BOWIN POWER COMPANY LIMITED

FINAL REPORT (REVISION)
FOR
ENVIRONMENTAL IMPACT ASSESSMENT
OF IPP PROJECT AT CIE

MAIN REPORT

PREPARED BY

TEAM CONSULTINIG ENGINEERS CO., LTD.

MARCH 2000

TEAM CONSULTING ENGINEERS CO., LTD.

ENV/979A/430216

16 March 2000

BOWIN POWER COMPANY LIMITED
20th Floor, UM Tower
9 Ramkhamhaeng Rd., Suanluang
Bangkok 10250

Attn: Khun Pajongwit Pongsivapai

Re: Revised Final Report for Environmental Impact Assessment of Independent Power Producer (IPP) Project at CIE.

Dear Sir:

We would like to submit, with our pleasure, 16 copies of the Revised Final Report (Main Report) 19 copies of the Summary Report and 3 copies of Addendum to Environmental Impact Assessment of the IPP project at CIE, Bowin Sub-district, Sriracha District, Chonburi Province, for your consideration. This set of reports need to be submitted to OEPP as follows :

- Main report 6 copies
- Summary report 9 copies
- Addendum to EIA 2 copies

We have received kind assistance and cooperation for all the concerned parties throughout the study period, and we would like to thank them all for their kindness.

Yours Sincerely,

Amnat Prommasutra
Senior Executive Director

AP/kt

151 TEAM Building Moo 12 Soi Nuan Chan, Nawamin Rd. (Sukhapiban 1) Klong Kum, Bueng Kum, Bangkok 10230 THAILAND Tel : 509-9000 Fax : 509-9090 WEBSITE: http://team.dds.co

รายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม

ชื่อโครงการ	โรงงานไฟฟ้าอิสระที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน)
ที่ตั้งโครงการ	นิคมอุตสาหกรรมชลบุรี (บ่อวิน) ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี
ชื่อเจ้าของโครงการ	บริษัท บ่อวินเพาเวอร์ จำกัด
ที่อยู่เจ้าของโครงการ	เลขที่ 9 ชั้น 20 อาคารยูเอ็มทาวเวอร์ ถนนรามคำแหง เขตสวนหลวง กรุงเทพฯ

การมอบอำนาจ

☐ เจ้าของโครงการได้มอบอำนาจให้บริษัท ทีม คอนซัลติ้ง เอนจิเนียร์ จำกัด เป็นผู้ดำเนินการเสนอรายงาน ดังหนังสือมอบอำนาจที่แนบ

☒ เจ้าของโครงการมิได้มีการมอบอำนาจแต่อย่างใด

จัดทำโดย

บริษัท ทีม คอนซัลติ้ง เอนจิเนียร์ จำกัด

แบบ สวล ๕

ใบอนุญาต

เป็นผู้มีสิทธิทำรายงานเกี่ยวกับการศึกษา

และมาตรการป้องกันและแก้ไขผลกระทบกระเทือนต่อคุณภาพสิ่งแวดล้อม

ใบอนุญาตที่ ๑๔/๒๕๔๑

อาศัยอำนาจตามความในมาตรา ๑๙ แห่งพระราชบัญญัติส่งเสริมและรักษาคุณภาพสิ่งแวดล้อมแห่งชาติ พ.ศ. ๒๕๓๘ คณะกรรมการสิ่งแวดล้อมแห่งชาติออกใบอนุญาตฉบับนี้ ให้แก่บริษัทที่ม คอนซัลติ้ง เอ็นจิเนียร์ จำกัด เพื่อแสดงว่าเป็นผู้มีสิทธิทำรายงานเกี่ยวกับการศึกษาและมาตรการป้องกันและแก้ไขผลกระทบกระเทือนต่อคุณภาพสิ่งแวดล้อมมีกำหนด ๕ ปี ตั้งแต่วันที่ ๒๙ เดือน ตุลาคม พ.ศ. ๒๕๔๑ ถึงวันที่ ๒๘ เดือน ตุลาคม พ.ศ. ๒๕๔๖ โดยกำหนดเงื่อนไขดังต่อไปนี้

(๑) ไม่มีเงื่อนไข.....

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(๒).....

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(๓).....

.....

(๔).....

.....

ให้ไว้ ณ วันที่ 30 เดือน ตุลาคม พ.ศ. ๒๕๔๑

(นายศักดิ์สิทธิ์ ตรีเดช)

อธิบดีกรมการสำนักงานนโยบายและแผนสิ่งแวดล้อม

F.fromeia4.doc

หน้า I - IV

บริษัท ทีม คอนซัลติ้ง เอนจิเนียร์ จำกัด
151 อาคารทีม ถนนนวลจันทร์ (ใกล้ทางด่วนอาจณรงค์-รามอินทรา)
แขวงคลองกุ่ม เขตบึงกุ่ม กรุงเทพฯ 10230
โทร. 509-9000-39 แฟกซ์ 509-9090 WEBSITE: http://team.dds.co.th

หนังสือรับรองการจัดทำรายงาน

15 มีนาคม 2543

หนังสือฉบับนี้ขอรับรองว่า บริษัท ทีม คอนซัลติ้ง เอนจิเนียร์ จำกัด เป็นผู้จัดทำรายงานเกี่ยวกับการศึกษาและมาตรการป้องกันและแก้ไขผลกระทบกระเทือนต่อคุณภาพสิ่งแวดล้อม

โครงการ **โรงไฟฟ้าอิสระ ที่นิคมอุตสาหกรรมชลบุรี**
ตำบล บ่อวิน อำเภอ ศรีราชา จังหวัด ชลบุรี

ให้แก่ **บริษัท บ่อวิน เพาเวอร์ จำกัด (มหาชน)**

เพื่อ **ขอเปลี่ยนแปลงรายละเอียดโครงการ**

โดยคณะผู้ชำนาญการและเจ้าหน้าที่ผู้ร่วมทำงานดังต่อไปนี้

ผู้ชำนาญการ	**ลายมือชื่อ**
ดร.สิรินิมิตร วังสุนทร	
นายไกรชาติ ตันตระการอาภา	
เจ้าหน้าที่ผู้ร่วมทำรายงาน	
นางเปรมวณี ปรีดาพันธุ์	
นางสาวอัจฉรา ทวีทรัพย์	
นายภูริภัท ว่องพิพัฒนานนท์	

(นายอำนาจ ชัลพิจิตรหฤโต)
กรรมการบริหารอาวุโส

บัญชีรายชื่อผู้จัดทำรายงาน

โครงการโรงไฟฟ้าอิสระ ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) อำเภอบ่อวิน จังหวัดชลบุรี

ชื่อ-นามสกุล	ด้าน/หัวข้อที่ทำการศึกษา	สัดส่วนผลงานคิดเป็นเปอร์เซ็นต์ของงานศึกษาจัดทำรายงานทั้งฉบับ
1. ดร.สิรินิมิตร วังสุนทร	หัวหน้าคณะผู้ศึกษา/ผู้ชำนาญการด้านสิ่งแวดล้อม/ผู้เชี่ยวชาญด้านคุณภาพน้ำ/นิเวศวิทยาทางน้ำ	20
2. นายไกรชาติ ตันตระการอาภา	ผู้ชำนาญการด้านสิ่งแวดล้อม/ผู้เชี่ยวชาญด้านคุณภาพอากาศและเสียง	20
3. นางเปรมวณี ปรีดาพันธุ์	นักวิทยาศาสตร์สิ่งแวดล้อมอาวุโส/คุณภาพน้ำ การจัดการกากของเสีย	10
4. น.ส.อัจฉรา ทวีทรัพย์	นักวิทยาศาสตร์สิ่งแวดล้อม/ประสานงานโครงการ คุณภาพอากาศและด้านอื่นๆ	20
5. นายภูริภัท ว่องพิพัฒนานนท์	นักวิทยาศาสตร์สิ่งแวดล้อม/การใช้น้ำและการจัดการน้ำเสีย	20
6. น.ส.แก้วตา อัมรานนท์	นักวิชาการด้านเศรษฐกิจ-สังคม	10

บัญชีรายชื่อรับรองหัวข้อศึกษาและคุณวุฒิของผู้ร่วมจัดทำรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม
โครงการโรงไฟฟ้าอิสระ ที่นิคมอุตสาหกรรมชลบุรี อำเภอบ่อวิน จังหวัดชลบุรี

หัวข้อศึกษา/ชื่อ - นามสกุล	วุฒิการศึกษา	ที่อยู่ปัจจุบัน	ตำแหน่งในโครงการ	ลายมือชื่อ
หัวหน้าคณะศึกษา/ผู้ชำนาญการสิ่งแวดล้อม/ ผู้เชี่ยวชาญด้านคุณภาพน้ำ/นิเวศวิทยาทางน้ำ ดร.สิรินิมิตร วังสุนทร	วท.บ.(ชีววิทยา), M.S.(Aquatic Ecology), Ph.D. (Limnology)	47 พหลโยธิน 34 (เสนานิคม 2) บางเขน กทม. 10900	บ.ทีมฯ	
ผู้ชำนาญการสิ่งแวดล้อม/ผู้เชี่ยวชาญด้าน คุณภาพอากาศและเสียง นายไกรชาติ ต้นตระการอาภา	วท.บ. (สถิติ), วท.ม. (เทคโนโลยีการบริหารสิ่งแวดล้อม)	10/444 ม.สวนทิพย์ ถ.นวลจันทร์ คลองกุ่ม บึงกุ่ม กทม. 10230	บ.ทีมฯ	
นักวิทยาศาสตร์สิ่งแวดล้อมอาวุโส/คุณภาพน้ำ/ การจัดการกากของเสีย นางเปรมวณี ปรีดาพันธุ์	วท.บ.(เคมี), วท.ม. (เทคโนโลยีสิ่งแวดล้อม)	643 ม.10 ซ.สวัสดี ถ.นวมินทร์ คลองกุ่ม บึงกุ่ม กทม. 10230	บ.ทีมฯ	
นักวิทยาศาสตร์สิ่งแวดล้อม/ประสานงานโครงการ/ คุณภาพอากาศ และด้านอื่น ๆ น.ส.อัจฉรา ทวีทรัพย์	วท.บ. (สาธารณสุขศาสตร์), วท.ม. (เทคโนโลยีสิ่งแวดล้อม)	542/1270 ซ.15 ม.เสนาวิลล่า ถ.แฮปปี้แลนด์ คลองจั่น บางกะปิ กทม. 10240	บ.ทีมฯ	
นักวิทยาศาสตร์สิ่งแวดล้อม/การใช้น้ำ และการจัดการน้ำเสีย นายภูริภัท ว่องพิพัฒนานนท์	วท.บ.(เทคโนโลยีชีวภาพ), วท.ม.(วิทยาศาสตร์สิ่งแวดล้อม)	137/202 ม.5 ซ.สยามธรณี ถ.รามอินทรา บางเขน กทม. 10220	บ.ทีมฯ	
นักวิชาการด้านเศรษฐกิจ - สังคม น.ส.แก้วตา อัมรานนท์	ศศ.บ.(ประวัติศาสตร์)	63/2242 ซ.104 ม.เคหธานี ถ.สุขาภิบาล3 สะพานสูง กทม. 10220	บ.ทีมฯ	

ที่ วว 0804/4093

สำนักงานนโยบายและแผนสิ่งแวดล้อม
ซอยพิบูลวัฒนา 7 ถนนพระรามที่ 6
กรุงเทพฯ 10400

30 ธันวาคม 2542

เรื่อง ผลการพิจารณารายงานการเปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมโครงการโรงไฟฟ้าอิสระ ของบริษัท บ่อวิน เพาเวอร์ จำกัด (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ตั้งอยู่ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี

เรียน ผู้ว่าการการนิคมอุตสาหกรรมแห่งประเทศไทย

สิ่งที่ส่งมาด้วย
1. สำเนาหนังสือบริษัท บ่อวิน เพาเวอร์ จำกัด ที่ Bowin 51/OEPP-002 ลงวันที่ 29 กรกฎาคม 2542
2. สำเนาหนังสือบริษัท บ่อวิน เพาเวอร์ จำกัด ที่ Bowin 51/OEPP-004 ลงวันที่ 5 สิงหาคม 2542
3. สำเนาหนังสือบริษัท บ่อวิน เพาเวอร์ จำกัด ที่ Bowin 51/OEPP-005 ลงวันที่ 6 สิงหาคม 2542
4. สำเนาหนังสือบริษัท บ่อวิน เพาเวอร์ จำกัด ที่ Bowin 51/OEPP-006 ลงวันที่ 31 สิงหาคม 2542
5. สำเนาหนังสือบริษัท บ่อวิน เพาเวอร์ จำกัด ที่ Bowin 51/OEPP-008 ลงวันที่ 29 พฤศจิกายน 2542
6. มาตรการลดผลกระทบสิ่งแวดล้อมและมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม โครงการโรงไฟฟ้าอิสระ ของบริษัท บ่อวิน เพาเวอร์ จำกัด (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ตั้งอยู่ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี ที่ ต้องยึดถือปฏิบัติ

ตามที่ สำนักงานนโยบายและแผนสิ่งแวดล้อม ได้ให้ความเห็นชอบรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมโครงการโรงไฟฟ้าอิสระ ของบริษัท บ่อวิน เพาเวอร์ จำกัด (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ตั้งอยู่ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี เมื่อวันที่ 12 มกราคม 2542 ต่อมาบริษัทฯ ได้เสนอรายงานการขอเปลี่ยนแปลงรายละเอียดโครงการฯ ซึ่ง

2/ จัดทำรายงานฯ...

จัดทำรายงานฯ โดยบริษัท ทีม คอนซัลติ้ง เอนจิเนียร์ จำกัด ให้สำนักงานฯ พิจารณา ด้วยความละเอียด ในสิ่งที่ส่งมาด้วย 1-5 นั้น

สำนักงานนโยบายและแผนสิ่งแวดล้อม ได้นำรายงานการขอเปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมโครงการโรงไฟฟ้าอิสระ ของบริษัท บ่อวิน เพาเวอร์ จำกัด (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) เสนอต่อคณะกรรมการผู้ชำนาญการพิจารณารายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมด้านโครงการอุตสาหกรรม ในคราวประชุมครั้งที่ 19/2542 เมื่อวันพุธที่ 8 ธันวาคม 2542 ซึ่งคณะกรรมการฯ มีมติเห็นชอบในรายงานการขอเปลี่ยนแปลงฯ โดยได้กำหนดมาตรการลดผลกระทบสิ่งแวดล้อมและมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม ให้บริษัทฯ ต้องยึดถือปฏิบัติดังรายละเอียดในสิ่งที่ส่งมาด้วย 6 ทั้งนี้ บริษัทฯ จะต้องรวบรวมรายละเอียดข้อมูลชี้แจงเพิ่มเติมทั้งหมดตามมติคณะกรรมการผู้ชำนาญการฯ จัดทำเป็นรายงานฉบับสมบูรณ์ เสนอต่อสำนักงานฯ เพื่อเผยแพร่แก่หน่วยงานที่เกี่ยวข้อง พร้อมทั้งจัดทำรายงานภาคผนวกโดยรวบรวมรายละเอียดข้อมูลเพิ่มเติมทั้งหมดตามลำดับการพิจารณาของคณะกรรมการผู้ชำนาญการฯ เสนอต่อสำนักงานฯ เพื่อจัดเก็บเป็นเอกสารอ้างอิงต่อไป

จึงเรียนมาเพื่อโปรดทราบและพิจารณาดำเนินการต่อไป ทั้งนี้ สำนักงานนโยบายและแผนสิ่งแวดล้อม ได้สำเนาหนังสือแจ้งสำนักงานนิคมอุตสาหกรรมชลบุรี สำนักงานจังหวัดชลบุรี และสำนักงานอุตสาหกรรมจังหวัดชลบุรี เพื่อทราบด้วยแล้ว

ขอแสดงความนับถือ

(นายชาครี ช่วยประสิทธิ์)
เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

สำเนาถูกต้อง
(นางสุปราณี แดงไทย)
เจ้าหน้าที่บริหารงานธุรการ 6

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
โทร. 2714231 2723020-9 ต่อ 641
โทรสาร 2785469 2713226

บริษัท บ่อวิน เพาเวอร์ จำกัด
Bowin Power Company Limited

สำนักงานนโยบายและแผนสิ่งแวดล้อม
รับที่ ๗๔๘ วันที่ 30 ก.ค. 2542
เวลา 10.10 ผู้รับ [illegible]

เลขที่ Bowin 51 / OEPP-002

29 กรกฎาคม 2542

เรื่อง ขอนำส่งรายงานคำชี้แจ้งเพิ่มเติมในการขอเปลี่ยนแปลงรายละเอียดโครงการ การศึกษาผลกระทบสิ่งแวดล้อม สำหรับโรงไฟฟ้าอิสระที่ นิคมอุตสาหกรรมชลบุรี ของบริษัทบ่อวิน เพาเวอร์ จำกัด

เรียน เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

อ้างถึง หนังสือที่ วว. 0804/511 ลงวันที่ 12 มกราคม 2542 ของเลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

สิ่งที่ส่งมาด้วย รายงานคำชี้แจงเพิ่มเติมจำนวน 18 ชุด

ด้วย บริษัท บ่อวินเพาเวอร์ จำกัด ซึ่งได้รับอนุมัติให้ก่อสร้างและดำเนินโครงการโรงไฟฟ้าอิสระ (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) อำเภอศรีราชา จังหวัดชลบุรี ตามรายละเอียดที่อ้างถึง เนื่องจากโครงการฯ ได้มีการเปลี่ยนแปลงการใช้เทคโนโลยีจากเดิมของ GE มาเป็นเทคโนโลยีของABB ซึ่งโดยภาพรวมจะเป็นการเปลี่ยนแปลงที่ดีขึ้นบริษัทฯ จึงได้จัดทำรายงานชี้แจ้งเพิ่มเติมของการเปลี่ยนแปลงดังกล่าวมาพร้อมหนังสือฉบับนี้

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
เลขที่ 423 วันที่ 30 ก.ค. 2542
เวลา 14.40 ผู้รับ [illegible]

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ

(นาย อนุดร จาติกวณิช)
กรรมการผู้จัดการใหญ่

สำเนาถูกต้อง
(นางสุปราณี แตงไทย)
เจ้าหน้าที่บริหารงานธุรการ 6

บริษัท บ่อวิน เพาเวอร์ จำกัด
Bowin Power Company Limited

สำนักงานนโยบายและแผนสิ่งแวดล้อม
รับที่ 9181 วันที่ 6 ส.ค. 2542
เวลา 14.40 ผู้รับ

ที่ Bowin 51 / OEPP - 004

5 สิงหาคม 2542

เรื่อง ขอนำกลับรายงานคำชี้แจงเพิ่มเติมในการขอเปลี่ยนแปลงรายละเอียด โครงการการศึกษาผลกระทบสิ่งแวดล้อม สำหรับโรงไฟฟ้าอิสระที่นิคมอุตสาหกรรมชลบุรี ของบริษัท บ่อวินเพาเวอร์ จำกัด

เรียน เลขาธิการสำนักนโยบายและแผนสิ่งแวดล้อม

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
รับที่ 3456 ลงวันที่ 9 ส.ค. 2542
เวลา 10.30 น. ผู้รับ สุนทรี

อ้างถึง หนังสือเลขที่ Bowin 51/ OEPP -002

ตามที่ บริษัท บ่อวิน เพาเวอร์ จำกัด ได้ขอเปลี่ยนแปลงการใช้เทคโนโลยีจากเดิมของ GE มาเป็น ABB ซึ่งโดยภาพรวมเป็นการเปลี่ยนแปลงที่ดีขึ้น และทางบริษัทได้จัดส่งรายงานชี้แจงเพิ่มเติมตามหนังสือเลขที่ Bowin 51/ OEPP - 002 ลงวันที่ 29 กรกฎาคม 2542 นั้น แต่ทางบริษัทฯ มีข้อมูลบางส่วนที่จะเพิ่มเติมเพื่อให้มีความชัดเจนสมบูรณ์มากขึ้น ดังนั้นทางบริษัทฯ จึงขอทำรายงานคำชี้แจงเพิ่มเติมกลับคืน เพื่อแก้ไขให้สมบูรณ์ขึ้น

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ

(นาย ปจงวิช พงษ์ศิวาภัย)
รองกรรมการผู้จัดการใหญ่

สำเนาถูกต้อง
(นางสุปราณี แดงไทย)
เจ้าหน้าที่บริหารงานธุรการ 6

ชั้น 20 อาคารเอ็มไพร์ทาวเวอร์ เลขที่ 1 ถนนสาทรใต้ แขวงยานนาวา สาทร กรุงเทพฯ 10250 โทร (662) 717-2244 โทรสาร (662) 717-2240, 717-2241

บริษัท บ่อวิน เพาเวอร์ จำกัด
Bowin Power Company Limited

สำนักงานนโยบายและแผนสิ่งแวดล้อม
รับที่ 460 วันที่ 9 ส.ค. 2542
เวลา 14.50 ผู้รับ

เลขที่ Bowin 51 / OEPP- 005

6 สิงหาคม 2542

เรื่อง ขอนำส่งรายงานคำชี้แจ้งเพิ่มเติมในการขอเปลี่ยนแปลงรายละเอียดโครงการ การศึกษาผลกระทบสิ่งแวดล้อม สำหรับโรงไฟฟ้าอิสระที่ นิคมอุตสาหกรรมชลบุรี ของบริษัทบ่อวินเพาเวอร์ จำกัด

เรียน เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

อ้างถึง หนังสือที่ วว. 0804/511 ลงวันที่ 12 มกราคม 2542 ของเลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

สิ่งที่ส่งมาด้วย รายงานคำชี้แจงเพิ่มเติมจำนวน 18 ชุด

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
รับที่ 46 ลงวันที่ 10 ส.ค. 254
เวลา 14.25 น. ผู้รับ

ด้วย บริษัท บ่อวินเพาเวอร์ จำกัด ซึ่งได้รับอนุมัติให้ก่อสร้างและดำเนินโครงการโรงไฟฟ้าอิสระ (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) อำเภอศรีราชา จังหวัดชลบุรี ตามรายละเอียดที่อ้างถึง เนื่องจากโครงการฯ ได้มีการเปลี่ยนแปลงการใช้เทคโนโลยีจากเดิมของ GE มาเป็นเทคโนโลยีของABB ซึ่งโดยภาพรวมจะเป็นการเปลี่ยนแปลงที่ดีขึ้น บริษัทฯ จึงได้จัดทำรายงานชี้แจ้งเพิ่มเติมของการเปลี่ยนแปลงดังกล่าวมาพร้อมหนังสือฉบับนี้

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ

(นาย ปจงวิช พงษ์ศิวาภัย)
รองกรรมการผู้จัดการใหญ่

สำเนาถูกต้อง
(นางสุปราณี แดงไทย)
เจ้าหน้าที่บริหารงานธุรการ 6

บริษัท บ่อวิน เพาเวอร์ จำกัด
Bowin Power Company Limited

สำนักงานนโยบายและแผนสิ่งแวดล้อม
รับที่ 6255 วันที่ 1 ก.ย. 2542
เวลา 15.00 ผู้รับ

เลขที่ Bowin 51 / OEPP- 006

31 สิงหาคม 2542

เรื่อง ขอนำแก้ไขรายงานคำชี้แจ้งเพิ่มเติมในการขอเปลี่ยนแปลงรายละเอียดโครงการ การศึกษาผลกระทบสิ่งแวดล้อม สำหรับโรงไฟฟ้าอิสระที่ นิคมอุตสาหกรรมชลบุรี ของบริษัทบ่อวินเพาเวอร์ จำกัด

เรียน เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

อ้างถึง หนังสือที่เลขที่ Bowin51/OEPP-005

สิ่งที่ส่งมาด้วย เอกสารแนบคำชี้แจงเพิ่มเติมจำนวน 18 ชุด

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
รับที่ 3694 ลงวันที่ 2 กย. 42
เวลา 15.00 น. ผู้รับ

ด้วย บริษัท บ่อวินเพาเวอร์ จำกัด ซึ่งได้รับอนุมัติให้ก่อสร้างและดำเนินโครงการโรงไฟฟ้าอิสระ (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) อำเภอศรีราชา จังหวัดชลบุรี และทางโครงการฯ ได้มีการเปลี่ยนแปลงการใช้เทคโนโลยีจากเดิมของ GE มาเป็นเทคโนโลยีของABB โดยได้จัดทำเอกสารเสนอสำนักงานนโยบายและแผนสิ่งแวดล้อมตามหนังสืออ้างถึงข้างต้น และเพื่อให้ข้อมูลมีความชัดเจนสมบูรณ์ยิ่งขึ้น ทางบริษัทฯ จึงใคร่ขอชี้แจงเพิ่มเติมในหน้าที่ 1,3.8 และ17 ตามเอกสารที่แนบมาพร้อมหนังสือฉบับนี้

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ

(นาย ปจงวิช พงษ์ศิวาภัย)
รองกรรมการผู้จัดการใหญ่

สำเนาถูกต้อง
(นางสุปราณี แดงไทย)
เจ้าหน้าที่บริหารงานธุรการ 6

ชั้น 20 อาคารยูเอ็มทาวเวอร์ เลขที่ 9 ถนนรามคำแหง สวนหลวง กรุงเทพฯ 10250 โทร: (662) 717-2244 โทรสาร: (662) 717-2240, 717-2241
ชั้น 20 อาคา
20th Floor

บริษัท บ่อวิน เพาเวอร์ จำกัด
Bowin Power Company Limited

สำนักงานนโยบายและแผนสิ่งแวดล้อม
รับที่ 11875
เวลา 10.00

เลขที่ Bowin 51 / OEPP- 008

29 พฤศจิกายน 2542

เรื่อง รายงานคำชี้แจงเพิ่มเติมในการขอเปลี่ยนแปลงรายละเอียดโครงการ
การศึกษาผลกระทบสิ่งแวดล้อม สำหรับโรงไฟฟ้าอิสระที่ นิคมอุตสาหกรรมชลบุรี
ของบริษัท บ่อวินเพาเวอร์ จำกัด

เรียน เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

อ้างถึง หนังสือที่ วว. 0804/2211 ลงวันที่ 19 พฤศจิกายน 2542 ของ เลขาธิการสำนักงานนโยบายและแผนสิ่งแวดล้อม

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม
เลขที่ 77 วันที่ - 1 ธ.ค. 2542
เวลา 15.00 ผู้รับ

สิ่งที่ส่งมาด้วย รายงานคำชี้แจงเพิ่มเติมจำนวน 18 ชุด

ด้วย บริษัท บ่อวินเพาเวอร์ จำกัด ซึ่งได้รับอนุมัติให้ก่อสร้างและดำเนินโครงการโรงไฟฟ้าอิสระ (ขนาดกำลังผลิต 713 เมกกะวัตต์) ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) อำเภอศรีราชา จังหวัดชลบุรี เมื่อวันที่ 12 มกราคม 2542 เนื่องจากทางโครงการฯ ได้มีการเปลี่ยนแปลงการใช้เทคโนโลยีจากเดิมของ GE มาเป็นเทคโนโลยีของ ABB และจากหนังสือ วว. 0804/2211 ลงวันที่ 19 พฤศจิกายน 2542 ให้จัดเตรียมเพิ่มเติมข้อมูลของรายงาน

บัดนี้ทางบริษัทฯ ได้ดำเนินการจัดทำรายงานคำชี้แจงเพิ่มเติมเสร็จเรียบร้อยแล้ว จึงใคร่ขอนำส่งรายงานคำชี้แจงเพิ่มเติมจำนวน 18 ชุด มาพร้อมหนังสือฉบับนี้

จึงเรียนมาเพื่อโปรดพิจารณา

ขอแสดงความนับถือ

สำเนาถูกต้อง
(นางสุปราณี แดงไทย)
เจ้าหน้าที่บริหารงานธุรการ 6

(นาย ปองวิช พงษ์ศิวาภัย)
รองกรรมการผู้จัดการใหญ่

ชั้น 20 อาคารยูเอ็มทาวเวอร์ เลขที่ 9 ถนนรามคำแหง สวนหลวง กรุงเทพฯ 10250 โทร: (662) 717-2244 โทรสาร: (662) 717-2240, 717-2241
20th Floor, UM Tower, 9 Ramkhamhaeng Road, Suanluang, Bangkok 10250, Thailand Tel: (662) 717-2244 Fax: (662) 717-2240, 717-2241

มาตรการลดผลกระทบสิ่งแวดล้อมและมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อมโครงการโรงไฟฟ้าอิสระของบริษัท บ่อวิน เพาเวอร์ จำกัด (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ตั้งอยู่ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี ที่บริษัท บ่อวิน เพาเวอร์ จำกัด ต้องยึดถือปฏิบัติ

1. บริษัท บ่อวิน เพาเวอร์ จำกัด จักต้องปฏิบัติตามมาตรการลดผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อมที่เสนอในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมโครงการโรงไฟฟ้าอิสระของบริษัท บ่อวิน เพาเวอร์ จำกัด (ขนาดกำลังผลิตสูงสุด 713 เมกกะวัตต์) ตั้งอยู่ที่นิคมอุตสาหกรรมชลบุรี (บ่อวิน) ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี รายงานการขอเปลี่ยนแปลงรายละเอียดโครงการ และรายงานชี้แจงเพิ่มเติมประกอบรายงานฯ ทุกฉบับ ดังรายละเอียดที่สรุปไว้ในเอกสารแนบ อย่างเคร่งครัด

2. หากบริษัท บ่อวิน เพาเวอร์ จำกัด จักต้องนำมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อมที่เสนอในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม และที่สำนักงานนโยบายและแผนสิ่งแวดล้อมกำหนดเพิ่มเติมไปกำหนดเป็นเงื่อนไขในสัญญาจ้างบริษัทผู้รับเหมาก่อสร้าง และจักต้องถือปฏิบัติตามมาตรการลดผลกระทบสิ่งแวดล้อมและมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม อย่างเคร่งครัด

3. เมื่อผลการติดตามตรวจสอบคุณภาพสิ่งแวดล้อมได้แสดงให้เห็นถึงแนวโน้มปัญหาสิ่งแวดล้อม บริษัท บ่อวิน เพาเวอร์ จำกัด จักต้องดำเนินการปรับปรุงแก้ไขปัญหาเหล่านั้นโดยเร็ว ตามมาตรการลดผลกระทบสิ่งแวดล้อมและมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม ที่เสนอในรายงานฯ อย่างเคร่งครัด

4. หากเกิดเหตุการณ์ใดๆ ที่อาจก่อให้เกิดผลกระทบต่อคุณภาพสิ่งแวดล้อม บริษัท บ่อวิน เพาเวอร์ จำกัด จักต้องแจ้งให้จังหวัดชลบุรี และสำนักงานนโยบายและแผนสิ่งแวดล้อม ทราบโดยเร็ว เพื่อสำนักงานฯ จะได้ประสานให้ความร่วมมือในการแก้ไขปัญหาดังกล่าว

5. บริษัท บ่อวิน เพาเวอร์ จำกัด จักต้องจัดทำ Environmental Audit โดยบุคคลที่สาม (Third Party) และรายงานผลให้สำนักงานนโยบายและแผนสิ่งแวดล้อมทราบเป็นประจำ

6. การติดตามตรวจสอบคุณภาพสิ่งแวดล้อมและวิธีการวิเคราะห์ผล ให้ใช้ตามวิธีการของราชการหรือเทียบเท่า

7. บริษัท บ่อวิน เพาเวอร์ จำกัด จักต้องเสนอรายงานผลการปฏิบัติตามมาตรการลดผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม โดยสรุปเสนอให้จังหวัดชลบุรี และสำนักงานนโยบายและแผนสิ่งแวดล้อม ทราบทุก 6 เดือน ตลอดการดำเนินการ

8. การเปลี่ยนแปลงมาตรการลดผลกระทบสิ่งแวดล้อม มาตรการติดตามตรวจสอบคุณภาพสิ่งแวดล้อม หรือรายละเอียดโครงการ จากที่เสนอไว้ในรายงานฯ บริษัท บ่อวิน เพาเวอร์ จำกัด จักต้องเสนอรายละเอียดการเปลี่ยนแปลงดังกล่าว ให้สำนักงานนโยบายและแผนสิ่งแวดล้อมพิจารณาให้ความเห็นชอบก่อนดำเนินการเปลี่ยนแปลง

ตารางที่ 5-1

สรุปลักษณะผลกระทบสิ่งแวดล้อมและมาตรการป้องกันแก้ไขฯ โครงการโรงไฟฟ้าอิสระ ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี

หัวข้อการสิ่งแวดล้อม	ระยะก่อสร้าง	ระยะดำเนินการ	สรุปผลกระทบสิ่งแวดล้อม	สรุปมาตรการป้องกันแก้ไขและลดผลกระทบสิ่งแวดล้อม
1. คุณภาพอากาศ	✓		- ผลกระทบจากไอเสียและฝุ่นจากการก่อสร้าง แต่เนื่องจากการก่อสร้างจะดำเนินการกลางวัน และมีระยะ 26 เดือนเท่านั้น อีกทั้งกระแสลมหลักเป็นทิศที่พัดมาจากชุมชนเข้าสู่ที่ตั้งโครงการ ดังนั้นผลกระทบจึงอยู่ในระดับต่ำ	- ฉีดพ่นน้ำในพื้นที่ก่อสร้างวันละ 2 ครั้ง - ใช้ความเร็วของยานยนต์ไม่เกิน 30 กม./ชม. - ซ่อมบำรุงเครื่องมือ / เครื่องจักรทุกเดือน - ห้ามเผาขยะในที่โล่งหรือทิ้ง
		✓	- มีสารมลพิษ ได้แก่ ฝุ่น, NO_x, SO_2 และ CO แพร่ออกมาจากปล่องระบายอากาศของโครงการ โดยเมื่อใช้กับก๊าซธรรมชาติเป็นเชื้อเพลิงจะระบายฝุ่น 20 mg/m^3, NO_x as NO_2 = 100 ppmvd, และ CO = 250 ppmvd และเมื่อใช้น้ำมันกรณีฉุกเฉิน จะระบายฝุ่น = 35 mg/m^3, NO_x as NO_2 = 140 ppmvd, SO_2 = 150 ppmvd และ CO = 290 ppmvd	- ความสูงของปล่องระบายอากาศต้องไม่น้อยกว่า 40 เมตร - ควบคุม NO_x as NO_2 ที่ระบายออกมาให้ไม่เกิน 100 ppm และติดตั้งเครื่องตรวจวัดแบบต่อเนื่องบริเวณปากปล่อง
2. เสียง	✓		- สำหรับชุมชนบ้านห้วยเหียนซึ่งอยู่ใกล้ที่สุด (2 กม.) จะได้รับเสียงดังจากโครงการเท่ากับ 62.5 dB(A) เท่านั้น เมื่อรวมกับเสียงเดิมที่มีอยู่จะมีค่า 64.4 dB(A) ซึ่งต่ำกว่าค่ามาตรฐาน (70 dB(A))	- ซ่อมบำรุงเครื่องมือสม่ำเสมอ ควบคุมความเร็วของยานยนต์ให้ไม่เกิน 30 กม./ชม. ก่อสร้างในเวลากลางวันสำหรับการทำงานที่ต้องใช้เครื่องมือหนัก - แจ้งกิจกรรมการทำงานกลางคืนให้ราษฎรทราบ - ซ่อมบำรุงเครื่องมือสม่ำเสมอ - ติดตั้งเครื่องหมาย / ป้ายเตือนในบริเวณที่มีเสียงดังเกิน 85 dB(A) และกำหนดให้ใช้อุปกรณ์ป้องกันหู
		✓	- เสียงจากโรงไฟฟ้าที่บ้านห้วยเหียน และบ้านบ่อวินได้รับ มีค่า 24.52 และ 22.58 dB(A) เท่านั้น	
3. อุทกวิทยา	✓		- ในพื้นที่โครงการ 70 ไร่ มีส่วนที่จะต้องพัฒนาเล็กน้อยเท่านั้น จึงไม่ก่อให้เกิดการท่วมขังของน้ำภายนอกโครงการ และทำให้การระบายน้ำในห้วยเปลี่ยนแปลง	- เศษวัสดุเหลือใช้จากกิจกรรมการก่อสร้างต้องกำจัดทำลายให้หมดไปเมื่อการก่อสร้างดำเนินจนเสร็จสมบูรณ์แล้ว - จัดสร้างบ่อดักตะกอนในพื้นที่โครงการ
		✓	- เนื่องจากปริมาณน้ำเสียเกิดขึ้น 88.50 ลบ.ม./ชม. ที่จะระบายลงห้วยตะนาว โดยห้วยตะนาวมีความสามารถรับน้ำได้ 26,614 ลบ.ม./ชม. นั้นคิดเป็นเพียงร้อยละ 0.33 ของความสามารถในการรับน้ำได้ของห้วย จึงไม่ก่อให้เกิดผลกระทบด้านอุทกวิทยา	
4. คุณภาพน้ำผิวดิน	✓		- โครงการวางแผนใช้ Septic tank บำบัดน้ำเสียจากชุมชนคนงาน ส่วนน้ำไหลบ่าหน้าดินจะเก็บขังในบ่อพักซึ่งมีระยะเวลาเก็บ 3 ชม. ก่อนระบายลงสู่ห้วยตะนาว ดังนั้นผลกระทบต่อคุณภาพน้ำจึงอยู่ในระดับต่ำ	- ที่พักคนงานต้องสร้างห่างจากลำน้ำ 150 เมตร เป็นอย่างต่ำ - มีห้องส้วมในอัตรา 15 คน ต่อ ส้วม 1 ห้อง - สร้างบ่อพักน้ำในพื้นที่โครงการ

ตารางที่ 5-1 (ต่อ)

ทรัพยากรสิ่งแวดล้อม	ระยะก่อสร้าง	ระยะดำเนินการ	สรุปผลกระทบสิ่งแวดล้อม	สรุปมาตรการป้องกันผลไม่พึงประสงค์ผลกระทบสิ่งแวดล้อม
		✓	- น้ำเสียจากโครงการทั้งหมด 2,124 ลบ.ม./วัน จะส่งเข้าระบบบำบัดน้ำเสียของนิคมซึ่งมีความสามารถรับน้ำได้อีก 5,000 ลบ.ม./วัน น้ำที่ระบายลงห้วยตะได้มาตรฐานของ MOI และน้ำนี้ไม่มีสารปนเปื้อนเป็นสารพิษ อีกทั้งน้ำเสียชุมชนจะบำบัดโดย Septic tank ดังนั้นผลกระทบจึงอยู่ในระดับต่ำ	- ดำเนินการตามมาตรการฯ ด้านคุณภาพน้ำผิวดิน - น้ำทิ้งต้องมี pH ประมาณ 7 - ตรวจสอบคุณภาพน้ำทิ้ง ณ จุดปล่อยทุกเดือน - ซ่อมบำรุงระบบบำบัดน้ำเสียอย่างสม่ำเสมอ
5. น้ำใต้ดิน	✓		- โครงการไม่ได้นำน้ำใต้ดินมาใช้ประโยชน์ จึงไม่มีผลกระทบ	- มีสัดส่วนสมดุลกับจำนวนคนงาน (15 คน/หลัง) ซึ่งต้องตั้งอยู่ห่างจากบ่อน้ำอย่างน้อย 150 เมตร - ห้ามนำน้ำใต้ดินมาใช้โดยเด็ดขาด
		✓	- โครงการมิได้นำน้ำใต้ดินมาใช้ประโยชน์ ส่วนขยะจะฝังกลบโดยหลักสุขาภิบาลและน้ำเสียจากคนงานจะบำบัดโดยใช้ Septic Tank ดังนั้นคาดว่าจะไม่ก่อให้เกิดผลกระทบต่อน้ำใต้ดิน	- ตรวจสอบ Septic tank ให้มีประสิทธิภาพสูงสุดอยู่เสมอ ๆ - ห้ามทิ้งน้ำเสียลงบนผิวดิน - กำจัดขยะโดยวิธีที่ถูกต้อง
6. ทรัพยากรชีวภาพ	✓		- เนื่องจากโครงการอยู่ห่างจากห้วยประมาณ 100 เมตร น้ำไหลบ่าหน้าดินที่จะไหลไปลงห้วยจะถูกพฤกษาที่ขึ้นอยู่ในพื้นที่โครงการกรองเอาตะกอนออก ดังนั้นผลกระทบต่อแพลงก์ตอน สัตว์หน้าดิน และปลาจึงอยู่ในระดับต่ำ	- ดำเนินการตามมาตรการฯ ด้านคุณภาพน้ำผิวดิน
		✓	- น้ำที่นำมาใช้ในโครงการ คือ ออกจากส่วนกลางของอ่างเก็บน้ำหนองค้อ ดังนั้นจึงมีแพลงก์ตอนติดมาน้อยมาก ส่วนน้ำทิ้งจากโครงการจะได้รับการบำบัดจนเป็นไปตามมาตรฐานของ MOI และมีอุณหภูมิสูงกว่าปกติไม่เกิน 3 °C อีกทั้งในห้วยตะนาวไม่ได้มีความอุดมสมบูรณ์ของสิ่งมีชีวิต ดังนั้นผลกระทบจึงอยู่ในระดับต่ำ	- ดำเนินการตามมาตรการฯ ด้านคุณภาพน้ำผิวดิน - น้ำทิ้งต้องมี pH ประมาณ 7 - ตรวจสอบคุณภาพน้ำทิ้ง ณ จุดปล่อยทุกเดือน - ซ่อมบำรุงระบบบำบัดน้ำเสียอย่างสม่ำเสมอ
7. การใช้น้ำ	✓		- น้ำใช้ในช่วงก่อสร้างมีเพียง 200 ลบ.ม. ซึ่งนำมาจากอ่างเก็บน้ำหนองค้อ ซึ่งมีความจุถึง 18.8 ล้าน ลบ.ม. ดังนั้นจึงไม่มีผลกระทบ	-
		✓	- แหล่งน้ำใช้ของโครงการ คือ อ่างเก็บน้ำหนองค้อ ซึ่งมีปริมาณน้ำท้า 21.76 ล้าน ลบ.ม./ปี และในอนาคตจะมีการวางท่อนำน้ำจากอ่างเก็บน้ำหนองปลาไหลมาใส่อ่างเก็บน้ำหนองค้อในอัตรา 63 ล้าน ลบ.ม./ปี ขณะที่โครงการต้องการน้ำเพียง 7.59 ล้าน ลบ.ม./ปี เท่านั้น ดังนั้นจึงไม่มีผลกระทบ	-

ตารางที่ 5-1 (ต่อ)

ทรัพยากรสิ่งแวดล้อม	ระยะก่อสร้าง	ระยะดำเนินการ	สรุปผลกระทบสิ่งแวดล้อม	สรุปมาตรการป้องกันแก้ไขและลดผลกระทบสิ่งแวดล้อม
8. การใช้ที่ดิน	✓		- พื้นที่โครงการถูกเปลี่ยนสภาพจากที่รกร้างมาเป็นพื้นที่อุตสาหกรรม และพื้นที่ในแนวการวางท่อแก๊ส และสายส่งไฟฟ้า ได้รับการรบกวนรูปแบบการใช้ที่ดิน ซึ่งเป็นพื้นที่เกษตรสำหรับชุมชนคนงานจะอยู่ในพื้นที่โครงการจึงไม่ก่อให้เกิดผลกระทบ	- ในกรณีที่มีความจำเป็นต้องสร้างชุมชนที่พักคนงานภายนอกโครงการแล้วนั้นจะต้องเป็นความรับผิดชอบของผู้รับเหมา ซึ่งต้องไม่ใช้ที่สาธารณะหรือที่ของราษฎร และต้องออกกฎระเบียบควบคุมไว้อย่างเคร่งครัด
		✓	- ไม่มีผลกระทบโดยตรง แต่โครงการอาจชักนำให้เกิดการลงทุนในด้านอุตสาหกรรมในบริเวณนี้เพิ่มขึ้น	
9. การคมนาคม	✓		- กิจกรรมการขนส่งและการคมนาคมในช่วงนี้มีประมาณ 100 เที่ยวต่อวัน ซึ่งมีผลทำให้ปริมาณการจราจรเพิ่มขึ้น 0.66 และ 0.72% บนทางหลวงหมายเลข 36 และ 331 ตามลำดับ	- ออกกฎระเบียบควบคุมรถบรรทุก โดยเฉพาะในด้านความเร็ว - ใช้ผ้าใบปิดคลุมท้ายรถบรรทุก - หลีกเลี่ยงการขนส่งในช่วงฝนตกหนักหรือสภาพอากาศเลวร้าย - ชี้แจงให้ชุมชนทราบเกี่ยวกับแผนการก่อสร้าง - พนักงานขับรถต้องปฏิบัติตามกฎระเบียบของกรมทางหลวง - ติดตั้งป้ายสัญญาณจราจรในตำแหน่งที่เหมาะสมในโครงการ - ให้ความสำคัญกับการขับรถอย่างปลอดภัย - จัดรถบริการรับส่งพนักงาน
		✓	- ปริมาณจราจรจากโครงการมีผลทำให้ปริมาณจราจรบนทางหลวงหมายเลข 36 และ 331 เพิ่มขึ้น 0.66 และ 0.727 ตามลำดับ	
10. เศรษฐกิจ-สังคม	✓		- เกิดการจ้างงานในชนบท ชักนำให้เกิดสิ่งอำนวยความสะดวกในด้านสาธารณูปโภคและสาธารณูปการเพิ่มขึ้น แต่ก็เกิดความแออัดและความไม่ปลอดภัยในชีวิตและทรัพย์สินด้วย	- ผู้รับเหมาต้องควบคุมดูแลสภาพสังคมและปัญหาของชุมชนคนงานก่อสร้างอย่างใกล้ชิด - จ้างแรงงานท้องถิ่น - ให้ข้อมูลข่าวสารรายละเอียดของโครงการแก่ชุมชน - จัดให้มีการประชาสัมพันธ์โครงการ - ให้ความรู้แก่ชุมชนเกี่ยวกับการดำเนินการของโรงไฟฟ้า
		✓	- โครงการมีผลดีต่อการยกระดับคุณภาพชีวิตในชุมชน และชักนำสาธารณูปโภคมาสู่ชุมชน รวมทั้งชักนำให้เกิดการลงทุน อย่างไรก็ตามก็ก่อให้เกิดความเสื่อมโทรมในสังคม และค่าครองชีพสูงขึ้น	

ตารางที่ 5-1 (ต่อ)

ทรัพยากรสิ่งแวดล้อม	ระยะก่อสร้าง	ระยะดำเนินการ	สรุปผลกระทบสิ่งแวดล้อม	สรุปมาตรการป้องกันแก้ไขและผลกระทบสิ่งแวดล้อม
11. สาธารณสุข	✓		- โครงการอาจนำมาซึ่งปัญหาสาธารณสุข ได้แก่ การแพร่ระบาดของโรคทางเดินอาหาร และเอดส์ การบาดเจ็บ และอุบัติเหตุจากการทำงานรวมทั้งอุบัติเหตุจากการจราจร	- ติดตามตรวจสอบการแพร่กระจายของโรคทางเดินอาหารอย่างต่อเนื่อง - ชุมชนคนงานต้องก่อสร้างให้เป็นไปตามกฎข้อบังคับของกระทรวงแรงงานและสวัสดิการสังคม - แนะนำวิธีการป้องกันโรคแก่คนงาน - จัดตั้งหน่วยปฐมพยาบาลในโครงการ - ประสานงานกับหน่วยบริการสาธารณสุขในท้องถิ่น - ส่งเสริมมาตรการด้านความปลอดภัย - ควบคุมและออกกฎระเบียบการขับขี่ยานยนต์ - ห้ามการเสพสุรา
		✓	- เสียงดังจากโรงไฟฟ้าสร้างความรำคาญแก่ชุมชน ส่วนสารมลพิษทางอากาศที่ระบายออกจะเป็นไปตามมาตรฐานของ MOI จึงไม่ก่อให้เกิดผลกระทบ อย่างไรก็ตาม สำหรับคนงานอาจได้รับอันตรายจากการทำงานได้บ้าง	- ตรวจสอบระดับของสารมลพิษที่ระบายออกมา - ให้การสนับสนุนสถานบริการสาธารณสุขในท้องถิ่น - ตรวจสุขภาพคนงานปีละ 1 ครั้ง - จัดตั้งฝ่ายความปลอดภัย - ตรวจสอบความดังของเสียงโดยรอบโครงการ
12. อาชีวอนามัยและความปลอดภัย	✓		- การก่อสร้างโครงการอาจก่อให้เกิดอุบัติเหตุ และมีผลต่อความปลอดภัยของคนงานก่อสร้าง อย่างไรก็ตาม โรงไฟฟ้าบ่อวินจะร่วมมือกับผู้รับเหมาปฏิบัติตามโปรแกรม "Zero-Accident-Performance" จึงคาดว่าผลกระทบจะอยู่ในระดับต่ำ	- โรงไฟฟ้าบ่อวินจะนำมาตรการด้านอาชีวอนามัยและความปลอดภัยให้ผู้รับเหมานำมาปฏิบัติใช้ โดยกำหนดเป้าหมายไว้ที่ "Zero-Accident-Performance"
		✓	- ผลกระทบต่ออาชีวอนามัยจาก •สารเคมี •มลพิษทางอากาศในพื้นที่ปฏิบัติงาน •เสียงรบกวน •ความร้อน •อุบัติเหตุหรือเหตุฉุกเฉิน	- ปฏิบัติตาม Health and Safety during the Operation Period ที่ได้กำหนดไว้แล้ว

ตารางที่ 6-1

สรุปมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม

มาตรการป้องกันผลกระทบสิ่งแวดล้อม	ระยะ		พารามิเตอร์	สถานที่ตรวจวัด	ความถี่	วิธีตรวจวัด	งบประมาณ (ตามความเหมาะสม)	หน่วยงานที่รับผิดชอบ
	ก่อสร้าง	ดำเนินการ						
1. คุณภาพอากาศ	✓		- ตรวจวัด TSP, NO_2 และ NO_x, SO_2, PM-10 และ Wind Speed/Direction	- ภายในพื้นที่โครงการ - วัดชุมชนตามความเหมาะสม - วัดบ่อวิน - วัดหินแดงฝั่งนอก - บ้านมาบชน - ชุมชนทั่วเพียน	- ทุก 6 เดือน ในช่วงก่อสร้าง โดยเก็บตัวอย่างต่อเนื่อง 3 วัน	TSP - ใช้วิธีการชั่งน้ำหนัก SO_2 - ใช้วิธี Pararosaniline NO_2 - ใช้วิธี TGS - ANSA PM-10 - ใช้วิธีการชั่งน้ำหนัก	120,000	โรงไฟฟ้าบ่อวิน
		✓	- ตรวจวัด Stack emission แบบต่อเนื่อง • NO_x as NO_2 • CO • TSP • O_2 • CO_2 • SO_2	- ปล่องโรงไฟฟ้า	- ติดตั้งเครื่องตรวจวัดต่อเนื่อง (Continuous Emission Monitoring System, CEMS)	NO_2 - ใช้วิธี TGS - ANSA CO - ใช้วิธี Non-dispersive infrared detection SO_2 - ใช้วิธี Pararosaniline TSP - ใช้วิธีการชั่งน้ำหนัก	5,000,000 บาท สำหรับการติดตั้ง 200,000 บาท สำหรับการดำเนินการ	โรงไฟฟ้าบ่อวิน
		✓	- ตรวจวัด TSP, NO_2 as NO_2, SO_2, PM-10, ทิศทางและความเร็วลม	- จุดตรวจนับการ - ภายในพื้นที่โครงการ - วัดชุมชนตามความเหมาะสม - วัดบ่อวิน - วัดหินแดงฝั่งนอก - บ้านมาบชน - ชุมชนทั่วเพียน	- ปีละ 2 ครั้ง โดยในเบื้องต้นตรวจวัดครั้งละ 7 วันต่อเนื่อง ปีถัดไปครั้งละ 3 วันต่อเนื่อง - ทำการตรวจวัด SO_2 ทุกครั้งที่มีการใช้น้ำมันเตาผสมปิโตรเลียมโดยตรวจวัด 3 วันต่อเนื่อง	TSP - ใช้วิธีการชั่งน้ำหนัก SO_2 - ใช้วิธี Pararosaniline NO_2 - ใช้วิธี TGS - ANSA PM-10 - ใช้วิธีการชั่งน้ำหนัก	120,000	โรงไฟฟ้าบ่อวิน
2. เสียง	✓		- L_{eq} (24) - L_{dn}	- ภายในโครงการ - ชำนบ่อวิน - ชำนชั่วเพียน - ชำนหินแดงฝั่งนอก	- ทุก 3 เดือน ในช่วงก่อสร้าง	ใช้วิธีของ ISO 1996	20,000	โรงไฟฟ้าบ่อวิน
		✓	- L_{eq} (24 hr.) - L_{dn}	- จุดจำนวนการ - บ้านบ่อวิน - ชำนชั่วเพียน - บ้านหินแดงฝั่งนอก	- ทุก ๆ 6 เดือน ในช่วงเดียวกันกับการตรวจวัดคุณภาพอากาศ	ใช้วิธีของ ISO 1996	25,000	โรงไฟฟ้าบ่อวิน
			- L_{eq} (8 hr.)	- พื้นที่ทำงานที่มีเสียงดัง	- ปีละ 4 ครั้ง	ใช้วิธีของ ISO 1996	15,000	โรงไฟฟ้าบ่อวิน
3. คุณภาพน้ำทิ้งจาก	✓		- อัตราการไหล, อุณหภูมิ, TDS, SS, pH, DO, Cl^-, SO_4^{2-}, ความเป็นกรดด่าง, น้ำมันและไขมัน	- จุดปล่อยน้ำทิ้งลงทั่วมหาสมุทร - เหนือน้ำและท้ายน้ำทั่วมหาสมุทรห่างจากจุดปล่อยน้ำทิ้ง 1 กม.	- ทุก ๆ 6 เดือน	วิธีวิเคราะห์มาตรฐานซึ่งกำหนดโดย APHA - AWWA และ WPCF	30,000	โรงไฟฟ้าบ่อวิน
		✓	- อัตราการไหล, อุณหภูมิ, TDS, SS, pH, DO, Cl^-, SO_4^{2-}, ความเป็นกรดด่าง, น้ำมันและไขมัน	- จุดปล่อยน้ำทิ้งลงทั่วมหาสมุทรห่างจากจุดปล่อยน้ำทิ้ง 1 กม.	- ทุก ๆ 6 เดือน ในช่วงที่เกิดสภาพน้ำขาดและมีน้ำหลาก-น้ำมาก	วิธีวิเคราะห์มาตรฐานซึ่งกำหนดโดย APHA - AWWA และ WPCF	30,000	โรงไฟฟ้าบ่อวิน
		✓	- วัดคุณภาพของน้ำในบ่อหลักน้ำทิ้งของโครงการ ได้แก่ อัตราการไหล, อุณหภูมิ, pH, SS, TDS, Cl^-, SO_4^{2-}, น้ำมันและไขมัน	- จุดปล่อยน้ำออกจากบ่อปรับคุณภาพน้ำ - จุดปล่อยน้ำจากบ่อตรวจคุณภาพน้ำ - จุดปล่อยน้ำออกจากหน่วยระบบบำบัดน้ำเสีย	- เดือนละ 1 ครั้ง	วิธีวิเคราะห์มาตรฐานซึ่งกำหนดโดย APHA - AWWA และ WPCF	30,000	โรงไฟฟ้าบ่อวิน

ตารางที่ 6-1 (ต่อ)

หัวข้อ และรายละเอียด	ระยะ		มาตรการ	ตำแหน่งที่ตรวจสอบ	ความถี่	วิธีตรวจวัด	ค่าใช้จ่ายรวม (บาท/ครั้ง)	หน่วยงานที่รับผิดชอบ
	ก่อสร้าง	ดำเนินการ						
4. พลังงานความร้อน	✓	✓	- แทงค์เก็บ - สัตว์หน้าดิน	- ห้วยแม่ปราบริเวณจุดปล่อยน้ำทิ้ง - คลองน้ำและห้วยน้ำ ห้วยแม่ปราบ ที่ระยะห่าง 1 กม. จากจุดปล่อยน้ำทิ้ง	- ทุก ๆ 6 เดือน ในช่วงกันยายน - ธันวาคม และ มีนาคม - เมษายน	แทงค์เก็บ เก็บโดยใช้ถุงเก็บแทงค์เก็บความลึกที่ ช่วงเวลา 70 โมงเช้า โดยจากตลิ่งน้ำ สัตว์หน้าดิน ใช้ Ekman dredge เก็บตะกอนท้องน้ำ แล้วนำมาคัดแยกตัวอย่าง โดยใช้กระแสกรองร่อนตัวอย่าง แทงค์เก็บและสัตว์หน้าดิน ตะกอนสารละลายไดโอไรฟอร์-มาลีน 4-7%	15,000	โรงไฟฟ้าน่าน
5. การใช้น้ำ	✓	✓	- ความต้องการของน้ำใช้ในแต่ละขั้นตอนการก่อสร้าง - จุดและปัญหาการใช้น้ำ - ความต้องการของน้ำใช้ - จุดและปัญหาการใช้น้ำ	- ตามจุดบริการของงานก่อสร้าง - โรงไฟฟ้า - ข้อมูลความต้องการน้ำ ตระหนักและจุดบริการน้ำของผู้รับเหมาต่อ ตรวจสอบการบริการประชาชน และโครงการพัฒนาพื้นที่ชายฝั่งทะเลตะวันออก	- ทุก ๆ 3 เดือน - ทุก ๆ 6 เดือน	-	-	Contractor โรงไฟฟ้าน่าน
6. การคมนาคม	✓		- ปริมาณจราจรจากกิจกรรมการก่อสร้าง - สถิติอุบัติเหตุจากกิจกรรมการก่อสร้างโรงไฟฟ้า	- ทางหลวงที่เป็นเส้นทางคมนาคมโรงไฟฟ้า - รวบรวมข้อมูลจากผู้รับเหมาและสถานีตำรวจ	- ทุก ๆ 4 เดือน	-	-	Contractor
7. สาธารณสุข อาชีวอนามัยและความปลอดภัย	✓		- สถิติอุบัติเหตุ การเจ็บและการป่วย - ประเมินปัญหาด้านสาธารณสุขหลัก	- หน่วยพยาบาลในพื้นที่โครงการ - สถานีอนามัยในชุมชน - โรงพยาบาลชุมแสง และศรีวิชา	- ทุก ๆ 2 เดือน	-	-	Contractor
		✓	- สถิติอุบัติเหตุและสถิติผู้ป่วย - ประเมินปัญหาด้านสาธารณสุขหลัก	- สถานีอนามัยในชุมชน - โรงพยาบาลชุมแสง และศรีวิชา	- ทุก ๆ ปี	-	-	โรงไฟฟ้าน่าน
			- ตรวจสุขภาพคนงาน • x-ray ปอด • ความดันโลหิต • การได้ยิน • ตรวจสุขภาพประจำปี	- โรงพยาบาลชุมแสง และศรีวิชา	- ปีละ 1 ครั้ง	-	1,000 บาท/คน	โรงไฟฟ้าน่าน
			- ตรวจระดับเสียงดังในพื้นที่ทำงาน (Control room) และพื้นที่เสียงดัง (Air compressor, Generator, Pumps เป็นต้น)	- ในโรงไฟฟ้า	- ปีละ 4 ครั้ง	-	5,000	โรงไฟฟ้าน่าน
			- จัดให้มีการฝึกอบรมการปฐมพยาบาล	- ในโรงไฟฟ้า	- ปีละ 1 ครั้ง	-	5,000	โรงไฟฟ้าน่าน
			- จัดร้อมแผนอุทกภัย	- ในโรงไฟฟ้า	- ปีละ 1 ครั้ง	-	10,000	โรงไฟฟ้าน่าน

FINAL REPORT (REVISION)
EIA FOR IPP PROJECT AT CIE

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CHAPTER 1 : INTRODUCTION

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

The electrical power consumption in Thailand has been drastically increased since 1970 with annual growth rate above 15%. It was estimated that the power demand will be 21,500 MW in 2006. In order to cope with the above needs, the Electricity Generating Authority of Thailand (EGAT) has invited independent power producers to submit proposals for the supply and sale of electricity to EGAT in the specified years.

Concerning the bidding, Bowin Power Company, Limited is the elect independent power producers.

Therefore, Bowin Power Company Limited has engaged TEAM Consulting Engineers Co., Ltd., to undertaken the Environmental Impact Assessment for the IPP project with 713 MW of maximum capacity at Chonburi Industrial Estate, Sri Racha District of Chonburi Province.

1.2 PURPOSE AND SCOPE OF STUDY

The purpose of the study is to prepare and submit an environmental impact assessment report to OEPP for approval prior to the construction of the power plant.

The specific objectives of the study are as follows:

(1) To investigate the study area within 5 km around the project vicinity which would be directly and indirectly affected by the implementation of the proposed project.

(2) To characterize and describe the physical, biological, human use and quality of life aspects that would affect and/or alternate project design, project cost and benefits.

(3) To identify the principal changes of the environment that may be reasonably expected as a result of the project implementation.

(4) To evaluate and predict the short and long-term impacts of the proposed project upon the environmental resource and values.

(5) To make general recommendations on short and long-term measures including alternatives to prevent or mitigate the adverse effects and/or maximize the positive results of the proposed project.

(6) Based on the investigation results, recommend the general environmental monitoring programs for the proposed project during project construction and operation.

1.3 METHODOLOGY

In conducting this environmental study the sequence of work for each parameter will generally be as follows:

(1) Data collection and review of all baseline information, e.g., those available literature, reports, maps, records of monitoring results conducted in the project area.

(2) Conducting detailed field data collection including field reconnaissances and field sampling, surveys.

(3) Analysis of collected data and description of past or existing environmental conditions of each parameter and projection of possible future conditions without the Project.

(4) Review of the Project features and all facilities, e.g., pollution control systems and measures, staged plans and alternatives, operation plans etc.

(5) A modelling of parameters concerned particularly those of air quality, corresponding to the operation plans of the Project.

(6) Based on results in (3), (4) and (5) above, the impacts will be evaluated under construction operation conditions for each environmental parameter.

(7) Recommendation for mitigation plan to minimize adverse impacts and concurrently, increased beneficial effects due to Project establishment.

(8) Recommendation of program for monitoring of environmental impacts or benefits including basic cost estimation of monitoring program.

1.4 REPORT CONTENT

The followings are the report components.

Chapter I	Introduction
Chapter II	Project Description
Chapter III	Existing Environmental Conditions
Chapter IV	Environmental Impact Assessment
Chapter V	Mitigation Measures
Chapter VI	Monitoring Programs
Appendixes	

CHAPTER 2 : PROJECT DESCRIPTION

CHAPTER 2
PROJECT DESCRIPTION

2.1 INTRODUCTION

This description cover the technical requirements for the natural gas-fired and diesel oil fired combined cycle power plant development.

2.2 PROJECT LOCATION

This power plant will be situated within Chonburi Industrial Estate (CIE) boundary in Tambon Bo Win, Sri Racha District, Chonburi Province (Figures 2.2-1 to 2.2-2). The project area is approximately 70 rai and the nominal capacity for this power plant is about 713 MW. The 713 MW facility will be situated on the right hand side of the Huai Manao. There are two ways to approach the site, namely:

(1) Via Highway 331, into the CIE main entrance, along BWG 1 road (4 lanes total width 20 meters, rights of way 35 meters), onto new road to site (to be constructed, 2 lanes 11 meters, right of way 30 meters) over Huai Manao and access on to site.

(2) Via Hubbon - Bo Win Road (two lanes, total width 8 meters) onto public road (2 lanes 6 meters width) and access onto site.

2.3 PROJECT SCHEDULE AND WORKFORCE

The construction will be completed within 26 months as shown in Figure 2.3-1. The construction worker is required about 800 persons at highest peak period. And the full time staff for operation period is required approximately 50 person. The organization of the personnel during the operation period is shown in Figure 2.3-2.

2.4 POWER PLANT COMPONENT

The power plant has maximum capacity of 713 MW. The ABB technology is selected for power plant which is composed of 2 single shaft units. The general components of the power plant are shown hereafter;

- two single shaft power trains consisting each of one combustion turbine generator (CTG) and steam turbine.
- two heat recovery steam generators (HRSGs)

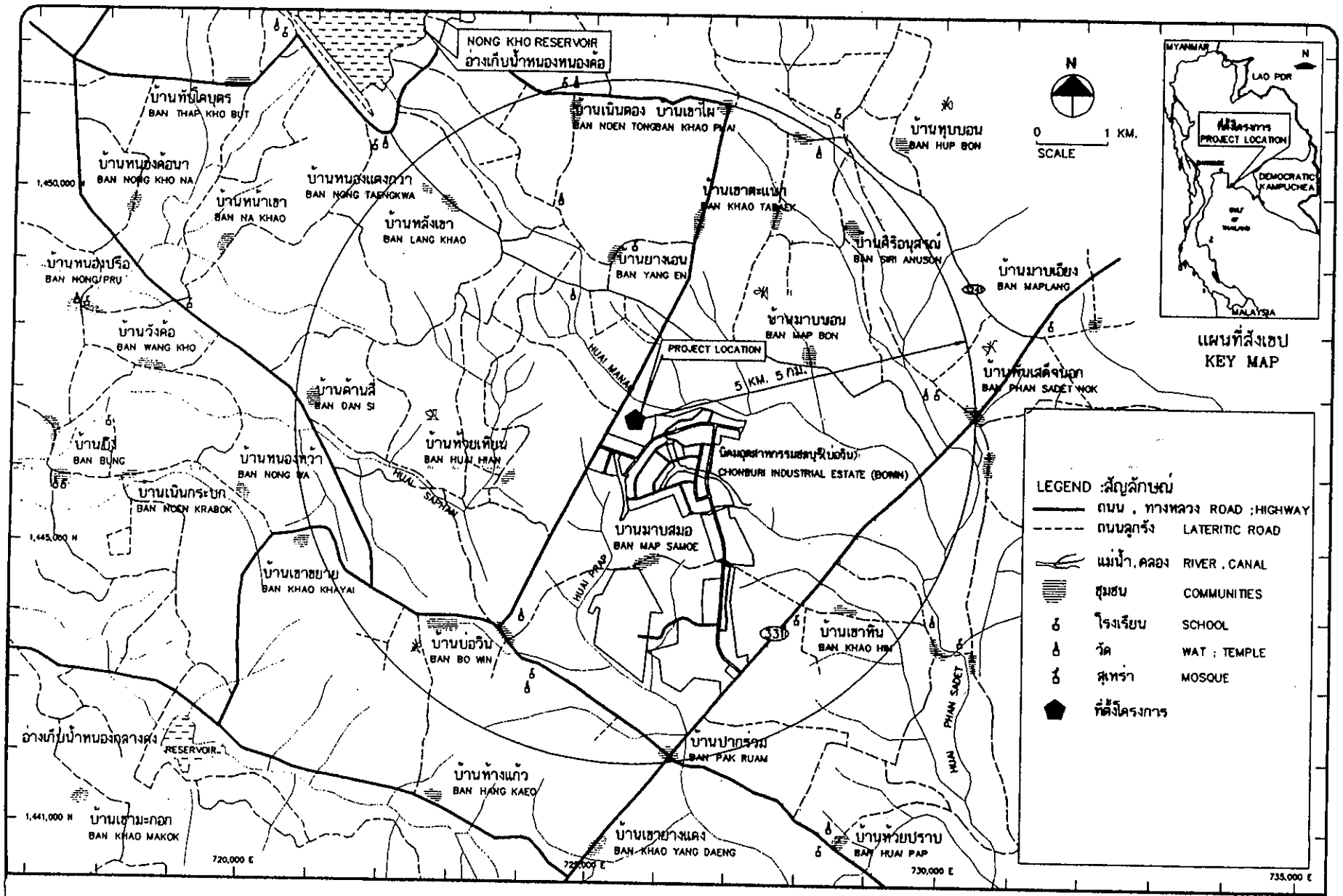


FIGURE 2.2-1 : PROJECT LOCATION

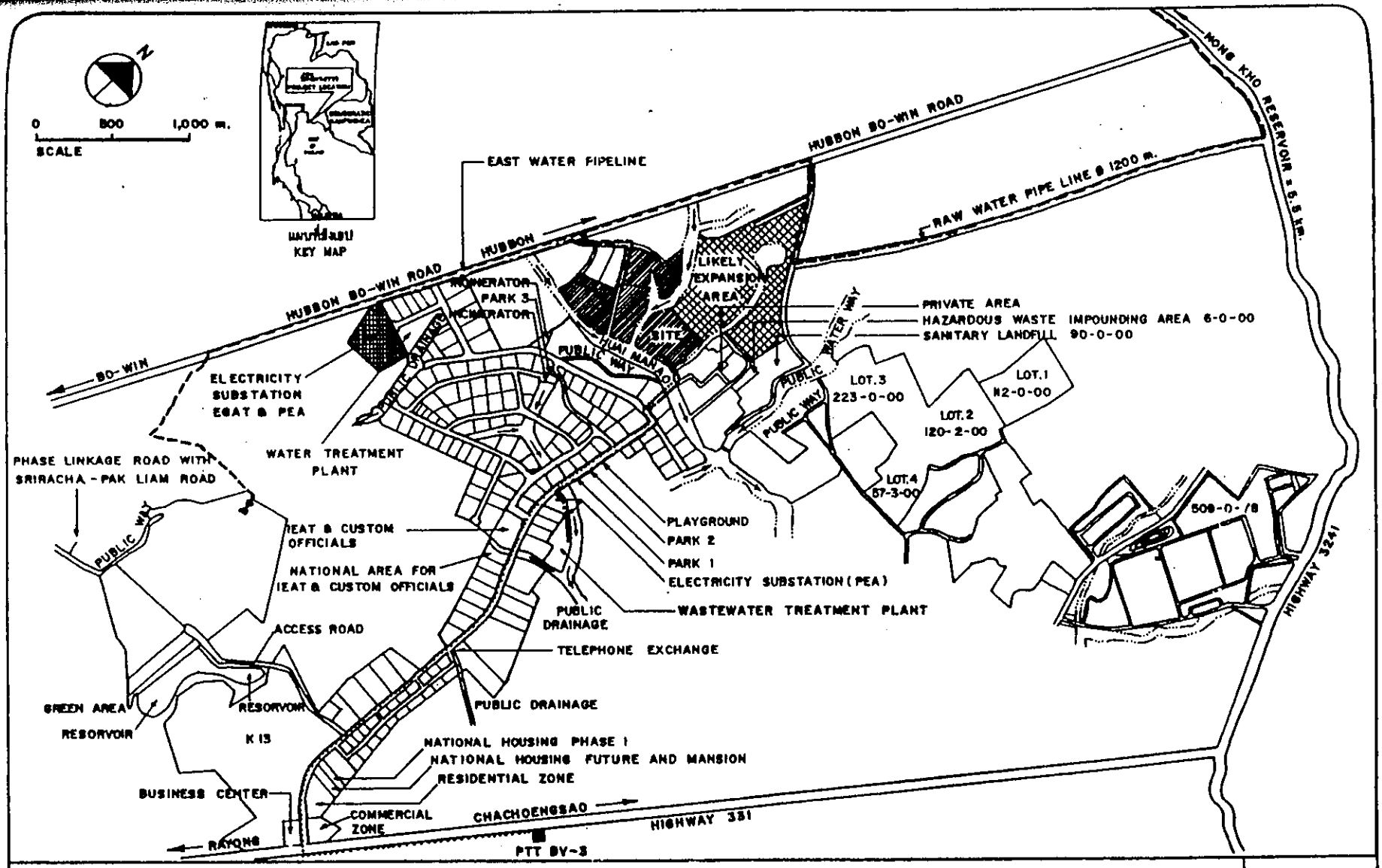


FIGURE 2.2-2 : PROJECT LOCATION WITHIN CHONBURI INDUSTRIAL ESTATE

TEAM

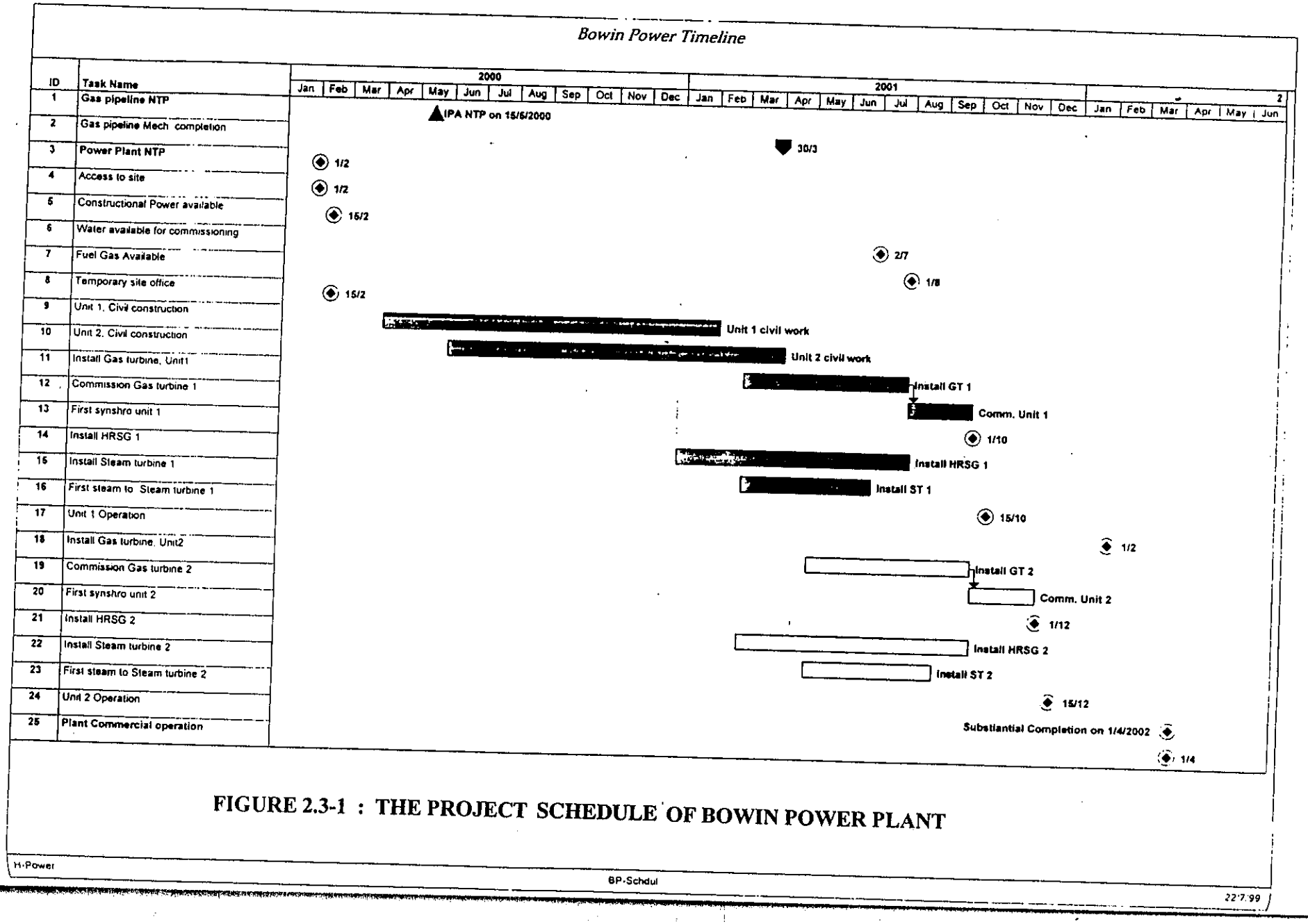


FIGURE 2.3-1 : THE PROJECT SCHEDULE OF BOWIN POWER PLANT

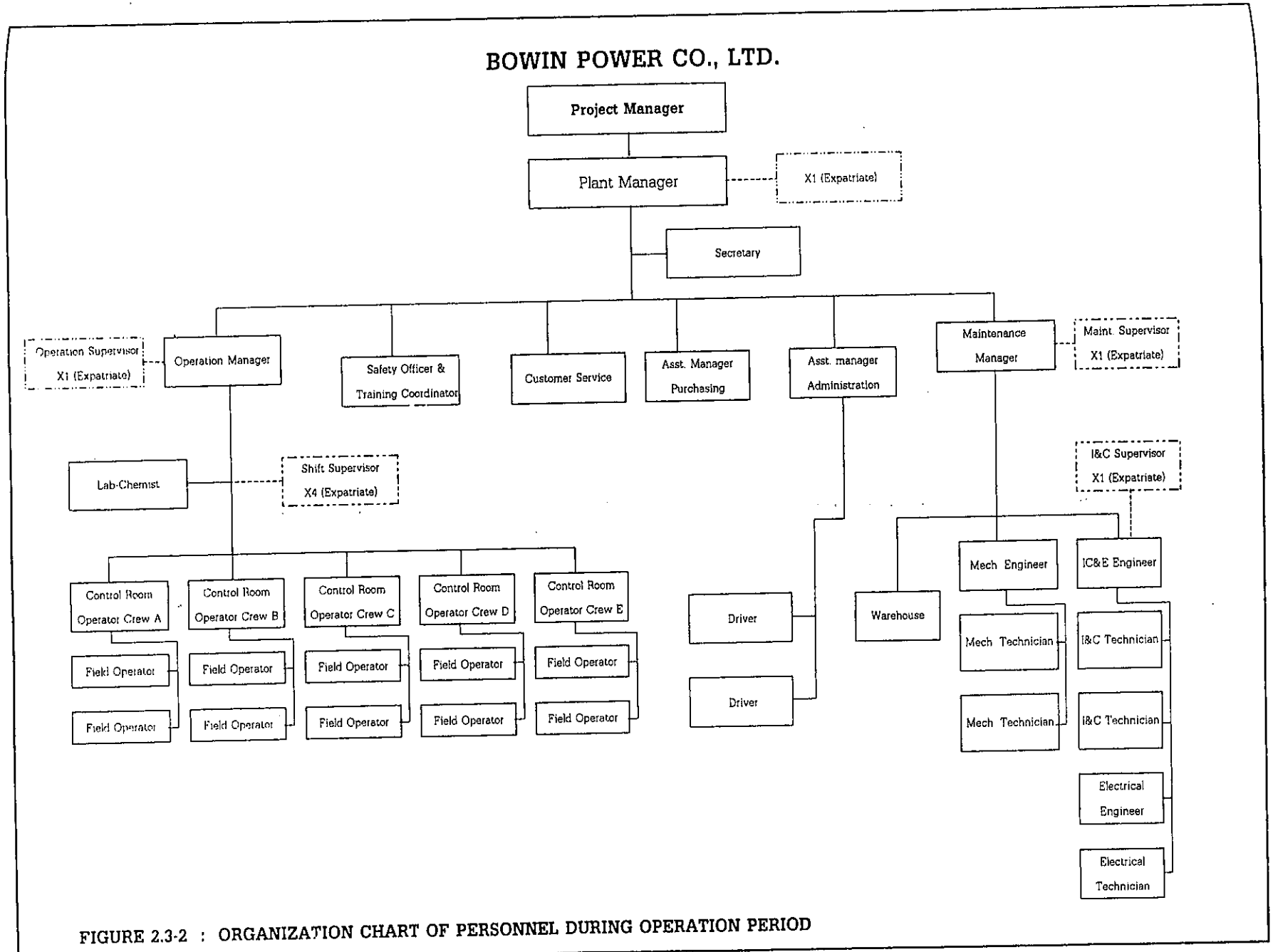


FIGURE 2.3-2 : ORGANIZATION CHART OF PERSONNEL DURING OPERATION PERIOD

The CTGs will be of the heavy-duty industrial type, each directly driving the generator common to the ST. The ST will be connected to the generator by a self-shifting synchronizing coupling. The HRSG will be of three pressure reheat type, without supplementary firing. Plant layout is shown in Figure 2.4-1.

