

#### (4) Others

BMA's policy aims at realization of "clean Bangkok" as an ultimate goal of solid waste management. Following to this policy, efforts have been made to well organize collection and transport system but, on the other hand, intermediate treatment and final disposal systems are left behind with many problems, of which measures of improvement are described in chapter 3 (short-term improvement plan). In short, it is essential necessity for solid waste management to operate collection, transport, intermediate treatment and final disposal as a series of solid waste disposal system under the sole control and order channel.

#### 9.4.4 Recommendations for solution of the problems

To be frank, all problems mentioned above can be said to have been caused by decentralization of authority which BMA performed several years ago. Decentralization itself is not only effective means to avoid declination of organization but also indispensable means to conduct delicate administration matching to the local characteristics of each District.

For implementation of decentralization, however, there must be convincible motivation and certain condition to be satisfied such as:

- a. The organization has grown up so huge that lowers its function and invites increase of the operating cost
- b. The organization has become too huge to perform administration as to satisfy individual local requirements
- c. Respective function, power and responsibility of the central authority and local authorities are clearly divided so that no practical confusion should be incurred by the decentralization.

As far as sanitation administration of BMA is concerned, its organization is not yet grown up to an extent that can be deemed as too huge: its organization alone is still able to perform flexible administration to satisfy the local requirements. Seeing its organizational function, no reason is found why power concerning sanitation administration had to be decentralized from BOS to Districts.

For any public utility enterprises as well as sanitation enterprise which necessitate sole control channel, division of the function, authority or responsibility should incur disadvantages, or should rather be said impossible.

Forcible implementation of decentralization incurred miscellaneous problems. The best solution for the problems is to reorganize the existing divided sanitation administration organizations into an organization topped by BOS. In other words, to centralize authority from Districts to BOS. Some concrete measures to be taken to this end are explained below.



(1) Transfer of Sanitation Sections of each District under control of BOS

The Sanitation Sections, which are presently under control of each District, should be separated from the District organizations and placed under direct control of BOS. As the result, the Sanitation Sections belong to BOS and function as district agents of BOS in order to perform solid waste collection and transport under direct control of BOS.

Even in case that any attempt be made in the future to avoid deficiencies caused by excessive growth of sanitation administration organization, meaningless division of the organization and authority has to be avoided lest unity, which is indispensable to sanitation enterprise, should be lost. A desirable countermeasure against excessive growth of the organization is to establish regional branch offices of BOS, each of which controls several Sanitation Section in the region. In this step-control system, BOS controls the regional branch offices and the branch offices control the Sanitation Sections belonging to each branch office, therefore, control by BOS over Sanitation Sections will be made indirectly through the branch offices but unity of control channel will be maintained. This system enables each regional branch office to perform peculiar administrative service to the local characteristics of the region. There are several ways to classify the Sanitation Sections into groups by region.

i) Grouping by local characteristics

Dividing the metropolitan area into zones according to its land-use characteristics such as densely populated urban area, typical urbanized area, semi-urbanized area, suburban area, etc., the Sanitation Sections in charge of each area are organized into one group which belongs to a regional branch office of BOS. This grouping facilitates performance of collection service matching to the local characteristics but, on the other hand, this tends to cause difference of grade of service and imbalance of work volume between the areas.

ii) Grouping by radial zones

Dividing the metropolitan area into several zones by radial lines stretching from the city center to the outskirts, the Sanitation Sections in charge of each zone are grouped into one. The advantages and disadvantages of this grouping will be contrary to that of mentioned in above i).

iii) Grouping by solid waste collection volume

The metropolitan area is divided into several branch office territories so as to make the planned solid waste collection volume in each territory even with that in other territories. Since larger volume of solid waste is discharged from densely populated areas, the result of this method may be similar to that of the above i), therefore, the advantages and disadvantages are also similar to i).



#### iv) Other methods

Other than the above three methods, various methods are considerable such as grouping to make number of equipment and size of manpower well balanced or to make solid waste transport distance to treatment/disposal facilities even.

Each method has advantages as well as disadvantages. Selection of the method depends upon what advantage should be respected most and what disadvantage should be avoided. After the deliberate examination, the most advantageous method should be selected and applied.

#### (2) Collection truck control system

From a viewpoint that collection trucks are nothing but equipment used for solid waste disposal, power to control collection trucks is thought to be borne by BOS. To the contrary, however, there is another viewpoint from which collection trucks are considered nothing but a part of large number of vehicles owned by BMA, therefore, transfer of the control power to BOS should disturb an organized vehicle control system of BMA as a whole. As a matter of fact, it may be difficult for BOS to assume full responsibility for control of collection trucks and, even if BOS assumes it, benefit derived from it is questionable. Therefore, except for the items of which implementation is urgently requested such as transfer of ownership of reserved trucks to BOS, the existing vehicle control system should better be kept as it is provided that endeavor be made to solve deficiencies caused by separated control of collection trucks upon collaboration among BOF, BOS and Districts.

#### (3) Management of compost plants

Compost sales function should be separated from the production function. One of the main purposes of composting is, other than producing compost for sale, to make solid waste inactive, harmless and reduced in volume through intermediate treatment. Participation of sales side in production is feared to weaken consciousness of significance of this purpose. All powers and responsibilities concerning composting should be given to BOS, with which BOS is able to positively promote composting as a measure of intermediate treatment as well as production of compost for sale. On the other hand, BOF (Fertilizer Section) should concentrate on compost sales and marketing. For this purpose, trommel and packing processes together with their equipment, staff and budget should be transferred under the control of BOS.

#### (4) Cleaning of rivers and Khlongs

Cleaning of main rivers and Khlongs to which application of mechanical cleaning boats is possible should be made by BSD and other rivers and Khlongs should be cleaned by BOS. BOS should specify cleaning territory of each Sanitation Section and give the Sanitation Sections orders to clean respective territory.



(5) Control of leachate treatment facilities

Capacity and manner of operation of leachate treatment facilities in final disposal site are to be determined according to landfill volume and landfill method. Accordingly, it is quite natural that BOS, which is in charge of landfilling, takes charge of leachate treatment, too. Therefore, leachate treatment facilities together with the operation staff and budget (at On-Nooch) which are presently under the control of BSD should be transferred under the control of BOS.

(6) Establishment of General Department of Environmental Affairs  
(tentative name) in BMA

In order to promote overall activities of environmental protection including solid waste management, a General Department of Environmental Affairs should be established in BMA, with authority to control other Departments and Districts. (Ref. Appendix 9.10-(7)).

Solid waste problems are at the same time environmental problems, solution of which should be attempted by all the concerned Departments. Above all, location and construction of solid waste management facilities are intimately concerned with road network organization, use of rivers and canals, utilization of energy and other products produced in solid waste management facilities, environmental coordination with the surroundings, water supply, sewage, etc.

