		Increase in noise levels due to traffic.	L	Earthworms should be constructed near sensitive receptors such as schools and hospitals.	
39	Utilities	The proposed housing project will enhance the supply of houses in the area. At present high class houses are lacking. It will also increases demand for utilities for domestic uses. This impact can be mitigated.	L L	More high class houses should be built. The relevant utility authorities should check their capacity and gradually increase it according to demand. They should also maintain support during emergency.	The rise in demand for utilities will be gradual depending on the rate of occupancy of the proposed houses.
40	Amenities	Provision of sufficient number of children playgrounds, jogging tracks and other sporting facilities would enhance the mental and physical health of workers as well as create a more harmonious living condition. The construction of nature park and golf courses and other infrastructural amenities will enhance the attractiveness of the area. The provision of amenities to meet the demand of the people will lead to an enhancement of employment as labour is required to man the various amenities and this will indirectly promote commerce.	L L	Provide sufficient number of play grounds and exercise grounds. Regularly maintain those amenities.	
41	Pest Control	The air quality may be affected if excessive fogging is carried out. Pest control would reduce population of pest such as flies, mosquitoes, etc. and thus physical health is enhanced. Pest-free environment will improve the psychological well-being of residents and it will help preserve buildings.	S L		
42	Security	The provision of security in the area will help promote a better psychological well-being and the system of security adopted such as the "Rukun Tetangga" can further promote a good sense of community.	L	Ensure fogging is done properly and excessive fogging should be avoided.	

43	Golf Course	Excessive and uncontrolled application of fertilizer, herbicides and pesticides would lead to surface water pollution and affect aquatic life and downstream aquacultural activities.	L	Excessive use of chemicals (fertilizers, herbicides and pesticides) should be avoided. Runoff from the course should be directed to retention pond.	Water pollution by golf course is an emerging problem in many countries. River water quality to be monitored according to the monitoring programme given in Table 9.3.
		Reduction in green biomass due to reduced vegetation could increase heat island effect.	L*	Increase the shaded area.	
		The provision of recreational facilities such as the golf course will contribute to a healthy society and good psychological well-being. It can indirectly lead to an enhancement of commercial activities arising from the need of the golfers.	P		
44	Research Institution	The liquid wastes involved are laboratory wastes and sewage. Improper discharge of laboratory wastes or insufficient treatment of sewage would lead to pollution of surface water.		The various dangerous wastes should be segregated and handled in the appropriate manner.	
		The presence of researchers will lead to an increasing demand for essential goods and services and this will enhance commerce and further create employment through the multiplier effect.	L		
45	Abandonment	The uncompleted physical structures if not removed will cause a threat to physical safety and the landscape will appear hideous.	P	The concrete structures has to be removed and the land be reverted to other land use types.	

Note: * moderately serious
** can be serious
*** very serious

L - Long term impacts
S - Short term impacts
P - Permanent impacts

4.5 Example of Forms for Agreement/Plan on Environmental Pollution Control

The following are examples of forms for Agreement/Plan on Environmental Pollution Control.

4.5.1 AGREEMENT FOR PREVENTION OF DETERIORATION OF WATER QUALITY

Kulim Hi-Tech Industrial Park (hereinafter referred to as (A)) and _____ _____ Industry Co., Ltd. (hereinafter referred to as (B)) exchange an agreement for prevention of public nuisance from being caused in connection with business activities of (B) when newly erecting_____ plant in the site of Kulim Hi-Tech Industrial Park.

No. 1 PURPOSE OF AGREEMENT

The purpose of this agreement lies in prevention of public nuisance from being caused in connection with the business activities of (B), and in contributing to the maintenance of health and living environmental condition of regional residents.

No. 2 COUNTERMEASURES FOR DRAINING OF WATER

When (B) drains water to a water draining area for public use from _____ _____ and other associated facilities, (B) shall assure that drained water meets the requirements as the following environmental criteria for draining water at the drainage site. (B) shall make all possible efforts to prevent injurious effects from being caused over utilization of water in the area for public use with a forward-looking attitude.

(1) Concentration of hydrogen ions (PH)	:	5.8 – 8.6
(2) Requirements of biochemical Oxygen demand (BOD)	:	160 mm or less (120 ppm or less on an average in the daytime)
(3) Mass of floating material (SS)	:	200 mm or less (150 ppm or less on an average in the daytime

(4) Content of oily substance : 5 ppm or less

(5) Coliform count : 300 ppm or less on an average in the daytime

No. 3 Maintenance of facilities

(B) shall operate and maintain completely preventive facilities for environmental pollution control and endeavor to prevent public nuisance form being caused.

No. 4 Reporting and investigation

(A) shall be able to ask (B) to submit a report to such an extent as required for putting this agreement into practice and, if necessary visit the plant or other facilities for investigation.

No. 5 Prenotification of change in planning

If (B) intends to install or change a main facility closely related with occurrence of public nuisance, (B) shall notify (A) of it beforehand in order to cooperate with (A) for prevention of public nuisance form being caused.

No. 6 Measures to be taken when violating the agreement

If (B) should violate this agreement, (A) shall instruct (B) to take corrective action immediately. If (A) judges that (B) is continuing to violate the agreement while continuing business activities, (B) shall be stopped from using the facility or plant which causes a public nuisance until corrective action is taken.

No. 7 Indemnity

If (A) or any other third party should suffer losses in connection with business activities of (B), (B) shall indemnify them.

No. 8 Others

If matters not stipulated in this agreement should be required for the purpose of prevention of public nuisance, arrangements shall be made on all such occasions to discuss countermeasures that need to be taken.

In order to prove the conclusion of this agreement, this agreement is prepared in 2 copies, signed and sealed by A and B respectively. A and B will each have one of them.

Date

A Kulim Hi-Tech Industrial Park

Address : _____

_____

Headman _____

B _____ Industry Co., Ltd.

Address : _____

_____

Headman _____

, Representative
Director & President

4.5.2 AGREEMENT FOR PREVENTION OF NOISE AND AIR POLLUTION

AGREEMENT for prevention of noise and air pollution Kulim Hi-Tech Industrial Park (hereinafter refereed to as (A) and _____ Industry Co., Ltd. (hereinafter referred to as (B)) exchange an agreement for prevention of public nuisance from being caused in connection with business activities of (B) in the future.

No. 1 PURPOSE OF AGREEMENT

The purpose of this AGREEMENT lies in prevention of public nuisance from being caused in connection with the business activities of (B), and in contributing to the maintenance of health and living environmental conditions of regional residents.

No. 2 COUNTERMEASURES FOR PREVENTION OF NOISE AND AIR POLLUTION

For the purpose of prevention of noise from being a public nuisance in connection with business activities of (B), (B) shall install noise reduction equipment with a forward-looking attitude, meeting the following criteria:

(1)	Daytime	(8 am – 6 pm)	65 dB or less
(2)	Morning & evening	(6 am – 8 am) (6 pm – 10 pm)	60 dB or less
(3)	Night	(10 pm – 6 am)	50 dB or less

To prevent air pollution nuisance, (B) shall install air pollution control equipment to need the prescribed permissible limits of concentration of air impurities. The permissible limits of concentration of air pollutions from any of the industries or process, or the operation of any fuel-burning equipment or industrial plant shall be set out in regulations 24 to 30 of Environmental (Clean Air) Regulations, 1978.

No. 3 MEASURES TO BE TAKEN WHEN PUBLIC NUISANCE IS CAUSED

If a dispute should anise between (B) and regional residents in connection with prevention of noise, (B) shall make all possible endeavor to solve the problem with a spirit of good faith. If no settlement is reached between the parties concerned, (A) shall exercise its good office in settling it, unless otherwise specified in rules, regulations and laws.

No. 4 REPORTING AND INVESTIGATION

If necessary, (A) shall be able to ask (B) to make a report on matters required for prevention of public nuisance, visit the plant or facility to an extend as required for implementation of this agreement and make investigations for prevention of public nuisance from being caused. (B) shall cooperate with (A) with a forward-looking attitude

(2) (B) shall pay regard to the views and opinions presented by (A) based on the above mentioned report and results of investigations.

No. 5 MEASURES TO BE TAKEN WHEN VIOLATING THE AGREEMENT

If (B) should violate this memorandum, (A) shall be able to ask (B) to take corrective actions immediately.

(2) If a judges that (B) is violating the agreement while continuing business activities, (B) shall be asked to stop operating the facility or plant which cause

public nuisance until corrective action is taken or alternatively shorten his operating time, temporally until corrective action is taken.

No. 6 APPLICATION FOR MAINTENANCE AND CHANGE OF FACILITIES

If any main items of equipment or facilities associated with generation of public nuisance are changed or installed, arrangements shall be made to notify (A) beforehand.

No. 7 SUPPLEMENTARY RULES

If matters not stipulated in this agreement should be required or if an doubts should be raised, arrangements shall be made after mutual consultation between (A) and (B).

In order to prove the conclusion of this memorandum, this memorandum is prepared in 2 copies, signed and sealed by A and B respectively. A and B shall each have one of them.

Date

A Kulim Hi-Tech Industrial Park

Address : _____

_____

Headman _____

B _____ Industry Co., Ltd.

Address : _____

_____

Headman _____

, Representative

Director & President

4.5.3 PLAN FOR PREVENTION OF PUBLIC NUISANCES

Example of Plan is shown in Table 4.5.1.

4.5.4 OTHER DOCUMENTS TO BE ATTACHED (including geographical conditions outside the industrial complex)

No. 1 Tree planting plan

No. 2 Copy of public drawings

No. 3 Location, water draining routes, access roads

No. 4 Divisional drawings

No. 5 Drawing for calculation of volumes

No. 6 Plant arrangement plan (production facilities, tree planting etc.) 1/250 – 1/300

No. 7 Drawing plan

No. 8 Foul water draining drawing

No. 9 Rain water draining drawing

No. 10 Drawing for purification tank

No. 11 Drawing for water supply facilities

No. 12 Settlement of accounts

No. 13 Company pamphlets (showing main machines and facilities etc.)

Table 4.5.1 A PLan for Revention of Public Nuisance

A PLAN FOR PREVENTION OF PUBLIC NUISANCE

Mr. _____ Governor of _____ Date

Submitter

Address_____

Name of Company _____

Name of Representative _____

Sealed

In connection with implementation of this business plan, we submit a prevention plan for public nuisance s mentioned hereunder together with related drawings.

1. Basic policies of prevention of public nuisance _____

_____

_____

2. Countermeasures for prevention of public nuisance

(1) Countermeasures for prevention of air pollution

Name of facility	
Expected starting time of construction	

Expected time of starting operation	
Capacity of production facilities	
Type and efficiency of air pollution treatment facilities	
Kinds of fuel materials	
Consumption of fuel materials (l/Hr) (kg/Hr)	
S in Fuel (%)	
Quantity of exhaust gas (nm^3/Hr)	
SOx in exhaust gas (%)	
Maximum ground concentration (ppm)	
Maximum concentration distance (km)	
Size of chimney (h. Ø)	
Temp. of exhaust gas (°C)	

Discharge speed of exhaust gas (m/sec)	
Dust content of exhaust gas (g/m^3)	
Kind and quantity of detrimental substance (g/m^3)	

(2) Countermeasures for prevention of deterioration of water quality

A. Construction of facilities for discharging water or other liquids

Name of facility	Type	Construction	Main dimensions	Capacity	Starting time of construction

B. Arrangement drawings showing the location of main equipment and facilities as well as waste water processing facilities (the drawings shall be attached)

C. Kind of processing facilities

Name of processing equipment	Type	Construction	Main dimensions	Capacity	Processing method	Remarks

D. Schematic drawing for processing system of waste water, collection of waste water, running method of water up to the processing facilities (the drawings shall be attached.)

E. Kind, quantity and processing method of residue produced by processing

Kind of residue	Yield (t/day)	Outline of processing method of residue	Remarks

F. Draining method of industrial waste water to public water areas
(Schematic drawing shall be attached : Mentioning the drain port number of (G)

G. Value and quantity of contamination of drain water at drain port of the plant

Water Q'ty / Wuality / Drain port No.	Draining quality (m^3 / da)		Parameter									
			PH		BOD (mg/l)		COD (mg/l)		SS (mg/l)			
	Nor.	max	Nor.	max	Nor.	max	Nor.	max	Nor.	max	Nor.	max

(3) Preventive countermeasures for noise

(4) Other countermeasures for prevention of public nuisances

(Enter the exhaustion condition of specific injurious substances stipulated in Art. 3, Item No. 2, No. 4 of the ATMOSPHERE CONTAMINATION PREVENTION LAW and for prevention of generation of bad odors.)

APPENDIX

ADVISARY WORKS ON THE MASTER PLAN STUDY BY JICA ADVISARY TEAM

TABLE OF CONTENTS

1. SUMMARY OF ADVISARY WORKS

1.1 General

In response to request of GOM, JICA agreed to execute the following advisary works on the master plan study for whole KHTP which has been scheduled to be completed in the end of February 1992 including the basic design by the MHLG with the local consultants, in view of the urgency and importancy.

(1) Town planning
(2) Power supply system
(3) Sewerage system
(4) Landscaping

The advisary works were carried out by four (4) experts with the following service periods.

Town planner (K. Yamazaki):	Dec. 13 to Dec. 27, 1991 and Jan. 08 to Jan. 19, 1992 at Malaysia (27 days)
Electrical engineer (Y. Watanabe):	Dec. 01 to 27, 1991 (27 days) at Malaysia
Sewerage engineer (H. Wakasa):	Dec. 01 to 27, 1991 (27 days) at Malaysia
Landscape planner (S. Yukutomi):	Dec. 1991 to Jan. 1992 (15 days) at Japan

JICA's advisary team forwarded the "advisary notes, No. 1 to 14" to the master plan study team during the service period containing the contents as briefly explained below.

1.2 Power Supply System

Scope of advisary service is to provide essential data and specifications. Comprehensive power demand was forecasted for the whole zone and subsequent master plan study was accelerated and ensured for realization of the project.

a) To provide data and specification of ring formation system of power distribution system for further basic and detailed design.
b) To advise and assist MHLG for operation and maintenance (control and protection and restoration) system on ring formation system of power distribution system.
c) To review power demand forecast for the whole zone
d) Review of implementation schedule
e) To provide draft master plan study report
f) Review of construction cost

Telecommunication system was also reviewed by the electrical engineer.

1.3 Town Planning

The advisary works were conducted mainly to avoid deviation as far as possible on the UNIDO's/JICA's concept and conceptual zoning for KHTP.

a) Comments on master plan study (PR 1 and draft master plan)
b) Management and institutional plan on KHTP
c) Master schedule for implementation on infrastructure works
d) Implementation schedule for first phase
e) Preliminary cost estimate for phase 1, KHTP

1.4 Sewerage System

a) Review of demand projection
b) Advice and direction of layout plan
c) Advice and direction of wastewater treatment plant
d) Advice and direction of other sectors related with sewerage system

1.5 Landscaping

The following fundamental data on the landscape plan for the whole Kulim Hi-Tech Park was given to the master plan study team.

a) Basic design policy
b) Basic design concept
c) Design standard
d) Design criteria
e) Planting

2. POWER SUPPLY SYSTEM

2.1 Scope of Additional Service and Service Period

(1) Scope of Additional Service

Scope of additional service is to provide essential data and specifications, to assist and to advise to MHLG for the Master Plan Study for the Kulim Hi-Tech Industrial Park. By this additional service, comprehensive power demand is forecasted for the whole zones and subsequent Master Plan Study is accelerated and ensured for realization of the Project. Major work item is as follows:

(a) To provide data and specification of power distribution system for further basic and detailed designs

(b) To advise and assist them for operation and maintenance (control and protection and restoration) system on ring formation system of power distribution system

(c) To review power demand on the whole zones

(d) Other services

(2) Service Period

Service period was as follows:

December 1, 1991 to December 27, 1991 (0.9 month)

Dec.1, 1991	Flight from Tokyo to Kuala Lumpur
Dec.2 to Dec. 3	Study of M/P Progress Report (1) and basic data ad materials
Dec.4 to Dec. 6	Discussion and study of strategy and tactics of subsequent M/P
Dec.7 to Dec. 20	Study, preparation of materials, advice and assist on documentation of M/P (Power demand forecast, ring system, construction schedule, construction cost, etc.)
Dec.25 to Dec.26	Final discussion and review (Advisory Services) on M/P
Dec.27	Flight from Kuala Lumpur to Tokyo

2.2 Progress of Work

(1) To provide data and specification of ring formation system of power distribution system for further basic and detailed designs.

For realization of design and construction of the System, technical specifications of the ring formation system of power distribution system were provided with reference figures and explanation was made in detail including specific and important requirements (Refer to Attachment - 1). The ring formation system, which was applied in the Industrial Zone by the recommendation of JICA Study Team, was also recommended to apply for the whole zones, not only the Industrial Zone but also Other Zones. The Kulim Hi-Tech Industrial Park is constituted from the high-tech industrial zone, urban zone, R & D zone, amenity zone housing zone,m etc. which have special features and essential for constitution of the Park, Therefore, a basic concept as applied for the Industrial Zone should be applied for the whole of the Kulim Hi-Tech Industrial Park.

(2) To advise and assist MHLG for operation and Maintenance (control and protection and restoration) system on ring formation system of power distribution system.

The major features of ring formation system are to enable to ensure the reliability and stability of power supply. For easy and quick operation and maintenance including restoration of the fault part (s), computer aided automatic distribution system was recommended to apply to the Project.

The technical specifications are included in the Attachment - 1. On this matter, advice and suggestion were made, and detailed explanation of system operation was performed.

(3) To review power demand forecast for the whole zones

Power demand forecast for the whole zones of the JICA Study was included the demands of which the land use plan was unsettled definitely at that time. Therefore, total power demand was forecasted roughly except the power demand for the Industrial zone. In the progress report (2) of Master Plan Study for Kulim Hi-Tech Industrial Park edited on December 18, 1991, the land use plan of the Industrial Zone Phase II and the other zones including housing unit and utilities to be constructed was settled definitely. Based on this plan, previous

power demand forecast was reviewed by using simplified calculation method, Attachment - 2 shows reviewed power demand for the whole zones.

As the result of this power demand forecast, required power for the Kulim Hi-Tech Industrial Park was 158 MVA which was increased approx. 40% comparing the previous forecast, because of increment of land of Industrial Zone Phase II, assumed power demand per housing unit and various facilities more than previous assumption. The installed transformer capacity was designed as 180 MVA for the required capacity of 158 MVA. Therefore, previous design by JICA Study was satisfied the total System.

(4) Others

(a) Review of Implementation Schedule

Due to delay of Master Plan Study, implementation schedule made by JICA Study team was reviewed. (Refer to Attachment - 3)

(b) Draft Master Plan Study report for power supply system

Attachment - 4 describes draft master plan of the power supply system for the Kulim Hi-Tech Industrial Park.

(c) Review of Construction Cost

Total construction cost was estimated on the basis of Master Plan (Refer to Attachment- 5).

