประสงค์นี้ด้วย จักขอบพระคุณยิ่ง

ขอแสดงความนับถือ
บริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด

(นายสมบูรณ์ ทรงไพบูลย์)
กรรมการผู้จัดการ

สท/วก

มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อมและมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม ที่โครงการก่อสร้างโรงแยกก๊าซธรรมชาติ หน่วยที่ 4 อำเภอชนอม จังหวัดนครศรีธรรมราช ของการปิโตรเลียมแห่งประเทศไทย ต้องยึดถือปฏิบัติ

1. ปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อมและมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม ที่เสนอมาในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม โครงการก่อสร้างโรงแยกก๊าซธรรมชาติ หน่วยที่ 4 อำเภอชนอม จังหวัดนครศรีธรรมราช ซึ่งจัดทำโดย บริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด ดังรายละเอียดที่สรุปไว้ในเอกสารแนบ และมาตรการที่คณะกรรมการผู้ชำนาญการพิจารณารายงานฯ ด้านโครงการอุตสาหกรรม กำหนดเพิ่มเติมดังนี้

1.1 การปิโตรเลียมแห่งประเทศไทย ต้องกำหนดให้ผู้ออกแบบระบบ API Separator ออกแบบให้ระบบดังกล่าวเพิ่มระยะเวลาเก็บกักน้ำฝนได้นาน 30 นาที (บ่อมีความจุอย่างน้อย 550 ลบ.ม.) และออกแบบให้มีบ่อพักน้ำที่มีขนาดเพียงพอเพื่อพักน้ำก่อนที่จะผ่านเข้าสู่ API Separator

1.2 การปิโตรเลียมแห่งประเทศไทย ต้องกำหนดให้มีการเทคอนกรีต และ/หรือปลูกพืชคลุมพื้นที่บริเวณที่เป็นที่ลาดชันที่เกิดจากการระเบิดเขา (บริเวณ Tank farm) ในช่วงดำเนินการตามสภาพความเหมาะสมของหิน และดินของภูเขา พร้อมระบบระบายน้ำฝนเพื่อป้องกันการกัดเซาะและพังทลายของบริเวณดังกล่าว

1.3 การปิโตรเลียมแห่งประเทศไทย ประสานงานและร่วมมือกับป่าไม้เขตจังหวัดนครศรีธรรมราช และป่าไม้จังหวัดนครศรีธรรมราช ในการปลูกป่าชดเชยในบริเวณอื่นเพื่อทดแทนพื้นที่ป่าอนุรักษ์ที่โครงการใช้ไป

1.4 การปิโตรเลียมแห่งประเทศไทย ต้องกำหนดให้ผู้ออกแบบ ออกแบบเผื่อสำหรับหน่วยแลกเปลี่ยนความร้อนสุดท้าย (Final Heat Exchanger Unit) ในขั้นตอนการทำ Detail engineering design

2. วิธีการตรวจวัดคุณภาพอากาศในบรรยากาศและวิธีการวิเคราะห์ให้ใช้ตามวิธีการของสำนักงานคณะกรรมการสิ่งแวดล้อมแห่งชาติ ตามประกาศกระทรวงวิทยาศาสตร์ เทคโนโลยีและการพลังงาน (ฉบับที่ 2 พ.ศ. 2535) หรือเทียบเท่า สำหรับการตรวจวัดสารมลพิษในปล่องให้ใช้วิธีการตามที่ราชการกำหนด

3. เมื่อผลการติดตามตรวจสอบได้แสดงให้เห็นถึงปัญหาสิ่งแวดล้อม การปิโตรเลียมแห่งประเทศไทย ต้องดำเนินการปรับปรุงแก้ไขปัญหาเหล่านั้นโดยเร็วและต้องปฏิบัติตามมาตรการลดผลกระทบและติดตามตรวจสอบคุณภาพสิ่งแวดล้อมโดยเคร่งครัด เพื่อประโยชน์ในการพิจารณาความเหมาะสมของการกำหนดระยะเวลาการติดตามตรวจสอบต่อไป

4. หากเกิดเหตุการณ์ใด ๆ ก็ตามที่อาจก่อให้เกิดผลกระทบต่อคุณภาพสิ่งแวดล้อม การปิโตรเลียมแห่งประเทศไทย ต้องแจ้งให้กรมโรงงานอุตสาหกรรม และสำนักงานนโยบายและแผนสิ่งแวดล้อมทราบโดยเร็ว

5. การปิโตรเลียมแห่งประเทศไทย ต้องเสนอรายงานผลการปฏิบัติตามมาตรการลดผลกระทบและติดตามตรวจสอบคุณภาพสิ่งแวดล้อม โดยสรุปให้อุตสาหกรรมจังหวัดนครศรีธรรมราช และสำนักงานนโยบายและแผนสิ่งแวดล้อมทราบทุก 6 เดือน

6. หากมีความประสงค์จะขอเปลี่ยนแปลงรายละเอียดโครงการ และ/หรือมาตรการป้องกันและลดผลกระทบและติดตามตรวจสอบคุณภาพสิ่งแวดล้อม ซึ่งแตกต่างจากที่เสนอไว้ในรายงานฯ การปิโตรเลียมแห่งประเทศไทย จะต้องเสนอรายละเอียดของการเปลี่ยนแปลงดังกล่าวให้สำนักงานนโยบายและแผนสิ่งแวดล้อมให้ความเห็นชอบทางด้านสิ่งแวดล้อมก่อนดำเนินการเปลี่ยนแปลง

Table 1 Mitigation measure

Environmental Impact	Measures	Locations	Duration	Responsibility
Construction Phase				
1. Air Pollution				
	- Periodically water spraying on the construction site or access roads at least 2 time/day.	- Construction site and access roads	- Constructin period	- Contractor
	- To prevent fugitive dust from traffic,speed limits (not over 40 km/hr) should be applied in the construction site.	- Construction site	- Construction period	- Contractor
	- Provide traffic system to minimize number of vehicle used.	- Construction site	- Construction period	- Contractor
	- Pave roads with asphalt or concrete to minimize fugitive dust.	- Construction site	- Construction period	- Contractor
2. Noise Pollution				
	- Ear protectors such as ear plugs should be provided for workers.	- Construction site	- Construction period	- Contractor
	- Minimized works at night time.	- Construction site	- Construction period	- Contractor
	- Allocate noise sources to reduce noise problems.	- Construction site	- Construction period	- Contractor
3. Surface Water Hydrology and Quality				
	- Use of a sedimentation pond (72 m^3) to trap sediments and oil/grease from construction site before the surface runoff is discharged to the sea water in Khanom shore.	- Construction site	- Construction period	- Contractor
4. Ground Water Hydrology and Quality				
	- Use Sulfate-resistant cement(Type 5) for minimizing corrosion attacks on underground part of structures.	- Project area	- Construction period	- Contractor
	- Coating steel, concrete or asbestos cement pipes with corrosion-resistant substance.	- Project area	- Construction period	- Contractor
	- Cathodic protection together with coatings must be provided for steel and other metallic structures.	- Project area	- Construction period	- Contractor
5. Terrestrial Resources				
	- Construction of tank farm on the evergreen forest of Khao Chai Son Preservation area must be clearing only necessary trees (on 5.6 rais of project area). The sides of the rock cutting will be sloped under 45° to the horizontal. Horizontal step of 0.8 to 1 m width shall be	- Nose of Khao Chai Son	- Construction period	- Constractor

Environmental Impact	Measures	Locations	Duration	Responsibility
	provided every 8 to 10 m in height to limit the free fall of lose rock and wash out by storm water. Mats or webbed wire mesh will be hung over the slopes to prevent rock slides.			
	- Between construction and operation phase, the rule warning the workers not to cut the tree and hunt wild-life resources must be set.	- Khao Chai Son Preservation area	- Construction period	- Contractor & PTT
	- Reforestation of fast-growing plant species around the project area must be undertaken as soon as possible, as follows : Casuarina junglugniana, Casuarina equisetifolia and Acasia spp or other species which have to be selected based on soil characteristic and local plant.	- Around the project area (Figure 1-1)	- Construction period	- Contractor & PTT
6. Land Use				
	- Establish workers' communities for their labor forces and control the development such that it is strictly within the land use development framework and regulations of local authorities concerned.	- Amphoe Khanom area	- Construction period	- Contractor
	- The communities must not be located adjacent to the access road and they shall not be allowed to invade private or public land.	- Amphoe Khanom area	- Construction period	- Contractor
7. Transportation				
	- Stringent regulations must be imposed on drivers of trucks and other vehicles requiring them to strictly observe traffic rules and regulations.	- Routes 401 and 4014, and the road of Khanom sanitary district	- Construction period	- Contractor
	- Speed limits must be set and monitored regularly. Construction material must be covered by canvas.	- Community areas of Khanom sanitary district	- Construction period	- Contractor
	- Avoid the transport during heavy rainfall to minimize traffic accidents and strictly observe traffic regulations especially those relating to weight and size limits.	- Routes 401 and 4014, and the road of Khanom sanitary district	- Construction period	- Contractor
8. Water Supply				
	- Provide good quality water supply from EGAT for workers' communities.	- Workers' communities	- Construction period	- Contractor