For promotion of environmental projects as well as solution of environmental problems, establishment of a powerful organization should be the most effective means. An outline of the proposed General Department of Environmental Affairs is described below:

a. Status of the Department

The Department, headed by Under Secretary of BMA in charge, should be under direct control of Governor. It should have power to control and issue orders to other concerned Departments.

b. Extent of power

The Governor should endow the Department with power to survey, plan, coordinate, order and control as necessary with respect to overall environmental administration.

c. Functions

The Department should be a cross-sectional organization which controls overall environmental administration. Its main functions should be to endeavor to solve problems common to the concerned Departments and to arbitrate troubles occurring among the Departments. As a part of



the functions, the Department should plan and promote major projects, secure funding, and exercise control over the implementing Department.

d. Staff

Competent officers should be selected from administrative and technical fields in BMA.

e. Scope of work

Establishment of the related laws, regulations and standards; formulation of long-term plan, master plan, guideline relating to environmental utilities enterprise; promotion and assistance to the related projects.

9.4.5 The aims of solid waste management

The aims of solid waste management, which BMA is recommended to pursue, are described hereafter. (The details are shown in Appendix 9.10-(8).)

(1) Suppression of generation volume, volume reduction and re-utilization of solid waste

Preparing for increase in solid waste volume and diversification of its properties in near future, capacity of the treatment and disposal should be expanded and, at the same time, activities to realize the above three goals - suppression of generation volume, volume reduction and reutilization of solid waste - should be positively promoted. For this purpose, collaboration of citizens and enterprises with the administrative side is an indispensable condition. BMA is requested to develop a campaign to make citizen aware of the significance of the three goals.

(2) Collection and transportation

A principle of collection is to remove discharged solid waste as soon as possible (within-the-day collection principle). This principle should focus on qualitative improvement of the service without expanding the service quantitatively because there are various problems requiring urgent solution such as to rid the city of uncollected areas and to raise transport efficiency. These activities should be based on proper allocation and control of collection trucks; therefore, BOF, BOS and Districts are requested to form an effective system in this connection upon mutual consent.



(3) Intermediate treatment

Existence of reliable intermediate treatment facilities is an indispensable condition for proper and stable maintenance of solid waste management system. Although construction of new facilities necessitates huge investment, BMA is requested to promote establishment of the necessary facilities. It is also essential necessity to maintain the existing facilities as long as possible.

(4) Final disposal

In order to improve the present condition of landfill sites at which almost no control is made, landfill method should be changed from the current open dump method to pre-embanked sanitary landfill method. For this purpose, rejected waste from composting process can be utilized as covering material. Proper treatment of landfill leachate is a problem to be urgently solved.

Without sound function of the final disposal system, sound management of solid waste cannot be realized.

(5) Promotion and education of citizens and private enterprises

When persuading citizens and private enterprises, oppressive control may incur antipathy of citizens and result in unfavorable situations. For effective promotion and education, the concerned authorities should know everything about the actual state of solid waste generation and discharge by citizens and private enterprises: based on the knowledge, responsibilities of discharger and disposer (the authority) can be clarified and some standards for promotion and education will be formulated.

In the case of business waste management, Polluter Pay's Principle should be applied and enterprisers' responsibility for self disposal should be requested. Preparing for the case that enterpriser cannot dispose of his own waste, positive attempts should be made to encourage commercial disposers.

(6) Financial source

Implementation of the Master Plan requires large amount of funding and its success depends upon whether or not the funds can be raised. BMA naturally has a financial limit, beyond which BMA alone cannot implement the Master Plan.

By its nature, the cost needed for upgrading of solid waste management system is to be paid from public funds. Upgrading of solid waste management system in Bangkok city is not only BMA's need, but also the national requirement; therefore, Government of Thailand ought to give BMA financial aid for this purpose.

In the case of Japan for example, the Solid Waste Management



Facilities Improvement Plan to cover the entire country is established on the Government level. Implementation of the plan is made by local authorities whom the Government gives financial aid to as stipulated by law. Normally, the amount of the subsidy is from one-third to one-half of the total cost. In addition, the Government permits issue of local debentures to make up for the shortage according to financial condition of the local authorities.

Such a system may be applicable to Thailand.

Needless to say, BMA is requested to endeavor to seek its own funding but, at the same time, continuous approach to the Government should be attempted to obtain a subsidy or interest coverage.



## 9.5 Solid Waste Collection Fee System

### 9.5.1 Analysis of the existing solid waste collection fee system

The revenue for fiscal 1980 from solid waste collection fees was estimated and is analysed below. Data used for the estimation are presented in Appendix 9.11 and the detailed results are given in Appendix 9.12.

- a. Levied solid waste collection fees in fiscal 1980 were 14 million Baht, which provided only 0.4% of a total revenue of BMA (8,400 million Baht).
- b. From among 510,000 household (estimated) upon which the collection fees ought to be levied, the actually levied households numbered only 97,750. This means that 81.8% of the eligible households were left uncollected.
- c. From an estimated solid waste volume generated in Bangkok city of 2,380 tons per day, only 1,966 tons per day (82.6%) was collected by BOS and districts. 59 tons per day (3%) of this volume was collected from public areas such as roads, parks, rivers and canals. Therefore, the remaining 1,970 tons per day of collected solid waste should be charged a collection fee.
- d. The cost of solid waste management was 313 Baht per ton whereas revenue from solid waste collection fees was 20 Baht per ton. The revenue therefore could only compensate for 6.4% of the cost.
- e. An average collection fee per household (including business sectors) was 11.9 Baht/month, which corresponds to 0.21% of an average revenue of a household of 5,651 Baht/month. If household waste alone is taken, the collection fee per household is 4 Baht/month, which accounts for 0.07% of an average revenue per household.
- f. Solid waste volume collected without collecting the fees was 562,600 tons per year in total, about 293,000 tons per year of which was household waste and 269,700 tons per year was business waste.