(d) Check List

Attachment - 6 describes Check List which is used for technical evaluation of basic and detailed designs and progress of documentation work of the power supply system.

(e) Draft Master Plan Study report for telecommunications system

Attachment - 7 describes draft master plan of the telecommunications system for the Kulim Hi-Tech Industrial Park.

ATTACHMENT - 1

Specification for
Computer Aided Automatic Distribution System

1. General

This specification covers Computer Aided Automatic Distribution System (CADS, hereinafter) for the automation of high-voltage distribution lines and applies to its performances and characteristics for the Kulim Hi-Tech Industrial Park. The system shall coordinate with the 33 KV and 11 KV circuit breakers and their control equipment in the substations described in the technical specifications of Section 6 and Section 7, to accomplish the automatic remote controlling functions.

The Scope of Work to be covered is as follows:

(1) Distribution line control center : 1 center

(2) Numbers of the feeders : approximately 40 - 50 feeders

(3) Number of the line-switch : approximately 200 sets

(4) Number of substations : 5 or 6 substations

(5) Number of measuring points of the voltages and the currents at the outgoing portions of the substations and the feeders
: approximately points

(6) Other necessary equipment in use for the equipment of the system to be completed.

2. Service conditions

2.1 Normal service conditions

(1) The ambient air temperature shall not exceed 35°C and the minimum ambient air temperature shall be not less than 10°C.

(2) The relative humidity shall be between 20 and 90 % at the temperature of between 10 and 35°C.

2.2 Abnormal service conditions (when the air conditioner is out of order for a sustained period)

(1) The ambient temperature shall not exceed 45°C and the minimum ambient air temperature shall be not less than 10°C.

(2) The relative humidity shall be between 20 and 90 % (non-condensing) at the temperature of between 10 and 45°C.

3. Scope of Work

The work to be carried out under this specification shall include the following items:

(1) Design of the system

(2) Supply, delivery on board of the equipment and spare parts for 2 years

(3) Installation, supervision of installation and testing of the system

(4) Training for system operators, system maintenance personnel and application personnel

(5) Software support and development

4. System Function and Capacity

4.1 System functions

The system function to introduce for the computer aided automatic distribution system of the automatic control of distribution lines in the Kulim Hi-Tech Industrial Park shall meet the following requirements:

(1) Isolation of the faulty section shall be operated by directly finding out the faulty section with current comparison method instantaneously form the upstream to the locked-out status of the control device which has sensed the fault on the section and it locked-out the associated line-switch, so that the control device(s) can supply the power to all healthy sections as soon as possible after detecting and isolating of the faulty section.

(2) Remote control and supervision of the line-switch.

(3) Automatic or Semiautomatic Line-power Transfer by the Computer and sequence programme.

(4) Supervision and alarm under the abnormal. condition of 3-phase voltage on bus-bar in substations and 3 phase currents in individual distribution feeders.

(5) Two (2) numbers of CRT displays and the interface with the controller which are high density and eight (8) colors equipment are required.

The CRT display with colors indicates the ON and OFF status of the line-switch and the associated distribution lines, with the different colors by ON-LINE and Semi-Graphic Mode, followed by Full-Graphic Mode.

Refer to Clause 6 hereafter in this technical specification for more detailed technical requirements.

(6) Remote measuring of the currents at the switching point. Refer to Clause 6 hereafter in this technical specification for more detailed technical requirements.

(7) Printing out of the load conditions i Table. Refer to Clause 6 hereafter in this technical specification for more detailed technical requirements.

(8) Printing out of operating orders and the results. Refer to Clause 6 hereafter in this technical specification for more detailed technical requirements.

(9) Interface with HDCS. Refer to Clause 6 hereafter in this technical specification of more detailed technical requirements.

(10) Releasing from the overload condition(s) of the distribution line(s) and substation(s).

(11) Shifting the load from the trouble shooting section to the healthy section and automatically rectification after clearing the trouble shooting section.

(12) Collection of the data of the load status on the whole distribution system so that the computer can estimate and suggest the personnel the load condition for a certain future period (for a certain hours). Refer to Clause 6 hereafter in this technical specification for more detailed technical requirements.

(13) The simulating operation on the whole distribution system. Refer to Clause 6 hereafter in this technical specification for more detailed technical requirements.

(14) The simulating operation and the actual automatic operation for a future shut-down maintenance.

(15) Control of the reactive power. Refer to Clause 6 hereafter in this technical specification for more detailed technical requirements.

4.2 System capacity

The real-time data-base in the control center shall be to accommodate the following capacities for the data:

(1) Controlling and measuring points in accordance with Clause 1 hereinbefore

(2) 100 pages of the report sheet

(3) 16 types of the lists

(4) Historical data storage for all events for the last 7 days

(6) All data can copy to 3.5" Floppy Format of Personal Computer(s) for further application(s).

5. Back-up functions

Due to any reason, like monsoon, flood, fire, earthquake, puncture of cable, loosening of the terminal connection, etc., if the telecommunication line over power cable line will cause any trouble, whole functions which are controlled by the computer will affect the performance(s), and in some case, it will cause to interfere the power supply to all distribution lines.

In order to cope with such the worst case, the control devices themselves shall be provided with the following functions which operate sequential programme without any function of the compute aid, so that they can supply the power from the substations in any case to all the healthy sections as soon as possible after detecting and isolating of the faulty section.

5.1 General Requirements

The line-switch and the associated control device shall be an automatic equipment working by sensing the presence or absence of the system voltage when a circuit breaker in the substation operated and automatically sectionalizing the faulted part of the distribution line without the need for coordination with the computer aided system in the primary (upstream) distribution feeder.

5.2 The functions of the line-switch and the control device shall be provided with the following functions:

(1) The line-switch and the control device of reclosing to pick up the load or the short-circuit currents as specified in the separate specification.

(2) The control device as specified in this specification

(3) The control cables to connect.between the line-switch and the control device, with the suitable accessories.

6. System Hardware

6.1 Hardware for Control Center

One set of the system hardware which is installed in the control center, shall consist of Computer, Interface, Printer, Collective Supervisory Board, CRT display, UPS, RTU and Console Desk.

6.1.1 Computers

The computer system shall be duplicated computer system operating in the concept of Main/Standby. The minimum requirements for each computer are as follows:

(1) A high-speed, real-time, digital computer with inter-computer link, floating point processor, each memory, memory managements, input/output controllers and other necessary modules. This computer shall be equipped with the sufficient memory function in accordance with the individual requirements of the Project, prefer 32 bits computer, main memory not less than 4 M bytes.

(2) Two magnetic tapes, not less than 95 M bytes, in each tape

(3) Two disks, not less than 100 M bytes in each disk, in conception of Main/Standby

(4) System console terminals

(5) Interface with others, if any

6.1.2 Man-machine interface

(1) Change-over equipment

The equipment for man-machine interface shall be connected to one of both computer, normally connected to the assigned main computer. The change-over shall be carried out with the static switching equipment, with automatic operation from the main computer to the standby computer and vice versa

(2) Control desk

The control desk shall include a Dispatcher's Function Panel, an alphanumeric Keyboard and a display function for the feeder currents.

The desk shall be provided with the following functions

(3) Operation

(a) Switching-over of telecontrolling system operation mode

(b) Selection of the feeder terminal units

(c) The line-switch remote control (ON/OFF, LOCK-OUT/RESET)

(d) Measurement for commands of the feeder currents

(e) Check for commands of system mimic board display indicating lamps

(4) Displays

(a) Monitored feeder terminal units' informations

(b) 3-phase current values of the feeder breakers

6.1.3 Printers

Two (2) printers and the associated controller shall be provided with and the printers shall have the following minimum characteristics:

(1) 100 PC

(2) Impact dot matrix method printer

(3) 15 inches paper width

(4) 110 V ac power supply

(5) Recording items

(a) Operating reports of the telecontrol and the automatic isolating the system
(b) 3-phase currents of the feeder breakers
(c) Others, if any

6.1.4 Collective Supervisory Board (CSB)

The collective supervisory board shall display the basic configuration of the important portions of the distribution system and the related substation. The map shall show the indicated distribution lines and their connected substations. The distribution lines shall be color-coded as Red, Green, Yellow, Orange, Blue and White to show their differences of the feeders. The annunciators shall be provided at each of the feeder breakers, and the substation feeder RTUs and the line-switches FTUs to show line outages, and the terminal unit selecting.

The annunciators shall be driven by the status of the associated feeder breaker(s) and the line-switch selecting received by the controller through the substation RTUs and the line-switch FTUs. The receiving indicator shall be provided at each of the feeder breakers and the line-switches to show Green for a tripped (open) condition and Red for a closed condition. The collective supervisory board shall be constructed using the mosaic technique and have the dimensions of 2800 x 5000 x 650 mm. The map shall be simple to modify and maintain. A lamp test facility shall be provided to test for in-place all annunciator bulbs.

6.1.5 CRT Display

Two (2) CRT displays interface with the controller including the keyboard shall be high density, eight (8) colors equipment. The CRT screen shall be rectangular with a minimum diagonal measurement of nineteen (19) inches or more. The monitor shall be constructed for integral console mounting. The controls and the adjustments shall be accessible from the front of the CRT monitor. One (1) CRT display shall show the characters only and the another one CRT display shall show graphic only. The functions of the CRT display are as follow:

(1) Command for searching the current of the breakers

(2) Up-to-date of data of the substation(s)

(3) Display the substation one-line-diagrams including all line-switches, and the feeder current charts, and display ON/OFF status of the line-switches and the current(s) at the points of the line-switches.

(4) Transfer one scroll for all directions on the request to the controller

(5) Indicate on the CRT screen within 10 seconds, prefer within 4 seconds for all characters and graphics.

The substation O/L diagram shall include the primary and the secondary line breakers and the transformer banks, and display the secondary bus-bar voltage and the 3-phase currents of each of the feeder breaker and display the secondary line-switches and their operating status. The feeder current charts are means for the dispatcher's review of data, entry of data, and control of the power system and the controller. Each chart shall include one substation data which contain the updated 3-phase currents of the feeder breakers. All dynamic data on a display shall be automatically updating process. The power source of the CRT display shall be 220V ac plus, minus 10 per cent.

6.1.6 Uninterruptible Power Supply (UPS)

In order to maintain the high level of reliability to accept the power system operation, the control center equipment shall be supported with uninterruptible power. The quality of the power provided by the UPS shall be adequate to support the control center equipment described in this specification and to supply the few power to operate emergency lighting in the control room. The control room emergency lighting is assumed not to exceed 40 VA.

The UPS shall accept 400V ac, 3-phase input and is provided with ac-dc & dc-ac converters to obtain 220V ac single-phase. The voltage regulation shall be plus, minus 5 per cent with voltage variation of plus, minus 10 per cent at UPS input-to-input terminals. The UPS floating battery Alkaline type, shall be provided to withstand to supply the power for not less than 30 minutes from the batteries. The capacity of the UPS received the power from the batteries shall be not less than 20 KVA. In addition, UPS shall be provided with at Auxiliary, Diesel Power Generator Set which shall be generated to the rated power within one (1) minute. The capacity of the generator shall be not less than 100 KVA and can supply the power to not only the computer system, but also the air conditioners for not less than two (2) hours. The Employer will provide with the primary and the secondary wirings and perform the wiring installations.

6.1.7 Main Controller

The controller shall be microprocessor based, control equipment installed in the control center for telecontrolling and monitoring of the entire distribution system.

The controller shall be in connection with the associated equipment by the photo-coupler to increase the electrical insulation level and the external surge protection where it is required. The details specifications are as follow:

(1) Controllers

The maximum length of the telecommunication cable(s) shall be within 15 km when the cable size is 0.9 mm diameter, and within 25 km when the cable size is 1.2 mm diameter, and within 10 km when the optical fiber is used between substation and control center.

The maximum numbers of the feeder terminal units shall be up to and including 500 units.

(2) Supervision items

(a) Feeder breaker

(i) The switching conditions

(ii) Changes of the switching conditions

(iii) The conditions of the reclosing relay

(b) Line-switch

(i) The switch conditions

(ii) Changes of the switching conditions

(iii) Power off the switch-power-supply

(iv) Locked-out and reset conditions

(c) Control items on the line-switch

(i) ON and OFF switching controls

(ii) Locked-out and reset controls

(d) Telemetering items

(i) Remote measuring on the main bus-bar voltages, 3-phase,

(ii) and each feeder of 3-phase load currents

(e) Automatic operation mode

(i) Initiation to receive the signal to the dispatch center

(ii) The commands for the feeder terminal units for selection from upstream one by one without present of the X-time

(iii) Receiving and checking of the signals which will come from the feeder breaker(s) and the line-switches

(iv) Recording the instructions with the printer

(v) Reset instruction(s) on the rectification signal

(f) Back-up operation mode (when the telecommunication cable or optical fiber has a trouble)

The whole operations shall meet on Clause 5, "Back-up functions", of this specification.

(g) Manual checking operation mode

(i) Check the system mimic board lamps

(ii) Testing the control center equipment by stimulating operation of the feeder terminal units

(h) Normal checking operation

(i) Self check of the microprocessor

(ii) Discovery of the microprocessor suspense

(iii) Surveillance of disconnection for the telecommunication cable or optical fiber

(i) Microprocessor

The controller shall be microprocessor based system for monitoring, selecting and controlling the whole feeder terminal units and telemetering the feeder breaker informations from the related substations.

Therefore, the microprocessor of the controller shall be superior operational reliability and be operated continuously for a long period of time, The microprocessor shall be able to easily modify with the increasing installations of the feeder terminal units. Furthermore, it should be able to connect with other computer system or other substation SCADA system to improve the level of the automation system.

(j) Control desk

Refer to Clause 6.1.2 of this technical specification

(3) Printer

Refer to Clause 6.1.3 of the technical specification

(4) Collective Supervisory Board

Refer to Clause 6.1.4 of the technical specification

(5) CRT display

Refer to Clause 6.1.5 of the technical specification

(6) Unitnterrupting Power Supply (UPS)

Refer to Clause 6.1.6 of the technical specification

6.1.8 Terminal Box

The terminal boxes shall be designed for the connection between the equipment in the control center and the telecommunication cables. Each terminal box shall be capable of installing the necessary telecommunication cables containing the sufficient pairs of 0.9 or 1.2 mm diameter copper conductors or optical fiber, and be equipped with the low voltage arrestors and the overcurrent protection fuses at each terminal to protect the equipment from the abnormal overvoltage, thunder, magnetic induction affection, etc. In case of optical fiber, arrestor is not required to equip. The contractor will provide with the primary wirings and perform the wiring installations.

6.2 Hardware for Substations

Each one set of the system hardware, which is installed in the substation, shall consist of RTU, Controller, and UPS.

6.2.1 Remote Terminal Unit (RTU)

The Remote Terminal Units shall be installed in the control room of the substation, and be the connection between the controller and the switchgear equipment in the substation which will give raw data to the control center. The RTUs shall include all necessary equipment to interface with the communication channel.

The functions of RTUs are as follows:

(1) To be selected by the controller for telemetering of the feeder breaker data in the substation

(2) Repeating of the feeder breaker pallet signal

(3) Repeating of the reclosing relay operation signal

(4) Detection of the change of the feeder breaker switching conditions and sending out the start signal to the control center

(5) Signalizing and repeating of the feeder currents

(6) Signalizing and repeating of the secondary bus-bar voltages

(7) Others, if any

The contact closures from auxiliary contacts on relays of the breaker shall interface with the input modules of the RTU's. The electrical power transducers shall be provided for measuring of the voltages and the currents. These transducers shall be prepared by the supplier. An accuracy for the voltages and the currents shall be less than plus, minus three (3) per cent for full scale. The current transducers shall be installed at each phase of the feeder breaker.

The RTUs shall be housed in electronic equipment cabinet that has sufficient feeder units for a cabinet.

The power supply for RTUs shall operate from 24 V dc battery installed in the substation and shall supply all necessary power to support the communications of RTUs.

6.2.2 Controller

Each set of remote controller to be installed in the substation shall include control equipment, microprocessor, change-over switched, indicators and control switches. Refer to main controller specified in Clause 6.1.7 for more detailed specifications.

6.2.3 Uninterrupting Power Supply (UPS)

UPS shall be so designed and provided as specified in Clause 6.1.6 hereinbefore.

6.3 Hardware of Distribution Lines

Each set of the system hardware, which is installed in distribution lines, shall consist of Automatic Line Sectionalizer, Feeder Terminal Unit (FTU) including control device, PT & CT and other accessories.

6.3.1 Automatic Line Sectionalizer (ALS)

ALS shall be so designed and provided as specified in Clause 4.1 herein before.

6.3.2 Feeder Terminal Unit (FTU)

Feeder Terminal Unit (FTU) installed in the same switchboard as the automatic line sectionalizer (ALS) shall be in connection with the remote controller to control and monitoring the ALS automatically.

In addition, the FTU shall be completely self powered, i.e., no external AC or DC control supply should be required to be provided for the operation. The use of a maintenance free battery is permissible but the life of the battery should not be less than 5 years. And the battery shall be capable to operate properly to control the FTU when the faulty section will be detecting and isolating by the computer aid automatic control distribution system.

The requisite details and description of the battery and associated accessories will be supplied by the tenderer so as to satisfy our company as to how to it is maintenance free and the long life at least 5 years and how company will know that the battery and the accessaries have gone out of order.

7. System Software and Control Devices/Indicators

7.1 System software for Control Center

The software for each set of the system, installed in the control center shall consist of:

(1) Real-time operation of the system

(2) Real-time data-base management

(3) Real-time data-base generation

(4) Driving the displays

(5) Standard language, and Operation System (OS)

(6) Full instruction manuals to be submitted to the Employer

(7) Design of the system, subject to under mutual discussion and agreement

(8) Supervision of installation and training of the system, subject to under mutual discussion and agreement

(9) Training for the Employer's operator(s), system maintenance personnel and application personnel

(10) Others, if any, from time to time, subject to under mutual discussion and agreement

Note : The discussion(s) and the agreement(s) shall be carried out/finalized between the Employer and the Contractor

7.2 Control Device for Substations and Distribution Lines

7.2.1 Type of Control Device

The control device for the line-switch to be supplied shall be of normal close type (NC type) which is used for the 3-phase normally closed line-switch using the voltage time control and sensing the voltage on either the line (source) side or the load side.

7.2.2 Functions

This control device (NC type) shall have the following functions:

(1) The line-switch shall open automatically with a time delay when the control device senses the loss of voltage caused by the opening of a circuit breaker in the substation or when the control device receives command signal to open from the control center. This time delay called "no-voltage released time" or "Z-time" shall be between 1.5 and 3 seconds including the opening time of the line-switch. (The Z-time in the control device only shall be between 1.5 and 2.7 seconds).

(2) When the circuit breaker closes at the first delayed reclosing (the line-switch is still in the open position), the line-switch automatically close after a pre-set time called "closing time" or "X-time" has expired. The closing time (X-time) shall be adjustable from 10 to 60 seconds with steps of 10 seconds, with the accuracy of plus, minus 5 per cent.

