c.2 Co-use Sanitary Landfill by the Two Municipalities

As San Martin and Tonacatepeque municipalities generate municipal waste 26.3ton/day and 22.9ton/day respectively in 1998 and 33.0ton/day and 28.7ton/day respectively in 2010, the capacity of the two municipalities co-use sanitary landfill should be about **60**ton/day.

In view of possibility of localizing the new disposal site, transport distance to the new site could be estimated for example about **average 7km** longer than to the present disposal site, since the centers of the two municipalities are about **10km** distant (access road from trunk road assumed **2km**).

Table K-75: Conceptual Cost Estimation for Co-use Landfill by 2 Municipalities

Item	Cost Increased	Remarks
grade up to sanitary landfill	US$14.0/ton	$15.0/ton (conceptual cost for 60ton/day capacity) minus $1.0/ton (present disposal cost estimated)
longer distance	US$2.8/ton	assumed US$0.4/km/ton x 7.0km
Total	US$16.8/ton	

The conceptual cost estimate gives additional cost of about US$16.8/ton.

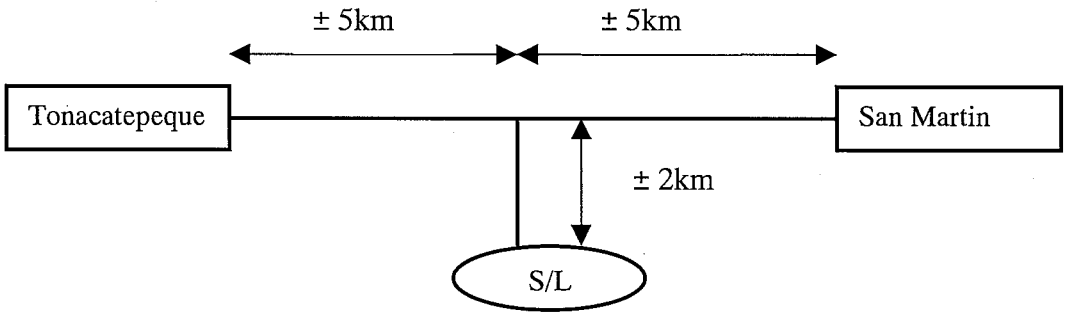

Figure K-11: Estimated Concept of Co-use Landfill by 2 Municipalities

c.3 Participate in MIDES Nejapa Sanitary Landfill

The conceptual cost estimate summarized in the table below gives additional cost of about US$33.8/ton and US$27.4/ton respectively for San Martin and Tonacatepeque.

Table K-76: Conceptual Cost Estimation for Participation in MIDES Nejapa Landfill

Item	Cost Increased		Remarks
	San Martin	Tonacate.	
grade up to sanitary landfill	US$17.0/ton	US$17.0/ton	$18.0/ton (MIDES landfill fee) minus $1.0/ton (present disposal cost estimated)
longer distance	US$16.8/ton	US$10.4/ton	assumed US$0.4/km/ton, 42km and 26km respectively
Total	US$33.8/ton	US$27.4/ton	

c.4 Participate in the New ESPIGA Sanitary Landfill

The conceptual cost estimate summarized in the table below gives additional cost of about US$31.5/ton and US$35.5/ton respectively for San Martin and Tonacatepeque.

Table K-77: Conceptual Cost Estimation for Participation in New ESPIGA Landfill

Item	Cost Increased		Remarks
	San Martin	Tonacate.	
grade up to sanitary landfill	US$11.5/ton	US$11.5/ton	$12.5/ton (New ESPIGA landfill fee estimated by the Team) minus $1.0/ton (present disposal cost estimated)
longer distance	US$20.0/ton	US$24.0/ton	assumed US$0.4/km/ton, 50km and 60km respectively
Total	US$31.5/ton	US$35.5/ton	

c.5 Participate in Another Regional Sanitary Landfill

There is no information of another regional landfill at this moment.