2.5 FUEL CHARACTERIZATION

(1) Base Fuel

The base fuel for the gas turbine will be natural gas which will be support by PTT with the maximum quantity requirement about 102,541 MMBTU per day (BTU : British Thermal Units). The general characteristic of this fuel is commercially free from material and dust or other solid matter, liquid matter, waxes, gums and gum forming constituents which might cause injury to or interference with proper and safe operations of the line meters, regulations or other appliances through which Sales Gas flows or which might be injurious to the IPP Facility. The general characteristic of natural gas are tabulated in Table 2.5-1.

The Sales Gas shall be odorized. The suitable standard test methods and measuring instruments of standard manufacture acceptable to both parties, together with procedures for checking and/or verification of the instruments, shall be agreed between the Parties or be determined by an Expert.

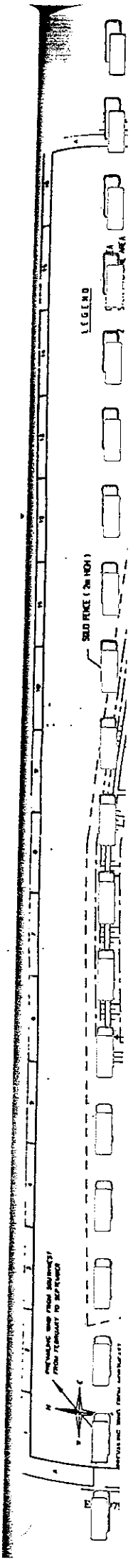
Natural gas from PTT will be transferred via underground pipeline at least 1.5 m. Natural gas pipeline development will be employed followed the international standard (EIA of natural gas pipeline is separated from this study). Detail of Sales Gas Agreement between PTT and Bowin Power Plant is shown in Appendix A.

(2) Back-up Fuel

The back-up fuel will be light distillate oil (Diesel) which is expected to be used about 3,000 m^3/d in case of emergency, the maximum flow to be pumped from storage tank is 129.38 m^3/h. The fuel storage tank will have a capacity allowing three days operation at full load (2×5,600 m^3). The Diesel specification is shown in Table 2.5-2. Diesel transportation will be conducted via the designed truck, the mitigation measures to prevent the oil spill and leakage are as follows:

1) Dike or Bund Wall

Dike or bund wall will be constructed around the storage tank with the capacity of 110% of largest tank. In addition, dike will be constructed within this to collect the storm water, and valve will also be installed to control the water discharge. Normally, this valve always be closed during the fuel transferring.



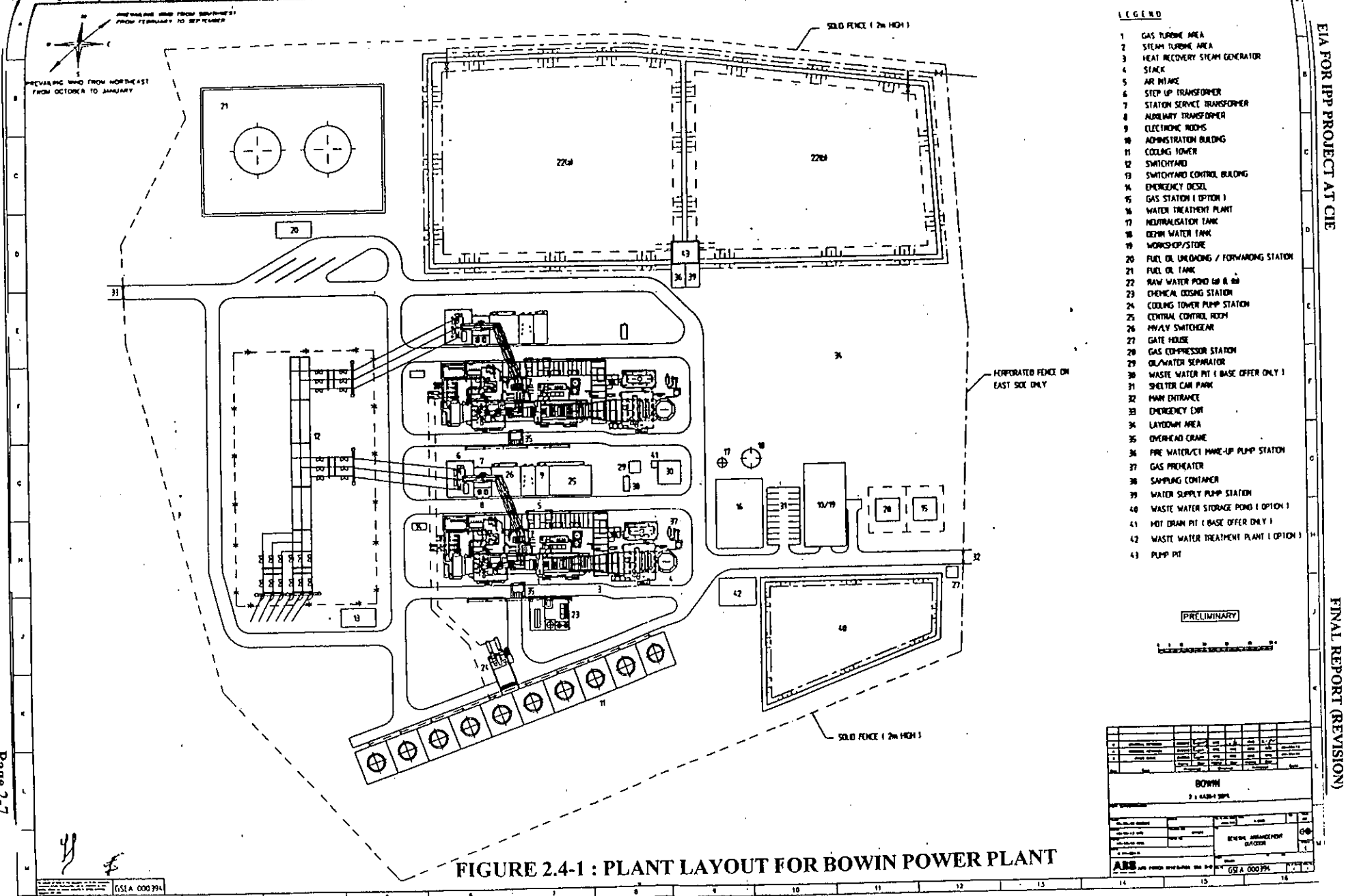


FIGURE 2.4-1 : PLANT LAYOUT FOR BOWIN POWER PLANT

TABLE 2.5-1
NATURAL GAS SPECIFICATION

Composition (mol%)	Performance Fuel	Minimum	Maximum
Methane (CH_4)	71.70	71.59	66.99
Ethane (C_2H_6)	5.99	5.67	7.58
Propane (C_3H_8)	1.98	1.79	3.75
Iso-butane (iC_4H_{10})	0.47	0.42	0.86
n-Butane (nC_4H_{10})	0.43	0.38	0.78
Iso-Pentane (nC_5H_{12})	0.13	0.11	0.22
n-Pentane (nC_5H_{12})	0.15	0.14	0.18
Hexane (C_6H_{12})	0.14	0.15	0.16
Heptane (C_7H_{14})	0.03	0.03	0.03
Higher Hydrocarbon (C_6^+)	0.01	0.01	0.01
Carbon Dioxide (CO_2)	16.33	16.81	17.61
Nitrogen (N_2)	2.64	2.90	1.83
Net Heating Value (LHV). Btu/scf	843	829	894
Gross Heating Value (HHV) Btu/scf	915	900	969
Specific Gravity (SG), @ 15.6/15.6 Deg C	0.794	0.794	0.841

Note :
1) The gas specifications above is the design basis for the plant.
2) Maximum and minimum cases are determined by the Heating value
3) Specific Gravity is reference with air at 15.6 Deg C

TABLE 2.5-2
DIESEL SPECIFICATION

	Restriction	High/Low Rate
1.	Specific Gravity at 15.6/15.6 (°C)	Not less than 0.81 and not more than 0.87
2.	Cetane Number or Calculated Cetane Index	Not less than 47 Not less than 47
3.	Viscosity at 40°C (cSt.)	Not less than 1.8 and not more than 4.1
4.	Pour Point, (°C)	Not more than 10
5.	Sulphur Content, (% wt.) (Since January 1, 1996) (Since January 1, 2000)	Not more than 0.5 Not more than 0.25 Not more than 0.05
6.	Copper Strip Corrosion, number	Not more than 1
7.	Carbon Residue, (% wt.)	Not more than 0.05
8.	Water and Sediment, (% Vol.)	Not more than 0.05
9.	Ash. (% wt.)	Not more than 0.01
10.	Flash Point, (°C)	Not less than 52
11.	Distillation 90% recovered, °C	Not more than 357
12.	Colour	Not more than 4.0
13.	Detergent Additive	-

Notes : % sulphur content in diesel which will be used must be followed the notification of ministry of industry.

2) Oil Separator

The potential area of oil leakage will be equipped with a common oil separator for oil pumping, fuel oil storage tank, transformer pit area and bund wall.

3) Fire Extinguisher

3.1) Water System

This water system will be installed around fuel oil storage tank and will be conducted followed UL standard (Under Writers Laboratory) and NFPA (National Fire Protection Association).

3.2) Foam System

3.3) Hydrant

Hydrant system will be installed every 90 metres.

Fire water system consists of water pumping unit to convey water to the hydrant and pipe. The fire water storage is from two storage ponds with 30,000 m^3 of capacity each.

Furthermore, the followings are fire extinguisher system.

- CO_2 at Gas Turbine thermal block and auxiliary compartment.
- Tank cooling system at fuel oil storage tank.
- Hydrant at Gas Metering Station.
- Waterspray system at oil filled transformers.

2.6 FUNCTIONAL UNIT SYSTEM

2.6.1 Condenser and Cooling System

The steam turbine condenser will be cooled in closed cycle by means of a closed cooling water loop passing through forced draft cooling tower. The make-up water of the closed system will be pumped from an intermediate storage basin located inside the boundary of the power plant. The water storage pond will be sized to hold an active volume of 60,000 m^3. The pond will be split in two halfes and constructed with earthen dikes. The anticipated location of the pond is shown on the Site Plan (Figure 2.4-1).

The feeding of this basin will be provided by fresh water coming from Nong Pa Lai reservoir located in Chonburi.

2.6.2 Control System and Instrumentation

The plant will be equipped with a Distributed Control System (DCS). The degree of plant automation shall be such that start-up, shut-down and normal operation can be done from the Central Control Room (CCR), requiring limited operator actions in the plant.

2.6.3 Facility Lay-out

The CTG/Generator/STG and the HRSGs will be of the outdoor design.

2.6.4 Connection to the Electrical Generation Authority of Thailand (EGAT) Grid

The plant will be connected to the 230 kV grid via an onsite substation that is part of the supply. The most efficient route for the transmission line between the plant and the EGAT Bo Win substation is along the Hubbon - Bo Win Road. The total distance for this route is 1.56 km (Figure 2.2-2).

2.7 PLANT OPERATING CONDITIONS

2.7.1 Ambient Conditions for Operation

The plant will be designed for optimum efficiency at the design condition as defined hereafter:

- Air:
  - temperature : 32.2°C;
  - relative humidity : 75%;
  - pressure : 1,010 mbar.
- Circulating Water:
  - temperature : 33°C

The temperature at the inlet of the condenser is based on the above ambient conditions and the design of the cooling tower.

The temperature of the make up water coming from the public reservoir is 28°C.

The plant will be designed to operate without any limitation of output due to constraints on any plant item over the range of ambient conditions.

2.7.2 Type of Operation

The facility is expected to operate as a base load unit with the following programme:

- 8,000 operating hours per year;
- 50 cold starts per year (after 48 hours shut down);
- 50 hot starts per year (after 12 hours shut down);
- 2 island operations per year with return to full power in one hour.

The facility will be capable of continuous operation at any output from 210 MW to full load.

2.7.3 Plant Life-time

The facility will be designed for a minimum life-time of 200,000 operating hours when operated according to the programme of section 2.7.2.

However, critical parts exposed to high temperatures will have to be exchanged before reaching 200,000 operating hours.

2.7.4 Electrical Conditions

The grid frequency is 50 Hz. The facility will be capable of delivering maximum continuous rating over the frequency range 49.5 Hz to 50.5 Hz. The high voltage grid voltage at step up transformer bushing is 230 kV, $\pm$7.5%.

The generators will be designed for a power factor of 0.85 lagging and 0.95 leading.

2.8 SCOPE OF SUPPLY

The turnkey supply includes design, engineering, manufacturing, procurement, transport, erection, commissioning and acceptance tests of all the electro-mechanical equipment, civil works, general infrastructure works required to operate and to maintain the power plant, i.e. all the facilities and equipment inside the power plant fence.

The scope of supply and services will include the following equipment and works:

2.8.1 Two Combustion Turbine Generators (CTGs) and Auxiliaries

Each CTG package will include the following:

- gas turbine itself;
- generator including its excitation system;
- turning gear;
- lubrication oil system;
- air intake including air filters and supporting structure;
- fuel system;
- fire protection and gas detection equipment;
- compressor cleaning system. (common compressor wash skid for both units);
- static starting device is common to both units.

2.8.2 Two Heat Recovery Steam Generator (HRSGs) and Auxiliaries

Each HRSG shall be completed with:

- pressure parts drums, economisers, evaporators, superheaters;
- supporting structure;
- the platforms walkways and stairs;
- ducting and insulation;
- interconnecting piping, headers, valves and fittings (including safety valves, blow down valves, vents and drains);
- 40 m. HRSG steel stack;
- 2×100% motor driven high pressure feedwater pump; with intermediate pressure extraction;
- cooling water system for auxiliaries;
- 100% capacity HP, IP and LP steam by-passes (one HP, one IP and one LP by-pass system);
- exhaust gas monitoring system (CO_2, SO_2, NO_2, O_2, CO and particulates).

2.8.3 Two Steam Turbine Generator (STGs) and Auxiliaries

The STGs will be of the condensing type.

Each STG will be completed with:

- steam turbine itself;
- sss-clutch to common generator
- gland sealing system,
- lubrication oil system and control oil system (common for ST and CT);
- turbine control system;
- condenser
- 1x100% steam jet hogging ejector and 1x100% 2-stage service ejector for evacuation and air removal
- piping, valves and special valves, insulation, for steam, condensate, feed water, auxiliary cooling water and interconnecting piping system;
- 3x50% condensate extraction pumps.

2.8.4 Circulating Water System

- closed loop cooling system composed of a multi cell mechanical draft cooling tower designed for fan-assisted air flow. Each cell will be fitted with an axial flow fan, electrical engine driven;
- 2×50% Circulation Water (CW) pumps;
- CW piping;
- chemical conditioning system;
- make-up water with pumping facilities;
- blow down system.

2.8.5 Fuel Systems

- **Fuel Gas System:**

Since the site is between the existing PTT gas pipeline and the new Parallel Pipeline, which is under construction and will be completed before 2001, the project plan to use natural gas as base fuel. The project plan to tap off the existing pipeline at Block Valve 3 is that the distance is only 7 km from the project location and most of which is through land owned by Hemaraj (Figure 2.2-2). Metering station which provide by The Petrolium Authority of Thailand, PTT comprise of the gas pressure reducing station, pressure relief and pressure control and interconnecting piping.

- **Light Distillate System:**

Fuel oil system including unloading, storage, transfer pumping station and all piping, valves and instrumentation required. The fuel storage tank will have a capacity allowing 3 days operation at full load (2x5,600 m^3), the maximum flow to be pumped from storage tank is 129.38 m^3/hr.

2.8.6 Closed Cooling Water System

Closed cooling system (closed loop cooling) with:

- 2×100% component cooling water pumps;
- 2×100% heat exchangers cooled by circulating water;
- all piping, filters, valves and instrumentation.

2.8.7 Demineralization Water Plant

Plant 2×100% including:

- storage tank;
- transfer pumps 3×33%.

2.8.8 Fire Fighting Water System

System with:

- fire fighting pumps (1×100% electrical, 1×100% diesel engine driven and 1×100% electrical pressurizing);
- underground hydrant loop encircling the plant;
- foam system for fuel oil tank;
- portable fire extinguishers.

2.8.9 Wastewater Facilities

Wastewater treatment facilities will include a wastewater neutralizing tank, and oil/water separator. The wastewater is stored on site in a wastewater holding pond. The wastewater treatment system consists of a clarifer and a sludge thickener. The wastewater discharge can be routed to the raw water holding pond as emergency.

2.8.10 Chemical System

Chemical conditioning system including steam cycle sampling and analyzing system for boiler water.

2.8.11 Compressed Air System

Compressed air system with:

- Instrument (control) and plant air system complete with 2×100% compressors.
- Air receiver, air dryer, for instrument air and complete piping and valves;

2.8.12 Pipes, Valves

Interconnecting piping, supporting, insulation and valves between all the equipment of the power plant.

2.8.13 Plant Instrumentation and Control

A single microprocessor based Distributed Control System (DCS) will be provide for centralized automatic plant control, for the total facility. The CTGs and STG are controlled by its associated microprocessor based control system.

2.8.14 Electrical Systems

The electrical system for the facility includes:

(1) High voltage (HV) electrical equipment and substation to the two overhead transmission lines' takeoff towers.

(2) Medium voltage (MV) and low voltage (LV) electrical equipment and systems are particularly:

- generator main circuit equipment such as isolated phase bus-ducts and generator circuit breakers;
- two station service transformers (one for each block);
- generator step-up transformers;
- generator MV system synchronization;
- MV switchgear equipment/motor control centers;
- Low voltage motor control center (MCC), DC/AC/switchgears;
- DC/AC power supplies (including instrumentation and control systems), battery chargers and inverters;
- emergency diesel generator set;
- complete power, control and instrument, cabling, cable trays.

2.8.15 Auxiliary Systems

- lightning protection;
- fire detection and protection;
- lighting and socket outlets;
- plant communication system;
- telephone system;
- synchronizing device;
- earthing ("ground grid") system;
- cathodic protection.

2.8.16 Materials Handling Equipment

- Electrical overhead travelling crane for gas and steam turbine and in workshop.

2.8.17 Ventilation System

Ventilation facilities for the various plant buildings or rooms, including natural ventilation and mechanical ventilation systems.

2.8.18 Air Conditioning System

The power plant electrical rooms and control room and the administrative offices will be air conditioned by central air conditioning plant. The demineralized water plant control room will be air conditioned by either package or window type air conditioners.

2.8.19 Civil Works

The civil works will include all works, steel structures, plant buildings, foundations, concrete structures, including:

Process buildings and equipment foundations

- gas turbine enclosure;
- steam turbine enclosure;
- electrical auxiliary building;
- heat recovery steam generator foundation;
- HRSG stack foundation;
- water treatment plant;
- major tanks (demineralized water and fuel oil);
- unit and step-up transformer foundations with appropriate fire walls;
- underground trenches and galleries as needed;
- foundations for pipe racks;
- other process and equipment foundations;
- HV substation.

Note : each power train (GT, ST and Generator) is in an outdoor enclosure.

Hydraulic and circulating water works:

- screening and pumping station;
- culverts and/or pipes;
- cooling towers;
- cooling water storage basin.

Service buildings:

- administrative building including at least
  - the cloakroom with lavatory/showers for extra working during maintenance period;
  - a first aid room
  - the administrative offices for the function of secretary, accounting chief manager, chief operator, lavatory;
- workshop;
- warehouse;
- gate-keeper lodge;

Site preparation and infrastructure:

- soil investigations;
- cleaning, leveling or backfilling;
- temporary facilities during construction:
  - provisional roads and sewers;
  - storage yards;
  - site offices and warehouses;
  - construction utilities : water, electricity and telephone;
  - provisional lighting;
  - sanitary conveniences;
- site infrastructure:
  - roads and road signs;
  - sewers;
  - car parking;
  - fences and gates;
  - outdoor lighting;
  - plantations;
  - water

2.9 WATER SUPPLY AND WATER USED

Water quantity of the project is summarized as follows.

- The water supply of the plant is raw water from Nong Pla Lai reservoir under the management of Eastern Water Resources Development and Management Public Co., Ltd.
- The quantity of water requirement in the year 2002 is expected to be 519,510 m^3/month. The maximum quantity of water will be required at 22,146 m^3/day.
- The capacity of single emergency water and fire water pond is to a 2-compartments pond. (2x30,000 m^3).
- For the construction period, the average water requirement is approximately 200 m^3/day which will be supplied by CIE's water work. In the amount of

worker requirement, it will be used by the construction workers about 80 m^3/day.

- For the operation period. in case of natural gas firing, the water requirement for operating of the power plant is 721 m^3/hr at 32.2°C.
- For the operation period, in case of oil firing, the water requirement for operating of the power plant is about 922.75 m^3/hr at 32.2°C.

The details of water usage in each case and type of fuel are shown in Figure 2.9-1 and Figure 2.9-2. The summary of water supply and consumption is shown in as below:

TABLE 2.9-1
WATER SUPPLY AND CONSUMPTION OF PROJECT

Item	Data
- Reservoir	Nong Pla-lai Reservoir
- Storage pond	
• For emergency and fire fighting	2×30,000 m^3
- Water demand of project during operation period	
• Natural gas	17,317 m^3/day
• Diesel	22,146 m^3/day

2.10 WASTEWATER CHARACTERISATION AND TREATMENT SYSTEM

In construction period, a 60 m^3/day of domestic wastewater is planned to be treated by septic tank. In addition, temporary holding pond will be constructed for sediment precipitation of surface runoff.

For the operation period, the quantity of wastewater which will be occurred from the power plant is about 2,114 m^3/day and from the workers is about 10 m^3/day. The wastewater from the power plant come from Cooling Tower Blow-down about 1,684 m^3/day and Demineralizer Regeneration Unit, HRSG Blow-down and drains about 430 m^3/day as shown in Table 2.10-1.

The details of wastewater sources are summarized as follows: (Figure 2.10-1)

- The domestic wastewater such as sanitary waste.
- Fire fighting water outside buildings.
- Rain water from buildings & area.
- Cooling water such as Cooling Tower Blow-down.
- Demineralizer regeneration wastewater such as filter backwash, regeneration solution from water treatment plant, chemical storage area, chemical unloading area, floor drains water treatment area, laboratory, and demineralized tank drain.
- Contaminate oil water such as fire fighting water, fuel oil unloading area, oil tank drain area.

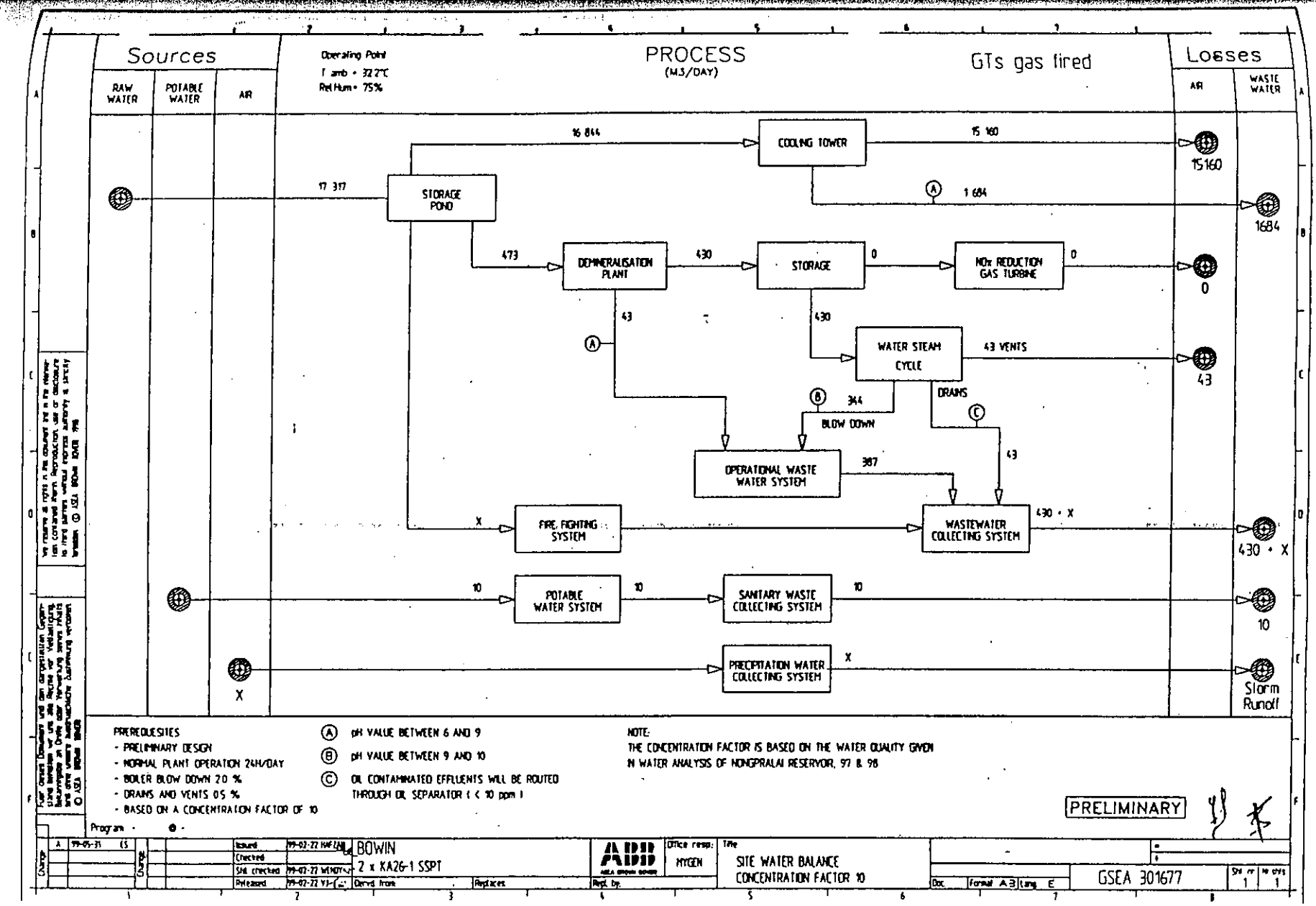


FIGURE 2.9-1 : WATER BALANCE FOR NATURAL GAS OPTION (AT 32.2°C)

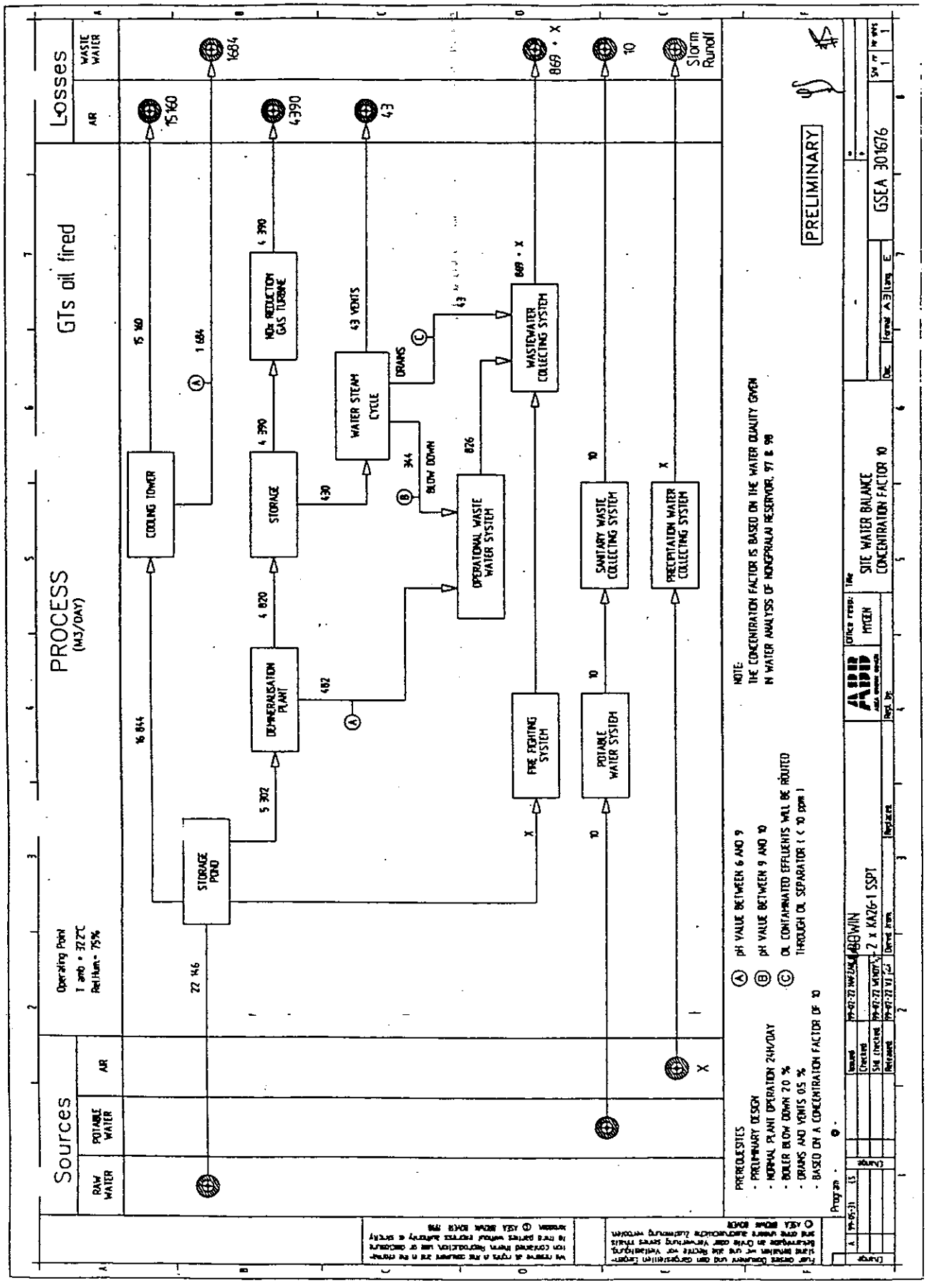


FIGURE 2.9-2 : WATER BALANCE FOR DISTILLATED OIL OPTION (AT 32.2°C)

FIGURE 2.9-2 : WATER BALANCE FOR DISTILLATED OIL OPTION (AT 32.2°C)

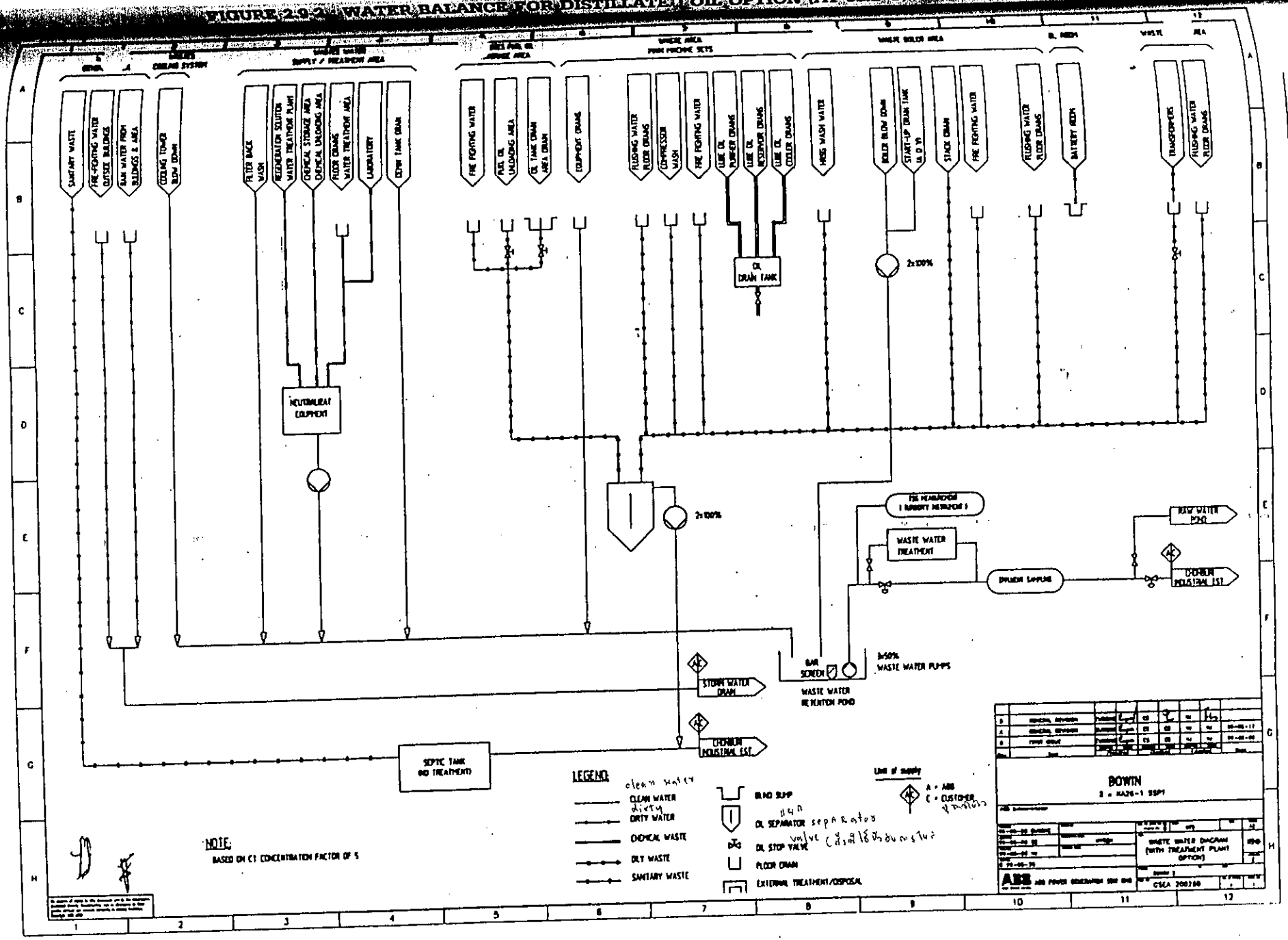


FIGURE 2.10-1 : WASTEWATER SOURCE AND MANAGEMENT FOR BOWIN POWER PLANT

TABLE 2.10-1
SOURCES AND QUANTITIES OF WASTEWATER

Source	Quantities (m^3/day)	Wastewater Treatment
1. Construction period	60	- package treatment
2. Operation period		
2.1 From processes		- neutralization and suspended solids removal
- Cooling water system	1,684	
- Demineralizer regeneration Unit, HRSG blow-down and drains	430	
2.2 From domestic	10	- by CIE

- Wastewater from washing equipment such as equipment drains, flushing water floor drains, compressor wash, fire fighting water, lube oil, purifier drains, lube oil reservoir drains, and lube oil cooler drains.
- Wastewater from boiler area such as HRSG wash water, boiler blow-down, start-up drain tank, stack drain, fire fighting water and flushing water floor drains.
- Other wastewater such as battery room, transformers and flushing water floor drains.

During operational period, the management of wastewater area are as following (Figure 2.10-1).

(1) The sanitary wastewater will be treated in septic tank and discharged to the CIE wastewater treatment plant for further treatment.

(2) The storm water from buildings and area and fire fighting water outside buildings will be drained to the public drainage system.

(3) Wastewater from cooling tower blow-down, filter backwash, demin. tank drain, equipment drains, and boiler blow-down and start-up drains will be drained to the wastewater pond, wastewater treatment plant and monitored on line before being discharged to CIE holding pond.

(4) Wastewater from regeneration of Demin., chemical storage area, chemical unloading area, floor drains water treatment area and laboratory will be drained to neutralization pond to be sent to wastewater pond, wastewater treatment plant and monitored on line before being discharged to CIE holding pond.

(5) Contaminated oil water such as fire fighting water floor drains in oil contaminated areas, fuel oil unloading area, oil tank drain area, compressor wash, HRSG wash, stack drain and transformer will be drained to oil/water separator prior to discharge to the CIE wastewater treatment plant.

From these above, it can be concluded in Table 2.10-2

TABLE 2.10-2
TYPE OF WASTEWATER OF BOWIN POWER PLANT

Type of wastewater	Pretreatment on site	Discharge to
1. Process wastewater 1.1 Cooling tower blow-down, filter backwash, demin. tank drain, equipment drains.	• Pretreatment / wastewater pond	CIE Holding Pond
1.2 Wastewater from boiler area such as boiler blow-down, start-up drain tank.	• Pretreatment/ wastewater pond	
1.3 Demineralizer regeneration wastewater such as regeneration solution of water treatment plant, floor drains of chemical storage area, chemical unloading area, water treatment area, laboratory.	• Wastewater Neutralization tank/ Pretreatment / wastewater pond	
2. Domestic wastewater 2.1 Stormwater and fire fighting water contaminated with oil from floor drains of fuel oil unloading area, and oil tank area.	• Oil/water separator	CIE waste water treatment plant
2.2 Equipment washing wastewater from equipment drains, floor flushing water drains, GT compressor wash drain, fire fighting water drain, HRSG wash water and stack drain.	• Oil/water separator	
2.3 Transformers pit area	• Oil/water separator	
2.4 Sanitary wastewater	• Septic Tank	
3. Others (uncontaminated with chemical and oil) 3.1 Stormwater outside building	• Stormwater drainage	Public sewage
3.2 Fire fighting water outside buildings	• Stormwater drainage	

The wastewater will be stored and treated as follows:

(1) Wastewater Pond

Power plant process water will pass through a 6,000 m^3 wastewater pond (equivalent to 2 days wastewater production) located on site. The process water will be treated in the on-site wastewater treatment plant for suspended solid removal. The process water quality will be monitored on line before being discharged to CIE holding pond (flow, temperature, pH, BOD, COD and conductivity measurement). The wastewater quality will comply with MOI requirements for industrial effluents.

(2) Wastewater Neutralization Tank

The capacity of this tank is 40 m^3. It collects wastewater from regeneration of demineralization plant, drains from chemical storage area, chemical unloading area, water treatment area and laboratory. The water in the neutralization tank is neutralized and pH is measured before being discharged to the wastewater pond.

(3) Oily / Water Separator Pit

The oily/water separator pit is designed for oily contaminated water such as rain water on oil tanks area equipment drain and floor drain, compressor wash water, drain from fuel oil unloading area, HRSG wash water, stack drain, drain from transformer pit etc. The wastewater from this area will be drained to the oil/water separation before discharged to the CIE wastewater plant.

From this above, the wastewater storage in Bowin Power Plant can be concluded in Table 2.10-3

Drainage system:

The whole areas are approximately 106,200 m^2 with the slope from North to South at Huai Manao which is the natural canal. The drainage system was designed to relate with the environmental condition, the storm water will be collected in open and closed pipe and discharged to Huai Manao. Plot plan indicates the drainage system is shown in Figure 2.10-1.

In the area of oil or chemicals pumping, the drainage system is designed to separate from storm water with the manual valve control system. Normal operation, valve is opened to drain the storm water and will be closed during the oil transferring.

The potential contaminated oil water will be drained to oil water separator prior to discharge to the CIE wastewater treatment plant.

The treated water will be stored at the pond prior to discharge, to keep the quality of water within the acceptable standard. (as shown in Table 2.10-4)

TABLE 2.10-3
THE WASTEWATER STORAGE IN BOWIN POWER PLANT

Wastewater storage	Capacity	Sources
1. Wastewater pond	6,000 m^3	- Cooling Tower blow-down - Flushing water floor drain - Filter backwash - Neutralized effluents - Demin., tank drain - Equipment drains - HRSG Blow-down and start-up drain.
2.Water Neutralization Tank	40 m^3	- Demineralizer regeneration solution. - Chemical storage area drain - Chemical unloading area drain - Floor drain water treatment area - Laboratory
3.Oil/water separator pit	**	- Rain water on oil tanks area - Drain from Fuel oil unloading area - Drain from transformer pit - Equipment drain and floor drain - Compressor wash water - HRSG wash water and stack drain - Fire fighting water

Remark: ** = capacity during design.
The total quantity of wastewater is about 2,124 m^3/day (Natural gas) during operation period

Sources: Bowin Power Co., Ltd., July, 1999

TABLE 2.10-4
WASTE WATER CHARACTERIZATION OF BOWIN POWER PLANT
@ 10 COC (CYCLE OF CONCENTRATION) IN COOLING TOWER (FUEL GAS FIRED)

Parameter	Unit	Raw Water Makeup	Cooling Tower (Blow-down)	Treated Domestic Waste	Operational Wastewater	Combined Wastewater	Discharge Limit
Flow	m^3/day	17,320	1,684	10	430	2,124	-
Calcium	mg/l	24	240	34.2	40.0	248.9	-
Magnesium	mg/l	15	150	20	0.0	149.2	-
Sodium	mg/l	8	80	58	5.0	81.1	-
Iron	mg/l	0.4	4	1	1.0	4.2	-
Manganese	mg/l	0.1	1	1	-	1.0	1
Alkalinity	mg/l as $CaCO_3$	40	400	77	-	398.1	-
Sulfate	mg/l	5	50	34	-	49.9	-
Chloride	mg/l	10	100	51	5.0	101.0	-
Nitrate	mg/l as NO_3	1.6	16	32	5.0	17.4	-
Fluoride	mg/l	0.4	4	0.4		4.0	-
Phosphate	mg/l as PO_4	0	2	20	6.0	3.6	-
pH	-	7 to 8	6 to 9	6 to 9	6 to 9	6 to 9	5.5 to 9
Silica (Active)	mg/l	13.2	132	13.2	5.0	132.6	-
TDS	mg/l	89	890	-	350.0	973.3	3,000
TSS	mg/l	11	110	30	10.0	50.0	50
Turbidity	NTU	9.1	91	-	90.5		
BOD	mg/l	4	4	20	20.0	20.0	20
Oil & Grease	mg/l	0.5	5	-	5.0	5.0	5
Ammonia	mg/l as N	5	50	6	10.0	52.3	-
Copper	mg/l	0.01	0.1	-	0.1	0.8	2
Zinc	mg/l	0.06	0.6	-	0.6	0.6	5
Hydrogen Sulfide	mg/l	0.1	1	-	-	1.0	1
Cyanide	mg/l	0.02	0.2	-	-	0.2	0.2
Tar	mg/l	none	none	-	-	none	none
Formaldehyde	mg/l	0.1	1	-	-	1.0	1
Phenol & Cresols	mg/l	0.1	1	-	-	1.0	1
Free Chlorine	mg/l	0.1	1	-	0.1	1.0	1
Insecticide		none	none	-	-	none	none
Rad. Compounds		none	none	-	-	none	none
Mercury	mg/l	0.0005	0.005	-	-	0.005	2
Synthetic Det.	mg/l	none	none	-	-	none	none

2.11 EMISSION DATA OF THE POWER PLANT

For the gas fired option and distillate oil fired option of the power plant, there are several emission data from operation as follows;

Emission Rates of Concern Pollutants from Bowin Power Plant [at design ambient conditions 32.2°C]

Pollutant	Stack #1		Stack #2		Standard[1]
	Concentration[1]	Emission Rate (g/sec)[2]	Concentration[1]	Emission Rate (g/sec)[2]	
1. Natural Gas					
- NO_X	100 ppmvd	51.60	100 ppmvd	51.60	120 ppmvd
- SO_2	-	-	-	-	20 ppmvd
- CO	250 ppmvd	78.6	250 ppmvd	78.6	870 ppmvd
- TSP	20 mg/m^3	4.67	20 mg/m^3	4.67	60 mg/m^3
2. Distillated Oil					
- NO_X	140 ppmvd	84.28	140 ppmvd	84.28	180 ppmvd
- SO_2	150 ppmvd	127.16	150 ppmvd	127.16	640 ppmvd
- CO	290 ppmvd	106.37	290 ppmvd	106.37	870 ppmvd
- TSP	35 mg/m^3	10.3	35 mg/m^3	10.3	120 mg/m^3

(1) = reference condition 7% O_2, dry 25°C, 1 atm
(2) = mass emission rates at anticipated operation condition

Note : - Exhaust flow rate of Natural Gas will be 710.5 m^3/sec (base on 0°C)
- Exhaust flow rate of distillated oil will be 710.1 m^3/sec (base on 0°C)
- Stack height is 40 meter and stack inner diameter is 7 meter.

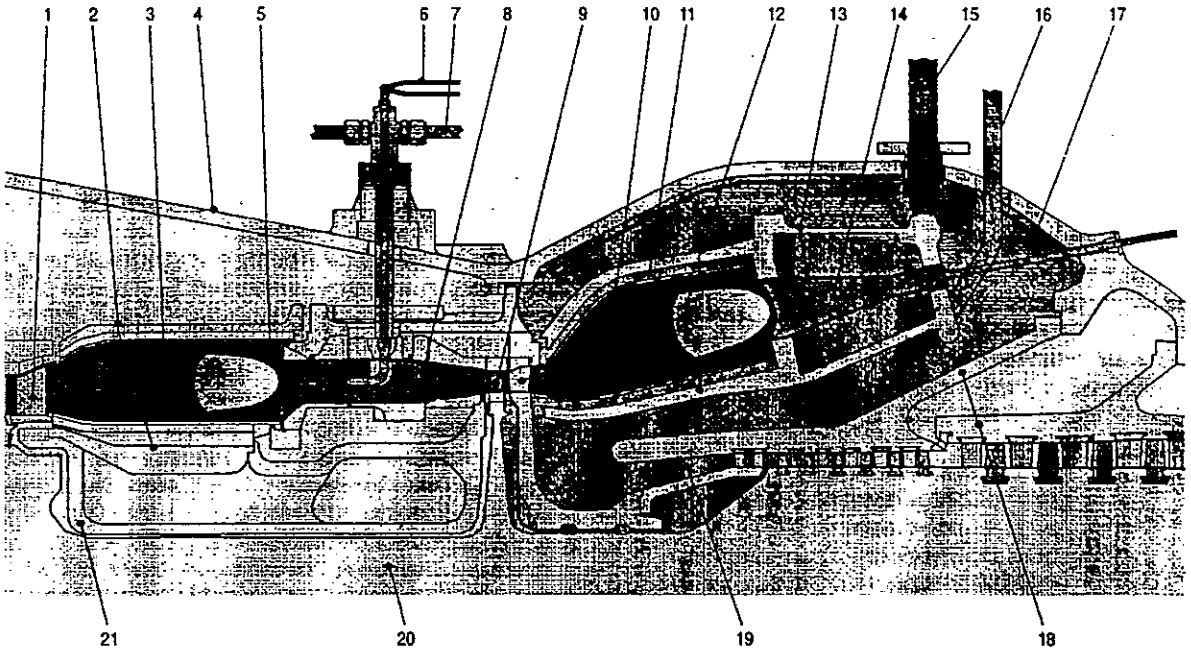
Source : Bowin Power Plant, August 1999.

For NO_x emission, project has designed to use low NO_x burner system as follows.

(1) NO_x System

For NO_x emission, Bowin Power Plant has designed of facility base on ABB GT26 Gas Turbine to use sequential lean-premix dry low NO_x combustion system as follows.

(a) Annular Combustor with EV-Burners



Legend

1 2nd turbine vane row
2 SEV combustor casing
3 Liner tiles SEV combustor
4 Turbine casing
5 SEV burner
6 Oil supply to SEV burners
7 Gas supply to SEV burners
8 Turbine exhaust
9 Turbine blade row 1
10 Turbine vane row 1
11 Liner tiles EV combustor
12 EV combustor casing (2nd section)
13 EV combustor casing (prim. section)
14 EV burners
15 Gas supply to EV burners
16 Pilot gas supply to EV burners
17 Oil / NO_x water supply to EV burners
18 Compressor vane carrier
19 Compressor diffuser
20 Rotor (turbine/ compressor shaft)
21 Shaft covering

The main parts of the combustors are:

- The EV combustor with EV-burners, liner tiles and outer casing
- The SEV combustor with SEV-burners, liner tiles and outer casing
- The flame monitors
- The igniter

(i) Combustors

After the compressor, the air flows through the compressor diffuser and the surrounding chamber of the turbine casing. In so doing, it not only provides counter-flow cooling for the EV combustor, but also cools the first stage turbine vanes and vane carrier.

The turbine casing encloses the EV combustor and directs air from the compressor through the ring shaped space in the double walled liner tiles in counter-flow cooling.

The EV combustor consists of a primary zone, in which the actual combustion takes place, and a secondary zone, which sends the hot gas to the first turbine stage with very slight losses.

The front segments form the primary zone with the EV burners inserted into them, and the first part of the liner tiles attached to the front segments. These parts are fixed in position by a support structure, which, in turn, provides the connection to the turbine casing. The secondary zone is formed by the second part of the liner tiles.

The EV burners are mounted in a ring-shaped arrangement in the front segments. After the first turbine stage and the turbine diffuser the SEV combustor is mounted. The ring shaped room following the exhaust duct with the SEV burners and the liner tiles forms the combustor.

The SEV combustor is fixed in the vane carrier for the first turbine vane row and the vane carrier for the turbine vanes stage two to five. The turbine casing encloses the SEV combustor and directs air from the compressor, through the ring shaped space in the double walled liner tiles in counter-flow cooling.

The zone with the SEV burners and the shaft drum with the inner part of the SEV combustor is also cooled by air withdrawn from the compressor. The hot gases from the first turbine stage flow through the turbine exhaust duct, to reach the SEV combustor. To reheat these gases additional fuel is sprayed into the combustor through the SEV burners. The SEV burners are supplied with fuel through manifold pipes outside of the turbine casing.

The annular arrangement of the combustors makes possible a uniform and low-loss flow to the turbine because the hot gas path can be kept quite short. In addition, the thorough mixing results in an even temperature profile and a complete combustion.

During part-load operation, the three variable guide vanes reduce the airflow so that emissions are low also at low load.

(ii) Ignition

Electrically activated ignition torches supplied from a gas system of their own are installed for the ignition of the EV burner flames. The flame then spreads from burner to burner without requiring further intervention.

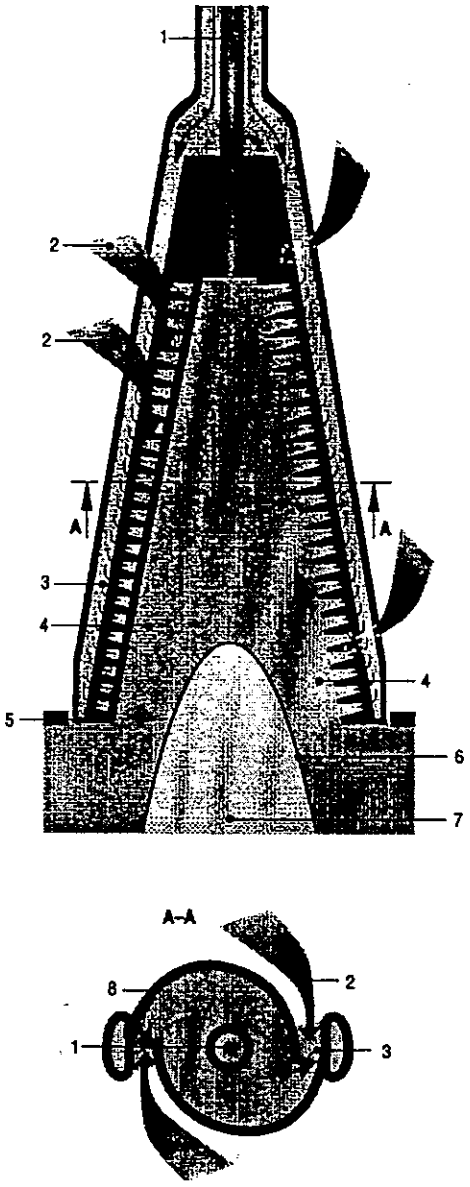
The fuel for superheating is ignited by the hot gases coming from the first turbine stage.

(iii) Monitoring

The combustion in the combustors is monitored by infrared flame monitors, which are evaluated in a 2-of-3 circuit.

The surrounding turbine casing is split horizontally in order to provide easy access to the combustor for purposes of maintenance.

(b) EV Burner



Legend

1 Oil	5 Burner exit plane
2 Combustion air	6 Flame front
3 Gas injection	7 Vortex breakdown
4 Premixing (gas – combustion air)	8 Swirler

The lean premix EV Burner design is based on many years of experience in developing and operating low NO_X premixing burners and on investigations conducted in our research center of the scientific principles involved in the behavior of strongly swirled flows.

The design of the EV burner itself is basically an axially split cone, with the two halves offset to give two constant-width inlet slots. The combustion air flows into the combustion zone through these slots.

When burning gas, the fuel gas flows through two lengthwise arranged gas channels (4), is injected through rows of fine holes (1) at the edges of the slots into the burner, and mixes there with the air.

When burning oil, the liquid fuel is sprayed in through an atomizer nozzle (2) at the apex of the cone.

A high-speed vortex then develops within the cone, creating a lean mixture, which is fed into the flame.

Excess air is a feature of the EV design giving a flame temperature around 500 K lower than that in a comparable diffusion burner. This results in a very low NO_X level.

The cone is completely surrounded by air during operation. The burner is inherently safe because the flame cannot touch the cone walls due to the high axial speed in the cone.

During operation on oil, additional water is mixed into the oil in order to meet prescribed emission levels.

2.12 NOISE POLLUTION

Concerning the plant operation, the several heavy machines will generate noise such as combustion turbine and steam turbine. The noise expose from the sources is shown below;

Source	Noise Expose Level (dB(A) (*)
• Combustion Turbine Enclosure	85
• Combustion Turbine Generator Enclosure	85
• Steam Turbine Enclosure	85
• Heat Recovery Steam Generator (HRSG)	85
• Cooling Tower	
- Air Inlet	87
- Air Exit	86

(*) Noise measured according to ANSI S12.36 at 1 meter from equipment or noise attenuating enclosure and 1.5 meter above ground level or permanently installed walkways and ladders.

Bowin Power Plant has designed to reduce noise due to equipments and machineries operation as follows:

(1) Project has designed all equipments to generate low noise as much as possible and will follow the standard or regulations of Ministry of Science Technology and Environment, Ministry of Industry and Ministry of Public Health.

(2) Noise generated from all equipment is designed to be 85 dBA at 1 meter from equipment or noise attenuating enclosure and 1.5 meter above ground level or permanently installed walkways and ladders, measured according to ANSI.S12.36. In case of equipments that generate more than 85 dBA of noise level, the personal protection will be provided for all concerned staffs.

The equipments that will be considered for noise protection and prevention by outdoor enclosure are shown hereafter.

(1) Combustion Turbine Generator.
(2) Steam Turbine, insulation will be installed at steam pipeline.
(3) Other facilities will be separately installed to reduce noise level and ear protection equipments must be provided.
(4) Sky valve is also considered to be installed to reduce noise level at boiler.

2.13 SOLID WASTE MANAGEMENT

The wastes to be generated during the construction period will be stored in container or tank and evacuated by plastic prior removed to dispose by CIE with incinerated and/or landfill method. For the expired resin, it will be removed for regeneration by suppliers.

During operation period, the followings are wastes generated by Bowin Power Plant and methods of management.

1) Wastes from Office and Power Plant

These wastes is estimated to be about 50 kg/day (18,250 kg/year) and can be categorized as follows:

Type	Percent
Paper and paper pack	54
Empty container	5.4
Metal residues	27
Oil sludge / oil waste material	10.8
Others	2.8

These wastes will be removed and incinerated properly by Chonburi Industrial Estate.

2) Waste Water Treatment

Normally, wastewater consists of solid waste 0.1% and all solid waste will be extracted from wastewater. Therefore, then will be sludge approximately 10.5 ton/year that extracted from wastewater.

3) Spent Resin

The resin from demineralized system is estimated to be 10,000 kg or 10.0 ton. The lifetime of resin is about 3 year and will be managed by supplier.

The waste oil generated from the following sources will be collected and conveyed to GENCO.

- Oil / Water Separators
- Tank farm
- Special containers

2.14 CODES, STANDARDS AND REGULATIONS

The plant shall be designed, build and commissioned according to the applicable local legislation. Unless in contradiction with the local legislation, the plant shall be designed, built and commissioned in conformity to the following international recognised standards and codes, as applicable:

- for mechanical and electrical equipment:
  - ANSI : AMERICAN NATIONAL STANDARD INSTITUTE
  - ASME : AMERICAN STANDARD OF MECHANICAL ENGINEERS
  - AWS : AMERICAN WELDING SOCIETY
  - ISO : INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
  - ASA : AMERICAN STANDARD ASSOCIATION
  - IEC : INTERNATIONAL ELECTROTECHNICAL COMMISSION
  - NFPA : NATIONAL FIRE PROTECTION ASSOCIATION
  - B.S. : BRITISH STANDARD
  - ASTM : AMERICAN STANDARD FOR TESTING MATERIAL
  - API : AMERICAN PETROLEUM INSTITUTE
  - HEI : HEAT EXCHANGE INSTITUTE
  - DIN : DEUTSCHE INDUSTRIE NORMEN
  - TEMA : TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION
  - VDI : VEREIN DEUTSCHER INGENIEURE
  - IEEE : INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

- ISA : INSTRUMENT SOCIETY OF AMERICA
- SI : UNITS SYSTEM

- for civil works:
  - ACI : AMERICAN CONCRETE INSTITUTE
  - AISC : AMERICAN INSTITUTE OF STEEL CONSTRUCTION
  - ASCE : AMERICAN SOCIETY OF CIVIL ENGINEERS
  - DIN 4024 and VDI 2056 : DESIGN OF THE FOUNDATIONS FOR THE TURBOGENERTORS
  - ISO 3443: TOLERANCES FOR BUILDING

2.15 ENVIRONMENTAL CONSTRAINTS

The plant will be designed to minimize the environmental impact, particularly with regard to safety, low level of pollutant emissions and discharge, high thermal efficiency, and low noise level.

2.16 OCCUPATIONAL HEALTH AND SAFETY

- **Potential hazards in working environment:**

The following estimation is based on a total a number of 50 operating people; as one person can be exposed to more than one danger, the summation of the hereafter table do not represent a number of real persons but well a quantity of potential hazardous situations.

Type of Hazard in Working Environment	Location of Occurrence	Number of Workers Exposed
Noise	- Turbine generation units area	35
Temperature	- heat recovery steam generator area - Steam turbine area - LP and HP steam pipes network	35
Electrical	- Overall in the power plant - Electrical building (high voltage switchboards room) - High voltage network and high voltage engine driven equipment - Generators outlet and step-up transformers areas - Switch-yard	35
Mechanical	- Overall in the power plant - Workshop (machine tools) - Overhead works (travelling cranes) - Maintenance of turning machines	20
Chemical	- Demineralizer regeneration plant - Laboratory - Make-up water treatment area - Cooling water vaccination area	35

Health and Safety philosophy during construction period and operation period are presented in Appendix B and C.

2.17 RISK ASSESSMENT FOR THE ENVIRONMENTS

- **Type/quantity of chemicals and storage:**

Chemical	Annual Usage	Storage	Inventory on Site
1. Demineralised System			
1.1 Sulfuric Acid (H_2SO_4)	50 m^3	2 m^3	None
1.2 Sodium Hydroxide (NaOH)	80 m^3	6 m^3	None
1.3 Sodium Chloride	60 m^3	2 m^3	None
2. Water Steam Cycle System			
2.1 Carbohydrazine	560 kg	1 m^3	None
2.2 Mixed Amine	280 kg	1 m^3	None
2.3 Phosphate	340 kg	1 m^3	None
3. Cooling Water System			
3.1 Sulfuric Acid	85 m^3	5 m^3	None
3.2 Sodium Hyperchloride	150 m^3	5 m^3	None
4. Wastewater Treatment			
4.1 Alum	35,000 kg	2.7 m^3	None
4.2 Polymer for Clarifer	200 kg	6.7 m^3	None
4.3 Polymer for belt press	4,200 kg	2.7 m^3	None

Annual Consumption is based on gas operation of approximately 8,000 hours per year.

- **Temperature**: the maximum temperature exists in the heat recovery steam generator and in the High-Pressure interconnecting piping with the steam turbine (±568°C)

- **Pressure**: steam-the maximum pressure exists in the heat recovery steam boilers and in the H-P interconnecting piping with the steam turbine (±119.5 bars)
  : natural gas - from 35 bars at the boundary fence up to 50 bars at the turbines combustors

- **Type and number of design control system**

  Alarms: All alarms will be centralized in a central control room and differentiated in order of importance.

  Detectors: All signals of any importance will be centralized in the central control room.

  Interlocks: All main components of the plant are related in regulation, detection and eventually trip.

  Pressure relief devices: Most of the devices will be directly situated on the main vessels or pipes. No valves or any other device shall separate them from the main vessel or pipe. The type of the device will be of a non assisted spring and sealed after testing by an official inspector. For every safety device, there will be a logbook.

Sprinklers system: will be used in all areas, as offices, workshops, step-up transformers, non-electric and electronic compartments. Additional to this system, special automatic fire extinguishing systems will be used all over the power plant to assure maximum security.

2.18 EMERGENCY RESPONSE PLAN

The followings are the concern issues in emergency response plan and the details are shown in Appendix D.

- internal distribution,
- external distribution,
- training,
- duties and responsibilities,
- evacuation procedures,
- emergency control,
- amendment of the emergency response plan.

CHAPTER 3 : EXISTING ENVIRONMENTAL CONDITIONS

CHAPTER 3
EXISTING ENVIRONMENTAL CONDITIONS

3.1 INTRODUCTION

The presentation of the existing environmental conditions for the concerned project is divided into 4 main categories, namely physical resources, biological resources, human use values and quality of life values, which will be further subdivided into each environmental components. In this section, the presentation will not be explicitly divided into 4 main categories, but will be described by components according to the order of these categories.

In this chapter, the Consultant emphasizes on the results of field observations/-interviews and the collected additional data/information. Important information from the relevant reports and documents are also summarized and included in this chapter.

3.2 CLIMATE

3.2.1 Introduction

This study is focused on the existing meteorological condition around the project area which directly influence the atmospheric residence time of concerned pollutants. Atmospheric motions determine the dilution extent of the contaminants and govern the dispersion path.

3.2.2 Study Methodology

The secondary data on climatic and meteorological condition around the project area were collected from the Meteorological Department and the study of NESDB on The Information and Potential for Water Resources Development in Eastern Coast Basin (1994). The meteorological condition in this area can be summarized as follows:

3.2.3 General Climatic Condition

The Proposed power plant is situated in the eastern part of Thailand. the climate of the project area is characterized by winter, summer and rainy season, under influence of northeast and southwest tropical monsoon. The rainy season begins in June to mid of October. During this season, the southwest monsoon is established with prevailing moisture from Andaman ocean and Gulf of Thailand resulting in longer period of rainfall. As the wet season progresses, rainfall becomes more intense and prolong in September and October,

which are usually the months of maximum rainfall. The winter or the northeast monsoon season begins in mid of October to mid of February. In this period, high pressure, with cold influence from China, moves towards Thailand and causes cold and dry weather. The summer starts from the cessation of the northeast monsoon which is approximately in mid of February and end around June. In this period the weather is rather hot. April is the hottest month. Intertropical convergence zone is formed in February to May over the project area when the southwest monsoon meet the cold air mass from the north. Then, the climate will be changed with the uncertainty of wind direction and rainfall.

The meteorological data were analyzed by using data record at Chonburi station, which nearby the project area. The Chonburi station is at Latitude 13° 22' N Longitude 100° 59' E with 30 years climatological data (1968-1997) (Table 3.2-1) which can be summarized as follows:

(1) Rainfall

The mean annual rainfall is about 1,289.10 mm. In September and October are the typical months of maximum rainfall. The average number of rainy days in a year is 118 days.

(2) Air Temperature

The temperature is almost uniform throughout the year. The value of mean monthly air temperature between 25.9°C in December to 29.8°C in April. The mean annual temperature is about 28.1°C.

(3) Relative Humidity

The relative humidity is mainly related to air mass and influence of monsoon. The mean annual relative humidity is 73%, while the mean monthly relative humidity varies from minimum 64% in December to maximum 80% in September.

(4) Wind

Wind direction at Chonburi prevails from southwest for the months of February through May and from east during October through January.

The mean monthly wind speed varies from 2.4 knot in September to 3.9 knot in March.

TABLE 3.2-1
CLIMATOLOGICAL DATA FOR THE PERIOD 1968-1997

Station	CHON BURI	Elevation of station above MSL	1	Meters
Index station	48459	Height of barometer above MSL	2	Meters
Latitude	13 22 N	Height of thermometer above ground	1.50	Meters
Longitude	100 59 E	Height of wind vane above ground	13.45	Meters
		Height of rain gauge	1.00	Meters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pressure (Hectopascal)													
Mean	1012.20	1011.11	1009.98	1008.52	1007.15	1006.56	1006.72	1006.79	1007.91	1009.70	1011.45	1012.75	1009.24
Est. max	1022.57	1020.65	1020.90	1018.00	1014.00	1012.93	1013.35	1013.15	1015.70	1017.22	1020.60	1022.50	1022.57
Est. min.	1003.14	1002.21	1002.50	1000.26	999.94	999.52	998.72	999.30	1000.40	1001.43	1003.19	1003.50	998.72
Mean daily range	4.66	4.64	4.76	4.63	4.21	3.63	3.52	3.75	4.32	4.47	4.43	4.60	4.30
Temperature (Celsius)													
Mean	26.2	27.5	28.8	29.8	29.5	29.2	28.8	28.6	27.9	27.5	26.9	25.9	28.1
Mean max.	32.3	32.9	34.0	34.9	34.0	33.2	32.7	32.5	32.2	32.4	32.3	32.3	33.0
Mean min.	21.0	23.1	24.8	25.9	25.9	25.8	25.4	25.3	24.6	23.9	22.5	20.7	24.1
Est. max.	37.5	37.6	38.4	39.9	38.5	36.8	37.2	36.2	35.8	36.1	36.7	36.9	39.9
Est. min.	12.4	16.6	14.0	21.0	21.2	20.8	20.5	21.3	21.0	17.9	14.2	12.0	12.0
Relative Humidity (%)													
Mean	67	70	71	71	74	74	74	76	80	78	71	64	73
Mean max.	83	86	86	86	87	87	87	88	92	91	86	80	87
Mean min.	48	53	54	54	58	59	60	61	64	62	52	45	56
Est. min.	18	20	19	26	32	40	40	43	32	32	24	22	18
Dew Point (Celsius)													
Mean	19.1	21.2	22.6	23.7	24.2	23.9	23.6	23.7	23.9	23.1	20.7	18.2	22.3
Evaporation (mm.)													
Mean-pan	141.2	141.0	177.6	178.8	162.7	154.0	152.9	152.0	132.3	128.9	135.2	149.2	1805.8
Cloudiness (0-10)													
Mean	3.7	4.2	4.3	5.4	7.5	8.6	8.9	9.2	9.0	7.5	5.3	3.8	6.5
Sunshine Duration (hr.)	NO OBSERVATION												
Visibility (km.)													
0700 L.S.T.	5.5	5.7	6.5	8.1	10.4	11.1	10.7	10.3	9.8	8.9	7.9	6.9	8.5
Mean	6.7	6.9	7.5	9.1	11.2	11.8	11.6	11.1	10.5	9.9	9.1	8.0	9.5
Wind (Knots)													
Mean wind speed	3.3	3.8	3.9	3.5	2.9	3.5	3.4	3.3	2.4	2.6	3.8	3.8	-
Prevailing wind	E	S	S	S	S	SW	S	SW	W	E	E	E	-
Max. wind speed	20	27	21	27	30	26	30	35	40	40	30	30	40
Rainfall (mm.)													
Mean	12.5	16.6	32.2	76.2	157.2	147.5	129.8	169.5	278.8	204.0	58.1	6.7	1289.1
Mean rainy day	1.5	2.4	3.9	7.3	13.7	14.7	15.2	17.3	19.4	16.0	5.6	1.0	118.0
Daily maximum	80.8	50.6	50.8	90.9	82.8	163.4	71.5	131.0	186.2	121.5	91.8	37.7	186.2
Number of days with													
Rain	26.5	23.0	24.3	15.1	2.7	2.1	1.7	1.7	1.1	4.8	14.9	24.9	142.8
Fog	0.8	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	2.0
Hail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thunderstorm	0.5	1.4	3.8	9.1	13.3	6.8	7.2	7.6	13.0	10.7	2.6	0.3	76.3
Squall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Computer Section
Climatology division
Meteorological department
30-Apr-99

3.3 AIR QUALITY

The implementation of the proposed power plant is anticipated to increase the concentration of concerned air pollutants in the project vicinity. Thus, it is essential to conduct air quality survey prior to the project implementation to establish the baseline data for the area.

3.3.1 Study Approach

The study approach for air quality aspect can be summarized as follows:

(1) Identification of Air Pollutant

Based on the previous experience, and literature reviews, the following pollutants NO_2, SO_2, and TSP were identified as major pollutants emitted from the thermal power plant operation. The relative importance of each pollutant depends on the type of fuel and emission control system. Therefore, these pollutants were selected as concerned pollutants for the study of air quality.

(2) Sampling and Analytical Methods

Sampling and analytical methods for the selected pollutants shown in Table 3.3-1. The methods are those that are required or accepted by the concerned regulatory agency which is the MOSTE (Ministry of Science Technology and Environment).

TABLE 3.3-1
AIR QUALITY SAMPLING AND ANALYSIS METHOD

Pollutants	Sampling Duration	Analysis Method
SO_2	24-hours	Pararoseniline
NO_2	1-hour	Sodium-Arsenite
TSP	24-hours	Hi-volume Gravimetric

The techniques used for the sampling and analysis of each particular pollutants can be described briefly below:

(a) Sulfur Dioxides (SO_2)

Sulfur dioxide is absorbed from air in a solution of potassium tetrachloromercurate (TCM). A dichlorosulfitomercurate complex, which resists to oxidation by the oxygen in the air, is formed. Once formed, this complex is stable to strong oxidising agents (e.g. ozone, oxides of nitrogen). The complex is reacted with pararosaniline and formaldehyde to form intensely colored pararosaniline methyl sulfuric acid. The absorbance of the solution is measured spectrophotometrically.

The method is applicable to the measurement of sulfur dioxide in ambient air using a sampling period up to 24 hours with a range of sensitivity of 25 to 1.050 mg/cu.m. Outside this range, the method is still applicable but somewhat less accurate unless certain precautions are taken.

(b) Nitrogen Dioxides (NO_2)

The method used for collection and measurement of nitrogen dioxides is the sodium arsenite method (EPA) which, at present is a tentative candidate method for the determination of nitrogen dioxides in the atmosphere. It is a continuous sampling method which is applicable to collection of 1-hour samples in the field and subsequent analysis in the laboratory.

In principle, nitrogen dioxide is collected by bubbling air through a sodium hydroxide-sodium arsenite solution to form a stable solution of sodium nitrite. The nitrite ion produced during sampling is reacted with phosphoric acid, sulfanilamide, and N-1-(naphthyl) ethylenediamine dihydrochloride to form an azo dye and then determined calorimetrically. The optimum range of sensitivity for the method is 20 to 750 mg/cu.m. nitrogen dioxide, although it can also be used outside this range with somewhat less accuracy.

(c) Total Suspended Particulates (TSP)

Air is drawn into a covered housing and through a filter by means of a high-flow-rate blower at a flow rate of 1.13 to 1.70 cu.m./min. This high-flow-rate allows suspended particles having a diameter of less than 100 mm (Stoke equivalent diameter) to pass to the filter surface. Particles within the size range of 100 to 0.1 mm diameter are ordinarily collected on glass fiber filters. The mass concentration of suspended particulates in the ambient air (mg/cu.m.) is computed by measuring the mass of collected particulates and the volume of air sampled. For the determination of average concentrations of suspended particulates in ambient air, a standard sampling period of 24 hours is required.