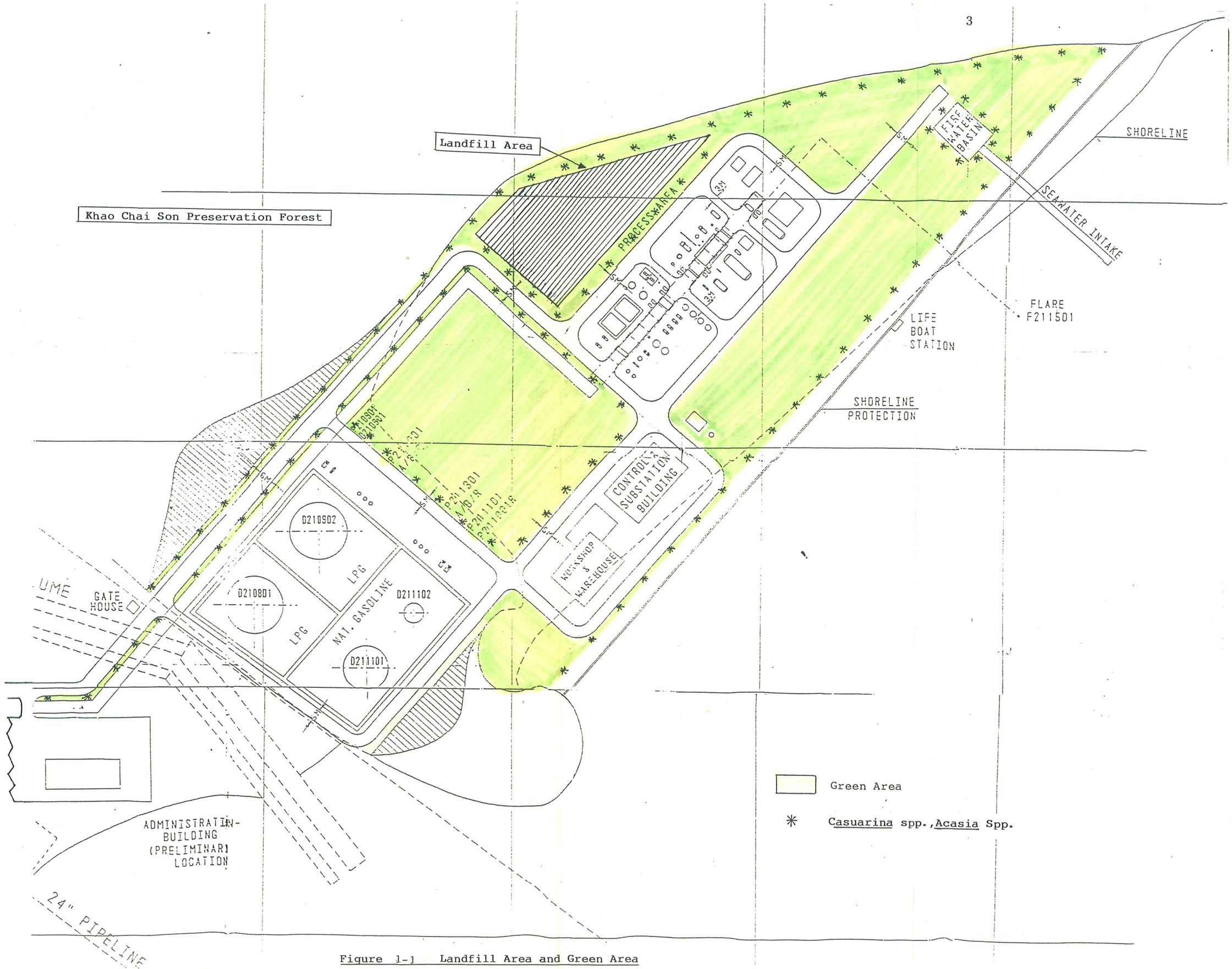


Figure 1-1 Landfill Area and Green Area

Environmental Impact	Measures	Locations	Duration	Responsibility
9. Solid Wastes				
	- Construction wastes must be separated at the source to reduce the amount of solid wastes by recycle or reuse.	- Construction site	- Construction period	- Contractor
	- Eight 200-liter drums should be provide for wastes receptacles.	- Workers' communities	- Construction period	- Contractor
	- The remaining solid wastes must be engaged collection and disposal services of the Khanom Sanitary District.	- Construction site	- Construction period	- Contractor
10. Socio-Economic				
	- PTT has to consider recommendations given by the local residents and community leaders as follows: 1. Take part in local development, i.e, road construction. 2. Avoid causing problems to the residents. 3. The Khanom residents must be given higher priorities for employment at the GSP than those of other areas. 4. Meeting should be set with the residents to provide information on the advantages/disadvantages of the GSP construction and measures for environmental pollution control. The local authorities must be reported of the progress for the plant construction.	- Amphoe Khanom	- Construction period	- PTT
11. Public Health				
	- Educate workers how to prevent mosquito-borne diseases and other communicable diseases by obtaining advices or demonstration assistance from the local public health office.	- Construction site	- Construction period	- Contractor
	- Provide adequate water supply and always improve environmental health and sanitation.	- Workers' communities	- Consturction period	- Contractor
	- Encourage workers' families to use sanitary latrines, provide basic drainage system, encouraged to take care of their own household environmental sanitation and personal higiene. And if workers lack of appropriate knowledge, contractor should seek and obtain assistance from local public health offices to	- Workers' communities	- Construction period	- Contractor

Environmental Impact	Measures	Locations	Duration	Responsibility
	launch the health improvement program.			
	- Workers' communities must use sanitary latrines with septic tanks and soaking pits.	- Workers' communities	- Construction period	- Contractor
	- Provide first aid office or center transportation to transfer sick or injured worker to hospital.	- Construction site	- Construction period	- Contractor
12. Occupational Health and Safety	- Workers who work in construction site must be provided suitable personal protective devices (PPD), e.g. hard hat and safety shoes, goggles for welders, ears protection equipment, e.g. ear plugs or ear muffs that can reduce the noise to lower level than the standard (85 dB(A)),respirators for dust and fume, glove to protect hands and fingers as necessary.	- Construction site	- Construction period	- Contractor
	- Provide enough and hygienic residences including facilities e.g. light and water supplies for the labors.	- Workers' communities	- Construction period	- Contractor
	- Provide enough sanitary toilets and bath-rooms for the labors.	- Workers' communities and construction site	- Construction period	- Contractor
	- Provide hygienic and enough trash cans including disposal method for those trash.	- Workers' communities and construction site	- Construction period	- Contractor
	- Monitor environmental health of the labors' communities and have it in good condition to reduce or prevent epidemic of the GI-tract disease.	- Workers' communities	- Construction period	- Contractor
	- Give knowledge and train the labor concerning: Safety regulation, PPD (What, when, where, why they need to use PPD and how to use).	- Construction site	- Construction period	- Contractor
	- In case of work at night, enough light must be provided.	- Construction site	- Construction period	- Contractor
	- Provide first aid office or center and transportation to transfer sick or injured worker to hospital.	- Construciton site	- Construciton period	- Contractor

Table 1 Mitigation Measures

Environmental Impact	Measures	Locations	Duration	Responsibility
Operation Phase				
1. Air Pollution				
	- Relief gases from each unit have to be collected to the Flare System by a close system.	- Flare System	- Operation period	- Contractor & PTT
	- Well design, good maintenance and strictly control for the combustion processes.	- Hot oil system and gas turbine power generation	- Operation period	- Contractor & PTT
	- Good design and good maintenance for Process Instruments. The maintenance must follow the specification of each Process Instruments.	- Value glands, pumps and compressors	- Operation period	- Contractor & PTT
2. Noise Pollution				
	- Operators or workers need to wear ear protectors when working at some unit operations which produce relative high noise levels.	- Compressors and cooling fans or some high pressure relief valves which produce relative high noise level within the specific area	- Operation period	- PTT
3. Surface Water Hydrology and Quality	- Provide oily wastewater treatment system (API separator), fire water basin (3,000 m^3) and SATS with the proper operation.	- Project area	- Operation period	- Contractor
4. Terrestrial Resources				
	- Between operation phase, the rule warning the workers not to cut the tree and hunt wildlife resources must be set.	- Khao Chai Son Preservation area	- Operation period	- Contractor & PTT
	- Reforestation of fast-growing plant species around the project area must be undertaken as soon as possible, as follows : Casuarina junglugniana, Casuarina equisetifolia and Acasia spp or other species which have to be selected based on soil characteristic and local plant.	- Around the project area (Figure 1-1)	- Operation period	- Contractor & PTT
5. Aquatic Resources				
	- The domestic wastewater must be well treated by SATS before discharge into the seepage pit and procolate into the soil. The process waste-water must be well treated by API separator and coalescer before discharge to fire water basin.	- Within the project area	- Operation period	- Contractor & PTT