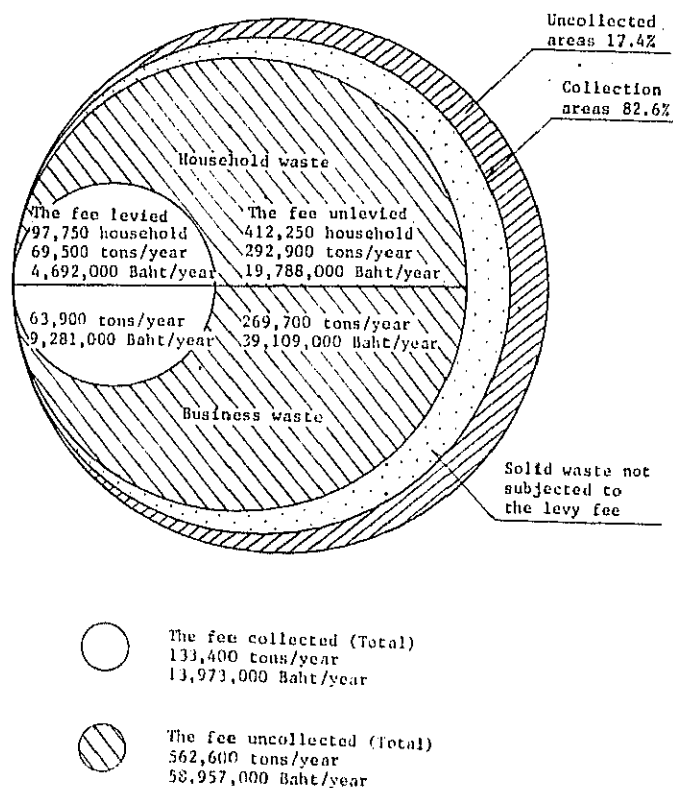
Uncollected fees accounted for 59 million Baht/year; 20 million Baht/year for household waste and 39 million Baht/year for business waste. (Ref. Fig. 9.1)

- g. The number of enterprises paying the collection fee according to the existing collection fee system (Type B and Type C) is unknown.



- h. The average discharge volume of household waste was 59.2 kg/month to which a 4 Baht/month collection fee was charged, whereas the volume of business waste was 173.1 kg/month for which 32.5 Baht/month was charged. The collection fee for business waste is one-third of that for household waste.
- i. It was estimated that, if the collection fees had been collected as stipulated in the regulations, approximately 59 million Baht/year of additional revenue could have been obtained. In practice, however, not more than 14 million Baht/year was collected probably for the following reasons:
- Even though solid waste collection was actually made, the collection fees were not collected from dischargers since their respective volumes of discharge were small.
  - Although solid waste collection was made, the authority was unable to collect the fees since the dischargers have a below average low income.
  - Although the fees were collected, they were misappropriated by the workers as tips and not deposited to the proper government authority.
  - Although solid waste collection was made, the authority would not collect the fees because the cost for collection exceeds the amount expected to be levied.
  - Inadequacy of fee collection system made the authority unable to collect the fees.

Fig. 9.1 Status of solid waste collection fee collection (1980)





### 9.5.2 Problems involved in the existing collection fee system

Solid waste collection fees in Bangkok city stipulated in BMA's Sanitation Ordinance are copied as they are from the Public Health Law, therefore, the fees and the rates are commonly applicable to every community in Thailand.

The current fees are classified into the following three types. (Ref. Appendix 9.12)

Type A. Fee for solid waste collection from buildings and houses

Type B. Fee for solid waste collection from markets, factories and places where a large volume of solid waste is discharged

Type C. Fee for periodical solid waste collection

As already mentioned, the collection fee for household waste is higher than that for business waste.

In general, it is desirable to distinguish domestic solid waste discharged daily from the waste discharged as a result of business and economic activities and establish a moderate collection fee rate respectively.

Public utilities charges in Thailand are relatively low. Compared with them, solid waste collection fee which account for 0.07% of an average household income cannot be said to be moderately low. In the case of Japan, solid waste collection fee is estimated to account for from 0.09% to 0.15% of a household's revenue, that is not much different from the case in Thailand. (Ref. Appendix 9.13)

These facts imply that an increase in the fee rate for household waste collection (Type A) is impractical for the time being. Accordingly as the solid waste management system is expanded in the future, solid waste management cost should also be increased. (As for the cost in fiscal 1980, refer to Appendices 9.14 and 9.15)

To accommodate the changes in conditions, a review of the existing fee system will be required in the near future.

### 9.5.3 Significance of solid waste collection fee

In the urban areas, solid waste collection fee is regarded as a type of public utility charge.

For the present, the benefit principle is being maintained in Bangkok since every household is imposed at least a 4 Baht/month collection fee. As a matter of fact, however, solid waste management cannot be maintained based on either the collection fee or public investment alone.

The rate of the collection fee depends upon how large a public investment can be made for solid waste management. Compared with



rather small financial burden for the citizens, solid waste management system inevitably is required to expand its scale and costs year after year. Therefore, the public's share of the burden for solid waste management should also be increased accordingly as the expansion is implemented.

#### 9.5.4 Reformation of solid waste collection fee system

Based on the above considerations, the Study team recommends that BMA examine the following reformation plan for the solid waste collection fee system.

##### (1) Promotion of the fee levy

Under the present circumstances, less than 20% of the total collection fee is collected and approximately 59 million Baht per year which could be collected is left uncollected. This situation is considered a serious problem. Due to the transfer of most of the solid waste management activities from BOS to districts, the fee collection rate has increased substantially although not yet to a satisfactory level. Therefore, it is recommended that BMA make a detailed examination of how to improve the fee collection rate.

##### (2) Reduction or exemption of the collection fee

A system to reduce or exempt the collection fee for the following cases should be examined

- a. Solid waste generated as the result of disasters such as floods and fire
- b. Solid waste discharged by those who belong to extremely low income brackets
- c. Solid waste for which BMA approves a reduction or exemption for specific reasons

##### (3) Acceptance of solid waste carried into the treatment/disposal facilities

When businesses or private disposers are unable to dispose of their waste in a proper manner, they should be permitted to carry the waste into public treatment/disposal facilities under the control of BMA, provided they pay a disposal fee.

This system also has advantages for BMA since BMA does not have to be involved with collection and transport of that part of the solid waste. Therefore, the disposal fee for the waste carried may be established half of the present fee.

##### (4) Revision of the current collection fee

BMA's solid waste collection fee is stipulated under National Law, therefore it cannot be amended without approval of the National Government.



Before revision of the fee, the collection rate should be increased.

Although the collection fee cannot be revised for the time being, the revision should be required sooner or later as application of the current fee system will become impractical in the near future.

When revision of the fee system is intended, the following recommendations should be taken into consideration:

- a. BMA should appeal to the National Government for amendment of the concerned National Law in order to enable the BMA to flexibly alter solid waste collection fee according to fluctuation of solid waste management cost and socio-economic circumstances.
- b. Cost accounting system upon which the collection fee is based should be introduced for solid waste management.
- c. Although the collection fee should be determined on the basis of cost accounting, it is not expected to change the current fee with a sharp increase. Accordingly, a portion of the public expenditure for solid waste management cost should be increased in order to minimize the portion of private expenditure. Political considerations will be necessary rather a cost accounting system in revision of the fee system.
- d. In revision of the fee, considerations should be paid to the financial burden of the citizens as it is balanced with other public utilities charges.
- e. The fee rate for business waste collection should be re-examined.

As a reference, TMG's internal standards for solid waste collection fee have been presented in Appendix 9.16.



