# PLAN FOR EQUIPMENT AND DEVELOPMENT OF TRINING MATERIALS

# CHAPTER SEVEN PLAN FOR EQUIPMENT AND DEVELOPMENT OF TRAINING MATERIALS

## A. PLAN FOR EQUIPMENT

### 1. Basic Policy of the Plan

In principle, though the equipment and materials to be provided shall meet the objectives of this Project, they must be within the scope of the basic policy of the grant aid program of the Government of Japan. According to the basic policy of the grant aid program, "Equipment and materials to be provided shall be those which are the minimum essential items required for implementation of the project". Therefore, the following points must be kept in mind in implementing the plan:

a. Equipment and materials shall be those which are directly required in the implementation of PDP, and shall not include those which are considered incidental to the New NPB Building.

b. Equipment and materials shall be those which correspond to the level of technology of Singapore and shall be those which will be highly utilized.

Taking the above factors into consideration, the most suitable equipment and materials shall be selected for this plan. In order for equipment and materials to be in full use at all times smoothly, considerations must be given to select equipment and materials so that their maintenance can be carried out in Singapore.

On the next page a list of equipment and materials by usage is shown. There are five usage classifications.

a. for training
b. for Resource Centre
c. for training of occupational safety and health
d. for computer related training
e. for promotion

## 2. List of Equipment

### (1) Training Equipment

| | Quantity | |
|---|---|---|
| | 1st phase | 2nd phase |
| 1-1 Lecture Room A/V Sytem | - | 32 |
| 1-2 Auditorium A/V System | - | 1 |
| 1-3 Seminar Room A/V System | - | 4 |
| 1-4 VTR & TV Monitor | VTR 15<br>TV 30 | VTR 25<br>TV 12 |
| | - | - |
| | - | - |
| | - | - |
| 1-11 Language Laboratory | 1 | - |
| | | |

* Lecture Room A/V System, Computer Lecture Room A/V System & Board Room A/V System

| | |
|---|---|
| Film Projector | * 1 |
| Sound Slide Projector | * 1 |
| Overhead Projector | * 1 |
| Remote Control Panel for Rear Projection System | * 1 |
| Video Projector | * 1 |
| VTR | * 1 |
| Audio Amplifier | * 1 |
| Speaker | * 2 |

* Auditorium A/V System

| | |
|---|---|
| P.A. System | * 1 |
| VTR | * 1 |
| Video Projector | * 1 |
| Interpretation System | * 1 |

* Seminar Room A/V System, Large Lecture Room A/V System

| | |
|---|---|
| P.A. System | * 1 |
| VTR | * 1 |
| Video Projector | * 1 |
| Film Projector | * 1 |
| Sound Slide Projector | * 1 |
| Overhead Projector | * 1 |
| Remote Control Panel for Rear Projection System | * 1 |

(2) Resource Center Equipment

| | Quantity | |
|---|---|---|
| | 1st phase | 2nd phase |
| 2-1 Printing Room Equipment | - | 1 |
| 2-2 Photocopier (Heavy Duty) | - | 1 |
| 2-3 Photocopier (Medium Duty) | 5 | - |
| 2-5 Video Camera Module (Indoor) | 1 | 1 |
| 2-6 Video Camera Module (Outdoor) | 1 | 1 |
| | - | - |
| 2-8 A/V Van | 1 | - |
| 2-9 Microfiche System | 1 | - |
| 2-10 Studio Equipment | - | 1 |
| 2-11 Post Production Equipment | 1 | 1 |
| 2-12 Color Slide Processor | 1 | 1 |
| 2-13 Audio Tape Duplicator | 1 | - |
| 2-14 Micro Teaching Equipment | 1 | 1 |
| 2-15 A/V Maintenance Instruments | 1 | 1 |
| 2-16 Audio Visual Information System | - | 1 |
| 2-19 Peripheral Graphic Equipment | 1 | - |
| | | |

Post Production Equipment

* 1st phase
  - Editing System * 1
  - Telecine Chain & Transcorder * 1
  - Video Duplication Equipment * 1
* 2nd phase
  - Editing System * 2
  - Audio Dubbing System * 1
  - Video Duplication Equipment * 1

(3) O.S.H Equipment

| | Quantity | |
|---|---|---|
| | 1st phase | 2nd phase |
| 3-1 Construction Heavy Machine Models | - | 1 |
| 3-2 Scaffolding (Metal) | - | 1 |
| 3-3 Gondola & Safety Line | - | 1 |
| 3-4 Power Tools | - | 1 |
| 3-5 Vessel Models | - | 5 |
| 3-6 Explosive/Oxygen Meter | - | 1 |
| 3-7 Arc Welding Machine | - | 1 |
| 3-8 Gas Torch, Cylinder, etc. | - | 1 |
| 3-9 Electric Power Press | - | 1 |
| 3-10 Safety Devices for Power Press | - | 1 |
| 3-11 Water-tube Boiler (Model) | - | 1 |
| 3-12 Mechanical Handling Equipment | - | 1 |
| 3-13 Lifting Gear/Lifting Appliances | - | 1 |
| 3-14 Electric Wiring Safety System | - | 1 |
| 3-15 Electrician's Tools | - | 1 |
| 3-16 Noise Control Materials | - | 1 |
| 3-17 Fire Protection Equipment | - | 1 |
| 3-18 Portable Fire Extinguishing | - | 1 |
| 3-19 Hand Tools | - | 1 |
| 3-20 Personal Protective Equipment | - | 1 |
| 3-21 Sound Level Meter | - | 15 |
| | - | - |
| 3-23 Octave Filter Sets & Tripod | - | 2 |
| 3-24 Noise Dose Meter | - | 15 |

(Cont'd)

| | Quantity | |
|---|---|---|
| | 1st phase | 2nd phase |
| 3-25 Graphic Level Recorder | - | 1 |
| 3-26 Alphanumeric Printer | - | 1 |
| 3-27 Personal Sampling Pump | - | 15 |
| 3-28 Pump Calibrator | - | 1 |
| 3-29 Drager Gas Detector | - | 15 |
| 3-30 Static Dust Sampler | - | 15 |
| 3-31 Microscope & Accessories | - | 2 |
| 3-32 Electronic-Balance | - | 2 |
| 3-33 Gas Chromatography | - | 1 |
| 3-34 Spectrophotometer | - | 1 |
| 3-35 Atomic Absorption Spectrophotometer | - | 1 |
| 3-36 Heat Stress Measurement Set | - | 15 |
| 3-37 Thermal Anemometer | - | 15 |
| 3-38 Light Measuring Equipment | - | 15 |
| 3-39 Smoke Tube Kit | - | 15 |
| 3-40 Models of Ventilation Systems | - | 1 |
| 3-41 Fume Hood | - | 2 |
| 3-42 Laboratory Desk | - | 1 |
| 3-43 Laboratory Sink | - | 1 |
| 3-44 Human Response Vibration Meter | - | 1 |
| 3-45 Gas Analyser | - | 1 |
| 3-46 Consumables | - | 1 |
| | | |

(4) Computer Equipment

| | Quantity | |
|---|---|---|
| | 1st phase | 2nd phase |
| 4-1 Computer System | - | 1 |
| 4-3 O.C.R. for Word Processor | - | 1 |
| 4-4 Peripheral Equipment for Library | - | 1 |
| | | |

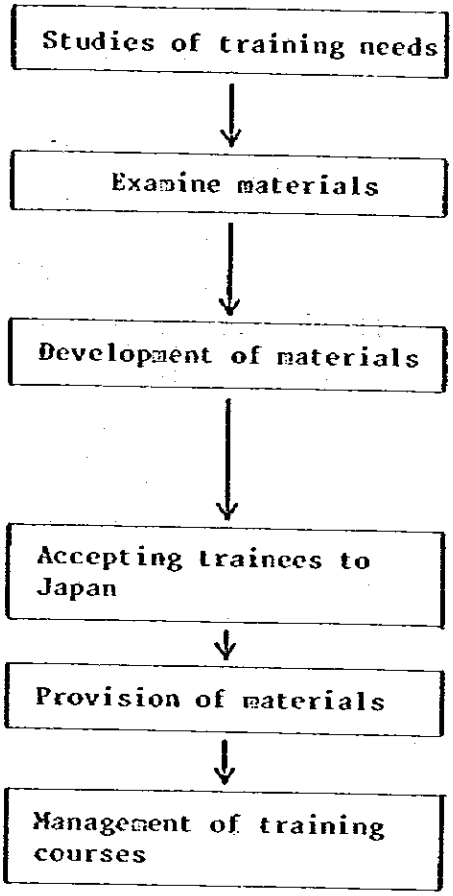
(5) Promotion Equipment

| | Quantity | |
|---|---|---|
| | 1st phase | 2nd phase |
| 5-1 Van | - | 2 |
| | | |

## B. PLAN FOR DEVELOPMENT OF TRAINING MATERIALS

### 1. Development

a. Steps for Development




1 Study on courses required
2 Setting of course outline

1 Those which require development
2 Those which revision will suffice

1 LMR and MSD Training Materials, Manuals and texts
2 OSH - Existing texts to be translated into English

1 Make use of materials provided
2 Training implemented in Japan

1 Receive suggestions from trainees, review them and print

1 Mainly by Singaporean instructors
2 Japanese experts serve as advisors
3 If needed, review them jointly and revise

b. System of Development

As for LMR and MSD, NPB requests the following to be implemented:

(1) As many specific examples as possible be used in materials which are based on PDP.
(2) As for labor-management relations, specific experience be used.

(3) The relationship between small group activity and PDP be defined clearly.

(4) As for OSH, occupational safety and health be dealt with based on the specific guidance experience and not on mere knowledge.

Development is to be carried out based on the above requests of NPB.

c. Development by Course

Tables 7-1, 7-2 and 7-3 show the course duration, number of pages of text, whether manual, VTR, slides, etc. are available for development of materials for LMR, MSD and OSH training courses.

TABLE 7-1 DEVELOPMENT OF MATERIALS BY COURSE (IMR)

| Course No. & Title | Hrs. | Pages | Manual * | Text | | VTR | | Slides | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | New | Revise | New | Revise | New | Revise |
| 1 JC Advance Course | 30 | 150 | o | | o | - | - | - | - |
| 2 JC Basic Course | 30 | 150 | o | | o | (1) | - | (1) | (1) |
| 3 IMR Practice in Prod'y Impr't Course | 60 | 300 | o | o | | - | - | (3) | - |
| 4 QCC Course for Top Mgt | 7 | 35 | o | o | | (3) | - | - | - |
| 5 QCC Facilitators * Course (I) | 18 | | | | | | | | |
| 5' QCC Facilitators * Course (II) | (20) 30 | 100 | o | | o | (1) | | (2) | |
| 5" QCC Facilitators * Course (III) | 15 | 75 | o | o | | | | | |
| 6 QCC Leaders Course * | 21 (15) | 75 | o | | o | - | - | - | (4) |
| 7 QCC Members Course | 15 | 75 | o | | o | - | - | - | (5) |
| 8 Problem Solving Course | 30 | 150 | o | | o | - | - | (2) | (3) |
| 9 New Empl. Induction Course | 30 | 150 | o | | o | - | - | (3) | (5) |
| 10 New Empl. Trainers Course | 30 | 150 | o | o | | (1) | - | - | - |
| 11 Prod'y Induction Course for Managers | 15 | 75 | o | | o | (2) | (-) | (3) | (3) |
| 12 Prod'y Induction Course for Supervisors | 15 | 75 | o | | o | - | - | - | - |
| Total | 331 (297) | 1485 | 13 | 4 | 9 | 8 | - | 14 | 21 |

TABLE 7-2 DEVELOPMENT OF MATERIALS BY COURSE (MSD)

| Course No. & Title | Hrs. | Pages | Manual* | Text | | VTR | | Slides | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | New | Revise | New | Revise | New | Revise |
| 1 Senior Mgt Course | 40 | 200 | o | o | | - | - | - | - |
| 2 Mgt Development Course (Core) | 40 | 200 | o | o | | - | - | (3) | (1) |
| 3 Supervisory Course (Core) | ** 60 (40) | 300 | o | o | | - | - | - | (8) |
| 4 Distribution Supervisors Course | 40 | 200 | o | o | | - | - | - | - |
| 5 Construction Supervisors Course | 40 | 200 | o | o | | - | - | - | - |
| 6 Human Development Course | 80 | 400 | o | o | | - | - | - | - |
| 7 Training Development Course | 80 | 400 | o | | o | - | - | - | - |
| 8 Training Instructors Course | 40 | 200 | o | | o | - | - | - | - |
| 9 Production Management Course | 250 (200) | 1000 | o | | o | - | - | - | - |
| 10 Industrial Engineering Course | 100 | 500 | o | | o | - | - | - | - |
| 11 Management Consultant Course | 300 (200) | 1000 | o | | o | - | - | - | - |
| 12 Corporate Planning Course | 100 | 500 | o | o | | - | - | - | - |
| 13 Personnel Management Course | 344 (100) | 500 | o | o | | - | - | - | - |
| 14 Staff Development & Career Planning Course | 20 | 100 | o | o | | - | - | - | - |
| 15 Performance Appraisal Course | 20 | 100 | o | o | | - | - | - | - |
| 16 Productivity Facilitators Course | 40 | 200 | o | | o | (2) | - | - | - |

(Cont'd)

| Course No. & Title | Hrs. | Pages | Manual* | Text | | VTR | | Slides | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | New | Revise | New | Revise | New | Revise |
| 17 Corporate Strategy Course (Mfg) | 40 | 200 | o | o | | - | - | - | - |
| 18 Corporate Strategy Course (Service) | 40 | 200 | o | o | | - | - | - | - |
| 19 Mgt Structural Strengthening Course (Mfg) | 40 | 200 | o | o | | - | - | - | - |
| 20 Mgt Structural Strengthening Course (Service) | 40 | 200 | o | o | | - | - | - | - |
| Total | 1754 (540) | 6800 | 20 | 14 | 6 | 2 | - | 3 | 9 |

* Since manuals are not usually used in Japan, manuals will be newly prepared.

** The figure parenthesized indicates the numbers of hours required for revision.

*** The figure circled indicates the number of the book related.

TABLE 7-3 DEVELOPMENT OF MATERIALS BY COURSE (OSH)

| | Course No. & Title | Hrs. | Pages Manual Text | VTR | | Slides | |
|---|---|---|---|---|---|---|---|
| | | | | New | Revise | New | Revise |
| 1 | Safety Officers Course | 164 | Refer to the following notes: | (1) | (4) | | (2) |
| 2 | Safety & Health Management Course | 30 | | | (2) | | (1) |
| 3 | Safety Committee Members Course | 29 | | | | (1) | (3) |
| 4 | OSH for Supervisors of General Factories | 25 | | | | | (1) |
| 5 | Shipyard Managers Course | 20 | | | | | |
| 6 | Shipyard Supervisors Course | 15 | | | | (2) | (2) |
| 7 | Safety Course on Press Machines & Related Machines for Supervisors | 25 | | | | | |
| 8 | OSH Course for Petrochemical Supervisors | 35 | | | (1) | (1) | |
| 9 | MRT Safety Course for Suprevisors | 25 | | | | (1) | (2) |
| 10 | Building Construction Safety Supervisors | 25 | | | | | (5) |
| 11 | Occupational Hygiene Technician Course | 120 | | (1) | | | |
| | Total | 513 | | 2 | 7 | 5 | 16 |

Note 1. In case of OSH, texts will have to cover a wide range. Translations of existing texts will be used (IMR and MSD are different). The same method is used in Japan. If texts are to be prepared to comply with the situation in Singapore, it would take sveral years and cannot be made available in time for accepting of trainees.