(3) After the line-switch closes, a time called "lock-out time" or "T-time" starts. If a fault occurs and the circuit breaker opens within the lock-out time (Y-time), the line-switch shall be opened and locked-out. The lock-out time (Y-time) shall be 5 seconds, fixed at the factory, with the accuracy of plus, minus 5 per cent.

(4) If the pre-set time of the lock-out time (Y-time) has expired with no loss of voltage, the control device returns to its initial condition.

(5) Sensing voltage comes from the line (source) side or the load side of the line-switch whether the voltages from either side is present.

(6) When the voltage is lost during the closing time (X-time) is running, the control device shall be automatically locked-out.

7.2.3 Other Requirements

It shall be ensured that NC type of the control device shall be locked-out only for a permanent fault. For the temporary voltage failure or the voltage dip, the control devices shall not be locked-out.

The control device shall be weather-proof type and sealed with the high quality synthetic rubber or the equivalent materials. Accumulation of moisture within the control device shall be prevented.

The enclosure of the control device shall be corrosion-proof construction. Steel enclosure and the other steel parts shall be hot-dip galvanized or coated with the anti-corrosion paint(s) and the finish cost whichever is applicable.

The control device shall be capable of controlling the line-switch either manually or automatically by an operating handle.

The NC type control devices shall be manually reset by the operating handle after the lock-out.

The front face of the control device shall be marked with the suitable indication.

Each control device shall be provided with the surge protector for protecting from any surge voltage coming into the control circuit.

A grounding terminal with M8 bolt of stainless made, accepting the copper earthing conductor, sized 22 mm^2 to 38 mm^2, at the control device shall be provided.

Control cables for connecting between the control device and the line-switch shall be supplied.

7.3 Faulty Point Indicator

Faulty point indicator is a device installed in a substation to indicate the faulty section of a distribution line.

The faulty point indicator will sense the operation of the circuit breaker in the substation while working in combination with the line-switch installed on the distribution line. The faulty part of the distribution line will be indicated on the indicator.

The power supply to the faulty point indicator shall be 110 V ac and the rated frequency shall be 60 Hz.

The faulty point indicator shall be quoted separately.

7.4 Coordination with circuit breaker in substation

The line-switch which associates with the control device shall be suitable for operation with or without the computer aid automatic control distribution system, in conjunction with the circuit breaker in the substation having the following operating sequence:

0 — 5 seconds — CO — 15 seconds — CO — 45 seconds — CO — lock-out

8. Performances

8.1 System performance

(1) Under normal condition

The system shall operate within 50% of the total capacity

(2) Under maximum treating condition

The system shall operate within 70% of the total capacity

8.2 Fail-over performance

The change-over from main (master) facility to standby (slave) facility shall be carried out within 15 seconds for full operations.

9. Test

9.1 Acceptance test at the factory

(1) The Contractor shall submit to the Employer whole necessary documentations for the acceptance test at the factory.

(2) The test shall be carried out at the factory under witness of the authorized personnel of the Employer.

9.2 Acceptance test at the Site

The acceptance test at the site shall be carried out in accordance with the Instruction by the Employer. The main item of site test is operation test.

ATTACHMET - 2

Total Power Demand

(Daytime/Night time)

	PHASE I			PHASE II			Total Load (day/night)
	Demand	Utility Factor (day/night)	Actual Load	**Demand**	Utility Factor (day/night)	Actual Load	
1. Industrial Zone	55 MVA	0.9/0.9	50/50 MVA	40 MVA	0.9/0.9	36/36 MVA	86/86 MVA
2. Urban Zone	10 MVA	0.8/0.5	8/5 MVA	4 MVA	0.8/0.5	3.2/2 MVA	11.2/7 MVA
3. Housing Zone	14.3 MVA	0.3/0.8	4.3/11.5 MVA	19 MVA	0.3/0.8	5.7/15.2 MVA	10/26.7 MVA
4. R & D Zone	2.5 MVA	0.6/0.1	1.5/0.3 MVA	4.5 MVA	0.6/0.1	2.7/0.5 MVA	4.2/0.8 MVA
5. Amenity Zone	1 MVA	0.5/0.6	0.5/0.6 MVA	3 MVA	0.5/0.6	1.5/1.8 MVA	2/2.4 MVA
6. Institutional Zone	-	0.8/0.8	-	2 MVA	0.8/0.8	1.6/1.6 MVA	1.6/1.6 MVA
7. Utilities	1 MVA	0.6/0.4	0.6/0.4 MVA	1 MVA	0.6/0.4	0.6/0.4 MVA	1.2/0.8 MVA
Total	83.8 MVA Say 84 MVA		64.9/67.8 MVA	73.5 MVA Say 74 MVA		51.3/57.5 MVA	116.2/125.3 MVA
Total Demand : 158 MVA							

Power Demand Forecast

Zonig	Component	Land Use Plan (ha) M/Plan	JICA	Calculation	Power Demand
		346	360		95MVA
1. Industrial Zone		---	---		---
	(1) Phase 1	236		135ha x 40VA/sq.m = 54MVA. Others = 1MVA total	55MVA
	(2) " 2	160		96ha x 40VA/sq.m = 39MVA Others = 1MVA toal	40MVA
		149	30		14MVA
2. Urban Zone	(1) Town Center	---	--		---
	(2) Sub center	101		101ha x 10va/sq.m = 10MVA	
	(3) Neighborhood center	28		1MVA x 10VA/sq.m = 2.8MVA -> 3MVA	
		-			
		478	710		33MVA
3. Housing		---	---		---
	(1) Low	189		Rever to attached calcultaion sheet	
	(2) Medium	163			
	(3) High	126			
		165	60		7MVA
4. R& D		---	--		---
	(1) University	90		4 MVA	
	(2) Polytechnic	35		2 MVA	
	(3) Public R&D			0.5 MVA	
	(4) Private R&D	40		0.5 MVA	
		273	290		4MVA
5. Amenity Zone		---	---		---
	(1) Golf Course	200		1.5 MVA	
	(2) Theme Park	30		2 MVA	
	(3) Sports Complex	10		0.5 MVA	
	(4) Natural park	33			
		37	0		2MVA
		--	-		---
6. Institutional	(1) Hospital	20		1.5 MVA	
	(2) Institutional Use	17		0.5 MVA	
	(1) Retention pond			2 MVA	2MVA
7. Utilities	(2) C.T.P				---
	(3) REservoir				
				Not considerd	0MVA
	(1) Primary				---
8. Road	(2) Secondary				
Total		1448	1450		157 MVA

Power Demand Forecast of Housing Zone

1. Assumption

Housing Unit	Unit/ha	Basic Demand (*)	Type	Area
(1) Low Density	13	4 kVA/Unit	Bungalow/Semi D.	112 ha
(2) Medium density	20	3 kVA/Unit	Terrace House	145 ha
(3) High Density	40	3 kVA/Unit	Apartment	33 ha
(4) High Density Low cost	45	2 kVA/Unit	Flats	72 ha
(5) Mixed Density	24	3 kVA/Unit	Apart./Terrace	108 ha

(*)Recent data in KL (Average)

2. Calculation

(1) Low Density (p-2)	112 ha x 4 kVA/unit x 13 Unit/ha =	5,824 kVA
(2) Medium Density (p-2)	145 ha x 3 kVA/unit x 20 Unit/ha =	8,700 kVA
(3) High Density (p-2)	33 ha x 3 kVA/unit x 40 Unit/ha =	4,455 kVA
(2) High D. L. C. (p-1)	72 ha x 2 kVA/unit x 45 Unit/ha =	6,840 kVA
(2) Mixed Density (p-1)	108 ha x 3 kVA/unit x 24 Unit/ha =	7,776 kVA
Total (installed capacity)		33,235 kVA
	Phase -1	14,256 kVA
	Phase -2	18,979 kVA

Utility factor : daytime 30%
night time 80%

IMPLEMENTATION PROGRAM OF POWER SUPPLY SYSTEM

Item \ Time	Unit	Q'ty	1992 2 3 4 5 6 7 8 9 10 11 12	1993 1 2 3 4 5 6 7 8 9 10 11 12	1994 1 2 3 4 5 6 7 8 9 10 11 12	1995 1 2 3 4 5 6 7 8 9 10 11 12	1996 1 2 3 4 5	Remarks
Arrangement of Fund								
Detailed Design & Tender Document								
Engineering Services								
Lot I 132 kV Transmission Lines								
I-1. Tender Call & Estimation								
I-2. Tender Evaluation & Contract Award								
I-3. Manufacturing & Shipment								
I-4. Overseas & Inland Transportation								
I-5. Site Erection/Construction								
Kulim S/S--New S/S	km	6		Civil engineering work / Tower construction / Stringing				
Sungai Petani S/S--New S/S	km							
I-6. Completion/Commissioning								
Lot II Substations								Industrial Zone
II-1. Tender Call Estimation								
II-2. Tender Evaluation & Contract Award								
II-3. Manufacturing & Shipment								
II-4. Overseas & Inland Transportation								
II-5. Site Erection/Construction								
Main Substation (90 MVA)	set	1		Civil engineering and building works / 132 kV GIS / 33 & 11 kV switchgear / Main transformers / Cabling				
Distribution Substation (30 MVA)	sets	2		Civil engineering and building works / 33 & 11 kV switchgear / Distribution transformers / Cabling				
II-6. Completion/Commissioning								
Lot III Distribution Lines								Industrial Zone
III-1. Tender Call Estimation								
III-2. Tender Evaluation & Contract Award								
III-3. Manufacturing & Shipment								
III-4. Overseas & Inland Transportation								
III-5. Site Erection/Construction								
III-6. Completion/Commissioning								
Lot IV Substation for Other Zones								
IV-1. Tender Call & Estimation								
IV-2. Tender Evaluation & Contract Award								
IV-3. Manufacturing & Shipment								
IV-4. Overseas & Inland Transportation								
IV-5. Site Erection/Construction				Civil engineering and building works / 33 & 11 kV switchgear / Distribution transformers / Cabling				
IV-6. Completion/Commissioning								
Lot V Distribution Lines for Other Zones								
V-1. Tender Call & Estimation								
V-2. Tender Evaluation & Contract Award								
V-3. Manufacturing & Shipment								
V-4. Overseas & Inland Transportation								
V-5. Site Erection/Construction								
V-6. Completion/Commissioning								

ATTACHMENT -3

Power System

1. Basic Concept

(1) 132 KV transmission Line

Interconnection with TEN's Power Grid by:
- 132 KV transmission line
- 2 routes (4 feeders)

(2) Substations

Construction of new substations consisting of:
- one indoor GIS type main substation with 180 MVA output capacity
- four indoor metal-clad type distribution substations with 30 MVA output capacity

(3) 33 KV and 11 KV Distribution Lines

Construction of new distribution lines consisting of:
- underground cables double circuits in ring formation system
- taping switching stations with line sectionalizers and computer aided automatic distribution system

2. Design Conditions and Criteria

(1) Basic Design Condition
- Sufficient power supply
- High reliability
- High stability
- Easy and safety operation and maintenance
- Environmental harmony

(2) Basic Design Criteria
- Voltage regulation : ± 5% or rated voltage
- Power interruption : no long time power interruption

— Regulation and standard : TEN's Regulation and IEC standard

3. Power Demand

Table 1 shows the forecasted power demand and summarized below:

	Industrial Zone	Other Zones	Total
Phase 1	55 MVA	29 MVA	84 MVA
Phase 2	40 MVA	34 MVA	74 MVA
Total	95 MVA	29 MVA	158 MVA

4. Basic Plan

Basic planning for construction of power supply system is made referring to the power demand forecast and specific requirements of the Kulim Hi-Tech Industrial Park. Figure 1 indicates the overall power supply system diagram.

(1) 132 KV Transmission Lines

(a) Lines route and distance

— No. 1 line : Kulim S/S --- New S/S (approx. 6 km)
— No. 2 line : Sq. Petani S/S --- New S/S (approx.30 km)

(b) Line voltage, No. of circuit and conductor size

— No. 1 line : 132 KV 2 circuits ACSR 300 mm^2
— No. 2 line : 132 KV 2 circuits ACSR 300 mm^2

(c) Support and insulator

Self-supporting broad based lattice steel construction or steel tubular poles or concrete poles with crossarms, brown glazed porcelain insulator.

(2) Substations

Figure 2 indicates the power supply system diagram in the Hi-Tech Industrial Park.

(a) Location of new substation (Main and Distribution substations) Center point of electrical load (See Figure 3).

(b) Main substation (132/33/11 KV) 1 set

— Type : indoor GIS type (132 KV side)

— Capacity : 90 MVA for Phase 1
90 MVA for Phase 2

— Arrangement and composition of switchgear :

° 132 and 33 KV bus : double bus
° 11 KV bus : single bus
° 33 and 11 KV switchgear : indoor metal-clad type
° protective relays system : high speed tripping and auto-reclosing
° transformer : outdoor oil-immersed type with OLTC

(c) Distribution substation (33/11 KV) 4 sets

— Type : indoor metal-clad switchgear type (33 and 11 KV side)
— Capacity : 30 MVA

(3) Distribution Lines

Figure 4 indicates the block diagram of 33/11 KV distribution lines in the Hi-Tech Industrial Park.

(a) 33 KV distribution lines

— Line voltage and conductor size : 33 KV, XLPE 300 mm^2

— No. of line : main S/S = 10 lines in total
distribution S/S = 54 lines in total

— Arrangement : double circuit ring formation system

(b) 11 KV distribution lines

— Line voltage and conductor size : 11 KV, XLPE 300 mm^2

— No. of line : main S/S = 20 lines in total
distribution S/S = 80 lines in total

— Arrangement : double circuit ring formation system

(c) Switching and power receiving station

— Operation system : Computer aided automatic power distribution system, see Figure 5

— Location of stations : See Figure 3

— Switchgear : 33 KV = circuit breaker
11 KV = section switch

5. Implementation Plan

(1) Scope of Work

Table 2 shows the scope of work for power supply system of the Project.

(2) Implementation Program

Figure 6 indicates the implementation program for power supply system of the Project.