## 9.6 Business Waste

### 9.6.1 The present state of business waste treatment and disposal

A field survey concerning business waste was held in Bangkok city during the period from May to October, 1981. The results are outlined below. Category of solid waste is shown in Appendix 9.17.

#### (1) The objective business sectors

Taking characteristics of Bangkok city into account, business sectors were classified into three categories (A, B, and C: Ref. Appendix 9.18) and the objective enterprises were selected from each category through random sampling (viz. 21 enterprises from category A, 8 from B, and 106 from C: Ref. Appendix 9.19). More than half of the 21 enterprises from category A are located in Pathum Wan, Bang Rak and Phra Kanong districts. This means that business activities which belong to category A are popular in these districts. Enterprises sampled from B and C sectors concentrate in Minburi and Rat Burana districts where industrial estates are located.

#### (2) Property of business waste

The business waste discharged from commercial sources is similar to that of household waste in its properties. Business waste from industrial sources has two patterns: when it is discharged from large factories, it contains considerable volume of a particular material related to the type of industry whereas no particular material is observed in the waste from small factories. (Ref. Appendices 9.20 and 9.21)

#### (3) Self disposal of business waste

Many factories and plants in Bangkok city dispose of their own waste by themselves by various means such as open dumping, on-site burning, landfilling, resource recovery and reutilization, entrusting to the commercial disposer and so on. Self disposal by enterprises is motivated by many factors: BMA does not carry on business waste collection; BMA collects only a portion of the business waste; BMA's collection is irregular; or self disposal is less expensive than collection by BMA. Result of the survey reveals that on-site burning is the most popular way of self disposal; half of the interviewed factories have been using this method. Open dumping is also a common practice for self disposal. Vacant lots or ponds on the site, disposal site or even roadside are used as open dumping sites. In many cases, vacant lots in the sites tend to have sufficient capacity for the time being however it is also considered necessary to prepare countermeasures against shortage of the capacity which might occur in the near future and



pollution of waterway and ground water caused by open dumping.

#### (4) Entrusted disposal

As far as the Study team surveyed, entrusted disposal of solid waste from factories was carried by private disposers free-of-charge. The private disposers were thought to make certain profit through retrieval of utilizable material from factory waste. Compared with collection and disposal by BMA, the disposal entrusted to private disposers was carried on more effectively: the disposers regularly collect all waste as requested and clean the waste depots. This may be because private disposers can make a profit from the activities whereas collection and disposal by BMA is maintained as public utility enterprise. (Ref. Appendix 9.22)

#### (5) Resource recovery

Resource recovery is positively promoted in factories and commercial shops in Bangkok city.

Among business sectors belonging to A-category, hotels were thought most responsive for resource recovery. On the other hand, no attempt at resource recovery was made in markets and offices. Market wastes contain only a little reutilizable material but office waste contains a large volume of reutilizable material such as paper.

In factories, paper and ferrous metal are the main objects of retrieval. The retrieved paper was classified into carton, newspaper, paperbags and others. Examples of material recovery at hotels are shown in Appendix 9.23.

#### 9.6.2 Estimation of business waste generation volume

An attempt was made to estimate the total volume of business waste generated in Bangkok city based on the result of the field survey but lack of basic data made it extremely difficult.

It was not possible to obtain the unit generation volume of all business sectors, so, estimation of solid waste generation volume per shipment amount by business sectors was attempted but also failed simply because basic data could not be obtained. As an alternative, the population of workers by occupation was quoted from a Report of the Labor Force Survey (by National Statistical Office). Applying this population to solid waste generation unit by business sectors, the total volume of business waste generated in Bangkok city was estimated as shown in Appendix 9.24. Solid waste volume generated from hotels and markets by districts are shown in Chapter 2.1.3.



#### 9.6.3 The existing problems

There are a number of private enterprises in Bangkok city, however, a large number of them are small enterprises with ten or less employees. Most of the large enterprises are located outside the Bangkok city area.

Active resource recovery and reutilization are made in small enterprises so that the solid waste volume discharged from them is relatively small.

Generally speaking, control of business waste is inadequate and the method of collection is unsanitary. For industrial enterprises particularly, neither solid waste collection system nor industrial waste treatment/disposal standards are yet established so that open dumping and on-site burning are taken as common means of industrial waste disposal, which probably cause water and air pollution.

#### 9.6.4 Matters to be considered

##### (1) The ideal method of business waste management

After discharge and storage, business waste should also be collected, transported, intermediately treated, and finally disposed of by landfilling except for some parts which are retrieved for reutilization. As a rule, this process from discharge until final disposal should be carried out under the responsibility of dischargers, that is, enterprisers. In other words, business waste management must be performed by the discharging enterprises themselves with assistance of private disposers according to a principle of business sectors' responsibility for management of their own business waste. There are however many cases which force BMA to undertake business waste management from necessity of living environment protection for citizens. Under the present circumstances, it is considered impracticable to request private enterprises to construct and maintain treatment and final disposal facilities. Therefore, BMA must participate in business waste disposal to give assistance to the enterprises but, even in this case, the above-said principle should be kept by means of imposing the management cost on the concerned enterprises.

##### (2) Necessity of fact-finding survey

The entire picture of business waste (property, generation volume, manner of treatment and disposal, etc.) was not completely revealed in the field survey.

Correct comprehension about the present state and the future prospect of business waste management is an indispensable factor for establishment of the proper management system. Without complete and adequate comprehension, it is not possible to clarify the problems and determine the best solution. For this reason, periodic field



surveys should be conducted in order to obtain a clear picture of the present state of business waste management and its movement, though it may be accompanied by difficulties under such circumstances as the enterprises themselves are not aware of the actual status of business waste.

### (3) Enterprises' responsibility

In principle, enterprises who discharge business waste should manage their own waste. The enterprises should cope with business waste generated through their business activity on their own responsibility in a proper manner so as not to cause environmental pollution

For this purpose, the enterprises are requested to consider the following articles:

- a. The enterprises should endeavor suppression of business waste generation volume and promote resource recovery and reutilization.

The enterprises should survey discharged volume of their own business waste and its property in order to treat and dispose of it according to the management standards.

- b. In case the enterprises entrust private disposers with the treatment and disposal of business waste, the enterprises should assume the responsibility for proper management of business waste by means of confirming the entrusted disposers having managed the waste in correct manner, and by means of reimbursing expenses required for the management.

### (4) Licensing system for business waste disposers

Presently, the private disposers cope with business waste upon request of enterprises; however, the treatment and disposal are not always properly conducted. To exclude undesirable treatment and disposal, a licensing system for business waste disposers should be established. Except for the case when dischargers dispose of business waste by themselves, those who wish to undertake business waste management upon request of enterprises should be obliged to bear license authorized by the Governor. The license should be granted when the applicants are confirmed to have the capability of performing business waste management properly. The licensed disposers are permitted to take charge of business waste management upon the enterprises' request to the extent that it does not exceed the disposers' capability, provided that the disposers cope with business waste in the manner which satisfies business waste disposal standards.