(3) Field Works

During the first phase of the study, existing air quality was measured during 13-15 March 1995 at 4 locations around the project site (Figure 3.3-1). This is to determine background air quality data of the project area where future air quality can be compared. These locations are sensitive receptors having potential impact from the project and can be described as follows:

(a) Wat Hup Bon Wanaram is located 4 km to the northeast of the project site.

(b) Wat Bo Win is located 3.5 km to the southeast of the project site. This area is in a composed state.

FIGURE 3.3-1 : AIR QUALITY MEASUREMENT STATIONS

(c) Wat Phan Sadet Nai is located 3.5 km to the southeast of the project site.
(d) Wat Phan Sadet Nok is located 4 km to the east of the project site.

The project area is located in Chonburi Industrial Estate (Bo Win Industrial Estate) and the surrounding is mostly orchard and sparsely populated by clusters of houses forming a village every 2-5 kilometres.

Air quality measurement was carried out for 3 consecutive days at each location.

3.3.2 Results of the Study

The air quality measurement results are shown in Table 3.3-2 while the wind speed and direction during the measurement period are shown in Table 3.3-3 and Figure 3.3-2 and can be summarized as follows:

(1) Sulfur Dioxide (SO_2)

Sulfur Dioxide 24-hour were also found to be very low at all 4 locations. The concentrations of SO_2 ranged from 33.52 to 58.94 $\mu g/m^3$ while the 3 days average for each location were between 40.52 to 52.29 $\mu g/m^3$. In comparison with NEB's Standard (300.00 $\mu g/m^3$, the results shown that the annual) SO_2 concentration are not over this standard values.

On an individual location basis, Wat Bo Win has the highest SO_2 concentration with the average of 52.29 $\mu g/m^3$. Wat Phan Sadet Nai and Wat Phan Sadet Nok came second and third, with the average of 47.94 and 45.09 $\mu g/m^3$, respectively Wat Hup Bon Wanaram has the lowest SO_2 concentration as the average of concentration as low as 40.52 $\mu g/m^3$.

(2) Nitrogen Dioxide (NO_2)

During the sampling period, it revealed that 1 hr NO_2 concentration at all 4 stations were not detected.

(3) Total Suspended Particulates (TSP)

Total Suspended Particulates (TSP) 24-hour for all 4 locations were found by the range of 44.17 to 78.98 $\mu g/m^3$ while the 3 days average were between 45.49 to 74.44 $\mu g/m^3$. In comparison with NEB's Standard (330 $\mu g/m^3$), the results show that the annual TSP concentration are not over standard values.

Consideration to an individual location basis, the results shown that Wat Phan Sadet Nok has the highest TSP concentration with the average of 74.44 $\mu g/m^3$ follow by Wat Phan Sadet Nai (72.55 $\mu g/m^3$), Wat Hup Bon Wanaram (71.46 $\mu g/m^3$), respectively. Wat Bo Win has the lowest level with the average of 45.49 $\mu g/m^3$.

FIGURE 3.3-1 : AIR QUALITY MEASUREMENT STATIONS

TABLE 3.3-2
EXISTING AIR QUALITY AROUND THE PROJECT AREA, MARCH 1995

Location	Date	Pollutant Concentration ($\mu g/m^3$)		
		SO_2 24-hr	NO_2 1-hr	TSP 24-hr
1. Wat Hup Bon Wanaram	13 March 1995	47.74	ND	62.69
	14 March 1995	34.62	ND	74.25
	15 March 1995	39.20	ND	77.44
Average		40.52	ND	71.46
2. Wat Bo Win	13 March 1995	58.94	ND	44.17
	14 March 1995	44.31	ND	49.74
	15 March 1995	53.63	ND	42.55
Average		52.29	ND	45.49
3. Wat Phan Sadet Nai	13 March 1995	56.94	ND	67.26
	14 March 1995	40.41	ND	76.15
	15 March 1995	37.92	ND	74.25
Average		45.09	ND	72.55
4. Wat Phan Sadet Nok	13 March 1995	46.46	ND	78.98
	14 March 1995	33.52	ND	70.55
	15 March 1995	43.15	ND	73.79
Average		41.04	ND	74.44
NEB Standard		300.00	320.00	330.000

Remark : ND = Not Detectable

TABLE 3.3-3
FREQUENCY OF OCCURRENCES OF WIND DIRECTION GROUPED IN VARIOUS WIND SPEED INTERVALS MARCH 13-16, 1995

Unit : %

Direction/ Speed	0-1 m/s	1-2 m/s	2-3 m/s	3-4 m/s	4-6 m/s	>6 m/s
N	0	0	0	0	0	0
NNE	0	0	0	0	0	0
NE	0	0	0	0	0	0
ENE	0	0	0	0	0	0
E	0	0	0	0	0	0
ESE	0	0	0	0	0	0
SE	5.56	2.78	0	0	0	0
SSE	4.17	2.78	0	0	0	0
S	16.67	0	0	0	0	0
SSW	0	0	0	0	0	0
SW	0	0	0	0	0	0
WSW	0	0	0	0	0	0
W	0	0	0	0	0	0
WNW	0	0	0	0	0	0
NW	0	0	0	0	0	0
NNW	0	0	0	0	0	0

CALM 68.06%
NO. OF TOTAL HOURS OF NON CALM 23
NO. OF TOTAL HOURS OF CALM 49

Note : Sampling Station : Wat Pan Sadet Nok, Tambon Khao Kan Song, Sri Racha District, Chonburi Province.
Source : TEAM (1995).

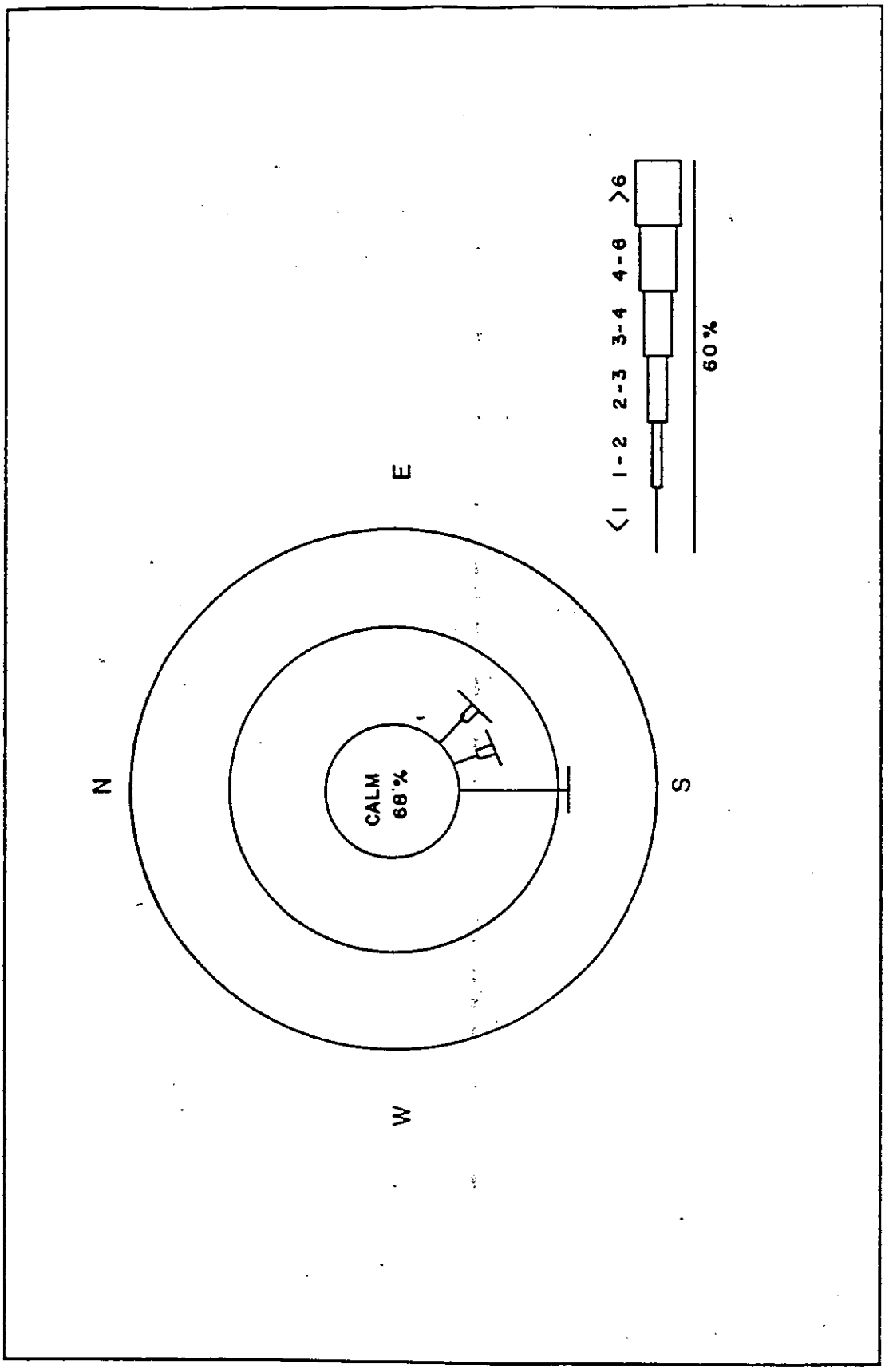


FIGURE 3.3-2 : WIND ROSE OF WAT PAN SADET NOK STATION, CHONBURI PROVINCE (13-16/3/1995)

In conclusion, the background air quality around the project area is in good condition. SO_2 and TSP levels were very low while comparison to NEB's Standard, these indicated that the great carrying capacity is available for air quality impact from the project. The undetectable of NO_2 was very useful for the project too. These are the advantage for proposed power plant to use natural gas as fuel.

3.4 NOISE

3.4.1 Introduction

Throughout the power plant development, both construction and operation phases, the level of noise is expected to be increased at the immediate vicinity of the power plant site. Therefore, it is essential to establish the baseline data of the communities' noise level in the existing condition prior to the project as a comparative mean with the data to be obtained from the future development.

3.4.2 Study Methodology

Noise measurements were undertaken at 4 sensitive receptors around the project vicinity as shown in Figure 3.4-1. At each station, noise measurement was conducted to comply with International Standard Organization (ISO) at the height of 1.5 m. from the ground level in the specially designated area in order to avoid the noise reflection from any structures by using Rion Integrating Sound Level Meter Model NL-10A with detecting noise level from 30-130 dBA at frequency of 20-12, 500 Hz. Noise measurement was conducted hourly for 24 hours for calculation of equivalent sound level (Leq 24) and day-night sound level (Ldn) as per the following equations:

$$Leq(24) = 10 \log \frac{1}{24} [10^{Li/10}] \text{ dBA; } i=1 \text{ to } 24$$

$$Ldn = 10 \log \{ \frac{1}{24} [10^{(leq)i/10} + 10^{((Leq)j+10)/10}] \}; \; i=1 \text{ to } 15, \; j=1 \text{ to } 9$$

or the simpler expression may be written as:

$$Ldn = 10 \log \frac{1}{24} [(15 \times 10^{Ld/10}) + (9 \times 10^{(Ln+10)/10})]$$

where :

i	=	the sum over the 15 hours during the daytime
j	=	the sum over the 9 hours during the nighttime
Li	=	equivalent noise level for i^{th} hour
(Leq)i	=	the equivalent noise level for the i^{th} hour during the day
(Leq)j	=	Leq for the j^{th} hour during the night
Ld	=	equivalent noise level at day during 7 am - 10 pm
Ln	=	equivalent noise level at night during 10 pm - 7 am

FIGURE 3.3-2 : WIND ROSE OF WAT PAN SADET NOK STATION, CHONBURI PROVINCE(13-16/3/1995)

KEY MAP
LEGEND
NOISE MEASUREMENT STATIONS
PROJECT LOCATION
DHON BURI INDUSTRIAL SETTLEMENT
SCALE
N
1
2
3
4

Leq 24

3.4.3 Description of Measuring Stations

The noise measurement was undertaken at 4 selected sensitive receptors (Figure 3.4-1) around the project areas during 20-24 March, 1995. The brief description of the above stations are as follows:

(1) Ban Hup Bon 378/2 Moo 1. This village is located about 5 km. northeast of the proposed site. The measuring station is near Hup Bon School and Wat Hup Bon Wanaram which surrounded by the communities.

(2) Ban Phan Sadet Nok school. This school is the sensitive receptor which far from the proposed project about 4.5 km. in the east direction.

(3) Wat Phan Sadet Nai. This temple is about 4.7 km. in the southeast direction from the proposed project. It is also surrounded by community and near Ban Phan Sadet Nai School on the east direction.

(4) Wat Bo Win. This temple is located approximately 3.5 km. south-southwest of the power plant site. School and the residential area are on the southern side of this temple.

3.4.4 Results of the Study

These sensitive receptors in the project vicinity can be affected by the increasing noise level during the construction and operation phase of proposed project. The noise measurement results at 4 designated station around the project site are shown in Table 3.4-1. The overall noise levels of the nearby communities are relatively low with the range of 53.701 to 64.397 dB(A) of Leq 24.

TABLE 3.4-1
EXISTING NOISE LEVEL AT SENSITIVE RECEPTORS
MARCH 20-24, 1995

Sampling Stations	Date	Noise Level (dB(A))	
		Leq24*	Ldn
Station 1 : Ban Hup Bon	20 Mar.1995	53.701	56.227
Station 2 : Phan Sadet Nok School	21 Mar.1995	64.397	69.146
Station 3 : Wat Phan Sadet Nai	23 Mar.1995	61.229	66.244
Station 4 : Wat Bo Win	24 Mar.1995	62.746	67.285

Source : Measurement by TEAM, 1995.
Note : * WHO Standard = 70 dB(A)

Concerning the US.EPA. noise level (Leq 24) standard of 70 dB(A), it can be concluded that the existing noise level around the project site are well within the standard.

3.5 GEOLOGY AND SEISMOLOGY

3.5.1 Introduction

The geological study of this project emphasize the identification and characterization of the underlying soil and rock layers for engineering uses. A seismic record in the area, if found to be serious, would account for special design of important structures of the project.

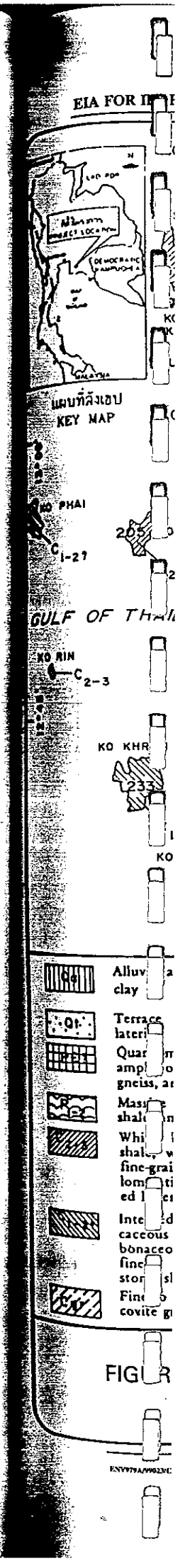
3.5.2 Study Methodology

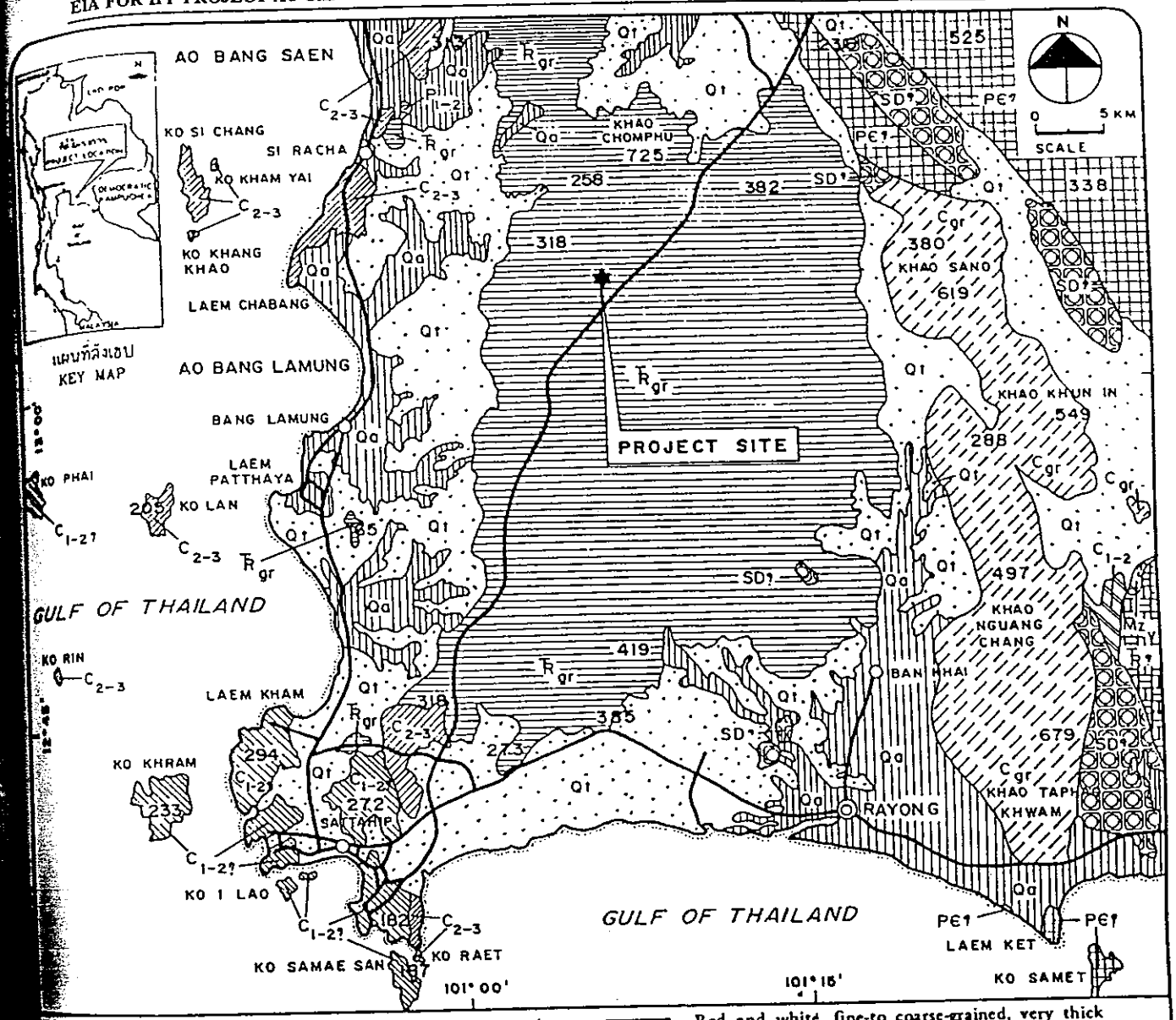
The study on geology and seismology was done by collect the secondary data from the Department of Mineral Resources.

3.5.3 Results of the Study

The geology of the study area is bear resulted from erosion surface which found in the area from Chonburi Province to Trad Province (Figure 3.5-1). Surface of this particular area is an undulating which erode from granite, quazite and mixed up by rough sand. These soil characteristics are suitable for cropping, Para rubber plantation and pasture. Considering on hydrogeology this area is granitic aquifers (Cretaceous to Precambrian) consisted of granites, diorites and associated intrusive rocks (Gr) and gneisses (Gn). Small quality of groundwater can be mainly obtained from jointing system or decomposed zones at a rate of meager to about 10 gpm although yields of up to 30 gpm has been obtained.

In term of seismologic influence, past experience and seismologic data for the project area imply an insignificant seismic potential. The project area is situated in Zone "O" which was the zone with no damage probability, as shown in Figure 3.5-2. However, if it is a requirement of the power plant, seismic conditions should be considered in establishing standard design criteria to provide adequate protection and safety of the plant.





Alluvial and coastal deposits: gravel, sand, silt, and clay

Terrace deposit: gravel, sand, silt, laterite, and lateritic soil

Quartz-mica schist, quartz-mica sillimanite schist amphibole schist, calc-silicate rock, marble, granite gneiss, and migmatite

Massive to thick bedded limestone, shale, slaty shale, and bedded chert

White bedded chert, radiolarian chert, siliceous shale, white shale, grey and carbonaceous shale, fine-grained quartz arenite, sublithic arenite, conglomeratic sandstone, and laminated to thick-bedded limestone

Interbedded sequence of thin to thick bedded micaceous sandstone and shale, grey and black carbonaceous shale; white, pink, brown, and black, fine-to coarse-foliated sandstone; foliated mudstone, slate, and chert

Fine to coarse-grained foliated, biotite and/or muscovite granites

Red and white, fine-to coarse-grained, very thick cross bedded sandstone; sandstone with shale clast, reworked mud clast conglomerate, friable quartzitic sandstone, quartz sandstone, quartz conglomerate, pebbly sandstone, siltstone, shale, and rhyodacitic flow and tuff, oncolitic limestone, undifferentiated sills of biotite porphyry, andesite and interbedded tuffaceous sandstone, shale, and local andesitic conglomerate

Medium-to very coarse-grained porphyritic biotite and/or muscovite granites, biotite-hornblende granite, quartz monzonite, and granodiorite; rarely oriented with common gigantic quartz vein, rare aplite and pegmatite

Hornblendite, diorite, andesite, and basaltic volcanic rocks (basalt porphyry, basaltic crystal tuff, basaltic lapilli tuff, basalt porphyry agglomerate), gabbro, minor rhyolite flow and tuff, and gold-bearing quartz vein

Grey, black and yellow phyllite, quartzose phyllite, and phyllitic schist, chert, quartzose schist, and graphitic schist

FIGURE 3.5-1 : GEOLOGY MAP OF THE STUDY AREA

TEAM

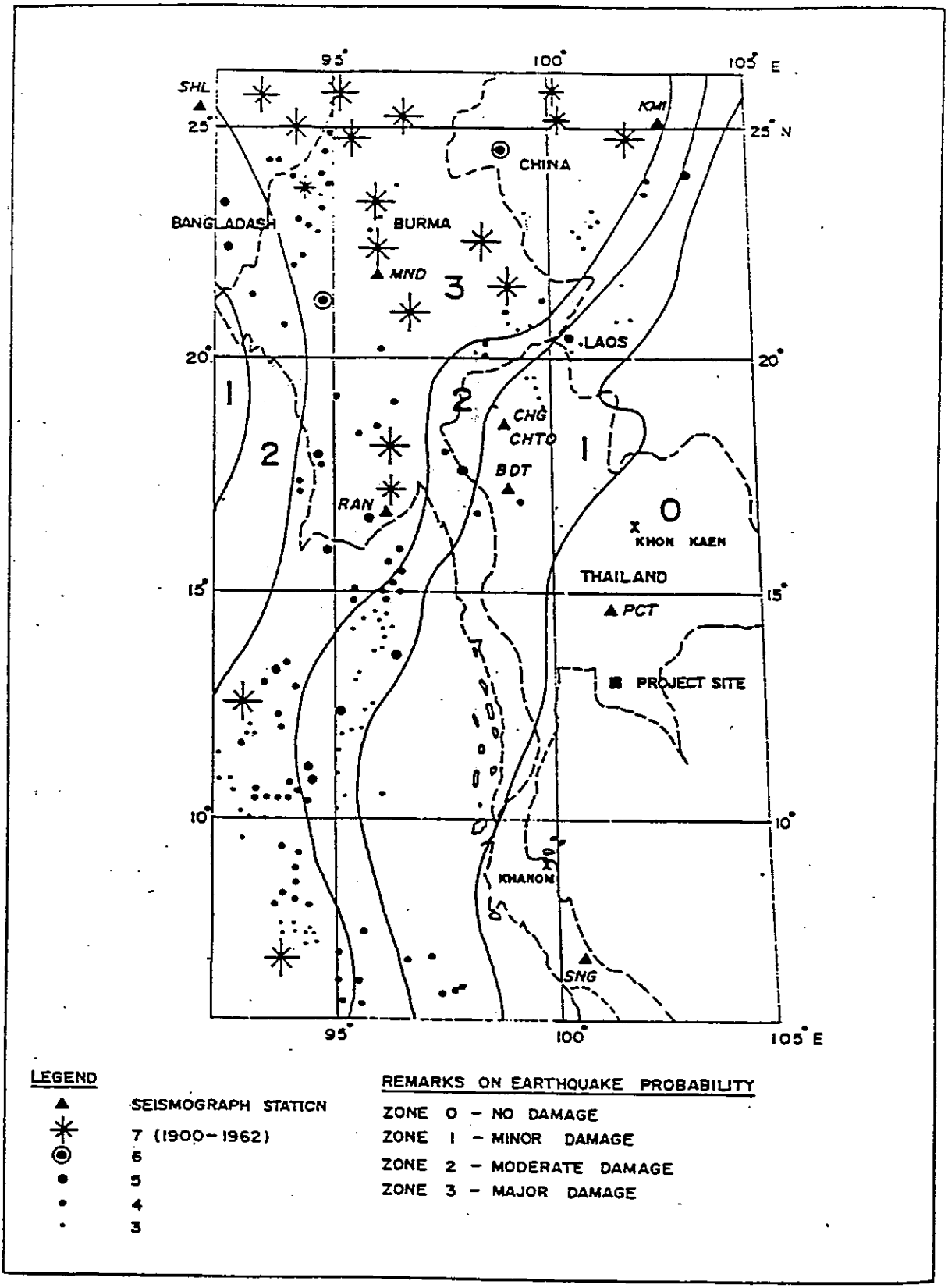


FIGURE 3.5-2 : DAMAGE PROBABILITY ZONES AND DISTRIBUTION OF EARTHQUAKE EPICENTER 1975-1981

3.6 SURFACE WATER QUALITY

3.6.1 Introduction

The power plant establishment usually affects water quality within the project vicinity. The discharging of water from the proposed project may adversely affect to water quality and aquatic ecology including fisheries, due to temperature rise and use of control fouling chemicals. The data obtained from the field survey at the concerned waterways will be taken into consideration as baseline data and for alleviating any problems which may result from the project.

3.6.2 Study Methodology

The field sampling program was designed to update the existing water quality data of concerned waterways near the project area. The 4 sampling stations (Figure 3.6-1) were designed to collect water samples for analization.

At each sampling site, water samples were collected by using Nansen Water Sampler Bottle. Water samples were collected at the middle of the canal or waterway and at the mid-depth of the water column. Some parameters, pH, temperature, conductivity, were determined in the site immediately and the remained parameters such as alkalinity, hardness, suspended solids, calcium, magnesium, sulfate, nitrate and phosphate, standard methods for examination of water and wastewater by AWWA-APHA-WECF (1992) was employed.

3.6.3 Description of Sampling Stations

The brief description of each stations are as follows:

(1) The sampling station 1-Huai Manao, the sampling point is the upstream of waterway of Bo Win Industrial Estate wastewater treatment plant discharged point. This sampling point are surrounded by idle land. This water resource is not utilized for consumption but utilized for agricultural purpose only in the rainy season due to its intermittent nature and its turbidity.

(2) The sampling station 2 - Huai Manao, downstream from Bo Win Industrial Estate wastewater discharged point, which is the tributary of Huai Phan Sadet. The surrounding areas are agricultural area which require water from this waterway. This portion of Huai Manao was relatively narrow with the depth of 0.60 m. at this sampling period. Water level fluctuates in the dry and rainy season and nearly dry out during the dry season. Major usages of this waterway is for agriculture.

(3) The sampling station 3 - Huai Phan Sadet, width at the sampling point is about 1 m. Water level fluctuates in the dry and rainy season and nearly dry out during the dry season. Major usage of this waterway is for agriculture.

KEY MAP
SCALE
1 KM.
PROJECT LOCATION
CHON BURI INDUSTRIAL SETTLEMENT
LEGEND
COMMUNITIES
SCHOOL
WAT ; TEMPLE
MOSQUE
SURFACE WATER QUALITY AND AQUATIC BIOLOGY MEASUREMENT STATIONS
GROUND WATER QUALITY MEASUREMENT STATIONS
720,000 E
730,000 E
735,000 E
1,450,000 N
1,445,000 N
1,441,000 N

(4) The sampling station 4 - The reservoir of Huai Phan Sadet, Ban Phan Sadet school is on the east of this station and utilize water from this source for all domestic purposes except drinking purpose.

3.6.4 Results of the Study

Field survey on surface water quality was conducted on 8 March, 1995 at 4 sampling stations. The results of water analysis are shown in Table 3.6-1 and concluded below:

Station 1 and 2 Huai Manao, the tributaries of Huai Phan Sadet which the water quality analysis results was in the good condition, pH value of all stations were ranged 7.1-7.7 with dissolved oxygen value of about 3.8-4.3 mg/l which the highest value was in the station 3 (Huai Phan Sadet). Oil & Grease were found consistent throughout the most sampling stations which the highest value was 0.4 mg/l at station 4. BOD_5 values were good at all station, station 1 and 2 had the BOD_5 value of 1.0 and 0.55 mg/l respectively and at Huai Phan Sadet (Station 3, 4) had the BOD_5 value of 0.60 and 1.9 mg/l respectively. In comparison with NEB standard, it showed that these values were lower than the standard while the concentration of phenol were higher than the NEB standard at all sampling station. However, Nitrate concentration was at acceptable level with values were ranged less than 0.01 to 0.23 mg/l which much lower than NEB standard (Table 3.6-2).

The concentration of Ammonia were 0.28, <0.05, 0.11 and <0.05 mg/l at station 1, 2, 3 and 4 respectively which considerably low in comparison with the surface water quality standard. In addition, total coliform and fecal coliform bacteria were much lower than the standard with the value of 110, 1600, 49 and 49 MPN/100 ml for total coliform and the value of 9, 220, 23 and 34 MPN/100 ml for fecal coliform at station 1, 2, 3 and 4 respectively. These analytical results indicated that most values of those parameters were within the class 3 of the NEB's standard which showed that the waterway is the medium clean fresh surface water resources for agricultural purpose.

For the quality of raw water for the operation activities which comprise of the water quality of Nong Kho reservoir and Nong Pa Lai reservoir are presented in Table 3.6-3 and 3.6-4.

3.7 GROUNDWATER QUALITY

3.7.1 Introduction

Since there is no plan to withdraw groundwater for any usages in the proposed project, the content of this section will, therefore, be only reference of the existing groundwater quality in the nearby project area to provide some basis for this environmental aspect.

TABLE 3.6-2
SURFACE WATER QUALITY STANDARD

Parameters	Units	Statistic	Standard Values for Class				
			1	2	3	4	5
1. Temperature	°C	-	n	n	n	n	-
2. pH value	-	-	n	5-9	5-9	5-9	-
3. Dissolved oxygen	mg/l	P20	n	6	4	2	-
4. BOD (5 days, 20°C)	mg/l	P80	n	1.5	2.0	4.0	-
5. Coliform bacteria							
- Total coliform	MPN/100 ml	P80		5,000	20,000	-	-
- Fecal coliform	MPN/100 ml	P80		1,000	4,000	-	-
6. NO_3 - N	mg/l	Max.allowance	n	<------5.0------->			-
7. NH_3 - N	mg/l	Max.allowance	n	:	0.5	:	-
8. Phenols	mg/l	Max.allowance	n	:	0.005	:	-
9. Cu	mg/l	Max.allowance	n	:	0.1	:	-
10. Ni	mg/l	Max.allowance	n	:	0.1	:	-
11. Mn	mg/l	Max.allowance	n	:	1.0	:	-
12. Zn	mg/l	Max.allowance	n	:	1.0	:	-
13. Cd	mg/l	Max.allowance	n	:	0.005* , 0.05*	:	-
14. Cr (hexavalent)	mg/l	Max.allowance	n	:	0.05	:	-
15. Pb	mg/l	Max.allowance	n	:	0.05	:	-
16. Hg (total)	mg/l	Max.allowance	n	:	0.002	:	-
17. As	mg/l	Max.allowance	n	:	0.01	:	-
18. CN	mg/l	Max.allowance	n	:	0.005	:	-
19. Radioactivity							
- Gross α	Becqurel/l	Max.allowance	n	:	0.1	:	-
- Gross β	Becqurel/l	Max.allowance	n	:	1.0	:	-
20. Pesticides (total)	mg/l	Max.allowance	n	:	0.05	:	-
- DDT	mg/l	Max.allowance	n	:	1.0	:	-
- BHC	mg/l	Max.allowance	n	:	0.02	:	-
- Dielrin	mg/l	Max.allowance	n	:	0.1	:	-
- Aldrin	mg/l	Max.allowance	n	:	0.1	:	-
- Heptachlor & Heptachlor epoxide	mg/l	Max.allowance	n	:	0.2	:	-
- Endrin	mg/l	Max.allowance	n	<------none------->			-

Note : P = Percentile value
n = naturally
n' = naturally but changing not more than 3°C
* = when water hardness not more than 100 mg/l as $CaCO_3$
** = when water hardness more than 100 mg/l as $CaCO_3$
*** = Water Classification

TABLE 3.6-2 (Cont'd)

Classification	Objective/Condition/Beneficial Usage
Class 1	Extra clean fresh surface water resources using for : (1) conservation, not necessary pass through water treatment processes require only ordinary process for pathogenic destruction (2) ecosystem conservation which basic living organisms can spread breeding naturally
Class 2	Very clean fresh surface water resources using for : (1) consumption which requrie the ordinary water treatment process before uses (2) aquatic organism conservation for living and assisting for fishery (3) fishery (4) recreation
Class 3	Medium clean fresh surface water resources using for : (1) consumption but have to pass through an ordinary treatment process before uses (2) agriculture
Class 4	Fairly clean fresh surface water resources using for : (1) consumption but require special water treatment process before uses (2) industry (3) other activities
Class 5	The resources which are not classified in class 1-4 and using for : (1) navigation

Source : Notification of the Ministry of Science, Technology and Environment (B.E.2528 (1985)). published in the Royal Government Gazette, Vol. 103. Part 60, dated April 15, B.E. 2529 (1986).

TABLE 3.6-3
WATER QUALITY OF NONG KHO RESERVOIR, 1996

No.	Parameter	Result of Quality Water Analysis						
		January	February	March	April	May	June	July
1	Turbidity (NTU)	24	26	39	31	13	24	9
2	Color (Hazen)	24.2	12.4	12.4	24.4	8.5	1.31	7
3	pH	7.12	7.78	7.57	7.20	7.05	7.35	7.84
4	Conductivity (mS/cm) at 25°C	93	96	98	98	95	96	93
5	Ca-Hardness (ppm as $CaCO_3$)	24	16	28	21	14	18	14
6	Mg-Hardness (ppm as $CaCO_3$)	14	32	10	29	10	28	20
7	Copper (mg/l)	0.04	0.01	0.04	0.03	nil	0.09	0.01
8	TDS (mg/l)	75	73	22	50	66	60	149
9	TS (mg/l)	100	91	86	69	85	79	155
10	Zinc (mg/l)	0.03	0.02	0.03	nil	0.04	0.01	0.06
11	SS (mg/l)	25	18	64	19	19	19	6
12	T-Hardness (ppm as $CaCO_3$)	38	48	38	30	24	46	34
13	Carbonate Hardness (ppm as $CaCO_3$)	30	30	28	28	24	28	24
14	Non-Carbonate Hardness (ppm as $CaCO_3$	8	18	10	2	nil	18	10
15	T-Alkalinity (ppm as $CaCO_3$)	30	30	28	28	28	28	24
16	P-Alkalinity (ppm as $CaCO_3$)	0	0	0	0	0	0	0
17	Nitrate (mg/l)	0.45	0.48	1.05	1.51	0.81	0.76	0.1
18	Nitrite (mg/l)	0.02	0.01	0.02	0.1	0.01	0.01	nil
19	Fluoride (mg/l)	0.50	0.40	0.50	0.50	0.50	0.40	0.60
20	Chloride (ppm as Cl)	7.5	4.6	8.0	8.5	6.2	6.9	5.5
21	Manganese (mg/l)	0.14	0.06	0.10	0.14	0.09	0.09	0.23
22	Total Iron (ppm as Fe)	1.17	0.32	0.55	0.32	0.38	0.49	0.13
23	Sulfatte (ppm as SO_4)	2.7	2.9	3.4	18.1	15.9	18.5	16.4
24	Fecal Coliform (mg/l)	-	<2	-	<2	-	11	-
25	DO (mg/l)	-	1	-	4	-	1.5	-
26	BOD_5 (mg/l)	-	5	-	4.1	-	4.8	-
27	Lead (mg/l)	-	-	-	nil	-	-	-
28	Cyanide (mg/l)	-	-	-	0.05	<0.01	-	-
29	Chromium (mg/l)	-	-	-	0.01	-	-	-
30	Arsenic (mg/l)	-	-	-	0.024	-	-	-
31	BHC (ppb)	-	-	-	-	-	-	-
32	Heptachlor (Less than ppb)	-	-	-	-	-	-	-
33	Heptachlor Epoxide (Less than ppb)	-	-	-	-	-	-	-
34	Aldrin (Less than ppb)	-	-	-	-	-	-	-
35	Dieldrin (Less than ppb)	-	-	-	-	-	-	-
36	DDD & DDT (Less than ppb)	-	-	-	-	-	-	-

Source : Eastern Water Resources Development and Management, 1996.

TABLE 3.6-4
WATER QUALITY OF NONG PA LAI RESERVOIR, 1996

No.	Parameter	Result of Quality Water Analysis						
		January	February	March	April	May	June	July
1	Turbidity (NTU)	4	4	5	7	4	13	6
2	Color (Hazen)	17.8	1.97	5.26	13.1	5.2	3.54	4
3	pH	8.39	7.64	7.69	7.38	7.16	7.22	7.46
4	Conductivity (mS/cm) at 25°C	98	96	105	119	100	100	97
5	Ca-Hardness (ppm as $CaCO_3$)	24	16	22	20	22	28	24
6	Mg-Hardness (ppm as $CaCO_3$)	20	32	10	12	18	14	10
7	Copper (mg/l)	0.02	nil	0.01	nil	0.03	0.07	0.09
8	TDS (mg/l)	76	70	98	68	57	100	531
9	TS (mg/l)	79	74	102	72	65	106	539
10	Zinc (mg/l)	nil	0.01	nil	0.02	0.04	nil	0.06
11	SS (mg/l)	3	4	4	4	8	6	8
12	T-Hardness (ppm as $CaCO_3$)	44	48	32	32	40	42	34
13	Carbonate Hardness (ppm as $CaCO_3$)	38	32	32	32	32	32	30
14	Non-Carbonate Hardness (ppm as $CaCO_3$	6	16	nil	nil	8	10	4
15	T-Alkalinity (ppm as $CaCO_3$)	38	32	34	32	32	32	30
16	P-Alkalinity (ppm as $CaCO_3$)	2	0	0	0	0	0	0
17	Nitrate (mg/l)	0.63	0.49	1.19	1.57	0.88	0.83	0.08
18	Nitrite (mg/l)	0.01	nil	nil	0.1	nil	nil	nil
19	Fluoride (mg/l)	0.30	0.30	0.30	0.30	0.40	0.30	0.40
20	Chloride (ppm as Cl)	7.5	5.2	9.5	7.8	7.6	7.9	6.2
21	Manganese (mg/l)	0.05	0.02	0.05	0.04	0.06	0.26	0.32
22	Total Iron (ppm as Fe)	0.03	0.03	0.09	0.17	0.08	0.31	0.11
23	Sulfatte (ppm as SO_4)	1.63	5.81	7.96	1.10	4.32	3.05	1.23
24	Fecal Coliform (mg/l)	-	<2	-	<2	-	7	-
25	DO (mg/l)	-	0	-	3	-	1.3	-
26	BOD_5 (mg/l)	-	5.1	-	4	-	5	-
27	Lead (mg/l)	-	-	-	nil	-	-	-
28	Cyanide (mg/l)	-	-	-	0.08	<0.01	-	-
29	Chromium (mg/l)	-	-	-	0.01	-	-	-
30	Arsenic (mg/l)	-	-	-	<0.001	-	-	-
31	BHC (ppb)	-	-	-	-	-	-	-
32	Heptachlor (Less than ppb)	-	-	-	-	-	-	-
33	Heptachlor Epoxide (Less than ppb)	-	-	-	-	-	-	-
34	Aldrin (Less than ppb)	-	-	-	-	-	-	-
35	Dieldrin (Less than ppb)	-	-	-	-	-	-	-
36	DDD & DDT (Less than ppb)	-	-	-	-	-	-	-

Source : Eastern Water Resources Development and Management, 1996.

3.7.2 Study Methodology

The field sampling program was designed to collect ground water sample from 3 designated wells (Figure 3.6-1). The parameters were same as the surface water quality.

3.7.3 Results of the Study

In project areas are using groundwater for community water supply and some houses have their own wells. The study was aimed at investigating existing groundwater quality in the project vicinity. It was analyzed in physical, chemical and bacterial characteristics, the results are shown in Table 3.7-1. In order to evaluate the suitability Table 3.6-3 of groundwater from these wells for drinking purpose, it is compared with the Department of Mineral Resources (DMR) Drinking Water Standard notified by Ministry of Industry in 1978 as tabulated in Table 3.7-2. The results shown that groundwater quality is good except coliform bacteria, that is over the maximum allowable concentration. The characteristics and properties of groundwater in each wells can be described as follow:

TABLE 3.7-1
GROUNDWATER QUALITY IN THE PROJECT AREA
MARCH 8, 1995

Parameters	Station*		
	1	2	3
Physical Properties			
Temperature (°C)	25	27	27
Conductivity (μmhos/cm)	196	178	96
Suspended Solids (mg/l)	0.40	<0.40	<0.40
Total Dissolved Solids (mg/l)	190	200	140
Chemical Properties			
pH	6.5	6.0	5.2
BOD_5 (mg/l)	0.60	0.45	0.45
Total Hardness (mg/l as $CaCO_3$)	121	62.0	36
NH_3-N (mg/l)	<0.05	<0.05	<0.05
NO_3-N (mg/l)	<0.01	12.2	6.0
Bacterial Properties			
Total Coliform Bacteria (MPN/100 ml)	140	13	180
Fecal Coliform Bacteria (MPN/100 ml)	34	<2	26

Source: Field Survey by TEAM, 1995

* Station 1 : 249 Moo 4 Ban Nong Kham
Station 2 : Ban Map Bon
Station 3 : Ban Phan Sadet Nai

TABLE 3.7-2
GROUNDWATER QUALITY STANDARDS FOR DRINKING PURPOSE

Properties	Parameters	Units	Standard Values	
			Suitable Allowance	Max. Allowance
Physical	Colour	Platinum-Cobalt	5	50
	Turbidity	NTU	5	20
	pH	-	7.0-8.5	6.5-9.2
Chemical	Fe	mg/l	0.5	1.0
	Mn	mg/l	0.3	0.5
	Cu	mg/l	1.0	1.5
	Zn	mg/l	5.0	15.0
	Sulphate	mg/l	200	250
	Chloride	mg/l	200	600
	Fluoride	mg/l	1.0	1.5
	Nitrate	mg/l	45	45
	Total Hardness as $CaCO_3$	mg/l	300	500
	Non Carbonate Hardness as $CaCO_3$	mg/l	200	250
	Total Solids	mg/l	750	1,500
Toxic	As	mg/l	none	0.05
	Cyanide	mg/l	none	0.2
	Pb	mg/l	none	0.05
	Hg	mg/l	none	0.001
	Cd	mg/l	none	0.01
	Se	mg/l	none	0.01
Bacterial	Standard Plate Count	Colonies/ml	500	-
	Coliform Bacteria	MPN/100 ml	2.2	-
	E. Coli	MPN/100 ml	none	-

Penalty : A licensee who does not comply with this notification shall be punished by fine not exceeding twenty thousand baht.

Source : Notification of the Ministry of Industry No.4 B.E.2521 (1978) issued under in the Groundwater Act B.E.2520 (1900), published in the Royal Government Gazette, Vol. 95, Part 66, dated June 27, B.E. 2521 (1978).

Station No.1 : 149 Moo 4 Ban Nong Kham. The usage purpose is for domestic consumption. The properties of this groundwater sample were that pH value was 6.5 with the hardness value was 121 mg/l which lower than the standard for drinking purpose. The concentration of nitrate was less than 0.01 mg/l which was much lower than the standard. However the amount of total coliform and fecal coliform bacteria were value 140 and 34 MPN/100 m. respectively. Therefore, treatment process is needed to improve the water quality for drinking.

Station No.2 : Ban Map Bon. This sampling point is at the community public health center. It is also utilized for drinking purpose and any domestic activities. The properties of this sample were that pH value was 6.0 which is not suitable for drinking follow with the standard. The hardness value was relatively low of about 62 mg/l with nitrate value was only 12.2 mg/l. The most parameters were within the standard for groundwater for drinking purpose except coliform bacteria and pH value. The amount of total coliform bacteria and fecal coliform bacteria were 13 and less than 2 MPN/100 ml respectively. Therefore, this sample should be treated by disinfection process before drinking.

Station No.3 : Ban Phan Sadet Nai. Water Quality of this well was similar to the station No.1 and 2. Amount of total coliform bacteria and fecal coliform bacteria were 180 and 26 MPN/100 ml respectively. This well was utilized for consumption and drinking purpose. Thus, disinfection process is needed to improve its quality before use.

3.8 AQUATIC BIOLOGY

3.8.1 Introduction

Currently, it is planned that Huai Manao and Huai Phan Sadet will be the main channel for the treated water after power plant usage will be discharged. These activities may pose some impacts on aquatic ecology and fishery due to the use of chemicals and cooling water discharge. This study, therefore, will obtain baseline data of the study area prior to any development which can lead to appropriate recommendations for this environmental aspects.

3.8.2 Study Methodology

Four sampling stations were designated along Huai Manao and Huai Phan Sadet stretch as shown in Figure 3.6-1. At each sampling site, the following specimens were collected:

(1) Plankton organisms and
(2) Benthic organisms

During sampling period, observation was also made on types and abundance of aquatic weeds in the canals.

Plankton samples collection: At each of the water sampling, station, samples were collected by using 70 micron mesh size plankton net. For their abundance, a known volume of water (30 liters) was taken from the water surface (0-30 cm), then poured through a plankton net and sample was transferred into a glass bottle, then preserved in 5% formalin solution for further identification at the Biological Productivity Laboratory, Kasetsart University. The characteristics of the plankton sampled being studies were included: family, genera or groups in population, predominant groups, frequency of occurrence and abundance of the population. Identification keys were Simonson (1974); Wicksteod (1965) and Kokudo (1960).

Benthic invertebrate animal collection: Benthic animals were also sampled at the same station as planktonic samples. The sampling device used was an Eckman dredge (0.5 sq.ft.). For each grab of sediments, quick observations were made of the texture of the mud including its cohesiveness, and composition of the sediments (debris, mud, clay, etc.). Then the sediments were sorted through a series of wire sieves to separate benthic animals. The samples were then preserved in 7% formalin solution for further identification in the research laboratory, Kasetsart University. The characteristics to be studied of these samples were the same as those of the plankton samples. Specimens' identification was made with the aid of Brandf (1974), Brinkhursf (1971), Merriff and Cummins (1984), and William and Felmate (1992).

3.8.3 Results of the Study

(1) Plankton Organism

Table 3.8-1 shows species composition and abundance of plankton organisms found at four sampling stations on March 8, 1995.

As for Phytoplankton, the filamentous blue green algae *Oscillatoria* sp. was the species presented with relatively high abundance at all sampling stations. Green algae *Microcystis aeruginosa* was very high abundance at station 2 with the density of 1,600,000 cells per litre. Nineteen species of diatom were found from the samples and there were only two species of diatom found at station 2.

TABLE 3.8-1
SPECIES COMPOSITION AND ABUNDANCE OF PLANKTON ORGANISMS
MARCH 8, 1995

(cell/Litre)

Scientific Name	Station			
	1	2	3	4
Phytoplankton				
Phylum Cyanophyta (Blue-green algae)				
Lyngbya martensiana Meneghini	-	-	-	18,000
Merismopedia convoluta Brebisson	-	-	-	60,000
Microcystis acruginosa Kutzing	-	1,600,000	-	-
Oscillatoria spp.	83,333	-	9,667	57,000
Phormidium mucicola Naumann & Huber - Pestalozzi	-	-	-	4,500
Trichodesmium lacustre Klebahn	8,333	-	-	9,000
Phylum Chlorophyta (Green algae)				
Closterium ehrenbergii Meneghini	-	8,000	-	-
Cl. Leibleinii Kutzing	1,667	-	-	-
Cl. setaceam Ehrenberg	-	-	-	3,000
Mougeotia sp.	13,333	-	1,933	3,000
Pediastrum biwae Negoro	-	-	-	1,500
P. simplex var. duedenarium (Bailey)	-	-	-	1,500
Schizomeris sp.	-	-	-	1,500
Spirogyra spp.	96,667	21,333	1,933	147,000
Staurastrum gracile Ralfs	-	-	-	3,000
Tetraedron gracile (Reinsch) Hansgirg	-	-	-	1,500
Phylum Bacillariophyta (Diatoms)				
Achnanthes lanceolata (Brebisson) Grunow	1,667	-	-	-
Diatoma elongatum Agardh	53,333	5,333	17,400	52,000
Eunotia pectinalis (Kutzing) Robenhorst	-	-	-	-
Gyrosigma sp.	1,667	-	-	-
Navicula lanceolata (Agardh) Kutzing	-	-	-	-
Navicula placentula (Ehrenberg) Grunow	-	-	-	1,500
Neidium affine (Ehrenberg) Cleve	3,333	-	-	-
Nitzschia commutata Grunow	-	-	5,800	-
N. palea (Kutzing) W. Smith	-	-	-	-
N. sp.	23,333	-	-	-
Pinnularia nobilis Ehrenberg	3,333	-	-	1,500
Pleurosigma sp.	-	-	-	1,500
Rhizosolenia longiseta Zacharias	-	-	-	4,500
Surirella elegans Ehrenberg	-	-	3,867	4,500
S. robusta Ehrenberg	-	-	-	-
S. robusta var. splendida (Ehrenberg) van Heurck	-	-	1,933	27,000

TABLE 3.8-1 (Cont'd)

(cell/Litre)

Scientific Name	Station 1	Station 2	Station 3	Station 4
Synedra tabulata str.	3,333	-	-	-
S. tabulata var. acuminata Grunow	1,667	-	-	-
S. pulchella var. lanceolata Str.	-	2,667	-	-
Phylum Pyrrophyta (Dinoflagellates)				
Ceratium hirundinella (O.F. Muller) Dujardin	-	-	-	1,500
Phylum Euglenophyta (Euglenoids)				
Euglena geniculata Dujardin	-	-	1,933	-
E. pisciformis Klebs	3,333	-	-	-
Phacus pleuronectes O.F. Muller	1,667	-	-	-
Subtotal Phytoplankton	299,999	1,637,333	44,466	404,500
Zooplankton				
Phylum Protozoa (Protozoans)				
Arcella vulgaris Ehrenberg	1,667	8,000	23,200	15,000
Centropyxis aculeata Stein	-	2,667	3,867	-
C. ecornis (Ehrenberg) Leidy	-	-	11,600	3,000
Difflugia globulosa Dujardin	-	5,333	9,667	6,000
D. limnetica Levander	-	-	-	7,500
Phylum Rotifera (Rotifers)				
Asplanchna brightwellii Gosse	-	-	-	3,000
Brachionus angularis Gosse	-	-	-	12,000
B. falcatus zacharias	-	-	-	127,500
Lecane rhenana Hauer	-	-	-	10,500
Monostyla crenata (Harring)	-	-	1,933	-
Polyarthra vulgaris Carlin	-	-	-	4,500
Phylum Arthropoda (Arthropods)				
Alona rectangula G.O. Sars	-	-	13,533	-
Copepod nauplius	20,000	5,333	15,467	12,000
Cyclop sp.	8,333	-	-	1,500
Diaptomus sp.	-	2,667	-	-
Insect larva	-	-	-	3,000
Moina micrura Kurz	-	-	-	1,500
Subtotal Zooplankton	30,000	24,000	79,267	207,000
Grandtotal	329,999	1,661,333	123,733	611,500

Station 1, 2 and 4 contained higher cell numbers and percentage of phytoplankton than zooplankton. On the contrary, station 3 was the only one station that contained cell numbers and percentage of zooplankton. The dominant zooplankton found at station 4 was protozoan, arthropod (larvae forms) and rotifera. Rotifera was found only at station 4 and the dominant species was *Brachionus falcatus*.

(2) Benthic Animals

Low biomass and species composition of benthic organisms were obtained in all samples collected on March 8, 1995 (Table 3.8-2).

TABLE 3.8-2
SPECIES AND ABUNDANCE OF BENTHIC ORGANISMS
MARCH 8, 1995

Scientific Name	Station 1	2	3	4
TAXON (OR GROUP)				
PHYLUM ANNELIDA				
Class Oligochaete (Aquatic Earth Worm)				
Family Tubificidae	22	-	22	-
Family Naididae	-	-	22	-
PHYLUM ARTHROPODA				
Class Insecta (Insect Larvae)				
Order Diptera (Two winged flies)				
Family Chironomidae	22	-	22	-
Family Ceratopogonidae	22	-	-	-
Family Tipulidae	-	22	-	-
PHYLUM MOLLUSCA				
Class Gastropoda (Snail)				
Family Thiaridae *Melanoides* sp.	-	-	-	66
Family Viviparidae *Ttochotaia* sp.	-	-	22	-
Density (individual/sq.m.)	66	22	88	66

Aquatic earth worms found in bottom samples collected from station 1 and 2 included those in the families of Tubificidae and Naididae and did not present in the others samples. Insect larvae of Family Chironomidae was found at station 1 and 2 whereas the aquatic midge of Family Ceratopomidae was found only at Station 1. Insect larvae of Family Tipulidae was found only at station 2.

There were no aquatic worms and insect larvae found at station 4 where the small snail of Family Thiaridae *Melanoides* sp. was collected only this stations.

It is interesting to note that there was only one species of benthic animal found at station 2 and 4.

3.9 WATER USE

3.9.1 Introduction

One major factor of power plant project is water supply for domestic consumption and uses in cooling system of the power plant. In this study, an investigation on various types of water use and existing water resources in the project area is conducted and the probable impacts which might occur as a result of proposed project are assessed.

3.9.2 Study Methodology

Information and secondary data on water use was collected from NESDB study on Information and Potential for Water Resources Development in The Eastern Coast Basin (1994) and the study on Nong Pla Lai - Nong Kho Water Pipeline Project (1992) of PWD.

3.9.3 Results of the Study

3.9.3.1 Water Resources

The purposes of water use in the proposed project can be classified into 2 main types, i.e., for domestic consumption and uses in cooling system. There are 2 main reservoirs that are major source of water supply in this project. The raw water will be pumped from these reservoirs through underground pipeline, which runs to the existing project, these reservoir include:

(1) Nong Pla Lai Reservoir

Nong Pla Lai reservoir is located in Tambon Lahan, Tambon Map Yang Phon, Tambon Pluak Daeng, Pluak Daeng District, Rayong Province. It's aimed to impound surface water for industrial uses in the Eastern Seaboard development project and for agricultural uses about 30,000 rai at Ban Khai District. Additionally, it is also for flood control in Rayong basin and enhancing fishery production. Dam is crossing Klong Rawoeng and Klong Pong Nam Pid. The mean average annual inflow is about 126.1 Mm^3/year and has water supply capacity of 102.5 Mm^3/year.

The details of the dam are as follows:

Dam height	:	24 m.
Crest length	:	4,060 m.
Crest width	:	8 m.
Dam Volume	:	164.7 Mm^3

At present, Nong Pla Lai reservoir has the main purpose to assure the irrigation water supply in the Ban Khai proper and extension areas in lieu of the Dok Krai reservoir and Nong Kho reservoir. Table 3.9-1 presents the water demand of Industrial sector in Chonburi Province. In the future, there will be Nong Pla Lai - Nong Kho water pipeline project, water from Nong Pla Lai reservoir will be piped to Nong Kho reservoir in Sri Racha District at the rate of 63 Mm^3/year with approximate distance of 41.1 km to supply water for Laem Chabang Industrial Estate and adjacent area. It is expected that this water resource will be adequated the demand up to the year 2001.

(2) Nong Kho Reservoir

This reservoir is located about 6 km. northwest of the project area with the capacity of 18.8 Mm^3. Most of water is supplied to the Laem Chabang municipality and nearby area. Quantity of water to be supplied to the industrial estate in this area is presented in Table 3.9-2.

3.9.3.2 Downstream Water Use

According to the field survey and interviews of local people in the project area, it is found that people down stream of Huai Manao and Huai Phan Sadet do not use water from these canals for consumption because of their turbidity, shallowness and intermittent nature. At present, water from these streams is only used for agricultural purpose in the wet season. However, at Ban Phan Sadet Nai, Huai Phan Sadet is now being dredged to connect to the small pond that will be utilized as source of water for village water work.

3.10 LAND USE

3.10.1 Introduction

The current land use pattern around the project site is predominated by agricultural area especially upland crop. The development of the proposed power plant may induced some alteration in land use pattern in the vicinity of the project. In order to be able to assess such impact, the existing information on land use needs to be obtained and the relevant measures and monitoring programs will be resulted from the study.

water use

TABLE 3.9-1
WATER DEMAND OF INDUSTRIAL ESTATE IN CHONBURI PROVINCE

User	Rate of Water Use (m³/rai/day)	1991 Area (rai)	1991 Water Demand (Mm³/year)	2001 Area (rai)	2001 Water Demand (Mm³/year)	2011 Area (rai)	2011 Water Demand (Mm³/year)
1. Bang Pakong Industrial Estate	7.67	2,908	8.14	3,700	10.36	4,510	12.63
2. Thong Grows Industrial Estate	7.67	-	-	400	1.12	488	1.37
3. Chonburi Industrial Estate (Bo Win)	7.67	1,600	4.48	350	9.80	4,266	11.94
4. Laem Chabang Industrial Estate	7.67	1,870	5.26	3,556	9.95	4,335	12.14
Total	30.68	6,378	17.88	8,006	31.23	13,599	38.08

Source : PWD Report Study on Nong Pla Lai - Nong Kho Water Pipeline Project, 1992.

TABLE 3.9-2
WATER DEMAND OF INDUSTRIAL SECTOR FROM NONG KHO RESERVIOR

Water User	Area (rai)	Water Quantity (mcm)					
		1994	1995	1996	2000	2003	2006
1. Laem Chabang Industrial Estate	3,566.00	4.80	5.90	7.00	11.40	12.50	12.50
2. Laem Chabang Port	-	0.63	0.75	0.88	1.38	1.50	1.50
3. Bo Win Industrial Estate	2,462.63	4.50	8.85	-	-	-	-
4. Sir Racha Farm Co., Ltd.	-	0.43	0.43	0.43	0.43	0.43	0.43
5. Thai Oil	-	0.50	1.26	1.56	2.25	2.50	2.50
6. Saha Phattana Industrial	1,202.00	2.20	3.50	4.80	4.80	4.80	4.80
7. Laem Chabang Waterwork	-	-	7.30	9.00	17.80	21.30	23.35
Total	7,230.63	13.06	27.99	23.67	38.06	43.03	45.08

Source : NESDB Study on Information and Potential for Water Resources Development in The Eastern Coast Basin, (1994).

3.10.2 Study Methodology

Major approaches were taken in the land use study. These steps can be summarized as follows:

(1) Aerial Photo Interpretation

The project area is situated on the undulating plain of the Eastern Part of Thailand river with the study area of about 78.57 km². The 1990 aerial photo was utilized to preliminary classify the land use.

(2) Field Verification

After the aerial photo interpretation, field verification was undertaken to confirm the existing land use pattern with the information on the aerial photo. This step is very important in order to ensure the accuracy of the future interpretation.

(3) Map Preparation

All of the detailed information recorded in the aerial photo were transferred into the reference map at 1:50,000 scale.

3.10.3 Results of the Study

The overall study area of about 78.57 km² can be divided into 5 main categories, i.e., agricultural area, residential area, industrial area, idle land and government institution. The detailed locations of these land use types shown in Figure 3.10-1 and Table 3.10-1 show land size of all land use categories.

(1) Agricultural Area

Agricultural area is the predominant land use type of the study area that occupied the total area of 54.27 km² (33,918.75 rai) or 69.0 percent of the overall study area. Agricultural practices include cassava 30.30 km² follows by mixed orchards 16.50 km², pine apple 5.36 km², coconut 0.90 km², mango 0.64 km², eucalyptus 0.41 km² and para rubber 0.16 km².

(2) Residential Area

Residential area in the 5 km radius of the project site covered the area of 1.54 km² (962.5 rai) or 2.0 percent of the study area.

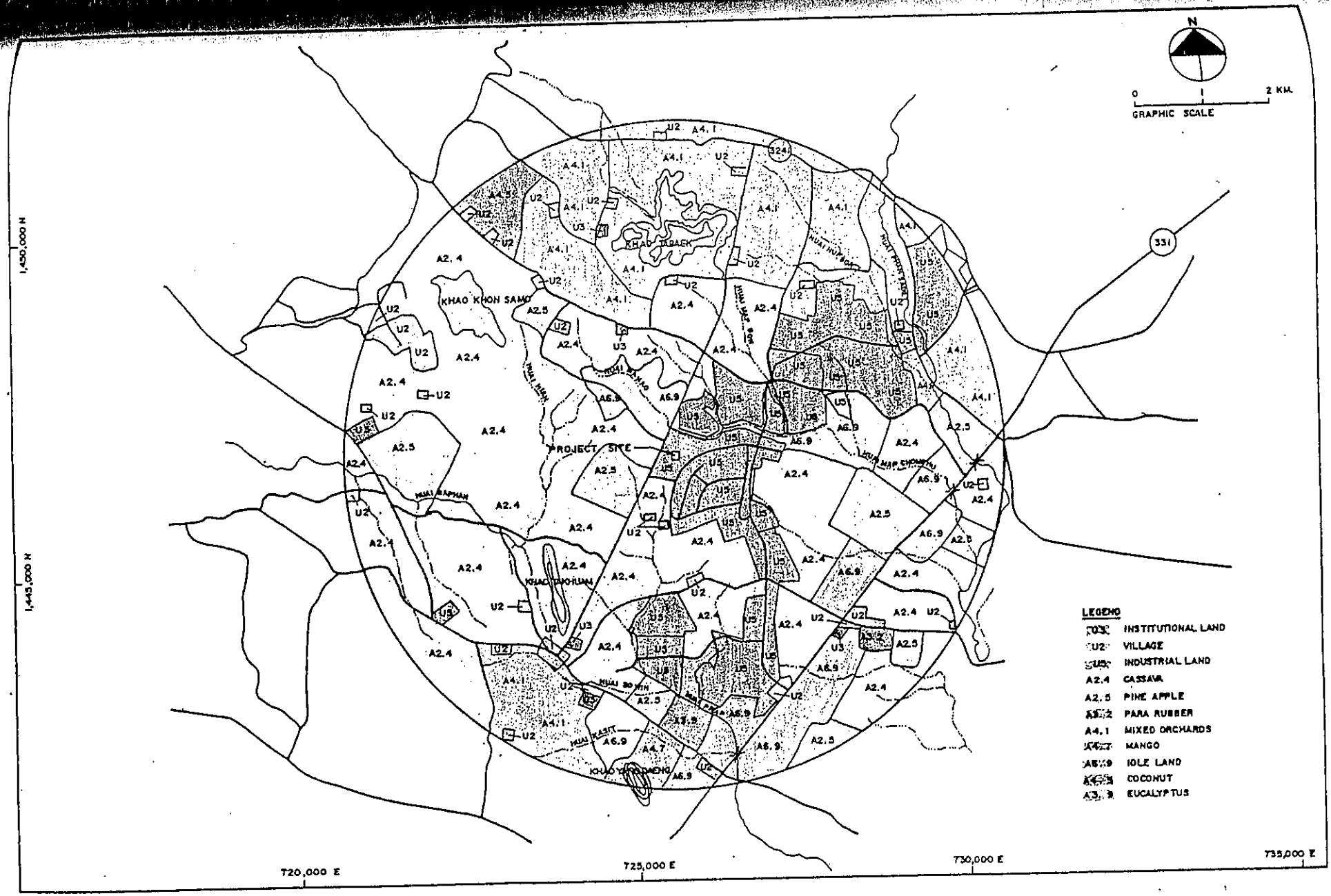


FIGURE 3.10-1 : LAND USE PATTERN IN THE VICINITY OF PROJECT AREA

TABLE 3.10-1
LAND USE CATEGORIES IN THE 5 KM RADIUS
OF THE PROJECT AREA, APRIL 1995

Land Use Categories	Area (km^2)	Percentage
Agricultural Area	54.27	69.1
- Cassava	30.30	38.6
- Pine Apple	5.36	6.8
- Para Rubber	0.16	0.2
- Mixed Orchards	16.50	21.0
- Mango	0.64	0.8
- Coconut	0.90	1.1
- Eucalyptus	0.41	0.5
Residential Area	1.54	2.0
Industrial Area	9.63	12.3
Idle Land	7.10	9.0
Government Institution	0.14	0.2
Other (Road, Water Bodies, etc.)	5.89	7.5
Total	78.57	100.0

Ban Bo Win, located on the south-west of the project site is the largest village in the project study area. Type of houses in this village is mostly occupied with shop-house. Ban Phan Sadet Nok, Ban Khao Hin and Ban Pak Ruam are settled along Highway No.331 in the east to south-east of the project site. Ban Huai Hian, Ban Dan Si and Ban Rai Khan Samo located on the west of the project site. Ban Nong Tangkwa and Ban Lang Khao settled on the north-west of the project site. Ban Yang En, Ban Noen Tong, Ban Khao Phai and Ban Hup Bon located on the north of the project site. Ban Siri Anusorn and Ban Map Bon located on the north-east of the project site.

These villages comprise of various types of houses, but are mostly made of wood or concrete with concrete roof. The roads between these villages are mostly asphaltic surface road.

(3) Industrial Area

Industrial area is covered the area of 9.63 km^2 (6,018.75 rai) or 12.3 percent of the study area. Bo Win (Chonburi) Industrial Estate which the proposed power plant will be situated is the major industrial land utilization in the study area with the area of 2,462.63 rai and planned to expand the area to 4,355 rai in the year of 2011. Industrial area is now highly increasing in the study area. The others industrial estate namely, Laem Chabang Industrial Estate, Sahapattana Industrial Estate are located outside the 5 km radius of the project site.

(4) Idle Land

This land use category covered the area with no predominant land use pattern. Some of the area are currently covered with grass and weeds. Idle land is occupied the area of 7.10 km² (4,437.5 rai) or 9.0 percent of the study area. The idle land utilization is bear results from the transfer of the land owner from the farmer to the investors.

(5) Government Institution

Government institution land utilization also included public and government area, e.g., schools, temples and public health stations such as Nikon Rat Bamrung school, Likhit Rat Bamrung school (Ban Bo Win), Wat Hup Bon Wanaram, Wat Phan Sadet Nok, Wat Santi Khiri, Wat Yang En, Wat Khao Tabaek, Wat Bo Win, Bo Win health station, Hup Bon health station etc.

Government institution is occupied the area of 0.14 km² (87.5 rai) or 0.2 percent of the study area.

(6) Others Land Use

The other land use category is included the water body, road and tracks etc. This land use type is covered the area of 5.89 km² (3,681.25 rai) or 7.5 percent of the study area.

3.11 TRANSPORTATION

3.11.1 Introduction

Traffic volumes of the major highways in the studied area were investigated as a basis for impact assessment of the project especially during construction and operation periods. In addition, the proposed project is adjacent to Highway number 331, thus, direct impacts may be on the increased traffic volume of this route.

3.11.2 Study Methodology

The information related to transportation network and traffic volumes in the project vicinity were collected and reviewed. The field observations were made on the road network and navigational pattern around the nearby waterway.

3.11.3 Results of the Study

3.11.3.1 Road Network

There is an existing network of inter-regional, national, secondary, and provincial highways as shown in Figure 3.11-1. Most of these highways are furnished with asphaltic surface. However, there are some rural roads with single surface treatment as lateritic surface linking between communities.

(1) Highway No.36 (New Chonburi - Pattaya) : The Highway starts from Chonburi Province and ends at Highway No.36 (by pass Rayong district). It is an asphaltic surface road.

(2) Highway No.331 : This Highway connects Rayong Province with Chachoengsao Province. It begins at Sattahip District and passes through Plaeng Yao District, Tambon Bo Win and ends at Bang Khla District. The total length is 135 km. It is an asphaltic surface road. It is the main road that people in the local communities in the project area use in traveling to Chachoengsao Province.

(3) Highway No.3241 : This Highway joins with Highway No.36 at Sri Racha Districtof Chonburi Province and end at Highway No.331, Ban Pak Ruam, Sri Racha District. The total length is 24.786 km. with an asphaltic surface treatment road.

3.11.3.2 Traffic Volume

The traffic volumes at major highway throughout the country are recorded by Department of Highway (DOH) as shown in Table 3.11-1 and 3.11-2 for the concerned highways in the project area.

(1) Highway No.36 : There were 2 observed stations as follows:

- Km. 2+000 JCT.R.3 (Bang Lamung) - R. 331 (Rayong Dist.)
- Km. 38+000 KM : 16+700 (Chonburi Dist.) - By Pass Rayong

The total traffic volume was within a range at 6,000-13,000 vehicles per day during 1991-1994. In 1991-1992, the number was within 6,000-10,000 vehicles per day and increased to 16,000 vehicles per day in 1993-1994. This was because of the new investment programs and the road improvement accelerated in the area as in Chonburi, By Pass Rayong. On route 36 (2+000) in 1991-1994 light vehicles occupied a proportion of 74% while heavy vehicles were about 26% (Table 3.11-2).

(2) Highway No.331 : There were 2 (DOH) observed station as follows:

- KM. 96+234 - KM. 66+000 (Chachoengsao Dist.)
- KM. 66+000 - (Chonburi Dist.) - KM. 40+000
- KM. 40+000 - R. No.304

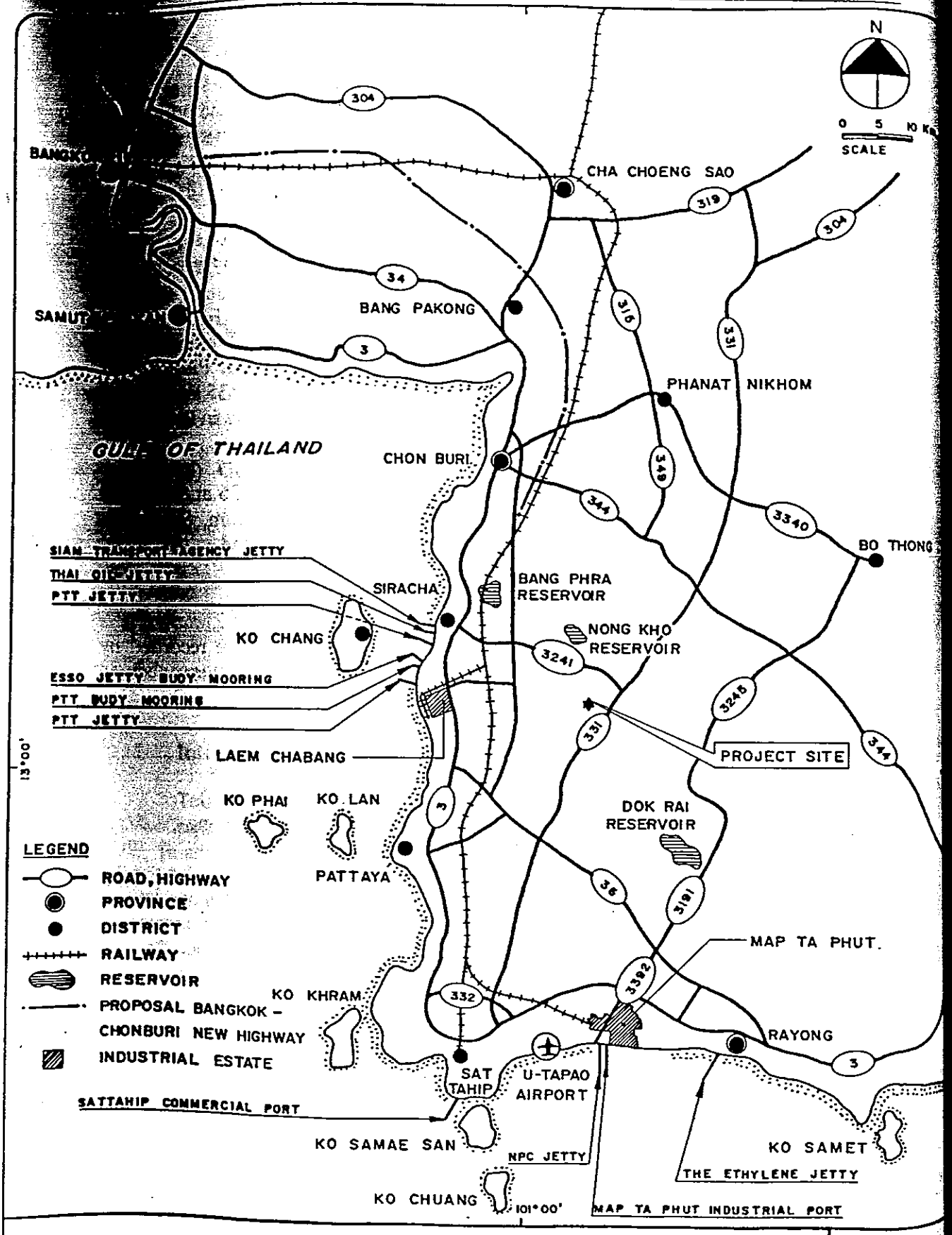


FIGURE 3.11-1 : THE EXISTING NETWORK OF MAINROAD IN THE PROJECT VICINITY AREA

TEAM

TABLE 3.11-1
ANNUAL AVERAGE TRAFFIC VOLUME ON MAJOR ROUTES IN THE PROJECT STUDY AREA, 1991-1994

Route No.	Control Section	Station Km.	Year 1991			1992			1993			1994		
			LV	HV	Total	LV	HV	Total	LV	HV	Total	LV	HV	Total
36	100	2+000	5,001	1,296	6,297	7,462	2,810	10,272	6,806	3,403	10,209	8,789	2,247	11,036
	200	38+000	4,844	1,310	6,154	6,822	1,484	8,306	11,319	2,890	14,209	12,371	2,727	15,098
331	200	76+000	2,140	680	2,820	2,168	733	2,901	2,950	985	3,935	3,548	1,349	4,897
	300	40+000	2,207	659	2,866	2,458	951	3,409	2,911	1,045	3,956	1,735	4,278	6,013
	400	17+000	2,077	1,822	3,899	1,999	1,837	3,836	4,920	3,807	8,727	8,043	5,757	13,800
3241	100	12+750	1,594	549	2,143	1,732	337	2,069	2,742	625	3,367	2,253	492	2,745

Remark : LV = Light Vehicles
HV = Heavy Vehicles

Source : Department of Highway.

TABLE 3.11-2
PERCENTAGE OF ANNUAL AVERAGE DAILY TRAFFIC VOLUME BETWEEN LIGHT VEHICLES AND HEAVY VEHICLES ON MAJOR ROUTES IN THE PROJECT STUDY AREA, 1991-1994

Route No.	Control Section	Station Km.	Year							
			1991		1992		1993		1994	
			LV	HV	LV	HV	LV	HV	LV	HV
36	100	2+000	79.4	20.6	72.4	27.6	66.7	33.3	79.4	20.6
	200	38+000	78.7	21.3	82.1	17.9	79.7	20.3	81.9	18.1
331	200	76+000	75.9	24.1	74.7	25.3	75.0	25.0	72.5	27.5
	300	40+000	77.0	23.0	72.1	27.9	73.6	26.4	71.1	28.9
	400	17+000	53.3	46.7	52.1	47.9	56.4	43.6	58.3	41.7
3241	100	12+750	74.7	25.6	83.7	16.3	81.4	18.6	82.1	17.9

Remark : LV = Light Vehicles
HV = Heavy Vehicles

Source : Department of Highway.