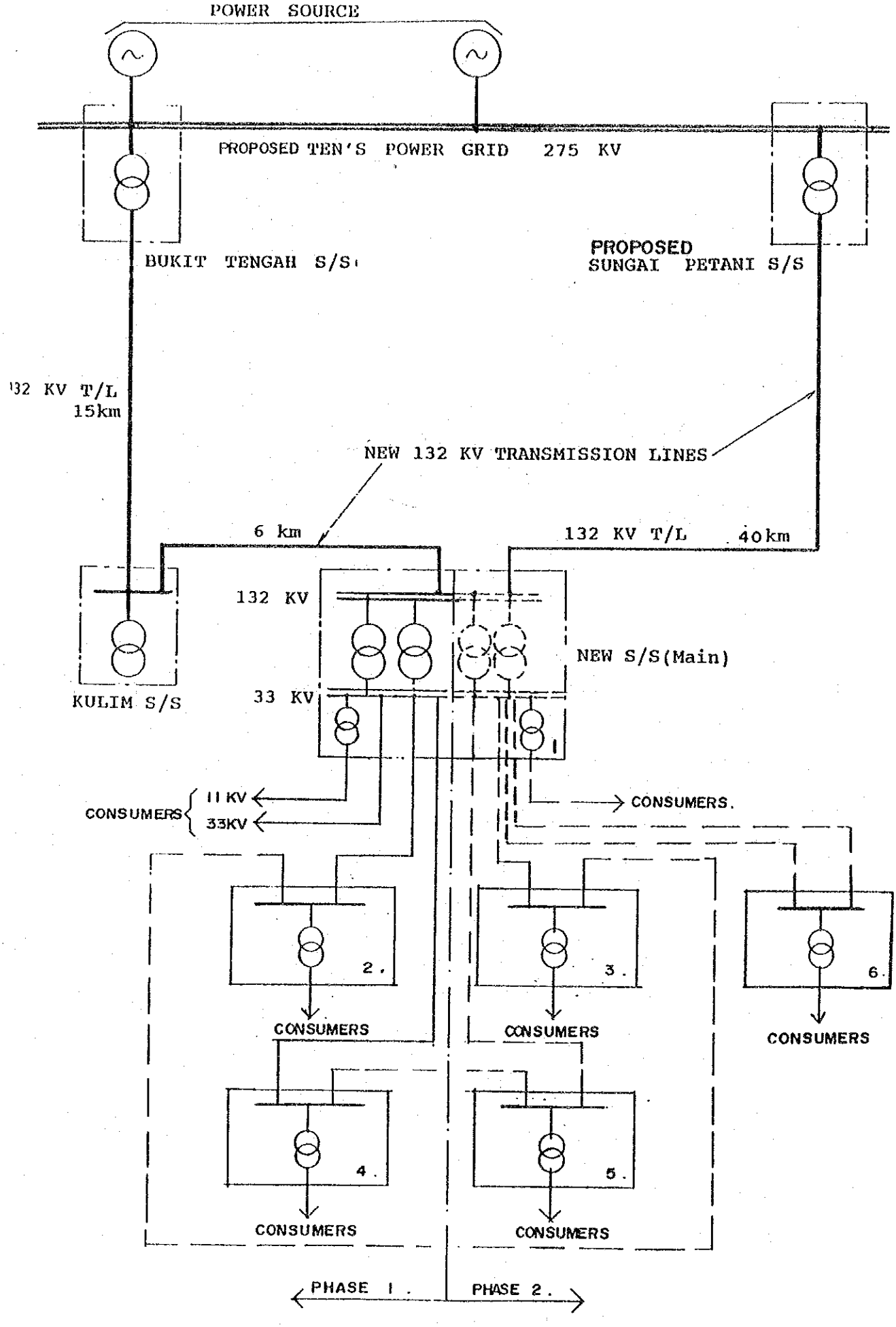


FIG. 1 OVERALL POWER SUPPLY SYSTEM DIAGRAM

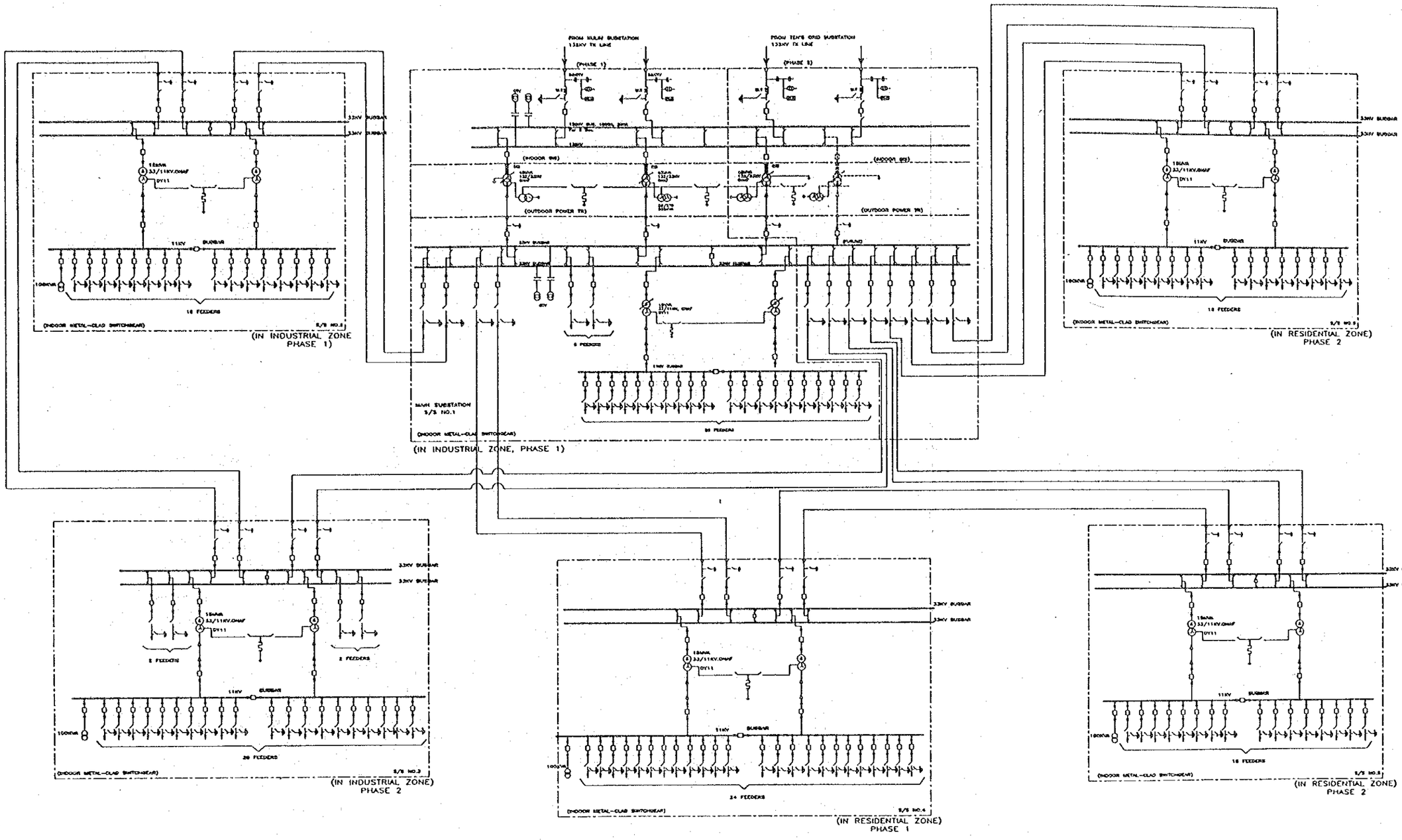


Fig.2 Power Supply System Diagram

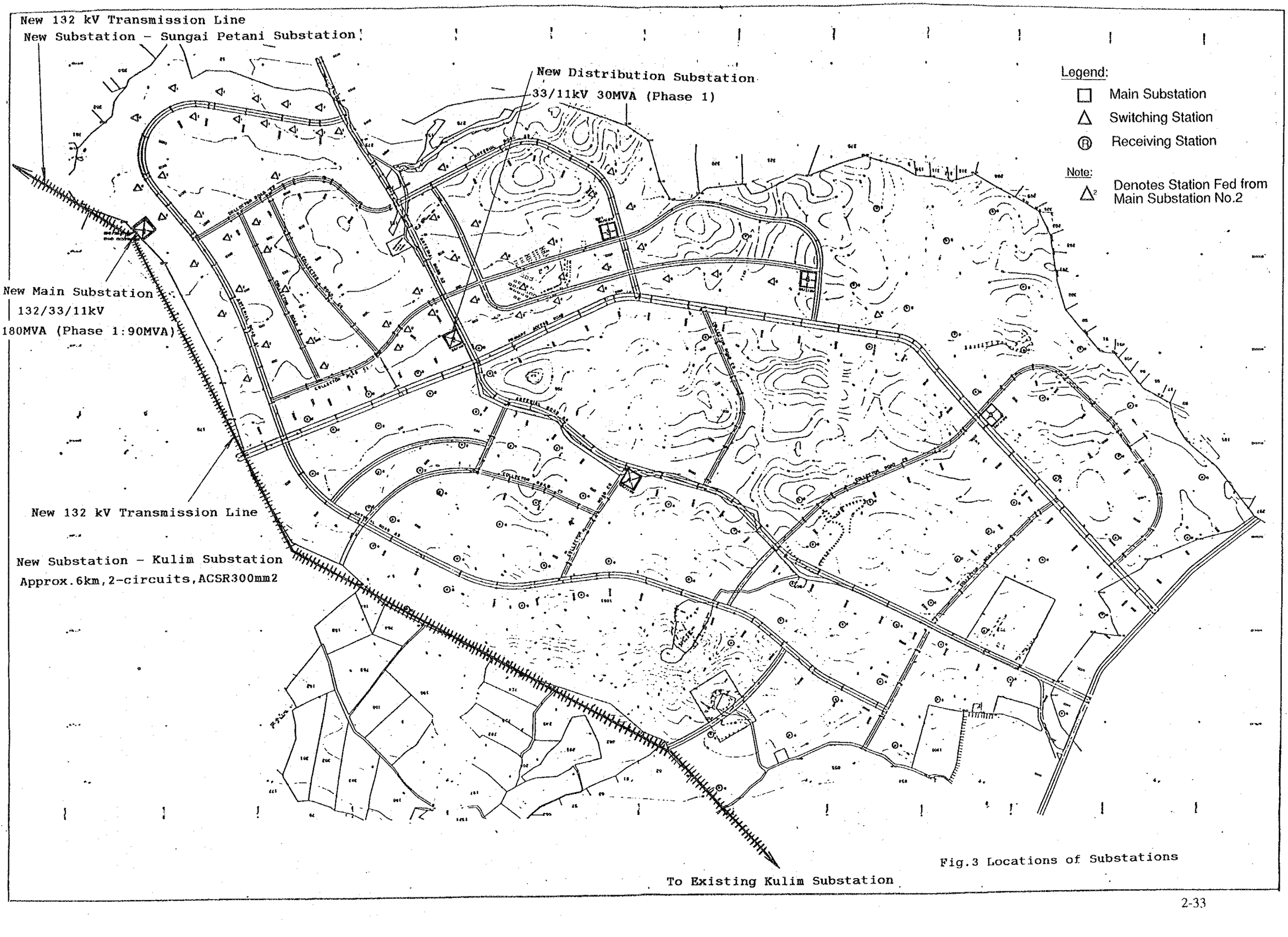


Fig.3 Locations of Substations

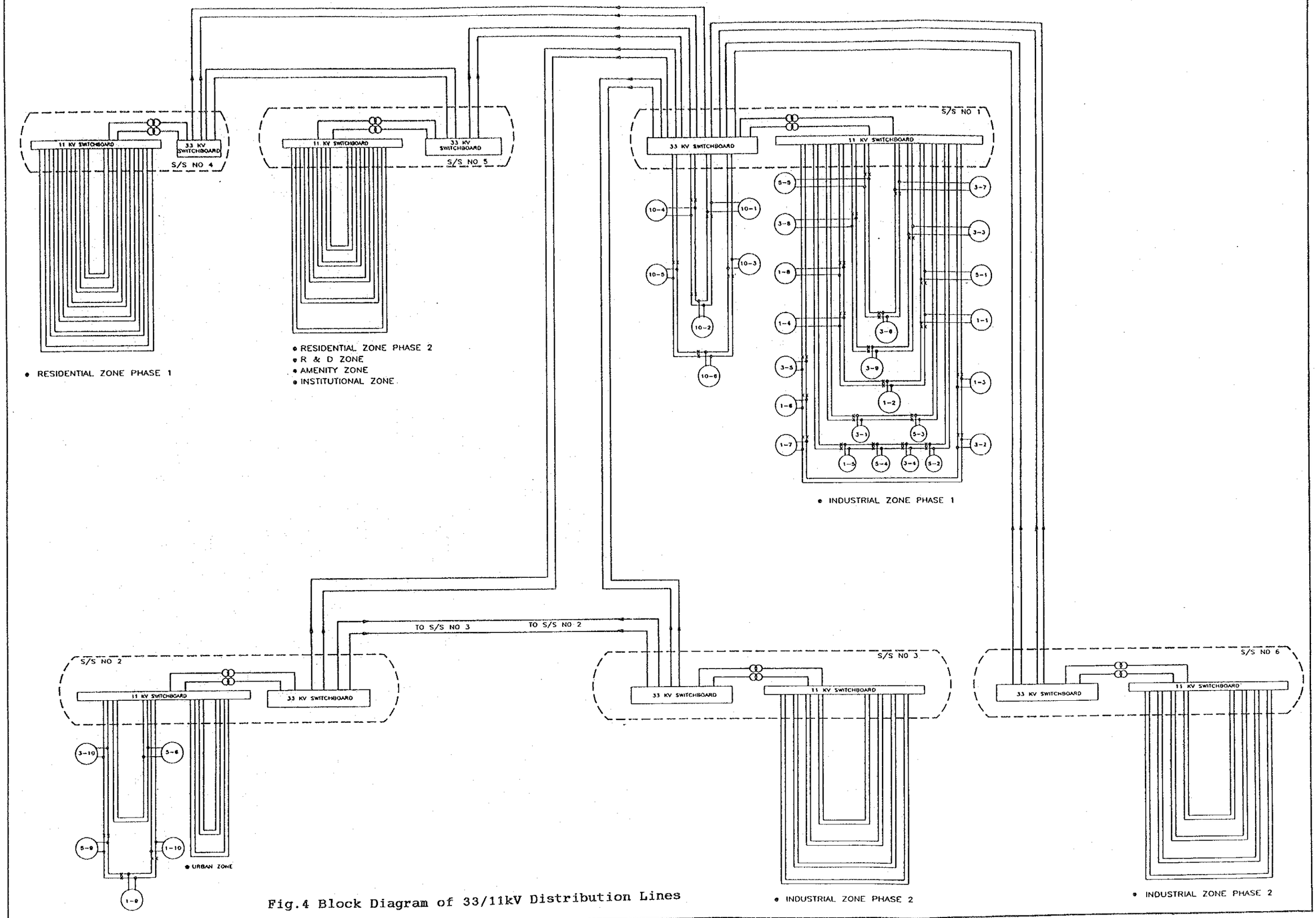
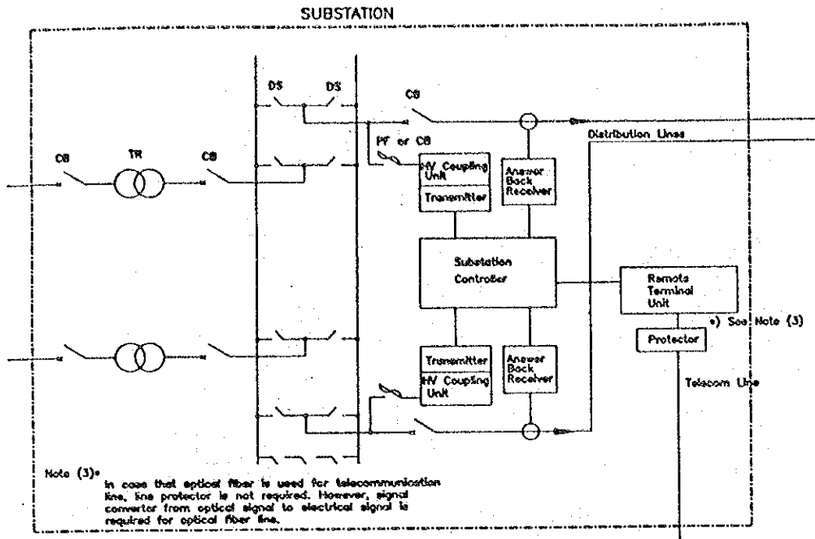


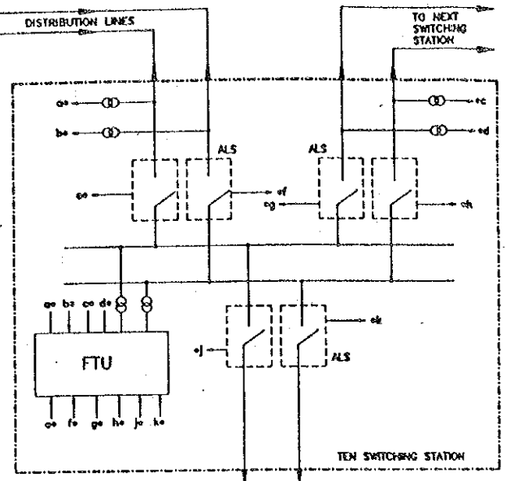
Fig.4 Block Diagram of 33/11kV Distribution Lines

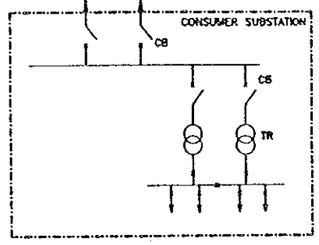
COMPUTER AIDED AUTOMATIC DISTRIBUTION SYSTEM (CAD)



TYPICAL SINGLE LINE DIAGRAM AT SUBSTATION

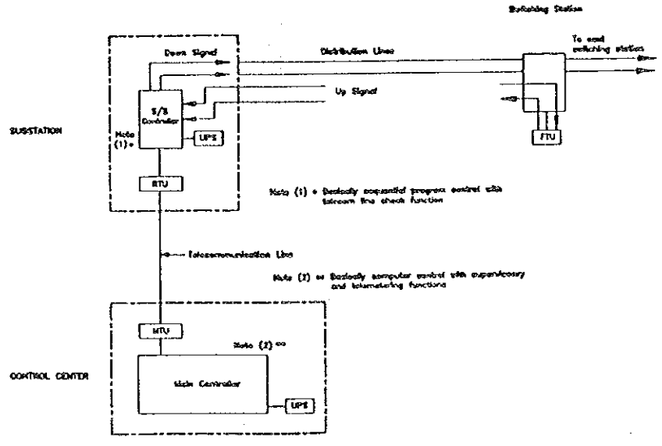
Control Center Diagram





LEGEND

MTU	=	Main Terminal Unit
RTU	=	Remote Terminal Unit
FTU	=	Feeder Terminal Unit
ALS	=	Automatic Line Sectionalizer
CB	=	Circuit Breaker (GIS or VCB)
TR	=	Transformer
UPS	=	Uninterruptible Power Supply System



TOTAL SYSTEM DIAGRAM (CADS)

Fig.5 Operation System

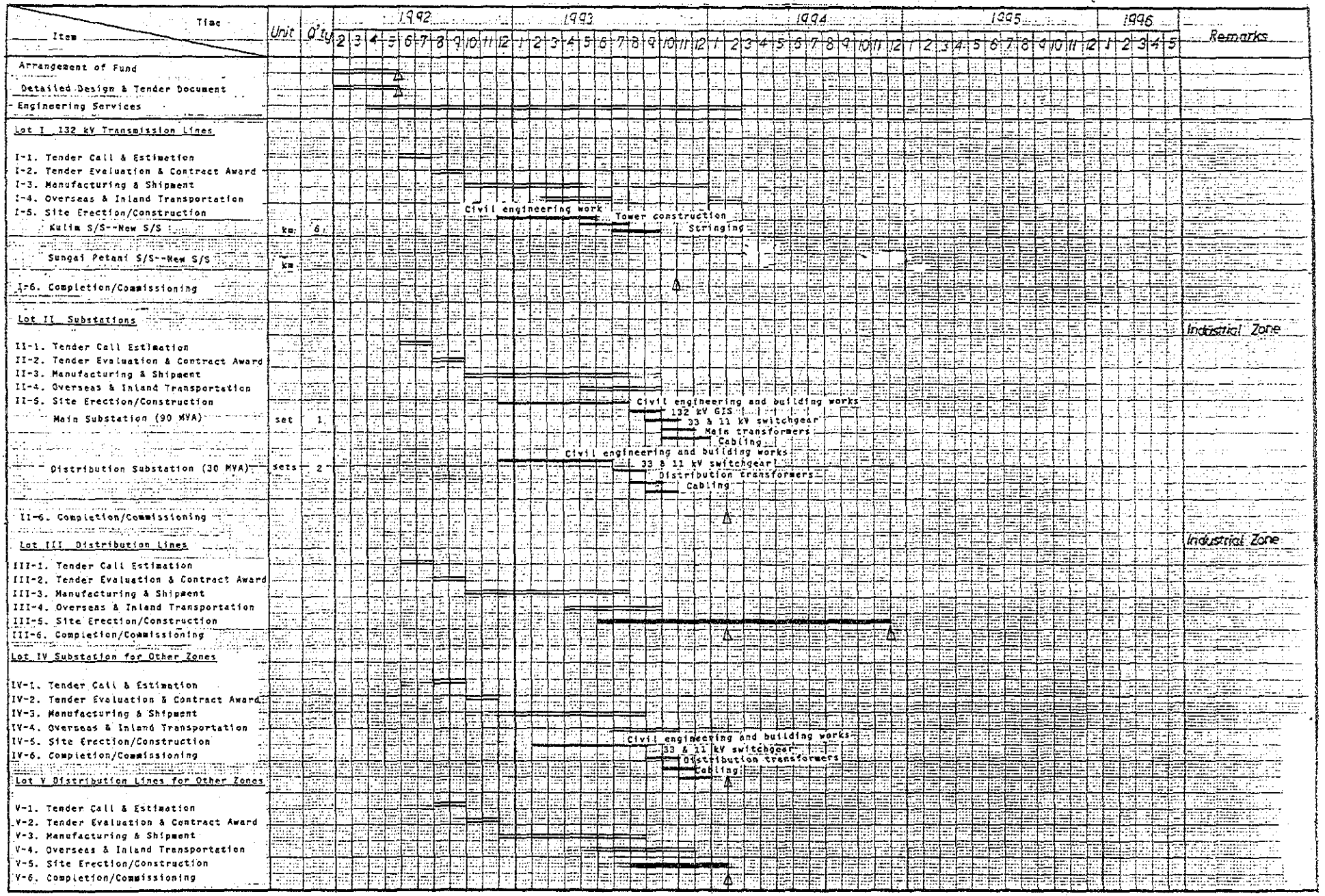


Fig.6 Implementation Programme

ATTACHMENT - 5

POWER SUPPLY SYSTEM - CHECK LIST

Progress

1. Power Demand Forecast

2. 132kV Transmission Lines
   (1) Line route
   (2) Economical size of conductor (loss and voltage drop)
   (3) Cable beam bridge(s) for crossing the river(s)
   (Underground cables)
   (4) Arrangement of cable pits
   (5) Backfilling materials (Sand quality)
   (6) Protection measure for bend parts of cables
   (7) Supervisory system (telemeter)
   (8) Types of foundations (soil condition)
   (9) Insulation coordination/Lightning protection design

3. Substation
   (1) Location and capacity of substation
   (2) Control and protection
   (3) Geological condition
   (4) Operation and maintenance
   (5) Type selection
   (6) Number of distribution line feeder
   (7) Remote control and supervisory system
   (8) Necessity of future expansion
   (9) Civil engineering and building works

4. Distribution Line
   (1) Line route
   (2) Economical size of conductor (loss and voltage drop)
   (3) Cable beam bridge(s) for crossing the river(s)
   (4) Arrangement of cable pits
   (5) Backfilling materials (Sand quality)
   (6) Protection measure for bend parts

(7) Supervisory system (telemeter)

(8) Computer aided automatic distribution system

5. Construction method and Schedule

6. Drawing (Refer to Drawing List)

7. Construction Cost

DRAWING LIST

Progress

Lot I 132kV T/L DWGS:

(1) Location
(2) Route map
(3) Typical tower skelton (A, B, C, & D)
(4) Typical foundation including pile foundation
(5) Assembly of insulator string set
(6) Underground cable erection method

Lot 11 132/33/11kV S/S DWGS:

(1) Symbol & Abbreviations
(2) Location map
(3) Grid substation location
(4) Power system diagram (northern part)
(5) Single line diagram (main S/S)
(6) Single line diagram (distribution-1 S/S)
(7) Single line diagram (distribution-2 S/S)
(8) Arrangement of equipment (main S/S)
(9) Arrangement of equipment (distribution-1 S/S)
(10) Arrangement of equipment (distribution-2 S/S)
(11) Single line diagram, AC/DC system & 48V system
(12) Protection system diagram
(13) PLC system diagram
(14) Building, plan & Section
(15) Single line diagram (Existing Kulim S/S)
(16) Single line diagram (Existing Sungai Petani S/S)
(17) Arrangement of equipment (Existing Kulim S/S)
(18) Arrangement of equipment (Existing Sg. Petani s/S)

Lot 111 33/11kV D/L DWGS:

(1) Location
(2) Route map & cabling block diagram
(3) Automatic distribution system diagram

(4) Control and indication system diagram
(5) Underground cable erection method
(6) Arrangement of line sectionalizers

TELECOMMUNICATIONS SYSTEM

1. Basic Concept

(1) Transmission System

Interconnection with STM's National Network by:

- Optical fiber digital transmission system and radio transmission system
- 2 routes

(2) Teleport (Telephone Office)

Construction of new telephone office in the Kulim Hi-Tech Industrial Park for Local Area Network (LAN) services.