#### (5) Establishment of business waste disposal standards

In order to exclude bad influence of living environment and public health caused by disposal of business waste, the business waste disposal standards should be established for each type of business waste. These standards are commonly applicable to the entire country, however, until establishment of such standards, provisional standards can be enacted for the city. As a reference, the business waste disposal standards enacted in Tokyo are shown in Appendix 9.25. Needless to say, these standards should be applied to all cases of business waste disposal: by dischargers themselves, by the licensed disposers, or by BMA.

Solid waste containing toxic substance such as Mercury and Cadmium which adversely affect human health, and which contain excessive toxic substances above the standard limit (Ref. Appendix 9.26) is defined as hazardous waste. Landfill standards for hazardous waste are described in Appendix 9.27.

A fact-finding survey about hazardous waste is urgently required to be made since the actual states of hazardous waste has not yet been clarified. Some examples of the probable generation sources of hazardous waste are medical, physical, chemical, electroplating business sectors.

#### (6) Obligation of BMA

Basic roles of BMA with respect to business waste management are to control and guide the enterprises and disposers to allow them to perform proper business waste management. In addition, BMA is obliged to take certain measures of compensation for imperfect business waste management accomplished by any enterprises, whenever required from the environmental protection point of view.

Other than the already-mentioned administrative activities such as implementation of a fact-finding survey about business waste, establishment of licensing system for business waste disposers and formulation of business waste disposal standards, BMA should implement the following actions:

- a. To educate the enterprises and disposers adequately about business waste disposal standards through public relations.
- b. To make the enterprises and disposers well aware of the importance of resource recovery, reutilization, and suppression of business waste generation volume.
- c. To organize a surveillance system in which the surveillants are able to control and guide the enterprises and



disposers for maintenance of proper business waste management by miscellaneous means such as on-the-spot inspection at their offices and factories.

- d. To set up a reporting system which requires the disposers and hazardous waste dischargers to submit a periodic report to BMA concerning generation volume, disposal method and place of disposal for each type of business waste.

When minor enterprises face difficulties with their business waste management in spite of paying full effort, BMA is obliged to provide them adequate assistance in their business waste management, provided that the enterprises should bear the expense required for BMA's assistance. In final disposal of business waste, particular assistance by BMA will be required.

At the present stage of business waste disposal where the management system is not yet well organized, BMA should take a leading position in promotion of business waste management for the time being. When BMA participates in business waste management, the priority of business waste to be handled by BMA may be determined based on the following criteria.

Business waste which:

- . may seriously affect the living environment
- . requires technically sophisticated intermediate treatment before final disposal
- . requires intermediate treatment and preparation of the treatment facilities necessitating huge investment
- . requires simple or no intermediate treatment but its volume is too large to be handled by the private sector.



## 9.7 Implementation Plan Formulation Method

### 9.7.1 Aim of the implementation plan formulation

Each of the miscellaneous plans contained in the Master Plan may be implemented respectively as an independent project.

For smooth and effective implementation of each respective project, a detailed implementation plan of the project should be formulated in advance. The implementation plan contains details of the construction, construction procedures, physical details of the facilities, methods operation for the facilities, financing the construction, and so on. These items should be fully examined and determined in the formulation of the implementation plan in order to evaluate the practical aspects to achieve the implementation without any unexpected difficulties occurring.

### 9.7.2 Items to be taken into consideration for the implementation plan and matters to be noted in formulation of the plan

Among miscellaneous projects contained in Bangkok Solid Waste Management System Master Plan, the construction of solid waste treatment facilities are of particular note since they require a relatively large investment and sophisticated technology.

Items to be taken into consideration for the implementation plan and matters to be noted in formulation of the plan with respect to construction of solid waste treatment facilities are as follows:

- (1) Implementation plan for construction of a new compost plant
  - i) Outline
    - a. Name of the facilities
    - b. Size of the facilities
    - c. Location
    - d. Area of the site
    - e. Treatment method
    - f. Plant capacity
    - g. Objects of the treatment
    - h. Scheduled date of completion of the construction
    - i. Financing



ii) Plant operation plan

- a. Conditions of incoming waste (quality, quantity, moisture content, organic material content, quantity of unsuitable material for composting, and particle size)
- b. Conditions of front-end and rear-end treatment
- c. Conditions concerning fermentation (length in days of primary fermentation, temperature and humidity control, and feeding air volume)
- d. Conditions concerning the products
  - . Products control (quality, exclusion test of hazardous substance)
  - . Storage and forwarding of products (stored quantity, forwarded quantity, type of packing)
  - . Treatment of residue (quantity to be treated, treatment method)
  - . Ferrous metal recovery

iii) Plant facilities plan

- a. Mechanical and electric facilities plan
  - . Solid waste reception facilities
  - . Front-end treatment facilities
  - . Fermentation facilities
  - . Rear-end treatment facilities (exclusion of foreign material, particle size, ferrous metal recovery)
  - . Storing facilities
  - . Conveying facilities (products, residue)
  - . Pollution protection facilities (leachate reservoir, deodorant facilities, noise and vibration prevention facilities)
- b. Civil engineering facilities plan (plant structure, office building, storage facilities)
- c. Plant facilities layout
- d. Infrastructure plan (construction of an access road)
- e. Utilities plan



iv) Financial plan

Same as the case for construction of the incineration plant

v) Implementation plan

Same as the case for construction of the incineration plant

(2) Implementation plan for construction of incineration plant

i) Outline (given conditions from the Master Plan)

- a. Name of the plant
- b. Location
- c. Incineration system
- d. Plant capacity
- e. The related urban infrastructure plan
- f. Scheduled date of completion of the construction
- g. Construction funds financing

ii) The plant operation plan

- a. Condition of incoming waste (quality and quantity of solid waste, solid waste reception plan, etc.)
- b. Disposal condition of the treatment residue
- c. Plant operation conditions (operation, operation hours, extent of automation, etc.)
- d. Plant repair conditions (repair, repair method, annual repair plan, etc.)
- e. Possibility of expansion or alteration in the future

\* Matters to be noted

In the case of construction of incineration plant with incinerator to which steam turbine system electric power generation facilities are attached (hereafter referred to as steam turbine generator-attached incinerator), the following matters should be noted

- . 24-h/d continuous operation is required.  
Therefore, the plant operation staff should be engaged in the work for both day and night shift system.