The traffic volume on Highway No.331 was with a range of 2,000-14,000 vehicles per day during 1991-1994. Highway No.331 at station (40+000) Km. 66+000 (Chonburi Dist.) - KM. 400+000 had a total traffic volume within a range of 2,000-4,000 vehicles per day during 1991-1993 and increased slightly in 1994.

(3) Highway No.3241 : Highway NO.3241 at (12+750) of Sri Racha District - R. NO.331 had a total traffic volume within a range of 2,000-4,000 vehicles per day during 1991-1994. Light vehicles and heavy vehicles on highway occupied a proportion of 80 and 20%, respectively.

3.11.3.3 Navigation

According to the field surveys and interviews at project area, it is found that Huai Phan Sadet Nai and Huai Manao are not means of transportation due to their shallowness and fluctuation of water levels.

3.12 SOCIO-ECONOMICS

3.12.1 Introduction

The socio-economic study covers the area within 5 km radius of the power plant with the concerns on villages in the immediate vicinity of the site and in the prominent wind direction of the power plant.

There are 4 major objectives in this study as follows;

(1) To evaluate the socio-economic condition of the area and find out occupation and other living problems of the people in the area;
(2) To learn about quality of life of the people living in such an environment;
(3) To evaluate the people's ability to live within this existing environment and their adaptability; and
(4) To learn about their perception, attitude and impact of the Project and recommend improving measures.

3.12.2 Methods of Study

Two methods of study were utilized, i.e., collecting information from secondary data and socio-economic study on field survey.

3.12.2.1 Secondary Data Collection

Documents and research reports relating to socio-economic of studied area were reviewed and analyzed. There are:

- Summary Report of Sri Racha District, Chonburi Province (1993)

- Summary Report on Socio-Economic Condition of Chonburi Province (1993)
- Summary Report on Marketing Condition of Chonburi Province (1993)
- Report on Sanitary Condition at Village Level (08 RB 3 T)

3.12.2.2 Data Collection

The data derived from field survey comprising constructed questionnaire for household can be elaborated below:

(1) Population and Sample

The frame of this study is the household heads in the studies area within 5 km. radius of the power plant. There are 7 villages in 3 Tambon of Sri Racha District, which expect to be affected from the proposed project were selected for the study, these villages are as follow:

(a) Tambon Bo Win
- Ban Huai Hian (Moo 1)
- Ban Bo Win (Moo 2)
- Ban Khao Hin (Moo 6)
- Ban Pak Ruam (Moo 3)

(b) Tambon Nong Kham
- Ban Khao Tabaek (Moo 4)

(c) Tambon Khao Khan Song
- Ban Phan Sadet Nok (Moo 8)
- Ban Siri Anuson (Moo 2)

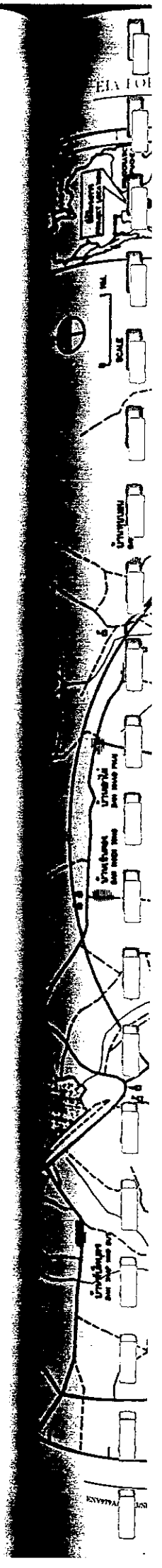
The data on population and household in the project area was collected from sub-district health station and Sri Racha District office.

In Selection of samples, about 10 percent of the number of household in each village were randomly picked. More details on sample distribution and the sample villages locations are shown in Figure 3.12-1.

(2) Questionnaire Structure and Administration

The Questionnaire used in this study cover 4 main components as follows:

(a) Basic socio-economic data of the households:
- Population structure, e.g., family size, age, sex, education, religion and occupation.
- Migration and settlement, e.g., origin domicile, causes of migration, length of time living here.



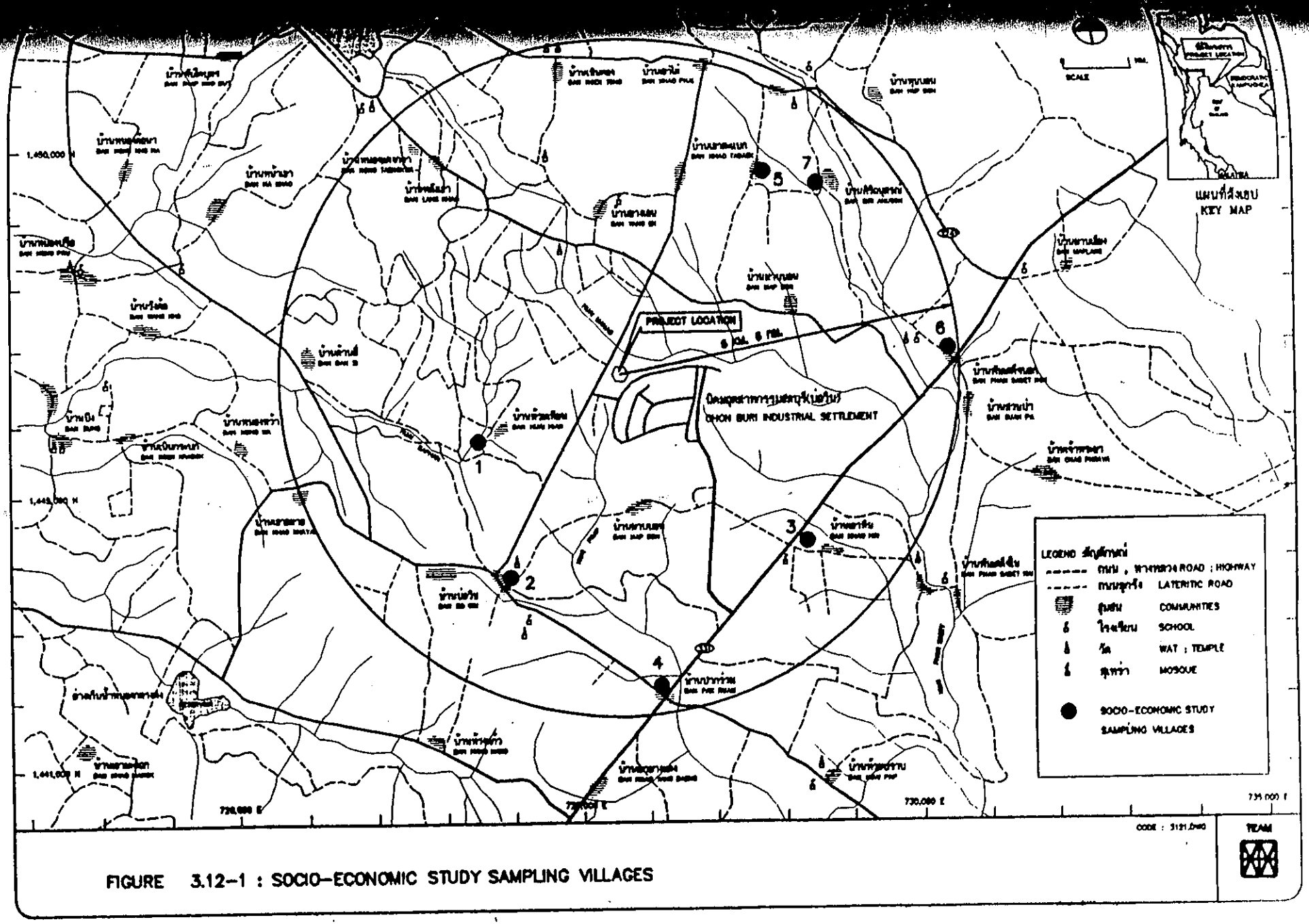


FIGURE 3.12-1 : SOCIO-ECONOMIC STUDY SAMPLING VILLAGES

- Socio-economic data of household members, e.g., sex, age, education, occupation, land holding, land utilization, income-expenditure, debts & saving, etc.
- Production and trends of change.
- Problems in making a living including occupational and other problems encountered.

(b) Housing and community environment:
- Physical condition and communication problem.
- Air and air pollution
- Water for drinking and for household use, for occupational use, problems of drainage and waste water treatments.
- Waste materials and their disposal methods and problems.
- Noise and noise pollution.

(c) Experience, impact and adaptation to big industrial projects within or around community.

(d) Awareness, attitudes toward the project and its impact including recommended measures to solve undesirable consequences.

(3) The Field Survey

(a) Training of Enumerators

Before the actual field survey, enumerators need training to administer the questionnaire properly. Among various topics given to enumerators are origins of the project, objectives of the socio-economic study, goals of the questionnaire, techniques in interviewing people. These are to ensure that the data to be collected will be most reliable and accurate.

(b) Data Collection in the Field

After having sufficiently trained, enumerators and field supervisors with field experience would be out in the field to interview samples in the studied area. Socio-economic survey was conducted during 16-19 March, 1995.

(4) Data Organization and Analysis

After editing, the field data would be organised for tabulation and analysis by employing SPSS (Statistic Package for the Social Science).

3.12.3 Results of the Study

3.12.3.1 Socio-economic Condition of Sri Racha District

(1) General Condition

Sri Racha District is located on the east coast of Gulf of Thailand. The distance from Bangkok and Chonburi Province down to the south is about 105 km. and 24 km. respectively

The total area is approximately 616.434 sq.km. The total area comprises of municipal area (4.058 sq.km.) and outside area (612.376 sq.km). The nearby Amphoe are as following:

North : Muang District, Chonburi Province
South : Bang Lamung District and Pluak Daeng District, Rayong Province
East : Ban Bung District, Chonburi Province
West : Coastline of King Amphoe Ko Sichang, Chonburi Province

(2) Government and Administration

Sri Racha District has 1 King Amphoe as namely King Amphoe Ko Sichang, 7 Tambon (sub-district) dividing into 67 Moo Ban (villages), local administrative organization are composed of 2 levels as sub-district municipality and sanitary district, 2 sub-district municipality as namely Sri Racha and Laem Chabang municipality and 2 sanitary district namely Ao-Udom and Bang Phra sanitary.

(3) Population

Total population in Sri Racha District including population in sub-district municipality area, as of 31 December 1994, was 142,729 of which 72,080 were male and 70,649 were female. For the portion of male and female is 1:0.98. The number of household is 35,362. The density population in municipal area and outside area is 12,206.998 and 153.815 persons/sq.km. respectively.

(4) Economic Structure

Most of local people are in agricultural sector, with cassava as the most popular crop followed by sugarcane and pineapple. Besides cultivation, the other important occupation are livestock raising and fishing. The main of livestocks are pig, chicken, cows and buffaloes. At present, cultivation and livestock in this area were decreasing because the increase of land price and some areas are converted to be the industrial estate. The manufacturing sector is more important increasingly. Sri Racha District consists of 3 industrial estates namely; Laem Chabang, Sahapattana and Chonburi (Bo Win) Industrial Estate.

3.12.3.2 Socio-Economic Condition in the Study Area

An investigation on socio-economic situation at household level was conducted in 110 sampled households in 7 villages. The sampling method implemented in this study is geographical proportional random sampling. List of the villages and number of sampled households are present in Table 13.2-1.

TABLE 3.12-1
DISTRIBUTION OF SAMPLE VILLAGES, MARCH 1995

Village	Sub District (Tambon)	No. of Household	No. of Sample	Percent of Sample
1. Ban Huai Hian (Moo 1)	Bo Win	108[1/]	10	9.3
2. Ban Bo Win (Moo 2)	Bo Win	214[1/]	20	9.3
3. Ban Khao Hin (Moo 6)	Bo Win	208[1/]	20	9.6
4. Ban Pak Ruam (Moo 3)	Bo Win	198[1/]	20	10.1
5. Ban Khao Tabaek (Moo 4)	Nong Kham	247[2/]	20	8.1
6. Ban Phan Sadet Nok (Moo 8)	Khao Khan Song	103[3/]	10	9.7
7. Ban Siri Anuson (Moo 2)	Khao Khan Song	102[2/]	10	9.8
Total		1,072	110	9.5

Source : 1/ Bo Win Health Station Sri Racha District
2/ Hup Bon Health Station Sri Racha District
3/ Khao Khan Song Health Sri Racha District

Results of the socio-economics survey can be described as follows:

(1) General Characteristic of the Sampled-Villagers

The collected information from socio-economic interviews indicate the average age of the sample-villagers is 40.19 years. Most of them (68.18%) completed their education from primary school, while 2.73% have never attended a school and a few have educated from university. All of them are Buddhists (Table 3.12-2).

The locally born people are 58 persons (52.73%), the remaining of them migrated from other places. Most of them migrated from the central Region. Reasons of migration are having new occupation (71.15%), to follow there couple and to follow there parents is 13.46% and 15.38% respectively. Average year of reside is 16.48 years. It is found that most of the villagers are bonded with the existing residence because about 93.64% of samples don't want to move to other places. However, some of them have thought about out-migration for occupation chance (Table 3.12-2).

TABLE 3.12-2
GENERAL CHARACTERISTIC OF THE RESPONDENTS, MARCH 1995

Items	Number	Percent
Number of Sample Households	110	100
1. Sex		
- Male	49	44.55
- Female	61	55.45
2. Age		
- not over 20 years	8	7.27
- 21-30 years	22	20.00
- 31-40 years	28	25.45
- 41-50 years	25	22.73
- 51-60 years	18	16.36
- over 60 years	9	8.18
Average of Age (years)	40.19	
3. Status in Household		
- Household Head	50	45.45
- Parents	15	13.64
- Spouse	26	23.64
- Ralatives	6	5.45
- Offspring	13	11.82
4. Religion		
- Buddhism	110	100
5. Education		
- No Education	3	2.73
- Primary school	75	68.18
- Secondary school	13	11.82
- High school	10	9.09
- Diploma	5	4.55
- Graduate school	4	3.64

TABLE 3.12-2 (Cont'd)

Items	Number	Percent
6. Domicile		
- Locally born	58	52.73
- Immigration	52	47.27
(1) Migrate from		
- Other province in eastern region	13	25.00
- Other province in central region	26	50.00
- Other province in northern region	5	9.62
- Other province in northeastern region	7	13.46
- Other province in southern region	1	1.92
(2) Reason of immigration		
- Occupation chance	37	71.15
- Follow their spouse	7	13.46
- Follow their parent	8	15.38
(3) Average years of migration	16.48	
7. Thinking about Out-Migration		
- Think	7	6.36
- Don't think	103	93.64
(1) Reason for out-migration		
- Have land in other place which can be increase their income	7	6.36
(2) Reason for incase of don't think about out-migration		
- Satisfy in existing occupation and income	24	23.30
- Have firm occupation	41	39.81
- Locally born/familiar place	33	32.04
- Just migrate from other place	5	4.85

(2) Household Structure and Members

According to the socio-economic interviews of the 110 sample households there are altogether 509 residents with 245 males and 264 females. The average household size is 4.63 persons per household. The portion of employed members and unemployed members is 2.34 persons per household and 2.74 persons per household respectively or 1:1.17 (Table 3.12-3).

(3) Residential and Land Holding

Most of informants (85.45%) have their own house, while 14.55% are tenants. Most of them do not have their own farmland. Average land holding per household for residential purpose and agricultural purpose is 1.92 rai and 16.77 rai respectively (Table 3.12-4).

(4) Family Occupation, Incomes and Expenses

Main occupation of the local people in the study area are general employee, merchant and agriculture.

Regarding supplementary occupation, the majority of the sample population (65.45%) have no supplemantary occupation, while 33% are agriculturalist. The remaining have engaged in general employee, trading etc., as supplemantary occupation. 75.45% of total sample households have no occupational problems while the rest have some problems. The main problem is the inadequacy of agricultural income (Table 3.12-5).

Average household income is approximately 8,780 baht per month. As for household expenses, it was found that the household expense is smaller than income. The average expense is about 8,181 bath per month (Table 3.12-5).

(5) Public Health and Water Use

The results obtained from the interviewing reveal that a government hospital (Somdej Na Sri Racha Hospital) is the place where most villagers visit when they need medical service (80.00%). About 10.00% go to see doctor at private clinic. Health stations are also utilized for unserious illness and self treatment by buying medicine from drugstore is also practiced (Table 3.12-6).

Water for drinking is mostly from groundwater and untreated before using. The rain water and bought water are also source of the drinking water in the study area. It is found that 19.09% of total have some problem about shortage of water in dry season. Water for other domestic use can be obtained from ground water and village waterworks. 25.45% have problem about shortage in dry season and turbid/not clean.

TABLE 3.12-3
FAMILY STRUCTURE OF THE RESPONDENTS, MARCH 1995

Item	Number	Percent
Number of Sample Households	110	100
1. Number of household members (persons) - Male - Female	 245 264	 48.13 51.87
Total	509	100.00
2. Family size (persons/household) - Male - Female	 2.29 2.54	
Total	4.63	
3. Number of man power equivalent (persons) - Employed - Unemployed	 257 252	 50.49 49.51
Total	509	100.00
4. Average of man power equivalent size (persons/household) - Employed - Unemployed	 2.34 2.74	

TABLE 3.12-4
LAND HOLDING AND OWNERSHIP, MARCH 1995

Items	Number	Percent
Number of Sample Households	110	100
1. Residential - Own house - Rent from other persons	 94 16	 85.45 14.55
2. Agricultural Land - Owner - Rent from other person - Landless	 23 2 85	 20.91 1.82 77.27
3. Average Land Holding (rai/household) - Residential land - Agricultural land	 1.92 16.77	

TABLE 3.12-5
ECONOMIC CONDITIONS OF THE RESPONDENT HOUSEHOLDS, MARCH 1995

Item	Number	Percent
Number of Sample Households	110	100
1. Main Occupation		
- Government officer	7	6.36
- Private business	9	8.18
- Merchant	23	20.91
- General employee	29	26.36
- Employee in private business sector	9	8.18
- Employee in industrial sector	13	11.82
- Agriculturalist	19	17.27
- Fisherman	1	0.91
2. Supplementary Occupation		
- No supplementary occupation	72	65.45
- Have supplementary occupation	38	34.55
- Merchant	8	21.05
- Employee in private business sector	3	7.89
- Employee in industrial sector	3	7.89
- General employee	12	31.58
- Agriculturalist	13	34.21
3. Problem of Occupation		
- No Problem	83	75.45
- Have Problem	27	24.55
Type of problems		
- Low price of agricultural products	8	29.63
- Agricultural income was inadequate	15	55.56
- Hardly to find work	4	14.81

TABLE 3.12-5 (Cont'd)

Items	Number	Percent
4. Average Household Incomes (Baht/Month)	8,780.00	
5. Average Household Expenditures (Baht/Month)	8,181.00	
6. Debts - No - Have	 85 25	 77.27 22.73
Average of Debts (Baht)	213,752.00	100.00
7. Saving - No - Have	 30 80	 27.27 72.73
Average of Saving (Baht)	281,600.00	100.00

TABLE 3.12-6
PUBLIC FACILITIES CONDITIONS, MARCH 1995

Items	Number	Percent
Number of Sample Households	110	
1. Methods of cure when sickness (Multiple answer)		
- Hospital	88	80.00
- Private medical clinic	11	10.00
- Self-treatment (Buying medicine from drugstore)	5	4.55
- Other public health service units (ie., Tambon health station)	6	5.45
- Average of distance between hospital and villages (km.)	23.00	
- Average of distance between medical clinic and community (km.)	25.00	
2. Source of household water use		
2.1 Drinking Water		
- Rain water	30	27.27
- Ground water	53	48.18
- Village waterwork	3	2.73
- Buy	24	21.82
2.2 Domestic use/consumption Water		
- Rain water	4	3.64
- Groundwater	93	84.55
- Village waterwork	13	11.82

TABLE 3.12-6 (Cont'd)

Items	Number	Percent
3. Problems in Water Using		
3.1 Drinking Water		
- No	89	80.91
- Yes	21	19.09
Kind of problems		
- Shortage in dry season	16	76.19
- Turbidity/not clean	5	23.81
3.2 Domestic Use Water		
- No	82	74.55
- Yes	28	25.45
Kind of problems		
- Shortage in dry season	21	75.00
- Turbidity/not clean	7	25.00
4. Solid Waste Disposal		
- Burn	77	70.00
- Bury	7	6.36
- Collected by municipality or sanitary district	26	23.64
5. No. of households with latrine	110	100.00
6. Wastewater Disposal		
- No (Pour off on ground)	72	65.45
- Yes (Cesspool)	38	34.55

It is found that all of the respondents have common latrine. 34.55% of them reported that they practiced wastewater disposal as draining into the cesspool. The remaining households are without wastewater disposal. It could be observed that the surrounding area of the house were without wastewater disposal was dry. This might be because most of this house were located in the high land with sandy ground. Methods of solid waste disposal are as burning, bury and collecting in a dust-bin (Table 3.12-6).

(6) Respondents Attitudes Toward The Community

The portion of satisfaction and unsatisfication on living in their communities is 80.00% and 18.18% respectively while the other have no comment. The main reasons in case of satisfaction are having job opportunities, good environment, convenient transportation, good public facilities while the bad environmental caused by industrial sector is the main important reason of those who responsed unsatisfied. For the opinion about the change of the community environment, most of respondents (72.73%) reported that the change is about the increasing of facility and the environment has been polluted due to increasing of industries and population growth (Table 3.12-7).

(7) Existing Environmental Impacts (Table 3.12-7)

(a) Dust : About 34.55% of the respondents reported about dust pollution around the area. The major source is vehicle (63.16%) and the remaining is industrial plant and most of the level of impact is high (52.63%).

(b) Noise pollution : 30.91% of the respondents experience the noise pollution around the study area, 76.47% and 23.53% of them believe that the increase of noise are from the vehicle and industrial plant respectively. Level of impact is remainded as high.

(c) Disturbed Odor : Only about 9.09% of the samples faced with bad smell and indicated that the source are vehicle and industrial plants and most of them report that the level of odor is moderate.

(d) Soot/Smoke : 25.45% of the informants face with smoke. They believe that the main cause is from vehicle.

(8) Opinion and Attitude Toward the Proposed Project

(a) Awareness of Project

Most of the respondents (72.73%) have never known about the project while the rest 27.27% got information from their neighbour and from notification.

TABLE 3.12-7
LIVING CONDITIONS OF THE RESPONDENTS, MARCH 1995

Items	Number	Percent
Number of Sample Households	110	
1. Satisfaction on living condition in the community		
- Yes	88	80.00
- No	20	18.18
- No Comment	2	1.82
(1) Reason for in case of Satisfaction		
- Have job opportunities	7	7.95
- Good environmental condition	8	9.09
- Convenient in transportation/Good public facilities	4	4.55
- Calm and safety	19	21.59
- Good neighbours	4	4.55
- All of above	46	52.27
(2) Reason in case of Unsatisfaction		
- Poor job opportunities	2	10.00
- Drought	5	25.00
- Poor environmental condition because of too much industries	9	45.00
- Bad neighbours	1	5.00
- No safety	1	5.00
- Inconvenient in transportation	2	10.00
2. Opinion towards the change of community environment		
- Increasing of facilities	56	50.91
- Increasing of population	5	4.55
- Poor environmental condition	19	17.27
- Not change	30	27.27

TABLE 3.12-7 (Cont'd)

Items	Number	Percent
3. Pollution Problems In The Villages		
3.1 Dust		
- No	72	65.45
- Yes	38	34.55
3.1.1 Cause		
- Vehicle	24	63.16
- Industrial Plants	14	36.84
3.1.2 Level		
- Low	3	7.89
- Moderate	15	39.47
- High	20	52.63
3.2 Noise		
- No	76	69.09
- Yes	34	30.91
3.2.1 Cause		
- Vehicle	26	76.47
- Industrial Plants	8	23.53
3.2.2 Level		
- Low	4	11.76
- Moderate	13	38.24
- High	17	50.00
3.3 Disturbed Odor		
- No	100	90.91
- Yes	10	9.09
3.3.1 Cause		
- Vehicle	5	50.00
- Industrial Plant	5	50.00
3.3.2 Level		
- Low	2	20.00
- Moderate	6	60.00
- High	2	20.00
3.4 Soot/Smoke		
- No	82	74.55
- Yes	28	25.45
3.4.1 Cause		
- Vehicle	20	71.43
- Industrial Plant	8	28.57
3.4.2 Level		
- Low	2	7.14
- Moderate	8	28.57
- High	18	64.29

(b) Attitude toward the project operation

Most of them (76.36%) agree with the project while 12.73% disagree with the project and 10.91% have no comment respectively. In case of agree with the project, they have expected on the growth of community, increasing income, increasing of job opportunities and increasing land price. For in case of disagree with project, they have worried about bad environment/pollution and only 14.29% have been afraid of slum problem.

(c) Impacts of Project

- **Family level**

The impact evaluation of family level was devided into 2 aspect; positive and negative impact. Most of respondents have expected that facility may be improved, income may be increased and expected that the transportation facilities may be improved. For the negative impact, most of them worried about pollution (Table 3.12-8).

- **Community level**

About 74.55% of them think that there will be positive impact i.e., growth of community, increasing income and improve transportation. For negative impact, all of them give reasons that the project will caused the pollution (Table 3.12-8).

(d) Opinion and Suggestion on Project Operation

The respondent's opinion and suggestion on project have been related with the attitude toward the impact of the proposed project and the expectation obtainable from the project. 64.55% of the samples have opinion and suggestion. Most of them want the project to install the pollution prevention system and 15.49% suggested that the project should provide public facilities, the local people should be the first priority of consideration on working in the plant.

3.13 PUBLIC HEALTH

3.13.1 Introduction

The possible health hazards created by the power plant could be effect of several factors such as effects resulting from air pollutants, wastewater and solid wastes. The emitted nitrogen dioxide, sulfur dioxide and TSP may affect the human health in the plant vicinity. The hazardous workplace environment like excessive levels of noise, temperature, leaking gas and chemical substances, improper uses of equipment, or lack of safety measures and health care can also directly and indirectly affect the worker health. In addition, traffic accidents and other accidents at the power plant could inflict damages to public safety in the nearby areas. Therefore, mitigation measures are needed to be emphasized.

TABLE 3.12-8
ATTITUDE TOWARDS THE PROJECT, MARCH 1995

Item	Number	Percent
Number of Sample Households	110	
1. Knowledge about the project		
- No	80	72.73
- Yes	30	27.27
Informer		
- Neighbour	25	83.33
- Notification	5	16.67
2. Attitude towards the project		
- Agree	84	76.36
- Disagree	14	12.73
- No Comment	12	10.91
(1) Reason for incase of agreement (Multiple answer)		
- Increasing in land price	3	3.57
- Have more job oppotunities/Earn more incomes	81	96.43
- Community growth		
(2) Reason for incase of disagreement		
- Poor environmental condition/Pollution	12	85.71
- Slum problem	2	14.29
3. Opinion on the impacts may occurred from the proposed project to households		
(1) Positive impacts		
- No	44	40.00
- Yes	66	60.00
Kind of impacts		
- Increase public facilities/Increase income	59	89.39
- Convenient in transportation	7	10.61
(2) Negative impacts		
- No	82	74.55
- Yes	28	25.45
Kind of impacts		
- Pollution	26	92.86
- Slum Problem	2	7.14

TABLE 3.12-8 (Cont'd)

Items	Number	Percent
4. Opinion on the impacts may occured from the proposed project to community		
(1) Positive impacts		
- No	28	25.45
- Yes	82	74.55
Kind of impacts		
- Community growth/Increase income	79	96.34
- Convenient in transportation	3	3.66
(2) Negative impacts		
- No	76	69.09
- Yes	34	30.91
Kind of impacts		
- Pollution	34	100.00
- Slum Problem	-	-
5. Anxiety towards the proposed project		
- No	93	84.55
- Yes	17	15.45
Kind of anxiety		
- Pollution	17	100.00
6. Opinion and suggestion towards the project implemntation		
- No	39	35.45
- Yes	71	64.55
Kind of opinion and suggestion (multiple answer)		
- Install pollution prevention system	49	69.01
- Local people should be employed first	3	4.23
- Assist on public facilities	11	15.49
- The plant should be accelerate development	5	7.04
- The plant should be located far from community	3	4.23

3.13.2 Objectives

(1) To assess the effects during construction phase including accidents of workers, effects of dust and exhausted emissions, and effects due to poor environmental conditions.

(2) To assess the effects of air pollution on public health and emphasize on the health of the local inhabitants living within 5 km. radius from the project site.

(3) To assess health hazards and safety of the power plant to the personnel and workers.

(4) To recommend measures that could avoid or reduce hazardous impact during the construction and operation phases.

3.13.3 Method of Study and Scope

Data on health facilities, personnels and prevalence of disease are collected from provincial health office of Chonburi Province, Sri Racha District health office and health station of Bo Win, Hup Bon, Khao Khan Song and Khlong Dara. Prevalence of illnesses in project area are relevant to air pollution probably caused by other industrial factories. Relating health personnels are interviewed and part of patient's record are reviewed. Influential groups and member of household in the project are discussed to pin point the nature and causes of skin and respiratory problems.

3.13.4 Results of the Study

(1) Public Health Facilities and Personnels

In 1994, the total amount of the population in Sri Racha District was 142,435, data obtain from provincial health office are presented in Table 3.13-1. There are 1 enterprise hospital, 1 community hospital, 42 medical clinics, 10 sub-district health stations, 2 private hospitals and other health services. The details of health personnel and ratio are shown in Table 3.13-2. There are 54 physicians, 5 dentists, 8 pharmacists, 308 professional nurses. In addition, there are a number of dental assistants, medical technicians and health workers in this district. The ratio of major health personnel to the total population are as follows:

Physician	1:2,637
Dentist	1:28,487
Pharmacist	1:17,804
Professional nurse	1:462

(2) Major Health Problem

Data of cause of diseases obtained from sub-district health station, around the project area was collected. The data revealed that among various disease reported in this region, respiratory disease, parasites disease, digestive disease, other external causes (eg: accidents, injury etc.), were the main problems (Table 3.13-3). The prevalence of Disease found in all sites were similar except the rate of skin disease and metabolic disease of Tambon Bo Win were higher than other sites.

TABLE 3.13-1
GOVERNMENT AND PRIVATE HEALTH FACILITIES IN SRI RACHA DISTRICT, 1994

Health Facilities		Number
Government Sector		
Enterprise Hospital (Somdej Na Sri Racha)	450 beds	1
Community Hospital (Ao-Udom)	30 beds	1
Municipal Public Station		2
Sub-Distric Health Station		10
Maralia Center		1
Private Sector		
Private Hospital (200 beds and 400 beds)		2
Medical Clinic		42
Drugstore		33
Traditional Drugstore		7
Drugstore (for narcotic drug)		11

Source : Public Health Office, Sri Racha District (1994).

Remark : 2 Private Hospital are under construction namely;
- Smittivate Hospital 200 beds
- Phaya Thai Hospital 400 beds

TABLE 3.13-2
NUMBER AND RATIO OF HEALTH PERSONNEL IN SRI RACHA DISTRICT, 1994

Health Personnel	Number of personnel					
	State Enterprise (Somdej Hospital)	Community Hospital (Ayudhaya Hospital)	Sri Racha District Public Health Office	Sri Racha Municipal Health Office	Total	Personnel/Population Ratio
1. Physician	50	4	-	-	54	2,638
2. Dentists	3	2	-	-	5	28,487
3. Pharmacists	7	1	-	-	8	17,805
4. Professional Nurses	285	20	-	3	308	463
5. Technical Nurses	-	25	-	2	27	5,275
6. Dental Assistant	-	3	-	1	4	35,609
7. Nursing Care Personnel	266	2	-	-	268	532
8. Medical and Science Technician	5	1	-	-	6	23,739
9. Public Health Community Personnel	-	4	34	1	39	3,652
10. Other	423	-	-	5	428	333

TABLE 3.13-3
RECORD OF CAUSE OF DISEASES IN THE PROJECT STUDY AREA
(DURING MARCH 1994 - FEBRUARY 1995)

TABLE 3.13-3
RECORD OF CAUSE OF DISEASES IN THE PROJECT STUDY AREA
(DURING MARCH, 1994 - FEBRUARY, 1995)

No.	Cause of Diseases	Patient Number (Person)							
		1		2		3		4	
		Case	Percent	Case	Percent	Case	Percent	Case	Percent
1	Certain infectious and parasities disease	1,652	19.19	448	7.65	146	5.95	326	7.34
2	Neoplasms	1	0.01	0	0.00	0	0.00	0	0.00
3	Diseases of the blood and blood forming organs and certain disorders involving the immune mechanism	5	0.06	3	0.05	0	0.00	24	0.54
4	Endocrine, nutritional and metabolic disease	196	2.28	539	9.20	0	0.00	6	0.14
5	Mental and behavioural disorders	76	0.88	2	0.03	15	0.61	0	0.00
6	Disease of the nervous system	345	4.01	445	7.60	45	1.84	112	2.52
7	Disease of the eye and adnexa	176	2.04	139	2.37	37	1.51	73	1.64
8	Disease of the ear and mastoid process	42	0.49	22	0.38	14	0.57	9	0.20
9	Disease of the circulatory system	198	2.30	142	2.42	229	9.34	124	2.79
10	Disease of the respiratory system	2,642	30.69	1,235	21.08	1,311	53.47	1,619	36.46
11	Disease of the digestive system	1,370	15.92	757	12.92	224	9.14	404	9.10
12	Diseas of the skin and subcutaneous tissue	162	1.88	1,056	18.03	80	3.26	310	6.98
13	Diseases of the musculoskeletal system and connective tissue	197	2.29	268	4.57	46	1.88	132	2.97
14	Disease of the genotourinary system	100	1.16	81	1.38	6	0.24	88	1.98
15	Complication of prgnancy, childbirth and the puerperium	51	0.59	0	0.00	13	0.53	1	0.02
16	Certain conditions originating in the perinatal period	0	0.00	0	0.00	0	0.00	0	0.00
17	Congenital malformations, deformation and chromosomal abnormalities	0	0.00	0	0.00	0	0.00	0	0.00
18	Sysmptoms, signs and abnormal clinical and laboratory finding, not else where classified	2	0.02	40	0.68	0	0.00	89	2.00
19	Poisoning, toxic effect, and their sequelae	84	0.98	3	0.05	5	0.20	0	0.00
20	Transport accident and their sequeale	457	5.31	194	3.31	253	10.32	21	0.47
21	Other external causes of morbidity and mortality (eg : accidents, injury etc.)	852	9.90	484	8.26	28	1.14	1,102	24.82
	Total	8,608	100.00	5,858	100.00	2,452	100.00	4,440	100.00

Rema
1. Khao Khan Song Health Station, Tambon Khao Khan Song
2. Bo Win Health Station, Tambon Bo Win
3. Hup Bon Health Station, Tambon Khao Khan Song
4. Khong Dara Health Station, Tambon Nong Kham

3.14 AESTHETIC/TOURISM

3.14.1 Introduction

Experience at other similar power plant projects indicates that aesthetic quality of thermal power plants generally does not induce any significant tourism activities at the plant. Visits are generally made due to curiosity or for educational purposes. Therefore, the tourism and aesthetic benefits of the project will not be emphasized in this report.

The specific purposed of the aesthetic/tourism study were:

(1) To review aesthetic and tourism attraction in Chonburi Province.
(2) To assess impacts of the proposed project development on aesthetic quality in the vicinity of the site and on tourism.
(3) To make recommendations for alleviation of adverse aesthetic effects and for promotion of study tourism relative to the new power plant.

3.14.2 Study Methodology

As stated above, a main purpose of the aesthetics and tourism study was to identify and assess possible effects caused or induced by the project implementation. The study procedure included data collection, review and evaluation of the available information. Field trips were carried out to the proposed site and its vicinity to observe the existing tourist attractions and aesthetic conditions of the study area. The data and information were also obtained from TAT and local government agencies.

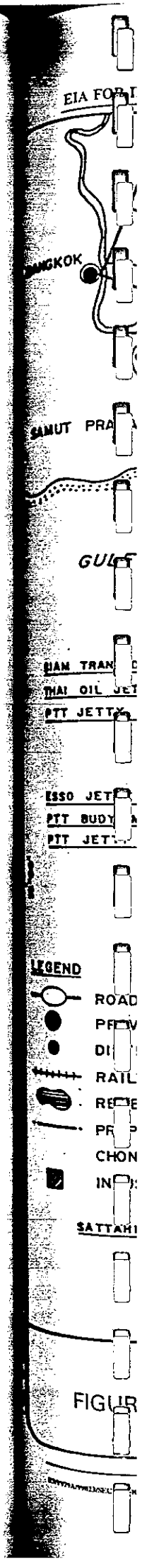
3.14.3 Results of the Study

There are no archaeological or tourism attractions located in the 5 km. radius of the proposed project site. However, there are some archaeological and tourism located in Chonburi Province.

Chonburi Province, located 81 km. from Bangkok Metropolis by Highway No.3 (Bang Na - Trad). Several beaches in Chonburi is the most famous for a long time, i.e., Pattaya, Bang Saen, etc. Besides there are the inland resorts such as, a wildlife sanctuary at Khao Khieo, Bang Phra Reservoir etc. The famous tourist attractions in Chonburi can be classified in to zones as follows (Figure 3.14-1).

(1) Muang Chonburi District

- Wat Yai Intaram (Wat Luang) is an ancient temple of Chonburi, built in the latest of Ayudhaya reign. Located on Jet Jamnong Road.
- Wat Khao Phra Putta Bath Bang Sai, located on Sukhumvith Road, built in King Rama 5th reign. There is a foot print of Buddha.
- Ang Sila is the fisher village and well know in the handicrafts from stone, i.e., mortar, stone dolls.



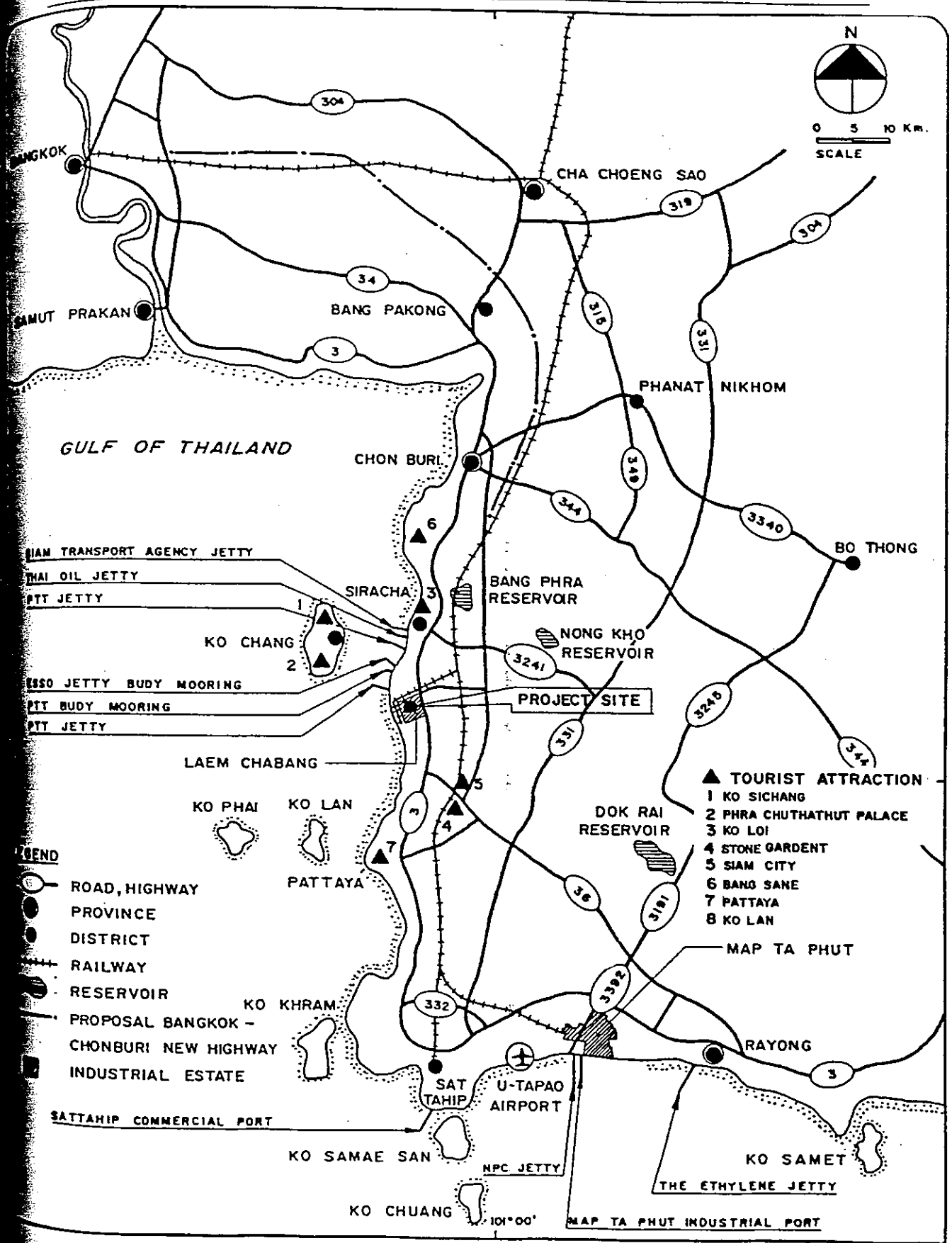


FIGURE 3.14-1 : TOURISM ATTRACTIONS IN CHONBURI PROVINCE

- Khao Sam Muk is the small hill between Ang Sila and Bang Saen Beach. Full of a crowd of monkeys stayed here.
- Bang Saen Beach is one of the famous beach, located 10 km. from Chonburi.
- Marine Science Museum is located in Bhurapha University.
- Nong Mon is the market for local handicrafts, food and sweet.

(2) Sri Racha/Koh Si Chang District

- Koh Loy is the small island near Sri Racha beach. Koh Loy is the park of Sri Racha.
- Khao Kheio Opened Zoo, located at Tambon Bang Phra with the area about 3,000 rai in the Khao Khieo National Park and Wildlife Sanctuary. In Khao Khieo there are various of wildlife, birds and other natural attractions, i.e., Chan Ta Thain waterfall.
- Koh Si Chang is the large island, located 12 km. from Sri Racha. There is a beautiful beach, the old palace of H.M. the King 5^{th} and an efficacious temple on Koh Si Chang.

(3) Pattaya

Pattaya is one of the most famous beach of Thailand which comprised of several tourist attractions both related to inland and beach resorts such as:

- Koh Lan, about 7.5 km. from Pattaya Beach or o ne hour by boat. Several beautiful beaches are located there.
- Jom Thien Beach, located 4 km. from the south of Pattaya Beach. This beach is appropriated for swimming and water sports.
- Mini Siam is the reproduce model of the importants place in Thailand.
- Pattaya Crocodile Farm. The farm covered an area of 72 rais, comprised of the crocodile farm, scarce animal and Rock-botanical garden.
- Wat Yanna Sang Wara Ram, the first class royal temple, located at the 160^{th} km. stone. This temple covered an area of 366 rais, besides there is 2,500 rais for the centre of development projects under the advice of H.M. the King.
- Nong Nuch Park is the private thai villages covered an area of 1,000 rais, located 15 km. from the south Pattaya. This park is the biggest recreation area in the east which full of various species of flowers and decorated plants. There is also a thai cultural show.

(4) Sattahip District

- Bang Sare is the fishery village which located 16 km. from the south of Pattaya. This is a well known area for the hobby fisher.
- Samae Sarn is the small fishery village on the road to Sattahip Port. This is one of the suitable grounds for fishing and diving. Besides there are some small islands.

CHAPTER 4 : ENVIRONMENTAL IMPACT ASSESSMENT

CHAPTER 4
ENVIRONMENTAL IMPACT ASSESSMENT

4.1 INTRODUCTION

The activities relating to the construction and operation of the Power Plant Project will generate both positive and negative impacts to the surrounding environment especially to the immediate vicinity of the site. Therefore, it is essential to thoroughly investigate and assess the potential impacts at the early stage of the development in order to be able to effectively minimize the adverse effects and enhance project benefits by appropriate measures.

4.2 CLIMATE

The proposed power plant is a relativity small project in size. Therefore, the construction and the operation activities of the proposed power plant would have no effects on climate at the project site and the vicinity. The climate will continue to be influenced by the northeast and southwest monsoons. On the other hand, climate will have some governing factors on the project activities.

4.2.1 Construction Period

Precipitation records at Pattaya Meterological Station, the closest station to the project site, shows that the rainy season begins in May, ends in mid of October, and peaks in September to October, with the annual rainfall of about 1,164.4 mm. During the rainy season, some construction activities including site excavation and hauling of heavy equipment could be delayed due to heavy storms, while some other activities have to be stopped temporarily. The appropriate construction schedules and practices should be planned, thus, the effects of storms on the construction of the power plant and its related structures would be minor.

4.2.2 Operation Period

Heavy storms and strong winds can damage the power plant and other related structures. The design of these structures have already taken the maximum wind velocities into consideration for the project to achieve their required stability and safety standards.

4.3 AIR QUALITY

4.3.1 Construction Period

The activities to be undertaken during the construction phase include:

- Site levelling and preparation
- Foundation preparation
- Piling of construction material
- Transportation of heavy machineries and equipment.

The above activities will increase the airborne pollutants in the form of fugitive dust and exhausted gases. However, the impacts due to construction activities will be concentrated only during the daylight hours and the construction phase will be approximately 26 months. In addition, the closest community to the site is Ban Huai Hian, about 2 km. in the west-southwest direction and Ban Bo Win located about 3.5 km in the south-southwest direction. The information on wind direction indicated that the wind directions are prominently from the southwest direction while the northeast direction is minor. Therefore, the exposures of Ban Huai Hian and Ban Bo Win's communities to the pollution will be limited to a short period between October and January, thus it can be considered as insignificant. In addition, the appropriate measures will also be practiced at the construction site, e.g., water spraying on the construction site to control dust, control vehicle speed, etc. to assure to minimum level of impacts.

In addition, project has estimated the TSP concentration due to construction activities following manner:

$$C = \frac{Q}{d \times w \times m}$$

where C = TSP concentration, mg/m^3
Q = TSP emission rates, mg/m^3
d = width of the area perpendicular to wind direction
w = wind speed (m/s)
m = mixing height, m

From the report of US.EPA (AP-42, 1995), the TSP emission is estimated to be 1.2 Ton/Acre/Month of the moderate construction activities, thus the emission due to project construction is as follows:

$$Q = 1.2 \text{ T/Acre/Month}$$

$$= \frac{1.2 \times 10^9 \text{ mg.} \times 31.11}{\text{Month} \times \frac{30 \text{day}}{\text{Month}} \times 24 \frac{\text{hr}}{\text{day}}}$$

$$= 5.18 \times 10^7 \text{ mg/hr}$$

The TSP emission will be 4,796.3 mg/sec in one day.

$$C = \frac{4{,}796.3 \text{mg/sec}}{440\text{m} \times 9.63\text{m} \times 1{,}000\text{m}}$$

$$= 1.13\ \mu g/m^3$$

This estimated value is the maximum concentration due to construction activities.

From the actual measurement, the maximum concentration is 78.98 $\mu g/m^3$. Therefore, the maximum concentration during construction period is estimated to be 80.11 $\mu g/m^3$ or 24.28% of MOSTE's standard (Ministry of Science Technology and Environment).

4.3.2 Operation Period

4.3.2.1 Selected Air Quality Model

The Industrial Source Complex (ISC) Dispersion Model was selected for prediction of air pollutant concentration induced by project activities during operation phase. This ISC dispersion model is a comprehensive set of computer programs that can be used to evaluate the air quality impact of emissions from large industrial source complexes.

The Industrial Source Complex Short Term Dispersion model provides options to model emission from a wide range of sources that might be present at a typical industrial source complex. The basis of the model is the straight-line, steady-state Gaussian plume equation, which is used with some modifications to model simple point source emissions from stacks, emissions from stacks that experience the effects of aerodynamic downwash due to nearby buildings, isolated vents, multiple vents, storage piles, conveyor belts, and the like. The model can estimate the concentration or deposition value for each source and receptor combination for each hour of input meteorology, and calculate user-selected short-term averages.

4.3.2.2 Dispersion Equations

The equations used in the dispersion model are basically Gaussian plume equation with some modification to suit the required computation procedures. The Gaussian plume equation for a continuous emission source gives the local concentration □ of a gas of aerosol at a ground-level location (x,y) by the following expression:

$$\chi(x,y) = \frac{Q}{\pi\sigma_y\sigma_z u} \exp\left[-0.5\left(y/\sigma_y\right)^2\right] \exp\left[-0.5\left(H/\sigma_z\right)^2\right.$$

where u : wind speed (The wind is adverting the plume at speed u along the x-axis and dispersing it along the crosswind and vertical direction with diffusion coefficients of σy and σ_z. The unit of u commonly is meter per second (m/s)

The units of other variable commonly used are σ in (gm^{-3}), Q in (gs^{-1}), and x, y, H, σ_y and σ_z in metre (m).

For stack emissions, the concentration model for stacks uses the steady state Gaussian plume equation for a continuous elevated source. For each stack and each hour, the origin of the stack's co-ordinate system is placed at the ground surface at the base of the stack. The fixed receptor locations are converted relative to each stack's co-ordinate system for each hourly concentration calculation. The hourly concentrations calculated for each stack at each receptor are summed up to obtain the total concentration produced at each receptor by the combined stack emissions.

4.3.2.3 Model Input Data

Three sets of information are required as input to the model.

(1) Meteorological Data

The 3 hours surface observations at Chonburi weather station and twice daily upper air observation data at Bang Na weather station (Bangkok) were used to be input data for the air quality dispersion model.

(2) Emission Source Data

The emission parameters used in the modelling are presented in Table 4.3-1 In addition, the other emission sources around project site were also taken into account including background or existing concentrations of concern air quality aspects (Appendix E).

TABLE 4.3-1
EMISSION RATES DUE TO BOWIN POWER PLANT OPERATION
(normal operation at design ambient conditions)

Pollutant	Stack #1		Stack #2		Standard[1]
	Concentration[1]	Emission Rate (g/sec)[2]	Concentration[1]	Emission Rate (g/sec)[2]	
1. Natural Gas					
- NO_x as NO_2	100 ppmvd	51.60	100 ppmvd	51.60	120 ppmvd
- SO_2					20 ppmvd
- CO	250 ppmvd	78.6	250 ppmvd	78.6	870 ppmvd
- TSP	20 mg/m³	4.67	20 mg/m³	4.67	60 mg/m³
2. Distillate Oil					
- NO_x as NO_2	140 ppmvd	84.28	140 ppmvd	84.28	180 ppmvd
- SO_2	150 ppmvd	127.16	150 ppmvd	127.16	640 ppmvd
- CO	290 ppmvd	106.37	290 ppmvd	106.37	870 ppmvd
- TSP	35 mg/m³	10.3	35 mg/m³	10.3	120 mg/m³

Note : - Exhaust flow rate of Natural gas will be 710.5 Nm³/sec (base on 0°C)
- Exhaust flow rate of Distillate oil will be 710.1 Nm³/sec (base on 0°C)
(1) = Reference condition 7% O_2, dry 25°C, 1 atm
(2) = Mass emission rates at anticipated operation condition
- Stack height is 40 meter and stack inner diameter is 7 meter.

Source : Bowin Power Plant, August 1999.

(3) Receptor Data

The ground-level concentration simulation of NO_2 and SO_2 were carried out covering the area within 10 km. radius around the plant. The 1 km., cartesian receptor grid interval was selected for this simulation.

The simulations were carried out into 2 scenarios as the fuel types namely: natural gas and distillate oil.

4.3.2.4 Results of Air Quality

The isopleth maps of simulation results are shown in Appendix F.

Air dispersion modeling was used to estimate the GLC (Ground Level Concentration) of concerned pollutants due to project operation and other sources, in order to assessed the impact on air quality the background concentration was also added to the predicted concentration. Results of modeling can be concluded as follows:

(1) Natural Gas

(a) NO_2 (avg. 1-hr)

The maximum ground level concentration of NO_2 in the period of one hour due to project operation would be 34.2 microgram/cu.m. (NO_2 = NO_x) at Ban Khlong Yai. This value would be 10.63% of MOSTE's standard (ambient standard of NO_2 1-hr is 320 microgram/cu.m.; MOSTE = Ministry of Science Technology and Environment). The concentration of nearby communities were in range 5.08-19.16 microgram/cu.m. or 1.58-5.98% of MOSTE's standard. After the emission other sources were combined as the input of model, that the maximum NO_2 concentration was estimated to be 162.58 microgram/cu.m. or 50.81% of MOSTE's standard at idle land in the northwest direction of project site with the distance of approximately 1.5 km. In addition, the concentration of nearby communities was experienced with the value of 83.82-157.13 microgram/cu.m. The above concentrations were approximately 26.19-49.10% of MOSTE's standard (as presented in Table 4.3-2).

(b) TSP (avg. 24-hr)

The maximum ground level concentration of TSP in the period of 24-hr due to project operation would be 1.39 microgram/cu.m. at idle land in the northwest direction of project site with the distance of approximately 10 km. This value would be 0.42% of MOSTE's standard (ambient standard of TSP 24-hr is 330 microgram/cu.m.). The concentration of nearby communities were in range 0.06-0.4 microgram/cu.m. or 0.02-0.12% of MOSTE's standard. When the emission other sources were included as the input of model, that the maximum concentration would be 28.90 microgram/cu.m. or 8.76% of MOSTE's standard. In addition, the concentration of nearby communities would be 9.87-14.11 microgram/cu.m. The above concentrations were approximately 2.99-4.27% of MOSTE's standard (as presented in Table 4.3-2).

TABLE 4.3-2
RESULT OF AIR QUALITY FOR BO-WIN POWER PLANT

15 July 1999

Receptor	UTM Coordinate	Distance from Project (km.)	Other Sources					Natural Gas: Emission Sources from Project			Natural Gas: Emission Sources from Other Source Combined with Project					Distillated Oil: Emission Sources from Project					Distillated Oil: Emission Sources from Other Source Combined with Project				
			TSP (24 hr)	NO_2 (1 hr)	CO (1 hr)	SO_2 (1 hr)	SO_2 (24 hr)	TSP (24 hr)	NO_2 (1 hr)	CO (1 hr)	TSP (24 hr)	NO_2 (1 hr)	CO (1 hr)	SO_2 (1 hr)	SO_2 (24 hr)	TSP (24 hr)	NO_2 (1 hr)	CO (1 hr)	SO_2 (1 hr)	SO_2 (24 hr)	TSP (24 hr)	NO_2 (1 hr)	CO (1 hr)	SO_2 (1 hr)	SO_2 (24 hr)
1. Max. Concentration																									
- Kao Hin Lat	- 731000E, 1449000N	5.8 (NE)	-	-	-	-	3.97								3.97										
- Idle land	- 736000E, 1445000N	10.0 (NE)	-	-	-	-		1.39	-	-	-	-	-	-	-	1.51	-	-	-	18.59	-	-	-	-	19.07
- Kao Ta Beg	- 725000E, 1450000N	2.9 (N)	-	-	126.81	17.4	-	-	-	-	-	-	-	17.4	-	-	-	-	-	-	-	-	-	-	-
- Ban Khlong Yai	- 736000E, 1435000N	10.0 (SE)	-	-	-	-	-	-	34.02	51.82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Nearby Ban Pong Sa-ket	- 724000E, 1438000N	8.3 (S)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Nearby Ban Bo-Win	- 722000E, 1444000N	4.3 (SW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Ban Pong Sa-ket	- 725000E, 1439000N	7.8 (S)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Idle land	- 725000E, 1440000N	6.5 (S)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.01	51.76	61.88	-	-	-	-	-	-
- Idle land	- 724000E, 1437000N	9.0 (S)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67.65	-
- Idle land	- 725000E, 1448000N	1.5 (NW)	-	162.58	-	-	-	-	-	-	-	162.58	-	-	-	-	-	-	-	-	-	-	-	162.05	-
- Idle land	- 719000E, 1439000N	9.5 (SW)	28.90	-	-	-	-	-	-	-	28.90	-	-	-	-	-	-	-	-	-	28.9	-	-	-	-
2. Receptor																									
- Ban Yang En	- 725500E, 1449000N	2.0 (N)	12.40	152.19	110.19	15.10	2.20	0.06	5.08	7.74	12.43	157.13	112.65	15.10	2.20	0.05	6.13	7.74	9.26	0.70	12.44	158.33	112.88	9.32	0.70
- Ban Map Bon	- 728000E, 1448000N	2.6 (NE)	11.42	123.84	113.45	14.73	2.37	0.14	7.43	11.32	11.50	123.84	113.45	14.73	2.37	0.14	7.91	9.99	11.94	1.75	11.49	123.84	113.45	14.73	3.09
- Ban Pun Sadet Nok	- 730500E, 1447000N	4.7 (E)	13.50	94.45	92.77	12.35	2.28	0.40	17.18	26.18	13.56	94.46	92.78	12.35	2.28	0.39	18.74	23.65	28.28	4.81	13.55	94.46	92.78	28.28	5.33
- Ban Chan Phraya	- 731000E, 1445500N	5.4 (E)	11.60	102.94	113.78	15.01	2.19	0.36	19.16	29.18	11.66	102.94	113.78	15.01	2.19	0.38	20.93	26.41	31.57	4.72	11.65	102.94	113.78	31.57	5.28
- Ban Pun Sadet Nai	- 730000E, 1443500N	5.0 (SE)	10.73	85.76	88.67	11.81	2.28	0.32	18.56	28.27	10.73	85.75	88.66	11.81	2.28	0.31	19.98	25.22	30.15	3.81	10.73	85.75	88.66	30.15	4.70
- Ban Kho Yang Daeng	- 727000E, 1441000N	5.6 (S)	9.78	124.82	92.40	12.91	1.73	0.11	13.38	20.38	9.87	124.82	92.40	12.91	1.73	0.12	14.86	18.76	22.43	1.42	9.87	124.82	92.40	22.43	2.35
- Ban Bo Win	- 723000E, 1444000N	3.7 (SW)	14.11	83.85	65.58	8.70	1.55	0.08	10.34	15.75	14.11	83.82	65.58	8.70	1.55	0.08	11.08	13.98	16.72	0.97	14.11	83.83	65.58	16.72	1.62
MOSTE's Standard			330	320	34200	780	300	330	320	34200	330	320	34200	780	300	330	320	34200	780	300	330	320	34200	780	300

Remark : - "microgram/m^3"
- $NO_2 = NO_x$
- Meteorological Station data is Chonburi 1997.

not e... conc... Beg... 780 ... were... SO_2 ... of M... conc... in Ta...

due ... south... MOST... conc... pres... fars ... of M... 65.55...

hour ... Pong-S... woul... micr... microg... conc... stand... addition... 83.8...

hr due ... direc... 0.46... The ...

(c) SO_2 (avg. 1-hr, 24-hr)

In case of using natural gas as a fuel, the SO_2 concentration would be not emitted from the project. The emission from other sources, the maximum ground level concentration of SO_2 in the period of 1-hr would be 17.40 microgram/cu.m., at Kao Ta-Beg. This value would be 2.23% of MOSTE's standard (ambient standard of SO_2 1-hr is 780 microgram/cu.m.) as shown in Table 4.3-2. The concentration of nearby communities were in range 8.70-15.10 microgram/cu.m. In addition, the maximum concentration of SO_2 24-hr was emitted from other sources with equal to 3.97 microgram/cu.m. or 1.32% of MOSTE's standard (ambient standard of SO_2 24-hr is 300 microgram/cu.m.) and the concentration of nearby communities would be 1.55-2.37 microgram/cu.m. (as presented in Table 4.3-2).

(d) CO (avg. 1-hr)

The maximum ground level concentration of CO in the period of 1-hr due to project operation would be about 51.82 microgram/cu.m. at Ban Khlong Yai in the southeast that far from the project site about 10 km. This value would be 0.15% of MOSTE's standard (ambient standard of CO 1-hr is 34,200 microgram/cu.m.). The concentration of nearby communities in range of 7.74-29.18 microgram/cu.m. which presented in Table 4.3-2. For the other sources that included to the project, the maximum concentration of CO average 1 hour equal to 164.87 microgram/cu.m. at idle land and it fars from the project about 9 km in the direction in south. The value of its equal to 0.48% of MOSTE's standard. In addition, the concentration of nearby communities would be 65.55-113.78 microgram/cu.m. (as presented in Table 4.3-2).

(2) Fuel Oil

(a) NO_2 (avg. 1-hr)

The maximum ground level concentration of NO_2 in the period of one hour due to project operation would be 41.01 microgram/cu.m. (NO_2 = NO_x) at Ban Pong-Saket where far from the project in the direction in south about 7.8 km. This value would be 12.81% of MOSTE's standard (ambient standard of NO_2 1-hr is 320 microgram/cu.m.). The concentration of nearby communities were in range 6.13-20.93 microgram/cu.m. When the other sources combined with project. The maximum NO_2 concentration was estimated to be 162.58 microgram/cu.m. or 50.81% of MOSTE's standard at idle land that far from the project in the direction in northwest about 1.5 km. In addition, the concentration of nearby communities was experienced with the value of 83.82-158.33 microgram/cu.m. with presented in Table 4.3-2.

(b) TSP (avg. 24-hr)

The maximum ground level concentration of TSP in the period of 24-hr due to project operation would be 1.51 microgram/cu.m. at idle land in the northeast direction of project site with the distance of approximately 10 km. This value would be 0.46% of MOSTE's standard (ambient standard of TSP 24-hr is 330 microgram/cu.m.). The concentration of nearby communities were in range 0.05-0.39 microgram/cu.m.

When the emission other sources were included as the input of model. That the maximum concentration would be 28.90 microgram/cu.m. or 8.76% of MOSTE's standard at idle land with far from the project about 9.5 km in the direction of southwest and the concentration of nearby communities would be 9.87-14.11 microgram/cu.m. The above concentrations were approximately 2.99-4.27% of MOSTE's standard (as presentedin Table 4.3-2).

(c) SO_2 (avg. 1-hr, 24-hr)

The maximum ground level concentration of SO_2 in the period of 1-hr due to project operation would be 61.88 microgram/cu.m. at Ban Pong-Saket with far from the project about 7.8 km in the direction of south. For this value is equal to 7.93% of MOSTE's standard and the concentration of nearby communities would be 9.26-31.57 microgram/cu.m. When other sources combined with project, the maximum ground level concentration of SO_2 in the period of 1-hr would be 67.65 microgram/cu.m. This value would be 8.67% of MOSTE's standard (ambient standard of SO_2 1-hr is 780 microgram/cu.m.) as shown in Table 4.3-2. The concentration of nearby communities were in range 9.32-31.57 microgram/cu.m.

For the maximum concentration of SO_2 24-hr was emitted from project operation with equal to 18.59 microgram/cu.m. or 6.19% of MOSTE's standard (ambient standard of SO_2 24-hr is 300 microgram/cu.m.) at idle land with far from the project about 10 km in the direction of northeast and the concentration of nearby communities would be 0.70-4.81 microgram/cu.m. (as presented in Table 4.3-2). When the other sources combined with project. The maximum SO_2 concentration was estimated to be 19.07 microgram/cu.m. or 6.35% of MOSTE's standard at idle land that far from the project in the direction in northeast about 10 km. In addition, the concentration of nearby communities was experienced with the value of 0.70-5.33 microgram/cu.m. with presented in Table 4.3-2.

(d) CO (avg. 1-hr)

The maximum ground level concentration of CO in the period of 1-hr due to project operation would be about 51.76 microgram/cu.m. at Ban Pong-Saket in the south that far from the project site about 7.8 km. This value would be 0.15% of MOSTE's standard (ambient standard of CO 1-hr is 34,200 microgram/cu.m.). The concentration of nearby communities in range of 7.74-26.41 microgram/cu.m. which presented in Table 4.3-2. For the other sources that included to the project, the maximum concentration of CO average 1 hour equal to 162.05 microgram/cu.m. at idle land and it fars from the project about 9 km in the direction in south. The value of its equal to 0.47% of MOSTE's standard. In addition, the concentration of nearby communities would be 65.58-113.78 microgram/cu.m. (as presented in Table 4.3-2).

From this study, the concentration of pollutants to be emitted into atmosphere are within MOSTE's standard as presented in Table 4.3-3.

TABLE 4.3-3
THE MAXIMUM CONCENTRATION OF POLLUTANTS TO BE EMITTED INTO ATMOSPHERE

Pollutants	Natural Gas				Fuel Oil				MOSTE's Standard
	Project		Other sources combined with project		Project		Other sources combined with project		
	$\mu g/m^3$	% of std.	$\mu g/m^3$	% of std.	$\mu g/m^3$	% of std	$\mu g/m^3$	% of std.	$\mu g/m^3$
- TSP (24-hr)	1.39	0.42	28.9	8.76	1.51	0.46	28.9	8.75	330
- CO (1-hr)	51.82	0.15	164.87	0.48	51.76	0.15	162.05	0.47	34,200
- NO_2 (1-hr)	34.02	10.63	162.58	50.81	41.01	12.81	162.58	50.81	320
- SO_2 (1-hr)	-	-	17.4	2.23	61.88	7.93	67.65	8.67	780
- SO_2 (24-hr)	-	-	3.97	1.32	18.59	6.19	19.07	6.35	300

Remark : - std. is MOSTE's standard.

According to the hydrological capacity of Huai Manao, from the manning's formula:

$$Q = \frac{1}{n} AR^{2/3} S^{1/2}$$

Where : Q = the mean flow rate (m^3/s)
A = the area of stream cross section (m^2)
R = the bed length (m)
n = Manning's coefficient of roughness
S = the slope of water surface

For Huai Manao, it can be assumed that the values for these factors are;

A = 3 m^2
R = 4.8 m
n = 0.040
Sw = 0.0012

From the above values, it can be roughly calculated the mean flow rate of Huai Manao (Q) as;

$$Q = \frac{1 \times 3 \times 4.8^{2/3} \times 0.0012^{1/2}}{0.040}$$

= 7.39 m^3/s
= 26,614 $m^3/hr.$

The discharge capacity of Huai Manao is estimated at 26,614 $m^3/hr.$ indicating found that the combined wastewater discharge from the proposed power plant of 106.8 m^3/hr is only 0.40 percent of Huai Manao capacity. Thus, it can be concluded that Huai Manao can adequately receive the discharged water from the power plant.

Moreover, a constant out flow of 106.8 $m^3/hr.$ from the power plant will benefit the downstream cultivation in term of surplus water for agricultures especially in the dry season. The quality of the cooling water will definitely meet the industrial effluent standard thus, this water will not pose any problems for agricultural uses.

4.7 SURFACE WATER QUALITY

4.7.1 Construction Period

During the construction period, wastewaters will comprise of the silted surface runoff, wastewater from construction activities and domestic wastewater. For the wastewater from construction activities i.e., water for concrete mixing, water for equipment washing, of which the quality is variable and small in quantity, mostly will be infiltrated into the ground. Domestic wastewater from the workers will be drained into the sanitary septic tank. During the peak period, the maximum workers will be about 800 persons which need water for about 60 m^3/day. Thus, the wastewater generated from the worker will be approximately 60 m^3/day (wastewater is 75% of water use; Ministry of Interior, 1982). Therefore, the septic tank should be adequately provided for treating these wastewater. The number of required septic tank can be calculated based on the retention time of septic tank that should at least 24 hours or calculated by the number of workers. For the first 80 workers, the septic tank should be provided at least 3 sets, and adding one more set for the additional 50 workers. Thus, for the total 800 workers, the project must provide at least 16 sets of septic tanks to adequately treat domestic wastewater.

The surface runoff with silty sediment and residue from construction materials will be drained into drainage channels which will be built around the construction area and then to the sump or holding pond with holding capacity of 3 hr. rain for sediment precipitation prior to draining out the clear effluent into Huai Manao.

4.7.2 Operation Period

The wastewater from various sources that need to be treated are as follows;

- Wastewater from Power Plant as shown in the following table.

Fuel	Ambient Temperature (°C)	RH (%)	Volume (m^3/day)
Natural Gas	32.2	75	2,124
Diesel Oil	32.2	75	2,563

- Domestic wastewater from the workers.

(1) Wastewater from Power Plant

The volume is 2,124 m^3/day (Natural Gas), which is mainly from the cooling tower blowdown; this is non-contaminated wastewater with minimal chemical additives. The wastewater is routed to the on-site wastewater retention pond. If required the on-site Wastewater Treatment Plant clarifies the wastewater prior to the discharge to the CIE, in order to comply with the Industrial effluent standard. Sludge from the clarifier will be solidified in a sludge solidifier (filter press) and will be disposed off-site. The plant

wastewater will be drained to CIE wastewater holding pond. From there the treated wastewater will be discharged into the drainage system and out to Huai Manao.

(2) Domestic Wastewater

The additional workers about 50 persons will generate the wastewater approximately 10 m^3/day which will be drained into the septic tank designed for receiving the wastewater at least 10 m^3/day.

All above treated water which are well within the standard will not significant effect to the receiving water quality.

4.8 GROUNDWATER QUALITY

4.8.1 Construction Period

During the construction period, raw water will be entirely supplied to the construction site by Nong Pla Lai reservoir. There will be no groundwater extraction from the shallow wells around the project area, thus, the impact on groundwater hydrology will not occur.

4.8.2 Operation Period

The water supply during power plant operation will also be from Nong Pla Lai reservoirs. There is no groundwater extraction for the power plant. Therefore, the impact on groundwater hydrology is nil. Concerning the solid waste disposal, both of oil/solvents and residual muds from demineralization plant will be removed by the designated contractor and disposed in the registered landfill. Thus, the effect to groundwater quality will not occur.

In addition, the domestic wastewater will be treated by septic system with the reliable treatment system. Furthermore, the power plant will be implemented in the area of Chonburi Industrial Estate and from the field survey, the nearest community is approximately 2 km. from the plant. Therefore, the impact from groundwater contamination will not occur throughout the operation period.

4.9 AQUATIC BIOLOGY

4.9.1 Construction Period

Site clearing and some earthwork for pile setting and foundation construction may induce turbid surface runoff during rainy season and drain into Huai Manao which may result in some adverse effects.

There are weeds growing around the construction site of about 70 rai and also the plant located about 100 m away from the khlong, some colloidal and soil particles are expected to be trapped by grass filtration then flow down to the Khlong, the water may become clearer and less impact to aquatic animals particularly on fishes.

Plankton has the very short life cycle, hence, the effect will be low. Benthos can normally move very slowly, then, therefore, may receive some negative impacts particular at the turbid water receiving point and the direct habitat cover up.

Fish can move and stay away from such condition, therefore, the overall adverse impact will be relatively low.

In addition, the temporary sedimentation pond is recommended to collect surface runoff before discharge to Huai Manao. Thus, the temporary increase of SS from the proposed site will not cause significant impact on aquatic ecology in Huai Manao.

4.9.2 Operation Period

The cooling water will be supplied from Nong Pla Lai reservoirs which is the designated source of water for Eastern Seaboard area. Normally, the water is drawn from the mid level of reservoir, thus, there is minimal impact on the amount of aquatic ecology particularity plankton entrained in this cooling water. Concerning the impact from thermal pollution from the cooling water purge, this volume of water of about 1,684 m^3/day with a maximum temperature of 40°C will be discharged into the CIE central wastewater holding pond prior to finally discharge to Huai Manao which the temperature at the discharge point will be less than 3°C above ambient water temperature. At the discharge point, the aquatic organism both of plankton and benthos can experienced some temperature rise but this impact will occur in the limited area. The temperature would be reduced along the waterways. In addition, at the designated discharged point in Huai Manao is not the complex food chain. Benthic populations in the study area are not rich. The species diversity in Huai Manao was very low consisting of Aquatic Earth Worm, Insect Larvae, and Snail. Huai Manao is currently the drainage channel of treated wastewater from Chonburi Industrial Estate's treatment plant. Thus, the potential impact on aquatic resources are considered as acceptable.

4.10 WATER USE

4.10.1 Construction Period

During the construction activities of 26 months approximately 200 m^3 of water will be utilized daily for construction purposes, including, construction workers, consumption, concrete mix, and etc. This volume of water will be supplied by Chonburi Industrial Estate from Nong Pla Lai reservoir with the capacity of 18.8 Mm^3. Thus, there will be no impact an the overall water use in the area due to project development.

4.10.2 Operation Period

Nong Pla Lai reservoir is the main source of water supply for the proposed power plant. It is estimated that the maximum water requirement for this power plant would be about 22,146 m^3/days. At present, water demand for industrial sector and waterwork from Nong Pla Lai reservoir is total about 28 Mm^3/year and in the future, water demand will be more increasing because of rapid growth rate of industrial sector, while the mean annual inflow is about 21.76 Mm^3/year and the reservoir capacity of 18.8 Mm^3/year. It is shown that, at present, water demand is higher than the supply, therefore, Nong Pla Lai water pipeline project was executed. Water from Nong Pla Lai reservoir is piped at a rate of 63 Mm^3/year. So, this reservoir can adequately supply water for the proposed IPP project and other industrial development in the Eastern Seaboard area. In addition, East Water Company has strongly confirmed that they can supply water for this power plant as 690,000 m^3/month in January 2001 (see letter of confirmation in Appendix G).

4.11 LAND USE

4.11.1 Construction Period

During construction period, the impacts on land use may occur in the proposed power plant site and those within the right of way of gas transmission pipeline and transmission line. All of these concerned areas will be cleared for the project development. Land use type within the project site is mostly idle land, while that along the right-of-way of gas transmission pipeline and transmission line are occupied by cassava, pineapple, mixed orchards and eucalyptus. At the plant site, the land use will be changed from idle land to a new land use comprising the power plant and associated buildings, power substations, access roads, oil tank farms, administration facilities, etc. These changes have been properly planned and have to be confined within power plant premises, so there will be no adversed effects on land use outside the power plant area.

According to the effects from construction camps with average of approximately 800 persons. The labor camps will be situated in the vicinity of the proposed plant site to minimize any effects of the construction on land use in the adjacent areas because housing for the construction personnel and labour forces can be controlled easily. Without such

control. some construction camps and the associated residential areas will be scattered somewhere else. and that will be some undesirable impacts on land use. There will also be commercial areas associated with such housing development. Control of land use by the contractors during the construction phase is quite important. Otherwise. undesirable land use changes in the approximately 26 months construction period will occur.

4.11.2 Operation Period

According to the rather low number of operating personnel approximately 50 persons. the effects of the power plant on land use such as development of a small community or commercial areas near the power plant to serve only the power plant staff are not expected. However. the expansion plan of Chonburi Industrial will be a major motivation factor to increase the commercial area around the Industrial Estate.

Concerning with the power plant site development, the power plant can induce other industry to be located in the vicinity area. The conversion of land use pattern from agricultural to industrial and commercial areas can be expected.

4.12 TRANSPORTATION

4.12.1 Construction Period

The construction period will cover about 26 months. During the construction phase. a number of workers will be employed to work at the site and some heavy equipment and construction materials will be transported to the site. Therefore, the traffic volume of the main highway and vicinity will be increased. It is estimated that the traffic volume will be about 100 trips/day. Currently, the Highway No.36, 331 with traffic assignment of 48,000 vehicle/day (2 Lanes Highway capacity is 2,000 vehicle/ hour; both directions) and the current traffic volume on HW. No.36, No.331 is 15,098 and 13,800 vehicle/day respectively. Thus. the increased traffic of 0.66% and 0.72% will not be significant.

4.12.2 Operation Period

Traffic during operation phase will be from the staff with estimate 100 vehicles/day. This amount of traffic due to power plant's operation will not cause any inconvenience for local communities because the increased increment is only 0.66 and 0.72% of the existing traffic on Highway. No.36 and 331 respectively.