Environmental Impact	Measures	Locations	Duration	Responsibility
6. Transportation				
	- Set strictly regulations for car drivers and imposition of speed limits within limits of major communities and in the urban centers.	- Khanom Sanitary district area	- Operation period	- PTT
7. Solid Wastes				
	- Solid wastes generated from the office buildings must be separated at the source to reduce the amount of solid wastes by recycle or reuse.	- Project area	- Operation period	- PTT
	- Eight 200-liter drums should be provided for wastes receptacles.	- Project area	- Operation period	- PTT
	- The remaining solid wastes must be engaged collection and disposal services of the Khanom Sanitary District.	- Project area	- Operation period	- PTT
	- The removal of molecular sieves containing mercury from the cylindrical units must be fully under the responsibility of the manufacturer who can provide professional technic in handling hazardous wastes. The removal must be done in every 2 years.	- Project area	- Operation period	- Manufacturer & PTT
	- Every 2 years, a total of 22.5 tons of molecular sieves from Dehydration unit must be landfilled in the vacant lot of 2,580 m^2 in the back of project site (north direction of process area). The landfilling process must be in compliance with the regulations set by the Department of Industrial Works (1988). A rectangular tranch with the depth of 3 meters must be prepared. The bottom of the trench have to be lined with a 60 cm layer of clay, the discarded molecular sieves must be compacted to about 30 cm thick. Another 60 cm layer of clay must be placed on the top of the compacted molecular sieves. The top surface must be covered with a 150 cm layer of soil on which short-rooted vegetation must be planted.	- North direction of process area (Figure 1-1)	- Operation period	- PTT
	- The manufacturer of molecular sieve for the LPG Treatment Plant must be responsible for removing and handling the used molecular sieves in every 2 years.	- Project area	- Operation period	- Manufacturer & PTT

Environmental Impact	Measures	Locations	Duration	Responsibility
8. Socio-Economic				
	- PTT has to consider recommendations given by the local residents and community leaders as follows: 1. Environmental protection such as gas leakage and explosion. 2. Take part in local development, i.e, road construction. 3. Avoid causing problems to the residents. 4. The Khanom residents must be given higher priorities for employment at the GSP than those of other areas. 5. Take the community leaders to visit the GSP that have been completed and in operation.	- Amphoe Khanom	- Operation period	- PTT
9. Occupational Health and Safety				
	- Give education and train workers concerning : Occupational health and safety. PPD (How, what, when, where, why need to use them). Accidents that may occur/what they have to do to prevent them and what to do if the accidents occurred.	- Project area	- Operation period	- PTT
	- Establish PPD service center to check, replace, and clean PPD including do the respirator fit test for workers and staff.	- Project area	- Operation period	- PTT
	- Provide the sign to remind or inform that this area need PPD. To select PPD, type of chemicals or gas must be considered. Supplied air respirator or self-contained breating apparatus must be used when maintenance personnel exposure to Hg, C_3H_8, C_5H_{12}, chemical cartridge respirator with appropriated cartridge when exposure to Hg. Safety hat, ear protection, goggles, gloves and safety shoes must be used as necessary.	- Project area	- Operation period	- PTT
	- Put on ear plugs or ear muffs.	- In any area where the noise level is higher than 85 dB(A) e.g. power generator plant and utility system area.	- Operation period	- PTT

Environmental Impact	Measures	Locations	Duration	Responsibility
	- The working period in any areas where WBGT index is higher than standard (Table 1.1) must be limited. The worker who work in hot area must be healthy person or at least must not have heart problem and high blood pressure.	- In any area where WBGT index is higher than standard e.g. hot oil system, all pipes transfering hot gases and hot liquid, heater, boiler and heat exchanger.	- Operation period	- PTT
	- Illumination level must be as recommend in table 1.2	- Office area, control room, in plant, warehouse	- Operation period	- PTT
	- Provide per-and post-employment, and annual physical check-up which include general and specific for occupational diseases for the workers. Specific check-up includes at least following items. - Audiometric examination (noise exposed workers). - Lung function test. - Complete blood count.	- Project area	- Operation period	- PTT
	- Isolate process and work operation to reduce the number of workers exposed.	- Project area	- Operation period	- PTT
	- Install good ventilation system in all building to provide clean air and safe atmosphere for workers.	- Project area	- Operation period	- PTT
	- Provide good working environments (heat, light, noise, etc.). - Other facilities contain: Health care office, full-time nurse and 24-hour service ambulance. Provide every 6-month physical check-up for special cases. Provide sport field and lawn. Set-up safety/improving working condition committee.	- Project area	- Operation period	- PTT
	<u>Fire Fighting System</u> (see attached sheet for more details) - Fire protection/fighting system consists of the following equipments must be provided: - Spray water system	- Project area - Recontactor, deethanizer, LPG column, LPG and NGL storage tanks and water curtain between hot oil heating system and the in-plant power generation.	- Operation period	- Constractor & PTT

Environmental Impact	Measures	Locations	Duration	Responsibility
	- Sprinkler system	- Office buildings, wastewater treatment building, control building, utility building, elective bases pipe racks.	- Operation period	- Contractor & PTT
	- Deluge sprinkler system	- Storage and process areas.	- Operation period	- Contractor & PTT
	- Water supply/stand pipes and hose	- Project area	- Operation period	- Contractor & PTT
	- Carbon Dioxide extinguisher systems	- Relevant part of the substation and process unit control house, in-plant power generation gas turbine hood.	- Operation period	- Contractor & PTT
	- Portable fire extinguisher/ mobile equipment (hose reels, wheeled dry chemical trailers)	- Throughout a plant and 50 kg-wheeled units must be concentrated at turbine, compressor and pump stations and the hot oil unit.	- Operation period	- Contractor & PTT
	- Fire detection system and alarms	- Throughout the plant and a central fire station.	- Operation period	- Contractor & PTT
	- Smoke detector, heat detector	- Building	- Operation period	- Contractor & PTT
	- Fire wall	- Walls separating high-hazard process area.	- Operation period	- Contractor & PTT
	- Fire door	- Process area	- Operation period	- Contractor & PTT
	- Gas detector and alarms	- Process area, utility area etc.	- Operation period	- Contractor & PTT
	- Hydrant, monitor	- Not more than 300 feet apart in tank farm and in the process areas not more than 250 feet.		
	- Fire proof	- Structural members which directly support piping, equipment, or vessels containing flammable and combustible liquid, control buildings and critical motor control buildings and critical motor control centers which may be	- Operation period	- Contractor & PTT

Environmental Impact	Measures	Locations	Duration	Responsibility
		exposes to fires in process units, enclosed exit ways which are essential to safe escape of personnel, wall and barrier separating high-hazard process areas.		
	- Foam system	- Static foam generator must be placed on the dike around the retention basins of the storage tanks and the floating roofs of the NGL storage and NGL day tank.	- Operation period	- Contractor & PTT
	- Component of any fire protection system must be maintained and inspected. Inspection schedules must be formulated according to the type of equipment to inspect. The inspection must cover the following items. 1. Automatic sprinkler systems. This will includes the inspection of water-supply valves, water-supply tests and physical inspection of system piping for obstruction to water distribution. 2. Fire stairway and door. The inspection is to ensure that they are not damaged, obstructed, blocked open. 3. Fire extinguishiers, hose, and special types of extinguishing system must be inspected to comply with the regulation. 4. Alarms and fire detection equipments. 5. The storage vessel threatened by fire will be kept sufficiently cool to prevent vessel failure. The protection is achieved by the discharge of water onto the vessels at a rate sufficient to maintain an adequate film of water over the surface of the vessel and support. 6. Water supply for the fire fighting used is the sea water. Therefore, the problem of	- Project area	- Operation period	- PTT

Environmental Impact	Measures	Locations	Duration	Responsibility
	7. All extinguishers must be checked regularly			
	Fire Protection			
	- LPG storage vessels should be adequately spaced to reduce the possibility of knock-on effects in the event of fire and to give adequate access for fire fighting. For two spheres of 3,000 cu.m. this would result in a spacing of about 1.5 D between vessels (where D is vessel diameter).	- Storage area	- Operation peirod	- contractor & PTT
	- An LPG fire must not be extinguished until the supply of LPG has been isolated otherwise a vapour cloud would be formed with the risk of more serious consequences.	- Project area	- Operation period	- PTT
	- Operators must also be aware that, in the event of a fire, LPG liquid must be left inside the vessel and not intentionally removed, thus allowing the boiling liquid to absorb heat and prevent the metal walls from getting too hot below the liquid level.	- LPG storage vessel	- Operation period	- PTT
	- Equipped vessel with remotely operated depressuring valves to flare which allow the stress on the vessel to be reduced below the relief valves set pressure in a fire.	- LPG Storage vessel	- Operation period	- PTT
	- Using a fixed water spray system for protecting LPG pressure storgae vessels under fire exposure conditions.	- LPG Storage vessel	- Operation period	- PTT
	- LPG pressure storage vessels and their supports must be adequately protected against fire. Eash vessel must be equipped with drenching/ water spray system capable of providing a film of cooling water over the total surface equivalent to about 10 litres/min/m^2. The leg joints with the vessel must also be adequately protected either by water cooling or by intumescent coating such as "Chartek 59". The legs are normally protected by encasing them in 50 mm (2 in) thick vermiculite concrete. There must be no unwetted areas during water tests. Records must be checked to see how often the water tests are performed. These tests must be carried out at six monthly intervals.	- LPG Storage vessel	- Operation period	- PTT