- . At least ten mechanical and electrical engineers are required in each plant for operation, maintenance and repair.

iii) Plant facilities plan

- a. Mechanical and electrical facilities plan
  - . Incinerator (type, capacity, unit, etc.)
  - . Pollution protection facilities (pollution protection standards, protection methods, etc.)
  - . Resource recovery facilities (resource recovery system, capacity, the recovered material sales plan, etc.)
  - . The facilities attached to buildings
- b. Civil engineering facilities plan (buildings, stacks, external structure, etc.)
- c. Plant facilities layout
- d. Infrastructure plan (construction plan for access roads, waste heat utilization facilities, etc.)
- e. Construction conditions

\* Matters to be noted

In order to compensate for environmental degradation of the surroundings caused by construction of the incineration plant, urban development plans which are beneficial to citizens of the surrounding areas are desired to be contained in the plant construction plan, such as construction of roads, parks which double as intermediate green belts, public facilities utilizing waste heat of the plant, etc.

iv) Financial plan

- a. Estimation of the construction cost
- b. The construction cost financial plan

\* Matters to be noted

- . In the BMA's long-term public finance plan, the detailed plans to raise funds for this project should be clearly formulated such as a share of investment by BMA, amount to be financed from external sectors including foreign sources, and the repayment plan.
- . Negotiations should be held with each of the financial sources to ensure adequate finding.

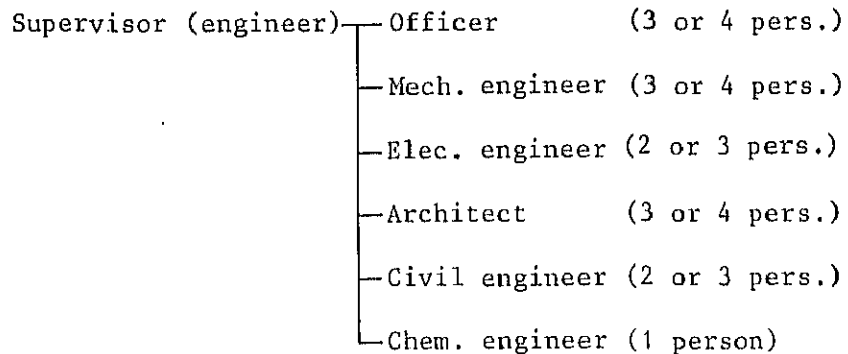


v) Implementation plan

- a. Persuasion of inhabitants. Land acquisition plan
- b. Contract method for the construction
- c. The plan implementation procedure
- d. Constitution of the work division
- e. Schedule (master schedule, task schedule)

\* Matters to be noted

- . Considering the ability of BMA's organization in charge of the plant construction and particularity of this project, the contract method described in 9.7.3 is thought to be reasonable for BMA.
- . Implementation procedure of construction of incineration plant on the basis of the above contract method is shown in Fig. 9.2.
- . For planning and construction of incineration plant, cooperation of engineers specialized in mechanical, electrical, architectural and civil engineerings is indispensable. For this purpose, the organization of a taskforce as shown below is desirable to implement the project.



Cooperation by foreign experts and supervision of the construction work by the consultants will be desirable assistance to the taskforce.

Mechanical, electrical and chemical engineers among the taskforce members may be reorganized for the plant operation staff after completion of the construction: in order to effectively initiate the plant operations by BMA.



(3) Implementation plan for construction of final disposal site

i) Outline

- a. Name of the landfill site
- b. Location
- c. Capacity of the site
- d. Life span of the site (years of the landfill starting and the completion)
- e. Construction plan for the attached facilities
- f. Land-use plan of the completed landfill site
- g. Financial plan

\* Matters to be noted

Land-use plan of the completed landfill site should be formulated considering particular aspects of the landfill such as land subsidence and gas generation. Landfill shape should be determined in order to satisfy the expected land use.

ii) The site operation plan

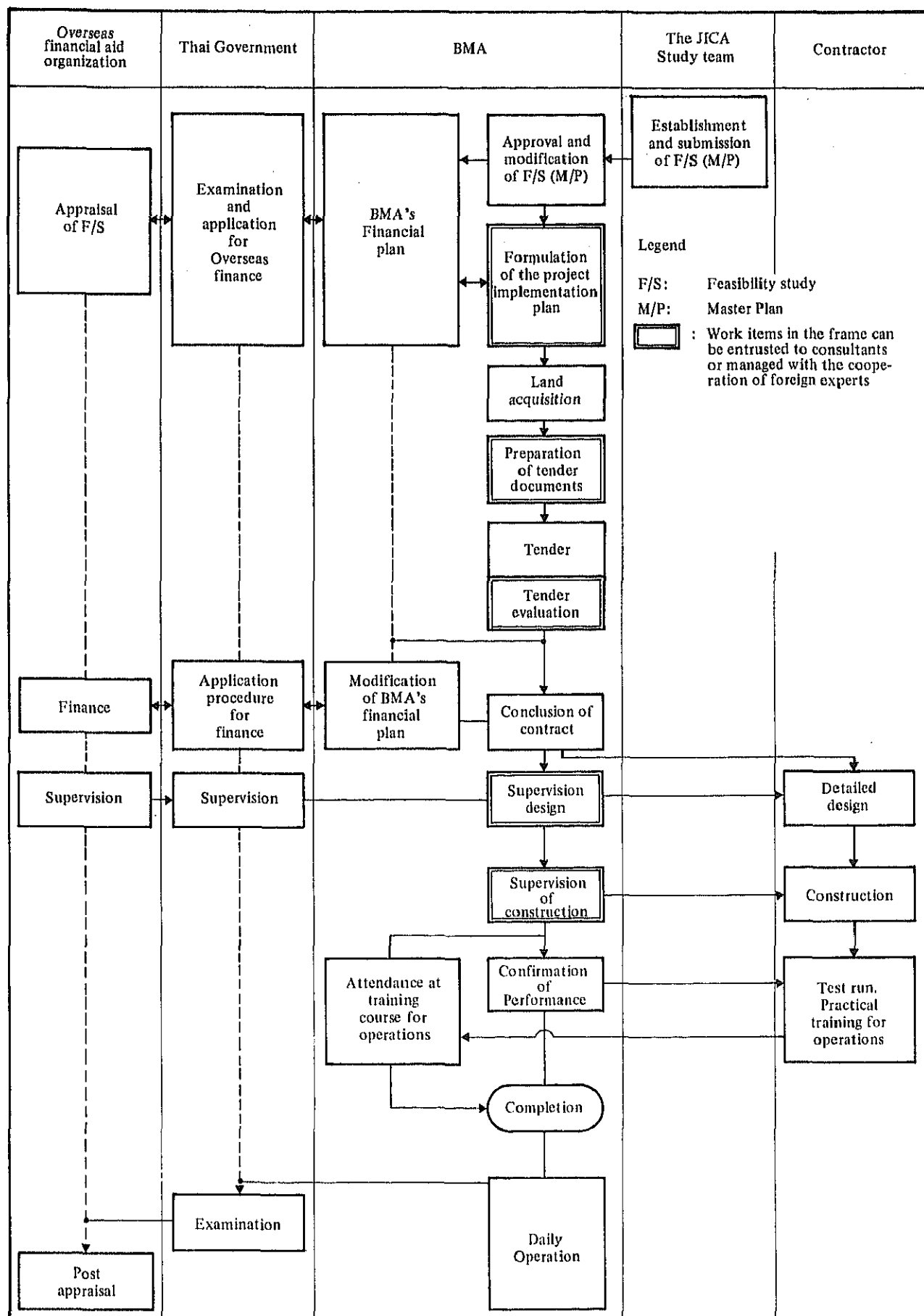
- a. Landfill plan
  - . Conditions for reception of solid waste to be land-filled
  - . Landfill area and landfill volume
  - . Landfill method (anaerobic landfill, sanitary landfill, etc.)
  - . Landfill technique (trench method, area method, etc.)
- b. Landfill and the facilities management plan
  - . Incoming waste control plan (examination of the transportation route, weighing facilities, etc.)
  - . The facilities maintenance plan
  - . Environment surveillance system