Note 2. With the special situation of Singapore taken into account, manuals will be prepared by Singapore counterparts on the basis of the advice given by the experts dispatched for long and short-term.

## 2. Purchase

### a. Purchase from overseas

Tables 7-4 and 7-5 show the number of the books and AV aids to be purchased from overseas for 1st and 2nd phases respectively.

TABLE 7-4 LIST OF BOOKS TO BE PURCHASED FROM OVERSEAS (1st Phase)

| Large Classification | Medium Classification | Books | AV Aids | |
|---|---|---|---|---|
| | | | VTR | SLIDE |
| LMR (Labour-Management Relations) | Joint Consultation | 0 | 0 | |
| | Quality Control Circles | 50 | 5 | |
| | Problem Solving | 100 | 5 | |
| | Productivity will and Technology | 100 | 10 | |
| | Training and Trainer | 150 | 10 | |
| | Others | 300 | 35 * | |
| | Total | 700 | 65 * | |
| MSD (Management Supervisory Development) | Business Strategy | 150 | 10 | |
| | Strengthening of Business Structure | 150 | 5 | |
| | Managers and Management | 1,000 | 15 | |
| | Supervisors | 150 | 10 | |
| | Personnel Management and Training | 200 | 10 | |
| | Production Control and Production Technique | 100 | 10 | |
| | By Type of Industry | 100 | 5 | |
| | Others | 150 | 10 | |
| | Total | 2,000 | 75 | |
| OSH (Occupational Safety & Health) | Occupational Safety<br>Occupational Health<br>Occupational Hazard<br>By Type of Industry<br>Others | 300 | 30 | |
| | Total | 300 | 30 | |
| | Grand Total | 3,000 | 170 * | |

* Out of the figure, 20 are packages.

TABLE 7-5 LIST OF BOOKS TO BE PURCHASED FROM OVERSEAS (2nd Phase)

| Large Classification | Medium Classification | Books | AV Aids | |
|---|---|---|---|---|
| | | | VTR | SLIDE |
| LMR (Labour-Management Relations) | Joint Consultation<br>Quality Control Circles<br>Problem Solving<br>Productivity will and Technology<br>Training and Trainer<br>Others | 4,000 | | 30 |
| | Total | 4,000 | | 30 |
| MSD (Management Supervisory Development) | Business Strategy<br>Strengthening of Business Structure<br>Managers and Management<br>Supervisors<br>Personnel Management and Training<br>Production Control and Production Technique<br>By Type of Industry<br>Others | 5,000 | | 90 |
| | Total | 5,000 | | 90 |
| OSH (Occupational Safety & Health) | Occupational Safety<br>Occupational Health<br>Occupational Hazard<br>By Type of Industry<br>Others | 1,000 | | 30 |
| | Total | 1,000 | | 30 |
| | Grand Total | 10,000 | | 150 |

b. Purchase from Japan

Table 7-6 shows the number of the books and AV aids (for 1st Phase only) to be purchased from Japan. Table 7-7 shows the number of the booklets in English version to be supplied from Japan.

TABLE 7-6 LIST OF BOOKS TO BE PURCHASED FROM JAPAN

| Large Classification | Medium Classification | Books | AV Aids | |
|---|---|---|---|---|
| | | | VTR | SLIDE |
| LMR (Labour-Management Relations) | Joint Consultation | 70 | 2 | 5 |
| | Quality Control Circles | 80 | 2 | 10 |
| | Problem Solving | 50 | 2 | 3 |
| | Productivity will and Technology | 100 | 2 | 5 |
| | Training and Trainer | 50 | 2 | 3 |
| | Others | 30 | 2 | 4 |
| | Total | 380 | 12 | 30 |
| MSD (Management Supervisory Development) | Business Strategy | 50 | 10 | 10 |
| | Strengthening of Business Structure | 30 | 5 | 5 |
| | Managers and Management | 120 | 5 | 15 |
| | Supervisors | 50 | 5 | 15 |
| | Personnel Management and Training | 100 | 5 | 10 |
| | Production Control and Production Technique | 100 | 5 | 10 |
| | By Type of Industry | 30 | 5 | 5 |
| | Others | 40 | 3 | 10 |
| | Total | 520 | 43 | 80 |
| OSH (Occupational Safety & Health) | Occupational Safety | 100 | 3 | 10 |
| | Occupational Health | | 3 | 10 |
| | Occupational Hazard | | 3 | 10 |
| | By Type of Industry | | 3 | 5 |
| | Others | | 3 | 5 |
| | Total | 100 | 15 | 40 |
| | Grand Total | 1,000 | 70 | 150 |

TABLE 7-7 LIST OF BOOKLETS IN ENGLISH VERSION TO BE SUPPLIED FROM JAPAN

| Large Classification | Medium Classification | 1st Phase | 2nd Phase |
|---|---|---|---|
| LMR (Labour-Management Relations) | Quality Control Circles | 12 | 15 |
| | Problem Solving | 2 | 2 |
| | Productivity will and Technology | 5 | 0 |
| | Joint Consultation | | |
| | Training and Trainer | 4 | 4 |
| | Others | | |
| | Total | 23 | 21 |
| MSD (Management Supervisory Development) | Business Strategy | | |
| | Strengthening of Business Structure | | |
| | Managers and Management | | |
| | Supervisors | | |
| | Personnel Management and Training | 12 | 14 |
| | Production Control and Production Technique | | |
| | By Type of Industry | | |
| | Others | | |
| | Total | 12 | 14 |
| OSH (Occupational Safety & Health) | Occupational Safety | | |
| | Occupational Health | | |
| | Occupational Hazard | 15 | 15 |
| | By Type of Industry | | |
| | Others | | |
| | Total | 15 | 15 |
| | Grand Total | 50 | 50 |

# PROJECT IMPLEMENTATION SCHEDULE

## A. CONSTRUCTION SCHEDULE

A tentative construction schedule until the completion of the building, if implemented, would be as shown Fig. 9-1.

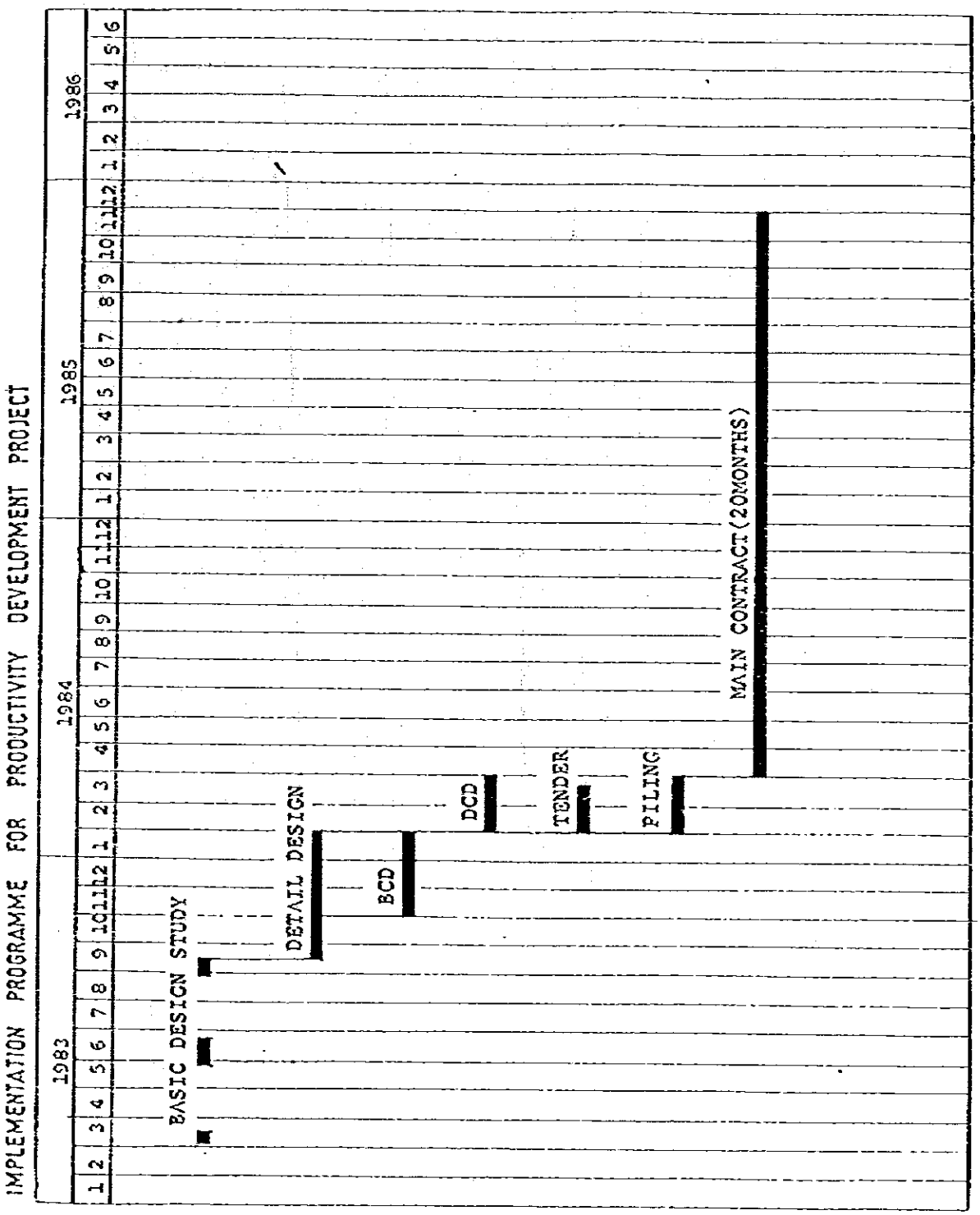



FIG. 9-1 IMPLEMENTATION PROGRAMME FOR PRODUCTIVITY DEVELOPMENT PROJECT

## B. PROCUREMENT PLAN

Table below shows the procurement procedure for equipment and materials and expected time of delivery therefor. Refer to Fig. 9-2.

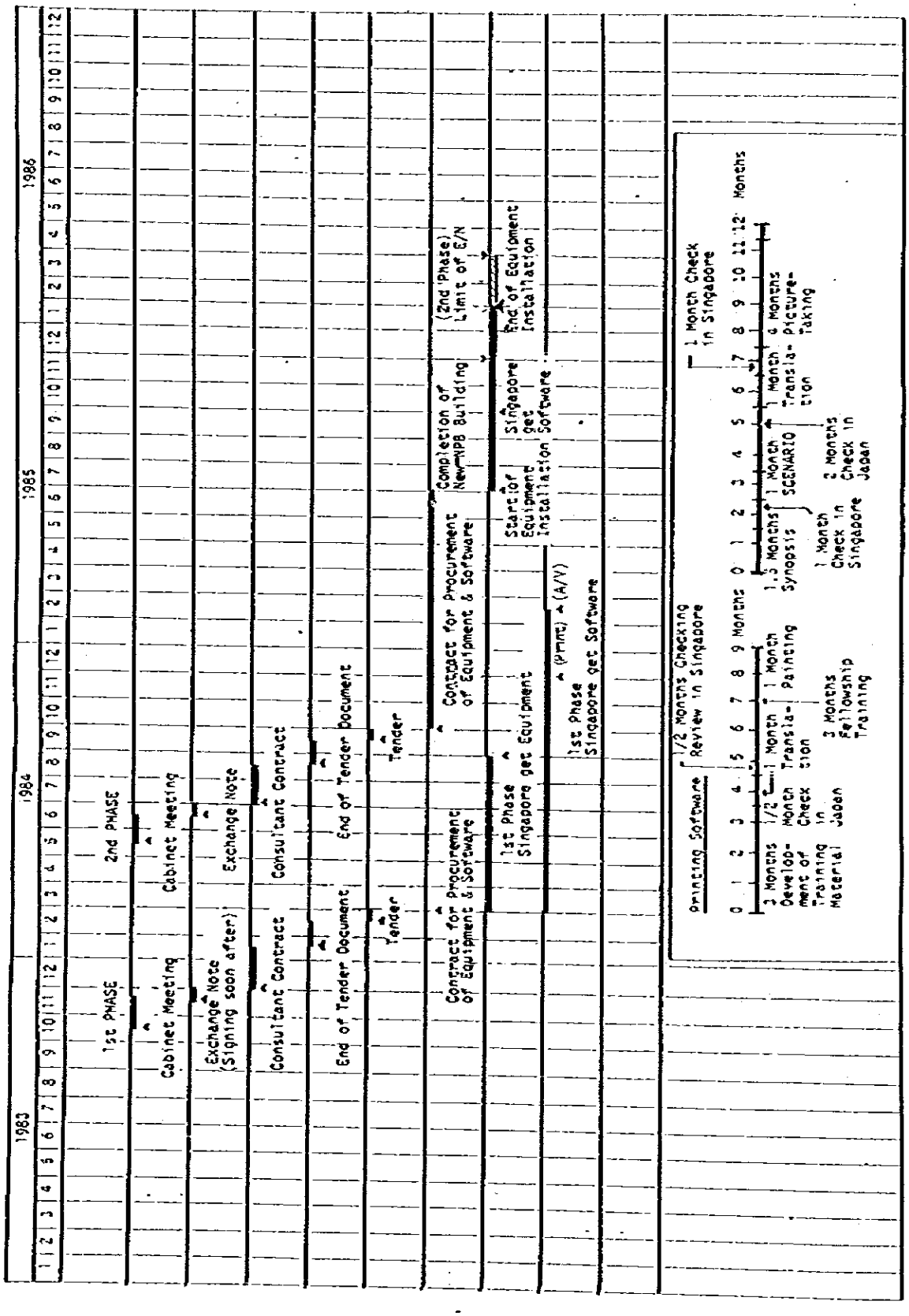



FIG. 9-2 PROCUREMENT PROCEDURES

## C. FUTURE ADMINISTRATION AND MAINTENANCE PROGRAM

### 1. Operation

The NPB has been functioning as a base of operation for training activities in relation to the productivity since its establishment in 1972. Operations for this project are also to be performed successively by the NPB. Organization and budgetary measures of the NPB are as described in Chapter Three Productivity Movement of this report. Budget shows rapid growth in the past three years (1980: 3.29 Millions S. Dollars, 1982: 9.12 Million S. Dollars). In 1983, 13.99 Million S. Dollar Budget (personnel expenses: 6.34 Million S. Dollars, operation expenses: 7.65 Million S. Dollar) has been appropriated for the project.

### 2. Organization

Organization of the NPB is as described in Chapter Four Description of the Project. Expansion of the staff has been planned to cope with the PDP proceedings. Staff of 108 persons in July 1983 is planned to be increased to 390 persons in 1987.

### 3. Maintenance Expenses

Annual maintenance expenses after completion of the new NPB Building is estimated tentatively as follows:

| | |
|---|---|
| Electric charges | 180,019,000 Yen |
| Water charges | 42,748,000 |
| City gas charges | 13,165,000 |
| Maintenance personnel | 70,000,000 |
| Total | 305,932,000 Yen |

(Above expenses do not include those for cleaning and security guards.)