Environmental Impact	Measures	Locations	Duration	Responsibility
	- Facilities must be provided to permit the operators to turn on the water sprays/deluge system from remote locations. These valves must be numbered, clearly identified and readily accessible or remotely operable.	- Valves	- Operation period	- Contractor & PTT
	- Where the site is unmanned for long periods such as weekends and nights, the water spray/deluge system must be arranged for automatic actuation on detection of fire.	- Storage and Process area	- Operation period	- PTT
	- Use passive protection involving the surface application of special materials to protect LPG storage vessels and road/rail cars against the fire hazard.	- LPG storage vessels	- Operation period	- Contractor & PTT
	- The ground in the storage area must be concreted or compacted and slope away from the LPG vessels. Low separation kerbs (0.6 m maximum height) must be installed around each vessel for containment and direction of spillage to a catchment/evaporation area via a graded ditch or drain. Stone chippings must not be used beneath vessels since they retain spillage and aid evaporation.	- Storage area	- Operation period	- Contractor & PTT
	- Where there is a possibility of significant LPG spillage or leakage, containment and dispersion of the resulting gas cloud can be achieved by water spray techniques before the cloud reaches a potential source of ignition. Fixed water spray systems must be installed for a storage area or for mobile equipment on plant. Where such risks exist, appropriate equipment must be readily available.	- In-plant and storage area	- Operation period	- Contractor & PTT
	- The national or municipal fire brigade should have visited the site and agreed the fire fighting plan. It must be established when the last joint practice was held and if there are any mutual aid arrangements with other industrial installations in the area.	- Project area	- Operation period	- PTT
	- In the absence of a full fixed water spray system on any LPG vessel, it must be confirmed that there is adequate access to permit water cooling be applied from every side.	- Storage area	- Operation period	- Contractor & PTT
	Action Plan for Emergency Events (see attached sheets)			

Environmental Impact	Measures	Locations	Duration	Responsibility
10. Major Hazard	Prevention Preventive measures are taken to minimize the release of flemmable substances. These measures include reducing the frequency (probability) of release and eliminating/reducing ignition sources. Specifically, the measures are:-			
	- Spacing consideration and segmentation			
	1) Location of equipment in the process area should take into account their orientation and effect towards each other. Spacing in between equipment also follows specified codes stringently.	- Process Area and Tank Farm	- Operation period	- Contractor
	2) Equipment in a particular segment is concentrated in one identified location wherever possible. This scheme of segregating equipment according to its segment enable invention and protection measures to be undertaken efficiently and conveniently.	- Process Area	- Operation period	- Contractor
	- Minimizing Flammable Release Probablity			
	- Application of spiral round gasket for all flammable services	- all flammable services	- Operation period	- Contractor
	- Application of double or tandem mechanical seal for C4 and lighter service pump.	- C4 and lighter service pump	- Operation period	- Contractor
	- Minimum flanges joint on the bottom shell of liquid container.	- bottom shell of liguid container	- Operation period	- Contractor
	- Limited application of flexible joints.	- Process Area	- Operation period	- Contractor
	- Ignition Source Control			
	- Exhaust of the gas with the temperatures exceeding 400 degree clesius in any operation mode shall be elevated more than 7.5 m.	- within the Plant	- Operation period	- PTT
	- Air intake of gas turbines shall be elevated more than 7.5 m.	- within the Plant	- Operation period	- PTT
	- Temperature of hot metal surfaces shall be controlled below 400° c by inside castable, lining or equivalent.	- hot metal surface	- Operation period	- Contractor
	- Gas detection shall be arranged near the ignition sources so as to put off burners before vapor	- ignition sources	- Operation period	- Contractor

Environmental Impact	Measures	Locations	Duration	Responsibility
	cloud reaches ignition sources.			
	- Prevention of BLEVE			
	1) To mitigate the risk, it is recommended that uninsulated pressurized flammable liquid containers by fire proofed.	- Storage Tank	- Operation period	- Contractor
	2) Water deluge/spray system should be applied.	- Storage Tank	- Operation period	- Contractor
	Intervention The purpose for this measures is to reduce the size and or effect of flammable releases when occurred.			
	1) Appropriate spacing of equipment in conjunction with the preventive measures discussed above.	- Within the plant both process area and tank farm	- Operation period	- Contractor
	2) Detection of release gas by gas monitoring devices near potential release area.	- Process Area and Tank Farm	- Operation period	- Contractor and PTT
	Protection These are the measures taken to protect the plant personels and facilities from participated events.			
	1) The design of control building which is done conservatively from the recommendation of Chemical Industry Association, UK (CIA) with regard to the blast overpressure.	- Control building	- Operation period	- Contractor
	2) Windows for non-process building facing the plant should be of wire-reinforced glass.	- non-process building facing the plant	- Operation period	- Contractor
	3) Fire fighting personels confronting a fire should be provided with appropriate safety gears and protected by water curtains.	- PTT's personels	- Operation period	- Contractor
	4) LPG storage tank should either be fireproofed or installed with water deluge.	- LPG storage tank	- Operation period	- Contractor
	5) Cable trays are recommended to be fireproofed especially those carrying signals to critical valves, etc.	- Cable trays	- Operation period	- Contractor

Environmental Impact (Operation Phase)	Measures	Locations	Duration	Responsibility
	- Facilities must be provided to permit the operators to turn on the water sprays/deluge system from remote locations. These valves must be numbered, clearly identified and readily accessible or remotely operable.	- Valves	- Operation period	- Contractor & PTT
	- Where the site is unmanned for long periods such as weekends and nights, the water spray/deluge system must be arranged for automatic actuation on detection of fire.	- Storage and Process area	- Operation period	- PTT
	- Use passive protection involving the surface application of special materials to protect LPG storage vessels and road/rail cars against the fire hazard.	- LPG storage vessels	- Operation period	- Contractor & PTT
	- The ground in the storage area must be concreted or compacted and slope away from the LPG vessels. Low separation kerbs (0.6 m maximum height) must be installed around each vessel for containment and direction of spillage to a catchment/evaporation area via a graded ditch or drain. Stone chippings must not be used beneath vessels since they retain spillage and aid evaporation.	- Storage area	- Operation period	- Contractor & PTT
	- Where there is a possibility of significant LPG spillage or leakage, containment and dispersion of the resulting gas cloud can be achieved by water spray techniques before the cloud reaches a potential source of ignition. Fixed water spray systems must be installed for a storage area or for mobile equipment on plant. Where such risks exist, appropriate equipment must be readily available.	- In-plant and storage area	- Operation period	- Contractor & PTT
	- The national or municipal fire brigade should have visited the site and agreed the fire fighting plan. It must be established when the last joint practice was held and if there are any mutual aid arrangements with other industrial installations in the area.	- Project area	- Operation period	- PTT
	- In the absence of a full fixed water spray system on any LPG vessel, it must be confirmed that there is adequate access to permit water cooling be applied from every side.	- Storage area	- Operation period	- Contractor & PTT
	Action Plan for Emergency Events (see attached sheets)			

Action Plan for Emergency Events

Action Plan for Emergency Events.

On-site Emergency Plan

The organization plan for the plant in case of emergency should be as following chart.

Manager and Assistant Manager : At the time of emergency, they should be called to emergency headquarters immediately to be available for counsel and for overall guidance of all protection activity.

Plant Protection Coordinator : Manage the plan and contact outside authorities, including the emergency services. He will take full charge in time of emergency

General Superintendents: Should be at emergency headquarters, where each will assume overall direction of the departments or groups in his organization and the coordination of his department's activities with the protection groups.

Area Superintendent : Each area superintendent and associated unit director should appoint and area protection coordinator and alternate, whose responsibility includes organization of the various area groups and development of coordination with the plant-wide organization.

Training Chief: Assist all other members of the plant protection organization in planning, organizing, conducting and following through programs designed to prepare personnel to meet any emergency.

Evacuation Chief: Responsible for the evacuation of all person to places of safety prior to, during or following a disaster, and initiation of rescue operation of disable or entrapped persons.

Security Chief : Responsible for protection against espionage and sabotage, the guarding of plant property, and materials, and identification of personnel.

Engineering Chief : Responsible for the maintenance of all building, equipments, utilities, services, etc.

Transportation Chief : Assemble vehicles and crews at strategic points and assign them work as requested by communications through the emergency headquarter.

Fire Chief : carry out the following procedure:

- Sound the appropriated alarm.
- Send firetruck with firemen to the scene.
- Direct field activities until the emergency is over.