\* Matters to be noted

- . The solid waste volume to be landfilled should be determined to match to the future solid waste management plan.



Fig. 9.2 Implementation procedure for incineration plant construction project





- . For maintenance of the normal function of the facilities, miscellaneous means should be taken such as formulation of a management manual for operations and environmental protection facilities and recruitment of specialists in civil, electrical, and chemical engineering.

iii) The site facilities plan

- a. Solid waste storage (embankment, protection wall, etc.)
- b. Waterproof facilities (sheet pile cutoff wall, earth retaining structure, etc.)
- c. Storm water drainage facilities
- d. Pollution protection facilities
  - . Dispersion prevention facilities (protection fence)
  - . Leachate treatment facilities (collection, treatment and drainage facilities)
  - . Gas treatment facilities
- e. Other related facilities (access road, management facilities, etc.)

### 9.7.3 Procedure of formulation of the implementation plan

An implementation plan is formulated based on the procedure shown in Fig. 9.3. An important key of the formulation is, to begin with operation and management plan for the facilities, and then, to determine the facilities plan required to satisfy the operation and management plan.

(1) *Method of contract for construction of incineration plant*

The method is summarized in the Table 9.1. The word 'plant' used in the table means incineration plant for which architectural structure is excluded.

(2) *Flow for formulation of the implementation plan*

The flow is illustrated in Fig. 9.3.

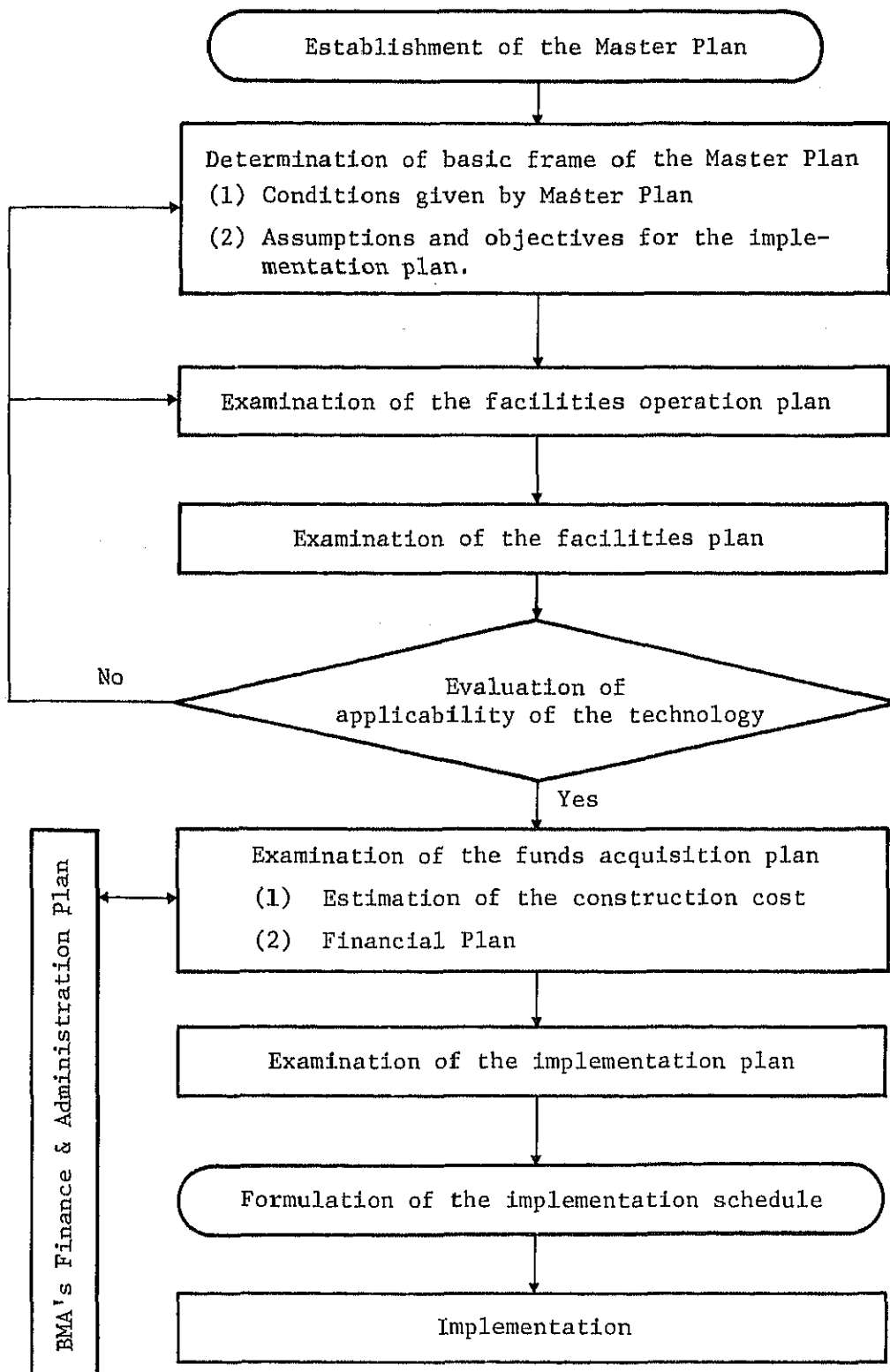


Table 9.1 Method of contract for construction of incineration plant

Condition		Contract method
Specifications for incineration plant construction	<p>1. Because of its huge, complicated and sophisticated nature, the first party (the owner) cannot design by himself.</p> <p>2. Various types of incinerators are designed and constructed by the manufacturers according to their own technology and patent so that there are few designers specialized in incineration plant construction</p>	<p>1. Design and construction contract (Turn-key contract).</p> <p>Previous to the contract, inquiry specifications should be prepared, in which the capacity, function and performance of the plant are specified and the structure may also be specified considering the patent requirements of the manufacturers.</p>
	<p>3. Incineration plant is a plant which will function well only when the plant facilities are well-combined with architectural structure. Therefore, in the course of designing and construction, cooperation of the plant manufacturer with the constructor is an indispensable factor for the successful completion of the project.</p>	<p>2. Joint venture contract</p> <p>Construction of all facilities of incineration plant is entrusted to a joint venture organization composed of incineration plant manufacturer and constructor.</p>
Assurance of economic and fair contract procedures		<p>3. Lump sum contract</p> <p>4. Nominated competitive bid contracts</p> <p>The above two methods require preparation of detailed inquiry specifications (made by the first party) and tender proposal (made by the second party - the contractor).</p>