Breakdown of the above expenses is as listed as follows:

a. Electricity

(1) Estimated load and power demand

(A) Approximate load estimated

30,000 SQ M x 110 W/SQ M = 3,300 KW
8,000 SQ M x 90 W/SQ M = 720 KW

Total : 3,300 KW + 720 KW= 4,020 KW

(B) Power demand

On the assumption of 0.7 demand factor:

4,020 KW x 0.7 = 2,814 KW
Power demand: 2,800 KW

(2) Approximate electric power consumption:

On the assumption of 0.25 daily load factor:
2,800 KW x 0.25 x 24 Hrs = 16,800 KWH/Day
Daily power consumption assumed: 16,000 KWH
Monthly power consumption: 480,000 KWH

(3) Operation expenses

Following expenses have been assumed by applying standard rates in Japan.

Basic charge, monthly:
2,800 KW x 2,000 Yen = 5,600,000 Yen

Charges for electric consumption, monthly:
480,000 KWH x 18.43 Yen = 8,846,000 Yen

Electricity tax, 5 percent:
(5,600,000 + 8,846,000) x 0.05 = 722,300 Yen

Monthly electric charges:
5,600,000 + 8,846,000 + 722,300 = 15,168,300 Yen/Month

Annual electric charges:
15,168,300 Yen/Month x 12 Months = 182,019,600 Yen/Year

b. Water supply

(1) Utility water

1400 Persons (400 Office staff + 1000 Participants) x
0.1 CU M/Person. Day = 140 CU M/Day

140 CU M/Day x 300 Days/Year = 42,000 CU M/Year

(2) Cooling tower replenishment water

1200 USRT x 0.013 CU M/RT. MIN
x 0.01 (Replenishment ratio)
x 60 Min x 10 Hrs/Day = 93.6 CU M/Day

(3) Total water quantity

42,000 CU M/Year + 28,080 CU M/Year = 70,080 CU M/Year

(4) Operation expenses

Unit cost (incl. sewer cost) 610 Yen/Cu M
Annual cost 610 Yen/CU M x
70,080 CU M/Year = 42,748,800 Yen/Year

c. City gas

(1) Cooking use for 1,400 persons
(2) Kitchen area, minimum: 260 SQ M
(3) Total gas quantity
260 CU M x 3,000 Kcal/H.SQ M x 4 Hr/Day = 3,120,000 Kcal/Day

3,120,000 Kcal/Day x 300 Days/Year
= 936,000,000 Kcal/Year
= 936,000 Mcal/Year

(4) Operation cost
Unit cost (11 MCal/CU M): 154.72 Yen/CU M
Annual cost: 154.72 Yen/CU M x (936,000 MCal/Year divided by
11 MCal/CU M) = 13,165,265 Yen/Year

d. Personnel expenses for maintenance

(1) Maintenance personnel: 7 persons

(2) Personnel expenses:

Unit personnel expenses: 10,000,000 Yen/Year.Person

Annual personnel expenses:

10,000,000 Yen/Year x 7 persons = 70,000,000/Year

Notes: Above operation cost does not include the followings:

(1) Cleaning cost

(2) Personnel expenses of security guards

(3) Operation cost of security equipment

# PROJECT EVALUATION

## CHAPTER NINE PROJECT EVALUATION

As this Project concerns software primarily, it is difficult to quantitatively measure precisely the effects of this program in a comprehensive manner. Therefore, this evaluation will deal mainly with the social and economic advantages for Singapore from this Project.

Based on the realization by the Goverament of Singapore that manpower is their only resource, it has been pursuing a policy where manpower development, in particular, technological education is emphasized to achieve industrialization of its industry which requires higher level of technology and value added.

While the technological development of workers is continuing due mainly to its education policy, in order to further develop its technology and for the maximum development of its productivity, the Government of Singapore has looked to the productivity development achieved in Japan which was based on the human aspects. The introduction, promotion and training of productivity techniques are the essence of this Project.

NPB, as the leader and promoter of PDP activities, is to strengthen and expand its organization and functions through this Project. The following effects are expected from this cooperation program.

### A. PROVISION OF EQUIPMENT

1. Training activities will be carried out more smoothly and effectively when A/V equipment and materials are used in the classrooms.

2. The enrichment and enlargement of Resource Centre, through the activities of development of training materials and collection and processing of information, etc. will support and strengthen PDP activities.

3. By provision of experiment apparatus, equipment and tools for OSH, practical research and training will become possible.

4. By improving computer systems of NPB, training of computer professionals and users, effective collection, processing and analysis of information on training and education as well as on management efficiency and productivity will be achieved. This meets the national policy of acquiring higher technology.

5. Promotion activities will become more efficient and active through the support provided by the Resource Centre.

## B. DEVELOPMENT OF TRAINING MATERIALS

For the introduction and promotion of the Japanese technique in productivity development which is based on human aspects, it is effective and smooth to utilize and train by using material developed in Japan.

## C. RELATIONSHIP WITH TECHNICAL COOPERATION

The technical cooperation by means of dispatching experts to Singapore and accepting trainees in Japan will be effectively carried out by utilization of equipment and materials provided under the grant aid program. Materials to be developed can also be reviewed and improved during the course of their development by trainees and experts, thus both programs will be supplementing each other.

In line with the continuing efforts of the Government of Singapore towards high productivity, worker's will for productivity must be strengthened for the Productivity Movement to succeed. Planting the productivity will among workers who are acquiring technology is an objective of PDP. This also involves convincing workers of the importance and benefit of productivity.

# CONCLUSION AND PROPOSAL

# CHAPTER TEN CONCLUSION AND PROPOSAL

This Project is an effort to promote knowledge-intensive, higher value added industry and to implement development and training of manpower based on human aspects. This is in line with the basic policy of the Government of Singapore to improve productivity and maintain its high rate of economic growth.

The Government of Singapore, as a means of achieving its objectives, has decided to take up the "Productivity Development Project-PDP" under Japan's "ASEAN Human Resource Development Project". Techniques of improving productivity are to be introduced and disseminated, including those of management and supervisory development and labour management relations, in the PDP plan.

As a result of the evaluation carried out on the effect and continuity of the implementation of PDP, it has been concluded that this Project will be significantly effective as explained in the previous chapter. This Project being implemented under the grant aids programme of the Government of Japan is significant and it is hoped that the Project will be implemented as soon as possible.

It is also sincerely hoped that the construction of the new NPB Building is carried out and completed on schedule by end of 1985, as the successful implementation of this Project relies greatly on its completion. In preparation for the commencement of the construction of the building, it is important that the drainage ditch traversing the northwest corner of the site is properly relocated by NPB in the near future.

It is also hoped that the materials which will be developed or procured under this grant aid program will continue to be improved in the future by Japanese technical cooperation.

It is our expectation that this Project will be smoothly implemented, and that it will enhance the cooperation in the field of productivity between Japan, Singapore and ASEAN.

# APPENDIX

**APPENDIX 1**

LIST OF PARTICIPANTS SINGAPORE SIDE

| | | |
|---|---|---|
| 1. | Mr. Ng Kiat Chong | Deputy Chairman, National Productivity Board (NPB) (Leader) |
| 2. | Mr. Lim Jit Poh | Executive Director (NPB), (Alternate Leader) |
| 3. | Mr. David Ang | Divisional Director, Management and Supervisory Development (NPB) |
| 4. | Mr. Koh Juan Kiat | Divisional Director, Labour Management Relations (NPB) |
| 5. | Mr. Freddy Soon | Divisional Director, Promotion and Information (NPB) |
| 6. | Mr. Daniel Ee | Divisional Director, Planning and Evaluation (NPB) |
| 7. | Mr. Lee Kok Wai | Divisional Director, Training Administration (NPB) |
| 8. | Mr. Bernard Poon | Assistant Director, Promotion and Information (NPB) |
| 9. | Mr. Lee Kok Seong | Assistant Director, Occupational Safety and Health (NPB) |
| 10. | Mr. William Wong | Senior Officer, Planning & Evaluation (NPB) |
| 11. | Miss Annie Tan | Senior Officer, Planning & Evaluation (NPB) |

## APPENDIX 2

### LIST OF PARTICIPANTS

BASIC DESIGN STUDY TEAM
ON THE PRODUCTIVITY DEVELOPMENT PROJECT
IN SINGAPORE

Leader

Mr. Eizen Irei
Second Economic Cooperation Div.,
Economic Cooperation Bureau, MFA

Project Coordinator

Mr. Takeshi Imazu
Deputy Head, Basic Design Div.,
Grant Aid Dept., JICA

Computer Specialist

Mr. Yoshihide Teranishi
System Development and Data Processing Div.,
General Affairs Dept., JICA

Architectural Planning

Mr. Hiroshi Kikuoka
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

Architectural Design

Mr. Tatsuya Morita
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

Utilities Planning

Mr. Masato Kobayashi
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

Structural Planning

Mr. Satoshi Dohata
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

Training Material Development

Mr. Daisaku Kobayashi
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

**APPENDIX 3**

SCHEDULE IN SINGAPORE

May/June 1983

| | | |
|---|---|---|
| 29th | Sun | Arrived Singapore<br>(Kikuoka, Morita, M. Kobayashi, Dohata, D. Kobayashi) |
| 30th | Mon | NPB, Site Investigation, Embassy of Japan |
| 31st | Tue | NPB (discussion on building), Data analyses |
| 1st | Wed | NPB (discussion on equipment and training material) |
| 2nd | Thu | NPB (discussion on building and training material),<br>visited NTC and DBS |
| 3rd | Fri | NPB (discussion on building and training material) |
| 4th | Sat | NPB (discussion on building and training material),<br>Field survey |
| 5th | Sun | Data analyses |
| 6th | Mon | NPB (discussion on building and training material) |
| 7th | Tue | NPB (discussion on building, equipment and training<br>material), Visited Jurong Engineering Pte Ltd. |
| 8th | Wed | NPB (discussion on building),<br>Arrived Singapore (Irei, Imazu, Teranishi) |
| 9th | Thu | Discussion with Mission of Technical Cooperation,<br>Team discussion on Basic Design |
| 10th | Fri | NPB (discussion on equipment and training material) |
| 11th | Sat | Data analyses, Discussion with Mission of Technical<br>Cooperation |
| 12th | Sun | Data analyses |
| 13th | Mon | NPB (discussion on building, equipment and training<br>material), Departed Singapore (Dohata) |
| 14th | Tue | NPB (discussion on training material),<br>Data analyses, Departed Singapore (M. Kobayashi) |
| 15th | Wed | NPB (discussion on building and equipment) |
| 16th | Thu | NPB (discussion on Minutes of Discussion),<br>Site investigation, Visited JSTC and JSIST |
| 17th | Fri | NPB (discussion on building), Embassy of Japan, JICA |
| 18th | Sat | Departed Singapore<br>(Irei, Imazu, Teranishi, Kikuoka, Morita, D. Kobayashi) |

APPENDIX 4

# MINUTES OF DISCUSSION

In response to a request by the Government of the Republic of Singapore, the Government of Japan has sent through the Japan International Cooperation Agency (JICA), which is an official agency implementing the technical cooperation of the Government of Japan, a team headed by Mr Eizen Irei, Second Economic Cooperation Bureau, Ministry of Foreign Affairs, to conduct a basic design survey on the Productivity Development Project in Singapore (thereinafter called as "the Project") for 21 days from May 29 to June 18, 1983. A list of participants of both sides for the consultation is attached as Annex I.

The Team had a series of discussions and exchanged views with officials of the National Productivity Board.

Both Parties have agreed to recommend to their respective Governments and the authorities concerned to examine the results of the survey attached herewith toward the realization of the Project. Both parties agreed that it is desirable for Grant Aid to be made available as soon as possible so as to integrate with the implementation of the Technical Cooperation Programme, for which the Record of Discussions was signed on 11 June 1983.

伊禮英金

Eizen Irei
Leader
Basic Design Survey Team

Lim Jit Poh
Executive Director
National Productivity Board

17 June 1983
Singapore

ATTACHMENT

1. The Productivity Development Project is of vital importance to Singapore because it will develop human resources for higher productivity. The Japanese assistance in the provision of experts, fellowships, hardware and software will therefore contribute significantly to the Productivity Movement in Singapore.

2. The objective of the Grant Aid component of the Project is to provide necessary equipment and materials for improvement of the Productivity Movement in Singapore.

3. The Executing Agency, which will be responsible for procurement of equipment and materials, will be the National Productivity Board.

4. The proposed site of the new NPB building is at Jalan Bukit Merah. The Government of Singapore will construct the building to conduct training, promotion, resource centre and research activities for the Productivity Movement. The equipment and materials which are to be provided in grant form from the Government of Japan will be used for these activities.

5. The Japanese Survey Team will convey the requirements of the Government of Singapore to the Government of Japan that the Japanese Government will take necessary measures to cooperate in implementing the Project and will provide the items in Annex II within the scope of Japanese economic cooperation in grant form.

6. The Government of Singapore will take necessary measures on condition that the grant assistance by the Government of Japan is extended to the Project:

(1) to complete the construction of the new NPB building by the end of 1985;

(2) to ensure unloading and customs clearance of equipment and materials to be supplied under the Project at ports of disembarkation in Singapore;

(3) to accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into Singapore and stay therein for the performance of their work;

(4) to provide necessary information and data required to carry out this Project.

ANNEX I

## LIST OF PARTICIPANTS

I. Japanese Basic Design Survey Team

| | | |
|---|---|---|
| 1. | Mr Eizen Irei | Second Economic Cooperation Division, Economic Cooperation Bureau, Ministry of Foreign Affairs (Leader) |
| 2. | Mr Takeshi Imazu | Deputy Head, Basic Design Division, Grant Aid Department, JICA |
| 3. | Mr Yoshihide Teranishi | System Development and Data Processing Division, General Affairs Department, JICA |
| 4. | Mr Hiroshi Kikuoka | Matsuda, Hirata & Sakamoto Architects, Planners & Engineers, Inc |
| 5. | Mr Tatsuya Morita | Matsuda, Hirata & Sakamoto Architects, Planners & Engineers, Inc |
| 6. | Mr Masato Kobayashi | Matsuda, Hirata & Sakamoto Architects, Planners & Engineers, Inc |
| 7. | Mr Satoshi Dohata | Matsuda, Hirata & Sakamoto Architects, Planners & Engineers, Inc |
| 8. | Mr Daisaku Kobayashi | Matsuda, Hirata & Sakamoto Architects, Planners & Engineers, Inc |

II. Singapore Side

| | | |
|---|---|---|
| 1. | Mr Ng Kiat Chong | Deputy Chairman, National Productivity Board (NPB) (Leader) |
| 2. | Mr Lim Jit Poh | Executive Director (NPB), (Alternate Leader) |
| 3. | Mr David Ang | Divisional Director, Management and Supervisory Development (NPB) |
| 4. | Mr Koh Juan Kiat | Divisional Director, Labour Management Relations (NPB) |

| | | |
|---|---|---|
| 5. | Mr Freddy Soon | Divisional Director, Promotion and Information (NPB) |
| 6. | Mr Daniel Ee | Divisional Director, Planning and Evaluation (NPB) |
| 7. | Mr Lee Kok Wai | Divisional Director Training Administration (NPB) |
| 8. | Mr Bernard Poon | Assistant Director, Promotion and Information (NPB) |
| 9. | Mr Lee Kok Seong | Assistant Director, Occupational Safety and Health (NPB) |
| 10. | Mr William Wong | Senior Officer, Planning & Evaluation (NPB) |
| 11. | Miss Annie Tan | Senior Officer, Planning & Evaluation (NPB) |

Items requested by the Government of Singapore whose costs will be borne by the Government of Japan are shown as follows:

1. Equipment

(1) Studio Equipment
(2) Training Material Production Equipment
(3) Audio-Visual, Training and Research Equipment
(4) Computer and Affiliated Equipment
(5) Vehicles
(6) Maintenance Workshop Equipment

2. Training, Promotion, Research and Resource Materials

To procure, develop and produce:

(1) Books, Publications and Printed Materials
(2) Trainer Manuals and Textbooks
(3) Films, Audio-Visual Tapes, Slides and Transparencies
(4) Training Packages
(5) Microfiche

Note:- Items in the detailed list of equipment and training, promotion, research and resource materials can be changed to take advantage of changes in technology and new developments.