(3) Distribution System

Construction of new distribution telecommunications lines to subscribers for the Kulim Hi-Tech Industrial Park by means of:

- direct underground cable distribution method, and
- Cross-connection cabinet distribution method

2. Design conditions and Criteria

(1) Design Conditions

- High speed and big capacity data transmission (digitalization)
- High reliability and stability (high quality)
- Simple and easy operation and maintenance system
- Environmental harmony

(2) Design Criteria

- Subscriber demand to be considered: 10 years
- Utilization factor of Exchange (subscriber/exchange line): 60%
- Transmission loss from local exchange to subscriber: 8 dB or less
- STM standard is applied

3. Telecommunication Demand

Table 1 shows the forecasted telecommunications demand and summarized below: (Unit: No. of subscribers)

	Industrial Zone	Other Zone	Total
Phase 1	1,200	8,660	9,860
Phase 2	600	2,280	2,880
Total	1,800	10,940	12,740

4. Basic Plan

Basic planning for construction of telecommunications system is made referring to the telecommunications demand forecast and specific requirements of the Kulim Hi-Tech Industrial Park. Figure 1 indicates the overall telecommunications system diagram.

(1) Main Transmission Trunk Lines

(a) Lines route and distance
- Existing Kulim GSC -- New telephone office (approx. 6 km)
- Existing Penang GSC -- New telephone office (approx. 18 km)

For future system:
- direct long distance optical fiber link; National Network -- New telephone office
- space satellite repeater link; (inter-) National Network -- New telephone office

(b) Type of transmission line
- optical fiber line (Kulim GSC -- New T. O.) recommended
- digital microwave radio line (Penang GSC -- Bukit Mertajam Hill -- New T. O.) future

(c) Capacity and Number of Line
- No. of lines: 770 lines (outgoing and incoming) for optical fiber
- Transmission capacity: 6 cores 30 MB for optical fiber
- Transmission capacity: 2 GHz 24 MB for microwave radio (future)

(2) New Telephone Office (Future:Teleport)
Figure 2, indicates the telecommunications system diagram in the Kulim Hi-Tech Industrial Park.

(a) Location of new telephone office: in the urban block where is the gravity center of telecommunications demand

(b) Required area: 1 ha for site area

(c) Office Building: air conditioned 4 storeys building with 1,000 m^2 floor area

(d) Exchange capacity: 5,000 CH for Phase 1

12,000 CH for Phase 2

(3) Distribution Lines

Figure 3 indicates the cabling and duct plan and location of cross connection cabinet of the telecommunications system in the Kulim Hi-Tech Industrial Park.

(a) Distribution method

- direct distribution for industrial zone
- Cross connection cabinet distribution for other zones

(b) Line loss between exchange and subscriber

- 0.4 mm dia. (1.81 dB/km): Max. distance 4.4 km
- 0.5 mm dia. (1.43 dB/km): Max. distance 5.6 km

Both are to be less than 1,500 ohm including impedance o f telephone set (marginal resistance).

(c) Cross connection ba=cabinet capacity

- Capacity: 1,600 pairs (1-ry 600 pairs: 2-ry 800 to 900 pairs)

(d) Duct and manhole
- PVC pipe 100 mm dia. or more
- STM's standard size manhole is applied

(4) New Service and Teleport

For the future demand of new services, following should be considered:

(a) ISDN (Integrated Service Digital Network) for digital telephone and data exchange services

(b) Teleport for long-distance communication media, local info-communication network and local development

5. Implementation Plan

(1) Scope of Work

(a) KSDC is responsible for procurement of the site for a telephone office and construction of underground ducts ways

(b) STM is responsible for construction of a telephone office building, installation of telecommunication equipment and cable laying.

(c) STM is also responsible for operation and maintenance of the whole system equipment including underground facilities after taken over from KSDC.

Table 2 shows the scope of work for the telecommunications system of the Project.

(2) Implementation Program

Figure 4 indicates the implementation program for the telecommunications system of the project.

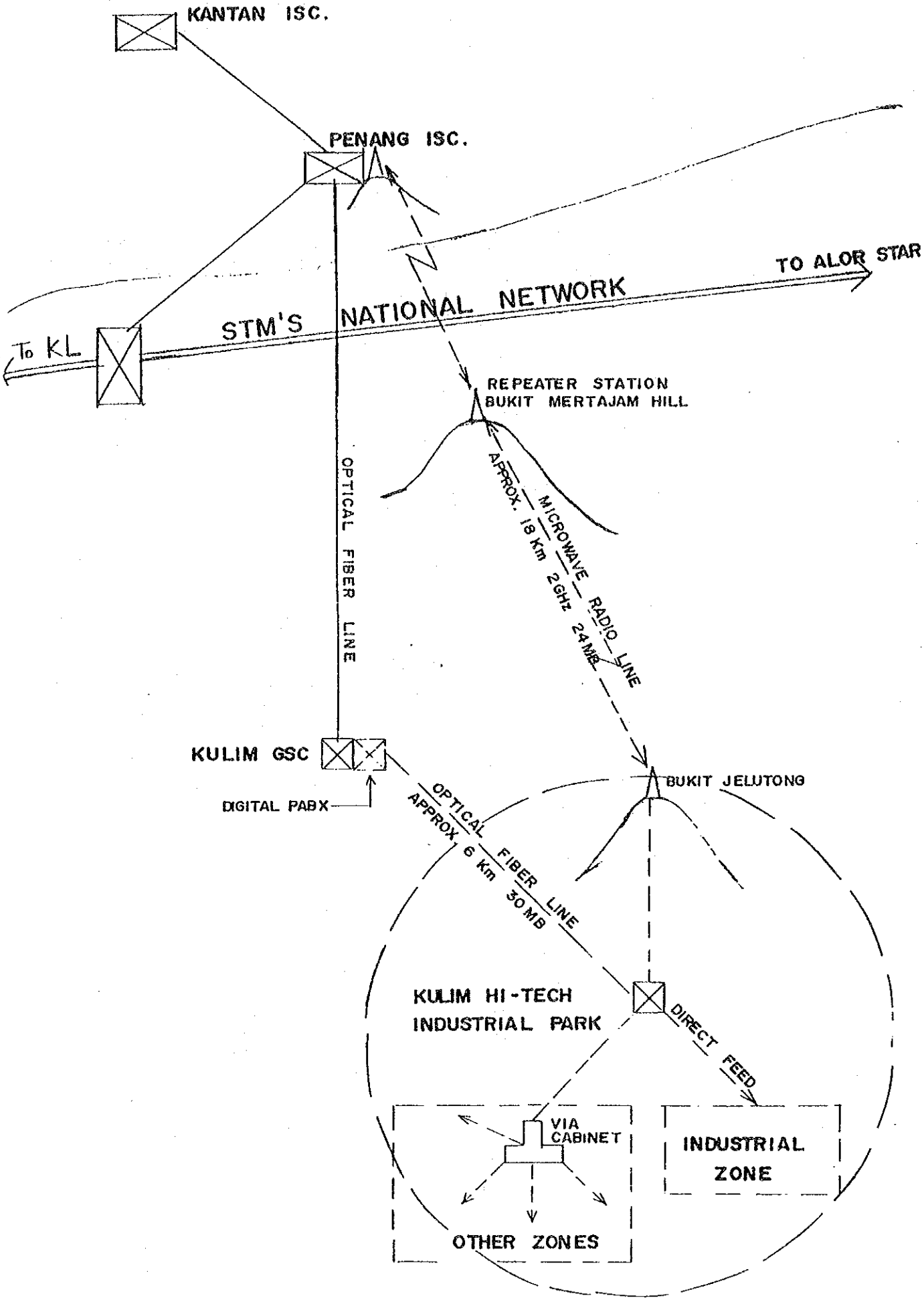
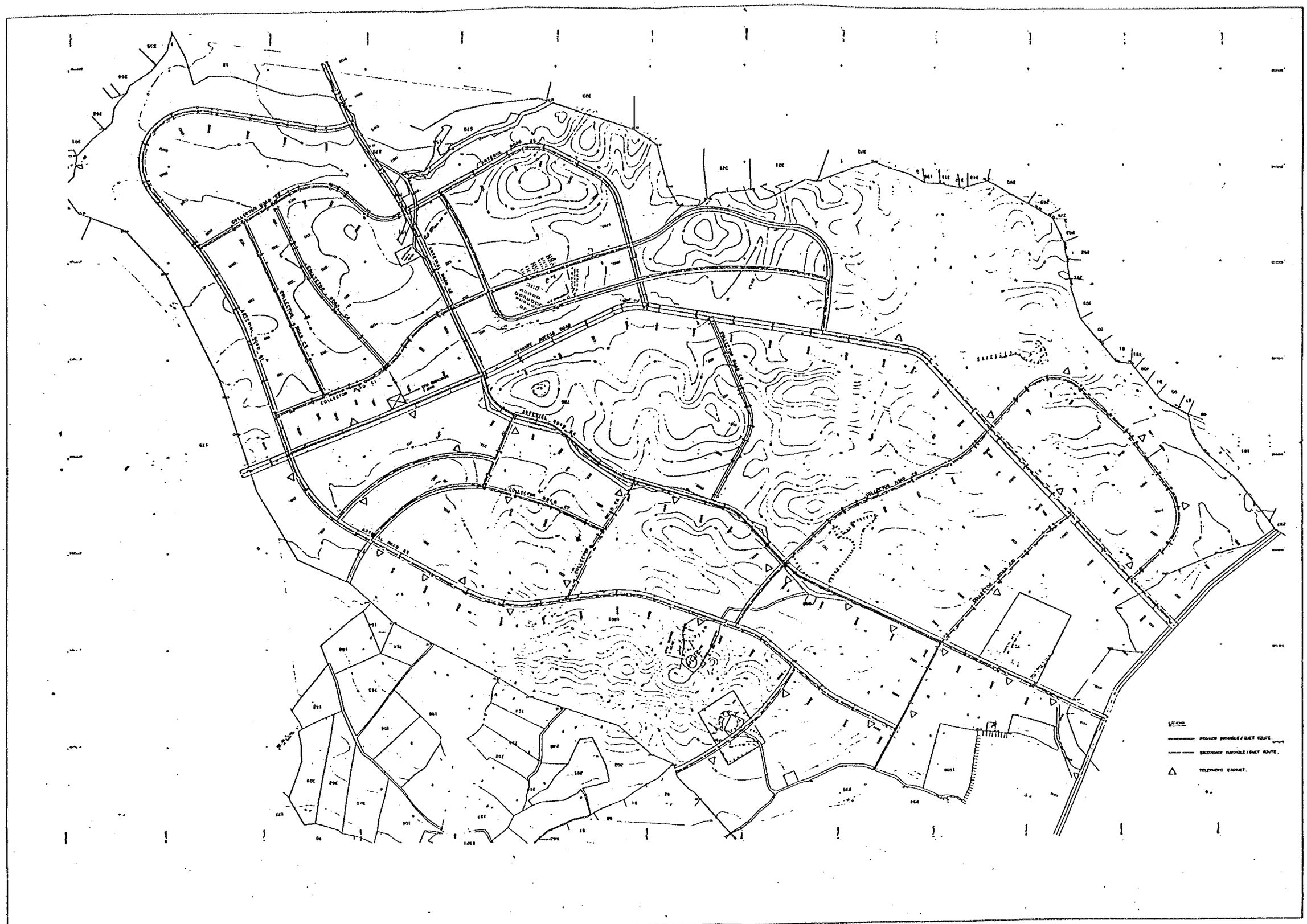


FIG. 1 OVERALL TELECOMMUNICATIONS SYSTEM DIAGRAM



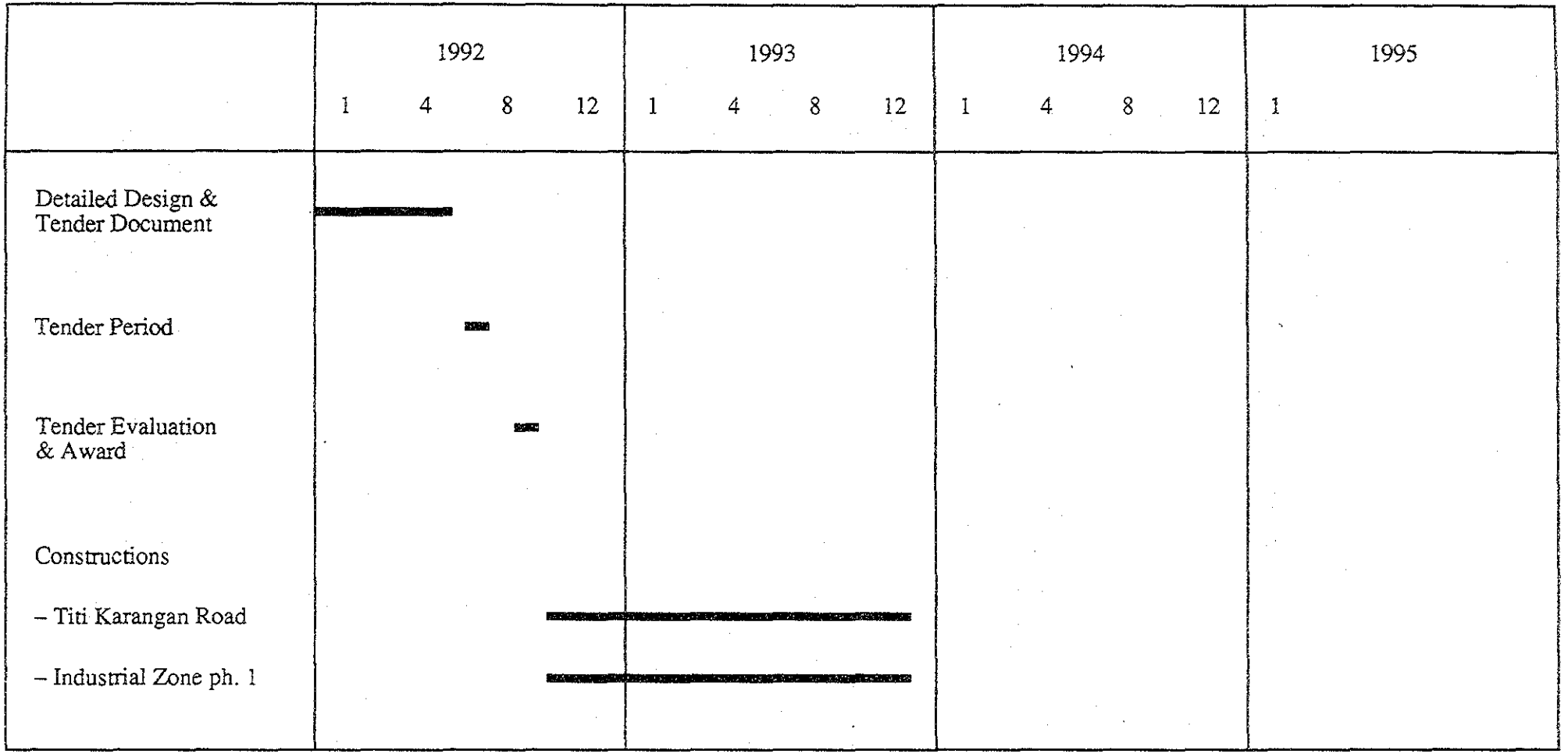


Fig. 4 IMPLEMENTATION PROGRAMME

3. TOWN PLANNING

3.1 Comments on Master Plan Study (Advisary Note No.7) (PR 1 and draft master plan, Dec. 9th 1991)

The following is JICA's comments on Progress Report of the study.

1) Page 1 - 6 : 1.5 Study Team

JICA is categorized as one of consultant Team under item of R & D zone. However as discussed i JICA Study Team's Technical/Steering Meeting, JICA in this case is an technical advisor seconded to PKNK under JICA's expert scheme.

2) Page 3 - 4 : 3.1.3 Utilities II

It says "if industrial expansion in Kedah moves at an extremely fast pace in the future .....". It seems the study has been done on only quantity part of the power supply while its quality aspect which is more important for hi-tech industries has not been examined at all.

3) Page 3 - 17 : 3.2.3 Target population/family size

55, iii) "Note" says that the JICA/UNIDO assumes a ratio of only 3.9 which ..... is too low. (Type missing?).

A family size of 5.1 was use for the analysis. In page 3-38 it says that "The average household size of the explain logical reason for determining 5.1 as a family size!

4) Page 4-23 : 4.4 Housing Zone 32

It says "High density is apartment and condominiums". Clarification should be made between low-cost housing area and apartment/condominium area, otherwise its term is very misleading.