4.13 SOLID WASTE MANAGEMENT

4.13.1 Construction Period

The major types of solid wastes to be generated during the construction period will be domestic waste from the construction camps. Number of workforce the peak period will be about 800 persons. The solid waste generated from them at the peak period would be approximately 800 kg/day (the average generation rate of solid waste is about 1 kg/person/day). However, the quantity of these wastes will be only for a short period (26 months).

In addition, solid waste to be generated during the construction period will be rubbish from construction material. These waste are not hazardous materials and some of them can be used for land leveling such as brick, soil, gravel, sand and rock.

The waste have to be removed and disposed of properly by CIE. Therefore, the level of impact on this aspect is not anticipated.

4.13.2 Operation Period

During the operation period, the operating staff of the proposed power plant will be 50 persons. The average domestic solid waste generation at the power plant office is estimated at 50 kg/day (the average generation rate of solid wastes is about 1 kg/-person/day).

The waste from power plant can be classified into 3 types as follows:

(1) Wastes from Office and Power Plant

This waste is estimated to be about 50 kg/day (18,250 kg/year) and can be categorized below:

54.0%	-	paper and paper pack
5.4%	-	empty container
27%	-	metal residues
10.8%	-	Oil sludge / oil waste material
2.8%	-	others

This waste will be removed and incinerated properly by Chonburi Industrial Estate.

(2) Waste Water Treatment Sludge

Normally, wastewater consists of solid waste 0.1% and all solid waste will be extracted from wastewater. Therefore, then will be sludge approximately 10.5 ton/year that extracted from wastewater.

(3) Spent Resin

The resin from demineralized system is estimated to be 10,000 kg. The lifetime of resin is about 3 year and will be managed by supplier.

In case of waste oil which generated from the following sources.

- Oil / Water Separators
- Tank farm
- Special containers

This waste oil will be collected and conveyed to GENCO for further management (See letter of confirmation in Appendix H).

Thus, the impact on solid waste management due to the proposed power plant will be insignificant.

4.14 SOCIO-ECONOMIC

4.14.1 Construction Period

It is estimated that the construction period will cover about 26 months and an average of approximately 800 workers will be recruited which can cause both positive and negative impacts.

(1) Positive Impacts

(a) Increased income to the subregional and regional level due to increase of job opportunities, utilizing some services and facilities of hired labours and other related activities.

(b) Other economic benefit to be gained by local people will relate to the commercial and service sectors.

(c) Better quality of life due to having higher income, reducing unemployment and other social problems.

(2) Negative Impact

(a) Increase in population due to labor forces immigration will create negative attitude among local people including crowdiness and some problem i.e.: security problem, gambling drug abuse, quarells, different culture, etc. So it is necessary for the contractors to closely monitor workers' behavior to mitigate this problems.

(b) Inconveniences, such as dust and noise generated from construction related vehicles. But this problem will be only in a short period of 26 months.

4.14.2 Operation Period

The expected number of staffs during the operation phase is about 50 persons. Approximately 10% will be supporting staff, e.g., drivers, guards, messengers, etc. This group of employee can be locally recruited.

(1) Positive Impacts

(a) The project would induce higher quality of life, the employment would generate cash flow, i.e. higher purchasing power to consume or to reach demand in living standard, especially for basic need. The project itself can also induce the better standard of service sector e.g. education and health services.

(b) The power plant can induce investment in the area, resulting in growth of community.

(c) Transformation of the life style and living standard of the agricultural society to industrial society due to the business and production process in the power plant as so called "function specialization of the industry system". It leads to the new attitude, skill and way of life.

(d) Other group of people who do not join the power plant directly can also participate in other induced service sectors.

(2) Negative Impacts

(a) The urbanization and development model may sometime be against the traditional norm, way of thinking which can lead to stress, conflict, uneasy in way of life of the people.

(b) Social problem may arise due to the newcomers who present the different culture practices.

(c) In crease cost of living due to changing life style from agricultural to industrial society.

4.15 PUBLIC HEALTH

4.15.1 Construction Period

(1) Sanitary Problems

As stated earlier, a large number of workers, about 800 persons are expected to live in construction camps within power plant premise during the construction period. In general, sanitary condition of this communities would be relatively poor due to limited water supply, unsanitary latrines, poor quality of domestic water and drinking water, poor drainage and improper practices of solid waste collection and disposal and inadequate provision of health services. Therefore, cholera which is the most serious and common problem could occur in these communities. Other diseases include food poisoning

and diarrhoeal diseases due to personal habit, contaminated food and water can occur. The occurrence of venereal disease and AIDS are also foreseen. Violence could also cause major health problems because the workers are likely to divide into groups according to their place of origins, culture and traditions.

(2) Work Injuries and Accident

During construction, the problem of injury and accident can occur. Machinery operators have frequent injuries of their eye, cuts punctured due to tiredness individual carelessness, or drug or alcohol abuses. Therefore, stringent supervision, education, training and control of workers are necessary in order to minimize these accidents.

(3) Vehicle Accidents

Vehicle accidents in this area are quite common. These accidents could occur because the personnel are not aware of safety precautions, do not use protective or safety devices, or do not observe safety regulations and rules. Others causes of such accidents could be unavailability or shortage of safety devices, inappropriate management of safety promotion program, poor condition of vehicles and machineries, improper habits of workers and unfriendly atmosphere. But, inexperienced driver with excess stimulant drugs and alcohol could be major cause vehicle accident. Moreover, the violences caused by drug and alcohol consumptions can be expected.

4.15.2 Operation Period

The important effect is the hazard caused by fuel combustion for example, emitted SO_2, NO_X and particulates. The health effect can be serious in villages located within 5 km around the plant especially in NE or SW directions. It is expected that the magnitudes of respiratory diseases, burning nose, sore throat, cough, difficult breathing, asthma especially in the young and old people, skin disease, sore eyes or injected eyes in working population and other allergic diseases may increase. The short term effect of exhaust, smoke and particulates are dirts on houses, clothes, vegetable, and water that cause nuisance or make vegetables inedible. However, the results of air quality modelling indicated that the concentrations of all concerned pollutants will be well below the MOSTE standard. Thus, the health effects are unlikely to be resulted from the proposed project.

The loud noise particularly during the pre-commissioning period will not cause serious harmful effect except nuisance. Additional road traffic is expected and may affect the existing traffic and induce more accident.

The chronic effects like problems of hearing, seeing, heat, deteriorated lung function, skin disease, allergy and musculoskeletal system are utmost important. There are the results of chronic exposure and negligence of workers. Particular problems are common among certain workers who face particular risks. Common illnesses are falling,

burns, exposure or inhalation of chemicals, traffic accident and wound. The main cause is human error. Thus it is necessary to have a regular training program on safety on the job and emphasis on using protective gears.

4.16 AESTHETIC/TOURISM

The aesthetic and tourism survey revealed that there is no aesthetic site or tourism attraction located in the adjacent area of the proposed power plant site. Therefore, the impacts on aesthetic and tourism values will not occurred.

Son Pradipatra (*Cassualina junghuniana*) will be planted around the power plant boundary in two alternate rows to enhance the aesthetic condition and alleviate noise impact around the project area.

4.17 RISK ASSESSMENT STUDIES

The examples of risk assessment studies are shown in Appendix I.

CHAPTER 5 : MITIGATION MEASURES

CHAPTER 5
MITIGATION MEASURES

5.1 AIR QUALITY

5.1.1 Construction Period

- Spray water on the construction area and roads twice a day.
- Set the speed limit within the construction site at 30 km/hr.
- Monthly visual inspection the heavy machinery to minimize any pollutants from exhausted gas.
- Prohibit open burning and dumping of solid wastes within the construction camps.
- Provide adequate number of waste receptors around construction camps.

5.1.2 Operation Period

- Set up the height of boiler stack of 40 m.
- Control NO_x level not to exceed the rate of 100 ppmvd for Natural Gas Usage at 7% O_2, dry 25°C, 1 atm and 140 ppmvd at the same condition for firing fuel oil.
- Install the continuous gas sampler for NO_2, O_2, CO, CO_2, SO_2 and TSP.

5.2 NOISE

5.2.1 Construction Period

- Properly maintains heavy machinery and vehicles to reduce the noise level.
- Enforce the speed limit at 30 km/hr for all vehicles around the construction area to minimize noise level.
- Construction activities with heavy equipment should be concentrated during daytime to prevent the serious effects of noise pollution.
- Inform the local communities about work schedule during the night.

5.2.2 Operation Period

- Properly maintain equipment to control the noise emissions not exceed 85 dB(A) at one meter from equipment or noise attenuating enclosure and 1.5 above ground level or permanently installed walkways and ladders.

- For the place which the noise level exceed 85 dB(A), the suitable warning sign must be posted and the hearing protection devices should be used.

5.3 SURFACE WATER HYDROLOGY

During the power plant construction period, there would be some minor amounts of sediments created from the construction site which would be brought into Huai Manao. That may cause some effects on the local water flow in the downstream section. Therefore, a measure should be established to prevent sediments and other waste materials from the construction site from entering the nearby creeks. As a rule of thumb, the best recommendations are:

- To properly dispose of residual construction materials, soil, sand, etc. after the completion of each major piece of work.
- Where appropriate or if sedimentation problems are serious, provide temporary sedimentation basins to trap the sediments.

5.4 SURFACE WATER QUALITY

5.4.1 Construction Period

- Construction camp must be located at least 150 m. from the waterways.
- Sanitary latrines must be provided at the rate of 15 workers/1 unit.
- Construct temporary sedimentation pond to reduce suspended solids load entering the waterways.
- Prohibit waste dumping into the waterways.

5.4.2 Operation Period

- Neutralize treated wastewater to pH 7 or slightly higher prior to discharge.
- Monitor treated wastewater at the discharge point monthly.
- Regularly check and maintain on wastewater treatment equipment.

5.5 GROUNDWATER

5.5.1 Construction Period

- Adequately provide the sanitary latrines for the workers (1 sanitary latrine/15 workers).
- The sanitary latrines must be at least 150 m. from the shallow wells.
- Prohibit groundwater utilization for construction activities.

5.5.2 Operation Period

- Regularly inspect on the septic systems to operate as designed.
- Prohibit direct discharge of wastewater onto the ground.
- Provide proper solid waste disposal.
- Provide proper sanitary wastewater treatment system within the project.

5.6 LAND USE

During the construction period, it is very desirable to keep all the workers camps within the CIE premises. If that is the case, there will be no or little changes in land use outside CIE area. If off site construction camps are allowed, conditions should be set such that the responsible contractors have to establish the communities for their labour forces and control the development within the framework and regulations of the authorities concerned. The communities must not be allowed the invoke private or public lands, and orderly housing facilities should be provided.

5.7 TRANSPORTATION

5.7.1 Construction Period

- Enforce the traffic regulation especially speed limit for trucks and other vehicles related to the project.
- Cover loose construction material with canvas or plastic sheet during transportation.
- Avoid transporting of heavy, large and long or oversized equipment under poor climate condition including heavy rainfall.
- Inform local communities about construction schedule and the increased traffic volume due to project.
- Strictly enforce the highway regulations on vehicle operators.
- Provide standard traffic signals at the appropriate locations around the project site.

5.7.2 Operation Period

- Emphasis with all concerned staff about safe vehicle operations.
- Provide bus services for staff to reduce traffic volume on local road.

5.8 SOCIO-ECONOMICS

5.8.1 Construction Period

- Contractors must have adequately and properly control social problems in the workers' communities such as gambling, drug abuse and problems within the workers' communities as well as in the nearby communities.
- Offer job opportunities to local residents as a priority. This measure should be given opportunity to share benefit derived from the project that it will also help minimize tension between the local and the project and create positive attitudes of the local people towards the project.
- Provide accurate information about the project. This information should include:

  - The project site to eliminate doubt about land appropriation.
  - The project operation system in clear and simple terminology to reduce worries about deteriorated environment condition.
  - Mitigation measures and plans for emergency of the project operation.
  - Benefits of the project.

5.8.2 Operation Period

- Continue the public relation program around the project area.
- Educate local residents about power plant operation.
- Open up communication channel with local residents.

5.9 PUBLIC HEALTH SAFETY

5.9.1 Construction Period

- Closely monitor the contagious diseases around the construction communities, e.g., cholera, diarrhoea, food poisoning, etc.
- The construction camps must be adequately provided with good quality water supply, sanitary latrines, proper waste disposal methods, proper drainage systems and clean housing under the law of the Ministry of Labor and Social Welfare.
- Advise workers on health education about disease prevention, by assistance from the local public health office.
- Contractors must provide adequate medical units at the construction site and at the worker's communities, to provide first aid services and transport services should also be provided in case of serious accidents or illnesses.
- The contractors should be in connection with local health agencies for further care and patient referral.
- The construction contractor should enhance safety of the workers on the construction site and at the workers' camps by taking the step and measures.

- Strict supervision and monitor of the regulations related to vehicle operation.
- Drinking and alcoholic consumption on job are strictly prohibited.

5.9.2 Operation Period

- Regularly monitor the pollution emission level from the site.
- Partially support the local public health services.
- Provide routine annual health examination to all staff.
- Strengthen the training program for new recruits.
- Set up committee for safety at all working level.
- Periodically check the noise level around the site.

The mitigation measures can be summarized in Table 5-1.

TABLE 5-1
ENVIRONMENTAL IMPACT & MITIGATION MEASURES FOR IPP PROJECT AT CHONBURI INDUSTRIAL ESTATES, SRIRACHA DISTRICT, CHONBURI PROVINCE

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
1. Air Quality	✓		- Fugitive dust and exhausted gas due to construction activities, however the construction actiyities will be conducted only the day time and only 26 months therefore, the impact is considered as minor.	- Spray water on the construction area and roads twice a day. - Set the speed limit within the construction site at 30 km/hr. - Visual inspect the heavy machineries monthly to minimize any pollutants from exhausted gas. - Prohibit open burning and dumping of solid wastes within the construction camps.
		✓	- The distributed particulates, NO_x SO_2 and CO from plant stack with the emission of 20 mg/m^3 (TSP) 100 ppmvd (NO_2) and 250 ppmvd (CO) in case of natural gas usage. For diesel firing, the emission rates will be 35 mg/m^3 (TSP), 140 ppmvd (NO_2), 150 ppmvd (SO_2) and 290 ppmvd (CO). (normal operation at design ambient conditions)	- Set up the height of boiler stack of 40 m. - Control NO_x level not to exceed the rate of 100 ppmvd for natural gas burning at 7% O_2, dry 25°C, 1 atm and 140 ppmvd at the same condition for firing fuel oil. - Install the continuous emission monitoring for NO_x, O2, CO, CO_2, SO_x and TSP at the stack.

TABLE 5-1 (Cont'd)

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
2. Noise	✓		- The nearest community (Ban Huai Hein) will have noise level of 62.5 dB(A) due to construction activities and noise level at this community will be 64.40 dB(A) when existing noise level is taken into account.	- Properly maintain the heavy machineries and vehicles to reduce the noise level. - Enforce the speed limit at 30 km/hr for any vehicles around the construction area to minimize noise level. - Construction activities with the heavy equipment should be concentrated during daytime to prevent the serious effects of noise pollution. - Inform the local communities about work schedule during the night.
		✓	- Noise level due to project operation at Ban Huai Hien and Ban Bowin will be only 24.52 and 22.58 dB(A) respectively.	- Properly maintain equipments to control the noise emissions not exceed 85 dB(A) at one meter. - For the place which the noise level exceed 85 dB(A), the suitable warning sign must be posted and the hearing protection devices should be used.
3. Hydrology	✓		- The construction activities within the area of 70 rai will not generate any effect on flooding in the vicinity area including the changing of flow at nearby khlong.	- To properly dispose of residual construction materials, soil, sand, etc. after the completion of each major. - Where appropriate or if sedimentation problems are serious, provide temporary sedimentation basins to trap the sediments.

TABLE 5-1 (Cont'd)

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
3. Hydrology (Cont'd)		✓	- Wastewater of 2,124 m^3/day (gas operation) or 2,563 m^3/day) (fuel oil operation) will be treated on site and discharged to the Huai Manao vai the CIE holding pond.	-
4. Surface Water Quality	✓		- Low level impact since the Septic Tank is designed to be used at the worker camp site and runoff water will be stored 3 hours prior to discharge to Huai Manao.	- Construction camp must be located at least 150 m. from the waterways. - Sanitary latrines must be provided at the rate of 15 workers / 1 unit. - Construct temporary sedimentation pond to reduce suspended solids load entering the waterways. - Prohibit waste dumping into the waterways.
		✓	- 2,124 m^3/day (gas operation) or 2,563 m^3/day (fuel oil operation) of wastewater will be discharged to central CIE wastewater holding pond. This treated water will be within the standard of MOI. Then, the impact level is low.	- Neutralize treated wastewater to pH 7 or slightly higher prior to discharge. - Monitor treated wastewater at the discharge point monthly. - Regularly check and maintain on wastewater treatment equipment.

TABLE 5-1 (Cont'd)

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
5. Groundwater	✓		- No impact.	- Adequately provide the sanitary latrines for the workers (1 sanitary latrine / 15 workers). - The sanitary latrines must be at least 150 m. from the shallow wells. - Prohibit groundwater utilization for construction activities.
		✓	- There will be no impact.	- Regularly inspect on the septic systems to operate as designed. - Prohibit direct discharge of wastewater into the ground. - Provide proper solid waste disposal. - Provide proper sanitary wastewater treatment system within the project.
6. Biological Resource	✓		- Sediment from runoff water will be trapped by weeds and grasses, then the impacts on biological resource namely plankton, benthos and fish are low level.	- Surface water quality mitigation measures must be employed.
		✓	- The treated water and uncontaminated water will be discharged to Huai Manao in which the temperature will be not changed $\pm 3^{\circ}C$ from the existing condition therefore the level of impact will be minor.	- Surface water quality mitigation measures must be employed.

TABLE 5-1 (Cont'd)

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
7. Water Use	✓		- The volume of estimated water is only 200 m^3, therefore the impact is considered to be minor.	-
		✓	- The water source is Nong Pla Lai which can supply 63 Mm^3/hr wherever the project demand is only 8.08 Mm^3/yr. Then the impact is low level.	-
8. Land Use	✓		- The worker camp is designed to locate in project area and then the impact on land use is non-significant.	- In case that the camp site is located outside project area, the workers community must be the responsibility of contractor.
		✓	- There will be a trend to stimulate land development at the arounding area, however the project site is located in Industrial Estate then the impact is unforeseen.	-

TABLE 5-1 (Cont'd)

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
9. Transportation	✓		- The increased traffic volume is estimated to be 0.66 and 0.72% of existing condition for Highway No.36 and 331 respectively.	- Enforce the traffic regulation especially speed limit for trucks and other vehicles related to the project. - Cover loose construction material with canvas or plastic sheet during transportation. - Avoid transporting of heavy, large and long of oversized equipment under poor climate condition including heavy rainfall. - Inform local communities about construction schedule and the increased traffic volume due to project. - Strictly enforce the highway regulations on vehicle operators. - Provide standard traffic signals at the appropriate locations around the project site.
10. Socio-Economic	✓		- Increased income to the subregional and regional area due to job opportunities increase. - Increase problems such as security problem, quarrels, and etc.	- Contractors must have adequately and properly control social problems in the workers' communities such as gambling, drug abuse and problems within the workers communities as well as in the nearby communities. - Offer job opportunities to local residents as a priority. This measure should be given opportunity to share benefit derived from the project that it will also help minimize tension between the local and the project and create positive attitudes of the local people towards the project. - Provide accurate information about the project.

TABLE 5-1 (Cont'd)

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
11. Public Health Safety	✓		- The proposed project may generate public health problems.	- Closely monitor the contagious diseases around the construction communities, e.g., cholera, diarrhea, food poisoning. - The construction camps must be adequately provided with good quality water supply sanitary latrines, proper waste disposal methods, proper drainage systems and clean housing under the law of the Ministry of Labor and Social Welfare. - Advise workers on health education about disease prevention. - Contractors must provide adequate medical units at the construction site and at the worker's communities to provide first aid services and transport services. - The contractors should be in connection with local health agencies for further case. - The construction contractor should enhance safety of the workers on the construction, site and at the workers' camps by taking the step and measures. - Strict supervision and monitor of the regulations related to vehicle operation. - Drinking and alcoholic consumption on job are strictly prohibited.

TABLE 5-1 (Cont'd)

Environmental Resource	Construction Period	Operation Period	Environmental Impacts	Mitigation Measures
11. Public Health Safety (Cont'd)		✓	- Loud noise may interrupt nearby communities including air pollution problems, however the estimated concentrations are well within the standard.	- Regularly monitor the pollution emission level from site. - Partially support the local public health services. - Provide routine annual health examination to all staff. - Strengthen the training program for a new recruits. - Set up committee for safety at all working level. - Periodically check the noise level around the site.
12. Occupational Health and Safety	✓		- Accidents' due to construction activities.	- Zero-Accident Performance must be employed.
		✓	- The impacts may be occurred as follows: •chemicals •air pollution •noise •heat •accidents	- Follow health and safety plans.

CHAPTER 6 : MONITORING PROGRAM

CHAPTER 6
MONITORING PROGRAM

6.1 AIR QUALITY

6.1.1 Construction Period

(1) Parameters
- PM10
- TSP
- NO_2
- SO_2
- Wind Speed/Direction

(2) Locations (Figure 6-1)
- Within the project
- Wat Hup Bon Wanaram
- Wat Bo Win
- Wat Phan Sadet Nok

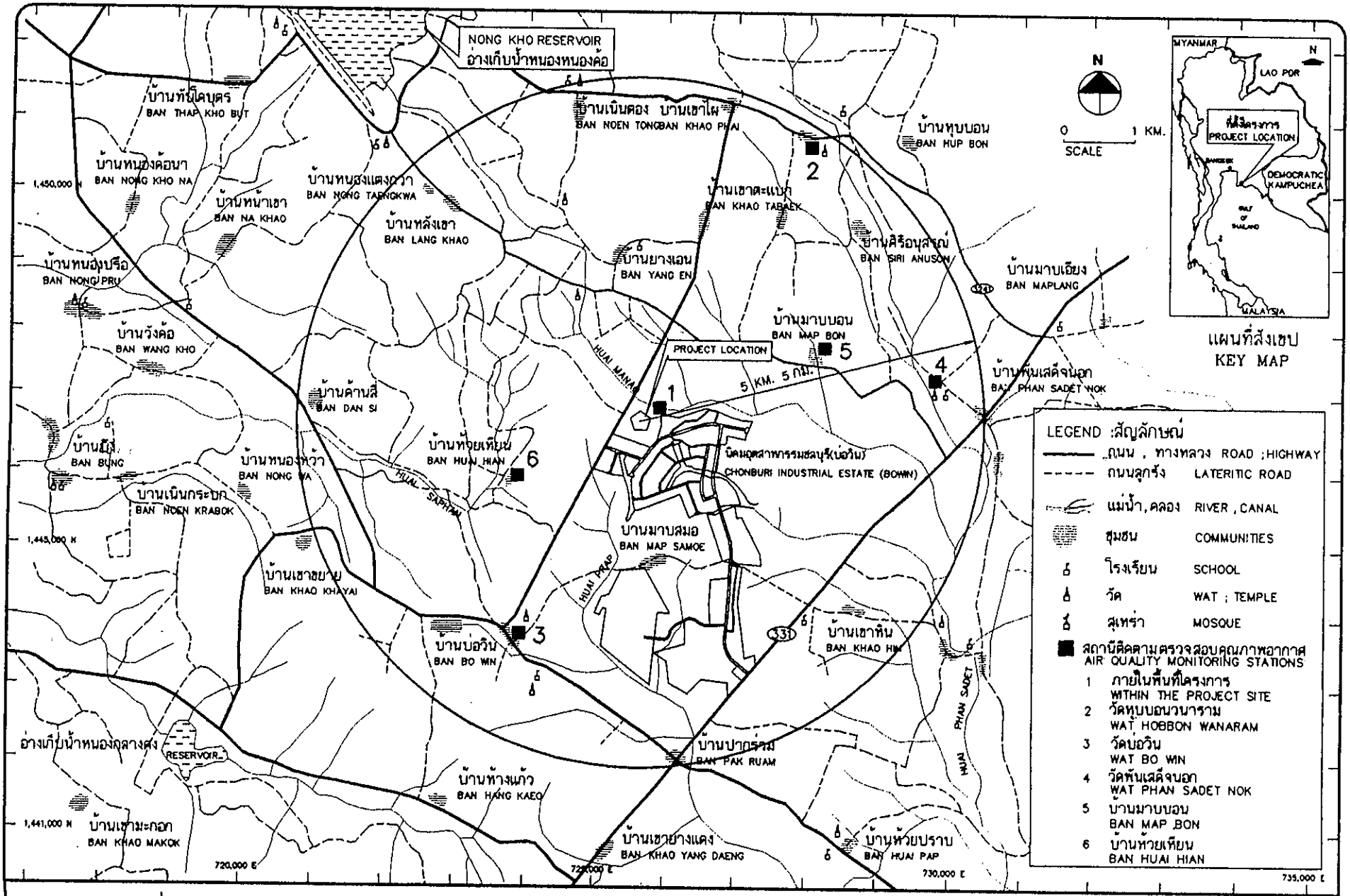
(3) Frequency
- Every year during the dry season. Each sampling period must be conducted for 3 days continuously.

(4) Methodology

Parameter	Method of Analysis
TSP	Gravimetric
SO_2	Pararosaniline
NO_2	TGS - ANSA
PM10	Gravimetric

(5) Estimated Expenses
- 120,000 baht/sampling period

(6) Responsible
- Bowin Power Plant (BPP)



รูปที่ 6-1 : สถานีตรวจสอบคุณภาพอากาศ

FIGURE 6-1 : AIR QUALITY MONITORING STATIONS

6.1.2 Operation Period

6.1.2.1 Ambient Air Quality

(1) Parameters
- PM10
- TSP
- SO_2
- NO_2
- Wind Speed/Direction

(2) Location
- Administrative building
- Wat Hup Bon Wanaram
- Wat Bo·Win
- Wat Phan Sadet Nok
- Ban Map Bon
- Ban Huai Hien

(3) Frequency
- Every six months during the north-east (November-December) and southwest (July-August) monsoons. Each sampling period must be conducted for 7 days continuously in the first year of operation and for 3 days continuously after the first year.

(4) Methodology

Parameter	Method of Analysis
TSP	Gravimetric
SO_2	Pararosaniline
NO_2	TGS - ANSA
PM10	Gravimetric Method

(5) Estimated Expenses - 120,000 baht/sampling period

(6) Responsible - Bowin Power Plant (BPP)

6.1.2.2 Stack Emission

(1) Parameters
- CO
- TSP
- O_2
- SO_2
- CO_2
- NO_2

(2) Location - Gas turbine stack of BPP

REVISION
รูปที่ 6-1 : สถานีตรวจวัดคุณภาพอากาศ
FIGURE 6-1 : AIR QUALITY MONITORING STATIONS
Page 6-2

(3) Frequency - Continuously monitoring equipment will be installed for NO_2, CO, CO_2, O_2, TSP and SO_2

(4) Methodology

Parameter	Method of Analysis
TSP SO_2 NO_2	Gravimetric Pararosaniline TGS - ANSA

(5) Estimated Expenses - 5,000,000 baht/installation period and 200,000 baht/operation period

(6) Responsible - Bowin Power Plant (BPP)

6.2 NOISE

6.2.1 Construction Period

(1) Parameters
- Leq (24)
- Ldn

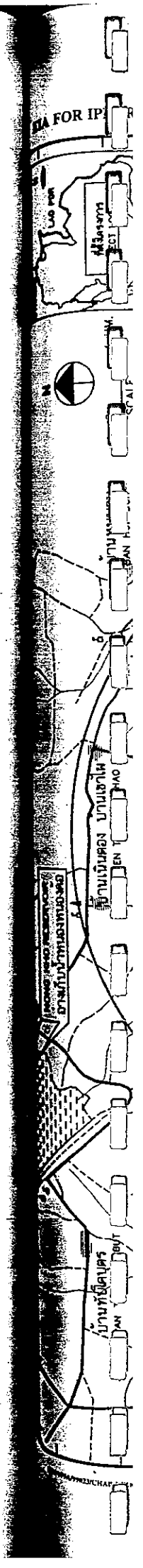
(2) Locations (Figure 6-2)
- Within the plant boundary
- Ban Bo Win
- Ban Huai Hian
- Ban Phan Sadet Nok

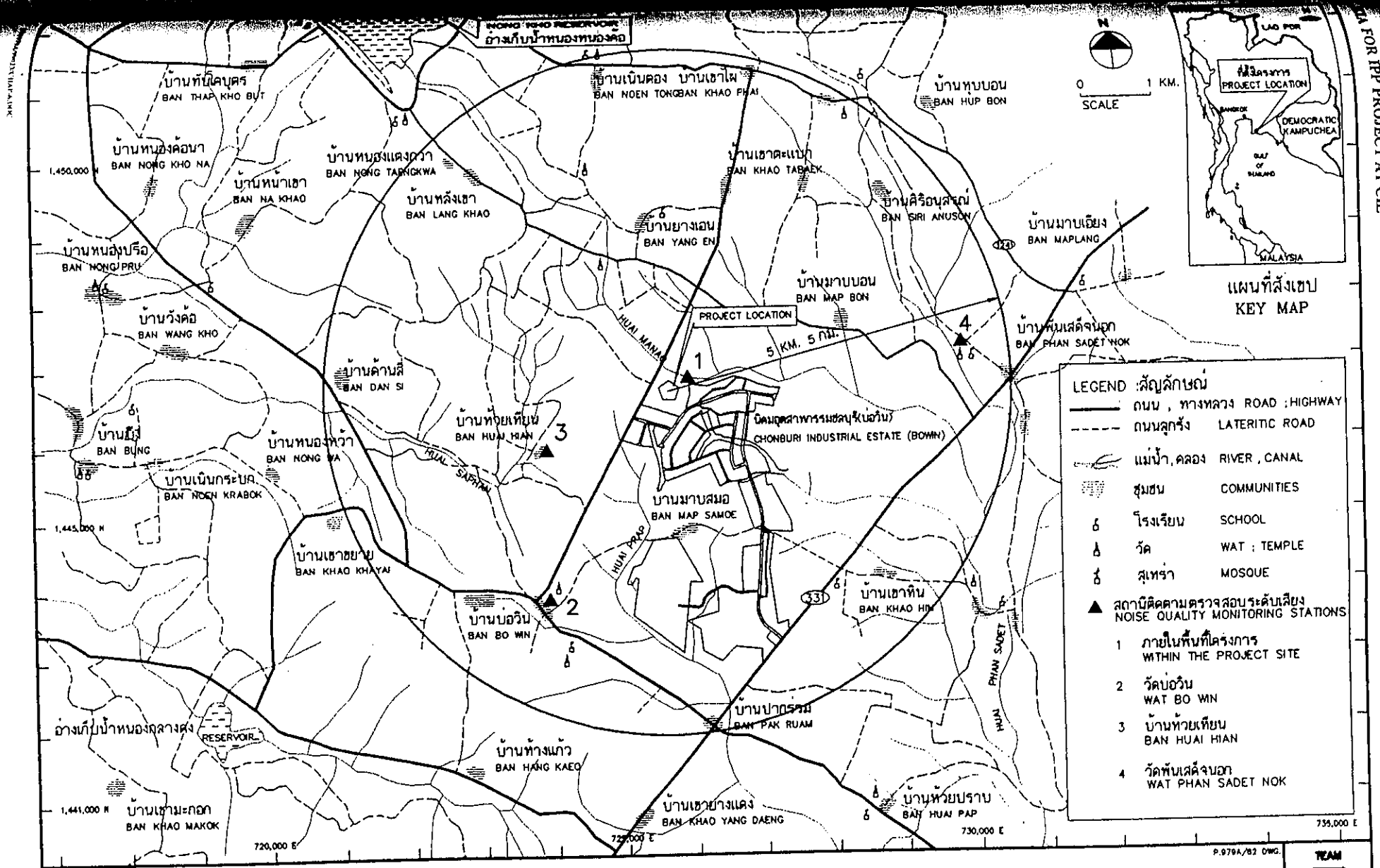
(3) Frequency - 4 times/year

(4) Methodology - Methods recommended by ISO 1996 (International Standardization Organization).

(5) Estimated Expenses - 20,000 baht/sampling period

(6) Responsible - Bowin Power Plant (BPP)





รูปที่ 6-2 : สถานีติดตามตรวจสอบระดับเสียง

FIGURE 6-2 : NOISE QUALITY MONITORING STATIONS

6.2.2 Operation Period

(1) Parameters
- Leq (24)
- Ldn
- Leq (8)

(2) Locations
- Leq (24) and Ldn
  - Administrative building
  - Plant boundaries
  - Ban Bo Win
  - Ban Huai Hian
  - Ban Phan Sadet Nok
- Leq (8)
  - Working area

(3) Frequency
- Leq (24) and Ldn - Every six months at the same period as the air quality monitoring.
- Leq (8) - 8 times/year

(4) Methodology - Methods recommended by ISO 1996 (International Standardization Organization).

(5) Estimated Expenses
- Leq (24) and Ldn - 25,000 baht/sampling period
- Leq (8) - 15,000 baht/sampling period

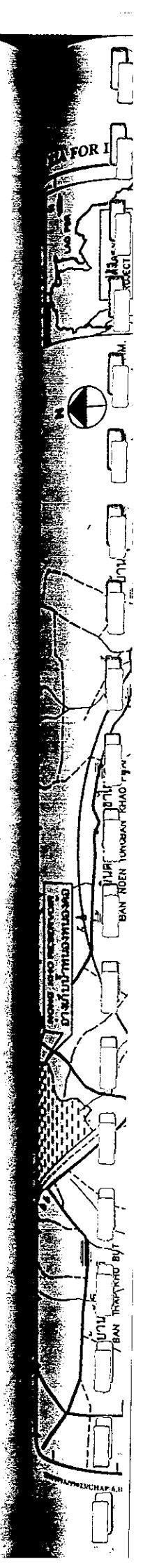
(6) Responsible - Bowin Power Plant (BPP)

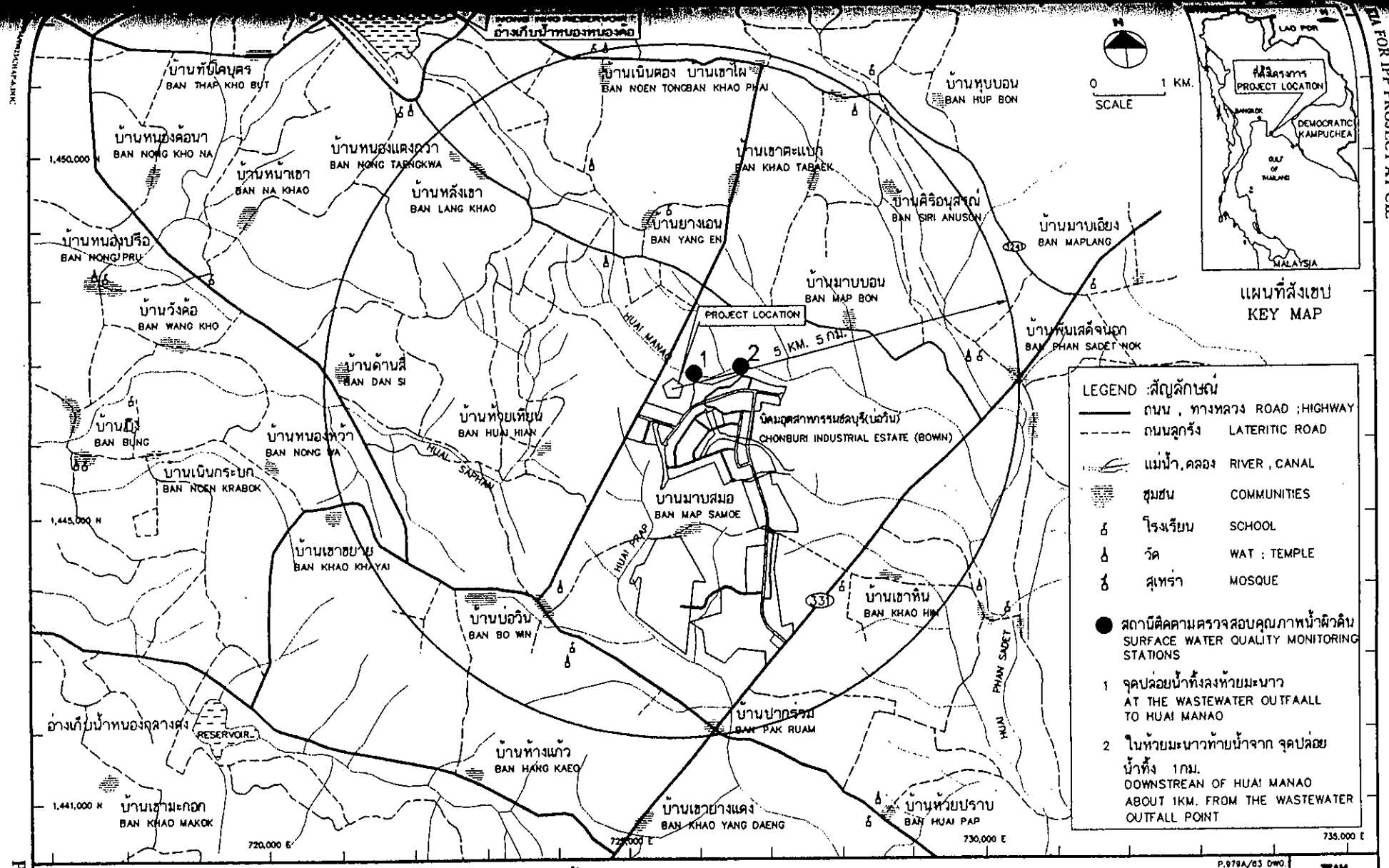
6.3 SURFACE WATER QUALITY

6.3.1 Construction Period

(1) Parameters
- Depth
- Temperature
- TDS
- SS
- pH
- DO
- Cl^-
- Sulphate
- Conductivity
- Oil & Grease

(2) Location (Figure 6-3)
- At the wastewater outfall to Huai Manao.
- Downstream of Huai Manao about 1 km. from wastewater outfall point.





รูปที่ 6-3 : สถานีติดตามตรวจสอบคุณภาพน้ำผิวดิน

FIGURE 6-3 : SURFACE WATER QUALITY MONITORING STATIONS

(3) **Frequency** - Every six months

(4) **Methodology**

Parameter	Method of Analysis
Depth	Sounding
Temperature	Remote Thermometer
SS	Non-Filterable residue through glass fibre filter discs
pH	pH meter
DO	DO meter
Cl^-	Argentometric Method

Note : Standard Method of the Examination of wastewater by APHA-AWWA-WPCF, other parameter will be measured.

(5) **Estimated Expenses** - 30,000 baht/sampling period

(6) **Responsible** - Bowin Power Plant (BPP)

6.3.2 Operation Period

6.3.2.1 Surface Water

(1) **Parameters**

- Depth
- Temperature
- TDS
- SS
- pH
- DO
- Cl^-
- Sulphate
- Conductivity
- Oil & Grease

(2) **Location**

- At the wastewater outfall to Huai Manao.
- Downstream of Huai Manao about 1 km. from wastewater outfall point.

(3) **Frequency** - Every six months (November-December and March-April) during the lowtide period.

(4) **Methodology**

Parameter	Method of Analysis
Depth	Sounding
Temperature	Remote Thermometer
SS	Non-Filterable residue through glass fibre filter discs
PH	pH meter
DO	DO meter
Cl^-	Argentometric Method
SO_4^{2-}	Titrimetric Method

Note : Standard Methods for the Examination of Wastewater by APHA-AWWA-WPCF, other parameters will be measured.

(5) **Estimated Expenses** - 30,000 baht/sampling period

(6) **Responsible** - Bowin Power Plant (BPP)

6.3.2.2 Treated Process Wastewater

(1) **Parameters**
- Flow rate
- Temperature
- pH
- SS
- TDS
- Cl^-
- Sulphate
- Oil & Grease

(2) **Location**
- Effluent from neutralization tank
- Effluent from sampling chamber
- Effluent from plant outfall

(3) **Frequency** - Once every month

(4) **Methodology**

Parameter	Method of Analysis
Depth	Sounding
Temperature	Remote Thermometer
SS	Non-Filterable residue through glass fibre filter discs
pH	pH meter
DO	DO meter
Cl^-	Argentometric Method
SO_4^{2-}	Titrimetric Method

Note : Standard Methods for the Examination of Wastewater by APHA-AWWA-WPCF, other parameters will be measured.

(5) **Estimated Expenses** - 30,000 baht/sampling period

6.4 AQUATIC RESOURCES

6.4.1 Construction/Operation Period

(1) Parameters
- Planktonic Organisms
- Benthic Organisms

(2) Locations
- Wastewater Outfall
- 1 km from wastewater outfall

(3) Frequency
- Every six months (November-December and March-April)

(4) Methodology
- Plankton; Samples of planktonic organisms will be collected by using 70 micron mesh size plankton net. The oblique trawling technique will be applied in the collection. The retained planktons will be transferred to a polyethylene bottle and preserved with 4% formalin solution for further identification (Lind, 1979).
- Benthos; Benthic organisms will be sampled by dredging bottom sediment with 3 successive grabs of Ekman dredge. Observations will be made on sediment texture and all sediment will be sorted through a series of wire seives. The retained organisms will be preserved in 4-7% formalin solution for further identification (Lind, 1979).

(5) Estimated Expenses
- 15,000 baht/sampling period

(6) Responsible
- Bowin Power Plant (BPP)

6.5 WATER SUPPLY

6.5.1 Construction Period

(1) **Parameter**	-	Sufficient of water supply at construction camp
	-	Quality of water supply
	-	Problem on water supply
(2) **Location**	-	Construction Camp
(3) **Frequency**	-	Every three months
(4) **Methodology**	-	By Record
(5) **Responsible**	-	Contractor

6.5.2 Operation Period

(1) **Parameter**	-	Sufficient of raw water supply
	-	Quality of raw water supply
	-	Problem on water supply
(2) **Location**	-	Power plant.
	-	Water demand, water supply and quality from Nong Kho reservoir should be collect from Royal Irrigation Department and Eastern Seaboard Project.
(3) **Frequency**	-	Every six months
(4) **Methodology**	-	By Record
(5) **Responsible**	-	Contractor

6.6 TRANSPORTATION

6.6.1 Construction Period

(1) **Parameter/Methodology**	-	Traffic volume related to construction activities.
	-	Record traffic accident concerning to the power plant construction activities.

(2) Location
- Highway to the power plant
- Accident record should be collect from contractor and police station

(3) Frequency - Every four months

(4) Methodology - By Record

(5) Responsible - Contractor

6.6.2 Operation Period

Due to the lower amount of traffic volume (100 vehicle/day). So, it is not necessary to set up the monitoring program.

6.7 PUBLIC HEALTH/SAFETY

6.7.1 Construction Period

(1) Parameter/Methodology
- Record case of accident, injury and illness.
- Evaluate major health problems

(2) Location
- First aid unit on site
- Tambon Health Station in the power plant area.
- Somdej Na Sri Racha Hospital

(3) Frequency - Every two months

(4) Methodology - By Record

(5) Responsible - Contractor

6.7.2 Operation Period

(1) Parameter/Methodology
- Accident records and patient record
- Evaluate major health problems
- Health Examination
  - X-ray (lung)
  - Hearing Capability
  - Annual Health Examination
- Noise level measurement in control room and the areas of Compressor, Generator, Pumps and etc.
- Training for first aid operation.
- Emergency Response Plan Training

(2) Location	- Tambon Health Station - Somdej Na Sri Racha Hospital - Power Plan Area
(3) Frequency	- Every year. (Noise Measurement = 4 tonnes/year)
(4) Methodology	- By Record - ISO1998 for noise measurement
(5) Estimated Expense	- 1,000 baht/person - 5,000 baht for noise measurement - 5,000 baht for first aid training - 10,000 baht for Emergency Response Plan Training
(6) Responsible	- Bowin Power Plant (BPP)

TABLE 6-1
ENVIRONMENTAL MONITORING PROGRAMS

Environmental Resource	Period		Parameter	Location	Frequency	Method	Estimated Expense (Baht/period)*	Responsible Agency
	Construction	Operation						
1. Air Quality	✓		- TSP, NO_x as NO_2, SO_2, PM-10 and wind speed, direction	- Project site - Wat Hubbornwanaram - Wat Bowin - Wat Pansadet Nok	- 3 consecutives day, twice a year	TSP - Gravimetric SO_2 - Pararosaniline NO_2 - TGS-ANSA PM10 - Gravimetric	120,000	Bowin Power Plant
		✓	1) Stack sampling - CEM (Continuous Emission Monitoring) • NO_x as NO_2 • CO, CO_2, O_2, SO_2, TSP	- Stack Power Plant - Stack Power Plant	- CEM's equipment - CEM's equipment	NO_2 - TGS-ANSA NO_2 - TGS-ANSA CO - Non-dispersive infrared detection	5,000,000 baht 5,000,000 baht for installation and 200,000 ß/year for operational cost	Bowin Power Plant Bowin Power Plant
			- Stack Sampling • NO_x as NO_2 • CO • TSP • SO_2 (Diesel usage as fuel)	- Stack Power Plant	- Samplings twice a year, if the results are deviated from CEMS $< \pm 10\%$; reduce frequency to be once a year.	TSP - Gravimetric NO_2 - TGS-ANSA CO - Non-dispersive infrared detection	150,000	Bowin Power Plant
		✓	2) Ambient - TSP, NO_x as NO_2, SO_2, PM-10, wind direction and wind speed	- Administrative building - Power plant area - Wat Hubbornwanaram - Wat Bowin - Wat Pansadet Nok - Ban Map Born - Choomchon Huai Hien	- Twice a year, 7 consecutives day for the first year of operation and 3 days continuously for the later year.	TSP - Gravimetric SO_2 - Pararosaniline NO_2 - TGS-ANSA CO - Non-dispersive infrared detection	150,000	Bowin Power Plant
2. Noise	✓		- Leq (24) - Ldn	- Project site - Ban Bo Win - Ban Huai Hien - Ban Pan Sadet Nok	- Twice a year during construction period.	ISO 1996	20,000	Bowin Power Plant
		✓	- Leq (24) - Ldn - Leq (8 hr.)	- Administrative building - Ban Bo Win - Ban Huai Hien - Ban Pan Sadet Nok - Working Area	- Twice a year the same period of air monitoring - 4 time/year.	ISO 1996 ISO 1996	25,000 15,000	Bowin Power Plant Bowin Power Plant

TABLE 6-1 (Cont'd)

Environmental Resource	Period		Parameter	Location	Frequency	Method	Estimated Expense (Baht/period)	Responsible Agency
	Construction	Operation						
3. Surface Water Quality	✓		- Flow rate, temperature, TDS, SS, pH, DO, Cl, $SO_4^{=}$, conductivity, Oil & Grease	- Discharge point to Huai Manao. - Upstream and downstream of discharge point 1 km. of distance in Huai Manao.	- Twice a year.	APHA-AWWA WPCF or standard method	30,000	Bowin Power Plant
		✓	- Flow rate, temperature, TDS, SS, pH, DO, Cl, $SO_4^{=}$, conductivity, Oil & Grease	- Discharge point to Huai Manao. - Upstream and downstream of discharge point 1 km. of distance in Huai Manao.	- Twice a year. • September - December • March - April	APHA-AWWA WPCF or standard method	30,000	Bowin Power Plant
		✓	- Flow rate, temperature, TDS, SS, TDS, Cl^-, SO_4^{2-}, Oil & Grease	- Polishing Pond. - Water quality checking pond. - Treated water discharge.	- Every month.	APHA-AWWA WPCF or standard method	30,000	Bowin Power Plant
4. Biological Resource	✓	✓	- Plankton - Benthos	- Huai Manao (Discharge Point) - Up and downstream of discharge point at 1 km. of distance.	- Twice a year. • September - December • March - April	- Plankton net 70 μ. - Ekman dredge.	15,000	Bowin Power Plant
5. Water Use	✓		- The sufficiency of water use at camp site. - Water quality and problems.	- Camp site.	- Every 3 months.	- By Record	-	Contractor
		✓	- The sufficiency of water use at camp site. - Water quality and problems.	- Power Plant. - East Water Company.	- Every 3 months.	- By Record	-	Bowin Power Plant

TABLE 6-1 (Cont'd)

Environmental Resource	Period		Parameter	Location	Frequency	Method	Estimated Expense (Baht/period)	Responsible Agency/ies
	Construction	Operation						
6. Transportation	✓		- Traffic volume due to construction activities. - Accidental record due to transportation activities.	- Camp site. - Gathering from polish station and contractor.	- Every 4 months.	- By Record	-	Contractor
7. Public Health Occupational Health and Safety	✓		- Accidental records, injuries and illness records. - Public Health problems.	- Health care unit in project site. - Community Health Centre. - Somdej Na Sri Racha Hospital.	- Every 2 months.	- By Record	-	Contractor
		✓	- Accidental, injuries and illness records.	- Community Health Centre.	- Annually	- -	-	Bowin Power Plant
			- Public Health Problems. - Health Examination • X-ray (Lung) • Visual Capability • Hearing Capability • Annual Health Examination	- Somdej Na Sri Racha Hospital.	- Annually	- -	1,000 baht/person	Bowin Power Plant
			- Noise level measurement in control room and the areas of Compressor, Generator, Pumps and etc.).	- Power plant area.	- 4 times a year.	- ISO 1996	5,000	Bowin Power Plant
			- Training for first aid operation - Emergency Response Plan Training.	- Power plant area. - Power plant area.	- Annually - Annually	- - - -	5,000 10,000	Bowin Power Plant Bowin Power Plant

APPENDIX A

GAS SALE AGREEMENT BETWEEN PTT AND BOWIN POWER COMPANY LIMITED

GAS SALES AGREEMENT

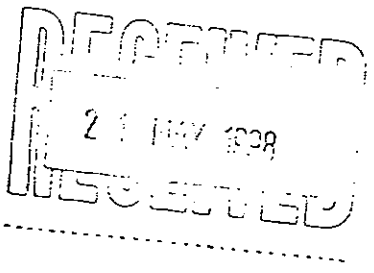
between

PETROLEUM AUTHORITY OF THAILAND

and

BOWIN POWER COMPANY LIMITED

Signed on 12 December 1997



AN AGREEMENT made in Bangkok Metropolis in the Kingdom of Thailand this 12 day of December 1997 between the PETROLEUM AUTHORITY OF THAILAND having its principal office at 555, Vibhavadi Rangsit Road, Bangkok 10900 represented by Mr. Pala Sookawesh, whose position is Governor of Petroleum Authority of Thailand (hereinafter called "PTT") of the first part, and BOWIN POWER COMPANY LIMITED, a limited company incorporated in Thailand and having its registered office at 20th Floor UM Tower, 9 Ramkhamhaeng Road, Suanluang, Bangkok 10250, Thailand represented by Mr. Prateep Trilohaka whose position is Director of Bowin Power Company Limited and Dr. Bart Lucarelli, whose position is Director of Bowin Power Company Limited (hereinafter called the "IPP"), of the second part;

Documents evidencing company registration and empowering the person(s) to sign on behalf of the IPP are attached hereto;

WHEREAS, the Government of Thailand has announced the policy of encouraging and promoting the development of independent power producers for generating electricity to meet the needs of electricity consumers;

WHEREAS, to advance such Governmental policy, EGAT and the IPP will enter into a power purchase agreement setting out the terms and conditions on which the IPP will agree to develop, construct, finance, operate and maintain a 713 MW contracted capacity, under Schedule 1 of the Power Purchase Agreement, combined cycle power plant to be located at Bowin, Chonburi Province,Thailand to provide electrical capacity and deliver electricity to EGAT;

WHEREAS, EGAT and PTT have entered into a Master IPP Program Gas Sales Agreement ("MGSA"), dated 17 March 1997, setting out, among other things, the terms and conditions upon which PTT and EGAT agree to the purchase, sale, delivery, receipt and redirection of certain aggregate amounts of Natural Gas in connection with independent power producers;

WHEREAS, PTT is a juristic person (and not a department of the government of the Kingdom of Thailand) established as a separate entity by the Petroleum Authority of Thailand Act and having the objectives of engaging in and promoting petroleum business and in furtherance of its commercial objectives;

WHEREAS, PTT has a supply of Natural Gas available for sale and PTT desires to sell some of such Natural Gas to the IPP, subject to the following terms and conditions;

WHEREAS, the IPP desires to purchase some of the Natural Gas which PTT has available for sale, subject to the following terms and conditions; and

WHEREAS, the IPP represents and PTT acknowledges that the Sales Gas to be purchased hereunder is intended for use as primary fuel by the IPP for generation of electricity at its power plant;

ARTICLE I DEFINITIONS

In this Agreement, reference to Articles and Clauses shall be reference to Articles and Clauses of this Agreement and words indicating the singular may also include the plural and vice versa as the context requires and unless otherwise indicated the following words and expressions in this Agreement, including the foregoing recitals, shall have the meanings set forth below:

1.1 "Alternate Delivery Point" shall mean the point or points to which EGAT may redirect certain volumes of Sales Gas pursuant to the Sixth Schedule.

1.2 "Alternate Fuel" shall mean fuel acceptable to the IPP for use at the IPP Facilities excluding Sales Gas.

1.3 "BTU" means one (1) British Thermal Unit which is further defined as the amount of heat required to raise the temperature of one (1) avoirdupois pound of pure water from fifty-eight and one-half (58.5) degrees Fahrenheit to fifty-nine and one-half (59.5) degrees Fahrenheit at a standard pressure of fourteen decimal seven three (14.73) pounds per square inch absolute.

1.4 "Commodity Charge" shall have the meaning set forth in the Fourth Schedule.

1.5 "Contract Delivery Pressure" shall have the meaning set forth in Article V.

1.6 "Contract Period" means the period from the Contractual Delivery Date to the date on which this Agreement shall be terminated in accordance with Article XVII.

1.7 "Contract Year" means a period beginning on the first Day of January in any calendar year after the First Contract Year during the continuance of this Agreement through and including the last Day of December in the same year or if earlier, the Day of termination of this Agreement.

1.8 "Contractual Delivery Capacity" (CDC) shall have the meaning set forth in accordance with Article VI.

1.9 "Contractual Delivery Date" shall be 1 April 2001, as adjusted by the IPP upon notice to PTT pursuant to Clause 6.2, which date shall be the commercial operation date of the IPP Facilities under the PPA.

1.10 "Cubic Foot" when applied to Sales Gas means the volume of Sales Gas being saturated with water vapor which occupies one (1) cubic Foot of space measured at fourteen decimal seven three (14.73) pounds per square inch absolute pressure at a temperature of sixty (60) degrees Fahrenheit.

1.11 "Current Price" shall have the meaning set forth in the Fourth Schedule.

1.12 "Day" means a period of twenty-four (24) hours beginning at twelve (12) o'clock a.m. on each day and ending at twelve (12) o'clock a.m. on the following day.

1.13 "Delivery Point" shall be the flange connecting PTT's Facilities, at the meter station containing PTT's Equipment, to the IPP Facilities at that point, as set forth in the First Schedule.

1.14 "EGAT" means the Electricity Generating Authority of Thailand, and any successor thereto.

1.15 "Effective Date" shall be the date of execution of this Agreement by the Parties.

1.31 "Natural Gas" means all kinds of gaseous hydrocarbons, whether wet or dry produced from oil or gas wells, and includes by products and/or the residue gas remaining after the extraction of liquid hydrocarbons, or any mixture of gases, both hydrocarbon or inert, and may include gas from other sources, such as LNG,

1.32 "NEPO" shall mean the National Energy Policy Office of Thailand.

1.33 "Party" or "Parties" shall mean either party to this Agreement or both as the term requires.

1.34 "PPA" shall mean the Power Purchase Agreement between the IPP and EGAT with respect to the IPP Facilities.

1.35 "PSIG" means pounds per square inch gauge.

1.36 "PTT's Equipment" shall have the meaning set forth in Article XII.

1.37 "PTT's Facilities" shall mean all facilities and associated equipment, including equipment owned by PTT and required for PTT to accept Natural Gas from producers and suppliers and used to deliver Natural Gas to the IPP Facilities, including, but not limited to, PTT's pipeline transmission system, gas plants, and compressors, including PTT's Equipment (including the Interconnecting Pipeline when title has passed to PTT pursuant to Clause 8.6).

1.38 "Reasonable and Prudent Operator" when used to describe the standard of care to be exercised by a Party in performing its obligations hereunder means the degree of diligence and prudence and foresight reasonably and ordinarily exercised by experienced operators engaged in the same line of business under the same or similar circumstances and conditions, and when used to determine the action that would be required of a Party to this Agreement means the action an experienced commercial operator engaged in the same line of business under the same or similar circumstances and conditions would take in the exercise of such due diligence, prudence and foresight.

1.39 "Rules" shall have the meaning set forth in Clause 20.2.

1.40 "Run-in Period" means the period commencing on the Start-up Date through and including the Day immediately preceding the Contractual Delivery Date.

1.41 "Sales Gas" means Natural Gas to be delivered to the IPP in accordance with the provisions of this Agreement.

1.42 "Specific Gravity" means the weight of a volume of dry Sales Gas divided by the weight expressed in the same units of an equal volume of dry carbon dioxide free air, both gases being at sixty (60) degrees Fahrenheit and an absolute pressure of thirty (30) inches of mercury at thirty-two (32) degrees Fahrenheit and under standard gravitational force (acceleration thirty-two decimal one seven four (32.174) feet per second per second).

1.43 "Specifications" shall mean the quality specifications set out in the Second Schedule to this Agreement.

1.44 "Start-up Date" means the Day notified by the IPP to PTT pursuant to Clause 6.3 on which the IPP expects to first require Sales Gas for commissioning and testing of the IPP Facilities.

1.45 "Tariff Charge" shall have the meaning set forth in the Fourth Schedule.

1.46 "Time" and "Calendar": any reference to time shall be construed as whatever time shall be in force in Bangkok, Thailand and any reference to calendar shall be construed as the Gregorian Calendar.

ARTICLE VI QUANTITIES

6.1 PTT shall, subject to the other terms of this Agreement after the Effective Date, at its own expense diligently proceed to provide and maintain facilities with a maximum capacity of one hundred twenty thousand three hundred eighty-eight (120,388) MMBTU/Day (hereinafter called the "Contractual Delivery Capacity") to enable it, on and after the Contractual Delivery Date, to use reasonable endeavors to deliver Sales Gas at the Delivery Point to meet the nominations of the IPP pursuant to Article VII up to the CDC, at the rate or rates calculated as hereinafter provided.

6.2 Subject always to Article XV, the Contractual Delivery Date shall be 1 April 2001, as may be adjusted by the IPP pursuant to the PPA. The IPP shall give PTT reasonable notice of any adjustment of the Contractual Delivery Date; provided that, the deferment of the Contractual Delivery Date due to an event constituting Force Majeure in accordance with Article XV, shall be limited to the number of Days and part Days during which such an event continues.

6.3 In the one hundred and eighty (180) Days immediately preceding the Contractual Delivery Date there shall be a Run-In Period for the purpose of proving the facilities required for the performance of the initial obligations of both the IPP and PTT. During such Run-In Period, PTT and the IPP shall use reasonable endeavors to have Sales Gas available and to deliver Sales Gas in accordance with the IPP's testing schedules and requirements. PTT and the IPP shall use reasonable endeavors to ensure that the delivery facilities for which they are respectively responsible, including PTT's Facilities and the Interconnecting Pipeline, are installed prior to the commencement of the Run-In Period. The IPP shall give PTT at least ninety (90) Days notice of the likely start of such Run-In Period (the "Start-up Date") and reasonable advance notice of testing schedules and requirements.

Following the completion of such Run-In Period, PTT shall use reasonable endeavors to deliver and the IPP shall use reasonable endeavors to take Sales Gas to meet the IPP Requirements.

6.4 In the event PTT does not have enough Natural Gas to fully satisfy its various markets then the priorities of access to Natural Gas (including Sales Gas) shall be established by regulation by NEPO as provided in the Fifth Schedule.

6.5 At the request of the IPP, PTT shall deliver Sales Gas at a rate exceeding the CDC if it is reasonably able to do so; provided however that, in no event shall PTT be required to install additional facilities or to upgrade existing facilities to enable it to deliver Sales Gas at such a rate.

6.6 For the purpose of this Agreement and the Sixth Schedule, the quantity properly notified for delivery on any Day shall be that quantity which would be tendered for delivery if the delivery rate or rates required by the IPP had been sustained throughout the number of hours for which it was or they were required to be effective.

6.7 After any material event affecting PTT's Facilities, or PTT's producers, which causes a material cessation of deliveries of Sales Gas, then for a period of forty-eight (48) consecutive hours following the resumption of deliveries, PTT, while using reasonable endeavors to meet nominations, shall be relieved from the consequences under this Agreement of any material failure to deliver the nominated amounts in full. Pursuant to the Sixth Schedule, PTT shall be required to resume deliveries of Sales Gas to the IPP at nominated rates within twenty-four (24) hours of receiving notice of resumption of supply from an Alternate Delivery Point from the IPP.

6.8 For the purpose of managed preventative maintenance and unexpected maintenance PTT and the IPP shall give notice of reduced deliveries or requirements, for limited periods, during preventative maintenance and unexpected maintenance periods, subject to the following conditions:

(1) the aggregate for all such maintenance for each Party shall not exceed fifteen (15) Days in any Contract Year;

(2) for managed preventative maintenance the Parties shall give at least five (5) Months advance notice, or such lesser period as may be agreed between the Parties on each occasion; for unexpected maintenance, the Parties shall give notice as soon as practicable after the event which caused the unexpected maintenance;

(3) not less than five (5) Months prior to the notified date of commencement of such maintenance, the IPP may request PTT or PTT may request the IPP to make such timing adjustments to the maintenance period as the IPP or PTT may reasonably require but such right shall not be used to the detriment of preventative maintenance which is in accordance with good oil, electrical, and gas industry practice.

6.9 PTT and the IPP shall be entitled to give notice of reduced deliveries or requirements during periods of exceptional major works. PTT's exceptional major works will consist of the installation of compressors or tie-in of other fields or sources of Natural Gas into the pipeline systems, and the IPP's exceptional major works will consist of the major overhaul and repair of major equipment, such as any combustion turbines or steam turbine.

The starting date and expected duration of such works, will be notified to the IPP or PTT in accordance with Article VII.

The frequency for major works, major overhauls and repair of major equipment shall be determined using the standards of a Reasonable and Prudent Operator, if required more frequently than every thirty thousand (30,000) hours of actual operating time for each item of major equipment and the period of these works will be added to the aggregate Days referred in Subclause 6.8(1) up to an additional thirty (30) Days maximum in any Contract Year.

6.10 PTT and the IPP will use reasonable endeavors to have their preventative maintenance periods coincide with the period elected for exceptional major works. Further, PTT and the IPP will coordinate with EGAT to ensure that preventative maintenance periods coincide and also to attempt to ensure that periods of exceptional major works coincide.

6.11 During any period of managed, preventative maintenance, unexpected maintenance and exceptional major works, the IPP will use its reasonable endeavors to notify EGAT of any Sales Gas available to be redirected to the Alternate Delivery Point.

IN WITNESS WHEREOF each Party hereto has caused this Agreement to be executed by its duly authorized representative as of the date first written above.

FOR: **BOWIN POWER COMPANY LIMITED**

บริษัท บ่อวิน เพาเวอร์ จำกัด
Bowin Power Company Limited

Mr. Prateep Trilohaka
Title: Director

Dr. Bart Lucarelli
Title: Director

Witness:

Mr. Sawasdi Horrungruang

FOR: **PETROLEUM AUTHORITY OF THAILAND**

Mr. Pala Sookawesh
Governor

Witness:

Dr. Piti Yimprasert
President, PTT Gas

FIFTH SCHEDULE

GAS POOL

1. Gas Pool

"Gas Pool" shall mean the aggregate of the gas supply agreements ("Gas Pool Agreements") entered into by PTT with producers of Natural Gas for the delivery of Natural Gas and the agreements for the acquisition, transportation, terminaling, storage, and regasification of LNG into Natural Gas. The Gas Pool will be comprised of Natural Gas from the following Gas Pool Agreements:

- UNOCAL 1
- UNOCAL 2 and extension
- Pailin
- Bongkot
- Tantawan
- Yadana

The Gas Pool may include the addition of Gas Pool Agreements for:

- LNG from Oman
- LNG from other areas
- Yetagun
- JDA

This Gas Pool may be amended from time to time to delete or add Natural Gas from other sources in accordance with PTT's Gas Pool Agreements and from the above list as required for PTT to manage the Gas Pool as a Reasonable and Prudent Operator so as to meet its obligations under the GSA and MGSA. PTT shall revise this Fifth Schedule to reflect any additions in the Gas Pool Agreements and shall promptly notify the IPP of any such amendment.

2. Supply from the Gas Pool

In the event of limitation in the available Natural Gas from Natural Gas fields in Thailand or imported by pipeline, the Natural Gas will be allocated in the following priorities with Priority 1 being the last priority to have any reduction applied and Priority 6 to the first priority to have any reduction applied.

Additional Natural Gas from LNG will be made available to replace and supplement supply to each of the priorities, subject to any limitations on LNG content in the specific Gas Pool Agreements or sales agreements and the quantity of Natural Gas available from LNG.

Natural Gas from LNG shall be added to the Gas Pool dependent on legislation, policy and priority and such allocation shall be determined and administered by NEPO.

The composition of the various priorities and of markets and other matters will be established and revised from time to time by NEPO and, as of the date hereof, are as shown below. PTT shall revise this Fifth Schedule to reflect any changes in the priority schedule set forth below and shall promptly notify the IPP thereof.

Priority 1	Gas Pool (Priority 1) shall be Natural Gas from the Gas Pool sources used to supply the feedstock market and petrochemical industry.

Priority 2	Gas Pool (Priority 2) shall be Natural Gas from the Gas Pool used to supply household users, transportation users, and industrial and commercial users who: • yield an economic value of Natural Gas higher than those using Natural Gas to generate electricity. • cannot easily convert their fuel requirements.
Priority 3.1	Gas Pool (Priority 3.1) shall be Natural Gas from the Gas Pool used to supply to EGAT under the EGAT Gas Sales Agreement dated 7 November 1996 and Cogeneration Projects according to the Regulation for the Purchase of Power from Small Power Producers entering into the gas sales agreements prior to the effective date of EGAT Gas Sales Agreement.
Priority 3.2	Gas Pool (Priority 3.2) shall be Natural Gas from the Gas Pool used to supply combine cycle generation plants of the Independent Power Producers associated with EGAT's 1994 Solicitation for Purchases of Power from Independent Power Producers, provided that such plants of the Independent Power Producers shall be included in Priority 3.1 only when there is Natural Gas from the Yetagun source and/or Natural Gas from Yadana source together with the interconnection of the pipeline system.
Priority 4	Gas Pool (Priority 4) shall be Natural Gas from the Gas Pool used to supply thermal plants and Cogeneration Projects other than those specified in Prior 3.1 and 3.2.
Priority 5	Gas Pool (Priority 5) shall be Natural Gas from the Gas Pool used to supply industrial and commercial users who can convert their fuel requirements easily.
Priority 6	Gas Pool (Priority 6) shall be Natural Gas from the Gas Pool used to supply Steam and Gas Turbine plants.

Within a priority level PTT will pro-rate the available Gas Pool among all users at the lowest Priority receiving Natural Gas.

CONTRACT NO. IPP/41-105

POWER PURCHASE AGREEMENT

BETWEEN

ELECTRICITY GENERATING AUTHORITY OF THAILAND

AND

BOWIN POWER COMPANY LIMITED

SIGNED ON NOVEMBER 19, 1997

Dated 19th November 1997

BOWIN POWER COMPANY LIMITED

and

ELECTRICITY GENERATING AUTHORITY OF THAILAND

POWER PURCHASE AGREEMENT

THIS AGREEMENT (the ***Agreement***) is made on this 19th day of November 1997.

BETWEEN

(1) **BOWIN POWER COMPANY LIMITED,** incorporated under the laws of Thailand, represented by Mr. Prateep Trilohaka, Director, and Dr. Bart Lucarelli, Director, with its registered address at 20th Floor, UM Tower, 9 Ramkhamhaeng Road, Suanluang, Bangkok 10250, Thailand (the ***Generator***); and

(2) **ELECTRICITY GENERATING AUTHORITY OF THAILAND,** represented by Mr. Viravat Chlayon, Governor, with its registered address at 53 Charansanitwong Road, Bang Kruai, Nonthaburi Thailand (***EGAT***).

The Generator and EGAT are also each referred to herein as a ***Party*** and collectively as the ***Parties***.

WHEREAS:

(A) The Government of Thailand has announced the policy of encouraging and promoting the development of independent power producers for generating electricity to meet electricity demands in Thailand.

(B) To advance such Governmental policy, EGAT and the Generator have entered into this Agreement setting out the terms on which the Generator has agreed to develop, construct, finance, operate and maintain a 713 MW combined cycle power plant located in Chonburi Province to provide electricity to EGAT in accordance with the terms and conditions of this Agreement.

NOW IT IS HEREBY AGREED as follows:

	EGAT dispatches the Generating Unit, and ***Available*** shall be construed accordingly;
Availability Notice	A statement in the form set out in Schedule 15 declaring or revising the capability of the Generating Unit to provide Availability and the other Contracted Operating Characteristics set out in paragraph 2 of Schedule 1;
Availability Payment	Payment made by EGAT to the Generator for the Actual Availability provided by the Generating Unit as determined in accordance with Schedule 2;
Back-Up Fuel Stock	The stock of Secondary Fuel to be arranged by the Generator in accordance with Section 9.4;
Back-Up Metering Equipment	The back-up metering equipment and associated devices as described in Schedule 13;
Baht	The lawful currency of the Kingdom of Thailand;
Billing Period	The period beginning on the Commercial Operation Date and ending on the last day of the month in which that date occurs, each full month in a Contract Year, and the period beginning on the first day of the month in which the Term expires and ending on the day the Term expires;
BTU	British Thermal Units;
Business Day	Any weekday from Monday through Friday, excluding in each calendar year (i) not more than sixteen (16) holidays designated by EGAT no later than December 20 of the preceding year, and (ii) any other holidays designated by the Bank of Thailand or the government of Thailand and notified by EGAT for such calendar year;
Change-in-Law	Any of the following events occurring after the Execution Date as a result of any action by any Governmental Authority: (i) a change in or repeal of an existing Law, (ii) an enactment or making of a new Law, and (iii) a change in the manner in which a Law is applied or in the application or interpretation thereof (including any interpretation of environmental standards);

Generating Unit	The combined cycle plant comprising two (2) gas turbine generators, two (2) waste heat boilers, one (1) steam turbine generator, the Facility switchyard and auxiliary equipment and systems;
Governmental Approval	Any approval, consent, concession, decree, permit, waiver, exemption or approval from, or filing with, or notice to, any Governmental Authority;
Governmental Authority	The Government of Thailand and any ministry, department, political subdivision, instrumentality, agency, authority (excluding EGAT or any successor to EGAT's interests under this Agreement), corporation or commission under the direct or indirect control of the Government of Thailand, any court or tribunal in Thailand, the Parliament or any other such entity;
Governmental Force Majeure	This term shall have the meaning assigned thereto in Section 14.1.2;
Grid Code	The code issued by EGAT and attached hereto as Schedule 20, which sets forth requirements with respect to the coordination of power facilities with the operation of the EGAT System, and as it may be amended, modified or supplemented from time to time;
Independent Engineer	The engineering firm appointed by the Generator in accordance with Section 2.3.1;
Initial Dependable Contracted Capacity	The lesser of the Contracted Capacity and the Tested Net Capacity demonstrated by the Generator, being established prior to the Commercial Operation Date in accordance with Section 2.11;
Initial Gas Sales Agreement	The Gas Sales Agreement between the Petroleum Authority of Thailand and the Generator for the sale and delivery of Primary Fuel to the Facility;
Initial Secondary Fuel Sales Agreement	The Diesel Fuel Supply Agreement between the Generator and the Petroleum Authority of Thailand for the sale and delivery of Secondary Fuel to the Facility;

Pipeline Completion Date	The date on which all pipeline facilities and associated equipment required for the Petroleum Authority of Thailand to accept natural gas from gas producers and suppliers and to deliver Primary Fuel to the Facility in accordance with the Initial Gas Sales Agreement (including but not limited to the pipeline system of the Petroleum Authority of Thailand) are completed and are fully operational;
Planned Outage	Any period during which the Generating Unit is withdrawn, in whole or in part, from service as determined in accordance with the Grid Code;
Post Event Notice	A statement given by EGAT in the form set out in Schedule 15 describing a failure by the Generating Unit to deliver the Contracted Operating Characteristics declared in a previous Notice;
Primary Fuel	Sales Gas as specified in the Initial Gas Sales Agreement and natural gas which satisfies the specifications set forth in any subsequent Gas Sales Agreement;
Primary Metering Equipment	The Primary Metering Equipment and associated devices as described in Schedule 13;
Project	The design, development, construction, financing, ownership, operation and maintenance of the Facility under the terms of this Agreement;
Project Agreements	The EPC Contract, the Gas Sales Agreement, the Secondary Fuel Sales Agreement, the Fuel Transportation Agreement (if any), the Financing Documents, the O&M Agreement, and the Site Agreement;
Prudent Utility Practices	The practices, methods and acts engaged in or accepted by a significant portion of the international electric generating and utility industry for facilities using the same type of fuel, being of a similar size and being located in a similar geographic environment that, at a particular time, in the exercise of reasonable judgement and in light of the facts known or that reasonably should have

	been known at the time a decision was made, would be expected to accomplish the desired result in respect of the design, engineering, construction, operation and maintenance of electric generating or transmission equipment of the type applicable to the Facility or the relevant portion of the EGAT System, as applicable, in a manner consistent with Law, Governmental Approvals, reliability, safety, economy, environmental protection and due consideration to the construction, operation and maintenance standards recommended by the suppliers and manufacturers of such equipment;
Rules	This term shall have the meaning assigned thereto in Section 15.2.2.
Scheduled Commercial Operation Date	The date set out in Section 10.4 (as adjusted in accordance with Section 10.5) on which the Facility is scheduled to begin commercial operation;
Scheduled Construction Commencement Date	The date set out in Section 10.4 (or as adjusted in accordance with Section 10.5) on which the Generator is scheduled to commence construction of the Facility in accordance with Section 11(i);
Scheduled Energizing Date	The date set out in Section 10.4 (or as adjusted in accordance with Section 10.5) on which the Connection is scheduled to be energized by EGAT for the pre-operation testing and start up of the Facility;
Scheduled Financial Close Date	The date set out in Section 10.4 by which the Generator is scheduled to complete the Financial Close of the Project;
Secondary Fuel	High speed diesel or any other alternate fuel which is compatible with the technical specifications and environmental limitations of the Facility;
Secondary Fuel Sales Agreement	The sales contract or contracts between Secondary Fuel suppliers and the Generator for supply of Secondary Fuel to the Facility, including the Initial Secondary Fuel Sales Agreement;

8.3 The Generator shall establish environmental management systems and facilities to ensure that the applicable environmental Laws and the standards set forth in Schedule 8 are complied with or exceeded. Unless otherwise directed by the relevant Governmental Authority, the Generator shall install and operate a suitable continuous emission monitoring system at the Facility's heat recovery steam generator stack. The Generator shall also install and operate on-line recorders at the Facility and, unless otherwise directed, make the information continuously available on a real time basis to the offices of the relevant Governmental Authority. The Generator shall comply with ambient air quality monitoring regulations to the extent required by the relevant Governmental Authority, including the operation and maintenance of at least four (4) ambient air monitoring stations at appropriate locations within a ten (10) kilometer radial distance from the Facility. The Generator shall conduct periodic ambient air monitoring tests no less frequently than is recommended in the Environmental Impact Assessment submitted by the Generator to EGAT and by the relevant Governmental Authority.