d. Comparison of Alternatives for SMT and TN

In view of the above examination on "conceptual cost estimate", the table below compares the alternatives.

d.1 Comparison of Alternatives for SMT

Table K-78: Comparison of Alternatives for SMT

Alternatives for Improvement	Cost Increased (US$/ton)			Remarks
	S/L level up	Longer distance	Total	
proper sanitary landfill	15.5	1.6	17.1	
co-use S/L by TN and SMT	14.0	2.8	16.8	
participate MIDES Nejapa	17.0	16.8	33.8	
participate new ESPIGA	11.5	20.0	31.5	
participate another regional S/L	-	-	-	no information

It could be suggested for San Martin to consider alternatives of "proper S/L" or "co-use S/L with Tonacatepeque".

To select other alternatives (e.g., MIDES or new ESPIGA) might not be recommended, since it will give crucial cost burden of longer transport distance. In other words, only when the tipping fee is considerably reduced by MIDES or new ESPIGA, such alternatives become selectionable.

d.2 Comparison of Alternatives for TN

Table K-79: Comparison of Alternatives for TN

Alternatives for Improvement	Cost Increased (US$/ton)			remarks
	S/L level up	Longer distance	Total	
c.1 proper sanitary landfill	15.5	1.6	17.1	
c.2 co-use S/L by TN and SMT	14.0	2.8	16.8	
c.3 participate MIDES Nejapa	17.0	10.4	27.4	
c.4 participate new ESPIGA	11.5	24.0	35.5	
c.5 participate another regional S/L	-	-	-	no information

It could be suggested for Tonacatepeque to consider alternatives of "proper S/L" or "co-use S/L with San Martin".

To select the "c.4-alternative (new ESPIGA)" is not be recommended, since it will give crucial cost burden for longer transport distance.

If the MIDES tipping fee is reduced by about US$10/ton, this alternative becomes selectionable comparatively.

K.4.4.6 Examination of A New Landfill Requested

The conceptual cost estimate for S/L (shown in Table K-69) indicates a wide range of possible unit cost for respective size of S/L. It is true that S/L has a wide range of possible unit cost even the size of S/L is same, because cost incurred will vary wide depending on the topographical, hydro-geological conditions etc. of the localization site and also depending on the environmental requirement that prevalent legislation demands. In other words, if there is a candidate site and the site information such as topographical, hydro-geological conditions is available, cost estimate will be more precise.

In view of the above examination presented by the Team, OPAMSS/COAMSS requested for the Team to examine S/L conceptual design and cost estimate for the candidate site in Tonacatepeque.

K.4.5 Medical Waste Management System

K.4.5.1 Outline

The Study Team in conducting the medical waste survey (MWS) investigated the status quo of medical waste management in AMSS. It consequently revealed that many medical institutions are practicing appropriate handling of medical waste following the recently published manual[5]. However, some large public hospitals and small private hospitals with small number of beds have not yet established appropriate handling of medical waste, since medical waste mixed with common waste are discharged by such institutions. This section describes appropriate and optimum medical waste management systems in AMSS awaited in respective stages of the medical waste flow (from generation to final disposal).

[5] Manual para Personal Médico y de Enfermería, Gestión y Manejo de Desechos Sólidos Hospitalarios ALA91/33

K.4.5.2 Medical Waste Separation

a. Principles of Separation

It should be avoided to deem that all wastes generated at medical institutions be medical waste, since it is anticipated that cost burden in such cases will be huge. Wastes generated at clerical office, kiosk and dinning room/restaurants in medical institutions are generally deemed as common waste. However, if they are handled inappropriately (e.g., mixed collection with infectious waste), then at that same time such common waste should be deemed as medical waste and should be handled and treated as medical waste. Therefore, it is the most basic principle of medical waste management to separate "common waste" and "medical waste" that has a great health risk for human-being. Categories of medical waste are shown in Table K-80.