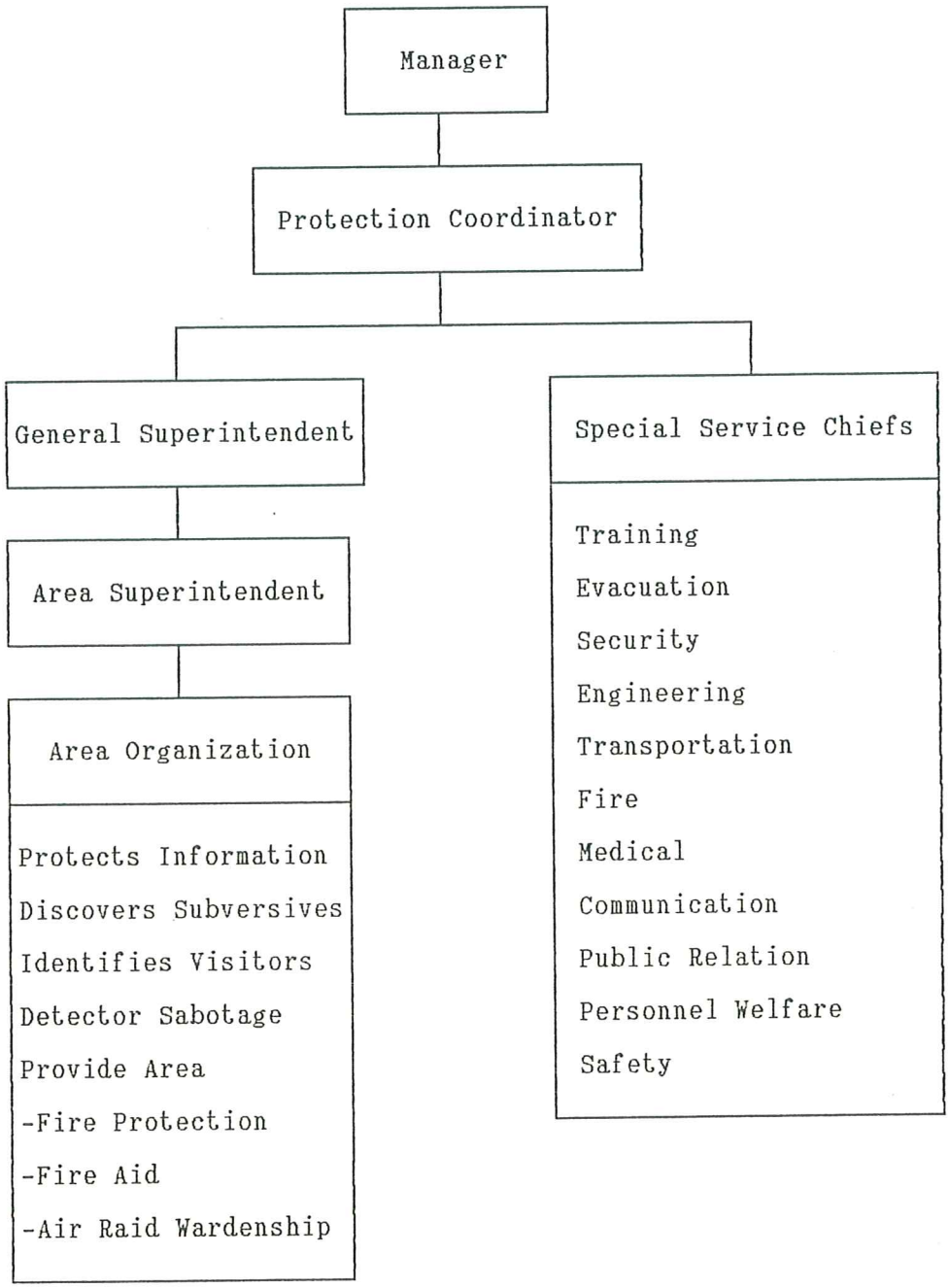
Police Chief: Dispatch the radio car to the scene of the emergency. All fence gates should be closed immediately to entry and exit except getting the permission from police chief.

Medical Chief: Prepare plans for emergency use of the plant dispensary as the primary medical center and alternative or additional medical centers. Assign specific jobs to all medical personnel. Arrange to train an adequate number of first-aid attendants (a minimum of 10% of plant employee). Coordinate drills with other groups in the disaster organizations.

Communication Chief: Handle both regular and emergency telephones services.

Public Relation Chief: Plant and handle public relations. The object of advance public relations planning is to see that reporters and photographers get accurate stories and pictures.

Personnel Welfare Chief : Arrange food, cloths and shelter. Also contacts with families of the injured or dead.



Safety Chief : Evaluate of safety hazards and in liaison, particulary as to detection and decontamination of chemicals.

When the emergency occur:

- Raise the alarms and communication both within and outside the works. Alarm and communication mechanism, any employee can raise an emergency alarm, so allowing the earliest possible action to be taken to control the situation. The fire brigade should be contacted directly at any time. The reliable system for informing the emergency services as soon as the alarm is raised should be installed on-site.

- Appointment of key personnels. Choose an emergency headquarter. It is the place where the key personnel are attended to handle the emergency. The emergency headquarter should contain the following:
  - Adequate number of external and internal telephones.
  - Radio equipment.
  - Map of the work to show the location of hazardous materials, safety equipment, fire fighting system, etc.
  - List of key personnel with address and telephone number.
  - etc.

- Other actions on site that need to be considered are:
  - Evacuation. Non-essential personnel will be evacuated from the incident area and the adjacent areas.
  - Accounting for personnel so that missing people who may be in the emergency area will be further searched.
  - Planning shut-down procedures. Safety shutdown system may be installed. The benefits obtained from installation the system are continuous plant operation and overall improvement of plant safety.
  - Rehearsing emergency procedures.
  - Plan appraisal and updating.

Off-site Emergency Plan.

Some aspects in off-site emergency plan.

Organization : Details of command structure, warning system, implementation procedures, emergency control center. Names and appointments of incident controller, site main controller, their duties and other key personnel.

Communication : Identification of personnel involve, communication center, call signs, network, list of telephone number.

Specialised Emergency Equipment : Details of availability and location of specified fire-fighting equipment.

Specialised Knowledge : Details of specialist bodies, firm, and people upon whom it may be necessary to call.

Voluntory Organizations : Details of organizers, telephone number, resource, etc.

Chemical Information : Details of the hazardous substances stored or processed on each site and a summary of their toxicity.

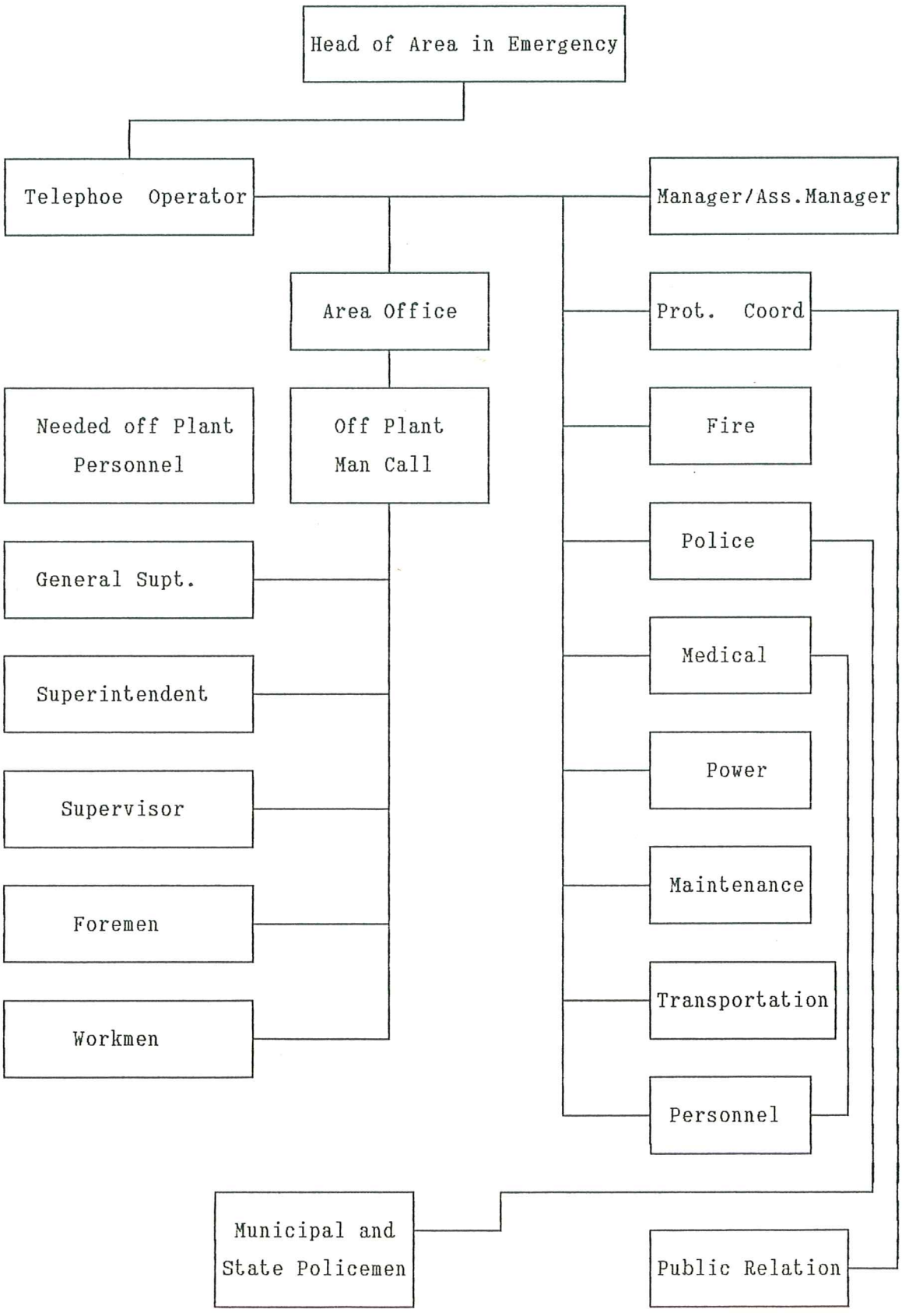
Meteorological information.