5) Page 4-23 :: 4.5.2 Hi-Tech Thema Park

Thema park requires full participation of private sector and, in fact, it is very expensive plan. Duc to its financial viability, there is none yet in Malaysia which can be called as a thema park. Proposal have been cited in K.L. and Johore, yet

most of them are still at nearly concept. stage. The government is now constructing "Science Centre" in KL which is being financed by federal grant in view of feasibility. Besides, if it is aiming at attraction of large population, adverse effect on R & D activities, if any, must be examined together with its financial feasibility and component.

6) Factors to be taken consideration on Engineering View.

Basic design policy is to be referred the JICA's P/R(3) for 1/zone. Major focusing points are;

Land preparation
- Present topography is to be utilized as far as possible.
- Minimization of cut and fill

Road network
- Functional layout

Power supply system
- Stable and high reliability

Water Supply
- gravity distribution

Telecom
- High reliability
- Real time communication with local and abroad

Drainage
- Usage existing geography as much as possible, means gravity drainage system & cost saving

Sewerage
- Industrial sewer should be flow to Jarak River
- Gravity system

Industrial Waste
- 10 ha of land was allocated as the temporary secure storage facility in the 1st Phase Industrial Zone covering for 360 ha with 25 years.

Landscaping
- The highest hill area is conserved as park and open space for recreational

purposes.

- A peripheral area of skirt the industrial zone is conserved as buffer green zone.

7) Zoning/Layout

JICA's basic policy for the zoning is : -

(1) High level R & D environment should be created

(2) Urban centre at a community level should be introduced

(3) Three types of housing should be introduced with exclusive zoning between the different types

(4) Housing zone should be separated from the industrial zone to maintain environment

(5) To create an intimate urban landscape, to harmonize with local community

A proposed zoning/layout plan of draft master plan study is generally agreeable. However, the followings need to be clarified.

Terminology

Housing	low, medium, high, mixed density
Town centre	JICA's one i urban zone.
Sub centre	
Institutional	
Utilities.	It means infrastructure facilities?

Industrial Zone

1) Industrial zone should be located in the North of Watershed.

2) An introduction of industrial zone of Phase III is to be considered carefully due to;

- demand forecast of basic infrastructure is being designed based on the 360 ha as : -

Phase	Target Industry	
Phase 1	Electronics and mechatronis based industries	250 ha
Phase 2	Bio-technology and new materials based industries	110 ha

- To avoid to enter unidentified industries t the Hi-Tech Park to meet the national strategy of industrialization.

Housing

1) Is including the area for park, utilities and roads, in the 13, 25 and 62 units/ha for low, medium and high housing density respectively?

2) High density housing area of 27 ha situated south-west to towncentre are not for low cost housing (M$25000). Isn't it?

   We recommend to induce middle or high stories housing in this area to meet our concept, which be saleable as dormitory for foreign company/ies locating industrial zone/s.

3) Population calculated by 5.1 persons/household is appropriate? Compared with JICA'a one of 5.8. It should comply with forecast such as Kulim Structure Plan.

Urban Zone (Town Centre)

1) Basically agreed to extend the area for urban zone upon clarification;

   - What contents of town centre of 121 ha?, and
   - Populated projection? (shiji jinko).
   - Is expected customers from Penang, Butterworth, Sungai Petani and Taiping for proposed shopping centre.

2) A part of Urban Zone of 7 ha in the Phase 2 for industrial zone is to be reconsidered, namely cancellation or extend the area viewing from;

- business function --- extend based on the road alignment/network.
  (Too close to crossing signal point.)
- commercial function --- cancellation.

R & D zone

1) Is appropriate or enough space of 90 ha as for the university main campus?

2) What type of university?

3) A alternative is to introduce foreign university or branch of USM, UKM, UTM or others with the function of innovation or R & D to proposed area of 90 ha such as;

   90 ha ------ 60 ha for university and 30 ha for R & D.

4) Polytechnic is recommended to locate close to Phase 1 development area and existing town, namely Kelang Lama.

Amenity Zone

1) It is quite acceptable to locate the golf course in the central and gentle slope area of the Hi-Tech Park.

2) Golf course : champion course is required 36 holes with the area of 200 ha approx. Low density houses of 7 and 10 ha in the golf course are to be cancelled in case of the champion course.

3) Reason why the thema park is located here? What contents?

4) It is necessary to study a basic concept for the R & D and thema park. The timing the introduction of these facilities are quite important.

8) Phasing of Development

(To be worked out as early as possible)

9) Important and Critical Issues

The following items shall be treated in the progress report (2) of master plan study in view of the time constraint in the project implementation period.

(1) High-ranked federal level officials are required to appoint as the implementation organizer/coordinator with full time assignment.

(2) Infrastructure. Realistic implementation plan and schedule should be provided by the respective agency concerned for the required infrastructural works to meet with the JICA's recommendation which was accepted by the technical and steering committee levels respectively, especially, power and water supply system, to ensure to start the commercial operation on time for production-oriented type industries.

3.2 Management and Institutional Plan
(Advisary note No.8)

As a recommendation, the followings on the management and institutional plan was presented to the master plan study team which are to be incorporated to the progress report No.2 on the said study.

(1) The terms used on this paper are defined as follows.

Management plan :
a plan of organization management body to implement and manage the proposed project.

Institutiional plan :
a plan for creating public services agencies,R & D function,human resources development and other stretegic institutional scheme to be initiated by the federal government level.

Institutions : the public,semi-public facilities.
public
- telephon office,post office,police station,fire station and local government offices.

semi-public
- public R & D institutes
- incuvation / start-up room
- skill development center
- science technology exchange plaza
- library
- university / innovation center
- exhibision and conference room

(2) Implementation organization

For the creation of this pioneer project,an overall implementation organization during basic and detailed design stages and construction stage is recommended the troika system as follows. The overall implementation plan should be coordinated by the implementation coordination unit.

The operation and maintenance the park are planned to be obliged by the local council to be created newly, subsidiary company and special unit of respective utility authorities.

(3) Management organization

JICA has indicated that the pending problems associated with the industrial estate in Malaysia are as follows.

1) There has been lack of spatial planning coordination among existing authoriries involved in industrial estate development at pre-construction stage.

2) there has been also lack of coordination for potential and existing investors among existing authorities in providing licenses, permits and approval at pre-investment stage,and

3) there has been absense of operation and maintenance organization of industrial estate providing adequate utilities services such as power,water,telecommunication for industrial estate at post investment stage.

In this connection, a question is raised how to integrate related functions or if it is appropriate to establish a new institution to solve the above matter. Here, three (3) alternative options are proposed by JICA and discussed :

Alternative 1 : (private corporation type)
Establishment of Kulim Hi-Tech Industrial Park Corporation

Alternative 2 : (state corporation type)
Establishment of Kedah Industrial Estate Authority

Alternative 3 : (extention of KSDC)
Strengthening Kedah State Development Corporation

The follow-up meeting was then held with JICA,KSDC and local consultant,further discussing the recommended form of management organization among the proposed three alternatives. After through examination,the suggested organizational structure should be a hybrid between the alternative one and three i.e.,

1) establishing a subsidiary under KSDC to deal with development and management of the Kulim Hi-Tech Industrial Park as well as promotion of R & D activities,and

2) creating a new local council under control of KSDC to provide " one-stop services " for maintenance services functions.

The subsidiary to be set up should be fully-owned private company by KSDC which undertakes implementation of industrial zone development. For housing/commercial zone it should contract out to private developers while for amenity zone it should create another subsidiary,this time a joint-venture with a private sector,which undertakes development and management of the sports facilities such as golf course with club.

The subsidiary should also perform R & D promotional activities for this Hi-Tech park which include incubation, technology ezchange plaza, skill development centre and joint reserch programme among industries,reserch institutions and university.

The local council which is to be newly created should administer the area of Kulim Hi-Tech Industrial Park which must be designated and legally gazetted under KSDC. It should facilitate foreign and local investors in thier plan approvals and thier ordinary maintenance services such as rubbish collection, road cleaning and lighting maintenance. It should, however, have a minimal number of the staff personnel by privatizing the said maintenance activities to the subsidiary company. The subsidiary company would be called upon to provide appropriate maintenance services to the park and cross-subsidise such services if the need arises.

To ensure financial viability,the proposed subsidiary should collect management fees from the industries while the new local council collect annual assessment. To further strengthenen financial sustainability, it is proposed that the federal grant for road maintenance services should be channeled through the new local council.

Besides,in order to ensure efficient management and implementation of the Hi-Tech Park, it is strongly suggested that the utility authorities should set up thier respective unit specifically to cator for the needs of the park, namely, TNB, STMB and JKA. The recommended form of the management organization is thus depicted in the Fig.1.

(4) Institutional Plan

It is strongly recommended that the federal government shall support, especially the financing plan of the subsidiary which is the executing body of institutional aspects as follows.

1) Introduction and promotion of the R & D facilities

2) Human resources development by introducing the ;
   - university,
   - polytechnic (with the state),and
   - skill development centre

3) Introduction of public services agencies such as police and fire stations,local government offices.

Timely realization of these facilities is critical issues †on ç this plan.

(5) Institution

It is defined that public and semi-public facilities to be introduced are an integral part of this Hi-Tech Park. These facilities categorized as semi-public ones are to be constructed under the management of subsidiary company with strong support of the federal government. Public facilities such as fire and police stations will be constructed by the respective agency in coordination with the state, KSDC and the subsidiary company.

3.3 Master schedule for implementation on infrastructure works

A master schedule as shown in Fig.2 was forwarded to the study team as for the formation of project implementation. The schedule was provided based on the ;

- the agreed target date to complete the land preparation in June 1993 for first phase industrial zone of 250 ha,between GOJ and GOM,and

- the results of discussion with the agencies concerned which are executing body of implementation.

3.4 Implementation schedule of first phase (Advisary note Nó.10)

An implementation schedule for first phase development, as shown in Fig.3, was forwarded to the study team as a reference data in preparation of implementation schedule of master plan level.

3.5 Preliminary cost estimate for phase 1 (Advisary note No.11)

JICA advisary team has been tried to estimate the direct construction cost for the first phase development based on the plan and study results by master plan study team as a preliminary and discussion purpose, and as shown in Table 1

3.6 Cost Breakdown of First Phase Industrial Zone

Table-2 shows the priced bill of quantities for construction of Hi-Tech zone of first phase, 250ha

Table - 1

SUMMARY OF DIRECT CONSTRUCTION CST FOR 1ST FHASE,639 HA
(JICA's 2nd trial, Dec. 19th '91)

	Cost Items	Cost.million M$
1.	Land acquisition,639 ha	19.2
2.	Infrastructure	
	2.1 Road network	51.7
	2.2 Power supply system	103.0
	2.3 Water supply system	49.8
	2.4 Drainage system	45.7
	2.5 Sewerage system	32.2
	2.6 Industrial solid waste	16.0
	2.7 Telecomminication system	11.7
	sub total of 2	310.1
3.	Hi-Tech industrial zone,236 ha	38.8
4.	R & D zone,30 ha	50.3
5.	Urban zone,101 ha	18.0
6.	Housing zone,180 ha	247.4
7.	Amenity zone,72 ha	32.3
	Total, 1 to 7	716.1

Table-2 PRICED BILL OF QUANTITIES FOR CONSTRUCTION OF HI-TECH ZONE OF FIRST PHASE, 250 ha

Item No.	Work Items	Unit	Q'ty	Unit Cost (M$)	Amount (mil.M$)
1.	Land preparation				
1.1	Earthwork, factory lots (137 ha, 33 lots)				
	1) Cut	cu.m	2,060,000.00	1.50	3.09
	2) Fill	cu.m	1,800,000.00	2.00	3.60
	Amount				6.69
1.2	Earthwork, urban block (17 ha)				
	1) Cut	cu.m	29,000.00	1.50	0.04
	2) Fill	cu.m	470,000.00	2.00	1.18
	Amount				1.22
1.3	Earthwork, R & D block (8.7 ha)				
	1) Cut	cu.m	250,000.00	2.00	0.50
	2) Fill	cu.m	35,000.00	2.50	0.09
	Amount				0.59
1.4	C.T.P & temporary storage (14.9 ha)				
	1) Cut	cu.m	86,000.00	1.50	0.13
	2) Fill	cu.m	290,000.00	2.00	0.58
	Amount				0.71
1.5	Site clearance	ha	217.00	5,500.00	1.19

Total of 1				10.40

2. Infrastructure

2.1 Road network

(1) Arterial road, A1
(L=2.94 km,W=30m)

1) Earthwork, cut	cu.m	134,600.00	2.00	0.27
2) Earthwork, fill	cu.m	32,300.00	2.50	0.08
3) Pavement and others	lin.m	2,900.00	1,500.00	4.35
4) Bridge, 1-set L=30 m,W=17 m	sq.m	510.00	2,500.00	1.28
Amount				5.97

(2) Arterial road, A2
(L=1.65 km,L=30m)

1) Earthwork, cut	cu.m	30,100.00	2.00	0.06
2) Earthwork, fill	cu.m	63,100.00	2.50	0.16
3) Pavement and others	lin.m	1,620.00	1,500.00	2.43
4) Bridge, 1-set L=30 m,W=17 m	sq.m	510.00	2,500.00	1.28
Amount				3.92

(3) Collector road, C1
(L=1.08 km,W=20m)

1) Earthwork, cut	cu.m	13,900.00	2.00	0.03
2) Earthwork, fill	cu.m	17,700.00	2.50	0.04
3) Pavement and others	lin.m	1,082.00	1,300.00	1.41
Amount				1.48

(4) Collector road, C2
(L=1.06km,W=20m)

1) Earthwork, cut	cu.m	23,400.00	2.00	0.05

2) Earthwork, fill	cu.m	26,900.00	2.50	0.07
3) Pavement and others	lin.m	1,060.00	1,300.00	1.38
Amount				1.49
(5) Collector road, C3 (L=1.0km,W=20m)				
1) Earthwork, cut	cu.m	23,100.00	2.00	0.05
2) Earthwork, fill	cu.m	17,700.00	2.50	0.04
3) Pavement and others	lin.m	998.00	1,300.00	1.30
Amount				1.39
(6) Collector road, C4 (L=1.04km,W=20m)				
1) Earthwork, cut	cu.m	40,000.00	2.00	0.08
2) Earthwork, fill	cu.m	11,300.00	2.50	0.03
3) Pavement and others	lin.m	1,035.00	1,300.00	1.35
Amount				1.45
Total of 2.1				15.71
2.2 Power supply system				
(1) Transmission line, 132 kV				
1) Overhead line with	km	33.00	800,000.00	26.40
erection cost		6.00	1,500,000.00	9.00
2) Underground line with	km			
erection cost				
Amount				35.40
(2) Extension of feeder bay				
1) Kulim substation	bay	1.00	800,000.00	0.80
2) Sungai Petani s/s	bay	1.00	800,000.00	0.80
Amount				1.60

(3) Main substation

1) Main t'former, 45 MVA	set	2.00	900,000.00	1.80
2) GIS, 132 kV	bay	6.00	600,000.00	3.60
3) ZG/STR TR.200 kVA	set	2.00	200,000.00	0.40
4) Metal-clad SWB, 33 kV	set	9.00	100,000.00	0.90
5) D'bution trans.,10 MVA	set	1.00	250,000.00	0.25
6) Metal-clad, 11 kV	set	6.00	80,000.00	0.48
7) Control & protection	set	1.00	900,000.00	0.90
8) NGR	set	1.00	30,000.00	0.03
9) Miscellaneous material	lot	1.00	880,000.00	0.88
Amount				9.24

(4) Distribution substation

1) Metal-clad SWB, 33 kV	set	20.00	100,000.00	2.00
2) D'bution trans.,10 MVA	set	4.00	250,000.00	1.00
3) Metal-clad SWB, 11 kV	set	32.00	80,000.00	2.56
4) Control & protection	set	2.00	500,000.00	1.00
5) NGR	set	2.00	30,000.00	0.06
6) Miscellaneous material	lot	1.00	660,000.00	0.66
Amount				7.28

(5) Distribution lines

1) D'tribution line, 33 kV	km	24.00	550,000.00	13.20
2) D'tribution line, 11 kV	km	36.00	80,000.00	2.88
3) Auto.line sectionalizer .33 kV	set	12.00	50,000.00	0.60
4) -"-, 11 kV	set	54.00	40,000.00	2.16
5) Control system	lot	1.00	300,000.00	0.30
Amount				19.14
Sub total, (1) to (5)				72.66
(6) Erection cost, 15% for item No.(3) to (5)	L.S	-	-	5.59

(7) Civil and building cost				
5% of sub total	L.S	-	-	3.63
Total of 2.2				81.88
2.3 Water supply system				
(1) Main supply line				
1) Muda intake	L.S	-	-	2.00
2) Treatment plant	L.S	-	-	15.00
3) Pump station	L.S	-	-	2.50
4) Transmission main	L.S	-	-	9.00
Amount				28.50
(2) Service reservoir, R1 (13000 m3)				
1) Excavation, common/rock	cu.m	30,000.00	8.00	0.50
2) Fill	cu.m	9,000.00	10.00	0.19
3) Concrete	cu.m	3,000.00	200.00	1.42
4) Re-bar	ton	300.00	1,600.00	1.14
5) Valve, fittings, others	L.S	-	-	2.10
Amount				5.35
(3) Service reservoir, R2 (32000 m3)				
1) Excavation, common/rock	cu.m	60,000.00	8.00	0.48
2) Fill	cu.m	18,000.00	10.00	0.18
3) Concrete	cu.m	7,000.00	200.00	1.40
4) Re-bar	ton	700.00	1,600.00	1.12
5) Valve, fittings, others	L.S	-	-	1.50
Amount				4.68
(4) Pipe laying cost				
1) Trench excavation	cu.m	13,000.00	4.00	0.05

	2) Fill	cu.m	18,600.00	6.00	0.11
	3) Re-bar	ton	9.00	1,600.00	0.01
	4) Pipe work, R1 to R2	lin.m	4,000.00	500.00	2.00
	5) Steel pipe, 600 mm dia.	lin.m	2,800.00	420.00	1.18
	6) - do -, 300 mm dia.	lin.m	8,800.00	220.00	1.94
	7) Welded slip joint	no.	400.00	80.00	0.03
	8) Valve, fitting, others	L.S	-	-	2.00
	Amount				7.32
(5)	Miscellaneous cost		-		0.50
	Total of 2.3				46.35
2.4	Telecommunication system				
(1)	Telephone office				
	1) Exchange/digital (4000 cct)	set	1.00	3,500,000.00	3.50
	2) Office building	set	1.00	1,500,000.00	1.50
	Amount				5.00
(2)	Duct/cables				
	1) Ducts	km	5.50	97,000.00	0.53
	2) Cable	km	5.50	57,000.00	0.31
	Amount				0.85
(3)	Outside park				
	1) Kulim GSC extension (Kulim switching Center)	lot	1.00	350,000.00	0.35
	2) Junction (truck) line (Fiber optics, microwave system w/antenna tower, and satellite station of first phase)	lot	1.00	1,300,000.00	1.30
	Amount				1.65