8.4 The Generator shall provide an annual report on all relevant aspects of the Generator's environmental facilities, activities and performance no later than thirty (30) days following each Contract Year. The annual report on environmental performance shall contain a statement of assurances to the effect that all applicable environmental Laws have been complied with or, where that is not the case, shall contain details of any failure to comply with the such environmental Laws and the actions instituted to prevent such failures from recurring.

8.5 The Generator shall not sever its possession of and legal responsibility for the Facility until the Site, including all environmental wastes and hazardous conditions thereon, has been fully cleaned up to the extent required by Law, regardless of whether the Site has been taken over by EGAT.

9. FUEL SUPPLY

9.1 Fuel Supply Obligations

The Generator shall use reasonable endeavors to assure that the Facility has sufficient quantities of Fuel to support the operation of the Facility at the Contracted Capacity during the Term. The obligations of the Parties under this Section 9 are material obligations under this Agreement.

9.2 Initial Gas Sales Agreement

9.2.1 EGAT acknowledges that it has reviewed the Initial Gas Sales Agreement to determine whether such Gas Sales Agreement satisfies the principles set forth in Schedule 9. EGAT confirms that such principles as set forth in Schedule 9 have been satisfied by the Initial Gas Sales Agreement and that the Initial Gas Sales Agreement has been approved by EGAT for purposes of Section 9.5.1 herein.

9.2.2 The Generator shall perform its obligations under the Initial Gas Sales Agreement.

9.2.3 Each of the Generator and EGAT shall comply with their respective requirements of the gas nomination procedures set forth as Schedule 23 of this Agreement.

9.2.4 The Generator shall provide ten (10) copies of the fully executed Initial Gas Sales Agreement within three (3) Business Days after the Execution Date.

9.2.5 EGAT shall not incur any liability whatsoever in connection with Primary Fuel tendered by the Petroleum Authority of Thailand (whether delivered under the Initial Gas Sales Agreement or by instruction of EGAT in accordance with EGAT's obligations regarding redirection under the MGSA) and accepted by the Generator regardless of whether such Primary Fuel satisfies the applicable specifications (including quality and pressure requirements) set forth in the Initial Gas Sales Agreement.

9.3 Subsequent Gas Sales Agreements

9.3.1 Subject to the provisions of Section 9.5, in the event of termination of the Initial Gas Sales Agreement, the Generator shall, subject to the immediately following paragraph, promptly negotiate and enter into a new Gas Sales Agreement and/or new Fuel Transportation Agreement, if required, or make other alternative arrangements to provide for the long-term supply of Primary Fuel for the Facility. The Generator shall be deemed to have met the requirements of this subsection 9.3.1 if it has used reasonable endeavors to enter into such new Gas Sales Agreement and/or new Fuel Transportation Agreement; provided, however, that the Generator's exercise of such reasonable endeavors shall not excuse the Generator's failure to enter into a new Gas Sales Agreement and/or new Fuel Transportation Agreement that meet the requirements of Schedule 9 (i) after there is more than one lawful supplier of Primary Fuel in Thailand, or (ii) if the Initial Gas Sales Agreement has been terminated due to termination of the MGSA as the result of (x) EGAT's default under the MGSA, or (y) force majeure under the MGSA (provided that termination of the MGSA due to such force majeure has rendered the Petroleum Authority of Thailand unable to perform its obligations under the Initial Gas Sales Agreement), after there is an alternative lawful supplier of Primary Fuel (other than the Petroleum Authority of Thailand or any successor thereto) which has an adequate source of Primary Fuel available to supply to the Facility to satisfy the requirements of Schedule 9.

9.3.2 The major terms and conditions of any new Gas Sales Agreement or related Fuel Transportation Agreement, as applicable, shall satisfy the applicable principles set forth in Schedule 9.

9.4 Secondary Fuel Sales Agreement and Back-Up Fuel Stocks

9.4.1 The Generator shall execute a Secondary Fuel Sales Agreement in accordance with the requirements of Section 9.5.1 prior to the Commercial Operation Date. The major terms and conditions of any future Secondary Fuel Sales Agreement or related Fuel Transportation Agreement, as applicable, shall satisfy the applicable principles set forth in Schedule 9 and

Section 9.5.1. The Generator may enter into multiple Secondary Fuel Sales Agreements to satisfy this supply obligation.

9.4.2 The Generator shall at its own expense maintain a storage capacity for Secondary Fuel of at least three (3) days' supply of Secondary Fuel ***(Back-Up Fuel Stock)*** at the Site or at such other reasonable place as the Generator and EGAT may mutually agree. On the Commercial Operation Date, the Generator shall have a Back-Up Fuel Stock sufficient for the Generating Unit to operate at its Contracted Capacity for three (3) consecutive days. The Facility shall be capable of on-load switching to use Secondary Fuel in such circumstances in order to avoid interruption of the Facility's operation.

9.4.3 The Generator shall provide EGAT with any information reasonably requested by EGAT from time to time regarding the Back-Up Fuel Stock and shall also keep EGAT advised from time to time of any material modifications to its Back-Up Fuel Stock arrangements.

9.4.4 The Generator shall promptly notify EGAT of any circumstances known by the Generator which could reasonably be anticipated to adversely affect the supply of Secondary Fuel for the Facility and EGAT shall have the right, but not the obligation, to purchase and to supply Secondary Fuel directly to the Facility in order to avoid Secondary Fuel supply interruptions.

9.5 Review and Approval of Fuel Supply Arrangements

9.5.1 The Generator shall not enter into a Gas Sales Agreement, Secondary Fuel Sales Agreement, or Fuel Transportation Agreement or agree to:

(i) any amendment or modification thereto which does not comply with the principles set forth in Schedule 9 or which would lessen, diminish or affect in any way the performance by the Generator of its obligations under this Agreement and/or the Project Agreements;

(ii) any assignment thereof (except collateral assignment for the benefit of the Financing Parties); or

(iii) any early termination thereof;

(except to the extent required by applicable Law), without the written consent of EGAT, which consent shall not be unreasonably withheld or delayed. EGAT shall be afforded not less than thirty (30) days to confirm whether or not such agreements, documents, or amendments or modifications thereof, satisfy the principles set forth in Schedule 9. EGAT shall notify the Generator in writing, as soon as practicable (but in any event within thirty (30) days) of receipt of such agreements, documents or amendments or modifications of whether or not the proposed Gas Sales Agreement, Secondary Fuel Sales Agreement, Fuel Transportation Agreement, or the amendment or modification thereof, satisfies the principles identified in Schedule 9. If the proposed Gas Sales Agreement, Secondary Fuel Sales Agreement, or Fuel Transportation Agreement, or the amendment or modification thereof, satisfies the principles set forth in

Schedule 9, EGAT shall consent to such agreement, amendment or modification. If EGAT determines that the proposed Gas Sales Agreement, Secondary Fuel Sales Agreement, or Fuel Transportation Agreement, or the amendment or modification thereof, does not satisfy the principles identified in Schedule 9, EGAT shall also provide the Generator with the reasons supporting such determination and proposed changes EGAT would recommend to enable the proposed agreements, new documents, or the amendment or modification to satisfy such principles or the terms under which EGAT would be willing to grant its consent with respect thereto.

Notwithstanding this Section 9.5.1, the Generator may from time to time enter into temporary interim Secondary Fuel Sales Agreements without EGAT's prior written approval, provided that such agreements (i) do not, either individually or together with other interim agreements, have a term which would exceed six (6) continuous months of duration; (ii) contain competitive market prices, and (iii) contain other market terms and conditions. The Generator shall provide EGAT with copies of all such interim agreements within three (3) days of the execution of each such agreement.

9.5.2 EGAT shall not incur any liability whatsoever in connection with the review, approval, objection or rejection of any Gas Sales Agreement, Secondary Fuel Sales Agreement, Fuel Transportation Agreement or any provision thereof, or any proposed amendment, modification, assignment or termination thereof, unless EGAT has requested that the Generator make, and the Generator has agreed to make, certain amendments or modifications which are not required to satisfy the principles set forth in Schedule 9, in which case, EGAT shall be obligated to reimburse the Generator for the increased costs incurred by the Generator (if any) as a result of making such amendments or modifications or, alternatively, the Parties shall agree upon an equitable adjustment to the Availability Payments and Energy Payments which the Generator is entitled to receive under this Agreement. EGAT's review, approval, objection to or rejection of any Gas Sales Agreement, Secondary Fuel Sales Agreement, Fuel Transportation Agreement, or any provision thereof, or any proposed amendment, modification, assignment or termination of such agreements shall not:

(i) lessen, diminish or affect in any way the performance by the Generator of its obligations under this Agreement and/or the Project Agreements;

(ii) increase, expand or affect in any way the obligations of EGAT under this Agreement (other than the obligation to reimburse the Generator for the increased costs contemplated under this Section 9.5.2); or

(iii) affect the application or interpretation of the provisions of this Agreement and/or the Project Agreements.

9.5.3 EGAT shall be deemed to have completed its review and consented to any Gas Sales Agreement, Secondary Fuel Sales Agreement, or Fuel Transportation Agreement, or any proposed amendment, modification, assignment or termination thereof, if it does not respond in writing to the Generator, in accordance with Section 9.5.1, within thirty (30) days from the

date of receipt of the proposed draft of such agreements, or amendments or modifications thereof.

9.6 Termination of Fuel Supply Arrangements

The Generator shall not exercise its rights to terminate any Gas Sales Agreement, Secondary Fuel Sales Agreement or Fuel Transportation Agreement unless approved by EGAT, which approval shall not be unreasonably withheld or delayed. In the event of a material breach of any Gas Sales Agreement, Secondary Fuel Sales Agreement or Fuel Transportation Agreement by the Generator, EGAT may upon reasonable advance notice to the Generator exercise the Generator's cure rights under such agreements, including the right for EGAT to make Fuel or transportation payments directly to the Fuel and transportation suppliers to remedy the Generator's payment defaults thereunder. The Generator shall promptly provide EGAT with copies of all correspondence involving the Generator in regard to deficient performance, default, force majeure or termination under any Gas Sales Agreement, Secondary Fuel Sales Agreement or Fuel Transportation Agreement.

Except as contemplated by paragraph 3 of Schedule 9, EGAT shall not have the right to direct the Generator to terminate any Gas Sales Agreement, Secondary Fuel Sales Agreement or Fuel Transportation Agreement which has been or is deemed to have been approved by EGAT under this Agreement. Notwithstanding the foregoing, EGAT is entitled to expect the Generator to monitor the performance of its Fuel suppliers and to address problems which may arise in connection with its Fuel supply arrangements (including consideration of substituting alternative Fuel supply arrangements as deemed necessary of the Generator) as part of the Generator's obligations under Section 9.1 herein.

10. CRITICAL DATES AND DURATION OF AGREEMENT

10.1 Initial Term

The Term of this Agreement shall begin on the Execution Date and shall continue for a period of twenty-five (25) years from the Commercial Operation Date, unless otherwise extended or terminated in accordance with the provisions of this Agreement.

10.2 Survival of Rights on Termination

The expiration or termination of this Agreement shall not affect any rights or obligations which may have accrued prior to or in connection with such expiration or termination, and shall not affect continuing obligations of each of the Parties under this Agreement or any other agreement between the Parties which are expressed to continue after such expiration or termination.

10.3 Extension of Agreement

The Term may be extended upon terms and conditions mutually satisfactory to the Parties.

IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their respective duly authorized officers as of the date first above written.

ELECTRICITY GENERATING AUTHORITY OF THAILAND

Witness:

Viroj Nopkhun

(Mr. Viroj Nopkhun)
Deputy Governor - Policy and Planning

By: Viravat Chlayon

(Mr. Viravat Chlayon)
Governor

BOWIN POWER COMPANY LIMITED

By:

(Mr. Prateep Trilohaka)
Director

Witness:

(Mr. Anut Chatikavanij)

บริษัท บ่อวิน เพาเวอร์ จำกัด
Bowin Power Company Limited

By:

(Dr. Bart Lucarelli)
Director

APPENDIX B

HEALTH & SAFETY

DURING THE CONSTRUCTION PERIOD

attachment 7.1-1

1 HEALTH &SAFETY DURING THE CONSTRUCTION PERIOD

1.1 INTRODUCTION

BPC will be respond for all aspect of site safety, and will ensure public safety both within the site and in adjoining area under its direct responsibility.

BPC will ensure suitable arrangement are made for all necessary welfare and hygiene provision.

BPC will comply with the requirement of all relevant Thai Regulations, and related codes, for the construction of power plant.

During the construction period the BPC will use Health and safety program as standards of the contractor" as the BPC's health & safety program.

The Contractor is committed to managing the Bowin project construction in compliance with BPC commitment and all rules, laws, and regulation that apply.

BPC also recognizes the importance of a joint, integrated approach to health and safety, linking together the BPC, the Employer and sub-contractors to ensure that the health and safety provisions of power plant are understood by all concerned, that relevant information is distributed, that all workers receive appropriate training and that safety instructions are obeyed at all times.

1.2 CONSTRUCTIONAL HEALTH & SAFETY OBJECTIVES

The Contractor 's safety objectives for the Bowin project is zero-accident performance. The zero - accident performance culture dispenses with the firm targets that communicate an idea that a certain level of accidents are acceptable. The health and safety program focuses on

- Management commitment
- Putting safety, health and environmental issues in the forefront
- Proactive accident prevention measures; and
- safety and supervision

In the past experience of the Contractor a 50 percent reduction in recorded accidents in the first year of their effort. Management carried its commitment through by implementing a breakthrough plan when their safety performance plateau two year after implementation. The breakthrough plan consists of several implementation points:

- Pre- employment selection
- Subcontractor selection
- training
- Behavior modification
- Management and supervision accountability
- Senior management involvement
- Safety services upgrade
- Designed physician training

1.3 CONSTRUCTIONAL HEALTH & SAFETY PLAN

The Contractor will develop a safety plan for the construction of the power plant to meet the Thai relevant regulation and codes applicable to the construction sites and achieve the "zero - accident program. The Safety Plan will address the following key aspects:

1.3.1 *Project description and cope of work*

Team member of the Contractor will be inform of the project description, scope of work and their responsibility.

1.3.2 *Organization*

The Contractor's plant designs are reviewed for both construction and operations safety before they are issued for construction. The Contractor assign site management with proven safety performance to take ownership of the plan and furnish trained and qualified safety professional to acts as agents for charge and improvement.

1.3.3 *Contractor controls*

Contractor companies are selected based on an evaluation of the management's attitude and commitment to safety and on evidence of their recent safety performance. Contractors are benchmarked, measured and evaluated during the project execution.

1.3.4 *Communications*

A communications network consisting of a corporate safety and health committee, a Contractor project steering committee, a Contractor/Contractor Zero- Accident Team, and daily safety briefings connects team members and enhances individual ownership of the safety effort.

1.3.5 *Training*

Training is designed to modify employee behavior. Training begin at hire with a comprehensive safety oriental and continues with The Contractor's Safe Worker Observation Program (SWOP). SWOP recognizes individual safe performance and communicates method that the work and are safe to the work force.

1.3.6 *Work method statement*

Theory and philosophy are applied through careful planing and documenting the method that will be used to perform work. Work method statements described the task scope, schedule, work assignment, sequence, risk areas and risk elimination method, personal protective equipment, permits and authorizations, equipment required, and environmental considerations.

1.3.7 *Risk Assessment*

Safety and health risk are identified, evaluated , and measured in terms of probability and severity, and ,methods to further reduce these characteristic are reviewed and implemented by management.

1.3.8 *Auditing*

What gets measured gets done. Daily observations, monthly safety audits, and individual supervisor safety audits are conducted on the project.

1.3.9 *Safety recognition*

The project team will develop a recognition program consisting of individual contractor, and project safety awards or incentives. Individual participation is promoted through solicitation and recognition of ideas and recognition of high levels or personal commitment to project safety.

1.3.10 *Personal protective equipment*

Each work task is evaluated for personal protective equipment required over the minimum of hard hat, safety glasses, safety footwear, and gloves. Particular attention is paid to work task that involve exposure to or handling of contaminated, toxic, or other hazardous materials

1.3.11 *Medical facilities*

Local medical resources are evaluated for use at the project site. A licensed nurse or a medical paraprofessional is employed on site for immediate attention and evaluate of medical cases. The safety and medical staff also follow up on all injuries to avoid lost work days.

1.3.12 *Occupational Health*

The long term well being of our employee, BPC employee, and the local community is of importance and an integral part of our comprehensive safety, an health plan. The Contractor will give its full support to environmental , safety, and health commitments made for the Bowin project.

1.3.13 *Incident reporting*

Each accident is evaluated by management, supervision, the employee involved, and the Contractor's safety professionals for cause, effect, process breakdown, and preconditions that contributed to the unsafe situation.

1.3.14 *Publicity*

Communication of the Contractor's success is vital to reinforcing safe behavior. The Contractor furnished booklets, flyers and onsite target broads for promoting positive safety and health accomplishments.

1.3.15 *Environment*

The Contractor is committed to managing its Bowin project operation in compliance with BPC commitments and all rules, laws, and regulations that apply. The Contractor has qualified and experienced personal in noise control, waste management, emission and discharge control, and public relations that can be made available to support the project.

1.3.16 *Emergency procedures*

Emergency preparedness is fundamental to the Contractor's zero - accident philosophy. The Bowin project will have emergency medical treatment procedures, evacuation procedures, fore suppression procedures, and security procedure designed for the project.

1.3.17 *Disciplinary procedures*

The unsafe work or conditions are stopped, and employees and contractors are notified of unacceptable behavior or conditions. Corrective actions are identified and implemented.

Employees and the subcontractors will be terminated or denied site access by the Contractor if the facts and circumstances warrant such action

APPENDIX C

HEALTH & SAFETY

DURING THE OPERATION PERIOD

HEALTH & SAFETY DURING THE OPERATION PERIOD

1.1 *OPERATIONAL HEALTH & SAFETY OBJECTIVES*

To ensure a high standard of health and safety for all aspects of power plant operations, the Bowin Power Co. Ltd. (BPC) will institute a comprehensive health and safety program. The objectives of the health and safety program will be as follows:

- prevention of accidents and exposure to materials resulting in injury, illness and/or property damage involving the BPC's employees, sub-contractors, visitors, members of the general public or others;
- implementation of, and adherence to, health and safety policies and procedures conforming to all applicable Thai Regulations and the BPC's own safety policies;
- selection and training of all employees in a manner that will ensure competence and professionalism in the performance of their duties with respect to health and safety and emergency response;
- provision of a safe and healthy work environment through the design of equipment and safe working practices;
- provision of safe, well-maintained equipment for use by staff and any other appropriate person; and
- provision of adequate welfare and hygiene facilities, including sanitation, wash rooms, potable water supplies and facilities for the preparation and eating of food.

1.2 *COMPLIANCE WITH SAFETY REGULATIONS*

The operational Safety Plan will be developed prior to the commencement of the operation of the power plant. The Safety Plan will lay down the health and safety policies and procedures for operating the power plant, and will be developed by combining the relevant parts of Regulations and any applicable standards and codes of practice governing safe methods of operation with the BPC's stringent corporate policies and directives pertaining to health and safety. As a general rule, where the BPC's corporate policies differ from the relevant safety regulations, the stricter of the procedures will be adopted in the safety plan.

1.3 *ENFORCEMENT OF SAFETY PROCEDURES*

Clear lines of authority and reporting will be established by the Safety Plan and designation of a Safety Manager and Safety Officer(s). All personnel working on, or visiting, the power plant, irrespective of their employers, will be expected to comply with all applicable provisions of the Safety Plan. Failure by anyone to comply with safety procedures and programs will be cause for immediate disciplinary action, including dismissal and removal from the power plant if appropriate.

1.4 *REGULATIONS*

The BPC will comply with the requirements of all relevant Government Regulations, and associated guides to the Regulations, for the operation of the power plant.

1.5 *SAFETY EQUIPMENT*

The BPC will provide adequate safety and personal protection equipment to staff, visitors and any other person at the power plant, commensurate with the tasks to be undertaken and the hazards within the areas of the power plant where the persons will be present.

The personal protective equipment will include, but not be limited to, haro hats, goggles, ear protectors, safety belts and harnesses, fire extinguishers, gloves, overalls, and first aid equipment. Emergency equipment will be located at key points around the power plant to allow easy access if required.

All such equipment will be kept in good working order and will be subject to regular inspection and maintenance.

1.6 *MAINTENANCE OF SAFETY EQUIPMENT*

The operational plant and equipment used at the power plant, including mechanical plant, electrical plant, lighting, scaffolds, ladders, platforms, safety equipment, etc, will be subject to regular inspection and maintenance, including cleaning, to minimize the risk of failure and potential safety hazards. Equipment not capable of functioning correctly, damaged or inappropriately positioned will be replaced. Notices and warning signs will be maintain clean and readable.

1.7 *SAFETY NOTICES*

The BPC will also ensure that the safety procedures and requirements for the power plant, as well as individual areas of activity, items of plant and specific materials handling, will be prominently displayed.

1.8 *SAFETY OFFICERS RESPONSIBILITIES*

The overall responsibility for health and safety, and for implementing and enforcing the Safety Plan, will be allocated to qualified, experienced and competent Safety Officers under the supervision of the Safety Manager. Provisions will be made to ensure that a designated member of staff retaining responsibility for health and safety is present on-power plant when the power plant are in operation in accordance with *Notification June BE 2538 (1114) Re Committee on Health and Safety and Working Environment*. The Safety Manager, will directly report to the General Manager of the power plant.

The power plant will be subject to regular inspections and audits by the Safety Manager and the Safety Officers.

During operation, the compliance of workers with respect to health and safety will also be subject to monitoring and review. The focus of the employee monitoring will be at supervisor level, where direct day-to-day control of operational activities lies. The results of monitoring/reviews will be recorded, providing an ongoing record of the practical performance of supervisor staff at

the operational level. At least annually, each supervisor will have a formal review of their performance with respect to health and safety.

PROVISION AND ROLES OF SAFETY OFFICERS

The BPC will employ a Safety Manager who will be a qualified Registered Safety Officer. His role will be to define, develop, organize, supervise and control health and safety. The Safety Manager will have designated deputies (Safety Officers) to act in his absence, providing 24-hour cover and back-up staffing as required. Any sub-contractor providing services for the operation or maintenance of the power plant will also be required to employ Safety Officers with respect to their activities.

The Safety Manager will be responsible for ensuring that all operations are carried out in an appropriate and safe manner, and with deputies will have the authority to issue instructions to enforce any necessary plant safety procedures and programs. The Safety Manager will have the authority to act on behalf of the BPC in all matters pertaining to health and safety, and will report directly to the General Manager. The supervision offered by the Registered Safety Officer will ensure that operations are performed in accordance with the Safety Plan and the BPC's health and safety policies and Government regulations.

Staff with responsibility to act as Safety Officers will always be present during operation of any of the components of the power plant. The Safety Officers at the power plant will be responsible for the working area, and the remainder of the power plant (offices, quarantine area, services, etc), respectively. This staffing is proposed to ensure close supervision of safety in the key areas of the operations.

SAFETY OFFICERS' QUALIFICATIONS

The designated Safety Manager and Safety Officers will be appropriately qualified, trained and registered, in accordance with the *Notification of Ministry of Labor and Social Welfare (1114) BE 2538 Re Committee on Health and Safety and Working Environment.*

The designated Safety Manager and Safety Officers will also undergo specific training with respect to the design of the power plant and their operation.

FIRST AID AND LIFE SAVING EQUIPMENT

All medical equipment will be kept in a clean and sanitary condition, and will be store in secure manner providing protection from accidental damage, the weather and thief (such as a lockable cabinet).

FIRE REGULATIONS AND SAFETY - POWER PLANT CONTROL IN THE EVENT OF FIRE

In the event of a serious fire involving the power plant, the BPC operators will accepts direction from the Fire Department. The power plant will remain under the Department's control until such time as it declares the emergency over, whereupon it will revert to the BPC.

COMPLIANCE WITH FIRE REGULATIONS

Contingency arrangements for fire fighting will be addressed in the management plan. The objective is that all fires can be quickly brought under control.

All fire fighting equipment and materials will comply with the latest Thai standard specifications, issued under the *Notification of Ministry of Interior regarding Working Safety Relating to Protection and Prevention of Fire for Employees*, where applicable, and will properly be selected, rated and suitable for continuous operation under local weather conditions.

The fire protection and lighting equipment will be maintained in a permanent state of readiness and staff will be trained in the use of the power plant requiring manual operation. The provisions for fire protection will be subject to the approval of the Fire Department.

All mobile items of the plants will have a fire extinguisher installed in the cab or at another appropriate position for immediate use by the driver or other staff if the plant catches fire, or if the operator is the first on the scene.

1.14 *Provision of Fire Protection Measures*

The designs of the power plant include extensive measures to protect against fire, including:

- fire protection built into the construction techniques and materials; and

The BPC will provide and maintain fire detection, alarm and fire-fighting equipment affording a high standard of fire protection throughout the power plant, as appropriate. Such measures may include the following:

- smoke detectors and alarms;
- audible and visual fire alarms;
- portable fire extinguishers and other fire-fighting equipment;
- fire hydrants and hoses;
- sprinkler systems; and
- fire blankets.

These features will be provided at appropriate locations within the power plant, including the offices and workshops, as appropriate. The measures, for example the type of fire extinguisher (water, carbon dioxide or foam, etc), will be suitable for the potential conditions and fire hazards likely to be encountered.

1.15 *Safety Requirements for Plant*

Any electrical or mechanical equipment, under test or in use by the BPC and its sub-contractors, will be operated subject to Government regulations, requirements and notices. In addition, all operatives will be trained and competent in the use of the equipment.

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1.16 *SAFETY PLAN DURING THE OPERATION PERIOD*

The BPC will collate the safety regulations and emergency procedures to be applied at the power plant into a Safety Plan. The Safety Plan will address the following key safety aspects, and will include the procedures associated with maintaining safety during operation of the power plant. An outline of the contents of the Safety Plan which may be used as a basis for the development of the full version is given below:

1.16.1 ***Overall health and safety policy***

The Safety Plan will address the overall health and safety policy and assist all the employees to comply with the plant safety policies and procedures.

1.16.2 ***Regulation and codes***

The Safety will address the relevant Regulations and Codes applicable to operation of the overall power plant and individual items of plant.

1.16.3 ***Responsibilities and organization***

The safety plan will address responsibilities and organization of on-power plant safety, including the details of the responsible staff and lines of reporting.

BCP will form a group of safety committee compose of safety manager, training coordinator, one representative of operation employee (safety officer), and one representative of maintenance employee (safety officer). The safety committee will develop the plant safety policies and procedure to practices, assist all the employee to comply with the government laws, and regulations, etc.. The responsibility of the safety committee will include survey for the unsafe conditions within the plant, and define the counter measures. The safety committee will also review the work related accident or sickness of the employees, and promotion for the plant safe working activities.

1.16.4 ***Identification of risk activities***

The key operational activities and the associated degree of risk to health and safety, with respect to the power plant will be identified in the safety plan.

1.16.5 ***Safety procedures and protective controls***

The Safety Plan will address details of safety procedures and protective controls, including:

- safe methods of operation of plant;
- safe working procedures;
- special working systems, for example operations requiring a permit-to-work;
- use of personal protective equipment; and
- personal and workplace monitoring.

1.16.6 ***First aid***

The safety plan will address the first-aid and associated medical provisions, emergency arrangements for medical care and the route(s) to the nearest hospital(s).

1.16.7 *Emergency response procedures*

The safety plan will address the emergency response procedures and provisions, including the roles of key staff, emergency contact numbers and addresses, control procedures, evacuation procedures, routes to local hospitals, emergency communication systems, etc;

1.16.8 *Plant safety audit*

The safety plan will address provisions for monitoring the effectiveness of safety precautions.

1.16.9 *Reporting*

The safety plan will address reporting, accident reports, safety reports, and investigation and review process; including route of reports and employees warning notices due to safety.

1.16.10 *Occupational health*

The safety plan will address occupational health and the arrangements for medical tests and monitoring.

1.16.11 *Training*

The safety plan will address the plant safety training for the new employee; including , training for plant safety policies and procedures-master, safety talks. Sources of training data will be from OEG safety training manual, tool box talks, and other as deem ed.

The Safety Plan will comply with the relevant parts of the Safety Regulations, any applicable codes and standards governing safe methods of operating and the BPC's corporate policies and directives pertaining to health and safety. As a general rule, where the BPC's corporate policies differ from the relevant safety regulations, the stricter of the procedures will be adopted in the Safety Plan. A key objective of the Safety Plan is the provision of accurate, practicable information, requirements and procedures for safe working, with an efficient and effective mechanism for dealing with any incident which may arise.

The BPC recognizes that for the Safety Plan to be a useful tool for advising and implementing health and safety provisions during operation throughout the lifetime of the Contract, it may need to be updated in line with ongoing developments in the independent power industry. Hence, the Safety Plan will be subject to regular review by the BPC. In addition, in the event of an incident resulting in, or capable of causing, bodily injury, occupational illness or property damage, the Safety Plan will also be reviewed.

All reviews will be the responsibility of the Safety Manager and the Safety Officers. Following any review, the Safety Manager and Safety Officers will revise the Safety Plan to take into account its results and findings. In particular, new measures will be entered into the plan to avoid the repetition of incidents involving risks to health and safety.

A record of each review of the Safety Plan and the resulting amendments/revisions will be maintained by the BPC.

It is the BPC's policy to work with the sub-contractors and others to ensure that a high standard of health and safety is maintained during operation.

Display of Safety Notices and Information

A copy of the Safety Plan will be displayed, in full, at the main power plant offices at the power plant. A copy will also be displayed at each gate-house. In addition, relevant sections and extracts from the Safety Plan will be displayed at key locations within the power plant, to provide local, readily available instruction and guidance to workers, visitors and any other person who may be present on-power plant. This provision of safety information will be supported by the display of other documents, posters and notices or necessary to fulfill statutory requirements.

APPENDIX D

APPENDIX D1 : EMERGENCY RESPONSIBLE PLAN FOR BOWIN POWER PLANT

APPENDIX D2 : EMERGENCY RESPONSE PLAN FOR CIE (CHONBURI INDUSTRIAL ESTATE)

APPENDIX D1

EMERGENCY RESPONSE PLAN FOR BOWIN POWER PLANT

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BOWIN POWER PLANT
EMERGENCY REPONSE PLAN

February 1998

Drafted by InterGen

BOWIN POWER PLANT

EMERGENCY RESPONSE PLAN

COMMITMENT OF RESOURCES

I have reviewed the Bowin Power Plant Emergency Response Plan, dated February 1997, and am familiar with its contents. This serves as a written commitment of the manpower, equipment, and materials required to implement the plan.

_____

General Manager
Bowin Power Company

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I. PURPOSE

This Emergency Response Plan establishes a systematic group of procedures for reacting to foreseeable emergency situations which might impact upon Bowin Power Plant. It represents a compendium of information regarding the steps that have been taken and are being taken on an on-going basis to prevent disaster situations, and it represents a guideline for the procedures that should be instituted to minimize the impact of a disaster if and when one should occur. The primary purpose of this plan is to ensure the protection of the health and safety of Bowin Power Plant employees and to preserve the integrity of the community and the environment in which it functions.

II. SCOPE

This plan applies to the Bowin Power Plant.

III. EMERGENCY RESPONSE PLAN: INTERNAL DISTRIBUTION

Controlled copies of the Emergency Response Plan are issued by the authority of the Plant Manager. Any revisions to shall be carried out with the Plant Manager's approval. Amendments are listed in every controlled copy of the manual and shall be used as a means of identifying the revision status of the plan.

Controlled copies of this Emergency Response Plan have been distributed to the following Bowin Power Plant employees or departments:

1. Bowin Power Plant Reference File
2. Plant Manager
3. Operations Manager
4. Shift Supervisor Office
5. Maintenance Manager
6. Security Office
7. Environmental Health & Safety Coordinator

IV. EMERGENCY RESPONSE PLAN: EXTERNAL DISTRIBUTION

Controlled copies of this document will be distributed to the following external emergency response agencies that may be called upon to respond in the event of an emergency.

Emergency Agency	Type of Emergency
Chonburi Industrial Estate (CIE)	Fire Floods or Storm Damage Industrial Accidents
Fire Authority	Fire Hazardous Materials Rescue Explosions Gas Leaks Spills and Leaks
Police	Explosive Devices Bomb Threats Threats to Life or Property Potential Suicides Hostage Situation Theft, Searches
Hospital	Road Accidents Treating Victims Casualty Transport
Health & Safety	Dangerous Goods Environmental Spills
Health Commission	Food Poisoning Radioactive Materials

V. EMPLOYEE TRAINING

At the time that this plan is implemented, designated employees shall receive specialized emergency response training which shall include discussion and practical demonstration of all of the details of this plan. This specialized training shall be provided for all of the following individuals:

1. All members of the Bowin Power Plant Emergency First Response Team
2. All members of the Bowin Power Plant Safety Committee
3. All supervisory employees
4. All Security employees

In addition to the above-described comprehensive emergency response training, all employees shall be introduced to the basic details of the Emergency Response Plan at the following times:

1. Initially when the plan is first implemented;
2. During the initial Company orientation of new employees;
3. Whenever the employee's responsibilities or designated actions under the plan change;
4. Whenever the plan is changed.

Bowin Power Plant shall review the details of the Emergency Response Plan with all new employ and with all employees assigned to new work areas. Emergency Response Plan training will be repe at least annually thereafter. In addition, written copies of the plan are available throughout the plant employees will be encouraged to review the plan periodically.

The Environmental Health & Safety Coordinator shall be responsible for overseeing Emerge Response Plan training. Records documenting all such training shall be maintained in Environmental Health & Safety Coordinator's office.

VI. EMERGENCY DUTIES AND RESPONSIBILITIES

A. Plant Manger (Emergency Commander)

In the event of an emergency, the Plant Manager, or authorized representantive, will immedia assume the role of Bowin Power Emergency Commander. In the event of an emergency the Bo Power Emergency Commander shall perform the following duties:

- Mobilize resources and commence efforts to overcome the emergency;
- Coordinate any evacuation efforts and the recording of employees and visitors;
- Coordinate initial notification of emergency services;
- Advise other managers of the nature and extent of resources likely to be required;
- Establish controlled areas;
- Assist outside agencies who take control of an incident on behalf of Bowin Power Company; and
- Interface with news media and conducts situation report meetings.

B. Department Managers

Department Managers shall ensure compliance with all instructions and procedures designed to reduc the possibility of an emergency situation arising. Department managers are responsible to see that safe device testing is performed on station equipment and that safety and emergency response trainining given to all employees.

C. Maintenance Manager

The Maintenance Superintendent will supervise employees and coordinate materials used for equipment repair activities. This includes the supervision of any outside contractors required for rep activities and any equipment required for work.

D. Operations Manager

The Operations Manager will:

- Evaluate the problem and ensure that the plant and employees are made safe;
- Establish plan for an orderly restoration of plant to full operating state; and
- Coordinate plant operating requirements both internal and external.

E. Shift Supervisor

The Shift Supervisor on assignment when an emergency arises shall assume the role of Bowin Power Emergency Commander until relieved by the Plant Manager or authorized representative.

F. Environmental Health & Safety Coordinator

The Environmental Health & Safety Coordinator will assist the Emergency Commander to ensure the coordination of Bowin Power resources to meet emergency conditions, participate in any accident investigation in line with station procedure requirements, and organize assigned activities to ensure the health and safety of Bowin Power Plant employees.

G. Bowin Power Plant Employees

It is the responsibility of all employees to be prepared for emergency situations and assist, as necessary and as qualified, in emergency response activities.

H. Bowin Power Plant Emergency First Responder Team

All qualified Bowin Power Plant employees are eligible to be called upon to be a member of the emergency response team. All emergency response team members are trained as Emergency First Responders and hold current first aid certificates. Teams will be formed at the discretion of the Bowin Power Emergency Commander and work under his/her direction. The Security Office provides first aid coverage on a twenty four (24) hour full time basis.

VII. EMERGENCY EVACUATION PROCEDURES

A. Evacuation Routes

In the event that Bowin Power Plant is involved in an emergency situation which calls for the evacuation of facility employees, it is imperative that all employees follow prescribed routes of egress in a safe and orderly fashion. When evacuation becomes necessary, employees will be notified via the central emergency alarm system. Regardless of which part of the plant an employee happens to be located in at the time of an alarm, there will be at least two (2) planned routes for safe evacuation, a primary route and an alternate route. In all cases, employees should first attempt to evacuate the plant via the primary route of egress. In the event that the primary route of egress is blocked (or for some other reason unsuitable or unsafe), then employees should proceed to utilize the alternate route of egress. The facility emergency evacuation routes are posted throughout the facility.

B. Partial Evacuation

No evacuation alarm will sound. Employees and visitors will be told by their supervisors or escorts to evacuate. They shall proceed immediately, in a calm and orderly manner, to the appropriate evacuation assembly area.

C. Full Evacuation

The central emergency alarm will sound to signify a full evacuation of all employees and visitors from the plant.

D. Designated Assembly Areas

Employees shall leave the plant through the designated exits and proceed to the primary evacuation assembly areas. The assembly area is located at points that are located away from immediate danger and are sufficiently large enough to accommodate a mass exit of the entire work force. This procedure is essential, as it will provide the means for accounting for all employees and visitors and determining whether or not complete plant evacuation has been accomplished.

The alternate designated rendezvious location will be adjacent to the main enterance as it enters/leaves the property. This location shall only be used if the primary assembly areas are blocked by emergency vehicles.

E. Emergency Evacuation Drills

1. Emergency evacuation drills shall be conducted periodically (at least once annually) at the discretion of the Environmental Health & Safety Coordinator and the Bowin Power Plant Safety Committee.

2. Emergency evacuation drills shall be discussed in advance with the Plant Manager and the Security Supervisor only.

3. Each emergency evacuation drill shall be documented according to standard format. The Environmental Health & Safety Coordinator is responsible for the completion Evacuation Drill reports.

4. Records regarding emergency evacuation drills shall be maintained in the Environmental Health & Safety Coordinator's office.

F. Emergency/Disaster Warning System

1. The plant emergency/disaster evacuation alarm system consists of a continuous wail siren.

2. The alarm system can be activated either via any of the fire safety automatic detection systems or by activating any of the alarm pull stations.

3. Warning system alarms are located in each department in the plant.

4. The alarm system is tested quarterly by the Maintenance Department. Records of these tests are maintained in the Environmental Health & Safety Coordinator's and Maintenance Manager's Offices.

VIII. EMERGENCY RESPONSE DESCRIPTION

A. General

a. An Emergency Action Checklist will be posted in designated areas of the plant along with a copy of this Emergency Response Plan. This checklist is attached as Appendix C of this plan.

b. First Aid and Cardio Pulmonary Resuscitation (CPR) training shall be conducted annually for eligible Emergency First Responders.

c. Each employee will verify the accuracy of the emergency phone numbers on the plant phone numbers list annually. The Environmental Health & Safety Coordinator will update the phone list associated with the emergency response.

d. Outside emergency response agencies, such as the Country Fire Authority (CFA) may legally assume control of the Bowin Power Plant during certain emergencies. The Bowin Power Plant Emergency Commander, or authorized representative knowledgeable with the operation of the plant, shall remain in close contact with these agencies in order to offer assistance.

e. The Enviromental Health & Safety Coordinator will arrange for annual site visits of Emergency Services, CFA, Ambulance, etc. in order familiarize these agencies with the plant operations and layout, employees, and plant and site access routes.

B. Emergency Situations

The Shift Supervisor will take initial control of any emergency. He/she will assess the situation and determine what immediate actions and notifications are necessary. The following is a list of specific action items to be accomplished during the initial stages of any emergency.

a. The Shift Supervisor will assess the need for outside assistance. If required, he/she will arrange or direct the Security Guard to arrange for required outside assistance.

b. If assistance is required from outside contractors, the Shift Supervisor will direct that those specific contacts be made.

c. The Shift Supervisor will notify the Plant Manager and Operations Manager of an emergency as soon as possible after all emergency calls have been made.

d. No employee will leave the plant during an emergency condition without approval from his/her Supervisor.

e. Each Supervisor shall account for his/her employees immediately to determine which employee(s) may be involved in the emergency. Employees must evacuate the plant and meet at the designated assembly area.

f. Only Bowin Power Plant Emergency First Responders and outside emergency agencies should be allowed on site during an emergency. All communications with the media are to be referred to Plant Manager or authorized representative.

g. Once the situation has been stabilized, the Plant Manager and Operations Manager will form a committee consisting of staff members and other employees well versed in their particular field who can provide guidance in the restoration of the plant to a normal condition and carry out any investigation in line with station procedures.

IX. EMERGENCY CONTROL

There are three levels of emergencies at the Bowin Power Plant based on the seriousness of emergency:

Emergency Level One (Potential Emergency Condition) - The level of emergency that can be control within thirty (30) minutes by using the Bowin Emergency First Response Team and equipment. T type of emergency has little potential to spread throughout the plant or to nearby neighbors determined by the Bowin Power Emergency Commander.

Emergency Level Two (Limited Emergency Condition) - The level of emergency that cannot controlled within thirty (30) minutes by using the Bowin Emergency First Response Team equipment. This type of emergency may spread throughout the plant or nearby neighbors and requi assistance from the Chonburi Industrial Estate or nearby neighbors as determined by the Bowin Pow Emergency Commander.

Emergency Level Three (Full Emergency Condition) - The level of emergency that is serious uncontrollable by using the Bowin Power Emergency First Response Team and equipment assistance from the Chonburi Industrial Estate. This type of emergency requires assistance from exter government or local agencies.

C. Initial Emergency Control

The Shift Supervisor, or designee, is the nominated officer to take initial control of an emergenc situation regardless of the time or place the emergency arises. The Shift Supervisor assumes the role o Emergency Commander whose principal functions are the control, command, and coordination of available resources.

The Shift Supervisor may be replaced by a more senior manager if the situation escalates into a majo emergency.

D. Requesting Emergency Services

In some circumstances, emergency services external to the Bowin Power may be requested to assist combating the emergency. The Emergency Commander, or alternate, will perform the followin activities:

- Call for an ambulance if required.

- Notify external emergency response agencies of emergency incident to alert them at an early stage that their services may be required. Give situation reports to appropriate authorities at least every hour.

- Notify the Environmental Health & Safety Coordinator of the level of assistance required (e.g. CFA, Police, Health and Safety Organization). The Environmental Health & Safety Coordinator has a key role to play in ensuring that proper liaison occurs between the Bowin Power Plant and external emergency response agencies.

- Assess the emergency often. An emergency may graduate from minor to serious in a short time frame. An early assessment of the situation and decisions taken will often determine whether a situation is terminated rapidly or escalates into an uncontrollable and costly incident.

- Notify external agencies of emergency incidents, since it is sound emergency incident management to signal external agencies at an early stage that their services may be required. The initial call by the Control Room Operator to emergency services facilitates the attainment of both these requirements.

E. Hand Over Control

When the external emergency response agency arrives onsite, their senior officer is called the Incident Controller. The Bowin Power Emergency Commander will brief the Incident Controller on the situation. The briefing will cover:

- Location, nature, and status of the emergency
- Details of employees injured or trapped
- Action taken to date
- Location of any persons involved
- Details of hazardous materials involved
- Particular plant hazards
- Location of equipment
- Access to buildings and plant

The Bowin Power Emergency Commander will continue to command all Bowin Power resources for the Incident Controller.

The Incident Controller will take charge of the emergency situation using the advice and the expertise of the Bowin Power Emergency Commander and other outside agencies.

F. Terminating the Emergency

No action shall take place to restore normal operation until all relevant authorities have advised the Bowin Power Emergency Commander that it is safe to start the cleanup process or to resume operations.

The Bowin Power Emergency Commander will immediately participate in any joint agency debriefing of the incident. Plant-only emergencies also require a debriefing involving all emergency response participants and management.

G. Recovery Procedure

When an emergency is ended it is important that the plant is returned to normal in the shortest pos amount of time to minimize losses.

The following are points which may be considered when initiating recovery procedures:

Dangerous Goods Reportable Incidents. No clean-up, repairs, or movement of wreckage, debris c shall commence without approval from Health and Safety Organization (HSO), Environme Protection Agency (EPA) and/or police.

General Clean-up. General clean up of affected areas. Replenish equipment as necessary.

Fire: Organize clean up as soon as area is safe. Remember smoke and water damage may be m greater than the actual fire.

Plant Failures. Expert assessment of damage should be arranged as soon as possible.

Trauma Incidents. Employees exposed to trauma may have long lasting physiological problems. T Environmental Health & Safety Coordinator shall initiate any necessary counseling that may be requ to minimize the after effects of trauma.

Construction Incidents. : The effected construction contract employees should be advised as soon possible. A team should be established to initiate recovery procedures.

Operation Incidents. Incidents that impact the operations of the power station should be advised to control room operating staff as soon as possible. Operating staff will then take action to instigation effect of the incident on plant operations and carry out any reporting in line with station procedures.

H. Stationary Investigations

Various types of statutory investigations may follow any emergency:

Fatal Injury Inquiries. The Coroner may investigate any fatality which he/she considers in the pub interest. In these cases preservation of evidence is critical. The Bowin Power Emergency Comman will ensure that there is no clean-up, repairs, or movement of bodies apart from what necessary control the emergency without approval of the senior police officer on site. The police will manage aspects of the inquiry. Cooperation shall be given to the investigating police.

Crime Scene: When the Bowin Power Emergency Commander becomes aware that an emergency potentially the result of criminal activity, he must ensure that all possible evidence is preserved. In the circumstances, all actions must be taken in conjunction with the senior police officer on site.

Other Departmental Investigations: Other relevant government authorities may decide to investigate emergency, e.g. Health & Safety Organization or environmental authority. They will be directed to the Plant Manager or authorized representative when safe conditions exist or hazards have been defined.

X. EMERGENCY RESPONSE PLANS

Fire and Explosion Response Plan

1. Purpose

This section of the Emergency Response Plan establishes a uniform, plant-wide system for reporting and responding to fires. It is intended to ensure that all of the appropriate plant personnel are notified and informed in the event of a fire, and it is intended to designate the specific duties and responsibilities assigned to these employees. The overall objective of this section of the plan is to maximize the protection of Bowin Power Plant employees and of the environment in which it functions.

2. Scope

The details of this section of the plan shall apply to all of the premises of Bowin Power Plant.

3. Procedural Instructions to all Employees

a. Any person detecting a fire should first attempt to extinguish it without endangering himself/herself. In the event of a larger fire, the fire alarm must be activated immediately. The following information should be reported to the Security Office:

(1) Fire Location
(2) Type of Fire
(3) Extent of Involvement

b. When the fire alarm is activated, all employees shall immediately evacuate the building via established emergency egress routes.

c. After activating the fire alarm, the Security Guard shall contact the Shift Supervisor and verify that all employees are evacuating the building.

d. The Shift Supervisor, in addition to overseeing the evacuation procedures, shall assign one employee to a safe post adjacent to the area of the fire for the purpose of directing fire department personnel to the proper area of the plant.

e. All employees shall proceed to their designated assembly areas; and Shift Supervisors shall proceed to take a head count of those employees assigned to their respective assembly areas. If any employees are missing, the Shift Supervisor shall report this information to the Security Guard. The Security Guard shall report this information to Fire Department officials immediately upon their arrival.

f. All employees shall remain in their designated assembly areas until clearance for release has been given by the Plant Manager or authorized representative.

Department Managers and Shift Supervisors shall be responsible for maintain the assembly area and ensuring that no employees are allowed to leave the assembly area until cleared to do so.

4. Duties and Responsibilities

a. All Employees

Any person detecting a fire should first attempt to extinguish it without endangering himself/herself. In the event of a larger fire, the fire alarm must b activated immediately. The following information should be reported to the Security Office:Any employee detecting a fire shall immediately activate the f alarm and notify the Security office.

b. Emergency Commander

(1) Obtain emergency communication equipment.

(2) Assess the emergency and coordinate emergency response teams.

(3) Oversee evacuation procedures.

(4) Assign employee(s) as needed to guide incoming emergency vehicles to the site of the fire.

(5) Provide the Security office with periodic status reports.

c. Department Heads/Shift Supervisors

(1) Supervise evacuation procedures to ensure that all employees exit the building in a safe and orderly manner.

(2) Assist in organizing employees in the designated assembly areas; determine the number and names of any missing employees and provide this information to the Security Guard. (The Security Guard will in turn present this information to Fire Department officials.

d. Special Trade Employees

(1) Report immediately to the Security Office.

(2) Assist as necessary with Disaster Control Activities.

8. Oil and Hazardous Materials Spill Prevention, Control and Countermeasures Plan

1. Purpose

This section of the Emergency Response Plan establishes a uniform, plant-wide system for the handling, clean-up and reporting of oil and/or hazardous materials spills. It is intended to ensure that all of the appropriate facility employees are notified and informed in the event of an oil and/or hazardous materials spill and to designate the specific duties and responsibilities assigned to these employees.

This section of the plan shall also serve as a guideline in complying with all pertinent, local, state and federal regulations. Finally, in accomplishing all of these preceding objectives, this section of the plan aligns with the overall objective of maximizing our protection of Bowin Power Plant employees and the environment in which it functions.

2. Scope

The details of this section of the plan shall apply to all of the premises of Bowin Power Plant.

3. Definition of Terms

a. Hazardous Materials Spill - A spill shall be defined as the loss or discharge of any amount of any hazardous waste or hazardous material into or upon any navigable waters or adjoining shorelines or on any plant property which could potentially threaten human health and safety of the environment.

b. Oil Spill - An oil spill means a discharge of oil into or upon any navigable waters or adjoining shorelines or on any facility property in any quantity which represents a potential threat to the environment or to human health or safety.

c. Oil - Oil is defined as any petroleum liquid used as fuel for the generation of energy or used as a lubricant or as hydraulic fluid.

d. Department of Spill Origin - That department within whose physical boundaries a spill occurs. In those loading or unloading and storage areas outside of the plant, the Maintenance Department shall be considered responsible (as indicated).

e. Supervisor - For the purpose of this section of the plan, a Supervisor is any person who is responsible for department or facility location or anyone acting in a supervisory capacity in a department or facility location at the time a spill occurs.

4. Duties and Responsibilities

a. All Employees

(1) Any employee detecting a spill shall immediately notify and inform the Supervisor in the department of spill origin.

(2) All employees are informed of this responsibility by posted written notice. This is also reviewed periodically during departmental safety meetings.

b. Department of Spill Origin

(1) The Supervisor in the department of spill origin shall make an immediate and expedient assessment of the spill, stop the source of the spill, and take any appropriate measures necessary to minimize the effects of the spill. Guidelines for these steps are provided in the form of the "Oil and Hazardous Material Spill: Clean-upChecklist."

(2) After this immediate intervention, the Supervisor in the department of the spill origin will notify the following the appropriate individuals. If appropriate, the Supervisor may delegate this notification procedure to the Security Guard.

(3) The Supervisor in the department of spill origin shall write a report of the spill incident, using the standardized Spill Report Form. This written report shall be completed before the Supervisor leaves the plant on the day of the spill. Copies of this report shall be submitted to the following plant employees:

1. Bowin Power Plant Reference File
2. Plant Manager
3. Operations Manager
4. Shift Supervisor's Office
5. Maintenance Manager
6. Security Office
7. Environmental Health & Safety Coordinator

c. Environmental Health & Safety Coordinator

If indicated, the Environmental Health & Safety Coordinator shall, upon notification, report immediately to the location of the spill and shall be responsible for the following:

(1) Perform an immediate assessment of the spill and advise the Supervisor in the department of any additional actions necessary to clean up the spill and to eliminate or minimize any adverse effects on employee health and safety and/or on the facility or the environment.

(2) After completion of this initial intervention, the Environmental Health & Safety Coordinator shall assist the Supervisor in performing a comprehensive investigation of the causes and effects of the spill.

(3) As indicated, the Environmental Health & Safety Coordinator shall also notify and report investigation of spill to the appropriate regulatory agencies.

(4) The following information will be provided upon notification of a major spill:

1. Name and telephone number of caller
2. Name and address of facility
3. Time, type and cause of incident
4. Quantity and type of materials involved to the extent known
5. Extent of injuries
6. Potential hazards to human health or environment

(5) As soon as possible after the spill (in the case of any significant spill), the Environmental Health & Safety Coordinator shall write a comprehensive follow-up report regarding the specific details of the spill. The focus of this report should be to recommend measures to prevent (or at least minimize the possibility of) similar incidents in the future. Copies of this follow-up report shall be submitted to:

1. Bowin Power Plant Reference File
2. Plant Manager
3. Operations Manager
4. Shift Supervisor's Office
5. Maintenance Manager
6. Security Office

(5) As required, the Environmental Health & Safety Coordinator shall also prepare and submit any necessary written reports to the appropriate government agency(s).

(6) If actual or potential health or safety hazards have occurred as a result of this spill, then the Environmental Health & Safety Coordinator shall report this to the Plant Manager, to the Supervisor in the department of spill origin, and to the Supervisor(s) of any other affected department(s). The Environmental Health & Safety Coordinator should apprise the involved Department Manager(s) of the nature of the hazard(s) and advise of the necessary steps to eliminate the hazard(s).

(7) Initiate necessary contacts with employees via the Human Resources Department to provide instructions (e.g. regarding changes in work shifts or work assignments).

(8) Prepare and provide (as indicated) statements to representatives of the community and/or press according to established guidelines.

C. Severe Weather Conditions

1. In the event severe weather conditions, Bowin Power Plant shall rely upon the external recommendations made by the National Weather Service in the process of internal decision-making.

2. National Weather Service warnings are broadcast on the public radio stations.

   a. In the event that an impending severe weather condition has been forecasted, the Plant Mangager, or authorized representative, shall instruct the Security office to monitor National Weather Service messages.

   b. A battery-operated transistor radio shall be kept in the Security office at all times for this purpose.

3. In the event that a storm watch as been issued by the National Weather Service, it is the duty of the Security Guard to notify the Plant Manager of said condition at once.

   a. If the Plant Manger is unavailable, then the Security Guard shall contact the Shift Supervisor.

   b. The Security Guard shall then continue to monitor the radio for National Weather Service broadcasts and provide the Plant Manager (or alternate) with up-to-date reports as necessary.

4. In the event that a storm warning has been issued by the National Weather Service, then it is the duty of the Security Guard to notify the Plant Manager of said condition at once.

   If the Director of Production is unavailable, then the Security Guard shall contact the Shift Supervisor.

5. The Plant Manger, or authorized representative, is responsible for plant shutdown and employee release as indicated.

D. Utilities Emergencies

1. In the event of any emergency situation involving any of the utilities, the individual first noting the problem shall immediately notify his/her supervisor.

2. The Supervisor shall notify the Maintenance Manger and the Security Office and request assistance as indicated.

E. Bomb Threat Procedures

In the event that a bomb threat is received, the person receiving the threat is to attempt to obtain as much detailed information as possible about the caller, the threat, and the call itself. A "Bomb Threat Checklist" has been established for assisting with this task. Copies of this checklist are kept at the switchboard and in the Security office; a sample copy is attached. The person receiving the threat should attempt to note all significant information in writing on this form.

Subsequent to receipt of a bomb threat, the person receiving the call or Security officer shall take the following steps:

1. Notify the Plant Manger immediately.

2. If the Plant Manager is unavailable, one of the following individuals shall be notified:

   a. Shift Supervisor
   b. Environmental Health & Safety Coordinator

3. Provide the above individuals with as much information as possible about the threat and the caller.

4. Proceed as instructed by the Plant Manager (or any of the alternates listed above).

The Plant Manager (or assigned alternative) shall next take the following actions:

1. Review all available information and authorize initiation of plant evacuation procedures as indicated.

2. If appropriate, instruct the Security Office to notify the Police and Fire Departments.

F. Disturbances or Demonstrations

1. If a disturbance or altercation occurs involving two individuals, then the first individual to witness this situation shall immediately report it to the shift Supervisor. The shift Supervisor shall immediately notify the Security Guard, who shall report to the scene and attempt to settle the dispute. The Shift Supervisor shall subsequently administer appropriate disciplinary action; Company policy dictates that such disturbances are serious violations and may result in termination of the involved parties. In the event that the Security Guard is unable to settle a dispute, the Police Department should be notified.

2. In the event that a disturbance or demonstration occurs involving more than two individuals, then the first individual to witness this situation shall immediately report it to the Shift Supervisor. The Shift Supervisor shall immediate notify the Security Guard, who shall report the incident to the Police Department and then proceed to the scene to assist with crowd control.

3. Subsequent to any disturbance or demonstration. the shift Supervisor and Security Guard shall complete a written report regarding the details of the incident; this repo shall include the following information:

   a. Date of the incident
   b. Time of the incident
   c. Employees involved in the incident
   d. Details of the incident, including any injuries
   e. Any outside parties contacted (e.g. police)
   f. Any disciplinary actions taken

4. Copies of this report should be submitted to the following individuals:

   a. Plant Manager
   b. Security Supervisor

5. Any inquiries from the community or media regarding any disturbances or demonstrations shall be directed to the attention of the Plant Manager.

G. Acts of War or Aggression

1. In the event that an act of war is declared by Thailand or by another country against T Thailand, the Plant Manager shall be responsible for coordinating employee communication procedures.

2. The Plant Manager shall provide employees with instructions based on any decisions made at the federal and/or state levels.

   a. Production may or may not continue under such circumstances.

   b. Government contracts may override any previous production schedule.

   c. The Bowin Power Plant staff shall remain in contact with corporate headquarters regarding any such changes.

3. The Plant Manager shall also coordinate and process all military leaves-of-absence which may occur as a result of such circumstances.

H. Adjacent Neighbor's Emergency

1. In the event that an adjacent neighbor is faced with an emergency situation of any magnitude, Bowin Power Plant shall maintain periodic contact with this neighbor in order to remain apprised of the status and provide assistance as needed.

2. When an individual receives a call from an adjacent neighbor regarding such a situatio the following steps shall be taken:

a. The individual receiving the call shall obtain and record all essential information (e.g. name of caller, name of neighbor, nature of emergency);

b. The individual receiving the call shall immediately notify Plant Manager and apprise him/her of the situation;

c. The Director of Production or Environmental Health & Safety Coordinator shall evaluate the situation and determine whether or not any actions are indicated (i.e. plant evacuation).

XI. PRESS RELATIONS

Press relations are of critical concern in the event of any major emergency; subsequent to such an event, Bowin Power Company may be required, by the press, to explain the factors that precipitated the emergency and to substantiate all of its responses. To ensure that this task is accomplished appropriately, any and all inquiries from the press or community regarding plant emergencies or disasters shall be directed to the Plant Manager.

All other employees are encouraged not to comment to the media during or after an emergency situation without first consulting with the Plant Manager. The intention is not to withhold information or opinion, but to ensure that questions are asked only of those individuals by whom the most accurate information is known.

Bowin Power Plant has formulated the following considerations/guidelines to assist with the media relations issue during or after a major emergency. The Plant Manager should consider each of these items prior to responding to media inquiries:

1. Discern in advance the purpose of a given interview; find out what specific purpose (objective) the interviewer intends to address.

2. Find out before you begin to answer any questions exactly how the material is to be used.

   a. Will you be quoted directly?

   b. Is the material intended for audio, visual or written publication, or is it for background/reference information?

3. Determine whom this release of information is to be addressed to:

   a. General public/community;
   b. Customers;
   c. Stockholders;
   d. Employees.

4. Assess the potential significance of this release to the Company and its employees.

5. Discuss the details of the emergency/disaster with all key Emergency Response Plan emp prior to discussing it with any members of the Press.

6. Ensure that all appropriate regulatory agencies have been contacted prior to discussing the emergency/disaster with any members of the press.

7. Ensure that all appropriate Company officials and managers have been notified prior to discussing the emergency/disaster with any members of the press.

8. If the event involves actual or potential environmental impact, consider each of the follow questions:

   a. Are you projecting a good environmental image?

   b. Is there a written environmental control policy?

   c. Is the Company's environmental control policy properly documented?

   d. Is the environmental control policy known at all Company levels (i.e. by all employees)?

   e. Have members of the media reported on Company environmental issues in the past

   f. Are employees informed regarding environmental issues?

      (1) Have Company policies been explained to employees?

      (2) Are employees aware of environmental problems and/or achievements?

      (3) Have hazard communication policy rights been explained to employees?

XII. AMENDMENT OF THE EMERGENCY RESPONSE PLAN

The Emergency Response Plan must be reviewed at least annually, and immediately amended, if necessary, whenever:

(a) Applicable regulations are revised;

(b) The Plan fails in an emergency;

(c) The facility changes- in its design, construction, operation, maintenance, or other circumstan in a way that materially increases the potential for fires, explosions, or releases of hazardous waste constitutes, or changes the response necessary in an emergency;

(d The list of emergency coordinators changes; or

(e) The list of emergency equipment changes.

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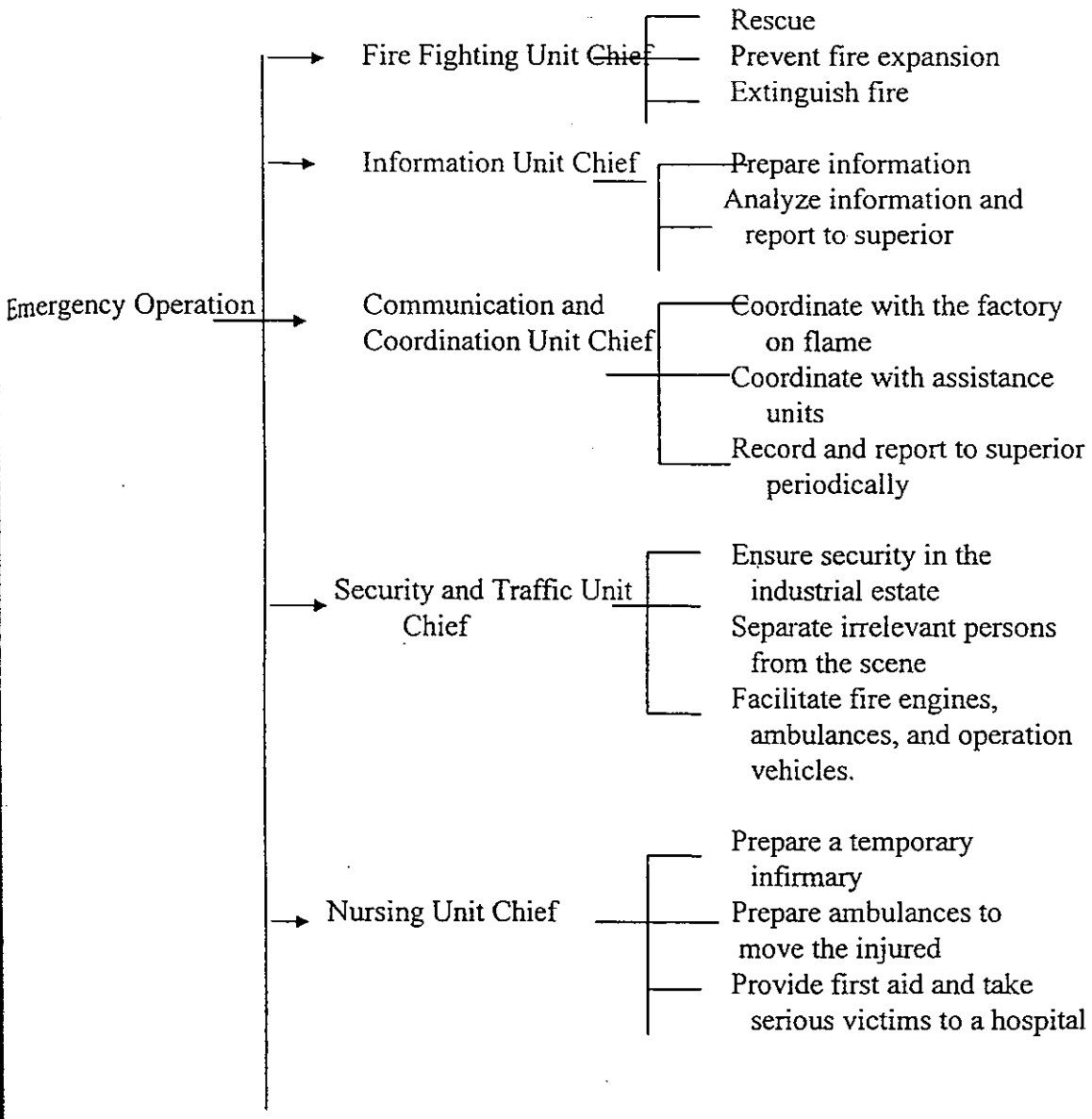
APPENDIX A
CHONBURI INDUSTRIAL ESTATE EMERGENCY OPERATIONS CENTER

Diagram of CIE's Emergency Operation Center



APPENDIX B

Vehicles and Equipment used in CIE's Emergency Operations

Vehicles/Equipment	Details	No. of Unit/Volume
Fire engines and fire Fighting equipment	- a fire engine loading 4,000 litters of water	1 fire engine/ 1 tank
	- 10-lb. fire extinguishers	one for dry chemical and another one for CO2
	- AFFF 3% foam	1,500-litre tank, 14,000-litre tank
	- reserve fire water	3 uniforms/1 fire engine
	- ordinary fire uniform	
	- 8-12 bar main pump with capacity 3,400 litters/minute	pressure of 55 bars
	- high pressure fire hose of 1 inch in diameter, 30 meters long	pressure of 650 lb./sq. inch
	- fire hose with quick coupling of 2 1/2 inches in diameter, 6 20-metre-long hoses	1 set
	- fire water pipe of 4 inches in diameter, 9 meters long	2 sets
	- 20-metre-long dry chemical hose rolled in a set with a valve ad nozzle and handle.	2 sets
	- fire water nozzle of 2 1/2 inches in diameter with a valve	400 liters/minute
	- foam nozzle with quick coupling of 2 1/2 inches in diameter and a valve	2,400 liters/minute pressure of 10 bars
	- water/foam spraying base, water spraying capacity of 60 meters and foam spraying capacity of 55 meters	capacity: 100 liters/minute 4.5 meters
Rescue equipment	- 2 water nozzles for self protection	500 watts
	- 4 undercarriage nozzles	2 sets
	- adjustable light post	
	- 3 halogen lamps installed on the post	1 set, cutting capacity of 4.5 tons, 32 cm. wide blade
	- turntable search light installed in front of the fire engine	2 sets
	- hydraulic cutting tool	
	- respirators	

APPENDIX C
Nearby Fire Station Information

Fire Station Location	Distance (KM.)	No. of Fire Engines	Telephone
Pluak Daeng Fire Station	15	2 fire engines 1 water tanker	659003
Map Ta Put Fire Station	50	1 fire engines 10 water tanker 4 foam-type fire engines	685191
Rayong Fire Station	60	3 fire engines 5 water tanker	611145
Grang Fire Station	70	4 fire engines 2 water tanker	671196
Ao Udom Fire Station	35	2 fire engines 1 water tanker	351111
Si Racha Fire Station	40	9 fire engines 4 water tankers	311666
Laem Chabang Fire Station	40	1 ladder-type fire engine 4 foam-type fire engines 2 water tankers	490554 490199
Bangsaen Fire Station	55	3 fire engines 3 water tankers	381061
Pattaya Fire Station	60	11 fire engines 3 water tanker	221000
PTT Operation 1 (Chonburi)	65	3 fire engines 1 water tanker	274390-5 ext.5049-56

APPENDIX D
Nearby Hospital Information

Hospital					
Hospital	Distance (KM.)	Beds for Accident	Beds for Fire Victims	Telephone	Ambulances
Pluak Daeng Hospital	15	2 beds	-	659005	1
Rayong Hospital	50	20 beds	4 beds	611104	3
Bumrungrad Hospital Rayong	50	6 beds	-	620401-35	4
Ao Udom Hospital	30	4 beds	2 beds	351010-1	3
Laem Chabang Memorial	35	5 beds	5 beds	491888	3
Somdej Na Sriracha	40	15 beds	5 beds	311009	3
Krungthep-Pattaya	60	10 beds	10 beds	427751-5	2
Samittivej Sriracha	40	6 beds	2 beds	314100	2
Phayathai Sriracha	40	15 beds	-	770200	3
Pattaya international	60	4 beds	-	428374	3
Pattaya memorial Hospital	60	6 beds	-	429422-4	2

APPENDIX E

EMERGENCY REPORT TO TRANSFER RESPONSIBILITIES

Date: ..... Time:.....

Receiver: .....

Sender: .....

Location of the Incident at Bowin Power:

.....

Time Notified of the Incident:

.....Nature of

Incident: .....

.....

.....

.....

Level of Emergency Condition:

[ ] Level 1: Potential Emergency Condition

[ ] Level 2: Limited Emergency Condition

[ ] Level 3: Full Emergency Condition

Activities Performed:

.....

.....

Medical Assistance Requested:

.....

No. of Injured Persons: [ ] None [ ] Yes .....persons

Name	Sex	Age	Position	Feature of Injury

Fatalities: [ ] None [ ] Yes .....persons

Wind Direction:

.....

Other details: .....

Signature:_____ Date:_____

APPENDIX F

BOWIN POWER EMERGENCY COMMANDER CHECKLIST

- ☐ Assume responsibility for all response activities until the arrival of outside emergency resp agencies. Principle functions are control, command, and coordination. Develop an action pl combat the incident and mobilize Bowin Power resources. Ensure the safety of all employees priority.

- ☐ On arrival of the emergency response agencies, conduct a change-over meeting and assume a operations role as Officer in Charge of Bowin Power resources providing assistance.
- ☐ If required, establish an Emergency Response Center. Assist the Incident Controller to establ readily recognizable assembly area for resources.

- ☐ Ensure adequate communications (radios and telephones) and planning instruments (maps, cu situation report, white boards) at the Emergency Response Center.

- ☐ Request Environmetal Health & Safety Coordinator to arrange maximum notification proced with external agencies.

- ☐ Think ahead at all times.

- ☐ Request Emergency Response Plan support services, such as catering, transport, next of kin information, as required by the Incident Controller.

- ☐ If critical incident exists, contact ITIM Chaplain who will initiate crisis intervention. The Critical Incident Response People (C.I.R.P.) need access to affected personnel as soon as possible after the incident. May be necessary for C.I.R.P. to be present during an emergency for response planning and initial defusing of individuals or groups who are withdrawn from the incident (and not returning) while the incident is still happening.

- ☐ It is important that the site return to normal operation as soon as possible after an emergency. The Bowin Power Emergency Commander should initiate procedures as soon as possible.

- ☐ Arrange a de-briefing of Bowin Power resources and participate in any Emergency Management inter-agency debrief.

- ☐ Assess situation for safe access to workplace for resumption of activities.

- ☐ Ensure chronological logs are kept regarding times, messages received, instructions given, arrival and departure of employees and outside emergency response agencies to and from incident scene.

Date of D

Time of Dri

Duration f

Descript n

Critique of

Remedia M

Recomm n

Report P

Report L

APPENDIX G
BOWIN POWER PLANT
Report of Emergency Evacuation Drill

Date of Drill: _____

Time of Drill: _____

Duration of Drill: _____

Description of Drill Activities:

_____

_____

Critique of Drill:

_____

_____

Remedial Measures/Corrective Actions:

_____

_____

Recommendations:

_____

_____

Report Prepared By: _____ _____
Signature Title

Report Reviewed By: _____ _____
Signature Title

APPENDIX H
BOWIN POWER PLANT

Fire Extinguishers

All fire extinguishers are inspected on a monthly basis by the Security Department. A written report of this inspection is then submitted to the Environmental Health & Safety Coordinator who is then responsible for overseeing the necessary follow-up/corrective actions.

Monthly fire extinguisher inspections are to be completed on or before the fifth day of each month. Completed inspection reports are kept on file in the Environmental Health & Safety Coordinator's office.

The monthly inspection process includes the following basic elements:

1. A check of all fire extinguishers to ensure that they are all present in their proper locations.

2. A check to ensure that all fire extinguishers are full. Extinguishers which have been used are reported to the Environmental Health & Safety Coordinator. The Environmental Health & Safety Coordinator then oversees the task of replacing any used extinguishers.

3. A check to ensure that the appropriate type of extinguisher is in the appropriate location. Any inappropriately placed extinguishers are reported to the Environmental Health & Safety Coordinator. The Environmental Health & Safety Coordinator then oversees corrective action.

4. A check for the static-test date on each extinguisher. Any extinguisher with more than five (5) years of elapsed time since the previous hydrostatic test is reported to the EnvironmentalHealth &Safety Coordinator. The Environmental Health & Safety Coordinator then collaborates with the Maintenance Manager in taking appropriate corrective action.

5. A check to ensure that the extinguisher is clearly accessible. This includes checking to see if the extinguisher is blocked in any way and also checking to see that the extinguisher is clearly labelled.

6. After completing all of the visual inspection checks indicated above, the inspector initials and dates the attached inspection tag.

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APPENDIX I
BOWIN POWER PLANT

Spill Report Form

Date: _____ Department: _____

1. Type of spill (include names of specific chemicals/hazardous materials:_____
_____
_____
_____
_____

2. Volume of spills:_____

3. Time of spill:_____

4. Exact location of spill:_____
_____
_____

5. Name of person(s) detecting spill:_____
_____
_____

6. Individuals notified and time of notification:_____
_____
_____

7. Type of container from which spill occurred (e.g. drum, tank, pipeline):_____
_____
_____

8. Probable cause of spill:_____
_____
_____

9. Corrective measures taken:_____
_____
_____

10. Results of corrective measures taken (i.e. were they successful):_____
_____
_____

11. Recommendations (How can such incidents be prevented in the future? How could this have been handled more efficiently?)_____

_____

_____

_____

12. Injuries or unsafe conditions occurring as a result of this spill or clean-up?_____

_____

_____

Prepared by: _____ _____ _____

Signature Date

Reviewed by: _____ _____

Signature Date

Date of f...e

Time fir...t

Departm...t

Specific loc...

Fire com...a

Extinguish...

Employ...(

Equipm...t

Cause o...fi...

Steps ta...e

Steps take...

Superv...b

Depart...e

Enviro...r

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APPENDIX J
BOWIN POWER PLANT

Fire Report

Date of fire:_____

Time fire started:_____

Department:_____

Specific location of fire:_____

_____

_____

Fire company contacted: _____Yes _____No

Extinguished by:_____

Employee(s):_____

Equipment _____Extinguisher #_____
_____Booster/Hose #_____
_____Sprinklers_____

Cause of fire:_____

_____

_____

_____

Steps taken to replace/recharge firefighting equipment:_____

_____

_____

Steps taken to prevent same or similar occurrences:_____

_____

_____

_____ _____
Supervisor's Signature Date

_____ _____
Department Manager's Signature Date

_____ _____
Environmental Health & Safety Coordinator's Signature Date

APPENDIX K
BOWIN POWER PLANT

Oil and Hazardous Materials Spills: Clean-Up Checklist

Remember, your safety is the primary concern when you are the first employee to detect a spill involving a hazardous or potentially hazardous material. The following guidelines will help you in taking the proper steps; all employees should be familiar with these guidelines:

1. Take the necessary steps to keep people/other employees (except for emergency response employees) away from the scene of a spill.

2. Take steps to avoid contact with the spilled substance. Do not touch it or walk in it. Avoid inhaling any gases, fumes or smoke.

   a. Be aware of the possibility of invisible and/or odorless gases or vapors.

   b. Be sure to select and utilize the appropriate personal protective equipment (e.g. respirator, impervious gloves).