## APPENDIX 5

SCHEDULE IN SINGAPORE (SECOND STUDY)

August/September 1983

| | | |
|---|---|---|
| 25th | Thu | Arrive Singapore<br>(Kikuoka, Morita) |
| 26th | Fri | Embassy of Japan, JICA<br>Discussions with Singaporean Officials |
| 27th | Sat | Discussions with Singaporean Officials<br>Arrive Singapore (Imazu, D. Kobayashi) |
| 28th | Sun | Team Discussion on Basic Design |
| 29th | Mon | Discussions with Singaporean Officials |
| 30th | Tue | Do |
| 31th | Wed | Do |
| 1st | Thu | Do |
| 2nd | Fri | Embassy of Japan, JICA |
| 3rd | Sat | Depart Singapore<br>(Imazu, Kikuoka, Morita, D. Kobayashi) |

## APPENDIX 6

### LIST OF PARTICIPANTS (SECOND STUDY)

Leader

Mr. Takeshi Imazu
Deputy Head, Basic Design Div.,
Grant Aid Dept., JICA

Architectural Planning

Mr. Hiroshi Kikuoka
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

Architectural Design

Mr. Tatsuya Morita
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

Training Material Development

Mr. Daisaku Kobayashi
Matsuda, Hirata & Sakamoto
Architects, Planners & Engineers, Inc.

# THE DRAFT REPORT OF THE BASIC DESIGN STUDY

# ON

# THE PRODUCTIVITY DEVELOPMENT PROJECT

The Government of Japan has sent, through Japan International Cooperation Agency (JICA), a Basic Design Study Team to the Republic of Singapore from 25 August to 3 September 1983 for the purpose of presenting and explaining the draft of final report of the Basic Design Study (The Report) on the Productivity Development Project in the Republic of Singapore (The Project).

The team held meetings with the officials concerned of National Productivity Board (NPB) to explain and discuss on The Report. As a result of the discussions, both parties have agreed as follows:-

1. The Report principally satisfied the Singapore side and appropriate alterations in design agreed during the discussion will be incorporated in the Final Report.

2. The Final Report (15 copies in English) on The Project will be submitted to NPB by the end of October 1983.

3. The Team and NPB understood and confirmed the measures to be undertaken by both parties for The Project.

MR TAKESHI IIAZU
Leader
Basic Design Study
Team

MR NG KIAT CHONG
Deputy Chairman
National Productivity
Board

2 September 1983
Singapore

# SUPPLEMENT

**SUPPLEMENT 1**

Climatological Statistics

| | | |
|---|---|---|
| Mean daily temperature | : | 26.6°C |
| Mean daily maximum temperature | : | 30.7°C |
| Mean daily minimum temperature | : | 23.7°C |
| Highest maximum temperature | : | 34.8°C |
| Lowest minimum temperature | : | 19.6°C |
| Mean daily relative humidity | : | 84.6% |
| Mean daily maximum relative humidity | : | 96.4% |
| Mean daily minimum relative humidity | : | 64.2% |
| Extreme minimum relative humidity | : | 33.0% |
| Mean daily sunshine hours | : | 5.59 hours |
| Mean annual rainfall | : | 2,388.7mm |
| Highest annual rainfall | : | 3,452.4mm |
| Lowest annual rainfall | : | 1,563.4mm |
| Highest rainfall in 24 hours | : | 512.4mm |

SUPPLEMENT 17

Monthly Total Solar Radiation (Kcal/Day M2) Location (Singapore)

| Orientation | Radiation | Jan. | Feb. | March | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Direct | 3012 | 2010 | 930 | 1719 | 2620 | 2979 | 2589 | 1680 | 875 | 1904 | 2897 | 3353 | 26568 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 3157 | 2158 | 1078 | 1863 | 2760 | 3115 | 2726 | 1821 | 1017 | 2046 | 3036 | 3493 | 28270 |
| WS | Direct | 2745 | 2234 | 1233 | 1928 | 2715 | 2887 | 2675 | 2165 | 1336 | 2102 | 2566 | 2673 | 27259 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 2890 | 2382 | 1381 | 2072 | 2855 | 3023 | 2812 | 2306 | 1478 | 2244 | 2705 | 2813 | 28961 |
| W | Direct | 2504 | 2526 | 2424 | 2259 | 2623 | 2564 | 2562 | 2636 | 2423 | 2354 | 2252 | 2136 | 29263 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 2649 | 2674 | 2572 | 2403 | 2763 | 2700 | 2699 | 2777 | 2565 | 2496 | 2391 | 2276 | 30965 |
| NW | Direct | 1311 | 1688 | 2275 | 1514 | 1457 | 1298 | 1413 | 1837 | 2089 | 1487 | 1154 | 974 | 18497 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 1456 | 1836 | 2423 | 1658 | 1597 | 1434 | 1550 | 1978 | 2231 | 1629 | 1293 | 1114 | 20199 |
| N | Direct | 0 | 160 | 792 | 151 | 0 | 0 | 0 | 209 | 662 | 129 | 0 | 0 | 2103 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 145 | 308 | 940 | 295 | 140 | 136 | 137 | 350 | 804 | 271 | 139 | 140 | 3805 |
| NE | Direct | 43 | 258 | 837 | 388 | 85 | 19 | 54 | 298 | 1002 | 306 | 60 | 3 | 3353 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 188 | 406 | 985 | 532 | 225 | 155 | 191 | 439 | 1144 | 448 | 199 | 143 | 5055 |
| E | Direct | 1288 | 1607 | 2209 | 1988 | 1611 | 1494 | 1326 | 1642 | 2368 | 1832 | 1473 | 1109 | 19947 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 1433 | 1755 | 2357 | 2132 | 1751 | 1630 | 1463 | 1783 | 2510 | 1974 | 1612 | 1249 | 21649 |
| SE | Direct | 2296 | 2367 | 2370 | 2672 | 2660 | 2655 | 2287 | 2298 | 2345 | 2549 | 2559 | 2192 | 29250 |
| | Sky | 145 | 148 | 148 | 144 | 140 | 136 | 137 | 141 | 142 | 142 | 139 | 140 | 1702 |
| | Total | 2441 | 2515 | 2518 | 2816 | 2800 | 2791 | 2424 | 2439 | 2487 | 2691 | 2698 | 2332 | 30952 |
| H | Direct | 6065 | 6420 | 6582 | 6353 | 5959 | 5727 | 5844 | 6172 | 6358 | 6213 | 5927 | 5828 | 73448 |
| | Sky | 293 | 299 | 301 | 295 | 285 | 276 | 278 | 286 | 291 | 290 | 287 | 288 | 3469 |
| | Total | 6358 | 6719 | 6883 | 6648 | 6244 | 6003 | 6122 | 6458 | 6649 | 6503 | 6214 | 6116 | 76917 |

SUPPLEMENT 3

## Solar Data for North Orientation

| Time | March 21 | | | | | June 22 | | | | | Dec 22 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT |
| 7 AM | 90 | +90 | 0 | 13 | 13 | 15 | +67 | 60 | 25 | 85 | - | - | 0 | 15 | 15 |
| 8 AM | 90 | +90 | 0 | 48 | 48 | 41 | +65 | 145 | 63 | 208 | - | - | 0 | 48 | 48 |
| 9 AM | - | - | 0 | 76 | 76 | 55 | +63 | 187 | 91 | 278 | - | - | 0 | 71 | 71 |
| 10 AM | - | - | 0 | 98 | 98 | 62 | +57 | 208 | 114 | 322 | - | - | 0 | 91 | 91 |
| 11 AM | - | - | 0 | 118 | 118 | 66 | +45 | 219 | 131 | 350 | - | - | 0 | 109 | 109 |
| 12 NOON | - | - | 4 | 129 | 133 | 68 | +21 | 222 | 141 | 363 | - | - | 0 | 117 | 117 |
| 1 PM | - | - | 0 | 133 | 133 | 68 | -14 | 225 | 141 | 366 | - | - | 0 | 116 | 116 |
| 2 PM | - | - | 0 | 123 | 123 | 66 | -41 | 219 | 134 | 353 | - | - | 0 | 108 | 108 |
| 3 PM | - | - | 0 | 104 | 104 | 63 | -55 | 209 | 119 | 328 | - | - | 0 | 93 | 93 |
| 4 PM | - | - | 0 | 85 | 85 | 57 | -62 | 195 | 98 | 293 | - | - | 0 | 73 | 73 |
| 5 PM | 90 | -90 | 0 | 60 | 60 | 44 | -65 | 156 | 71 | 227 | - | - | 0 | 50 | 50 |
| 6 PM | 90 | -90 | 0 | 28 | 28 | 21 | -66 | 81 | 33 | 114 | - | - | 0 | 20 | 20 |

Key: θ1 : Vertical shadow angle

θ2 : Horizontal shadow angle

ID : Intensity of direct radiation ($W/m^2$)

Id : Intensity of diffuxe radiation ($W/m^2$)

IT : Intensity of total radiation ($W/m^2$)

SUPPLEMENT 4

Solar data for North-East Orientation

| Time | March 21 | | | | | June 22 | | | | | Dec 22 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT |
| 7 AM | 6 | +45 | 94 | 23 | 117 | 6 | +22 | 159 | 33 | 192 | 15 | +69 | 52 | 20 | 72 |
| 8 AM | 26 | +45 | 293 | 76 | 369 | 21 | +20 | 387 | 86 | 473 | 46 | +70 | 111 | 63 | 174 |
| 9 AM | 44 | +46 | 336 | 106 | 442 | 34 | +18 | 462 | 116 | 578 | 67 | +74 | 87 | 170 | 71 |
| 10 AM | 59 | +47 | 278 | 126 | 404 | 47 | +12 | 435 | 133 | 568 | 81 | +81 | 28 | 98 | 126 |
| 11 AM | 72 | +48 | 154 | 136 | 290 | 58 | - 0 | 345 | 141 | 486 | - | - | 0 | 109 | 109 |
| 12 NOON | 83 | +52 | 31 | 136 | 167 | 68 | -24 | 216 | 141 | 357 | - | - | 0 | 116 | 116 |
| 1 PM | - | - | 0 | 133 | 133 | 78 | -59 | 98 | 110 | 208 | - | - | 0 | 116 | 116 |
| 2 PM | - | - | 0 | 123 | 123 | 88 | -86 | 29 | 116 | 145 | - | - | 0 | 108 | 108 |
| 3 PM | - | - | 0 | 104 | 104 | - | - | 0 | 93 | 93 | - | - | 0 | 93 | 93 |
| 4 PM | - | - | 0 | 85 | 85 | - | - | 0 | 76 | 76 | - | - | 0 | 73 | 73 |
| 5 PM | - | - | 0 | 60 | 60 | - | - | 0 | 53 | 53 | - | - | 0 | 50 | 50 |
| 6 PM | - | - | 0 | 28 | 28 | - | - | 0 | 23 | 23 | - | - | 0 | 20 | 20 |

Key: θ1 : Vertical shadow angle

θ2 : Horizontal shadow angle

ID : Intensity of direct radiation ($W/m^2$)

Id : Intensity of diffuse radiation ($W/m^2$)

IT : Intensity of total radiation ($W/m^2$)

SUPPLEMENT 5

Solar Data for East Orientation

| Time | March 21 | | | | | June 22 | | | | | Dec 22 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT |
| 7 AM | 4 | + 0 | 136 | 25 | 161 | 7 | -23 | 159 | 33 | 192 | 6 | +24 | 159 | 30 | 189 |
| 8 AM | 19 | + 0 | 429 | 88 | 517 | 21 | -25 | 374 | 83 | 457 | 21 | +25 | 394 | 86 | 174 |
| 9 AM | 34 | + 1 | 504 | 121 | 625 | 36 | -27 | 427 | 110 | 537 | 36 | +29 | 445 | 114 | 559 |
| 10 AM | 49 | + 2 | 435 | 139 | 574 | 51 | -33 | 360 | 126 | 486 | 51 | +36 | 373 | 129 | 126 |
| 11 AM | 64 | + 3 | 282 | 146 | 426 | 66 | -45 | 213 | 131 | 344 | 67 | +49 | 216 | 134 | 109 |
| 12 NOON | 79 | + 7 | 74 | 141 | 215 | 81 | -69 | 44 | 126 | 170 | 82 | +73 | 41 | 126 | 116 |
| 1 PM | - | - | 0 | 133 | 133 | - | - | 0 | 116 | 116 | - | - | 0 | 116 | 116 |
| 2 PM | - | - | 0 | 123 | 123 | - | - | 0 | 109 | 109 | - | - | 0 | 108 | 108 |
| 3 PM | - | - | 0 | 104 | 104 | - | - | 0 | 93 | 93 | - | - | 0 | 93 | 93 |
| 4 PM | - | - | 0 | 85 | 85 | - | - | 0 | 76 | 76 | - | - | 0 | 73 | 73 |
| 5 PM | - | - | 0 | 60 | 60 | - | - | 0 | 53 | 53 | - | - | 0 | 50 | 50 |
| 6 PM | - | - | 0 | 28 | 28 | - | - | 0 | 23 | 23 | - | - | 0 | 20 | 20 |

Key: θ1 : Vertical shadow angle

θ2 : Horizontal shadow angle

ID : Intensity of direct radiation ($W/m^2$)

Id : Intensity of diffuse radiation ($W/m^2$)

IT : Intensity of total radiation ($W/m^2$)