Humanitarian Arrangements : Transportation, evacuation centers, emergency feeding, treatment of injured, first aid, ambulances, etc.

Public Information : Deal with the media press office and informing the relatives, etc.

Assessment : Collecting information on the causes of the emergency and reviewing the efficiency and effectiveness of all aspects of the emergency plan.

Notification Plan in Case of Emergency



Exercise of the emergency plan should be carried out regulary (training with exercise or practice should be held once a year in every year and unwarning exercise twice a year in every year, the trainer is from PTT's training center) an in order to keep the responsible teams and personnel alert and ready to perform their duties correctly and rapidly in case of emergencies, accidents or fires. The exercises whould include simulation of various types of accidents and how to handle them effectively.

PTT should cooperate with local authorities, e.g. Khanom hospital, police, health service places at the sanitary district, district, and provincial levels, in order to get good understanding with them and to obtain necessary assistance from these sectors. In exercising the emergency plan, these sectors should be requested to take part. If a serious accident is suspected these sectors should be informed immediately so that necessary actions such as evacuation of workers and nearby residents can be conducted in time.

Table 1.1 Permissible Heat Exposure Threshold Limit Values
(Values are given in °C and (°F) WBGT)

Work-Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% Work - 25% Rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% Work - 50% Rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% Work - 75% Rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

Table 1.2 Recommended Levels of Illumination

Area/Type of Work	Standard (Lux)
Office Area	
- regular office work	300
- computer, printer	300
Control Room	
- computer	300
- panel	200
- board	200
In plant	
- walk way	50
- panel, board	200
Warehouse	50

Fire Protection/Fighting System

Fire Protection/Fighting System

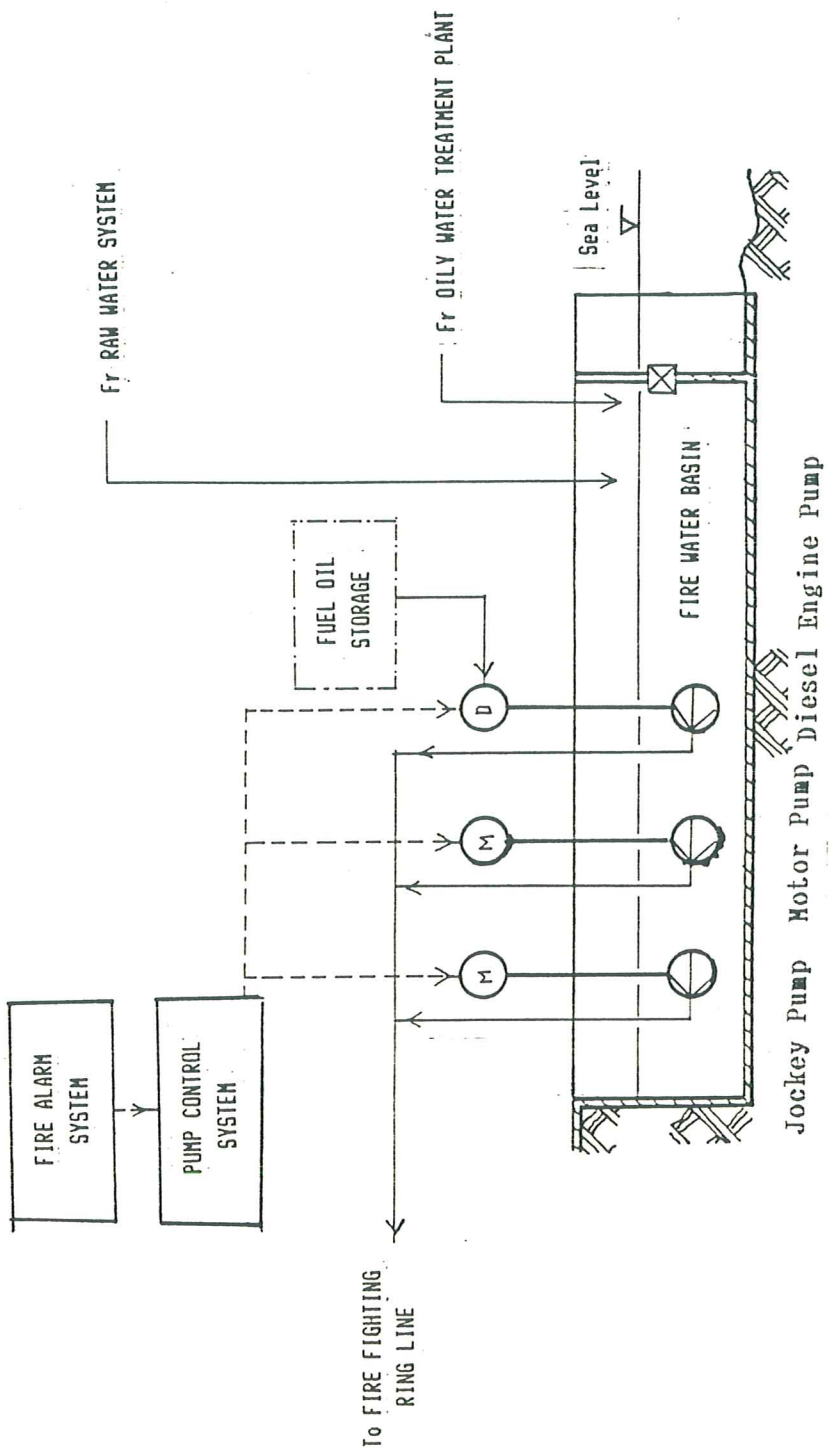
Fire protection/fighting system consists of the following equipments :

- spray water system (tower, storage tank)
- automatic sprinkles (warehouse)
- water supply/standpipes and hose
- fixed-extinguisher systems
- portable fire extinguisher
- fire detection system and alarms
- smoke detector, heat detector (building)
- fire wall
- fire door
- gas detector and alarms (process area, utility area etc.)
- hydrant, monitor
- fire proof

1) Water system

a) Source of water : Water from oily water treatment plant and from the sea which the quantity will meet American Petroleum Institute API-RP-2001 Fire protection in Refineries requirement. The sweet water reservoir with the approximate capacity 3,000 m^3 will be sufficient.

b) Pipe and pressure : Underground cast iron or welded steel pipe with 175 to 225 psi cold pressure design are normally used for transmission lines. Around the separation plant and the tank farm loop system will be provided and the others will be tree system. All joints for fire water will be the same size with the local fire department.



Fire Figthing System

c) Pumping capacity : Four submerged fire water pumps shall be installed with a total capacity of 1,900 m^3/h. Two pumps shall be electric-motor-driven with a capacity of 500 m^3/h, and two pumps shall be diesel-engine-driven with a capacity of 950 m^3/h each. One of the engine driven pumps serves as a spare. The fuel tank for the engine-driven pumps shall have a capacity for one day continuous operation of both pumps. Pressure in the fire water header is maintained at 140 pounds by a jockey pump. The pressure can be increased to 150 pounds during an emergency by the 2500-gpm pumps. (Figure 2-8)

d) Water Volume : Consider at storage tank area where largest volume of water is needed in case of fire. Suppose one LPG tank (6000 m^3) is on fire. Surface area of the tank = 17,184 ft^2. Based on NFPA-15, a range of water spray application rates that apply to most ordinary combustible solids or flammable liquids is from 0.2-0.5 gpm/ft^2 of protected surface area. Thus water required here = 5,155 gpm (rate of 0.3 gpm/ft^2). And water is needed for cooling the other tanks. Based on API-RP-2001, 0.1-0.25 gpm/ft^2 is required for surface cooling, i.e. = 1,719 gpm (at rate of 0.1 gpm/ft^2 for another LPG tank), 1,311 gpm (at rate of 0.1 gpm/ft^2 for NGL 4000 m^3) and 207 gpm (at rate of 0.1 gpm/ft^2 for 250 m^3 tank). Total water requirement = 8,392 gpm. Therefore pumping capacity of 10,000 gpm (4-2,500 gpm pumps) is adequate for the GSP. However, different size of pump can be use as far as water volume supplied is not less than 8,205 gpm.

2) Spacing of Hydrants and Monitors

Hydrant and monitors should be not more than 300 feet apart in tank farm and in the process areas not more than 250 feet apart.

3) Water Spray Systems

Fixed water spray systems shall be provided for recontactor, deethanizer, LPG column, the LPG and NGL storage tanks and a water curtain between the hot oil heating system and the in-plant power generation. Actuation shall be possible by remote-controlled valves.

4) Sprinkler System

The following areas should install an automatic wet-pipe sprinkler system.

- Office buildings
- Wastewater treatment building
- Control building
- Utility buildings (warehouse building)
- Elective bases pipe racks

5) Deluge Sprinkler System

Deluge sprinkler system should be installed in storage and process areas where fire may flash ahead of the operation of ordinary automatic sprinklers.

6) Foam Systems

A multipurpose foam agent shall be used to cover all necessary air foam ranges.