Table K-80: Categories of Medical Waste

Waste Category	Description and examples
Infectious waste	Waste suspected to contain pathogens e.g., laboratory cultures: waste from isolation wards: tissues (swabs), materials, or equipment that have been in contact with infected patients; excreta
Pathological waste	Human tissues of fluids e.g., body parts; blood and other body fluids; fetuses
Sharps	Sharp waste e.g., syringes; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste	Waste containing pharmaceuticals e.g., pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substances with genotoxic properties e.g., waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances e.g., laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g., unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

Source: Safe management of waste from health-care activities, World Health Organization, Geneva 1999.

b. Separation Standard of Minimum Compliance

It is difficult for all medical institutions in AMSS at first instance to introduce such integrated intra-hospital separations that some large hospitals with large number of beds are currently practicing. Hence, it should be necessary to establish the separation standard of minimum compliance that medical institutions first time introducing separation could also observe. Which consequently will encourage and promote actual practices of safe and secure medical waste management in future.

The separation standard of minimum compliance is drafted as follows:

1) Separate Collection of "medical waste" and "common waste"

"Medical waste" and "common waste" shall be separately collected. Out of common waste category, glass metals paper carton board used X-ray film and film development fluids are recyclable materials. Recycling of such materials are effective in contributing resource conservation and waste minimization, however, it should be reminded that existence of the infrastructure and market demand of such recycling is the preconditions of separation of these recyclable materials in medical institutions.

2) Category of Medical Waste

It is recommended to separate medical waste into the categories listed in the table above. However for medical institutions first time introducing separation (especially small ones), works of separation into many items will become complicated and induce additional cost burden for hospitals. Therefore, introduction of separation should begin with the following 4 categories as the minimum category of separation.

- **Sharps:** Sharps (e.g., syringe, surgical knife, sharps such as ampoule) have pointed angles to cause injuries and infection of handling workers, as used sharps might be medical-hazardous by themselves. On the other hand, when sharps are mixed with other medical waste, bags for collecting such waste might be broken by mixed sharps and it consequently will enlarge contamination risks. Therefore, separation of this category is indispensable.
- **Infectious and pathological waste:** Medical waste containing and/or stained with blood should be exclusively separated and collected in order to prevent contamination by blood.
- **Radioactive waste:** There are few medical institutions to generate medical waste of this category. However radioactive waste is completely different from other medical wastes and special treatment/disposal is required. Therefore, sufficient intra-hospital separation management on radioactive waste should be duly practiced and then which has to be handed for a satisfactory disposal management.
- **Other medical waste (than the above categories):** Medical waste in this category can be further classified into sub-categories. However, it will require additional works and costs in so doing. Therefore, it is suggested that the integrity of further sub-categorization should be decided depending on cost examination of respective cases of medical institutions.

3) Central Storage Area for Separately Collected Medical Waste

It is necessary to establish a central storage area for separately collected medical waste. Larger hospitals with many beds establish, in some cases, temporary storage areas. In both cases, storage areas shall be thoroughly managed and controlled. Storage area and its control are indispensable for preventing contamination expansion.

4) Appropriate Discharge Manners of Separate Medical Waste

In discharging medical wastes from central storage area, specialized workers and/or agents should handle them. In these occasions, medical wastes in containers collected and stored shall not be transferred to other containers.

c. Intra-Hospital Separation

c.1 Separation at Outpatient Consultation/Treatment Room

Many outpatients visit the consultation/treatment room in short a time. An example of separation at consultation room in Japan is to locate a set of containers for respective separation categories at one place not distant from patients. A set of containers with written instruction draws patients' attention that to which container a waste in his/her hand should be deposited. Consequently collaboration by patients and medical staff for separate discharge was attained. As a matter of course, medical waste and common waste are separated at such places. A container for common waste should not necessarily be a sealed type. However, a container for medical waste, in which such as alcohol cotton to wipe blood after injection should be disposed, needs to be a sealed type in order for its isolation. Meanwhile a container for sharps (e.g., syringe) should be an impenetrable container such as used medicine bins.