3. Stop the spill at its source if at all possible.

   a. Close any/all open valves.

   b. Secure any/all pumps.

   c. Close any ventilation ports.

   d. If the spill is outside, use sandbags, gravel, etc. to prevent its entry into water or any other dispersion.

   e. Close any dike gates, cover any/all drains, close any exits as indicated to stop the spill at its source.

4. Contain the spill - take the appropriate steps depending on whether the spill is inside or outside the plant.

   a. Surround the spill with dikes or dams, using earth, boards, straw, etc. (whatever spill containment materials are available in the area).

   b. Dig ditches large enough to divert the flow of the spill away from the direction of any waterways or inhabited areas.

   c. Use appropriate absorbents to clean up small amounts of spilled hazardous materials (e.g. sand)

APPENDIX L
Hazardous Materials Spills
Clean-Up Equipment Inventory

Date: _____

Department: _____

Equipment and materials available for clean-up of spills:

_____
_____
_____
_____
_____

Recommendations to Department Manager (e.g. materials that should be purchased, employee training needs, etc.):

_____
_____
_____
_____
_____

1. The inventory should be completed by a department supervisor and then reviewed on a monthly basis.

2. One copy should be filed in the Department (in the Emergency Response Plan), a copy should be submitted to the Department Manager, and a copy should be submitted to the Environmental Health & Safety Coordinator.

3. The Department Head is responsible for follow-up i.e. that used equipment is replaced, damaged equipment is repaired, etc.

APPENDIX M
BOMB THREAT CHECKLIST

Date:_____Time call received:_____

Exact words of caller:_____
_____
_____

Questions to ask caller:

1. Exact location of bomb:_____
_____

2. Time set for detonation:_____

3. What kind of bomb/type of explosive:_____

4. What does the bomb look like?_____
_____

5. Why did you place the bomb?_____
_____

6. Where are you calling from:_____
_____

Description of caller's voice:

____Male ____Female ____Estimated age _____Tone of voice ____Any accent?

Does the voice sound familiar to you? _____Yes _____No

If yes, who does it sound like?_____

Description of background noises:

_____Planes _____Traffic _____Train _____Machinery

Time caller hung up?_____

Person receiving the bomb threat?_____

APPENDIX N
EMERGENCY RESPONSE INSTRUCTIONS

Instructions to allemployees for fire or accident:

- Raise the ALARM by reporting IMMEDIATELY to the EMERGENCY SERVICES CENTR on **Emergency Number** ALERT other personnel in the area
- Call for assistance and attack the fire with your buildings fire extinguishing equipment, but do not place yourself at risk

To obtain assistance, supply the following information:

In the event of **fire**:

- Dial Emergency Number from any office telephone
- State **WHO** is calling
- State **WHAT** is burning
- State **WHERE** the fire is
- ***Wait*** do **NOT** hang up until asked to do so

On being informed to evacuate the office:

1. STOP What you are doing
2. SECURE Documents, computer files, etc.
3. LEAVE The building
4. PROCEED To the Assembly Point at the gate to the car park, north of the office complex.
5. WAIT Report to the Evacuation Warden, Remain at the assembly point until further instruction or until the emergency situation is controlled.

Where an **Accident** has happened:

- Dial **Emergency Number** from any office telephone
- Speak **CLEARLY** and **SLOWLY**
- State **WHO** is calling
- State **WHAT** has happened
- State **WHERE** the accident has occurred
- ***Wait*** do **NOT** hang up until asked to do so
- **ALERT** other personnel in the area
- Attempt to **ASSIST** in controlling the situation if it is within your capabilities.

APPENDIX O

EVACUATION INSTRUCTIONS

Purpose

To provide information for all Bowin Power employees should the need arise, to evacuate the Bowin Power , so that they will be able to do so in a safe and expedient manner.

1. Evacuation Assembly Areas - Areas for particular groups are signposted.
2. Partial Evacuation - No evacuation alarm will sound. If you are told by your Supervisor/Team Leader to evacuate, proceed immediately in a calm and orderly manner to the nearest Evacuation Assembly Area via the most direct safe route.
3. Full Evacuation - The Emergency Alarm will sound and red flashing lights at pedestrian gates and roadway will activate to signify a full evacuation of the Power Station.

When evacuating, employees must proceed immediately in a calm and orderly manner to the Evacuation Assembly Areas via the most direct safe route. If there are any visitors on site, the assigned escort will be responsible for the evacuation of those employees.

The Shift Supervisor will initially take control of the emergency situation. Details of this and other key roles are available in Emergency Response Action Checklists.

Evacuation Procedures

If due to an emergency, whether fire, explosion, threat, or hoax, it becomes necessary to evacuate employees from any of the buildings within the environs of the Bowin Power at any time 24 hours of the day 7 days of the week, it will be the responsibility of the Emergency Commander on site to initiate the Evacuation Procedure.

- On hearing the siren, all employees and visitors under their control are to immediately proceed to the nearest assembly point.
- Only Emergency First Responders are permitted to enter the site while the red flashing lights are operating.
- Bowin Power Emergency Commander will appoint a warden to account for all employees at the assembly point.
- Emergency Commander is to take action to ascertain the whereabouts of any employees not located at the assembly area following an evacuation.
- Following any evacuation, employees must not return to their work site until instructed by the assembly point warden.

Communication is to be maintained with the Control Room to identify employee

movements and the status of the operating plant.

Full Evacuation

If due to any emergency, whether fire, explosion, threat, or hoax, it becomes necessary to evacuate visitors and employees from all buildings within the Power Station, the Shift Supervisor (or the nominated deputy) is to request the Emergency Services to continue to sound the emergency alarm to signal the need for evacuation.

Employees must proceed immediately in a calm and orderly manner via the most direct safe route to the nearest Evacuation Assembly Area.

Where circumstances require shift production employees to evacuate their posts, employees must proceed immediately in a calm and orderly manner to the Evacuation Assembly Area via the most direct safe route. In these circumstances, relevant supervision must be informed immediately of any operating plant left unattended.

Partial Evacuation

If the particular emergency situation requires only limited evacuation of employees from specific areas, the Shift Supervisor will work through supervision in these areas to achieve this, using the most effective method of communication available.

In the event of a fire in any building the emergency number must be called and details given, thereby initiating the emergency response to bring the fire under control. However, the total evacuation alarm will not sound. A chain of instruction must be initiated by the occupants to ensure that all affected employees are evacuated as quickly as possible.
Employees who are directed to evacuate their posts must proceed in a calm and orderly manner to the Evacuation Assembly Area via the most direct safe route without delay.

Post Evacuation

Following any evacuation, employees must remain at the assembly area until instructed otherwise by their immediate supervisor, who will be responsible for the identification and control of their employees at the assembly area.

Shift Supervisors must initiate action to ascertain the whereabouts of any employees not at the assembly area following evacuation.

The Shift Supervisor must not direct employees in their group to return to work site until given the all clear to do so by the Emergency Response Commander, or designee.

Assembly Points

Please report to the Security Office you are not at your primary assembly area.

If Out on PLANT

1. **STOP** What you are doing.
2. **SECURE** Make work area safe unless to do so would endanger the person concerned.
3. **LEAVE** The area, use stairs. Do not use lifts.
4. **PROCEED** To nearest Assembly Point.
5. **REPORT** To the Evacuation Warden.

If in a VEHICLE

1. **STOP** What you are doing.
2. **PARK** Vehicle off access way.
3. **PROCEED** To nearest Evacuation Assembly point.
4. **REPORT** To Evacuation Warden.

Instruction for Evacuation of Buildings

1. **STOP** What you are doing.
2. **SECURE** Documents, computer files, etc. Make work area safe unless to do so would endanger the person concerned.
3. **LEAVE** Building, use stairs. Do not use lifts.
4. **PROCEED** To nearest Evacuation Assembly Area.
5. **WAIT** At the **Bowin Power** employees sign, until the roll is called follow further instructions. Notify the Security Office of any missing persons.

Warehouse and Projects Office

On being informed to evacuate the Warehouse Complex or the Projects Office.

1. **STOP** What you are doing.

2. **SECURE** Documents, computer files, etc. Make work area safe unless to do so would endanger the person concerned.
3. **LEAVE** The building.
4. **PROCEED** To the ASSEMBLY point at the gate to the car park north of the project office complex.
5. **WAIT** Report to the Shift Supervisor. Remain at the assembly point until further instructions or until the emergency situation is controlled.

Production Employees

Are to be accounted for by their Shift Supervisors.

Performance Employees

Are to be accounted for by their Supervisor.

Administration Employees

Are to be accounted for by their Supervisors.

Warehouse and Projects Employees

Are to be accounted for by their Supervisor.

All staff are responsible for alerting and escorting visitors from the area involved.

Evacuation Warden Responsibilities

Upon hearing the evacuation alarm and/or being notified that an evacuation is in progress:

1. Pass on order to evacuate premises to employees and visitors in vicinity.
2. Direct employees and visitors to use stairs.
3. Notify other Department Wardens.
4. Check the floor, including rest rooms, to ensure all employees have left the area.
5. Proceed to nearest evacuation assembly point.
6. Check employee count and account for absent persons.
7. Report to Security Office as to persons unaccounted for.

APPENDIX P
FIRE RESPONSE INSTRUCTIONS

1.0. INSTRUCTION TO ALL STAFF FOR FIRE

- Raise the ALARM by reporting IMMEDIATELY to the EMERGENCY RESPONSE CENTER

⇒ State **WHO** is calling
⇒ State **WHAT** is burning
⇒ State **WHERE** the fire is
⇒ **Wait**. Do **NOT** hang up until asked to do so

- ALERT other employees in the area.
- INFORM Unit Control Room.
- Call for assistance and attack the fire with fire extinguishing equipment, but do not pl self at risk.

2.0 RESPONSIBILITIES IN THE EVENT OF A FIRE

2.1 A person discovering a fire will assess the situation and immediately call the Emerge Services, being sure to give the exact location, severity and type of fire. If conditions per attempt to gain control of the fire until help arrives.

2.2 The Operator/Technician in the Control Room will call site Emergency Services and broad the location of the fire over the portable radios.

2.3 The Operator/Technician will notify the Shift Supervisor and monitor the operation of the f and general service (F&GS) pumps and the F&GS water header pressure. If the fire falls in the protective zones of any unit fixed fire spray systems, Shift Supervisor will make sure t systems operate properly.

2.4 The Shift Supervisor will be responsible for directing the fire fighting teams and bring under control, any fire occurring within the boundaries of the plant.

2.4.1 Employees are directed to report to their immediate Supervisor for accountability instructions in containing the situation.

2.4.2 The Control Room Operator is to account for their respective operators.

2.4.3 Performance and Warehouse employees are to report to the Performance Te Leaders in the Workshop/Warehouse.

2.4.4 Engineering staff and Clerical employees are to report to the Control Center Building.

2.4.5 The Shift Supervisor will account for all visitors.

2.4.6 The Managers of Production and Performance will report to the control

room and assist as necessary in the continued operation of the units and provide additional resources, if required.

2.4.7 All fires will be reported to the Country Fire Authority(CFA), by the Emergency Services. The Shift Supervisor will confirm the CFA has been notified.

When the responding fire fighting agency arrives at the plant, overall fire fighting activity will then be under the direction of the Country Fire Authority, in conjunction with the Shift Supervisor. The main responsibility of the Shift Supervisor once professional fire fighters are on site, is to ensure them safe access to the scene. This may require shut down and isolation of plant, etc.

3.0 SHIFT SUPERVISOR

3.1 CONTROL PANIC AND CONFUSION

Remain calm - reassure others.

Give specific job assignments.

3.2 ASSESS THE SITUATION OF EQUIPMENT AND EMPLOYEES

Identify and isolate sources of danger feeding the fire. Monitor fire's progress.

Evaluate problems associated with on line units and units removed from service.

De-energize electrical equipment in or near fire area.

3.3 DETERMINE IF HAZARDOUS CHEMICALS ARE INVOLVED

Review the Material Safety Data Sheet (MSDS) sheets for the chemical hazards; i.e. flash point, extinguishing agent, health hazard, reactivity, etc. Barricade the affected area if safe to do so. Furnish outside agencies MSDS information, include CFA, paramedics and ambulance staff.

Have self-contained breathing apparatus and respirators available, if required.

Furnish an assessment of plant damage and employee status to the Production Manager and Plant Manager. (This report will be updated following a more thorough investigation.)

3.4 ORGANIZE TEAM/S TO CONTAIN THE SITUATION

3.5 ESTABLISH A COMMUNICATION CENTER

The Unit Control Room will be the primary communication center during an emergency situation. All plant activities will be thorough and recorded in chronological order in the Operator's Log.

3.6 SECURE PLANT PERIMETER

3.7 ESTABLISH ON-SITE TEAMS FOR AROUND THE CLOCK COVERAGE

During the crisis, management employees will supervise and co-ordinate around-the-clock teams through the unstable and transition periods. This surveillance will continue until conditions stabilize and there is no further danger to employees or equipment.

APPENDIX Q
ACCIDENT RESPONSE INSTRUCTIONS

1.0 INSTRUCTIONS TO ALL STAFF OF SERIOUS ACCIDENT RESPONSE

Raise the alarm by reporting immediately to the Emergency Response Center.

Supply the following information:

⇒ Speak **CLEARLY** and **SLOWLY**
⇒ State **WHO** is calling
⇒ State **WHAT** has happened
⇒ State **WHERE** the accident has occurred
⇒ ***Wait*** do **NOT** hang up until asked to do so

ALERT other employees in the area
Attempt to **ASSIST** in controlling the situation if it is within your capabilities.
All staff are responsible for alerting/escorting visitors from the area.

2.0 BOWIN POWER EMPLOYEES RESPONSIBILITIES

2.1 A person discovering an accident will assess the situation and immediately call Emergency Response, being sure to give the exact location, severity and type of accident. If conditions permit, attempt assist the injured until help arrives.

2.2 The Operator/Technician in the Control Room will call site Emergency Response and broadcast the location of the accident over the portable radios.

2.3 The Operator/Technician will notify the Shift Supervisor.

2.4 The Shift Supervisor will be responsible for directing the Emergency Response teams to any accident occurring within the boundaries of the plant under Bowin Power control.

2.4.1 Employees are directed to report to their immediate Supervisor for accountability and instructions in containing the situation.

2.4.2 The Control Room Operator is to account for their respective operators.

2.4.3 Performance and Warehouse employees are to report to the Performance Team Leaders in the Workshops/Warehouse.

2.4.4 Engineering staff and Clerical employees are to report to the Control Center Building.

2.4.5 The Shift Supervisor will account for all visitors at Bowin Power.

3.3.2 If capable of being moved, co-ordinate the transfer of the injured to the Emergency Services Center.

3.3.3 Post a Bowin Power employee or other nominated person equipped with a radio at the Power Station entrance to open the gate and direct emergency vehicles to the incident control area.

3.4 CONTROL PANIC AND CONFUSION

Remain calm - reassure others. Give specific job assignments.

Update employees on Station status.

Remove non-essential employees from affected area.

3.5 REASSESS THE SITUATION OF EQUIPMENT AND PERSONNEL

Forward this report to the Production Manager and Plant Manager.

Determine if additional assistance is required.

3.6 DETERMINE IF HAZARDOUS CHEMICAL ARE INVOLVED

Review the MSDS sheets for the chemical hazards; i.e. flash point, extinguishing agent, health hazard, reactivity, first aid, etc. Furnish outside agencies with MSDS information, include CFA, paramedics ambulance staff, hospitals.

Barricade the affected area if safe to do so.

Have self-contained breathing apparatus and respirators available, if required.

3.7 ORGANIZE TEAM TO CONTAIN THE SITUATION

3.7.1 Plant Operations

3.7.1.1 Identify and isolate and barricade sources of potential danger.

3.7.1.2 Use the MSDS Sheets if hazardous chemicals are involved.

3.7.1.3 Evaluate problems with on-line units and units removed from service.

3.7.2 PERFORMANCE/WAREHOUSE PERSONNEL

3.7.2.1 Provide personnel and materials as required by situation.

3.7.3 ENGINEERING STAFF

3.7.3.1 Co-ordinate engineering and administrative functions.

3.8 ESTABLISH A COMMUNICATION CENTER

3.8.1 Unit Control Room will be the primary communication center during an emergency situation.

3.8.2 Plant activities will be thorough and recorded in chronological order in the Operators' Log.

3.9 SECURE PLANT PERIMETER

3.9.1 Group 4 Security and/or Bowin Power employees as designated by the Shift Supervisor will be performing security functions.

3.9.2 Only authorized persons will be allowed on site.

3.10 ESTABLISH ON-SITE TEAMS FOR AROUND THE CLOCK COVERAGE

During the crisis, management employees will supervise and co-ordinate around-the-clock teams through the unstable and transition periods. This surveillance will continue until conditions stabilize and there is no further danger to personnel or equipment.

APPENDIX D2

EMERGENCY RESPONSE PLAN FOR CIE (CHONBURI INDUSTRIALESTATE)

Draft

Emergency Operation Plan

For Chon Buri Industrial Estate (Bo Win)

รับรองสำเนาถูกต้อง
CERTIFIED CORRECT TRANSLATION
สุขุมา สรรพุนทอง
SUKUMA SORNSUNTHONG
14 SEP 1995

Draft

Emergency Operation Plan
In case of Accident in Chon Buri Industrial Estate (Bo Win)

This emergency operation plan will be implemented as an action plan by every employee when fire breaks out or other accidents occur to property, buildings, office of the industrial estate as well as areas outside factory buildings which are under the responsibility of Chon Buri Industrial Estate (Bo Win).

1. Objectives

Objectives of the emergency operation plan are as follows:

1.1 to stop the accident to reduce casualties to lives and community to the least

1.2 to prevent damage to property and equipment to the least

1.3 to be a guideline and action plan when an accident takes place in the industrial estate specifying role and responsibilities of every organization involved directly or indirectly in the accident

1.4 to be a guideline for an exercise to cope with an actual situation which may occur in order to equip the staff and responsible persons with expertise and correct weak points

1.5 to be a principle to coordinate with other organizations to put an end to the accident.

2. Scope

This operation plan has been mapped out for implementation in Chon Buri Industrial Estate (Bo Win) only which may be corrected or adjusted to situation and time as deemed appropriate by the industrial estate.

The following 4 areas under its responsibility:

2.1 General Industrial Zone (GIZ)

2.2 Export Processing Zone (EPZ)

2.3 Commercial Area

2.4 Residential Area

3. Definition

"Emergency Condition" refers to a dangerous or risky condition which may cause danger to persons, property or environment. In other words, it refers to an uncontrollable situation which may cause injury or casualties to lives and/or damage to property and/or affect environment.

4. Controlling an Emergency Condition

To quickly and effectively control or react to an emergency situation in Chon Buri Industrial Estate (Bo Win), Operation and Maintenance Manager has been appointed to be responsible to control and give command to control the emergency situation.

Emergency condition can be divided into three levels as follows:

4.1 Potential Emergency Condition

Referring to a situation in which the factory/organization where an accident takes place can control by itself with its own equipment and prevent it from spreading to nearby factories or areas.

4.2 Limited Emergency Condition

Referring to a situation which the factory/organization where an accident takes place feels that it cannot control the situation by itself and the accident may spread to nearby areas and it's necessary to ask for assistance from the industrial estate or nearby factories.

4.3 Full Emergency Condition

Referring to a situation which the factory/organization where an accident takes place and Operation Manager feel that it's serious and cannot control the situation with equipment available in the industrial estate and it's necessary to ask for assistance from the Civil Accident Suppression Command and other organizations. A provincial emergency command has to be set up to prevent and alleviate the situation.

5. Vehicles and Equipment to cope with emergency situation

Vehicles and equipment shall be kept in good and workable condition at the industrial estate's fire unit.

6. Emergency Operation Units

In order to effectively control emergency conditions, men will be on duty 24 hours a day. Five emergency operation units are as follows:

6.1 Fire Control Unit
6.2 Information Unit
6.3 Communication and Coordination Unit
6.4 Security and Traffic Unit
6.5 Rescue Unit

7. Position and Duties of Emergency Team

7.1 Emergency Control Director that's Operation Manager, is the highest commander to make decision and order.

7.2 Emergency Coordinator is an assistant to the Emergency Control Director giving technical advise and coordination to the Director to control the situation or being asked to be responsible for a specific assignment.

7.3 Emergency Controller is the person who orders to take action to cope with the emergency situation:

- Security chief
- representative of factory where the accident takes place
- assignee

7.4 Emergency Response Team is a group of persons under the command of the Operation and Maintenance Manager who receive command from the emergency controller.

8. Preliminary Action Plan in Emergency Situation

8.1 Control

Prevent or reduce the cause of the emergency.

8.2 Damage Control

Prevent or control the level of damage, for example, in case of fire and it's expected to spread to a nearby factory, spray water to put out the fire.

8.3 Rescue

Check whether anyone is trapped in the accident. Count the number of employees in each department immediately and rescue those who are trapped in the accident.

8.4 First Aid

Provide first aid to the injured at a safest place. If it's possible to move the injured to a specified safe place, move them immediately. If not, provide the first aid at a safest place possible.

8.5 Transfer of Emergency Operation

In case a staff member is in the accident, when Operation Manager or Supervisor arrives the spot, the staff member shall transfer the operation command to his superior to take charge of the emergency situation by briefing the following:

8.5.1 the current incident, location and situation
8.5.2 details of the injured and persons who are trapped in the incident
8.5.3 emergency operation in action
8.5.4 location of the emergency team
8.5.5 other significant information

(See sample of emergency report to transfer emergency operation in the appendix)

9. Establishing an Emergency Command

An emergency command shall be set up at the industrial estate's fire station. The emergency command shall be equipped with communication equipment such as telephone, transceivers, and chart showing the location of fire engines, temporary infirmary, ambulances, pit hydrants, map of the industrial estate and map of the province and outlying areas with ability to communicate to coordinate with external organizations with the provincial governor is the commander.

10. Joint Operation with Factories in the Industrial Estate

In case the factory/area of the accident cannot control the situation and asks for assistance from the industrial estate's office, Operation Manager or an authorized person will assess the situation whether the situation can be put under control by the industrial estate. If yes, action shall be taken under the command of Operation Manager. If not, ask for assistance from other factories in the industrial estate.

11. Joint Operation with the Civil Accident Suppression Command

If the Manager feels that the situation cannot put under control, he shall coordinate with the Civil Accident Suppression Command at Tel: 322448 or transceiver at 161.440 MHz coding "Koh Loi". The Civil Accident Suppression Command reports the incident to the provincial governor and asks for assistance from such organizations as police, municipality, hospitals, etc.

After the governor has announced an emergency situation, the Operation Manager shall immediately get everything for emergency operation such as fire station of the industrial estate, temporary infirmary, ambulances. In the initial stage, the said facilities will be set up in the industrial estate. If it's not safe to the operation staff, it shall be the Operation Manager's discretion to give a guideline.

12. Evacuation

If it's not safe to the operation staff in the industrial estate, the Operation Manager may order an evacuation of the staff and other people from the spot to a safe area or windward.

13. First Aid

If someone is injured, a medical team will move the injured to the temporary infirmary to provide first aid. If it's not possible to move the injured, provide first aid at a nearest safe place.

14. Lifting the Emergency Condition

When the condition is calmed down, the staff in charge will consider lifting the emergency condition and reports to his superior to reconfirm the decision. After careful consideration, he will report the lifting of the emergency condition to the chief or Operation Manager to make announcement of the lifting on transceivers or broadcast.

15. Public Relations and News Release

Chon Buri Industrial Estate (Bo Win) has authorized the following persons to give news release to reporters, mass media and outsiders:

15.1 Operation Manager

15.2 Assistant Operation Manager

Other staff members can provide information to outsiders after conclusion of the situation.

When an accident takes place, local reporters will usually arrive at the scene in 30 minutes, a coordinator shall lead them to a press conference room and a supervisory officer shall take care of the media representatives until a person who can release news arrives.

16. Direction of Press Conference

Choose appropriate time to have a press conference. For example, the emergency incident takes place for more than 12 hours, a press release should be held every 4 hours. If the situation can be put under control within 12 hours, two press conferences may be held. Specify a person who drafts the press release before sending it to the Operation Manager.

16.1 No staff shall give any information to media representatives

16.2 Information to be released must be "truth" about

16.2.1 cause of the accident

16.2.2 efficiency to problem solution

16.2.3 time taken to control the situation

16.2.4 cooperation required from mass media

16.2.5 the first press conference should be held some 30 minutes after media representatives have arrived the scene, and the second conference when there is sufficient information.

16.2.6 in case of injury or death, details of casualties, injury or death shall not be given to the media unless their families are informed.

17. Reporting and Investigating

Investigation for the actual cause of the accident may be done by a few organizations, both internal and external, as follows:

17.1 External organization such as police investigators, National Safety Council of Thailand, Office of the Prime Minister or Office of Environmental Policy and Planning, Science, Technology and Energy Ministry.

17.2 Internal organization such as a summary report of the Industrial Estate Office and a report of the factory where the accident occurs.

18. Training

Training to cope with the emergency situation shall be as follows:

18.1 Firemen

Staff who are designated as firemen shall receive theoretical and practical training every three months covering a theory of ignition, fire extinguishing, fire chemicals, fire fighting plan and techniques, how to use fire equipment and personal protection equipment, etc.

18.2 Fire Volunteers

Fire volunteers are staff or workers who learn the theory of ignition, fire extinguishing equipment installed at the industrial estate office. Fire volunteers will reinforce firemen and receive training every six months.

18.3 Back-up Team

Other staff members apart from those with specific duties in 18.1 and 18.2 shall be in the back-up team and receive training once a year on the theory of ignition, fire extinguishing equipment, especially portable fire extinguishers.

18.4 Rescue Team

Some staff members in the Operation Department will be assigned as rescue team and they have to learn how to move the injured and how to provide first aid and receiving training once a year, both theoretically and practically.

19. Duties and Responsibilities of the Staff

In order to have regular exercise and ready to cope with the emergency situation, Chon Buri Industrial Estate (Bo Win) has designated the following persons:

19.1 Operation Manager

19.1.1 Before the Emergency Situation

19.1.1.1 mapping out policy and direction for safety and control of emergency condition.

19.1.1.2 setting up a safety and emergency control organization with the existing staff

19.1.1.3 organizing emergency control exercise at least twice a year

19.1.1.4 auditing readiness of the emergency control plan at least once a year

19.1.1.5 updating information on chemicals and safety at the Safety Information Center on a monthly basis

19.1.2 During the Emergency Situation

19.1.2.1 directing the emergency control activities at the Emergency Operation Center, monitoring operation of every units. If a team leader is found to make a wrongful order which may expand the situation, the Operation Manager shall withhold the order immediately. But it the operation teams work well, the Operation Manager shall support them in terms of manpower, materials and other facilities.

19.1.2.2 assessing the situation and reporting it to his superior

19.1.2.3 giving the first press conference to mass media

19.1.2.4 coordinating with the provincial administration or other related organizations as well as other factories and private organizations.

19.1.3 After the Emergency Situation

19.1.3.1 giving another press conference to mass media

19.1.3.2 examining the scene

19.1.3.3 visiting people affected by the accident

19.1.3.4 preparing an accident report (form in the appendix) to submit to the fact finding committee in case of an accident in the industrial estate.

19.2 Every Supervisor

19.2.1 Before the Emergency Situation

19.2.1.1 arranging for exercise in line with the emergency control plan

19.2.1.2 testing the accident prevention system as well as equipment

19.2.2 During the Emergency Situation

19.2.2.1 controlling the operation team

19.2.2.2 providing supporting manpower and equipment

19.2.2.3 reporting the situation to the Operation Manager periodically

19.2.2.4 final inspection upon receiving a request to lift the emergency situation from an operation worker to propose to the Operation Manager

19.2.3 After the Emergency Situation

19.2.3.1 controlling the situation and investigating the cause

19.2.3.2 preparing a report of investigation to the Operation Manager

19.2.3.3 checking fire fighting equipment used in the operation and replacing it

19.2.3.4 providing food and drinks for operation staff

19.2.3.5 providing general facilities

19.2.3.6 others

Note: The Operation Manager is the supreme commander in controlling the emergency situation.

Emergency Plan when the Industrial Estate Office/Utility Control Building is on Fire

Step 1: Initial fire fighting

1. When a fire is detected, press an fire alarm button

2. Try to extinguish fire with fire chemicals until others come to assist.

Step 2: When a fire alarm sounds

1. Detect where the fire starts, inform a communication officer or radio officer to relay the message to responsible people.

2. Try to extinguish fire with fire chemicals. If fire is not put out, withdraw from the scene immediately.

3. Evacuate people not related to fire fighting operation from the building except communication and responsible officers who can withdraw only at his superior's or Operation Manager's order.

Step 3: Responsible people have the following duties

1. Operation Manager or his assignee has a duty to issue order.

2. Operation Manger's assignee shall act as a team leader to control the emergency situation immediately.

3. Emergency operation team and back-up team shall act as follows:

3.1 staff who knows the office building electricity system shall cut electric supply to the office building.

3.2 Utility staff who knows the water supply system shall be positioned at a pit hydrant ready to supply water.

3.3 fire engines with firemen shall rush to the scene ready to operate.

3.4 firemen shall start operation immediately when there is an order.

3.5 Security chiefs shall control entry of people at security checkpoints. Security guards are positioned in their responsible areas and ready to bring out fire hose when there is an order.

3.6 Back-up team is ready to provide assistance, first aid and move the injured.

3.7 Ask for assistance from other factories in the industrial estate if the situation intensifies to Level 2 or 3.

Emergency Operation Unit

1. Fire Control Unit

The fire control unit has a duty to rescue, control and prevent fire expansion under the command of the emergency operation director or an assignee. Command and communication will be on 140.75 MHz and a runner as a messenger. The fire chief shall wear a white helmet while on duty.

Responsible Person

Mr. Preecha Varasai, Fire Fighting Unit Chief
Telephone (Emergency) 345234

2. Information Unit

The information unit has a duty to get information on chemicals and factory safety ready in the computer along with document files of the factory/area where the accident takes place in order to report to the Operation Manager or other supervisors.

Responsible Person

Mr. Kopong Sripawathakul, Information Unit Chief
Telephone (Emergency) 345234

3. Communication and Coordination Unit

The unit has a duty of coordinating the factory/area where the accident occurs with assistance or operation units and periodically report it to the Operation Manager or other relevant supervisors.

Emergency Communication Equipment

1. Radio communication at 140.75 MHz
2. Telephone No. 345234
3. Mobile Phone No. -

Responsible Person

Mr. Sanong Changnil, Communication and Coordination Unit Chief
Telephone (Emergency) 345240

4. Security and Traffic Unit

The unit has a duty to provide security in the industrial estate, preventing people not related to the accident from entering the scene, and facilitating traffic flow for fire engines and ambulances, etc.

Responsible Person

Mr. Chaiyan Suramitmaitri, Security and Traffic Unit Chief
Telephone (Emergency) 345219, and Radio Communication at 165.15 MHz

5. Nursing Unit

The unit has a duty to prepare a temporary infirmary and an ambulance to take the injured to a hospital. (The staff in this unit has to be trained for first aid and moving of the injured, etc.)

Responsible Person

Mr. Suriya Wanthip, Nursing Unit Chief
Telephone (Emergency) 345241

List of Persons in the Emergency Operation Unit

Responsible Person	Position	Telephone (Emergency)
1. Mr. Kuldanai Sirisuay	Operation Manager	01-4853029
2. Mr. Sanya Baopoonthong	Assistant Operation Manager	162-109317
3. Mr. Preecha Varasai	Fire Fighting Unit Chief	345234
4. Mr. Kopong Sripawathakul	Information Unit Chief	162-083456
5. Mr. Sanong Changnil	Communication and Coordination Unit Chief	345240
6. Mr. Suriya Wanthip	Nursing Unit Chief	345241
7. Mr. Chaiyan Suramitmaitri	Security and Traffic Unit Chief	345145, 345219
		165.15 MHz

Emergency Plan in case of Fire in a Factory

Step 1

1. When fire breaks out in a factory in the industrial estate and the factory cannot control it, notify the responsible person and the industrial estate office immediately.

2. Try to put out the fire with available fire fighting equipment while waiting for assistance from others.

Step 2

1. Communication officer upon receiving the notice from the factory shall immediately inform the responsible person.

2. The responsible person shall have the following duties:

2.1 Operation Manager or his assignee shall take the supreme command of the operation.

2.2 The Operation Manager's assignee shall act as the leader in the operation unit.

2.3 Emergency operation team and back-up team shall act as follows:

2.3.1 coordinate with security guards to know exactly where the accident takes place and other significant data such as nearest pit hydrants, chemicals, explosives which may be dangerous to firemen in operation, etc.

2.3.2 evacuate persons not involved in the operation to a safe place

2.3.3 fire engines with firemen shall rush to the scene ready to operate.

2.3.4 security guards shall control people passing in and out of the scene and come into assistance where there is an order.

2.3.5 Back-up team is ready to provide assistance, first aid and move the injured.

2.3.6 Ask for assistance from other factories in the industrial estate if the situation intensifies to Level 2 or 3.

Emergency Plan in case of Fire in the Open Space

The open space refers to:

- an area outside factory fence
- an area with no buildings

Step 1

1. When fire breaks out, the person nearest to the scene shall notify communication officer immediately.or inform the responsible person.

2. Try to put out the fire with available fire fighting equipment while waiting for assistance from others.

Step 2

1. Communication officer upon receiving the notice of an accident shall immediately inform the responsible person.

2. The responsible person shall have the following duties:

2.1 Operation Manager or his assignee shall take the supreme command of the operation.

2.2 The Operation Manager's assignee shall act as the leader in the operation unit.

2.3 Emergency operation team and back-up team shall act as follows:

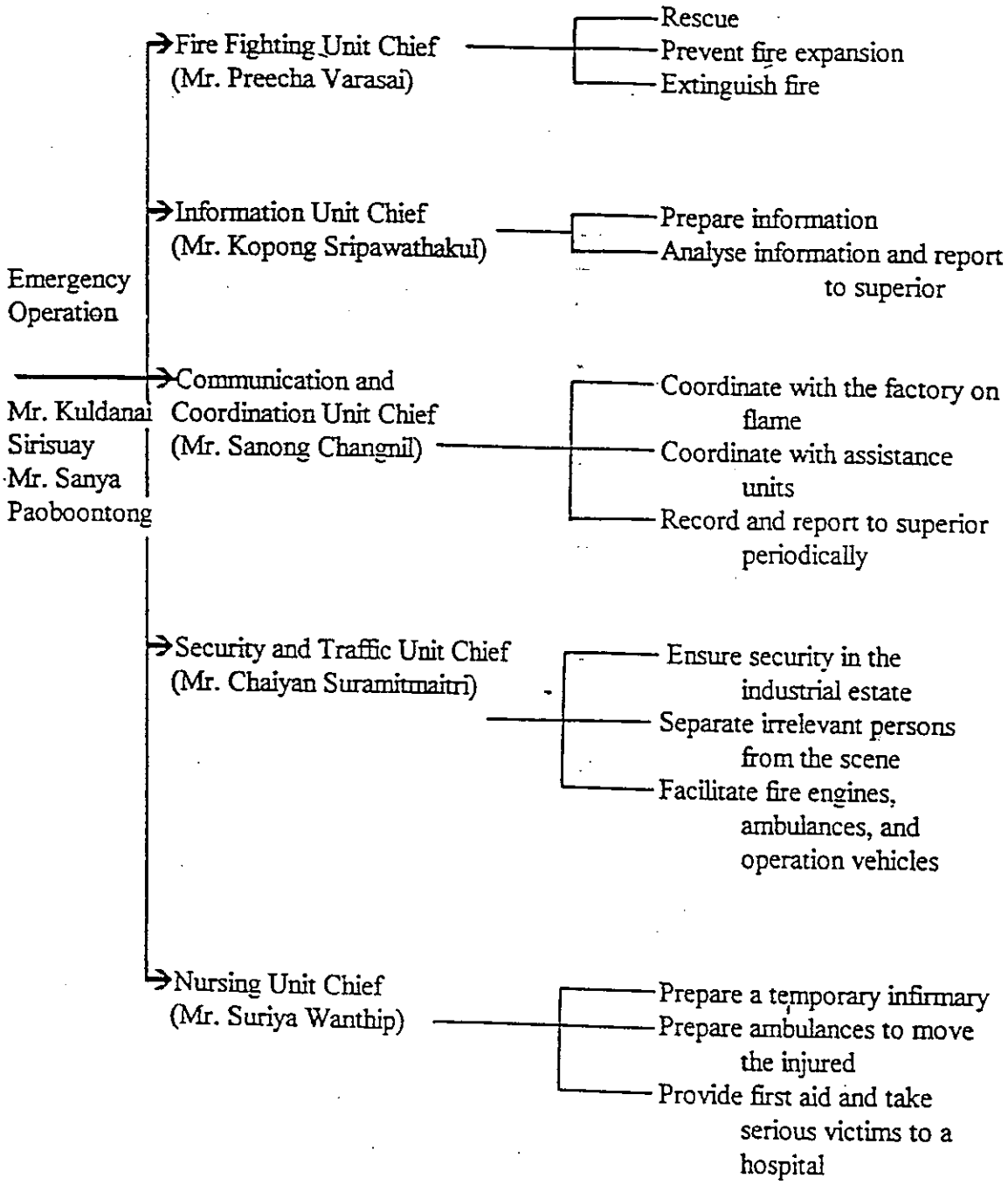
2.3.1 Emergency operation team and back-up team with fire-fighting equipment rush to the scene.

2.3.2 fire engines with firemen shall rush to the scene ready to operate.

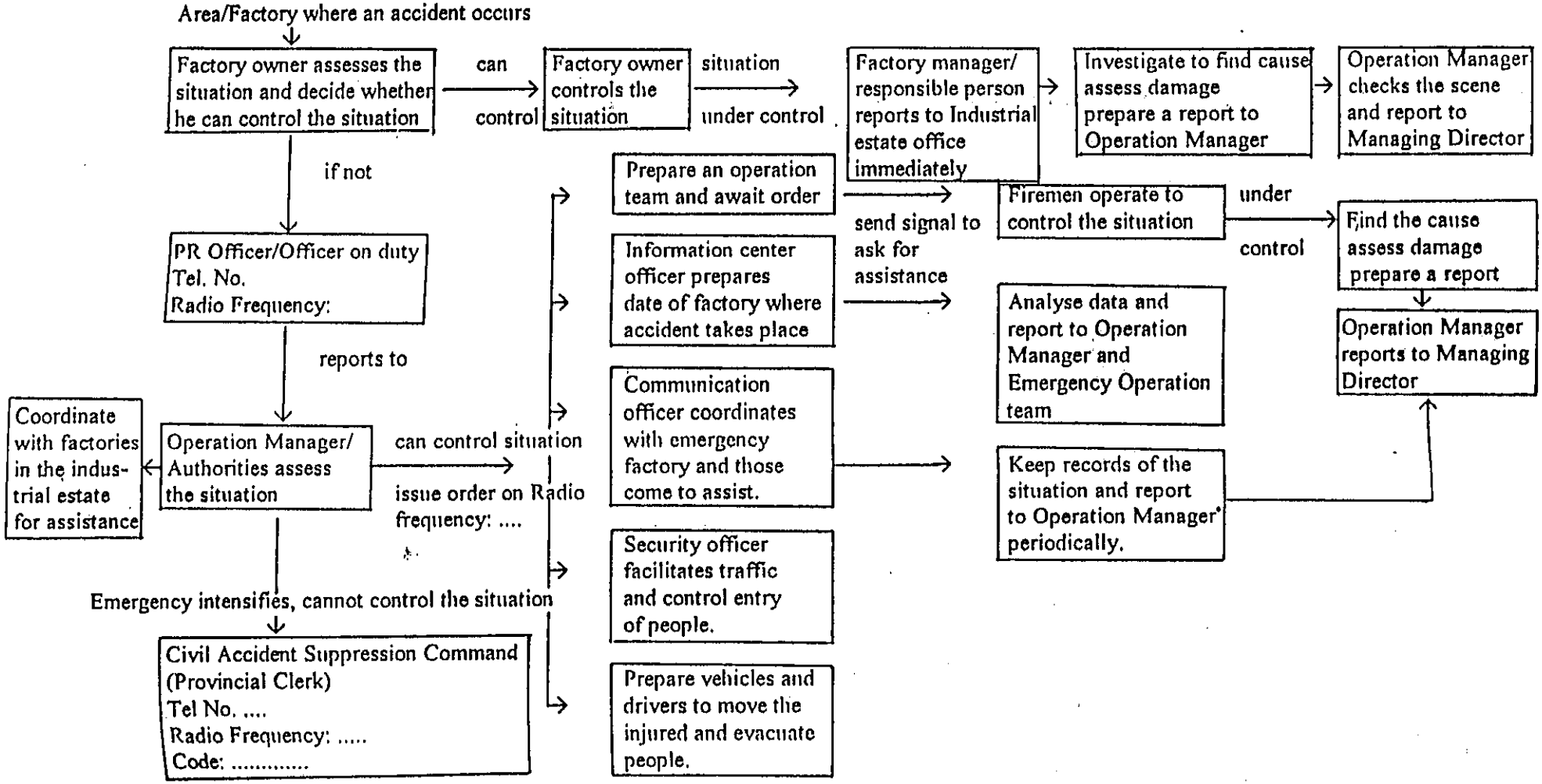
2.3.3 security guards shall control people passing in and out of the scene and come into assistance where there is an order.

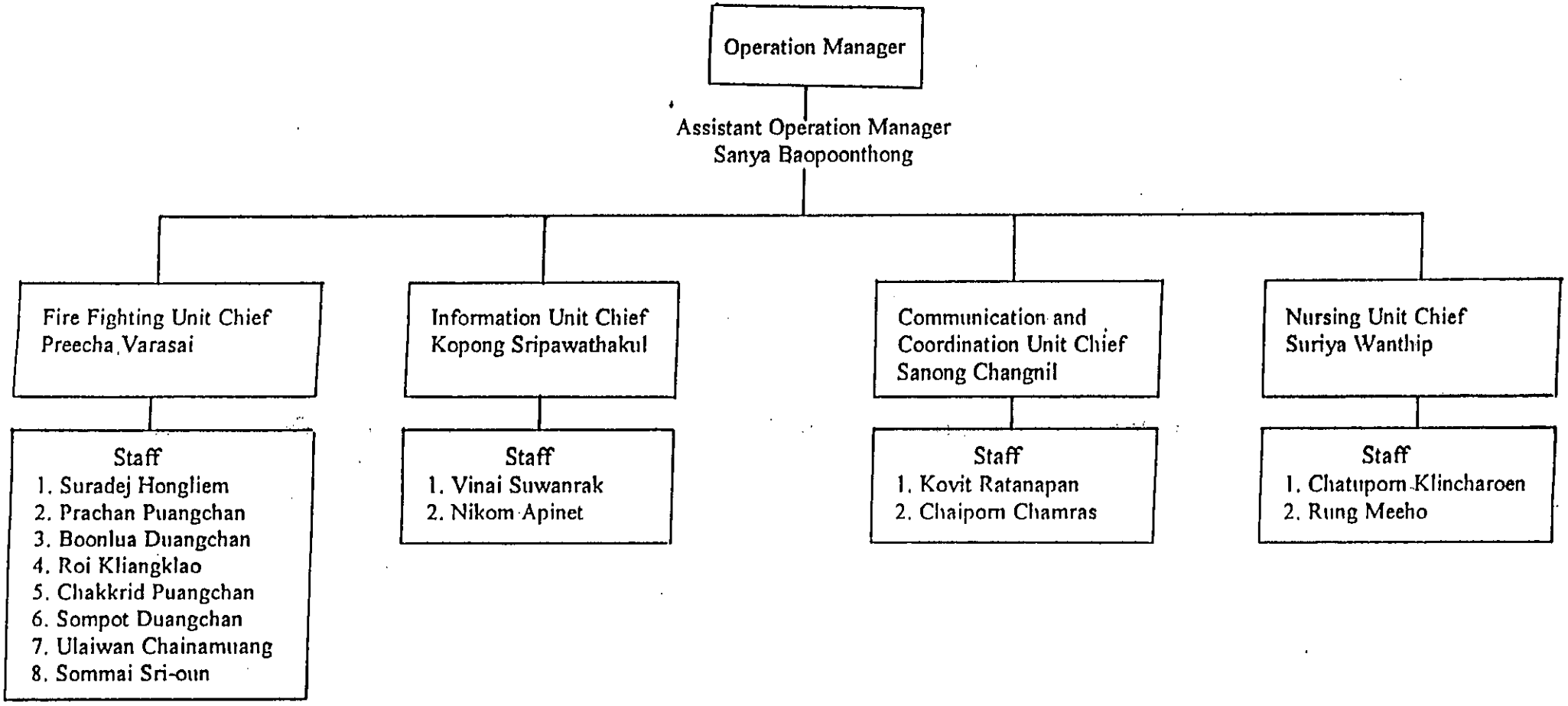
2.3.4 back-up team is ready to provide first aid.

Chart Showing Operation of the Emergency Operation Unit



Operation Procedure in Case of Emergency in Chon Buri Industrial Estate (Bo Win)




Operation Manager
Assistant Operation Manager
Sanya Baopoonthong
Fire Fighting Unit Chief
Preecha Varasai
Staff
1. Suradej Hongliem
2. Prachan Puangchan
3. Boonlua Duangchan
4. Roi Kliangklao
5. Chakkrid Puangchan
6. Sompot Duangchan
7. Ulaiwan Chainamuang
8. Sommai Sri-oun
Information Unit Chief
Kopong Sripawathakul
Staff
1. Vinai Suwanrak
2. Nikom Apinet
Communication and
Coordination Unit Chief
Sanong Changnil
Staff
1. Kovit Ratanapan
2. Chaiporn Chamras
Nursing Unit Chief
Suriya Wanthip
Staff
1. Chatuporn Klincharoen
2. Rung Meeho

Vehicles and Equipment used in the Emergency Operation
Hemaraj Land Development Public Co., Ltd.

Vehicles/Equipment	Details	No. of Units/Volume
Fire engines and fire fighting equipment	- a fire engine loading 4,000 litres of water	1 fire engine/1 tank
	- 10-lb fire extinguishers	one for dry chemical and another one for CO_2
	- AFFF 3% foam	
	- reserve fire water	1 500-litre tank, 1 4,000-litre tank
	- ordinary fire uniform	3 uniforms/1 fire engine
	- 8-12-bar main pump with capacity 3,400 litres/minute	
	- high pressure fire hose of 1 inch in diameter, 30 metres long	pressure of 55 bars
	- fire hose with quick coupling of 2 1/2 inches in diameter, 6 20-metre-long hoses	pressure of 650 lb/sq. inch
	- fire water pipe of 4 inches in diameter, 9 metres long	1 set
	- 20-metre-long dry chemical hose rolled in a set with a valve and nozzle and handle.	2 sets
	- fire water nozzle of 2 1/2 inches in diameter with a valve	2 sets
	- foam nozzle with quick coupling of 2 1/2 inches in diameter and a valve	400 litres/minute
	- water/foam spraying base, water spraying capacity of 60 metres and foam spraying capacity of 55 metres	2,400 litres/minute pressure of 10 bars
	- 2 water nozzles for self protection	capacity: 100 litres/minute
	- 4 undercarriage nozzles	
	- adjustable light post	4.5 metres
	- 3 halogen lamps installed on the post	500 watts
	- turnable search lights installed in front of the fire engine	2 sets
Rescue equipment	- hydraulic cutting tool	1 set, cutting capacity of 4.5 tons, 32 cm. wide blade
	- respirators	2 sets

Data of Fire Stations

Fire Station			
Location	**Distance (KM.)**	**No. of Fire Engines**	**Telephone**
Ao Udom Fire Station	25	2 fire engines 1 water tanker	351111
Si Racha Fire Station	30	9 fire engines 4 water tankers	311666
Laem Chabang Fire Station	30	1 ladder-type fire engine 4 foam-type fire engines 2 water tankers	490554 490199
Bangsaen Fire Station	45	3 fire engines 3 water tankers	381061
Pattaya Fire Station	50	11 fire engines 3 water tankers	221000
PTT Operation 1 (Chon Buri)	60	3 fire engines 1 water tanker	274390-5 ext. 5049-56
Ban Suan Fire Station	65	2 fire engines 1 water tanker	282153

Data of Hospitals

Hospital					
Hospital	Distance (KM.)	Beds for Accident	Beds for Fire Victims	Tele-phone	Ambu-lances
Ao Udom Hospital	20 km.	4 beds	2 beds	351010-1	3
Laem Chabang Memorial	25 km.	5 beds	5 beds	491888	3
Somdej Na Sriracha	30 km.	15 beds	5 beds	311009	3
Krungthep-Pattaya	50 km.	10 beds	10 beds	427751-5	2

Sample of Emergency Report to Transfer Responsibilities

This form is used to record information and check whether the information is correct and accurate.

Date: ..... Time: .....
Receiver: ..... Sender: .....
Place of the Incident: .....
.....
Time of being Notified of the Incident: .....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
Level of Emergency Condition: [ ] Level 1 [ ] Level 2 [ ] Level 3
Activities already done: .....
.....
Medical Assistance Required: .....
No. of Injured Persons: [ ] None [ ] Yes, ... persons
No. of Persons Killed [ ] None [ ] Yes, ... persons
Direction of Wind: .....
Other details: .....
.....
.....

Time: ..... Date: .....
Name of Sender: .....
Telephone: .....

Accident Report

Factory/Company: .....
Type of Business: .....
Location in the industrial estate/port office: .....
Location: .....
Date of Accident: ..... Time: .....
Place of Accident (attach a chart, picture of the scene): .....
.....
.....
.....
.....
Cause of Accident: .....
No. of Injured: ..... persons

Name	Sex	Age	Position	Feature of Injury

Level of Accident:
[ ] Level 1 Potential Emergency Condition
[ ] Level 2 Limited Emergency Condition
[ ] Level 3 Full Emergency Condition

Damage to Property (Specify damaged property): .....
.....
.....
.....
Estimated cost of damage: Baht.....

Signed .....
(.....)
.....Manager/Director

Appendix

- Chart showing pit hydrants in the project

- Chart showing factories in the industrial estate and pit hydrants in the factories

Accident Report

Factory/Company: .....
Type of Business: .....
Location in the industrial estate/port office: .....
Location: .....
Date of Accident: ..... Time: .....
Place of Accident (attach a chart, picture of the scene): .....
.....
.....
.....
.....
Cause of Accident: .....
No. of Injured: ..... persons

Name	Sex	Age	Position	Feature of Injury

Level of Accident:

[ ] Level 1: Potential Emergency Condition
[ ] Level 2: Limited Emergency Condition
[ ] Level 3: Full Emergency Condition

Damage to Property (Specify damaged property): .....
.....
.....
.....
Estimated cost of damage: Baht.....

Signed .....
(.....)
.....Manager/Director

APPENDIX E

EMISSION SOURCES AROUND PROJECT

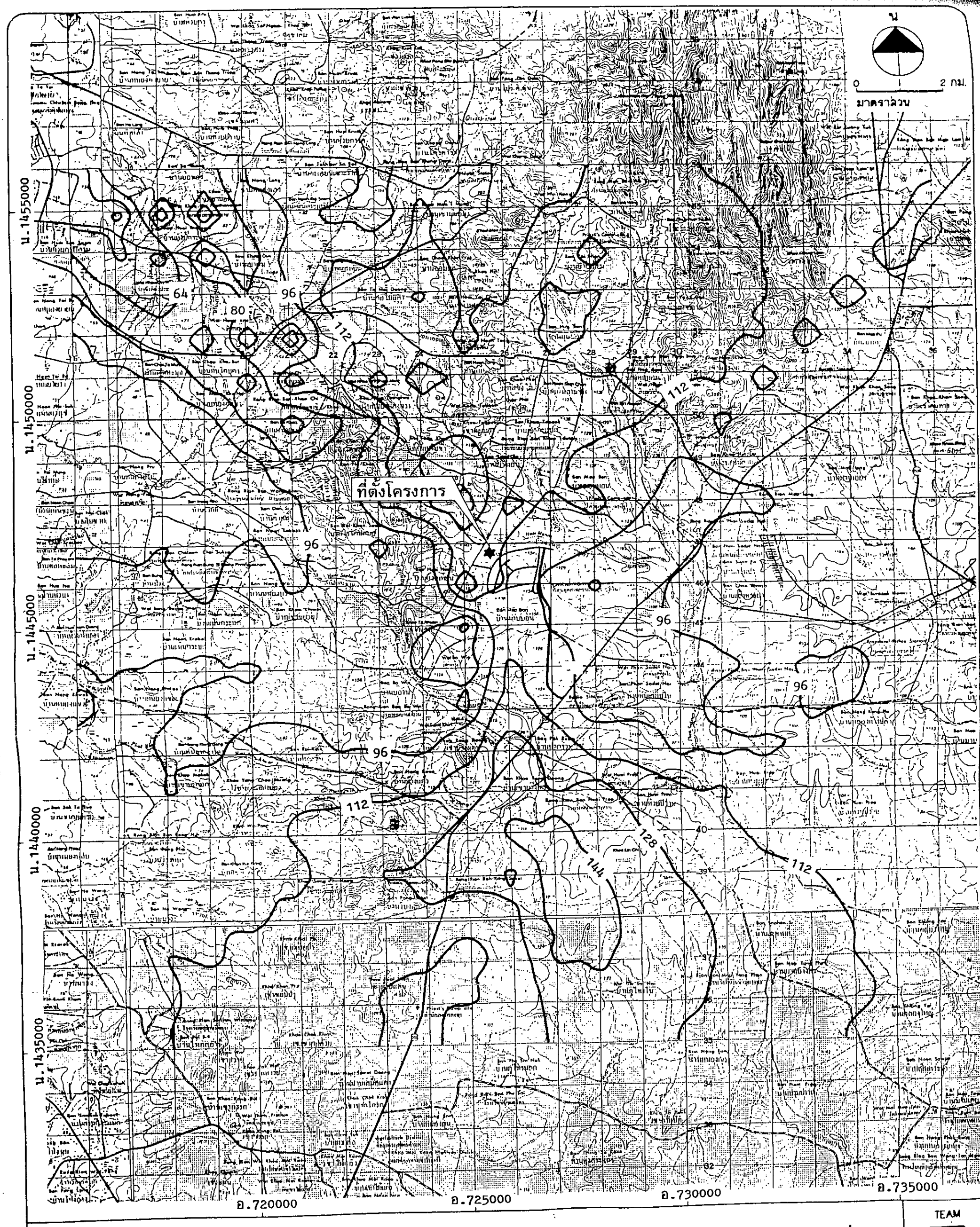
ตารางที่ 8

STACK CHARACTERISTICS AND EMISSION RATES FROM OTHER PLANTS NEARBY

No.	Plant Name	Source Name	Stack Height (m)	Stack Diameter (m)	Exit Temperature (°k)	Exit Velocity (m/s)	TSP g/s	Emission Rate			Coordinate Position		
								NO_X (g/s)	SO_2 (g/s)	CO (g/s)	Y (North)	X (East)	Z (m)
1.	SIAM NISSAN CASTING	Dust collector											
		- UDC - 1264	11.5	2.2	293	13.35	1.087	-	-	-	1446500	725500	128
		- UDC - 1256	11.5	2.4	293	15.1	0.93	-	-	-	1446550	725550	128
		- UDC - 1220	11.5	2.4	293	15.1	0.34	-	-	-	1446500	725950	128
2.	IRON & STEEL PLANT	Melting furnace with bag filter	20	3	500	23.97	83	-	-	-	1444500	726800	121.3
3.	NTS STELL GROUP CO.,LTD.	- EAF & IE Bag-house stack	20	3	376	14.61	3.1	-	-	-	1443500	726800	97.2
		- Melting Building	20	3.5	293	3	0.007	-	-	-	1443600	726500	97.2
4.	Nakhon Thai Strip Mill Co.,Ltd.	- EAF Melting furnace	27	5	360	3.51	7.48	4.092	2.923	20.916	1444000	725200	114.9
		- EAF Melting furnace	27	5	360	3.51	7.48	4.092	2.923	20.916	1443700	725200	114.9
		- RHF	20	2	367	5.39	0.102	9.39	0.012	0.812	1444400	725600	114.9
		- RHF	20	2	367	5.39	0.21	9.39	0.012	0.812	1443900	725700	114.9

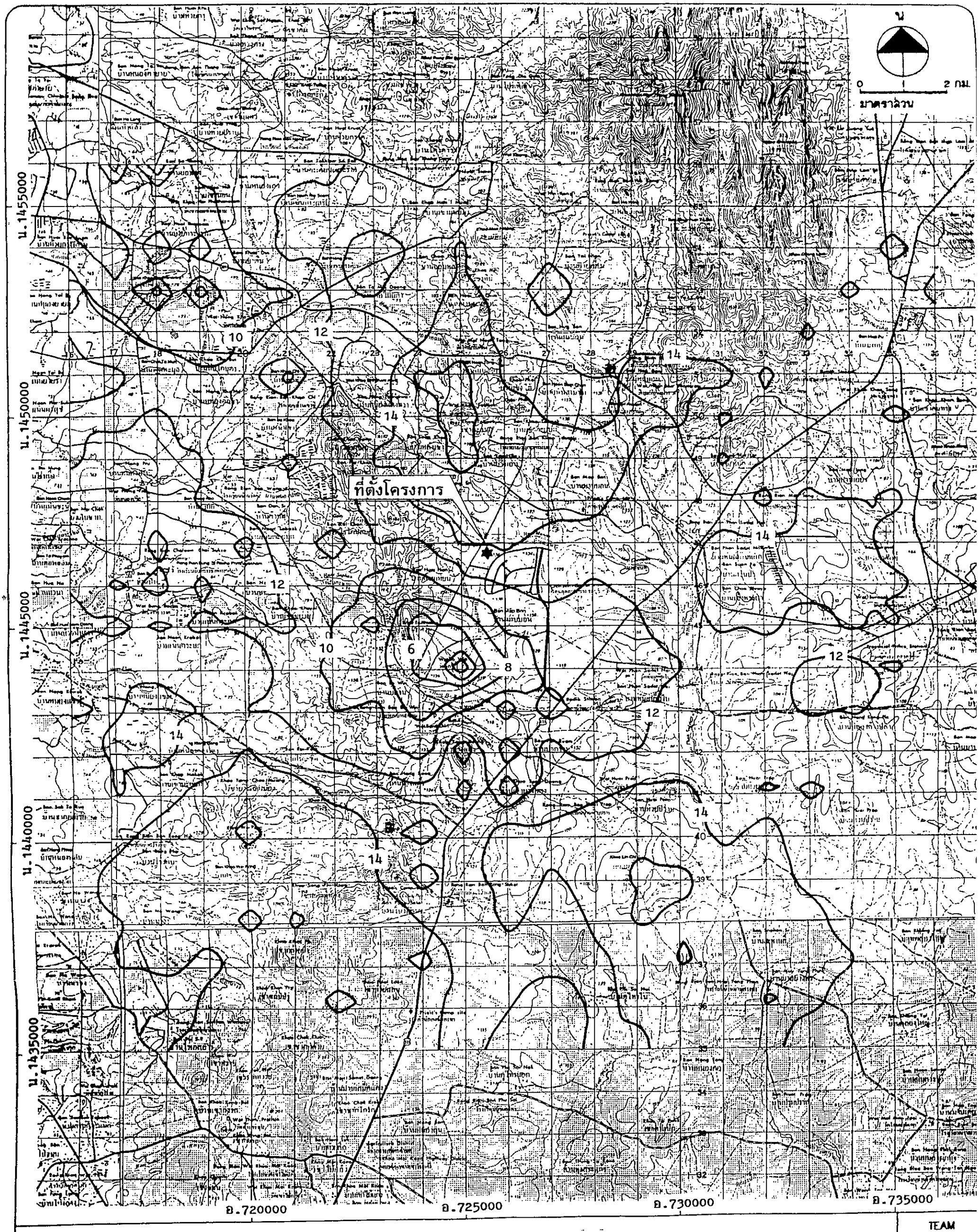
APPENDIX F

ISOPLETH MAP OF EMISSION CONCENTRATION DUE TO THE PROJECT OPERATION



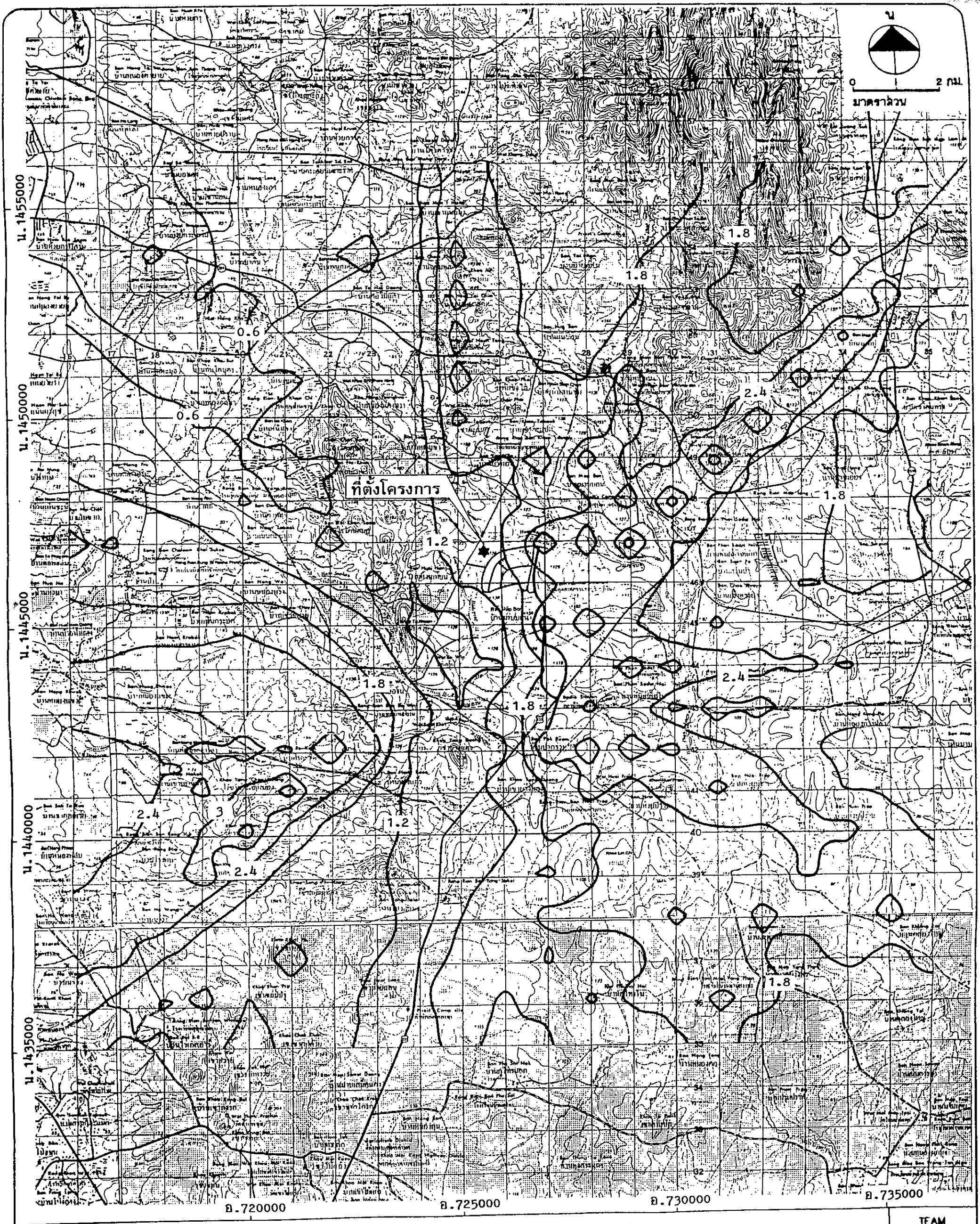
รูปที่ 1 : Isopleth แสดงระดับความเข้มข้นของ NO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสารอื่น ๆ
; มคก./ลบ.ม.

TEAM



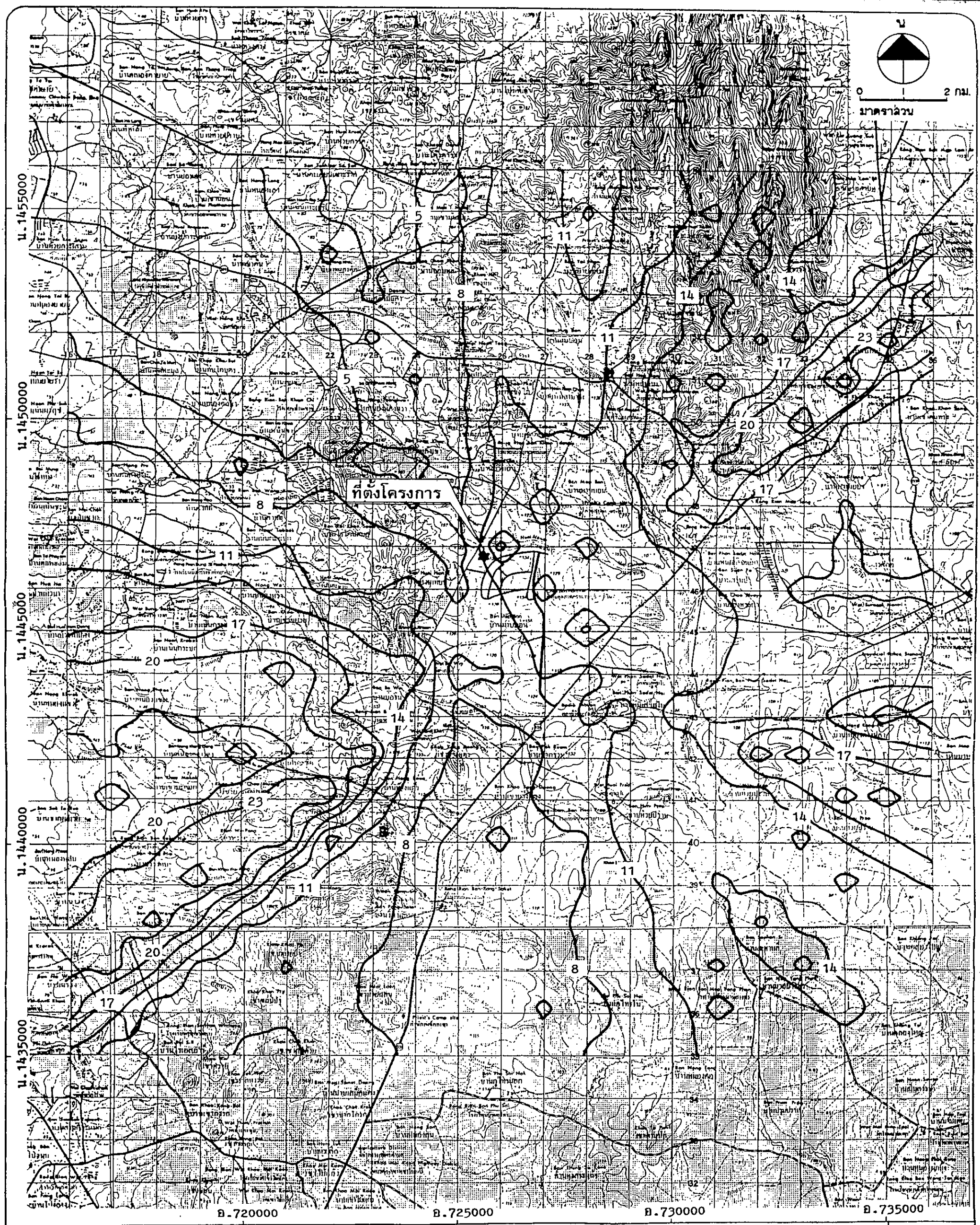
รูปที่ 2 : Isopleth แสดงระดับความเข้มข้นของ SO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสารอื่น ๆ ; มคก./ลบ.ม.

TEAM



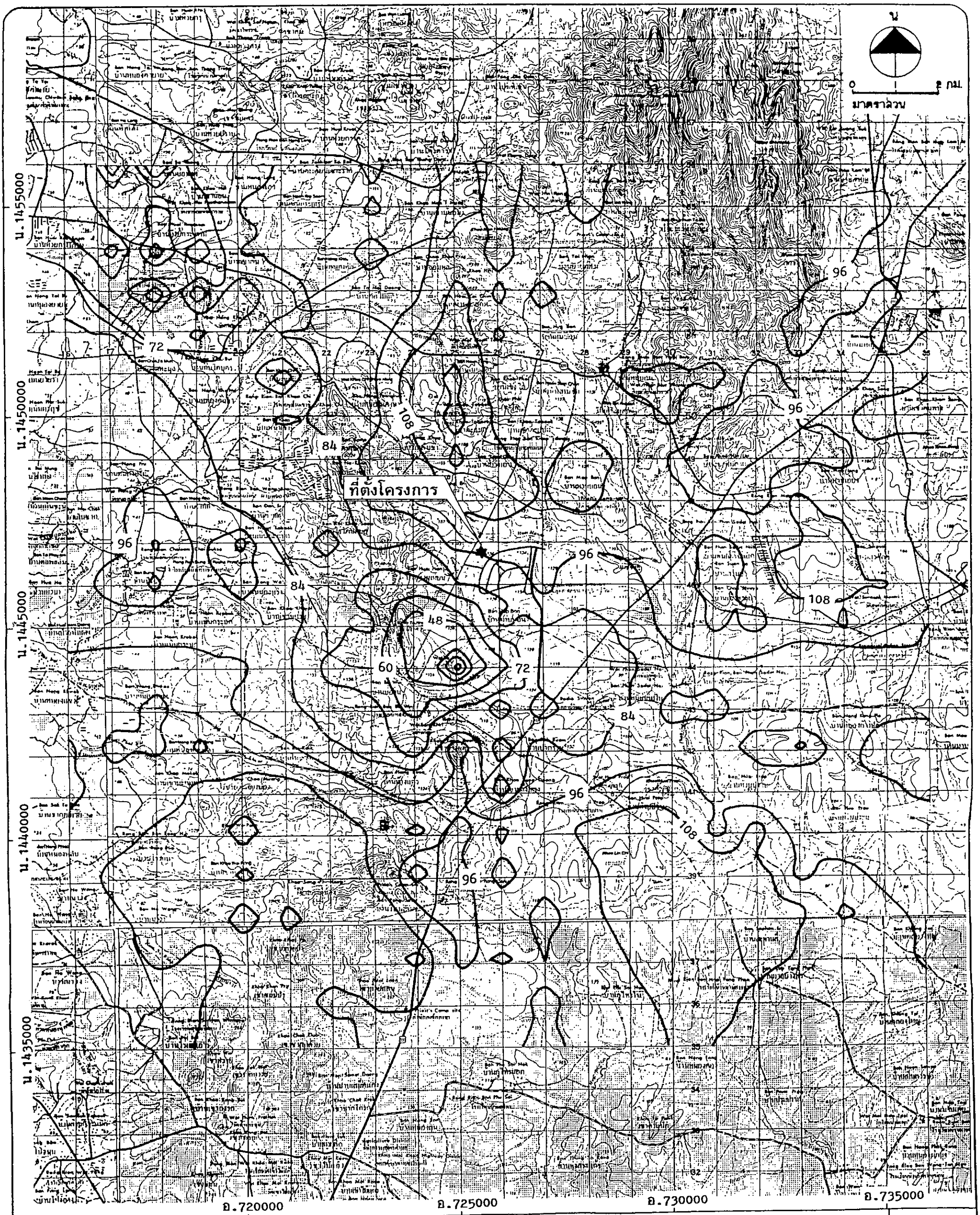
รูปที่ 3 : Isopleth แสดงระดับความเข้มข้นของ SO_2 (เฉลี่ย 24 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสารอื่น ๆ
; มคก./ลบ.ม.

TEAM



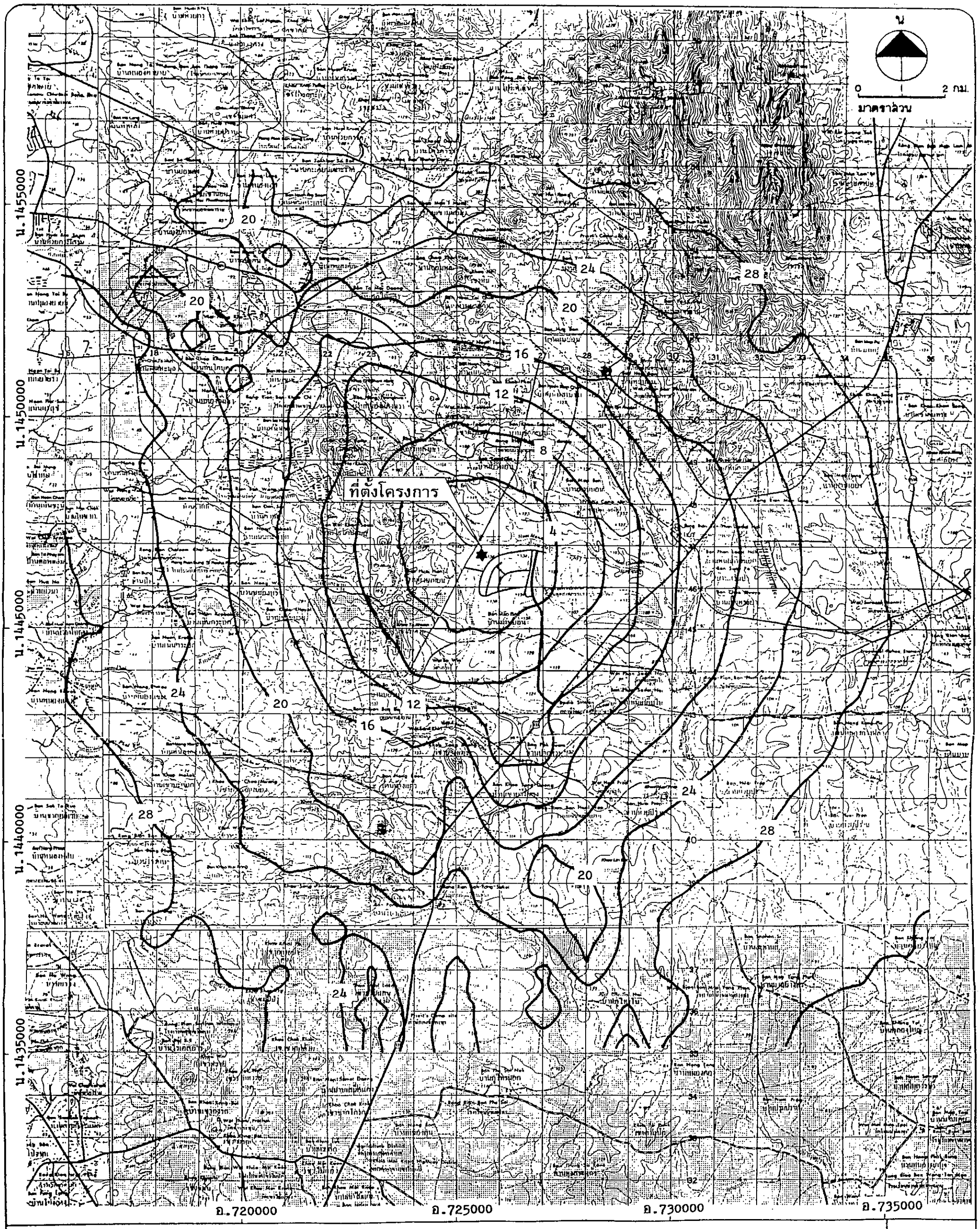
รูปที่ 4 : Isopleth แสดงระดับความเข้มข้นของ TSP (เฉลี่ย 24 ชั่วโมง)ที่เกิดจากแหล่งกำเนิดมลสารอื่น ๆ
; มคก./ลบ.ม.