SUPPLEMENT 6

Solar Data for South-East Orientation

| Time | March 21 | | | | | June 22 | | | | | Dec 22 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT | θ1 | θ2 | ID | Id | IT |
| 7 AM | 6 | -45 | 94 | 23 | 117 | 16 | -68 | 53 | 23 | 76 | 6 | -21 | 162 | 30 | 192 |
| 8 AM | 26 | -45 | 321 | 48 | 368 | 46 | -70 | 114 | 63 | 177 | 20 | -20 | 417 | 88 | 505 |
| 9 AM | 44 | -44 | 382 | 76 | 458 | 65 | -72 | 97 | 86 | 183 | 34 | -16 | 496 | 119 | 635 |
| 10 AM | 58 | -43 | 325 | 98 | 423 | 79 | -78 | 38 | 98 | 136 | 46 | - 9 | 470 | 136 | 606 |
| 11 AM | 70 | -42 | 180 | 139 | 319 | - | - | 0 | 106 | 106 | 57 | + 4 | 389 | 146 | 530 |
| 12 NOON | 82 | -38 | 47 | 139 | 186 | - | - | 0 | 116 | 116 | 67 | +28 | 244 | 144 | 388 |
| 1 PM | - | - | 0 | 133 | 133 | - | - | 0 | 116 | 116 | 76 | +60 | 99 | 131 | 230 |
| 2 PM | - | - | 0 | 123 | 123 | - | - | 0 | 109 | 109 | 86 | +84 | 9 | 111 | 120 |
| 3 PM | - | - | 0 | 104 | 104 | - | - | 0 | 93 | 93 | - | - | 0 | 93 | 93 |
| 4 PM | - | - | 0 | 85 | 85 | - | - | 0 | 76 | 76 | - | - | 0 | 73 | 73 |
| 5 PM | - | - | 0 | 60 | 60 | - | - | 0 | 53 | 53 | - | - | 0 | 50 | 50 |
| 6 PM | - | - | 0 | 28 | 28 | - | - | 0 | 23 | 23 | - | - | 0 | 20 | 20 |

Key: θ1 : Vertical shadow angle

θ2 : Horizontal shadow angle

ID : Intensity of direct radiation ($W/m^2$)

Id : Intensity of diffuse radiation ($W/m^2$)

IT : Intensity of total radiation ($W/m^2$)

SUPPLEMENT 7

Climatic Data

| Month | Average Temperature (over 45 yrs) °C | Average Humidity (over 45 yrs) % | Average Rainfall (over 100 yrs) mm |
|---|---|---|---|
| Jan. | 25.5 | 84.9 | 243.1 |
| Feb. | 26.1 | 83.4 | 173.5 |
| Mar. | 26.5 | 84.1 | 189.2 |
| Apr. | 26.9 | 85.2 | 185.4 |
| May | 27.3 | 84.9 | 171.5 |
| Jun. | 27.3 | 83.7 | 170.4 |
| Jul. | 27.1 | 83.1 | 160.5 |
| Aug. | 26.9 | 83.5 | 182.6 |
| Sep. | 26.8 | 83.9 | 172.7 |
| Oct. | 26.6 | 84.7 | 204.3 |
| Nov. | 26.1 | 86.7 | 257.1 |
| Dec. | 25.6 | 87.1 | 278.4 |
| Annual Mean | 26.6 | 84.6 | 2,388.7 (total) |

Velocity/Direction of Wind

| | | | |
|---|---|---|---|
| Jan. ..... | 2.3 m/sec | Jul. ..... | 1.3 m/sec |
| Feb. ..... | 2.2 | Aug. ..... | 1.3 |
| Mar. ..... | 1.6 | Sep. ..... | 1.3 |
| Apr. ..... | 1.0 | Oct. ..... | 1.1 |
| May ..... | 1.0 | Nov. ..... | 1.2 |
| Jun. ..... | 1.2 | Dec. ..... | 1.7 |

Annual Mean = 1.4 m/sec.

Direction of Wind

Dec. - Mar. ..... From North to North-East
(North-East Monsoon)

May - Sept. ..... From South to South-West
(South-West Monsoon)

Apr., Oct., Nov. ..... Light and variable winds

SUPPLEMENT 8

Population Distribution in Singapore

(Unit: 1,000)

| | Total | Chinese | Malayan | Indian | Others | Rate of Increase |
|---|---|---|---|---|---|---|
| 1970's Census | 2,075 | 1,580 | 311 | 145 | 39 | 1.7% |
| 1971's mid-year estimate | 2,110 | 1,607 | 317 | 148 | 38 | 1.7% |
| 1972 " | 2,147 | 1,635 | 323 | 150 | 39 | 1.8% |
| 1973 " | 2,185 | 1,663 | 329 | 152 | 41 | 1.7% |
| 1974 " | 2,219 | 1,690 | 334 | 154 | 41 | 1.4% |
| 1975 " | 2,250 | 1,713 | 339 | 155 | 43 | 1.3% |
| 1976 " | 2,278 | 1,735 | 343 | 157 | 43 | 1.3% |
| 1977 " | 2,308 | 1,758 | 347 | 158 | 45 | 1.2% |
| 1978 " | 2,334 | 1,777 | 351 | 160 | 46 | 1.2% |
| 1979 " | 2,362 | 1,798 | 355 | 161 | 48 | 1.2% |

Source: Yearbook of Statistics

SUPPLEMENT 9

Population by Age and Sex in 1982

| Sex | Total | Age Group (In Years) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 - 4 | 5 - 9 | 10 - 14 | 15 - 19 | 20 - 24 | 25 - 29 | 30 - 34 | 35 - 39 | 40 - 44 |
| Person | 2,443,302 | 171,806 | 212,653 | 239,204 | 296,575 | 305,756 | 257,399 | 221,730 | 131,804 | 140,407 |
| Male | 1,236,267 | 88,605 | 111,051 | 126,606 | 147,999 | 156,333 | 131,206 | 112,846 | 65,108 | 67,707 |
| Female | 1,207,035 | 83,200 | 101,602 | 112,598 | 148,577 | 149,422 | 126,193 | 108,885 | 66,696 | 72,700 |

| Sex | Age Group (In Years) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | 70 - 74 | 75 - 79 | 80 -84 | 80 & over |
| Person | 110,968 | 102,324 | 73,463 | 64,262 | 47,449 | 35,380 | 19,186 | 8,623 | 4,312 |
| Male | 55,825 | 50,646 | 37,629 | 32,410 | 23,126 | 16,442 | 8,438 | 3,260 | 1.031 |
| Female | 55,144 | 51,678 | 35,834 | 31,853 | 24,323 | 18,938 | 10,748 | 5,364 | 3,280 |

Source: Report on the Labour Force Survey of Singapore 1981.
Ministry of Labour

SUPPLEMENT 10

Principal Statistics of Manufacturing, 1960, 1970 and 1979-1982

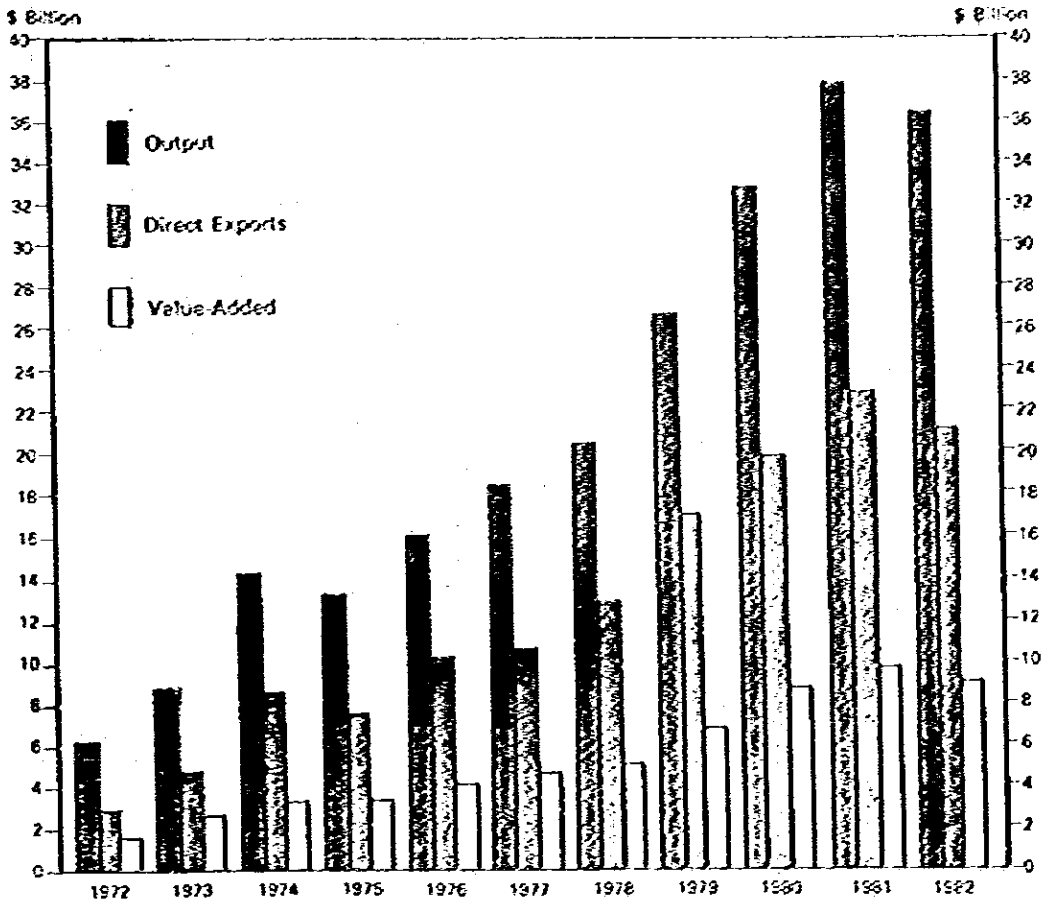
| | Unit | 1960 | 1970 | 1979 | 1980 | 1981 | 1982P | 1969-1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Annual Growth Rate (%) | | | |
| Establishments | Number | 572 | 1,774 | 3,137 | 3,369 | 3,451 | 3,561 | 6.1 | 7.4 | 2.4 | 3.2 |
| Employment | Number | 32,900 | 125,121 | 271,378 | 287,227 | 283,501 | 273,042 | 9.9 | 5.8 | -1.3 | -3.7 |
| Output | $ Million | 1,661 | 4,613 | 26,304 | 32,710 | 37,560 | 196,088 | 19.9 | 24.4 | 14.8 | -3.9 |
| Input | $ Million | 1,473 | 3,435 | 19,311 | 23,425 | 26,825 | 25,896 | 19.2 | 21.3 | 14.5 | -3.5 |
| Remuneration | $ Million | 78 | 410 | 2,103 | 2,545 | 2,956 | 3,146 | 20.2 | 21.0 | 14.1 | 6.4 |
| Value Added | $ Million | 185 | 1,129 | 6,501 | 8,573 | 9,758 | 9,251 | 21.8 | 31.9 | 13.8 | -5.2 |
| Direct Exports | $ Million | 1,043 | 2,044 | 16,903 | 19,875 | 22,894 | 21,877 | 24.0 | 17.6 | 15.2 | -4.4 |

Note: Refers to establishments engaging 10 or more persons and includes rubber processing.

Source: Department of Statistics

SUPPLEMENT 11

Output, Direct Exports & Value-Added of Manufacturing



SUPPLEMENT 12

## Principal Statistics of Manufacturing by Major Industry Group, 1981

| Industry | Establishments | | Employment | | Remuneration | | Output | | Value Added | | Workers Per Establishment | Remuneration Per Worker | Value Added Per Worker | Ratio of Value Added to Output |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | $ Mil | % | $ Mil | % | $ Mil | % | No. | $'000 | $'000 | % |
| Food & Beverages | 297 | 8.6 | 13,795 | 4.9 | 159.1 | 5.4 | 2,213.4 | 6.0 | 563.7 | 5.8 | 46 | 11.5 | 40.9 | 25.5 |
| Textiles | 94 | 2.7 | 7,906 | 2.8 | 68.8 | 2.3 | 422.1 | 1.1 | 134.9 | 1.4 | 84 | 8.7 | 17.1 | 32.0 |
| Wearing Apparel | 471 | 13.7 | 30,484 | 10.8 | 197.4 | 6.7 | 1,029.3 | 2.8 | 340.9 | 3.5 | 65 | 6.5 | 11.2 | 33.1 |
| Wood Products | 132 | 3.8 | 8,291 | 2.9 | 77.4 | 2.6 | 641.0 | 1.7 | 175.5 | 1.8 | 63 | 9.3 | 21.2 | 27.4 |
| Furniture | 117 | 3.4 | 6,561 | 2.3 | 54.8 | 1.9 | 277.0 | 0.8 | 102.4 | 1.0 | 56 | 8.4 | 15.6 | 37.0 |
| Paper Products & Printing | 390 | 11.3 | 16,982 | 6.0 | 184.8 | 6.3 | 976.5 | 2.7 | 445.5 | 4.6 | 44 | 10.9 | 26.2 | 45.6 |
| Chemical Products | 130 | 3.8 | 6,349 | 2.3 | 95.8 | 3.3 | 1,027.1 | 2.8 | 460.0 | 4.7 | 49 | 15.1 | 72.5 | 44.8 |
| Petroleum | 11 | 0.3 | 3,511 | 1.2 | 114.7 | 3.9 | 14,453.8 | 39.3 | 1,707.2 | 17.6 | 319 | 32.7 | 486.2 | 11.8 |
| Rubber & Plastic Products | 244 | 7.1 | 10,637 | 3.8 | 86.5 | 2.9 | 623.5 | 1.7 | 222.6 | 2.3 | 44 | 8.1 | 20.9 | 35.7 |
| Non-metalic Minerals | 89 | 2.6 | 5,059 | 1.8 | 69.1 | 2.4 | 874.5 | 2.4 | 276.5 | 2.8 | 57 | 13.7 | 54.7 | 31.6 |
| Basic Metals | 28 | 0.8 | 2,369 | 0.8 | 37.6 | 1.3 | 473.6 | 1.3 | 163.7 | 1.7 | 85 | 15.9 | 69.1 | 34.6 |
| Fabricated Metal Products | 371 | 10.8 | 19,481 | 7.0 | 202.0 | 6.9 | 1,492.7 | 4.1 | 537.8 | 5.5 | 53 | 10.4 | 27.6 | 36.0 |
| Machinery & Appliances | 617 | 18.0 | 109,462 | 38.9 | 1,055.3 | 36.0 | 9,263.0 | 25.2 | 3,155.2 | 32.5 | 177 | 9.6 | 28.8 | 34.1 |
| Transport Equipment | 261 | 7.6 | 28,491 | 10.1 | 433.1 | 14.7 | 2,223.8 | 6.0 | 1,181.3 | 12.2 | 109 | 15.2 | 41.5 | 53.1 |
| Precision Equipment | 52 | 1.5 | 5,419 | 2.0 | 47.3 | 1.6 | 290.6 | 0.7 | 110.4 | 1.1 | 104 | 8.7 | 20.4 | 38.0 |
| Other Products | 135 | 4.0 | 6,378 | 2.4 | 54.3 | 1.8 | 505.2 | 1.4 | 143.0 | 1.5 | 51 | 7.9 | 20.8 | 28.3 |
| Total excl Rubber Processing | 3,439 | 100.0 | 281,675 | 100.0 | 2,938.1 | 100.0 | 36,787.1 | 100.0 | 9,720.4 | 100.0 | 82 | 10.4 | 34.5 | 26.4 |
| Rubber Processing | 12 | - | 1,826 | - | 18.3 | - | 772.6 | - | 37.0 | - | 152 | 10.0 | 20.3 | 4.8 |
| Total incl Rubber Processing | 3,451 | - | 283,501 | - | 2,956.4 | - | 37,559.7 | - | 9,757.5 | - | 82 | 10.4 | 34.4 | 26.0 |

Note: Refers to establishments engaging 10 or more persons.