(4)	Miscellaneous	L.S	-	-	1.00
	Total of 2.4				8.50
2.5	Drainage system				
(1)	Drainage channel (improve. of Air merah river, 1.31 km)				
	1) Excavation	cu.m	102,700.00	3.00	0.31
	2) Embankment	cu.m	26,800.00	4.00	0.11
	3) Stone masonry	sq.m	17,000.00	50.00	0.85
	4) Sod facing	sq.m	25,000.00	1.00	0.03
	5) Culvert	L.S	-	-	0.11
	Amount				1.40
(2)	Drainage channel (Improve. of Parit B.river, 1.68 km)				
	1) Excavation	cu.m	50,000.00	3.00	0.15
	2) Embankment	cu.m	40,200.00	4.00	0.16
	3) Stone masonry	sq.m	15,500.00	50.00	0.78
	4) Sod facing	sq.m	47,000.00	1.00	0.05
	5) Culvert	L.S	-	-	0.27
	Amount				1.40
(3)	Drainage ditch/pipe				
	1) Excavation	cu.m	58,400.00	4.00	0.23
	2) Stone masonry	sq.m	47,000.00	50.00	2.35
	3) Concrete w/re-bar	cu.m	10,600.00	180.00	1.91
	4) Culvert, 900 mm	lin.m	80.00	350.00	0.03
	5) Culvert, 1050 mm	lin.m	20.00	450.00	0.01
	6) Culvert, 1200 mm	lin.m	20.00	550.00	0.01
	7) Culvert, 1350 mm	lin.m	20.00	650.00	0.01
	8) Culvert, 1800 mm	lin.m	40.00	1,000.00	0.04
	9) - do -, box, 2100*1500 mm	lin.m	40.00	1,500.00	0.06

10) P.C drain	lin.m	17,400.00	40.00	0.70
Amount				5.35

(4) Retention pond, No.1

1) Excavation, pond	cu.m	37,000.00	4.00	0.15
2) Land reform/levelling	ha	2.50	5,000.00	0.01
3) Sod facing	sq.m	3,400.00	1.00	0.00
4) Culvert & spillway	L.S	-	-	0.21
5) Ditch/pipe	L.S	-	-	0.03
Amount				0.40

(5) Retention pond, No.2

1) Excavation, pond	cu.m	87,500.00	4.00	0.35
2) Land reform/levelling	ha	4.50	5,000.00	0.02
3) Sod facing	sq.m	4,700.00	1.00	0.00
4) Culvert & spillway	L.S	-	-	0.19
5) Ditch/pipe	L.S	-	-	0.03
Amount				0.60

(6) Retention pond, No.3

1) Excavation, pond	cu.m	87,500.00	4.00	0.35
2) Land reform/levelling	ha	6.50	5,000.00	0.03
3) Sod facing	sq.m	7,100.00	1.00	0.01
4) Culvert & spillway	L.S	-	-	0.13
5) Ditch/pipe	L.S	-	-	0.03
Amount				0.55

Total of 2.5				9.70

2.6 Sewerage system

(1) Sewer collection

1) Excavation	cu.m	57,500.00	4.00	0.23
2) Sheetpiling	L.S	-	-	0.10

3) Sand foundation	cu.m	4,000.00	6.00	0.02
4) Backfill	cu.m	49,600.00	6.00	0.30
5) Manholes	L.S	-	-	0.50
6) Material, PVC pipe D=225,300 mm	lin.m	3,900.00	200.00	0.78
7) Material,RC pipe D=400,600,800 mm	lin.m	2,800.00	160.00	0.45
8) Steel Gas pipe, 150 mm	lin.m	240.00	100.00	0.02
9) Sewer relay pump with appurtnants - Head : 6.0 m - Discharge : 1.46 m3/m	set	2.00	50,000.00	0.10
10) Sewer relay pump with appurtnants - Head : 7.0 m - Discharge : 1.02 m3/m	set	2.00	50,000.00	0.10
Amount				2.60
(2) Waste water central treatment plant				
1) Civil works	L.S	-	-	2.00
2) Procurement cost for plant	L.S	-	-	3.60
3) Erection & miscellaneous works	L.S	-	-	1.00
Amount				6.60
(3) Monitoring system				
1) Construction, monitoring pit, 600*900 mm	place	32.00	5,000.00	0.16
2) Procurement cost for laboratory equipment	lot	1.00	240,000.00	0.24
Amount				0.40 0.80
Total of 2.6				10.00

2.7 Industrial Solid Waste

(1)	Land preparation				
	1) Temporary access road (W=3.0m,asphalt pave.)	lin.m	450.00	660.00	0.30
	2) Gate, fence, perimeter road	L.S	-	-	0.50
	3) Drainage	L.S	-	-	0.50
	Amount				1.30
(2)	Workshop/office				
	1) Workshop	L.S	-	-	0.60
	2) Office w/facilities	L.S	-	-	0.30
	3) Park lot/weigh bridge	L.S	-	-	0.30
	4) Equipment	L.S	-	-	0.60
	Amount				1.80
(3)	Storage facility				
	1) Concrete wall w/column floor and others	L.S	-	-	2.00
	2) Sheet, t=2 mm	L.S	-	-	1.20
	3) Roof/doors	L.S	-	-	1.00
	4) Fire fighting	L.S	-	-	1.20
	5) Miscellaneous works	L.S	-	-	0.50
	Amount				5.90
	Subtotal of 2.7				9.00
	Total of 2				181.14
3.	Architecture works (Related facilities)				
(1)	Foundation works for all buildings	L.S	-	-	1.00
(2)	Skill Development center,				

institutional (Area : 1.0 ha)				
1) Building, 3-story - Training room, 100 m2*6 - Workshop, 200 m2*2 - Adm. office, 100 m2*1 - Others, 300 m2	sq.m	1,400.00	1,000.00	1.40
2) Utilities	L.S	-	-	0.20
3) Training facilities	L.S	-	-	0.10
Amount				1.70
(3) Administration core, institutional (Area :1.2 ha)				
1) Building, 5-story - Office of managing company, 1000 m2*1 - Local government office 25 m2*4 - Post office, 400 m2*1 - Incubation/start-up room, 50 m2*15 - Public R & D branch 200 m2*10 - Innovation center, 100 m2*1 - Assembly/Exhibition hall 500 m2*1 - Conference room, 100 m2*2 - Library, 200 m2*1 - Others	sq.m	7,000.00	1,000.00	7.00
2) Utilities	L.S	-	-	0.50
3) Facilities	L.S	-	-	0.20
Amount				7.70

(4) Business center, institutional
(Area : 0.6 ha)

1)Building, 3-story - Private office, 100 m2*12 - Business consulting 100 m2*2 - Business supporting service, 100 m2*1 - Bank, 300 m2*3 - Restaurant/Coffee shop 200 m2*1 - Science & Technology Exchange Plaza, 600 m2*1 - Others	sq.m	4,000.00	1,000.00	4.00
2) Utilities	L.S	-	-	0.20
3) Facilities	L.S	-	-	0.10
Amount				4.30

(5) Fire station, institutional
(Area : 1.0 ha)

1) Building, 2-story	sq.m	2,000.00	1,000.00	2.00
2) Utilities	L.S	-	-	0.30
3) Facilities	L.S	-	-	1.00
Amount				3.30

(6) Police s'tion institutional
(Area : 0.8 ha)

1)Building	sq.m	2,000.00	1,000.00	2.00
2) Utilities	L.S	-	-	0.10
3) Facilities	L.S	-	-	0.10
Amount				2.20

(7) Commercial center, supporting
(Area : 2.0 ha)

1) Building, supporting	sq.m	3,000.00	800.00	2.40
2) Utilities	L.S	-	-	0.10
3) Facilities	L.S	-	-	0.10
Amount				2.60
(8) Central plaza, supporting (Area : 2.0 ha)				
1) Utilities	L.S	-	-	0.30
2) Amenity facilities	L.S	-	-	0.30
Amount				0.60
(9) Parking (Area :1.0 ha)				
1) Utilities	L.S	-	-	0.20
2) Facilities	L.S	-	-	0.10
Amount				0.30
(10) Road and greenbelt (Area : 1.2 ha)				
1)Earthwork	L.S	-	-	0.20
2) Utilities	L.S	-	-	0.10
3) Facilities	L.S	-	-	0.10
Amount				0.40
(11) Landscaping, urban block				
1) Building area for the above item (2) to (7)	L.S	-	-	0.20
2) Other are for the above item (8) to (10)	L.S	-	-	0.10
Amount				0.30
Total of 3				24.40

4. Landscaping, industrial zone

(1)	Conservation open space area	ha	25.00	40,000.00	1.00
(2)	Waterfront open space	ha	10.00	70,000.00	0.70
(3)	Central plaza, community, corner and neighbor parks	ha	15.00	70,000.00	1.05
(4)	Pocket plaza (100 m2,12 places)	L.S	-	-	0.48
(5)	Arterial roads	L.S	-	-	0.70
(6)	Collector roads	L.S	-	-	0.67
(7)	Shade promenade	L.S	-	-	0.30
(8)	Screen greenery	L.S	-	-	0.10
	Total of 4				5.00
	GRAND TOTAL, 1 to 4				220.94

Fig. 1

HYBRID ALTERNATIVE : ESTABLISHMENT OF KULIM HI-TECH INDUSTRIAL PARK SDN BHD AND NEW LOCAL COUNCIL

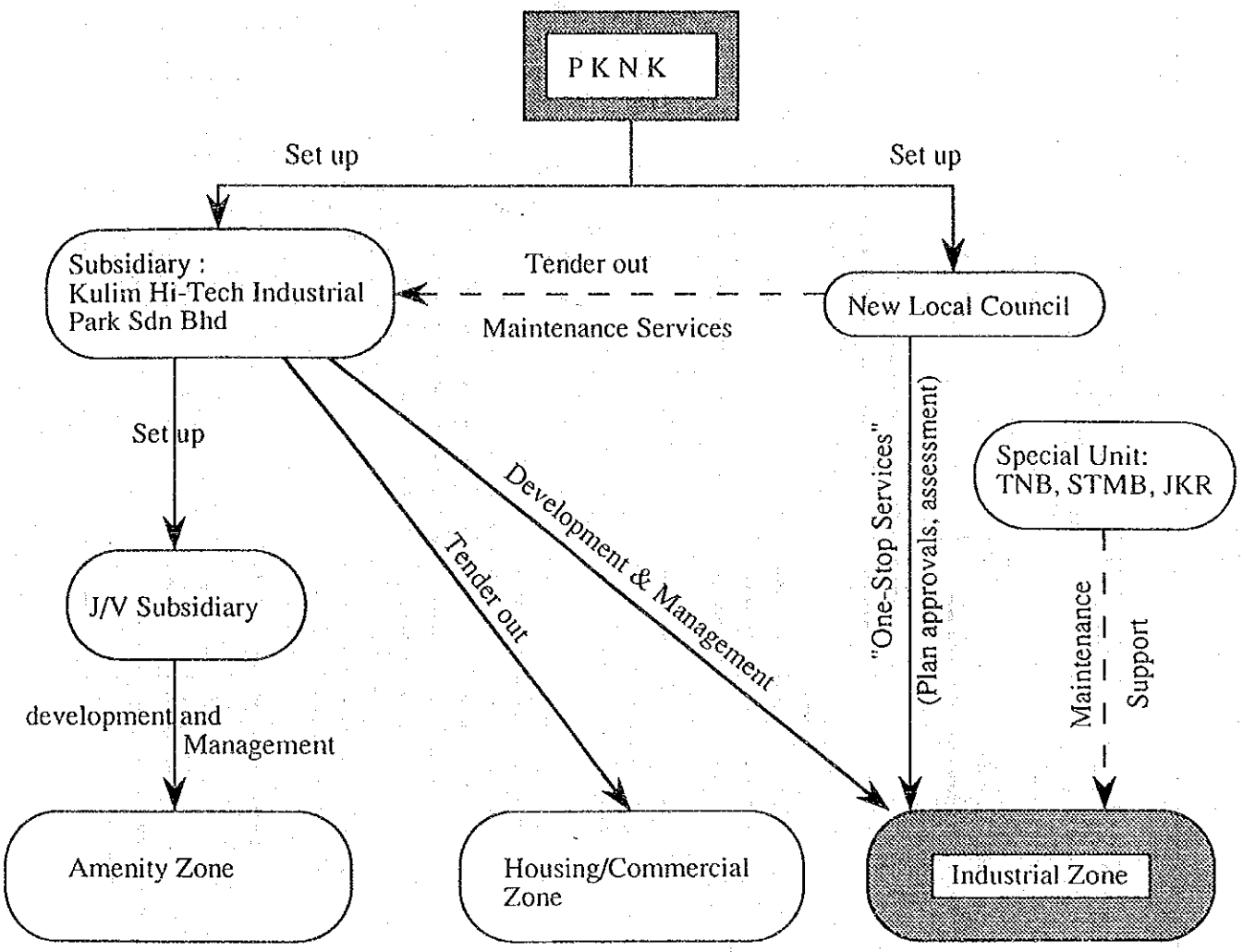


Fig.2 MASTER SCHEDULE FOR IMPLEMENTATION
(Infrastructure Sector)

(Nov. '91 by JICA)

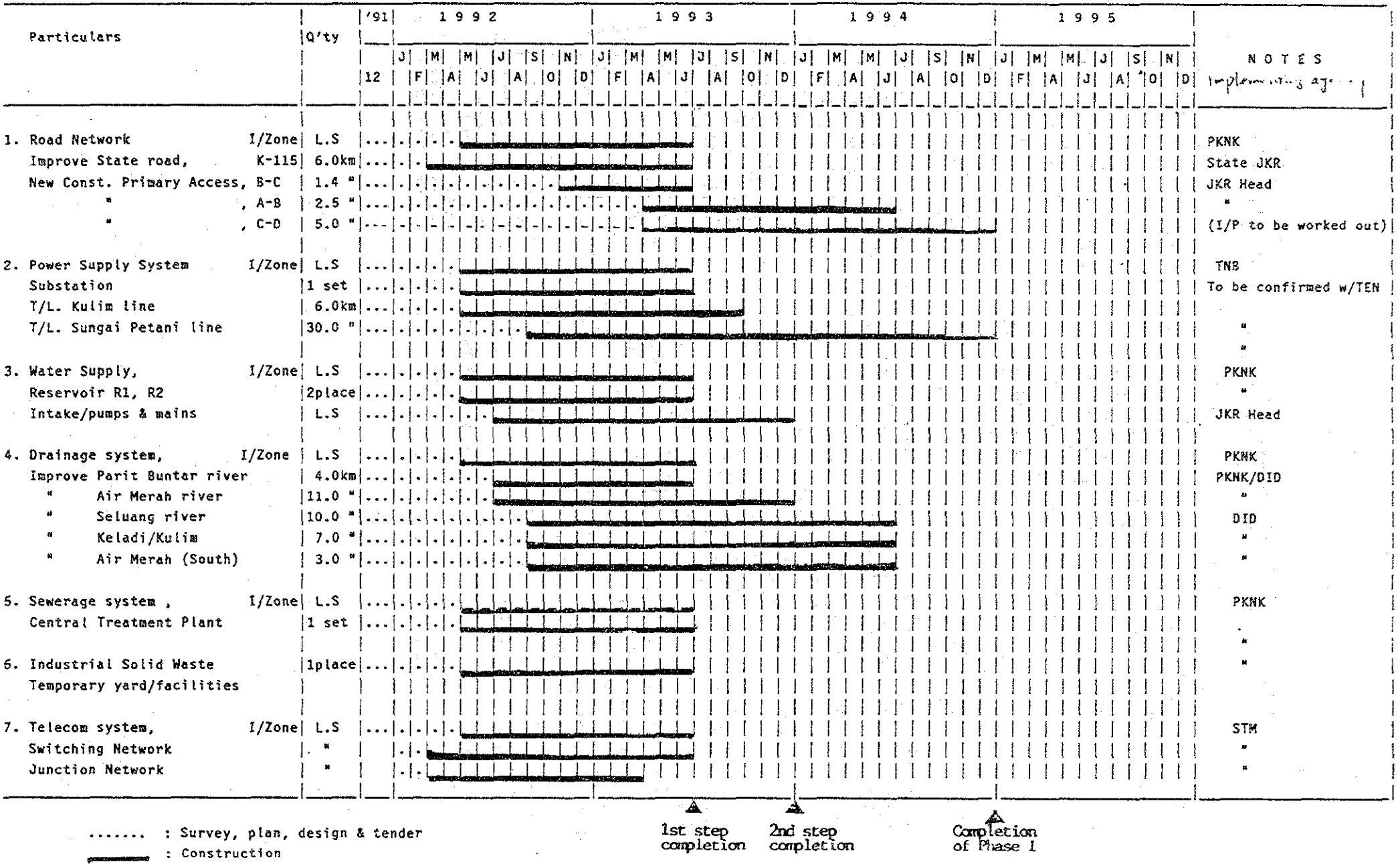
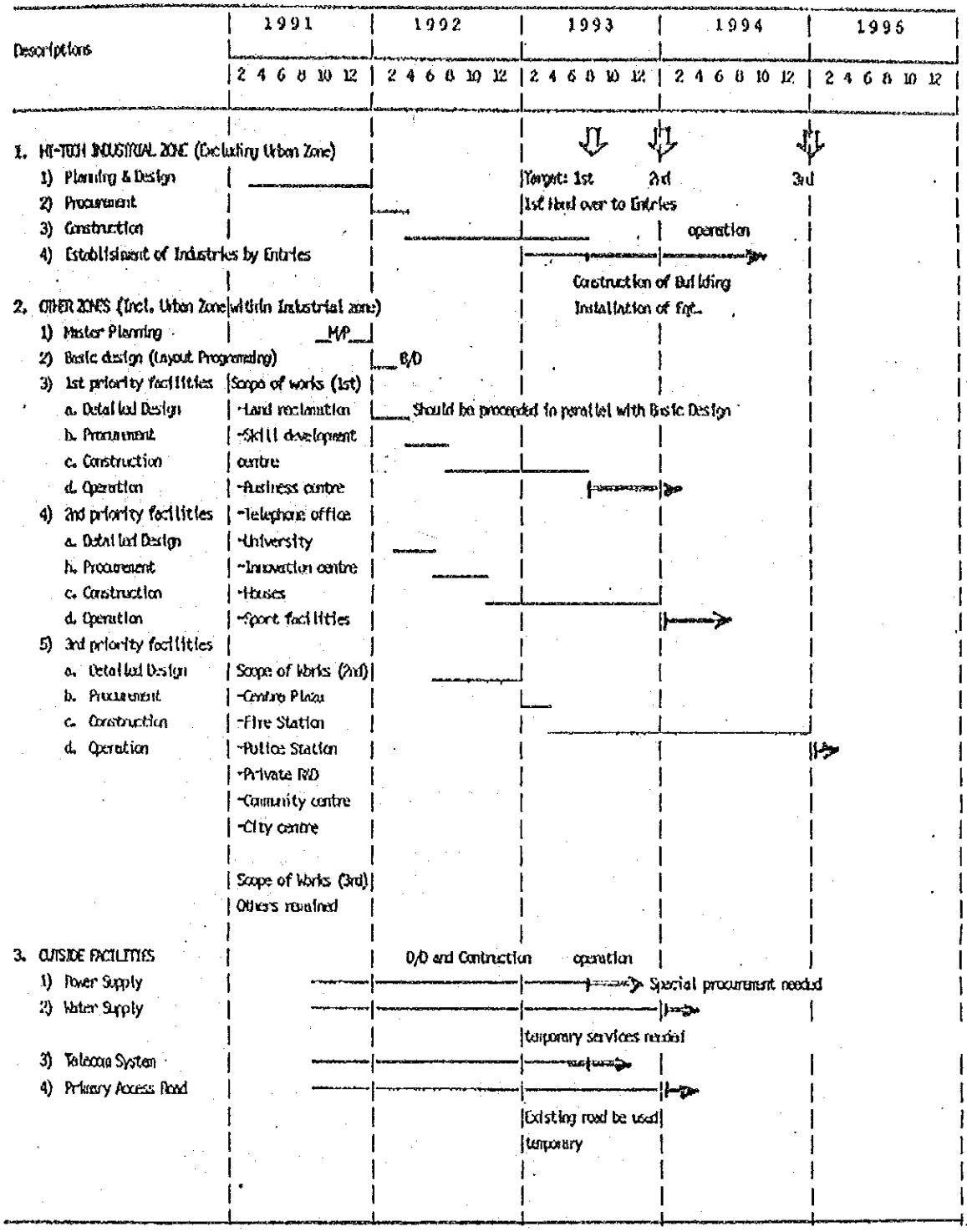


Fig.3 PROPOSED IMPLEMENTATION SCHEDULE FOR FIRST PHASE(770 Ha)
KULIM HI-TECH INDUSTRIAL PARK



NOTE: The Final Implementation Schedule will be prepared after Master Plan Study has been completed

4. SEWERAGE SYSTEM

4.1 Scope of Works

(1) Review of demand projection for water supply & sewerage

(2) Advice & direction for layout plan of sewerage

(3) Advice & direction for wastewater treatment plant

(4) Advice & direction for other sectors related with sewerage

4.1 Check List

The following sectral check lists were prepared and submitted to KSDC and EEC, in order to carry into effect of Master Plan smoothly. According to the sectral check list, the additional works were performed.