TEAM



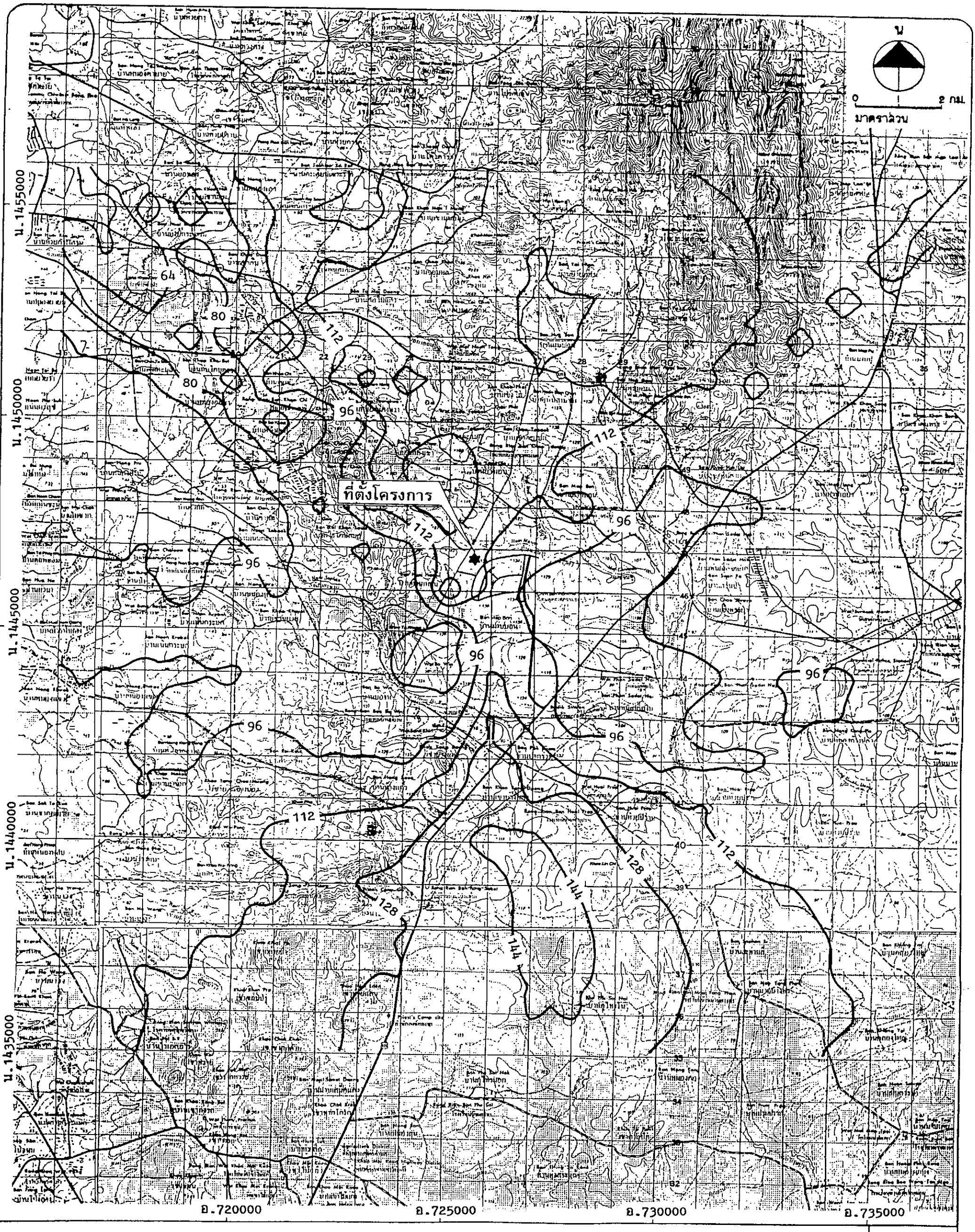
รูปที่ 5 : Isopleth แสดงระดับความเข้มข้นของ CO (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสารอื่น ๆ ; มคก./ลบ.ม.

TEAM



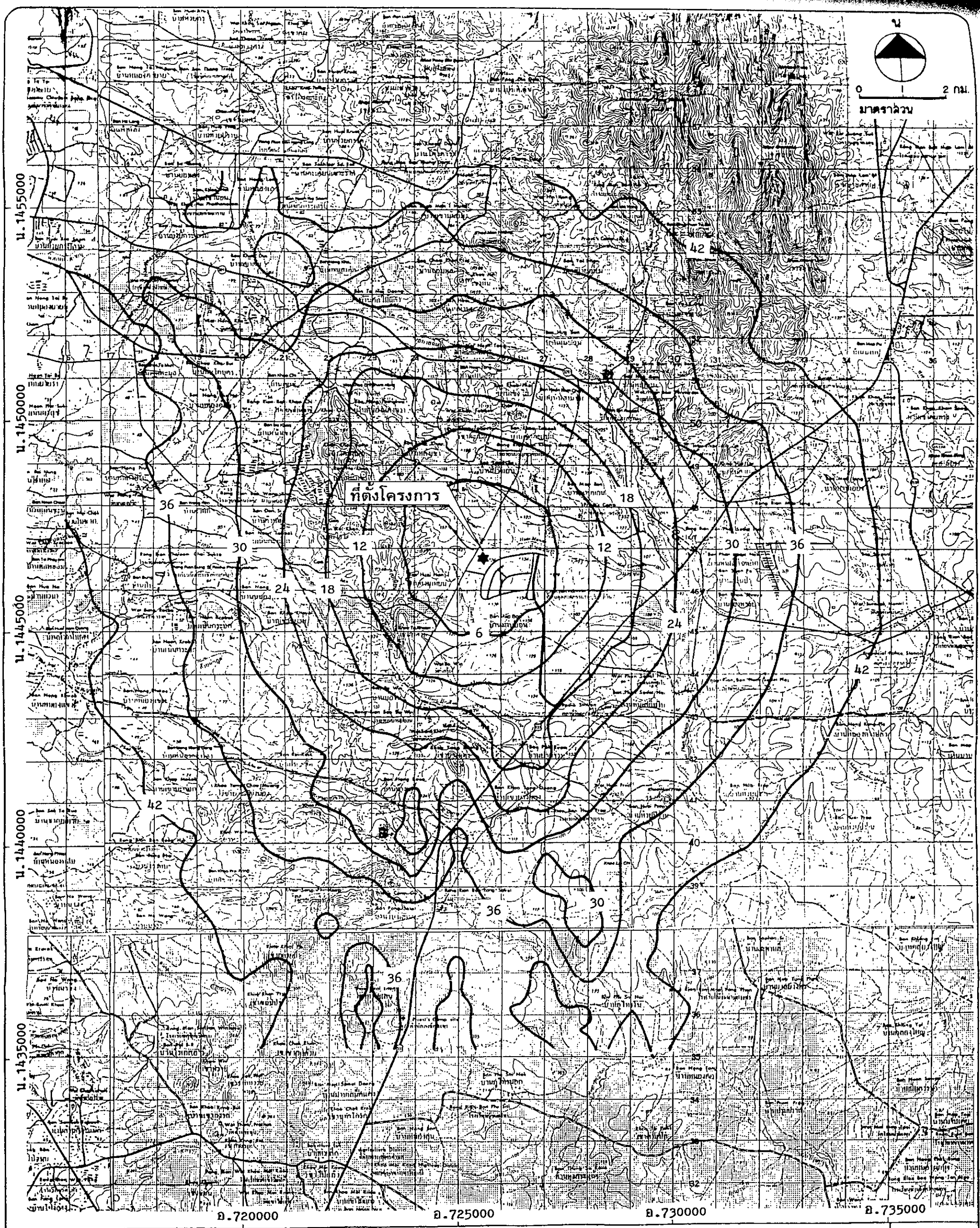
รูปที่ 6 : Isopleth แสดงระดับความเข้มข้นของ NO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่*ใช้ก๊าซธรรมชาติ*เป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



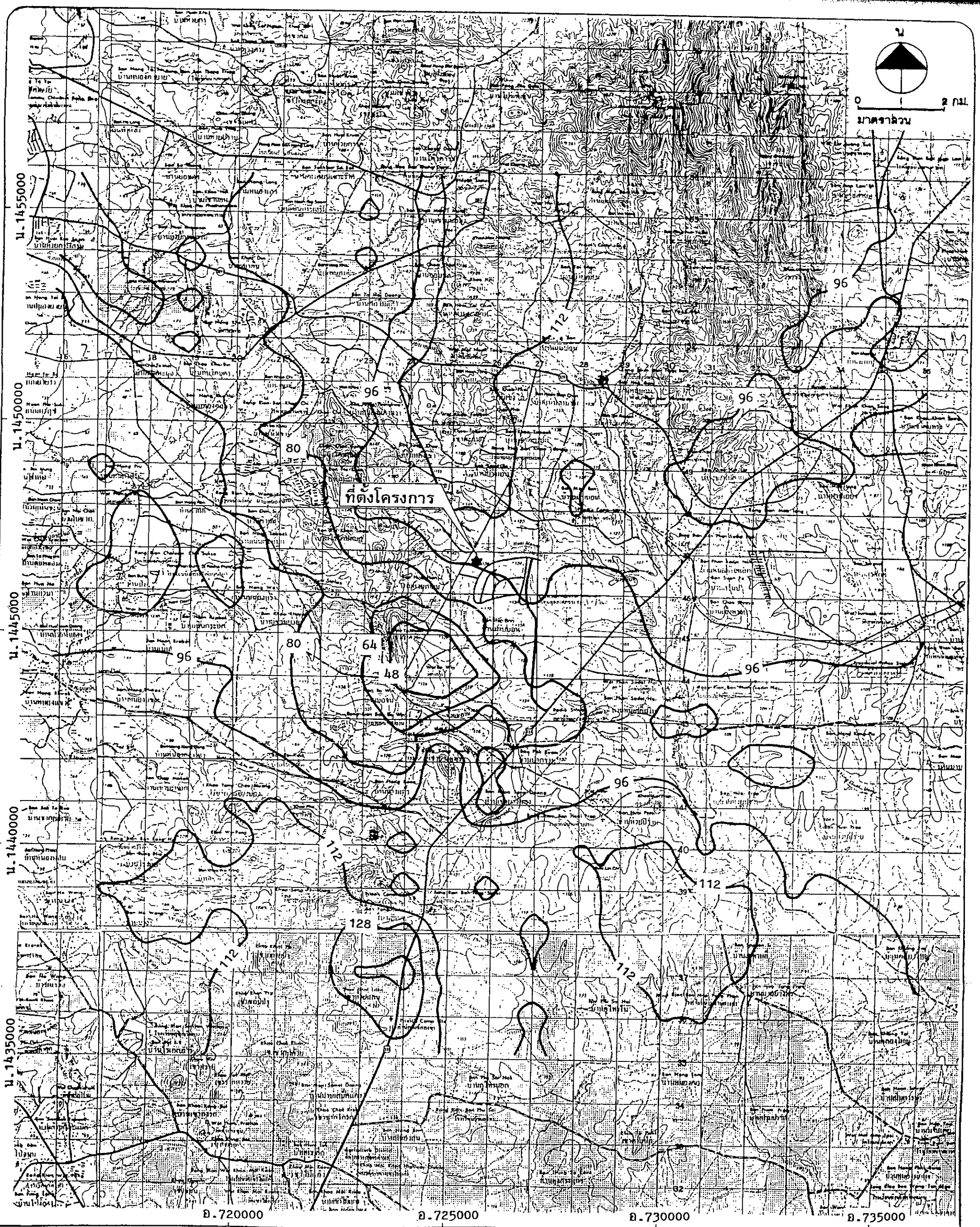
รูปที่ 7 : Isopleth แสดงระดับความเข้มข้นของ NO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆ ในกรณีที่ใช้ก๊าซธรรมชาติเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



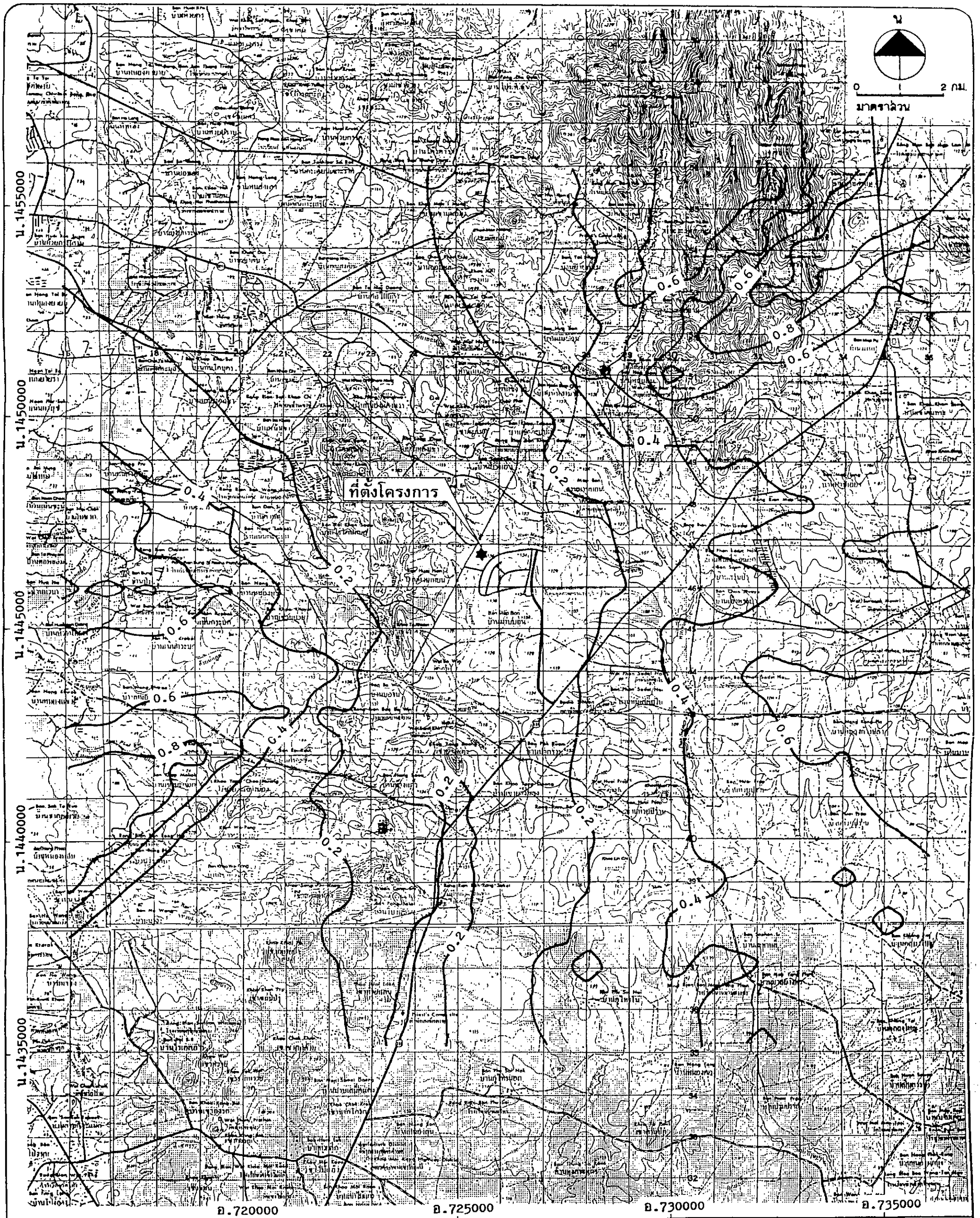
รูปที่ 8 : Isopleth แสดงระดับความเข้มข้นของ CO (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่*ใช้ก๊าซธรรมชาติ*เป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



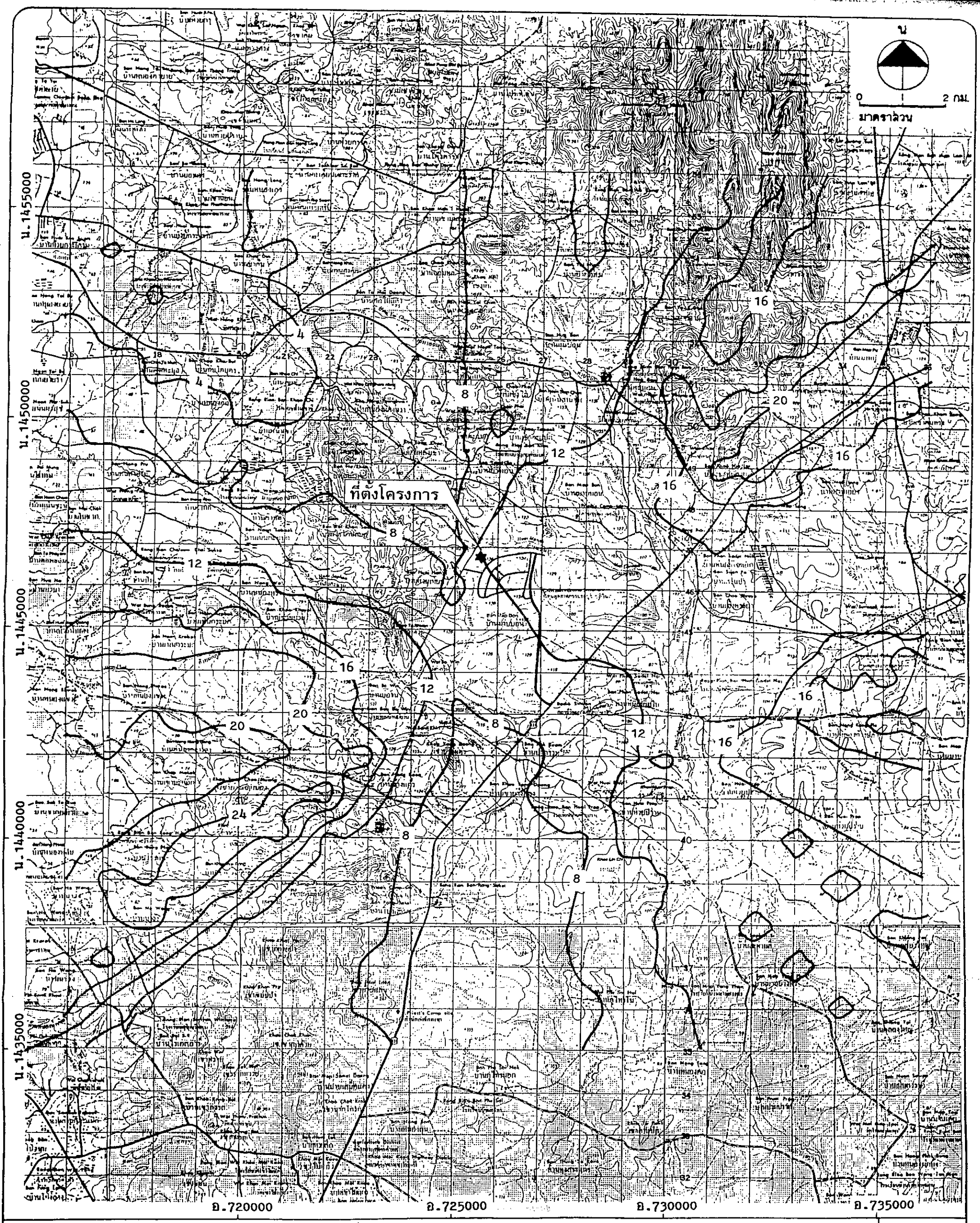
รูปที่ 9 : Isopleth แสดงระดับความเข้มข้นของ CO (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆในกรณีที่*ใช้ก๊าซธรรมชาติ*เป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



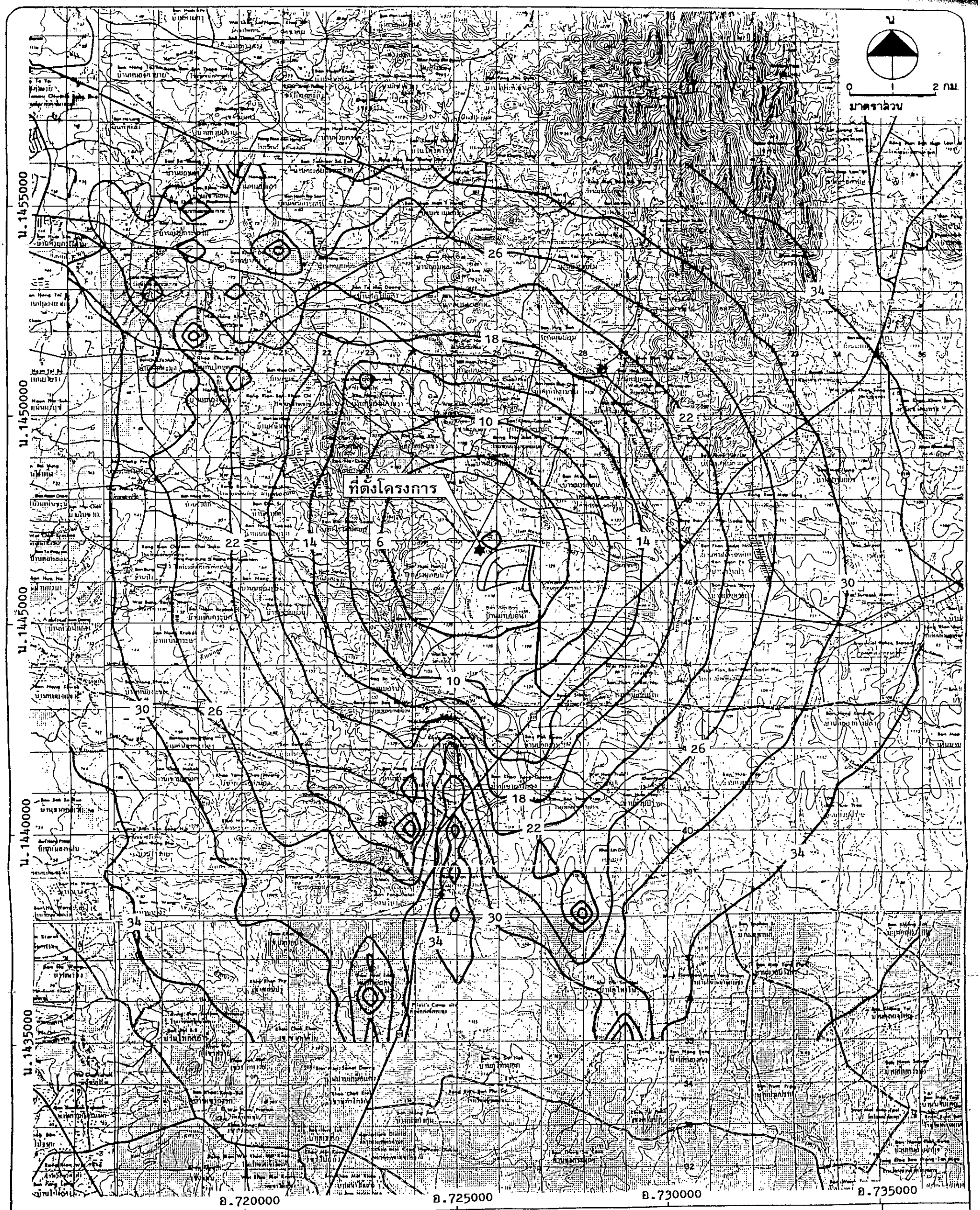
รูปที่ 10 : Isopleth แสดงระดับความเข้มข้นของ TSP (เฉลี่ย 24 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่ใช้ก๊าซธรรมชาติเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



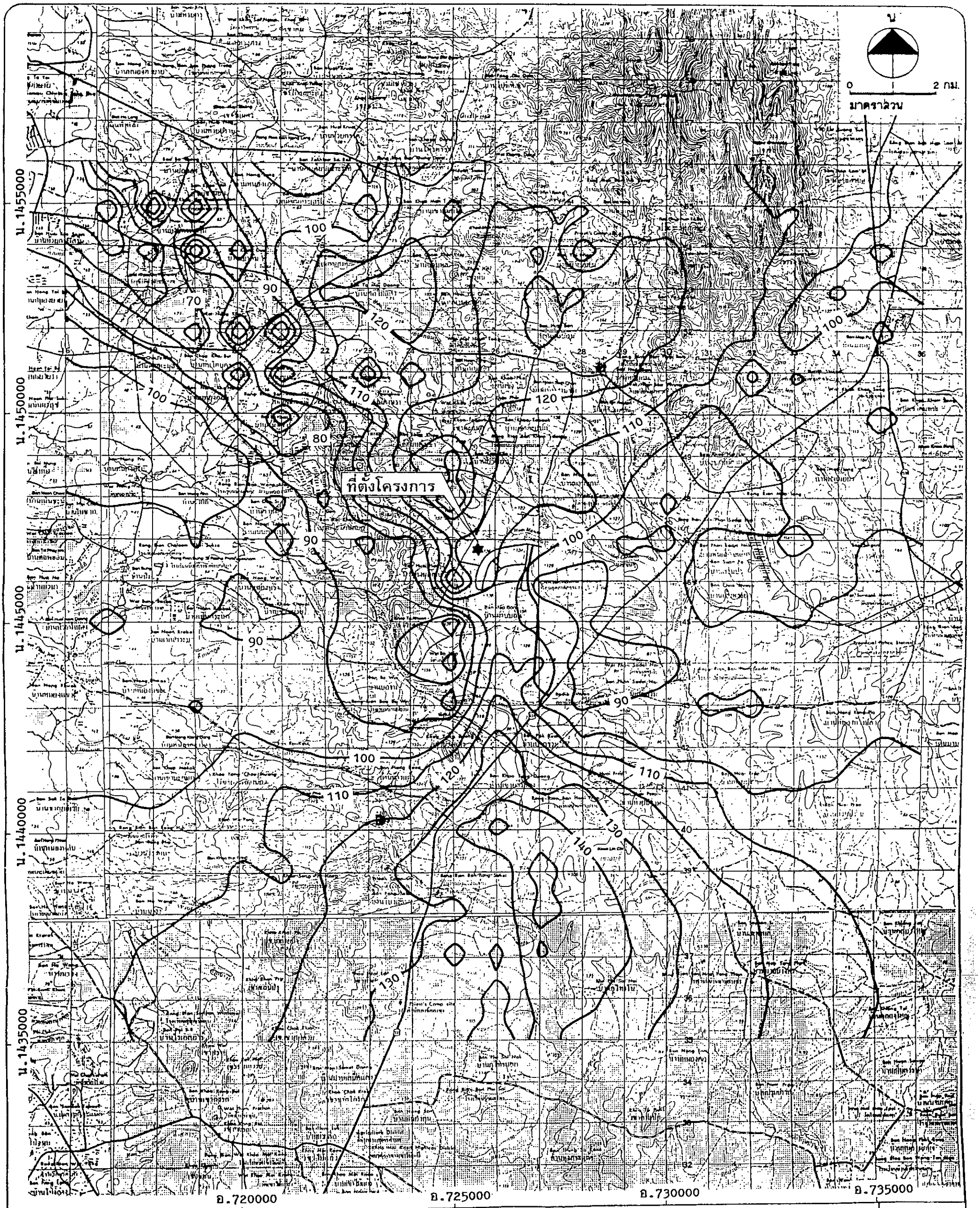
รูปที่ 11 : Isopleth แสดงระดับความเข้มข้นของ TSP (เฉลี่ย 24 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆในกรณีที่*ใช้ก๊าซธรรมชาติ*เป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



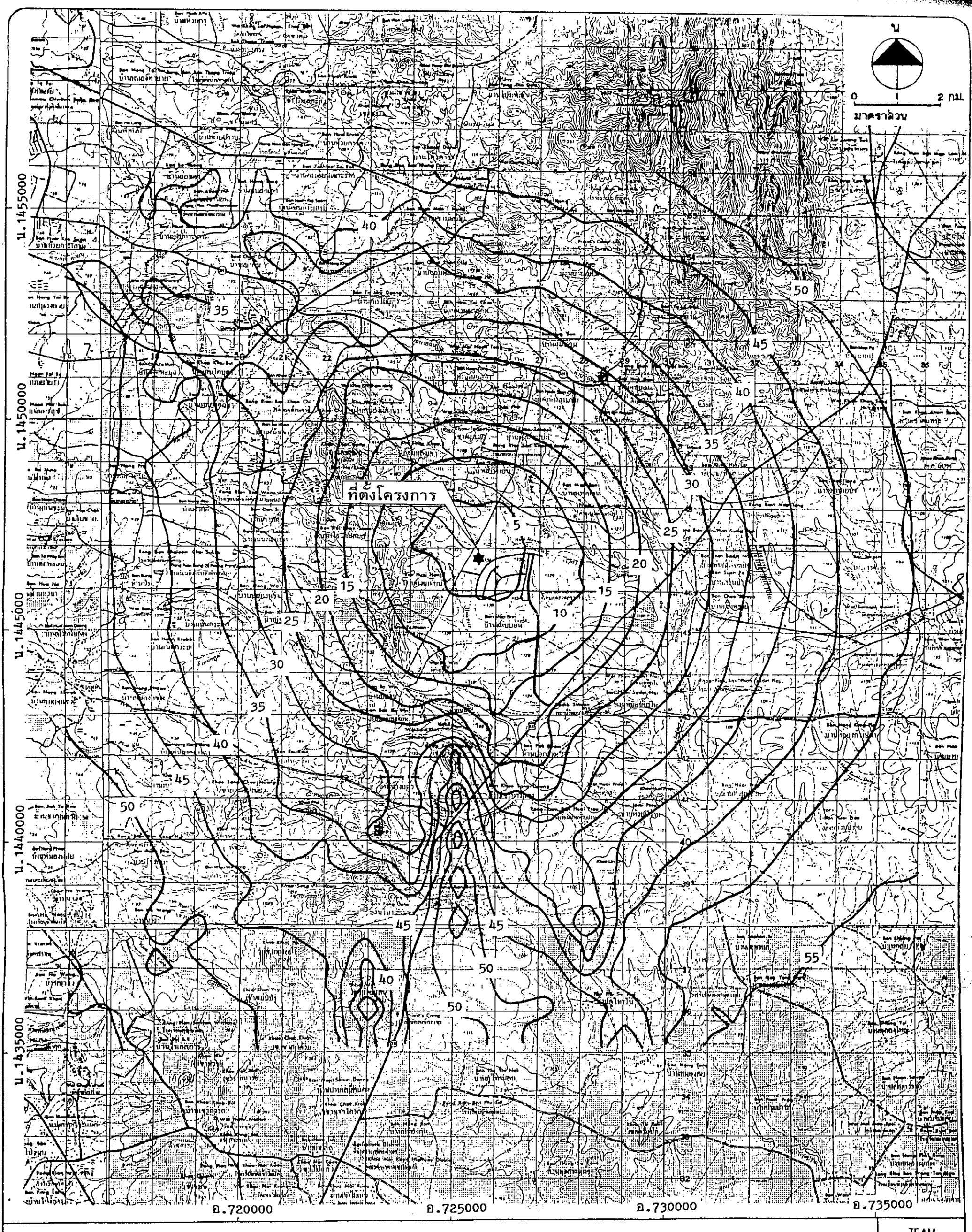
รูปที่ 12 : Isopleth แสดงระดับความเข้มข้นของ NO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



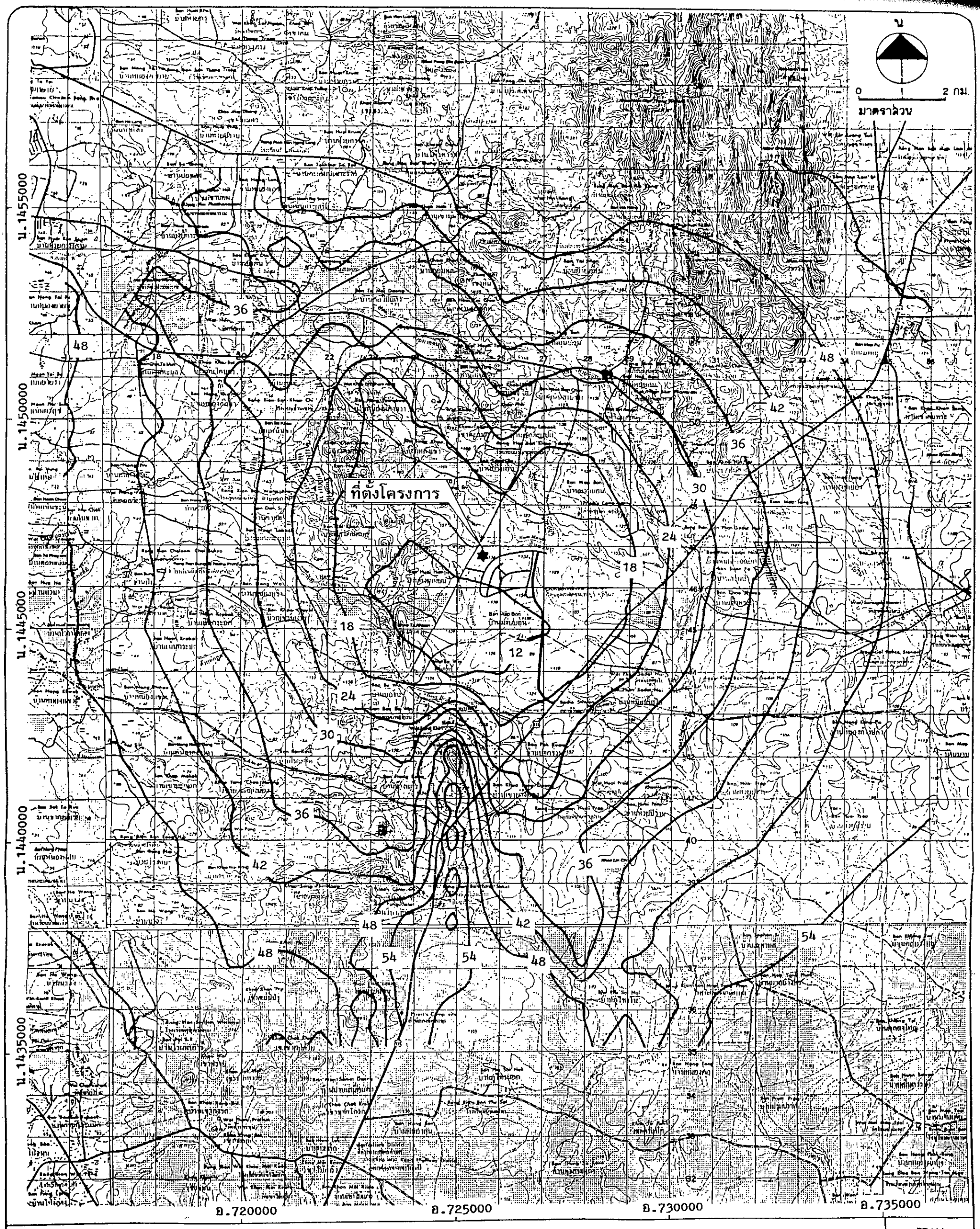
รูปที่ 13 : Isopleth แสดงระดับความเข้มข้นของ NO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง : มคก./ลบ.ม.

TEAM



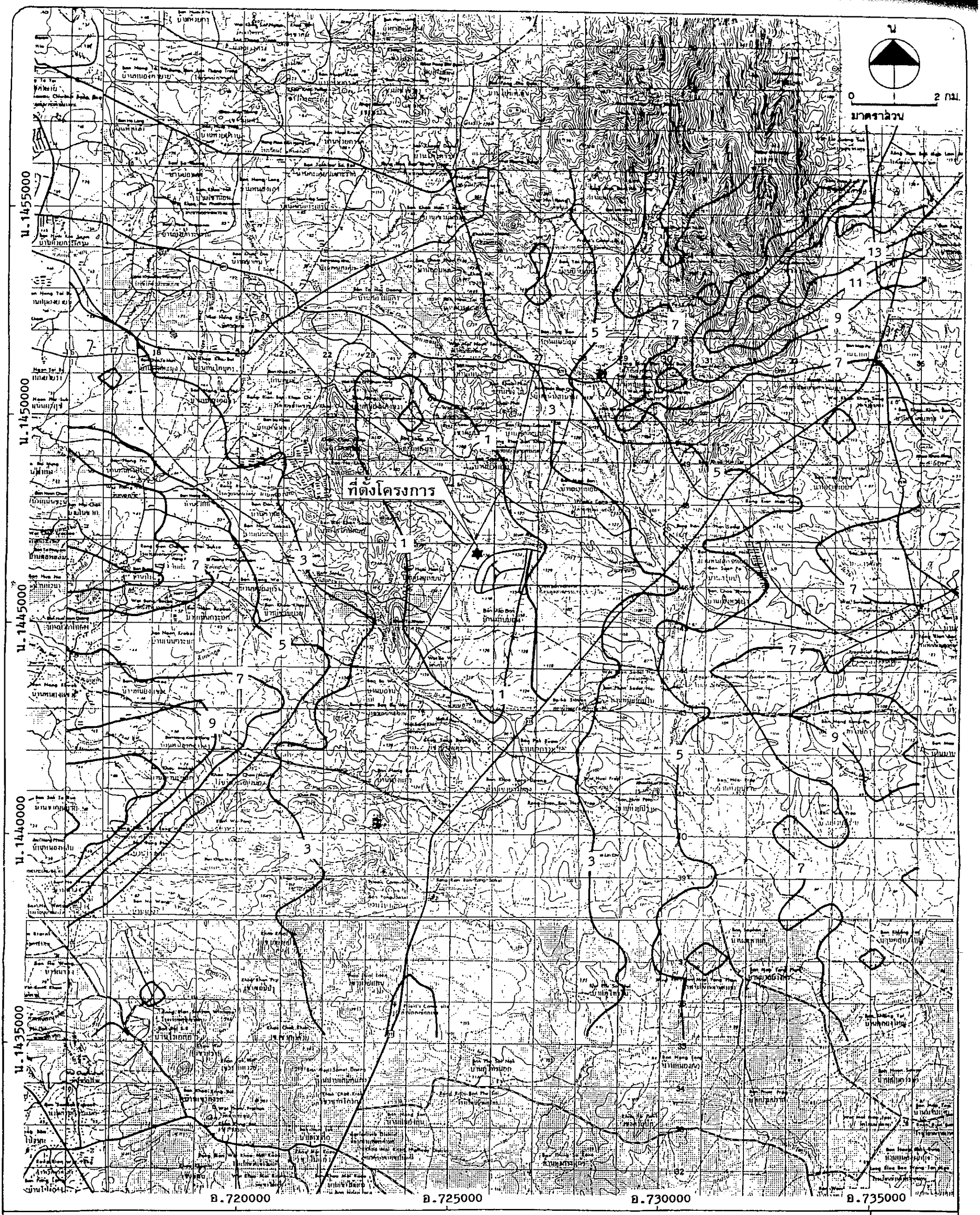
รูปที่ 14 : Isopleth แสดงระดับความเข้มข้นของ SO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



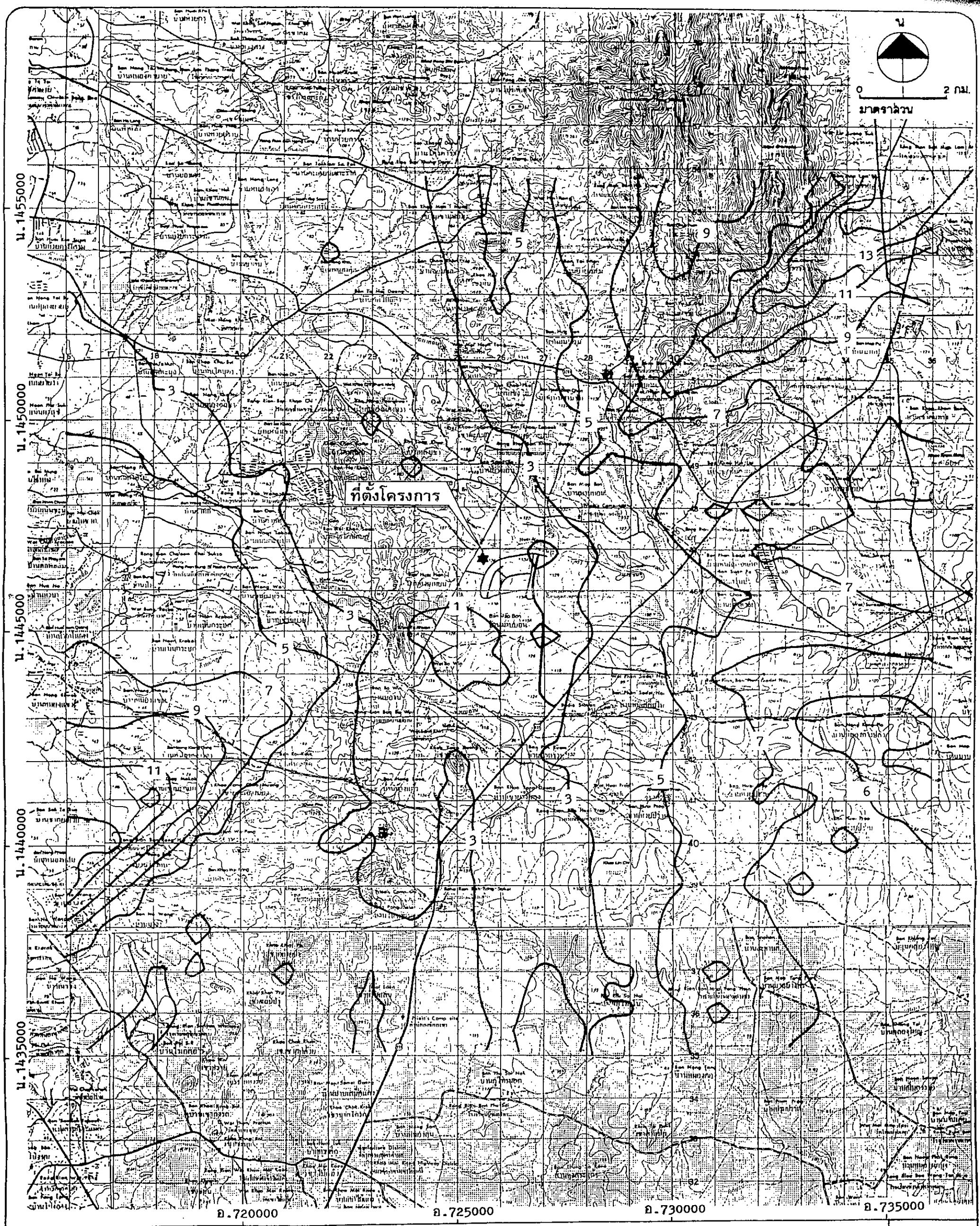
รูปที่ 15 : Isopleth แสดงระดับความเข้มข้นของ SO_2 (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



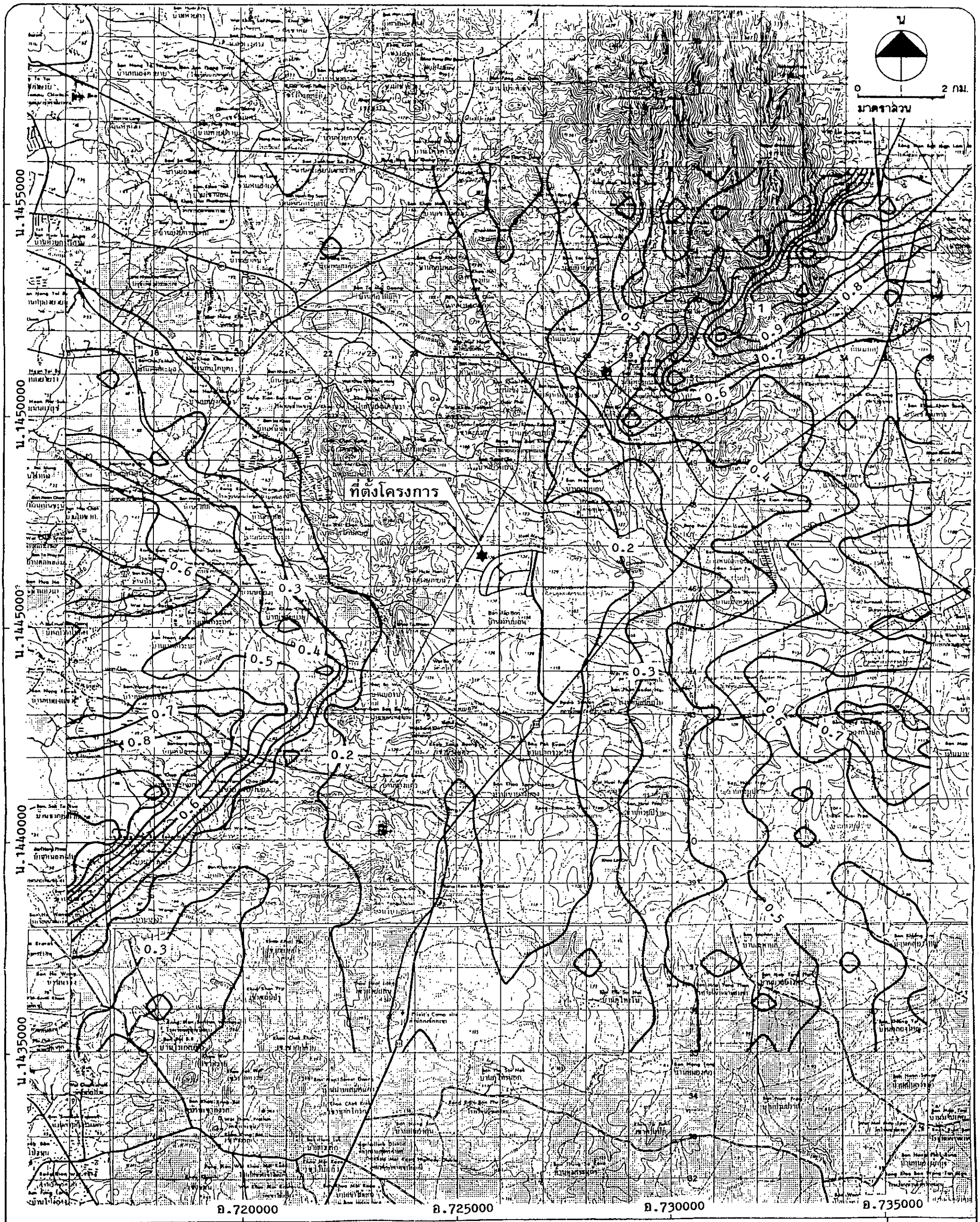
รูปที่ 16 : Isopleth แสดงระดับความเข้มข้นของ SO_2 (เฉลี่ย 24 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



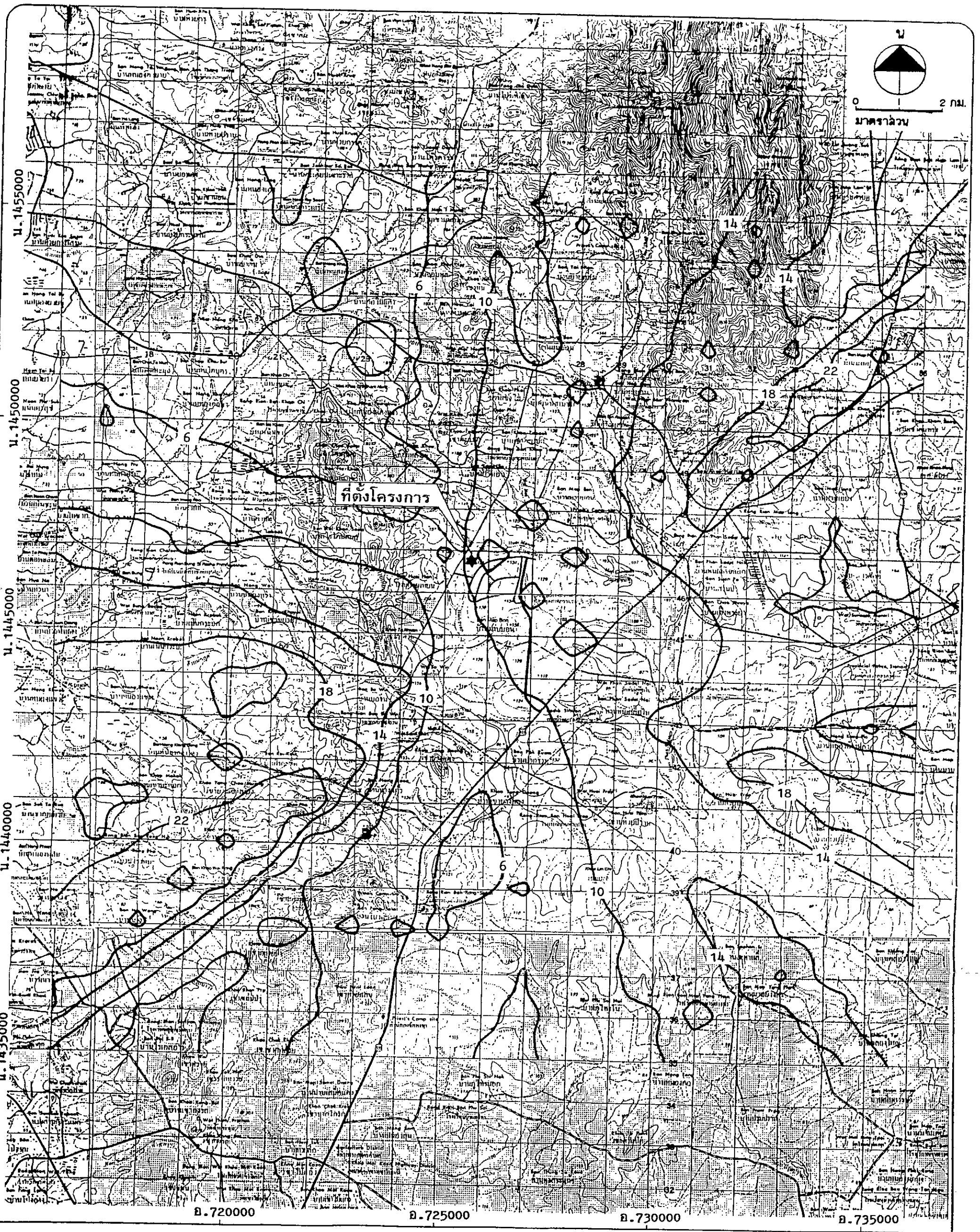
รูปที่ 17 : Isopleth แสดงระดับความเข้มข้นของ SO_2 (เฉลี่ย 24 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



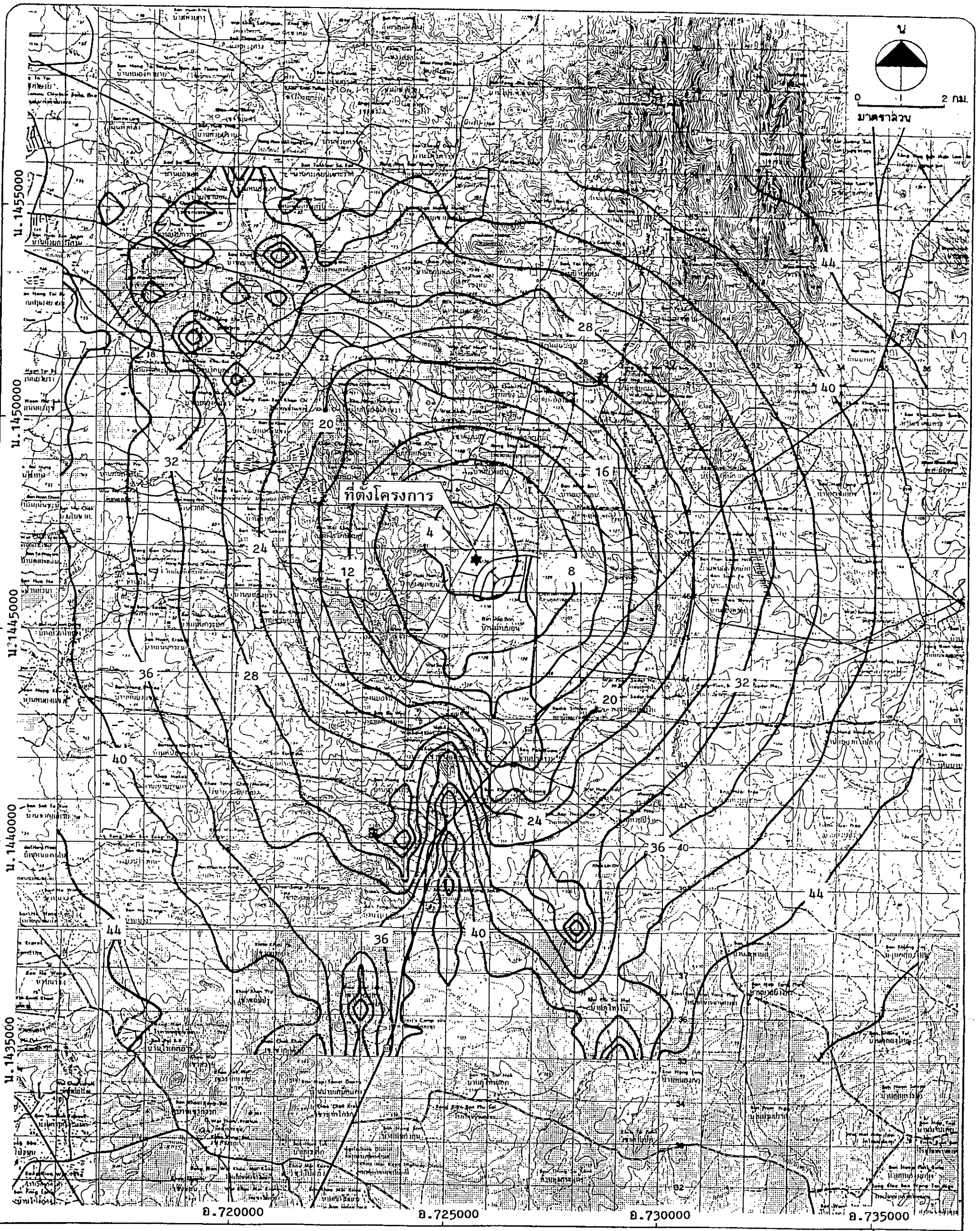
รูปที่ 18 : Isopleth แสดงระดับความเข้มข้นของ TSP (เฉลี่ย 24 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



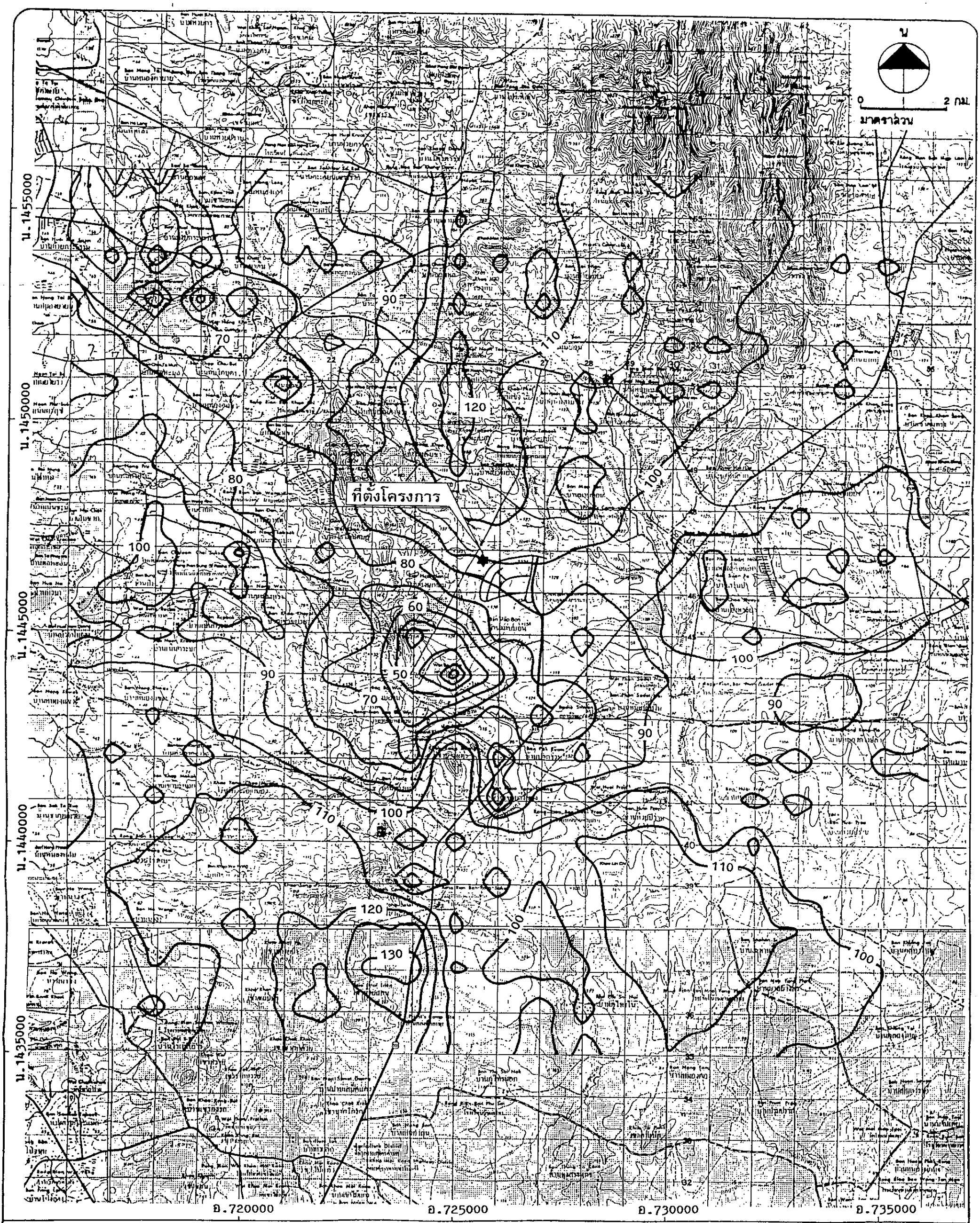
รูปที่ 19 : Isopleth แสดงระดับความเข้มข้นของ TSP (เฉลี่ย 24 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆ ในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



รูปที่ 20 : Isopleth แสดงระดับความเข้มข้นของ CO (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากแหล่งกำเนิดมลสาร ของโครงการในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง ; มคก./ลบ.ม.

TEAM



รูปที่ 21 : Isopleth แสดงระดับความเข้มข้นของ CO (เฉลี่ย 1 ชั่วโมง) ที่เกิดจากโครงการรวมกับแหล่งกำเนิดอื่น ๆ ในกรณีที่ใช้น้ำมันเป็นเชื้อเพลิง : มคก./ลบ.ม.

TEAM

บริษัท เหมราชพัฒนาที่ดิน จำกัด (มหาชน) มมจ 141
HEMARAJ LAND AND DEVELOPMENT PUBLIC COMPANY LIMITED

HRD 186 / 2541
April 28, 1998

Khun Anut Chatikavanij
Managing Director
Bowin Power Co., Ltd.

Dear Khun Anut,

Referred to your request upon the water consumption during Construction and Startup, Testing and Operation Period, we would like to inform you as follows:

1. **Construction Period:** during December 98 – April 2000 (17 months)

The temporary water supply pipe shall be placed at the front of the plot and ready to supply treated water with the capacity 469 Cu.m /Day during Construction Period.

2. **Startup & Testing and Operation:** from May 2000

At present, Hemaraj has completely laid raw water pipe connecting Nong Plalai-Nongkho pipeline to the estate. The additional pipeline shall be implemented by connecting with the existing pipeline to Bowin Power Plant with some extra cost. It is essential that this new route of pipeline shall be mutually concurred with both two parties, Hemaraj and Bowin Power. The determination of this route including construction will need 12-month lead time. Finally, due to the approved amount of raw water to be allocated by EAST WATER, Hemaraj confirms to supply raw water to cope with the proposed monthly raw water demanded by Bowin Power as schedule 1.

We do hope this information will respond to your request.

Sincerely yours,

Vivat Jiratikamsakul
Senior Vice President

Encl. Monthly Raw Water Demand by Bowin Power from May 2000

18th Floor, UM Tower, 9 Ramkhamhaeng Road, Suanluang, Bangkok 10250 Thailand
Tel. (662) 719-9555, 719-9559 Fax : (662) 719-9546-7
http : //www.hemaraj.com

Schedule 1

Monthly Raw Water Demand by Bowin Power

From May 2000

No.	Year	Month	Demand (Cu.m / Month)	Note
1	2000	May	1,900	Startup & Testing
2	2000	June	1,900	Startup & Testing
3	2000	July	3,800	Startup & Testing
4	2000	August	3,800	Startup & Testing
5	2000	September	3,800	Startup & Testing
6	2000	October	3,800	Startup & Testing
7	2000	November	61,000	Startup & Testing
8	2000	December	600,000	Startup & Testing
9	2001	January	690,000	Operation
10	2001	February	690,000	Operation
11	2001	March	690,000	Operation
12	2001	April	690,000	Operation
13	2001	May	690,000	Operation
14	June 2001 onwards		690,000	Operation

APPENDIX H

LETTER OF CONFIRMATION FROM GENCO (GENERAL ENVIRONMENTAL CONSERVATION PUBLIC COMPANY LIMITED)

12 May 98.

GENCO

Facsimile

To	: H-Power Company Limited.	**Fax No.**	: (66 2) 717-2240
Attn.	: Khun Pajongwin Pongsivapai	**cc.**	:
From	: Sompong Kraivutinundh	**Our Ref.**	:
Date	: 28/04/41	**Page(s)**	: 6 (Included this page)

Subject : H-Power Waste Treatment

Dear Sir,

According to our conversation by phone this' s afternoon, concerning waste oil from 713 MW IPP locate at Bo Win Industrial Estate. We would like to inform you that your waste can be treated and disposal by GENCO. The treatment cost will be define after receiving the waste sample from your operation.

Please fill our customer profile and waste profile to create your company profile and looking forward to provide you with our service soon.

If you have further question, please feel free to contact our customer service representative (Khun Rungnapa Channuan)

Sincerely yours,
General Environmental Conservation Public Company Limited.

Sompong Kraivutinundh
Plant Manager

APPENDIX I

EXAMPLES OF RISK ASSESSMENT STUDIES

Hazardous Operations and Risk Assessment

All potential hazard events anticipated will be addressed during construction and commercial operation. Each hazard will be quantified as to the level of potential impact to life, property and/or the environment. Worker actions to mitigate such on-going hazards will be encouraged through training, education and by demonstrations.

In addition, an Emergency Response and Evacuation Program will be required of plant operations and put into effect prior to staffing the facility. Those materials, that if released to the environment, would endanger not only those within the facility, but those outside the facility due to wind direction, drainage characteristics, or some other directional feature, will be identified and registered with the local and province officials (like the police, fire department, HAZMAT team, etc.). The owners of the facility and each and every worker are responsible for the hazaqrds created by the facility. The hazard assessment of this project will be prepared as indicated below.

RISK ANALYSIS AND HAZOP

Introduction

Accidental releases of hazardous materials can pose significant risk to plant employees and to the general public as well. In order to prevent or minimize the consequences of such incidents, the United States' Occupational Safety and Health Administration (OSHA) has published a standard found in Tide 29 Code oi Federal Regulations (CFR) Section 1910-119. This regulation is referred to as Process Safety Management. Process Safety Management is defined as the pro-active identification, evaluation and mitigation or prevention of chemical releases that could occur as a result of failures in the process, procedures or equipment.

The Process Safety Management Standard involves Process Hazards Analyses for facilities that handle highly hazardous materials. In order to assure that each plant operates within the guidelines of the Process Safety Management Standard, Process Hazard Analyses are an integral put of the plants overall safety program.

Purpose

This Process Safety Management (PSM) Program has been developed for Independent Power Plants to help prevent the occurrence of, or minimization of the consequences of catastrophic releases of toxic, reactive, flammable or explosive materials. The PSM Program develops an approach which integrates technologies and procedures with management practices.

The PSM Standard applies to a plant in which there is the possibility of catastrophic or near-catastrophic accidents involving hazardous materials. Each system within the power plant must be evaluated to determine whether it poses potentially hazardous situations. Once the PSM Program is developed for the power plant, it is the company policy to comply with all elements of that Program.

Process Hazards Analysis (PHA)

A Process Hazard Analysis (PHA) is an organized and systematic effort to identify and analyze the significance of potential hazards associated with the processing or handling of hazardous materials within the power plant. A PHA forms the basis for making decisions to improve the safety and to reduce the consequences for unwanted or unplanned releases of hazardous materials. The PHA forms the basis for making decisions to improve safety and to reduce the consequences for unwanted or unplanned hazardous upsets. The PHA is directed toward analyzing potential causes and consequences of fires, explosions, chemical releases and chemical spills. The PHA focuses on equipment, instrumentation, utilities, human actions, and external factors that might impact the process. These considerations assist in determining the hazards and potential failure points or failure modes of processes within the power plant.

During the PHA the employees are to be consulted concerning the development of the PHA Power plant personnel must be involved in all stages of PHA development. They must also have access to information generated during the PHA.

To assure that the PHA's are consistent with the current processes used at the power plant, the PHA's must be updated at regular intervals after completion of the initial PHA.

Process Hazards Analyses must address the following:

- Hazard Identification;
- Administrative and Engineering
- Controls; Consequences of Failure of
- Safeguards;
- Evaluation of Safeguards;
- Analysis of Previous Incidents;
- Facility Analysis
- Human Factors.

An initial hazard analysis must be completed, using at least one of the six OSHA specified methodologies: What-if, Checklist, What-if/Checklist, Hazard and Operability Analysis (HAZOP), Failure Mode and Effects

Analysis (FMEA), and Fault Tree Analysis. Selection of the appropriate methodology depends on the process involved. The methods most often used include the What-If and the HAZOP methods.

The What-If method is a relatively unstructured brainstorming method. The purpose of the What-If analysis is to consider carefully the result of unexpected events that would produce an adverse consequence. The method involves examination of possible deviations from the design or operating intent. It requires a basic understanding of what is intended and the ability to mentally combine or synthesize possible deviations from the design intent that would produce an undesired result. Therefore, this method is highly dependent on the experience of the PHA team. For every equipment item and operating task, a "what-if..." list of questions is assigned. The team then identifies any associated consequences or hazard, and a recommendation. If the recommendation involves a required human response, the individual responsible for that response is also noted.

The HAZOP method is a more structured method It was developed to identify hazards and operability problems which might compromise the capability of the plant to perform as desired. The approach to identify hazards and operability problems by searching for deviations from design intent. An experienced facilitator leads the team through the plant design using "guide words". These guide words are applied to distinct portions of the process, known as "study nodes", to identify potential deviations from intended parameters. For example, the guide word "no" is combined with a process parameter such as "flow" and the team addresses possible causes and consequences of "no flow".

The team must have expertise in engineering, process safety and process operations. The team includes at least one person with experience and knowledge in the specific process, and one person knowledgeable in the analysis methodology used. A typical team will include a facilitator, a note taker, a plant operations representative, a plant maintenance representative, a safety/environmental specialist and a process engineering representative. The facilitator must not introduce any bias to the PHA. Typical activities of the facilitator include:

Initial study of the projects processes and technologies;
Decide on PHA methodology and set up of documentation; Formulate guidance questions;
Select the team and arrange the meetings;
Assemble necessary design information;
Set the rules-of-conduct for the meetings;
Facilitate the meetings and identify action items;
Ensure documentation of follow-up activities;
Complete the PHA analysis report.

The following key design documents included as part of the PHA

PFD's (including heat and material balances);
P&ID's;
Piping specifications;
Process equipment specifications;
Relief system and their design bases;
Control systems definition;
Instrument specifications;
Plot plan;
Area electrical classification;
Emergency power list;
Area monitors used for hazard detection;
Risk assessment criteria.

A general approach used in the hazard analysis involves review of the plot plan and equipment arrangement and spacing. This addresses accessibility for normal, maintenance, and emergency scenarios. Drainage and diking provisions are reviewed. Monitoring and fire protection facilities are also reviewed. P&ID's are analyzed in detail to identify hazards, Specific hazards are identified relative to process control, start-up and shutdown hazard, emergency depressurizing, major vent and overpressure scenarios, flare design basis, vent and blowdown scenarios, vapor cloud or toxic release potential, combustible and toxic gas detection systems, site building classification, bulk storage system and transfer system, area electrical classification, fire hazards, waste methods, corrosion potential, and special maintenance considerations. Computer control applications are reviewed regarding safety and plant integrity.

The hazard analysis will also identify any previous incident which has had a likely potential for catastrophic incidents in the workplace (near-miss). The objective of the previous incident review is to determine whether any previous incident is relevant to the hazard analysis. A number of sources can be considered for identification of previous incidents. The team members may have personal experiences with incidents or accidents. Additional facility data may be found in documents such as logs, loss control data, contractor data, or accident investigations. Other facilities within the corporations involved may have had similar units with incidents. This data may be shared. Industrial data concerning process operation or safety should be reviewed.

The PHA also identifies engineering and administrative controls that are applicable to the identified hazards. The consequences of failure of these controls is also addressed. The PHA also qualitatively evaluate the range of possible safety and health effects associated with control failure.

The PHA also includes a facility analysis The objective of the facility analysis is to identify safety critical buildings and locations to determine the potential consequences that may impact these buildings if a catastrophic incident occurs. The first task of this analysis should be to identify the safety critical buildings with respect to the unit area under investigation. Control rooms contain process control instruments that are essential for the orderly shutdown of an operating process. These buildings also contain personnel who, in the event of an emergency, are instructed to initiate emergency shutdown. Remote emergency shutdown stations are also classified as control rooms. High occupancy buildings are those buildings which may include shops, operating shelters, warehouses and administration offices. Emergency response shelters and locations are those locations designated as places of refuge in the power plant's emergency response plan. Once the safety critical buildings and locations have been identified the team should determine if these buildings and locations are subject to a potential catastrophic or near miss event. Such events may include fires, explosions toxic chemical releases, or combinations of these certain types of hazards. All of this information must be included in the documentation.

Human factors refers to the mental and physical capabilities of people in their interactions with the working environmental. Human factors covers a wide range of issues, including the influence of equipment and system design on work performance and the organization characteristics which may impact safety related behavior. Operating process related issues define the employee-machine interface which may result in the creation of a hazardous condition. Primarily the interface entails an employee, such as an operator, performing a task involving equipment, and due to human factor, a hazardous condition may be created.

For each specific hazard identified, a qualitative evaluation is performed to assess the risk in terms of severity and probability. Appropriate corrective recommendations are developed and documented for each hazard. An action list is generated of open issues to be resolved. All responses by the appropriate party and then forwarded to the facilitator within a specified period of time. Responses are compiled and reviewed by the team for approval. A final issue of the action item list with all items resolved and documented is then issued.

Timing of the PHA is critical to the success of a project. Completing the PHA too early in a project, as the design is still evolving, can result in numerous changes. PSM's Management of Change procedures must then be implemented. It is also possible to wait until too late in the project to complete the PHA If this is done, it is possible that the PHA's will point out the need for major design changes.

Changes in the plant design or operation following the hazard analysis are addressed under a Management of Change (MOC) program, MOC is designed to allow flexibility for change when it is required while still maintaining the integrity of the origina.1 hazard analysis. Changes that arc to be included under MOC include process chemicals, technology, equipment, instrumentation and operating procedures With each change, the following must be considered prior to approval of the change:

Technical basis for the proposed change;
Safety and health impacts of the change;
Modifications to operating procedure;
Necessary time period for the change;
Authorization requirements for the change.

PROCESS HAZARD ANALYSIS - EXAMPLE

1. Hazard Identification

1.1 Diesels fire from leak at fuel storage or process piping.

Diesel fuel is a secondary fuel for use when natural gas in not available. Diesel fuel is a flammable colorless liquid, with a distinct odor at ambient conditions. Upon spillage, a vapor is given off which travels in the direction of the wind, and if ignited flashes back along the vapor trail, If vapor builds up in an enclosed area, it may explode upon ignition.

Diesel vapor is irritating to eyes nose and throat of exposed personnel while the liquid is irritating to the skin and eyes.

In terms of environmental hazards, the effects of diesel in low concentrations on aquatic life is not known however it is known to cause fowling of shoreline if released at sea.

1.2. Diesel fuel tank rupture

Failure of the diesel fuel tank will result in fuel being spilt into the diked area. People are expected to be in this area during periods of maintenance or tank filling. Also it is expected that there would be a high probability of personnel being able to escape the effect of a fire in the diked area, further limiting the hazard effects.

1.3 Diesel Fuel Line Rupture

Diesel releases from combustion turbine generator fuel feed pump is not expected to result in fatalities either. The releases rate is limited by the line

size (or the pumping rate) thereby increasing the likelihood of personnel escaping the effects of a leak. In addition, since line leaks are continuous release events, the opportunity exists for personnel to take action to isolate the release, thereby limiting the mass of diesel fuel releases and the consequences, by closure of emergency valves.

2. Administrative and Engineering Controls

The diesel fuel storage facility consists of two storage tanks of approximately 4750 cubic meters volume each, within one diked area. The diked area is sized to retain 110% of the volume of one diesel tank.

The diesel fuel storage tanks area includes an automatic foam system, which will become activated in the event of a fire in the tank area. The system will be able to control fires along with a timely response by the local fire department and /or onsite fire brigade.

3. Consequences of Failed Safeguards.

In the event of a diesel fuel in the storage area the fire will be contained on site.

4. Evaluation of safeguards.

On the basis of the above, continuous releases of diesel into the diked areas would not lead to unacceptable risks at the site. Diesel spills due to ruptured piping systems will be contained in the local area. Excess spillage will be collected in the process waste water sumps and intercepted in the oil-water seperator.

5. Analysis of previous incidents

Not applicable

6. Human Factors

Review of the practices of fuel truck drivers should be done by monitoring their actions. Safety procedures should be followed at all times. No smoking policy must be strictly enforced. Spills during unloading must be cleaned up to avoid hazards.

ตารางที่ 1

ผลการตรวจวัดก๊าซไนโตรเจนไดออกไซด์ในเวลา 1 ชั่วโมง ในบรรยากาศ

เดือนพฤษภาคม 2541

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ตารางที่ 2

ผลการตรวจวัดฝุ่นละอองรวมในเวลา 24 ชั่วโมง ในบรรยากาศ

เดือนพฤษภาคม 2541

สถานตรวจวัด	ปริมาณฝุ่นละอองรวม มก./ลบ.ม.		
	วันแรก	วันที่สอง	วันที่สาม
1. บริเวณโครงการ (A1)	0.044	0.036	0.034
2. สถานีอนามัยบ่อวิน (A2)	0.053	0.022	0.024
3. วัดพันเสด็จนอก (A3)	0.034	0.034	0.075
มาตรฐาน [2/]	0.33		

หมายเหตุ : 1. ตรวจ 3 วันต่อเนื่อง

2. มาตรฐานคุณภาพอากาศในบรรยากาศโดยทั่วไปตามประกาศ คณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 10 (พ.ศ.2538)

ที่มา : รวบรวมโดยบริษัท คอนซัลแทนท์ ออฟ เทคโนโลยี จำกัด

ตารางที่ 3

ผลการตรวจวัดก๊าซซัลเฟอร์ไดออกไซด์ในเวลา 24 ชั่วโมง ในบรรยากาศ

เดือนพฤษภาคม 2541

สถานีตรวจวัด	ความเข้มข้น (มก./ลบ.ม.)		
	วันแรก	วันที่สอง	วันที่สาม
1. บริเวณโครงการ (A1)	0.001	0.001	0.001
2. สถานีอนามัยบ่อวิน (A2)	0.001	0.001	0.001
3. วัดพันเสด็จนอก (A3)	0.001	0.001	0.001
มาตรฐาน [2/]	0.3		

หมายเหตุ : 1. ตรวจ 3 วันต่อเนื่อง

2. มาตรฐานคุณภาพอากาศในบรรยากาศโดยทั่วไปตามประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 10 (พ.ศ.2538)

ที่มา : รวบรวมโดยบริษัท คอนซัลแทนท์ ออฟ เทคโนโลยี จำกัด