Source: Department of Statistics

SUPPLEMENT 13

## Principal Statistics of Manufacturing by Major Industry Group, 1982

| Industry | Establishments | | Employment | | Remuneration | | Output | | Value Added | | Workers Per Establishment | Remuneration Per Worker | Value Added Per Worker | Ratio of Value Added to Output |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | $ Mil | % | $ Mil | % | $ Mil | % | No. | $'000 | $'000 | % |
| Food & Beverages | 301 | 8.5 | 13,312 | 4.9 | 169.5 | 5.4 | 2,183.3 | 6.1 | 577.9 | 6.3 | 44 | 12.7 | 43.4 | 26.5 |
| Textiles | 91 | 2.6 | 6,586 | 2.4 | 61.3 | 2.0 | 335.5 | 0.9 | 105.4 | 1.1 | 72 | 9.3 | 16.0 | 31.4 |
| Wearing Apparel | 497 | 14.0 | 31,016 | 11.4 | 209.9 | 6.7 | 1,018.5 | 2.9 | 338.0 | 3.7 | 62 | 6.8 | 10.9 | 33.2 |
| Wood Products | 132 | 3.7 | 7,312 | 2.7 | 68.6 | 2.2 | 530.0 | 1.5 | 134.7 | 1.5 | 55 | 9.4 | 18.4 | 25.4 |
| Furniture | 118 | 3.3 | 6,425 | 2.4 | 63.3 | 2.0 | 270.4 | 0.8 | 99.9 | 1.1 | 54 | 9.9 | 15.5 | 36.9 |
| Paper Products & Printing | 400 | 11.3 | 17,108 | 6.3 | 209.3 | 6.7 | 939.3 | 2.6 | 428.7 | 4.6 | 43 | 12.2 | 25.1 | 45.6 |
| Chemical Products | 129 | 3.6 | 6,530 | 2.4 | 108.8 | 3.5 | 1,074.6 | 3.0 | 484.0 | 5.2 | 51 | 16.7 | 74.1 | 45.0 |
| Petroleum | 11 | 0.3 | 3,834 | 1.4 | 140.7 | 4.5 | 14,370.3 | 40.3 | 1,680.2 | 18.2 | 349 | 36.7 | 438.2 | 11.7 |
| Rubber & Plastic Products | 248 | 7.0 | 10,348 | 3.8 | 95.7 | 3.0 | 619.8 | 1.7 | 230.5 | 2.5 | 42 | 9.2 | 22.3 | 37.2 |
| Non-Metalic Minerals | 88 | 2.5 | 5,181 | 1.9 | 76.2 | 2.4 | 959.1 | 2.7 | 293.9 | 3.2 | 59 | 14.7 | 56.7 | 30.6 |
| Basic Metals | 27 | 0.8 | 2,228 | 0.8 | 41.1 | 1.3 | 521.1 | 1.5 | 164.2 | 1.8 | 83 | 18.4 | 73.7 | 31.5 |
| Fabricated Metal Products | 383 | 10.8 | 19,871 | 7.3 | 236.4 | 7.6 | 1,527.4 | 4.3 | 546.9 | 5.9 | 52 | 11.9 | 27.5 | 35.8 |
| Machinery & Appliances | 640 | 18.0 | 99,912 | 36.8 | 1,091.9 | 34.9 | 8,483.7 | 23.8 | 2,847.3 | 30.9 | 156 | 10.9 | 28.5 | 33.6 |
| Transport Equipment | 289 | 8.1 | 29,798 | 11.0 | 443.4 | 14.2 | 2,059.2 | 5.8 | 1,053.2 | 11.4 | 103 | 14.9 | 35.3 | 51.1 |
| Precision Equipment | 51 | 1.4 | 5,463 | 2.0 | 52.5 | 1.7 | 296.3 | 0.8 | 108.8 | 1.2 | 107 | 9.6 | 19.9 | 36.7 |
| Other Products | 144 | 4.1 | 6,607 | 2.5 | 59.6 | 1.9 | 462.4 | 1.3 | 126.6 | 1.4 | 46 | 9.0 | 19.2 | 27.4 |
| Total excl Rubber Processing | 3,549 | 100.0 | 271,531 | 100.0 | 3,128.2 | 100.0 | 35,650.9 | 100.0 | 9,220.2 | 100.0 | 77 | 11.5 | 34.0 | 25.9 |
| Rubber Processing | 12 | - | 1,511 | - | 17.4 | - | 437.0 | - | 30.8 | - | 126 | 11.5 | 20.4 | 7.0 |
| Total incl Rubber Processing | 3,561 | - | 273,042 | - | 3,145.6 | - | 36,087.9 | - | 9,251.0 | - | 77 | 11.5 | 33.9 | 25.6 |

Note: Refers to establishments engaging 10 or more persons.

Source: Department of Statistics

SUPPLEMENT 14

## Principal Statistics of Manufacturing, 1960-1981

| Year | Establishments | Workers | Materials | Output | Value Added | Sales | | Employees' Remuneration | Capital Expenditure |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | Direct Exports | | |
| | Number | | Thousand Dollars | | | | | | |
| 1960 | 548 | 27,416 | 302,846 | 465,568 | 142,143 | 457,033 | 164,310 | 66,795 | 9,806 |
| 1961 | 562 | 27,562 | 321,143 | 518,373 | 174,364 | 520,872 | 179,068 | 71,633 | 10,539 |
| 1962 | 605 | 28,642 | 432,626 | 660,300 | 201,680 | 664,285 | 217,501 | 76,863 | 33,274 |
| 1963 | 858 | 36,586 | 558,560 | 840,753 | 252,566 | 836,816 | 223,807 | 97,552 | 17,720 |
| 1964 | 930 | 41,488 | 605,744 | 927,928 | 282,462 | 914,907 | 266,422 | 111,125 | 52,688 |
| 1965 | 1,000 | 47,334 | 693,345 | 1,086,363 | 348,361 | 1,075,494 | 349,163 | 131,692 | 59,226 |
| 1966 | 1,123 | 52,807 | 870,605 | 1,325,782 | 415,043 | 1,313,699 | 404,865 | 150,754 | 75,533 |
| 1967 | 1,200 | 58,347 | 1,160,857 | 1,687,234 | 478,629 | 1,666,443 | 508,204 | 170,310 | 84,805 |
| 1968 | 1,586 | 74,833 | 1,498,244 | 2,173,668 | 611,758 | 2,172,291 | 598,466 | 210,699 | 89,573 |
| 1969[1] | 1,714 | 100,758 | 2,271,584 | 3,213,899 | 856,631 | 3,235,401 | 1,265,286 | 319,803 | 212,578 |
| 1970[2] | 1,747 | 120,509 | 2,868,394 | 3,891,012 | 1,093,722 | 3,846,164 | 1,523,033 | 397,618 | 421,342 |
| 1971 | 1,813 | 140,552 | 3,150,082 | 4,699,246 | 1,366,520 | 4,654,892 | 1,954,683 | 503,209 | 460,571 |
| 1972 | 1,931 | 170,352 | 3,742,698 | 5,722,224 | 1,782,278 | 5,679,554 | 2,641,681 | 648,676 | 647,961 |
| 1973 | 2,079 | 198,574 | 5,064,990 | 7,938,073 | 2,540,597 | 7,961,293 | 4,269,774 | 861,407 | 787,954 |
| 1974 | 2,179 | 206,067 | 9,236,569 | 13,346,913 | 3,528,220 | 13,128,138 | 7,811,939 | 1,075,892 | 620,543 |
| 1975 | 2,385 | 191,528 | 8,586,011 | 12,610,144 | 3,411,129 | 12,401,049 | 7,200,693 | 1,180,524 | 622,635 |
| 1976 | 2,505 | 207,234 | 10,629,406 | 15,317,439 | 3,961,813 | 15,556,536 | 9,575,927 | 1,309,841 | 618,670 |
| 1977 | 2,638 | 219,112 | 12,224,625 | 17,518,249 | 4,475,458 | 17,390,502 | 10,969,405 | 1,471,749 | 751,639 |
| 1978 | 2,946 | 243,724 | 13,561,952 | 19,666,684 | 5,162,922 | 19,555,504 | 12,632,733 | 1,724,243 | 821,838 |
| 1979 | 3,122 | 269,334 | 17,513,440 | 25,133,686 | 6,412,934 | 25,172,888 | 16,202,989 | 2,085,918 | 1,424,463 |
| 1980[3] | 3,355 | 285,250 | 21,415,150 | 31,657,895 | 8,521,888 | 30,046,697 | 19,172,916 | 2,526,873 | 1,861,859 |
| 1981 | 3,439 | 281,675 | 24,891,517 | 36,787,096 | 9,720,545 | 36,543,494 | 22,375,250 | 2,938,058 | 1,966,771 |

Note: Rubber Processing and Granite Quarrying are excluded.

1 Data for the petroleum industry in the 1969 Census was extended to include blending activity, which accounted for about 28% of the increase in output.

2 Prior to 1970 data included repair and servicing of motor vehicles and other household goods and carpentry and joinery work which accounted for about 0.6% of output and 1.0% of value added in 1969.

3 Prior to 1980, data on output and sales of petroleum refining industry included the value of products processed for third party overseas.

SUPPLEMENT 15

Estimates of Labour Force, 1966-1981*

Unit: 1,000

| Mid-Year | Population 15-64 Years | Total | Labour Force 15-64 Years | | Participation Rate (%) | Unemployment Rate (%) |
|---|---|---|---|---|---|---|
| | | | Employed | Unemployed | | |
| 1966 | 1,038.5 | 575 | 524 | 51 | 55.4 | 8.9 |
| 1967 | 1,074.7 | 601 | 552 | 49 | 55.9 | 8.1 |
| 1968 | 1,109.8 | 626 | 580 | 46 | 56.4 | 7.3 |
| 1969 | 1,147.0 | 654 | 610 | 44 | 57.0 | 6.7 |
| 1970 | 1,200.3 | 693 | 651 | 42 | 57.7 | 6.0 |
| 1971 | 1,242.3 | 726 | 691 | 35 | 58.4 | 4.8 |
| 1972 | 1,286.9 | 761 | 725 | 36 | 59.2 | 4.7 |
| 1973 | 1,330.2 | 818 | 781 | 37 | 61.5 | 4.5 |
| 1974 | 1,389.6 | 836 | 803 | 33 | 60.2 | 4.0 |
| 1975 | 1,427.7 | 852 | 813 | 39 | 59.7 | 4.5 |
| 1976 | 1,473.0 | 885 | 845 | 40 | 60.1 | 4.5 |
| 1977 | 1,502.2 | 919 | 883 | 36 | 61.2 | 3.9 |
| 1978 | 1,558.1 | 975 | 940 | 35 | 62.6 | 3.6 |
| 1979 | 1,614.8 | 1,035 | 1,000 | 35 | 64.1 | 3.4 |
| 1980 | 1,645.3 | 1,083 | 1,050 | 33 | 65.8 | 3.0 |
| 1981· | 1,704.5 | 1,127 | 1,095 | 32 | 66.1 | 2.9 |

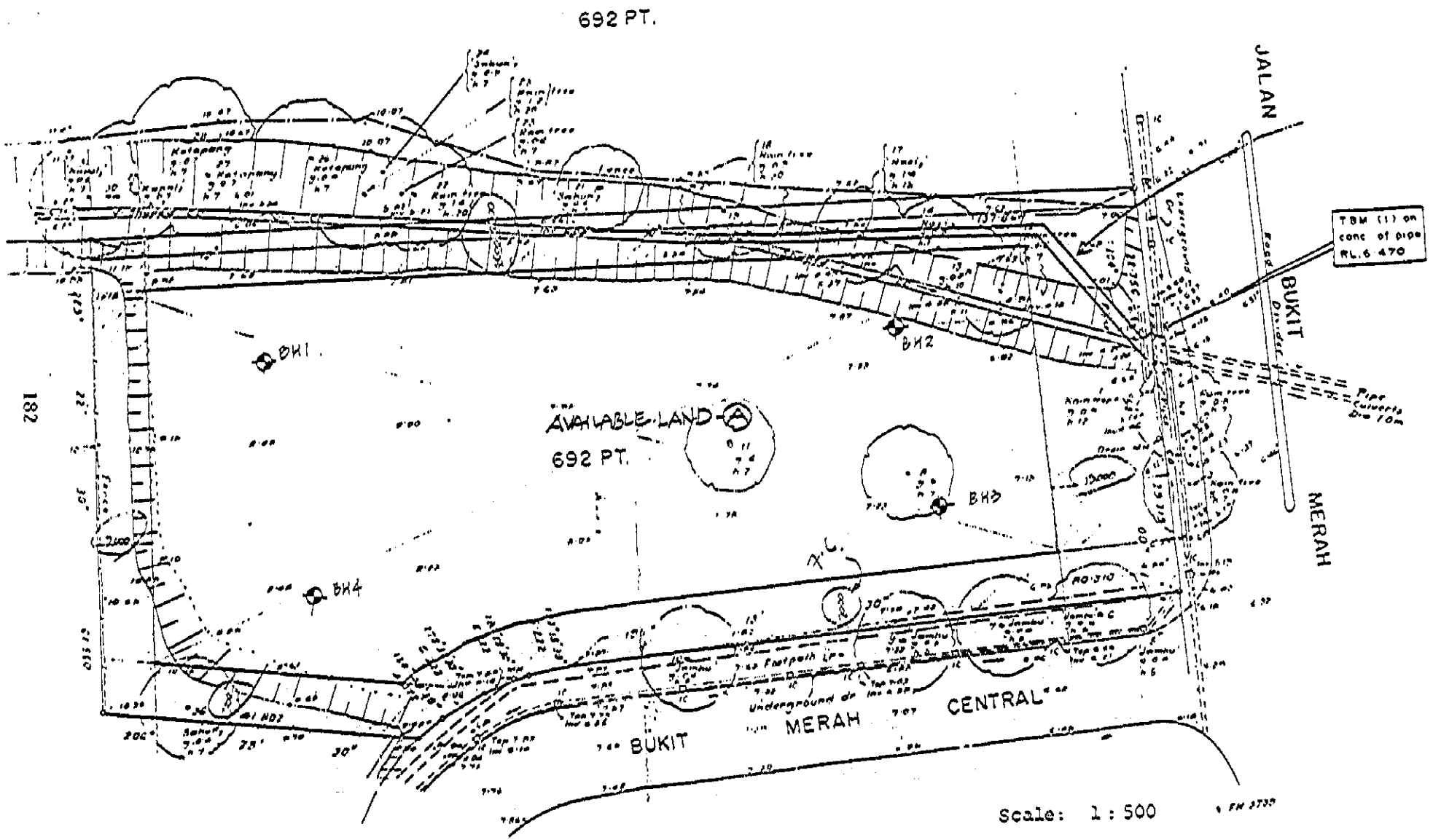
Note: Data for 1978 to 1981 are strictly comparable with that for 1974 to 1977. Prior to 1978, the data did not include non-citizens working in Singapore without a work permit. In 1978, exit control was imposed at the Causeway. Consequently, many of them who had been working illegally applied for work permits. The number of foreign workers had been underestimated, therefore, in previous labour force surveys.