Fig. 9.3 Work flow for formulation of the implementation plan





## 9.8 Establishment of Engineering Organization

### (1) Necessity of engineering organization

The modernization of a solid waste management administration in Bangkok city which the Master Plan suggests use of advanced technology. An incineration plant equipped with steam turbine power generation facilities requires advanced technology which accounts for a more important role than ever in modern solid waste treatment. For proper planning, construction, operation and management of sophisticated solid waste treatment facilities like the incineration plant by BMA, an engineering organization should be established within BMA which assumes full responsibility for all technical affairs. Evaluating the existing technical organization of BOS from this point of view, it is observed that two items are urgent requirements to be satisfied:

- a. In the case of implementation of construction project contained in the Master Plan, an organization in charge of the construction should be established at the initial stage of the implementation plan.
- b. A considerable number of mechanical and electrical engineers should be recruited. At the present time BMA employs a far lower number than required for planning, construction and operation of modern solid waste treatment facilities.

### (2) Establishment of engineering staff training system

Establishment of an engineering organization is essential but not the best means of achieving the modernization of the Bangkok solid waste management administration. Success of the modernization depends mostly upon the competence of the individual engineer. Modern solid waste treatment technology consists of varied specific technology. To cope with technically complicated and sophisticated administrative problems, BMA is required to train highly educated engineers in specific technology. For this purpose, the training of technical staff on the line for the following items should be considered by BMA:

- a. Solid waste treatment technology (incl. resource recovery technology)
- b. Regulation and technique of pollution control
- c. Control techniques (environmental, operational, maintenance, safety, and finance control)
- d. Control engineering (systems engineering, industrial engineering, etc.)



(3) Overseas training of engineers

In the case of introducing a modern and sophisticated engineering system with which BMA has no experience, BMA should entrust consultants with formulation of the facility plan and the construction with the cooperation of foreign experts; however, for proper operation and management of the system, BMA officers in charge are requested to have sufficient knowledge and skill to control the system. For this purpose, competent engineers should be selected from among the technical staff of BMA and despatched to technically advanced countries for study and practical training in control (management, operation and maintenance) techniques with the system to be introduced.

(4) Invitation of foreign experts

Modern solid waste treatment technology is composed of miscellaneous specific technology. Therefore, when BMA sets about modernizing its solid waste management administration according to the Master Plan, highly technical judgement will be required for every step in the process.

To assist BMA in coping with technical affairs and in training BMA staff, specialists of the concerned technology should preferably be invited from the technically advanced countries.

Although the establishment of an engineering organization and the training system is an essential requirement for introduction of modern technology, more important factors for the successful end are positive will, effort and morale of BMA staff engaged in the work. To promote their positive will, BMA is requested to adopt an ability-reward system into their personnel control system.



## Chapter 10 CONCLUSION







## CHAPTER 10 CONCLUSION

The Master Plan presented in this Final Report requires review and certain corrections at appropriate intervals. The Study team recommends that review be made at completion of each stage of the Master Plan, that is, every five years, concerning the following five items:

- a. Evaluation of already executed parts of the Master Plan. (Particularly, problems and troubles involved in the executed parts which must be clarified.)
- b. Prospect about financing the required budget and facilities construction sites for implementation of the next stage of the Master Plan.
- c. Review of the administrative organization to confirm its adequacy for further implementation of the Master Plan.
- d. Confirmation of solid waste treatment/disposal volume and composition, and preparation of a new forecast.
- e. Re-examination of applicable treatment/disposal methods (technology). (Collection and examination of data and information concerning solid waste treatment/disposal technology should not be neglected since the technology is developing rapidly. Nevertheless, adoption of new technology should be determined through deliberate considerations because, in many cases, application of new but little used treatment/disposal technology incurs unexpected trouble or failure.)

For performance of the study, the Study team set up four goals: solid waste total volume collection, total volume treatment or disposal, establishment of reliable solid waste management system, and promotion of citizen cooperation. Based on these four goals, the most urgent requirement of BOS is the establishment of a technical organization. This establishment of technical organization alone cannot solve various problems of solid waste management and hence the management organization should also be strengthened as well. Some people believe that solution of solid waste problems depends only on money; however, knowledge, effort and fair judgement of the concerned staff should be considered more important than money. Approaching problems scientifically is also an important measure. From this point of view, performance of periodic surveys concerning solid waste composition, fertility and quality of compost, are necessary contributions to the purpose. An essential key for solution of solid waste problems is to obtain citizen cooperation. Perfunctory public relations will never stimulate citizen cooperation. Solid waste collection workers share an important role in promotion of citizen cooperation since citizens normally evaluate sanitation activities through the collection workers' behavior. Under the present circumstances in which the collection workers retrieve utilizable material from solid waste or compell citizen to tip them, citizen come to disregard their social status and will not cooperate with them. The collection workers should be required to submit themselves to the laws and regulations in order to obtain equivalent social status to citizens when they are going to lead and cooperate with. Rationality and discipline



are indispensable conditions for maintenance of labour-intensive enterprise like sanitation activities. It is expected that "recommendations for administrative organization" in Chapter 9 of this report will give BOS useful advices when BOS sets about improvement of its administrative organization. The administrators of BOS are expected to pay full effort to upgrade social status of sanitation enterprise by means of raising priority of sanitation administration in the total administration of BMA, keeping closer relation with National Assembly and national organizations, recruiting competent staff and training them, and so forth.

The short-term improvement plan was formulated based on the several field surveys which were performed as detailed as possible; however, when it is implemented, some improvement items will require more detailed and exact implementation planning.

A collection and transportation plan to cover every corner in an entire city, for example, has to be formulated applying knowledge and experience of those who are engaged in practical work daily in these areas. Prior to formulation of such plan, preparation of miscellaneous instruction manuals are required such as work route maps, work manual, work safety manual, citizen instruction manual, etc. Preparation of these manuals and formulation of the plan may require assistance of specialists. The Study team hopes that BOS will continue the task to establish the detailed collection and transportation work plan applicable to every district in the city.







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