(1) Water supply system

- Water demand forecast
- Layout plan for Receiving system & Distribution system
- Pipe line (Minimum Residual Pressure at Urban area, Water hammer & Negative pressure and Economical diameter)
- Pumping station (System, Type of pump and Power system)

(2) Drainage system

- Rainfall data, Return Period & Rainfall Intensity
- Peak Flow & Overall Run-off Coefficient at each river basin
- Tentative computation of allowable discharge (S. Parit Bunian, S. Air Merah, S. Seluang & S. Kulim)
- Computation of Storm-water control
- Layout plan of Drainage system
- Checking the Rivers Improvement Plan by DID and coordination between KHTP's drainage system and DID's plan

(3) Sewerage system

- Design Population & Design Wastewater Flow at each zone
- Design concept of system (Design area, Individual/Central, Separate/Combined)
- Layout Plan(Selection of treatment process, Collection pipeline)
- Characteristic of Influent
- Effluent Standards
- Proposal of O/M system

(4) Solid waste

- Solid waste generation rate for reach Zone & calculation of generation
- Investigation of exiting solid waste dumping site (capacity, collection system & treatment method)
- Proposal of new dumping site & system, if necessary
- Proposal of O/M system & collection system
- Characteristic of solid waste (Domestic, Sludge & Hazardous / Toxic : R&D, Hospital, Polytechnic & University)

4.3 Review of demand projection

(1) Standard of demand projection

Please refer to Table 4.1

(2) Model Plant for Industrial Zone of 2nd phase

According to the target factories, Model Plant was recommended as shown at Table 4.2. The model plant was decided based on the Report on Location Load Per Unit Activity of source for Core Industrial Estate in Japan (March, 1990) published by Japan Industrial Location Center & Japan Regional Development Corporation.

(3) Supply water demand for 2nd phase Industrial Zone

Supply water demand was calculated by Table 4.2 as follows;

Average Industrial water demand : 108.3 m^3/d/ha

Average Domestic water demand : 5.56 m^3/d/ha

Average Employee : 34.8 employees/ha

Zoning of Industrial Zone for 2nd phase is as follows;

Factory lot	60 %	96 ha
Utilities	25	40
Park & Green belt	15	24
Total	100 %	160 ha

Therefore,

Total of Industrial water demand : 10397 m^3/d

Total of Domestic water demand : 535 m^3/d

Total of Population : 3341

(4) Design wastewater flow

Assumed equivalent to supply water demand.

(5) Demand projection for the whole area of Kulim Hi-Tech Park

Tentative demand projection was recommended as shown at Table 4.3. Some portion at Table 4.3, such as Them park and University, should be reexamined at the stage of basic design.

4.4 Layout Plan of Drainage system

According to the policy and concept for 1st phase Industrial Zone, layout plan was recommended as shown in Fig. 4.1. It is possible to discharge storm water out of KHTP except Industrial Zone directly to the revers. But retention ponds are still necessary since DID's plan for river improvement is not defined.

4.5 Layout Plan of Sewerage system

Layout plan was recommended as shown in Fig. 4.2, in consideration of the following points;

(1) Keeping the policy & concept for 1st phase Industrial Zone

(2) Consideration of watershed

(3) Minimized number of treatment plant as far as possible

4.6 Central Treatment Plant

Activated Sludge Method, what was adopted at 1st Industrial Zone, was recommended in consideration of operation and maintenance. As for sludge method, thickener & dry bed was recommended since the operation & maintenance of dehydrator is not reliable in Malaysia. Number of plants is three and necessary area each plant is as follows.

	In case of Dry Bed	In case of Dehydrator
CTP No. 1	4 ha	2.5 ha
CTP No. 2	5 ha	3 ha
CTP No. 3	6 ha	5 ha

4.7 Solid Waste

Generation of solid waste for the whole area of KHTP is shown at Table 4.3. Although Toxic/hazardous generated by R&D, Polytechnic and University should be re-examined again, it is judged that these generation rate is little.

Existing solid waste dumping site in Kulim was investigated. The result has been mentioned in the Progress Report No. 2 prepared by EEC. New dumping site must be prepared by Kulim Local Council by 1995.

Table 4.1 DEMAND PROJECTION (STANDARD)

CLASSIFICATION	BUILDING TYPES	QUANTITIES OF WASTE PRODUCED *1	QUANTITIES OF WATER DEMAND *2	QUANTITIES OF DOMESTIC WASTEWATER *3	
				FLOW	BOD (m^2/l)
Residential	Private Homes	2.25kg/d+0.45kg/bed/d	160-250L/ca/d	200/m^2/d	200
	Apartment Buildings	1.8kg/sleeping room/d	160-250L/ca/d (0.16 persons/m^2	10L/m^2/d m^2=Floor Area	200
Schools	Grade Schools	4.5kg/room/d+0.12kg/p/d	40-50L/pupil/day	50L/pupuil/d	180
	High Schools	3.6kg/room/d+0.12kg/p/d	80L/pupil/day	60L/pupuil/d	180
	Universities	Survey required	100-200L/pupil/day	60L/pupuil/d	180
		p: pupil	160/L/Teacher/day	60L/pupuil/d	180
Commercial Buildings	Office	0.05kg/m^2/d	100-120L/ca/d	15L/m^2/d	150-200
	Department Stores	0.20kg/m^2/d	3L/visitor/d 100L/clerk/d	30L/m^2/d	150
	Shopping Centre	Survey required	100L/ca./d (Capital: 0.16 Person/m^2)	15L/m^2/d	150
	Supermarkets	0.44kg/m^2/d	40L/ca./d	15L/m^2/d	150
	Restaurants	0.9kg/meal/day	65L/ca./d	110-260L/m^2/d	240-450
	Drug Stores	0.24kg/m^2/d			
	Banks	Survey required	120L/ca./d	15L/m^2/d	150-200
Institutions	Hospitals	3.6kg/bed/d	>1000L/bed/d	100-1300 l/bed/d	150-320
		0.24kg/m^2/d	8L/visitor/d 120-160/staff/d		
	Clinics		8L/visitor/d 120L/staff/d	25L/m^2/d	300
Hotel, etc.	Hotels	1.35kg/room/d +0.9kg/meal/d	250-300L/bed/d 120L/staff/d	30L/m^2/d	200
	Coffee shop	Survey required	30L/ca./d		
Industrial Buildings	Factories Warehouses	Survey required 0.1kg/m^2/d	Survey required Domestic Water 60-140L/worker/d (Worker:0.1-0.3/m^2)	60-100L/ca./d -	150-300 -
Miscellaneous	Parking Services Area	Survey required			
	- Toilet		50L/ca./d	820L/car/d	300
	- Canteen		15L/ca./d	170L/car/d	350
	Public Toilet		50L/ca./d	2400L/chamber pot	260
	Miscellaneous		Survey required		

*1 Source: Solid Waste hand book - A Practical Guide, 1986, William D. Robinson

*2 Source: Building Standard in Japan

*3 Source: Domestic Wastewater Standard - JIS A3302, April 1, 1988, JAPAN

Table 4.2 MODEL PLANT OF INDUSTRIAL ZONE FOR 2ND PHASE

Target Factories	Site Area (ha)	Production (Million Japanese Yen/ha)	Employee		Industrial Supply Water		Domestic Water	
			Ratio(Workers/ha)	Total	Rate(m^3/d/ha)	Total(m^3/d)	(l/ca.d)	Total(m^3/d)
Pharmaceuticals	5	900	21	105	246	1230	160	16.8
Agriculture Cemical	5	"	21	105	77.4	387	"	16.8
Plant Species Improvement	5	"	21	105	77.4	387	"	16.8
Amporphous Alloy	3	830	22	66	117	351	"	10.6
Telecom Equipment	3	1420	81	243	56	168	"	38.9
Disk Drive	3	1420	81	243	56	168	"	38.9
Photomagnetic Materials	3	100	22	66	117	351	"	10.6
Fine Ceramic	1	310	17	17	60	60	"	2.7
Software House	1	1420	58	58	40	40	"	9.3
Total	29			1008		3142		161.4

Table 4.3 DEMAND PROJECTION FOR KULIM HI-TECH PARK

Phase	Land Use	Area	Population	Water Supply		Wastewater Flow		Solid Waste Generation	
				Demand Per Unit	Total (m^3/d)	Type of Treatment	(MB/d)	Generation Rate	Total (t/d)
I	1. Industry Zone	236							
	Factory Lot	136	12540.00	Industrial Water: 183.3m3/d/ha	24,745	Individual Treatment	24745	Toxic/Hazardous: 0.038t/d/ha	8.97
				Domestic Water: 160l/ca/d	2,006	C.T.P. No. 1	2006	Domestic: 0.44t/d/ha	103.84
	R&D	8		Domestic Water:	250	C.T.P. No. 1	250		
	2. Urban Zone	21		Domestic Water: 5.2m3/ha	109	C.T.P. No. 1	109	Domestic: 0.1t/d/ha	2.10
	3. Tower Center	80		Domestic Water:	416	C.T.P. No. 2	416	Domestic: 0.1t/d/ha	8.00
	4. Golf Course	72		Domestic Water: 46m3/d/ha	46	C.T.P. No. 2	46	Domestic:	0.50
	5. Polytechnic	30	5000.00	Domestic Water: 80l/ca/d	400	C.T.P. No. 3	400	Domestic: 0.1kg/ca/d	0.50
	6. Housing Zone	180							
	Mixed Density	108	13219.00	Domestic Water: 250l/ca/d	3,305	C.T.P. No. 2	3305	Domestic: 0.5kg/ca/d	6.61
	High Density	72	16624.00		4,131	C.T.P. No. 3	4131	Domestic: 0.5kg/ca/d	8.26
Sub-Total		619			35,408			Toxic/Hazardous Domestic	8.97 129.81
II.	1. Industry Zone	160							
	Factory Lo	96	3341.00	Industrial Water 108.3m3/d/ha	10,397	Individual Treatment	10397	Toxic Hazardous:	6.08
				Domestic Water: 160l/ca/d	535	C.T.P. No. 1	535	Domestic: 0.44t/d/ha	70.40
	2. R&Dt	25		Domestic Water:	250	C.T.P. No. 1	250	Domestic: 0.44t/d/ha	11.00
	3. Urban Zone	111		Domestic Water: 5.2m3/ha	46	C.T.P. No. 3	46	Domestic: 0.44t/d/ha	0.50
	4. University	90	10000.00	Domestic Water: 160L/ca/d	1600	C.T.P. No. 3	1600	Domestic: 0.1kg/ca/d	1.00
	5. Housing	290							
	Low density	112	7425	Domestic Water:	1856	C.T.P. No. 2	928	Domestic: 0.5kg/ca/d	3.71
				250L/ca/d		C.T.P. No. 3	928	Domestic:	
	Medium density	145	14790	Domestic Water: 250L/ca/d	3698	C.T.P. No. 3	3698	Domestic: 0.5kg/ca/d	7.40
	High density	33	673	Domestic Water: 250L/ca/d	168	C.T.P. No. 3	168	Domestic: 0.5kg/ca/d	0.34
	6. Institutional	15		Domestic Water:	78	C.T.P. No. 3	78	Domestic: 0.07t/d/ha	1.05
	7. Sub center	28		Domestic Water: 5.2m3/ha	146	C.T.P. No. 3	146	Domestic: 0.1t/ha/d	2.80
	8. Sports Complex	10		Domestic Water: (JICA Report)	83	C.T.P. No. 3	83	Domestic: 0.1t/ha/d	1.00
	9. Theme Park	30		Domestic Water: 33.7m3/ha(EEC)	1011	C.T.P. No. 3	1011	Domestic: 0.1t/ha/d	3.00
	10. Hospital	20			–		–	–	–
	11. Natural Park	50			–		–	–	–

(Continued)

Phase	Land Use	Area	Population	Water Supply		Wastewater Flow		Solid Waste Generation	
				Demand Per Unit	Total (m^3/d)	Type of Treatment	(MB/d)	Generation Rate	Total (t/d)
Sub-Total		829		19868				Toxic/Hazardous Domestic	6.08 102.20
Total		1448			55276	Individual Treatment C.T.P. No. 1 C.T.P. No. 2 C.T.P. No. 3	35142 3150 4695 12289	Toxic/Hazardous Domestic	15.05 232.01

RETENTION PONDS

POND NO	AREA (HECTARE)
1	2.5
2	4.50
3	6.50
4	4.00
5	3.40
6	3.60
7	2.50
8	2.0
9	1.7
10	2.5
11	2.4
12	3.0
13	7.5
14	5.1
15	2.0
TOTAL	54.9 ha

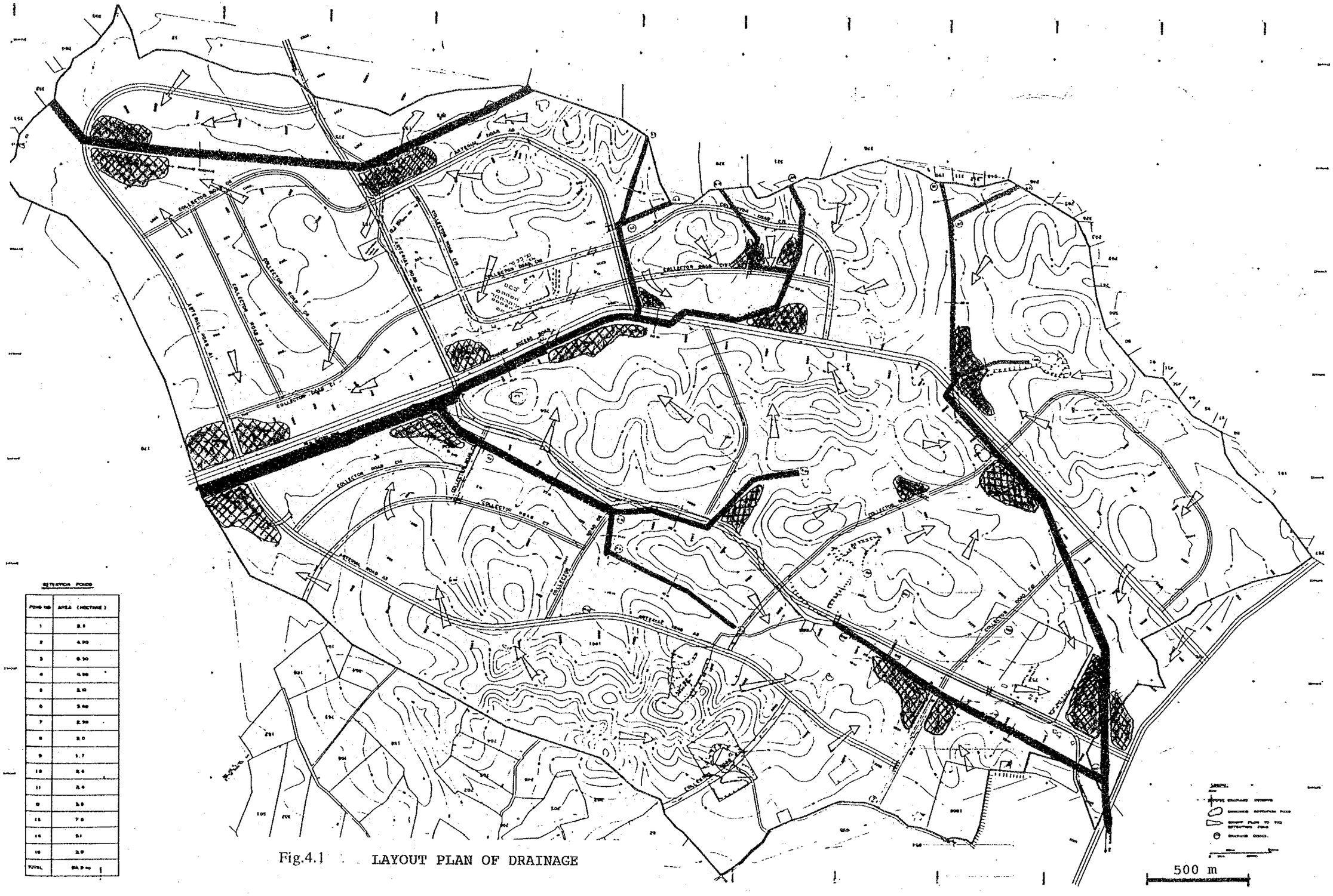


Fig.4.1 LAYOUT PLAN OF DRAINAGE