· Preliminary

Source: Singapore's facts and pictures 1982

SUPPLEMENT 16

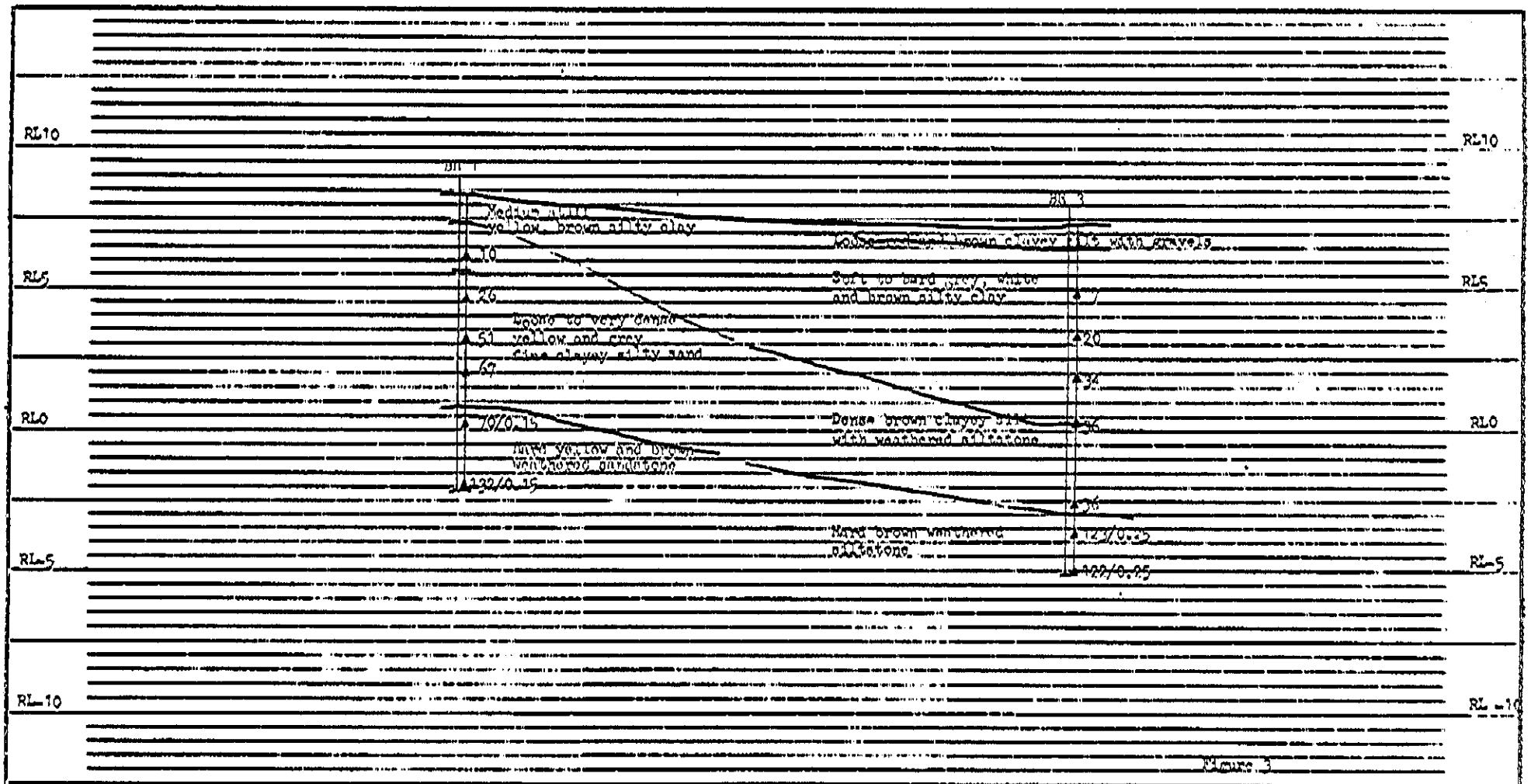
# Test Boring Location Plan



PRELIMINARY

# GEOLOGICAL CROSS-SECTION

Location:- Jalan Bukit Merah




| | | |
|---|---|---|
| Silty clay | Marine clay | Decomposed granite |
| Sand and sandstone | Peaty clay | Shale or shaley clay |
| Silt and siltstone | Organic clay | |

**Soil & Foundation (Pte) Ltd.**

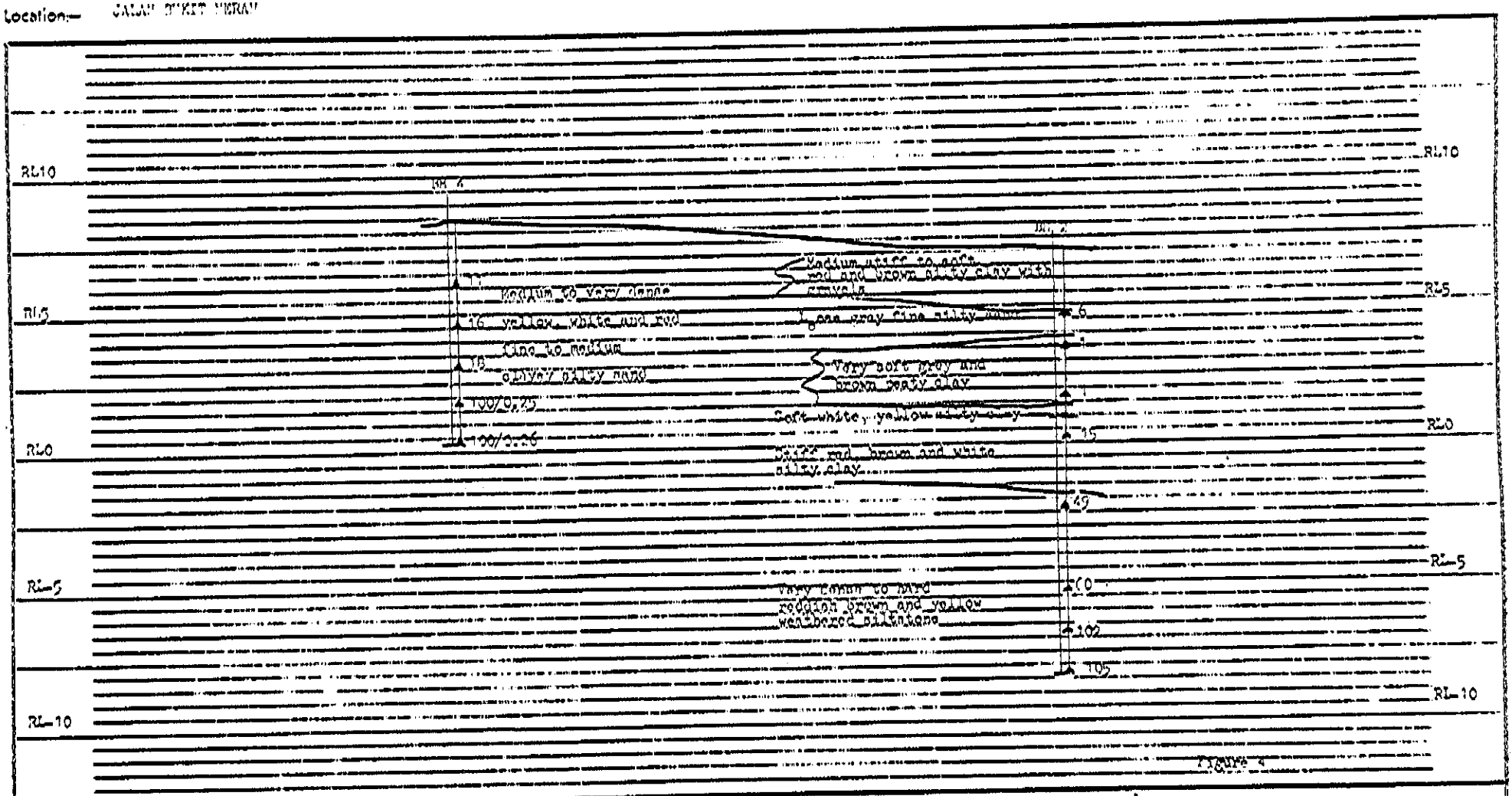
NOTE : Strates are interpolated and may vary considerably in between borings

(2) Nos beside borehole indicates Standard Penetration Resistance N value for
0.30m of penetration
132/0.15 indicates 132 blows for 0.15m of penetration

# GEOLOGICAL CROSS-SECTION

PRELIMINARY

Location:— JALAN BUKIT MERAH




| | | |
|---|---|---|
| Silty clay | Marine clay | Decomposed granite |
| Sand | Peaty clay | Shale or shaley clay |
| Silt | Organic clay | |

Soil & Foundation (Pte) Ltd.

NOTE : Strata are interpolated and may vary considerably in between borings

(2) Non penetrable borehole indicates standard penetration resistance
N value for 0.30m of penetration
100/0.26 indicates 100 blow for 0.26m of penetration

**PROJECT:**

Type of boring: Power Auger

Type of rig: Rotary (HT 7)

Dia of boring: 0.15m

Casing details: 0.15m

**BOREHOLE No. 1**

Sheet 1 of 1

Location: Jalan Bukit Merah

Ground level: 8.48

| Strata | | | | Samples & Tests | | | Shear Strength | | m/c | bulk den | LL | PL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | Thickness | Log and | Description | Depth | Sample | Test | C | φ deg | % | | % | % |
| | | | | | | | (u-u) | | | | | |
| 1.10m | 1.10m | | Medium stiff yellow and brown silty clay with fine sand | 0 | SD1 | | | | | | | |
| | | | | 1.10m | SD2 | | | | | | | |
| | | | Loose yellow and grey fine clayey silty sand | 1.50m to 2.00m | U1 | | | | | | | |
| | | | | 2.15m to 2.45m | SP1 | 10 blows (0.30m) | | | | | | |
| | | | | 3.00m to 3.50m | U2 | | | | | | | |
| 4.00m | 2.90m | | | 3.65m to 3.95m | SP2 | 7 blows (0.30m) | | | | | | |
| | | | | 4.00m | SD3 | | | | | | | |
| | | | Very dense grey with yellow and red fine silty sand | 4.50m to 5.00m | U3 | | | | | | | |
| | | | | 5.15m to 5.45m | SP3 | 51 blows (0.30m) | | | | | | |
| | | | | 6.25m to 6.55m | SP4 | 70 blows (0.30m) | | | | | | |
| 7.60m | 3.60m | | | 7.60m | SD4 | | | | | | | |
| | | | Hard yellow and brown weathered sandstone | 8.15m to 8.30m | SP5 | 70 blows (0.15m) | | | | | | |
| 10.65m | 3.05m | | | 10.50m to 10.65m | SP6 | 132 blows (0.15m) | | | | | | |
| | | | END OF BOREHOLE | | | | | | | | | |

Water Recording

(Measured Below Ground Level)

| Date | Time | Hole depth | Water level |
|---|---|---|---|
| 5.5 | 1800 | 5.50m | 3.80m |
| 6.5 | 0845 | 5.50m | 1.00m |

SD Small disturbed sample
LD Large disturbed sample
U Undisturbed sample
SP Standard penetration test
W Water sample
O Drill core sample
V Vane test
P Field permeability test
M Moisture content (%)

Remarks

1. Water table should be read from a water standpipe or a piezometer which can be easily installed, if required.
2. Presence of boulders cannot be ruled out

Contractor: Soil & Foundation

Date started: 5.5.83

Date finished: 6.5.83

Client: National Productivity Board

Scale: 25mm = 2m

Logged by: Ray

Checked by: Tec

Date: 7.5.83

Fig No.

**PROJECT:**

Type of boring: Power Auger

Type of rig: Rotary (HT 7)

Dia of boring: 0.15m

Casing details: 0.15m

**BOREHOLE No. 2**

Sheet 1 of 2

Location: Jalan Bukit Merah

Ground level: 7.07

| Strata | | | | Samples & Tests | | | Shear Strength | | m/c | bulk den. | LL | PL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | Thickness | Legend | Description | Depth | Sample | Test | C | Ø deg | % | | % | % |
| | | | | | | | (u-u) | | | | | |
| 0.80m | 0.80m | | Medium stiff red and brown silty clay with gravel | 0 | SD1 | | | | | | | |
| | | | | 0.80m | SD2 | | | | | | | |
| 2.20m | 1.40m | | Soft brown silty clay with fine sand | 2.20m | SD3 | | | | | | | |
| 3.20m | 1.00m | | Loose dirty grey fine silty sand with pockets of clay | 2.15m to 2.45m | SP1 | 6 blows (0.30m) | | | | | | |
| | | | | 3.20m | SD4 | | | | | | | |
| | | | | 3.00m to 3.50m | U1 | | | | | | | |
| | | | Very soft grey and brown peaty clay | 3.65m to 3.95m | SP2 | 1 blow (0.30m) | | | | | | |
| | | | | 4.50m to 5.00m | U2 | | | | | | | |
| 5.60m | 2.40m | | | 5.15m to 5.45m | SP3 | 1 blow (0.30m) | | | | | | |
| | | | | 5.60m | SD5 | | | | | | | |
| 6.20m | 0.60m | | Soft white and yellow silty clay with traces of decomposed vegetation | 6.20m | SD6 | | | | | | | |
| | | | | 6.00m to 6.50m | U3 | | | | | | | |
| | | | Stiff red and brown and white silty clay | 6.65m to 6.95m | SP4 | 15 blow (0.30m) | | | | | | |
| 9.00m | 2.80m | | | 9.00m | SD7 | | | | | | | |
| | | | | 9.00m to 9.50m | U4 | | | | | | | |
| | | | | 9.65m to 9.95m | SP5 | 45 blows (0.30m) | | | | | | |
| | | | Very dense to hard reddish brown and yellow weathered siltstone | | | | | | | | | |
| | | | | 12.15m to 12.45m | SP6 | 60 blows (0.30m) | | | | | | |
| | | | | 13.65m to 13.95m | SP7 | 100 blow (0.30m) | | | | | | |

SD Small disturbed sample
LD Large disturbed sample
U Undisturbed sample
SP Standard penetration test
W Water sample
D Drill core sample
V Vane test
F Field permeability test
M Moisture content (%)

Remarks

Contractor: Soil & Foundation
Date started: 4.5.83
Date finished: 5.5.83
Client: National Productivity Board

Scale: 25mm = 2m

Logged by: Ezz
Checked by: Yeo
Date: 5.5.83

Fig No

PRELIMINARY

PROJECT:

Type of boring: Power Auger

Type of rig: Rotary (HT 7)

Dia of boring: 0.15m

Casing details: 0.15m

**BOREHOLE No. 2**
Sheet 2 of 2

Location: Jalan Bukit Merah

Ground level: 7.07

| Strata | | | | Samples & Tests | | | Shear Strength | | w/c | bulk den. | LL | PL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | Thickness | Log | Description | Depth | Sample | Test | C psi | Ø deg | % | pcf | % | % |
| | | | | | | | (u-v) | | | | | |
| | | | Very dense to hard reddish brown and yellow weathered siltstone | | | | | | | | | |
| 15.45m | 6.45m | | | 15.15m to 15.45m | SPT | 105 blows (0.30m) | | | | | | |
| | | | END OF BOREHOLE | | | | | | | | | |

Water Recording
(Measured Below Ground Level)

| Date | Time | BH depth | Water level |
|---|---|---|---|
| 5.5 | 0830 | 12.50m | 3.20m |
| | 1300 | 15.45m | 5.00m |
| | 1800 | 15.45m | 6.00m |

SD Small disturbed sample
LD Large disturbed sample
U Undisturbed sample
SP Standard penetration test
W Water sample
D Drill core sample
V Vane test
P Field permeability test
M Moisture content (%)

Remarks

1. Water table should be read from a water standpipe or a piezometer which can be easily installed, if required.
2. Presence of boulders cannot be ruled out.