LPG/Gasoline Retention Basins

To cover LPG or gasoline spillages, static foam generators shall be placed on the dikes around the retention basins of the storage tanks. The system design shall be in accordance with NEPA 11A.

The water-powered generators or groups of generators shall be connected with motorized valves to the fire water network and a foam agent network. The generators shall have a self-protecting water spray system during fire, which is in operation, when no foam is generated.

The generators may operate with sweet water or sea water and produce foam with a fixed expansion rate of 300 : 1. The generators shall be capable to cover a basin by 0.3 m of foam within 1 minute. The factor for normal foam shrinkage shall be 1.15.

The foam agent storage and pumping unit shall be located in the neighbourhood of the diked areas. The foam agent storage quantity shall permit application at the initial design rate sufficient for fire control to reach steady state conditions and to provide maintenance control for the calculated fire duration. The tank shall be provided with sun protection shielding.

The system shall be operable manually and automatically upon local and remote start signal.

The foam agent pump plus standby pump shall feed the foam agent network. The foam agent pump shall start automatically, when one of the fire water pumps starts. The pump shall stop on low level in the foam agent tank.

By pressure differential control the foam agent pressure is to be kept above the fire water pressure. The standby pump shall start automatically in case of low differential pressure. The pumps shall be connected to the emergency power supply.

Gasoline Tanks

The floating roofs of the natural gasoline storage and natural gasoline day tanks shall be equipped with a low expansion foam system in accordance with NEPA 11A.

It shall be a fixed system with connection to the fire water and foam agent net-works. The system shall be provided with motorized valves and work manual and remote-controlled.

7) Carbon Dioxide Extinguisher Systems

Automatic total flooding systems shall be provided for :

- relevant part of the substation and process unit control house
- in-plant power generation gas turbine hood.

8) Portable Fire Extinguishers/Mobile Equipment

Hose reels, hand extinguishers and wheeled dry chemical trailers will be distributed at strategic locations throughout a plant to combat small fires. Also combination water foam and dry chemical fire trucks and utility fire trucks are provided. 50 kg-wheeled units shall be concentrated at turbine, compressor and pump stations and in the hot oil unit.

9) Plant Fire Detection and Alarm System

The plant fire detection alarm system feeds to fire stations throughout the plant and a central fire station with supervisory panels. The central fire station should house fire alarm panels for remote supervision of all fire-water pump activities, remote manual start of pump, remote supervision and actuation of water deluge system, remote supervision of fire alarm station and sequence of starting pumps.

10) Construction Material

The following items should warrant fire resistive construction:

- Structural members (columns, beams, vessel skirts, and saddles) which directly support piping, equipment, or vessels containing flammable and combustible liquid.
- Control buildings and critical motor control centers which may be exposed to fires in process units.

- Enclosed exit ways (stair towers, corridors, etc.) which are essential to safe escape of personnel.
- Walls and barrier separating high-hazard process areas.

11) Training

Training makes it all work, i.e. fire fighting.

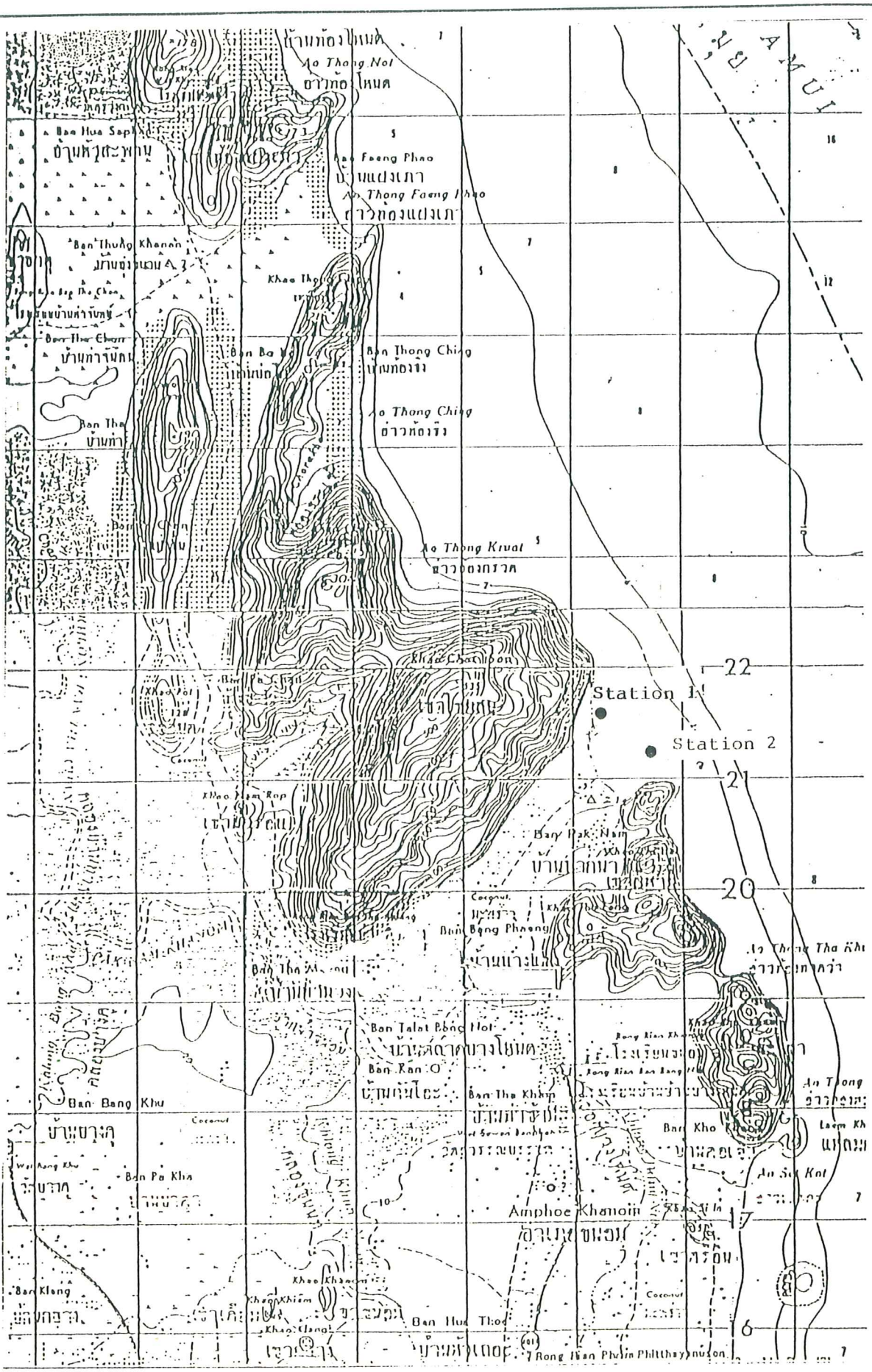
To know, to be able to operate fire fighting equipments is important in fire fighting system. Therefore training is crucial all workers should be trained in fire fighting. However, the Ministry of Interior's mandate limits at least 40% of the workers in each section have to be trained in basic fire extinguishing.

Fire brigades : An organized brigade must be established and actual fire fighting exercises conducted in which real fires of types most likely to occur in the plant are extinguished with the various types of the equipments existing in the plant. Every shift must have fire brigade.

All fire fighters must be provided suitable protective clothing for fire fighting.

Table 2 Monitoring Program

Parameters	Sampling Point	Duration/Frequency	Responsibility	Cost (Baht/year)
Construction Phase				
1. Surface Water Quality				
- pH, turbidity, total suspended solids, grease and oil, DO, BOD, total coliform bacteria	- Khanom seashore at station 1,2 (Figure 2.1)	- every 4 month	- PTT	7,920
2. Aquatic Resource				
- Monitoring of the plankton and benthic community	- Khanom seashore at station 1,2 (Figure 2.1)	- two times a year (wet and dry season) for high and low tide	- PTT	19,200
3. Occupational Health & Safety				
- Collect and analysis the data on cause and effect of accident and occupational disease to find the way for solving the problem.	-	- Continuously	- PTT	-
- Follow up and check on the high risk job and the jobs that may often cause accidents and find the solutions to reduce those accidents.	-	- Continuously	- PTT	-
- Restrict on the PPD use of all workers.	-	- Continuously	- PTT	-
- Do a survey to identify the occupational health and safety problems on the construction site to solve or reduce the problems.	-	- Continuously	- PTT	-



Station 1 : In Front of the Project Site Station 2: EGAT shore

Figure 2.1 Map Showing Location of Water Quality Sampling Station and Monitoring of the Plankton and Benthic Community

Parameters	Sampling Point	Duration/Frequency	Responsibility	Cost (Baht/year)
Operation Phase				
1. Air Quality				
1.1 Ambient				
- Sulfur Dioxide	- EGAT's guest quarter, EGAT's jetty building, Ban Tha Muang and Wat Suwanbanphot (Figure 2.2)	- 3 days avg. /2 times/year	- PTT	- 28,800
- Nitrogen Dioxide		- 3 days avg. /2 times/year	- PTT	- 28,800
- Total Suspended Particulate		- 3 days avg. /2 times/year	- PTT	- 28,800
- Hydrogen Sulfide		- 3 days avg. /2 times/year	- PTT	- 28,800
- Wind Speed & Direction	- EGAT's guest quarter (Figure 2.2)	- 3 days/times/2 times/year	- PTT	- 8,800
1.2 Emission				
- Sulfur Dioxide, NO_2, CO, HC	- Hot oil heater system and gas turbine	- Normal operation/ 2 times/year	- PTT	- 36,000
Noise				
- Leq_{24}	- Fence boundary of the plant, EGAT's guest quarter and EGAT's jetty building (Figure 2.2)	- at least 3 days/ 2 times/year	- PTT	- 27,000
3. Vibration				
- Measuring the amount of vibration	- EGAT's guest quarter and EGAT's jetty building (Figure 2.3)	- at least 8 hrs. cover blasting period	- PTT	- 12,000 Baht/Time
4. Surface Water Quality				
- pH, turbidity, total suspended solids, DO, BOD, grease and oil, total coliform bacteria	- Khanom seashore at station 1,2 (Figure 2.1)	- every 6 month	- PTT	- 5,280
5. Aquatic Resources				
- Monitoring of the plankton and benthic community	- Khanom seashore at station 1,2 (Figure 2.1)	- two times a year (wet and dry season) for high and low tide	- PTT	- 19,200
6. Occupational Health /Safety				
- Inspect working environments concerning heat, light, chemical concentration, and ergonomics to keep them in good condition.	- In - plant	- Continuously	- PTT	-
- Continuously inspect the tool, machines and equipments if they are maintained properly and are safe to use.	- In - plant	- Continuously	- PTT	-

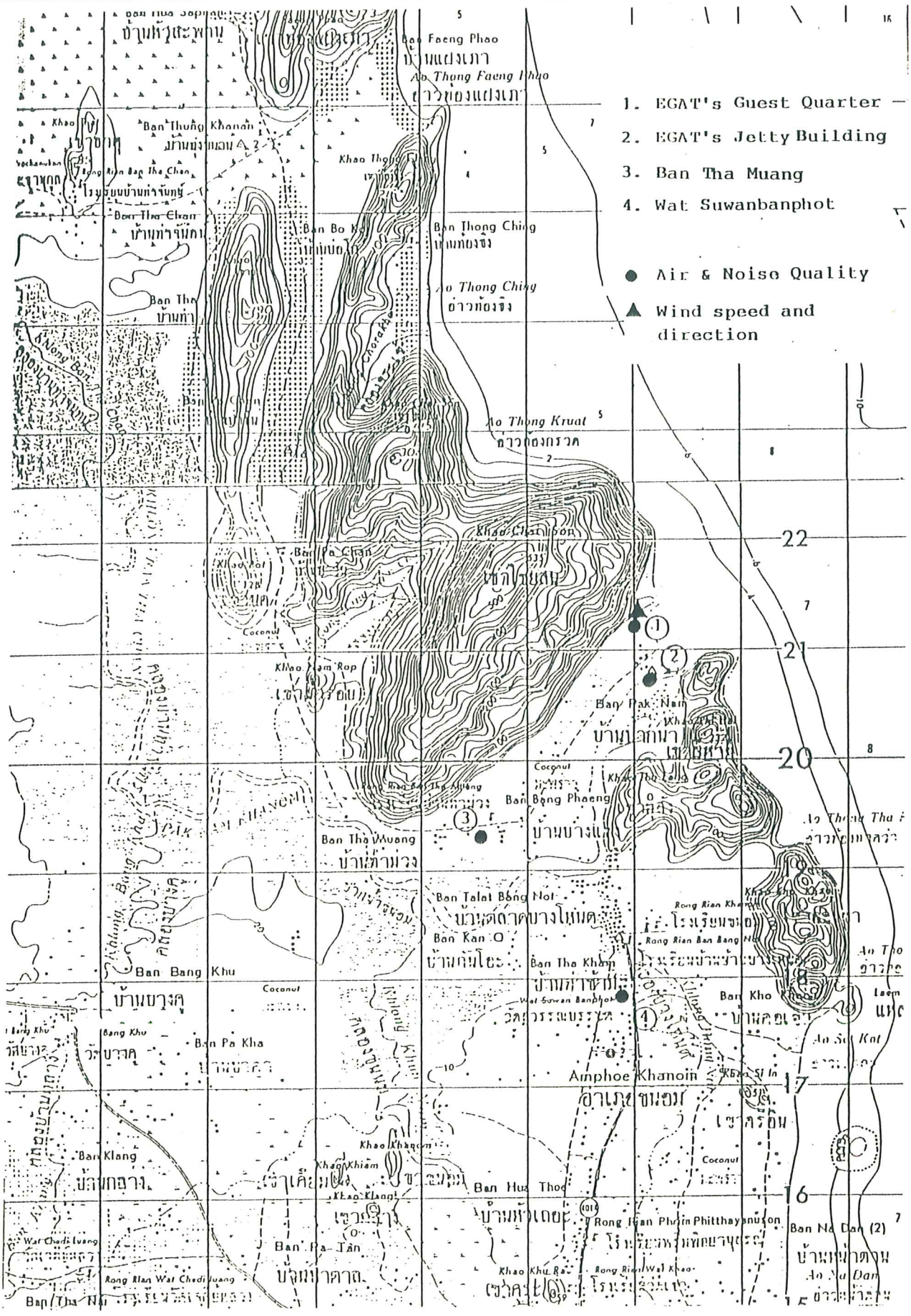
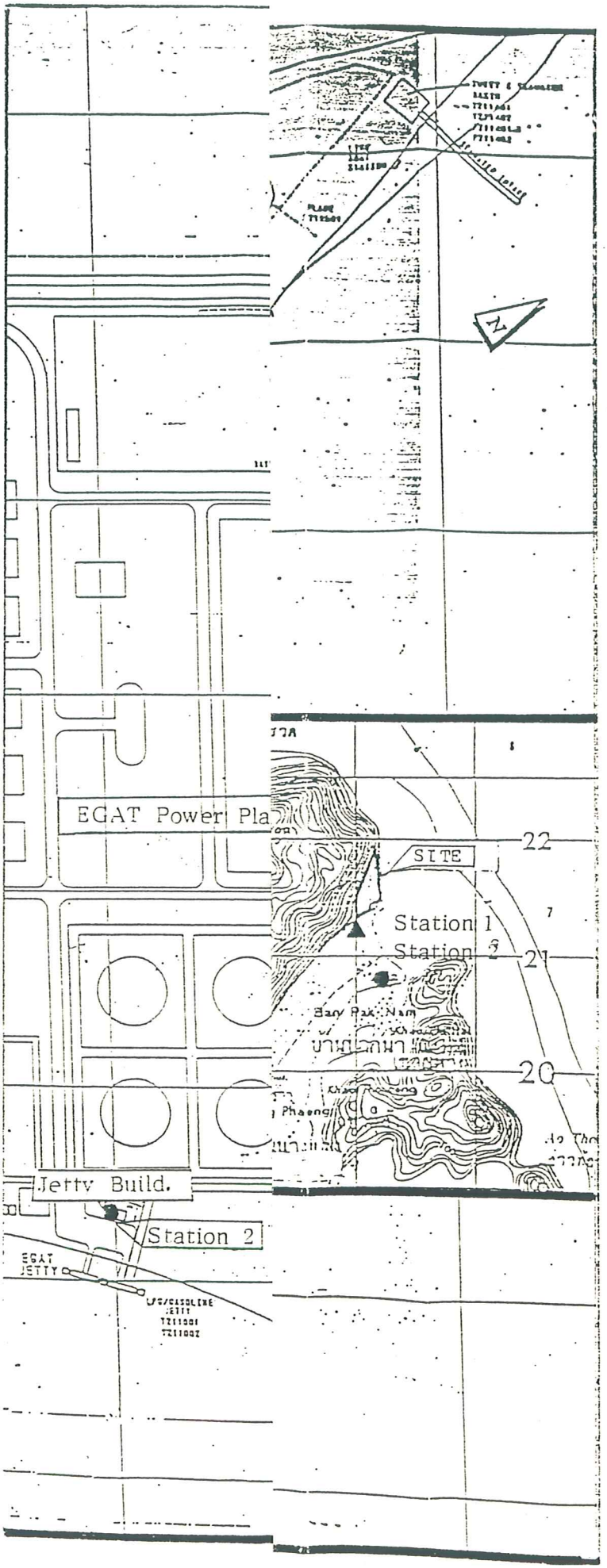


Figure 2.2 Sampling Stations for Air & Noise Quality Measurement and Location of Wind Speed & Direction Measurement


EGAT Power Pla
Jetty Build.
Station 2
EGAT JETTY
SITE
Station 1
Station 2
22
21
20
Bang Pak Nam

Parameters	Sampling Point	Duration/Frequency	Responsibility	Cost (Baht/year)
- Regular inspect and test all automatic system if they are still work.	- In-plant and storage area	- Continuously	- PTT	-
- Keep record of workers' health status from pre-, post-employment and annual physical check up and also of work-related employee injuries and illness.	-	- Continuously	- PTT	-
- Keep accident records for the use of the analysis to prevent or reduce them.	-	- Continuously	- PTT	-
- Inspect and test all fire protection equipments and alarms.	- In-plant and storage area	- Continuously	- PTT	-