Contractor: Soil & Foundation
Date started: 4.5.83
Date finished: 5.5.83

Client: National Productivity Board

Scale: 25mm = 2m

Logged by: Roy
Checked by: Yeo
Date: 6.5.83

Fig No.

PRELIMINARY

**PROJECT:**

Type of boring: Power Auger

Type of rig: Rotary (HT 7)

Dia of boring: 0.15m

Casing details: 0.15m

**BOREHOLE No. 3**
Sheet 1 of 1

Location: Jalan Bukit Merah

Ground level: 7.20

| Strata | | | | Samples & Tests | | | Shear Strength | | m/c | bulk den. | LL | PL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | Thickness | Legend | Description | Depth | Sample | Test | C | $\phi$ deg | % | | % | % |
| | | | | | | | (v-v) | | | | | |
| 0.70m | 0.70m | | Loose red and brown clayey silt with gravel | 0 | SD1 | | | | | | | |
| | | | | 0.70m | SD2 | | | | | | | |
| 1.20m | 0.50m | | Soft brown and grey silty clay with coarse sand | 1.20m | SD3 | | | | | | | |
| 2.10m | 0.90m | | Medium stiff grey, white & yellow silty clay with coarse sand | 1.50m to 2.00m | U1 | | | | | | | |
| | | | | 2.10m | SD4 | | | | | | | |
| 3.10m | 1.00m | | Medium stiff grey, white and yellow silty clay with coarse sand | 2.15m to 2.45m | SP1 | 7 blows (0.30m) | | | | | | |
| | | | | 3.10m | SD5 | | | | | | | |
| | | | | 3.00m to 3.50m | U2 | | | | | | | |
| | | | Very stiff white, orange and brown silty clay | 3.65m to 3.95m | SP2 | 20 blows (0.30m) | | | | | | |
| | | | | 4.50m to 5.00m | U3 | | | | | | | |
| 6.00m | 2.90m | | | 5.15m to 5.45m | SP3 | 34 blows (0.30m) | | | | | | |
| | | | | 6.00m | SD6 | | | | | | | |
| | | | Hard brown silty clay | 6.00m to 6.50m | U4 | | | | | | | |
| 7.00m | 1.00m | | | 6.65m to 6.95m | SP4 | 36 blows (0.30m) | | | | | | |
| | | | | 7.00m | SD7 | | | | | | | |
| | | | Dense brown clayey silt with weathered siltstone | 9.00m to 9.40m | U5 | | | | | | | |
| 10.20m | 3.20m | | | 9.55m to 9.85m | SP5 | 36 blows (0.30m) | | | | | | |
| | | | | 10.20m | SD8 | | | | | | | |
| | | | Hard brown weathered siltstone | 10.65m to 10.90m | SP6 | 123 blows (0.25m) | | | | | | |
| 12.25m | 2.05m | | | 12.00m to 12.25m | SP7 | 122 blows (0.25m) | | | | | | |
| | | | END OF BOREHOLE | | | | | | | | | |

**Water Recording**
(Measured Below Ground Level)

| Date | Time | BH depth | Water level |
|---|---|---|---|
| 20.4 | 1800 | 7.00m | 6.50m |
| 3.5 | 0900 | 2.00m | 1.00m |
| | 1200 | 6.85m | 3.20m |
| | 1800 | 12.25m | 8.00m |

SD Small disturbed sample
LD Large disturbed sample
U Undisturbed sample
SP Standard penetration test
W Water sample
D Drill core sample
V Vane test
F Field permeability test
M Moisture content (%)

Remarks

1. Water table should be read from a water standpipe or a piezometer which can be easily installed, if required
2. Presence of boulders cannot be ruled out

Contractor: Soil & Foundation
Date started: 30.4.83
Date finished: 3.5.83

National Productivity
Client/Board

Scale: 25mm = 2m

Logged by: Roy
Checked by: Yeo
Date: 4.5.83

Fig No.

PRELIMINARY,

**PROJECT:**

Type of boring: Power Auger

Type of rig: Rotary (HT 7)

Dia of boring: 0.15m

Casing details: 0.15m

**BOREHOLE No. 4**
Sheet 1 of 1

Location: Jalan Bukit Merah

Ground level: 8.48

| Strata | | | | Samples & Tests | | | Shear Strength | | w/c | bulk den. | ll | PL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | Thick-ness | Log-end | Description | Depth | Sample | Test | C | $\phi$ deg | % | | % | % |
| | | | | | | | (u-u) | | | | | |
| 0.60m | 0.60m | | Medium yellow, red fine to medium silty clayey sand with traces of gravel | 0 | SD1 | | | | | | | |
| | | | | 0.60m | SD2 | | | | | | | |
| 1.70m | 1.10m | | Medium yellow with patches of orange fine to coarse silty sand and gravel | | | | | | | | | |
| | | | | 1.70m | SD3 | | | | | | | |
| | | | | 1.50m to 2.0 m | U1 | | | | | | | |
| | | | Medium yellow, white and red fine to medium silty sand | 2.35m to 2.45m | SP1 | 11blows (0.30m) | | | | | | |
| | | | | 3.00m to 3.50m | U2 | | | | | | | |
| 4.00m | 2.30m | | | 3.65m to 3.95m | SP2 | 16blows (0.30m) | | | | | | |
| | | | | 4.00m | SD4 | | | | | | | |
| | | | Medium yellow, white and red fine to coarse silty sand with pockets of clay | 4.50m to 5.00m | U3 | | | | | | | |
| 6.00m | 2.00m | | | 5.15m to 5.45m | SP3 | 18blows (0.30m) | | | | | | |
| | | | | 6.00m | SD5 | | | | | | | |
| | | | | 6.00m to 6.35m | U4 | | | | | | | |
| | | | Very dense purple, grey and yellow fine to medium clayey silty sand | 6.50m to 6.75m | SP4 | 100blows (0.25m) | | | | | | |
| 7.91m | 1.91m | | | 7.65m to 7.91m | SP5 | 100blows (0.26m) | | | | | | |
| | | | END OF BOREHOLE | | | | | | | | | |

Water Recording:
(Measured Below Ground Level)

| Date | Time | BS depth | Water level |
|---|---|---|---|
| 5.5 | 0830 | 5.50m | 3.95m |
| | 1300 | 6.75m | 3.45m |

SD Small disturbed sample
LD Large disturbed sample
U Undisturbed sample
SP Standard penetration test
W Water sample
D Drill core sample
V Vane test
P Field permeability test
M Moisture content (%)

Remarks

1. Water table should be read from a water standpipe or a piezometer which can be easily installed, if required.
2. Presence of boulders cannot be ruled out.

Contractor: Soil & Foundation
Date started: 4.5.83
Date finished: 5.5.83

Client: National Productivity Board

Scale: 25mm = 2m

Logged by: S Rice
Checked by: Yeo
Date: 6.5.83

Fig No.

SUPPLEMENT 24

Tentative Schedule of Implementation of Technical Cooperation

| Content of Cooperation \ Phase / Fiscal Year | 1st Phase | | | 2nd Phase | |
|---|---|---|---|---|---|
| | 1983 | 1984 | 1985 | 1986 | 1987 |
| General Schedule | | | | | |
| I. Term of Corporation | — | | | | |
| II. Construction of NPB New Building | | — | — | | |
| Japanese Side | | | | | |
| I. Dispatch of Japanese Experts | | | | | |
| A. Long-term Experts | | | | | |
| 1. Chief Advisor | — | | | | |
| 2. Coordinator | — | | | | |
| 3. Planning and Research | — | | | | |
| 4. Prómotion | — | | | | |
| 5. Labor - Management Relation | — | | | | |
| 6. Managerial and Supervisory Development | — | | | | |
| 7. Occupational Safety and Health | | — | | | |
| 8. Resource Centre | | — | | | |
| B. Short-term | | | — | | |
| 1. Planning and Research | | | | | |
| (1) General and Sectoral Productivity Studies | — | — | — | | |
| (2) Productivity Measurement | — | — | — | | |

SUPPLEMENT 25

| Content of Cooperation \ Phase / Fiscal Year | 1st Phase | | | 2nd Phase | |
|---|---|---|---|---|---|
| | 1983 | 1984 | 1985 | 1986 | 1987 |
| (3) Survey Techniques | — | — | | | |
| (4) Selection and Development of Productivity Model Companies | | — | — | | |
| 2. Promotion | | | | | |
| 3. Labor - Management Relations in Productivity Improvement | — | — | — | — | — |
| (1) Labor - Management Relations | | — | — | | — |
| (2) Small Group Activity | | — | — | — | — |
| (3) Worker Productivity Induction | | — | — | | |
| 4. Management and Supervisory Development | — | — | — | — | — |
| (1) Productivity and Strategy, Corporate Strategy | | — | | — | |
| (2) Senior Management Development | | — | — | | — |
| (3) Management Development Management Skill | | — | | — | |
| (4) Supervisory and Core Development Programme | | — | | — | |
| (5) Human Development | | | — | | — |
| (6) Personnel Management | | | | — | |
| (7) Production Management, Construction I.E. | | | — | | |
| (8) Distribution, Supervisory | | | | | — |

SUPPLEMENT 26

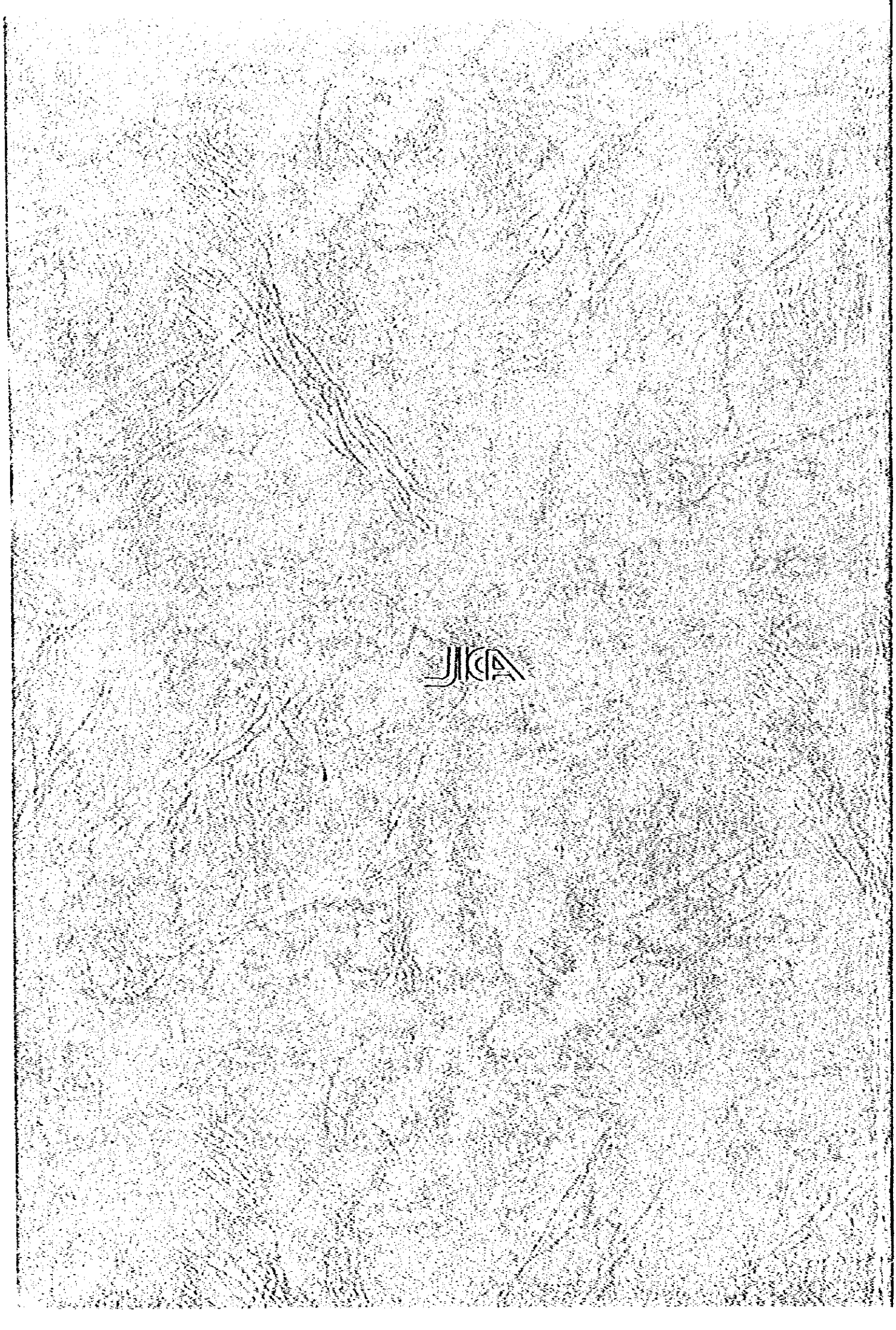
| Content of Cooperation \ Phase / Fiscal Year | 1st Phase | | | 2nd Phase | |
|---|---|---|---|---|---|
| | 1983 | 1984 | 1985 | 1986 | 1987 |
| (9) Management Consultant | | | | | — |
| (10) Computer | — | — | — | — | |
| 5. Occupational Safety and Health | | | | | |
| (1) Shipyard Safety Course | | | | | — |
| (2) Safety Course on Press Machines and Related Machines | | | | — | |
| (3) Petrochemical OSH Course | | | | — | |
| (4) Building Construction Safety Course | | | | — | |
| (5) MRT Safety Course | | — | | | |
| (6) Occupational Hygiene Technician Course | | | | — | |
| 6. Resource Centre | — | — | — | — | — |
| II. Training of Singapore Counterpart Personnel in Japan | | | | | |
| 1. Planning and Research | — | — | — | — | — |
| 2. Promotion | | | | | |
| 3. Labor - Management Relations | — | — | — | — | — |
| 4. Managerial and Supervisory Development | — | — | — | — | — |
| 5. Occupational Safety and Health | — | — | — | — | — |
| 6. Resource Centre | — | — | — | — | |

SUPPLEMENT 27

| Items \ Phase / Fiscal Year | 1st Phase | | | 2nd Phase | |
|---|---|---|---|---|---|
| | 1983 | 1984 | 1985 | 1986 | 1987 |
| Singapore Side | | | | | |
| I. Training Facilities before Completion of NPB New Building | ——— | ——— | ——— | | |
| II. Office Facilities for Japanese Chief Advisor and other experts | ——— | ——— | ——— | ——— | ——— |
| III. Recruitment of Necessary Number of Counterparts | ——— | ——— | ——— | ——— | ——— |
| IV. Recruitment of Necessary Number of Administration Staff | ——— | ——— | ——— | ——— | ——— |
| V. Provision of Operational Expenses | ——— | ——— | ——— | ——— | ——— |

NOTE: This schedules if formulated tentatively on the assumption that necessary budget will be acquired by both sides.

This schedule is subject to change within the Scope of the "Record of Discussions" if necessity arises during the course of implementation of the Project.


JICA