In case of surgery treatment rooms for outpatients, containers for respective medical waste categories shall be placed in such rooms in order to secure separation in required categories. Meanwhile, there are some that can be categorized as common waste even though which is employed for medical actions. Therefore, training and education is needed to clarify and confirm items entailed in respective categories.

c.2 Separation at Inpatient Wards (Bedrooms) and Nurses' Stations

Most medical conducts themselves at inpatient wards and nurses' stations are same as those at outpatient consultation rooms. However, such medical conducts do not take place at one fixed place (consultation room) but at many bedside places by a tour of doctor and/or nurse. Therefore, mobile medical treatment platforms/carts should equip several containers for medical waste separation (e.g., impenetrable bin for sharps, etc.) based on the features that respective platforms/carts possess.

c.3 Separation at Operation/Surgery Rooms

All waste generated through operation/surgery shall be categorized as medical wastes. Respective medical waste shall be sealed in each operation/surgery and it would be recommended to entrust treatment/disposal of such waste for a specialized agent.

In case of medical institutions in Japan that owns a proper incinerator, tissue particles from operation/surgery are incinerated by a proper incinerator. Even in such cases, sealing of the medical waste is completely carried out.

As for blood and body fluid from operation/surgery, only at the medical institution that has sewage treatment facilities, they are disposable to specified drains. In other cases, they should be regarded and controlled as "infectious and pathological waste".

c.4 Separation at Laboratories

Blood, urine, culture, specimen recipients, tissue etc. are regarded as medical waste therefrom. It is recommended that fluids such as blood and urine be disposed at

specified drains for sewage treatment or be subject to thermal treatment (e.g., autoclave) and subsequent disposal.

If other medical waste (than fluid) from the laboratory is in small quantity, to entrust its treatment as infectious waste to a specialized agency might be more economical that to sterilize by the laboratory itself.

c.5 Separation at Isolation Wards (Bedrooms)

Basic practices for separation are same as those at impatient wards. However, all medical waste from isolation wards shall be sealed on-site immediately and to deposit in special containers. Subsequent procedures could be incineration by a proper incinerator of the medical institution or to entrust the treatment/disposal to a specialized agent.

c.6 Home Treatment

In recent years, home treatment of patient becomes popular. Major medical wastes generated from the home treatment are: blood (e.g., from heamodialysis patients equipped with machines); incontinence pads; dressings; or syringes and hypodermic needles (e.g., from diabetics). If appropriate instructions are absent, those medical wastes from home treatment are discharged mixed with common wastes. As medical waste generated by one home patient is very small in quantity, medical institutions in charge of home treatment should instruct the home patient or its helper to store the medical waste temporarily in a specific container at home in order not to mix with common waste. A special container for sharps (such as hypodermic needles) shall be provided by the medical institution in charge. And at a specific time interval the containers shall be handed to the medical institution.

K.4.5.3 Containers at Medical Institution and its Management

a. Containers for Medical Waste

Medical institutions in AMSS that already practice separation utilize red-color plastic bags for medical waste and black-color plastic bags for common waste for separate collection. As for intra-hospital separate collection, for example a hard plastic container is used for sharps, a small carton box is used for separation of such as small glass, cylinders. In these practices, categories of medical waste should be clearly indicated on containers in order not to mix up nor commit an error.

At central storage area of most medical institutions in AMSS that medical waste are temporarily stored, red color plastic boxes of 30cm high X 40cm wide X 60cm long are used as standardized containers for medical waste.

To maintain those practices standardized for medical institutions in AMSS for the future is recommendable. As a reference information, features of various containers for medical waste utilized in Japan are detailed in Table K-81.

b. Intra-Hospital Movement of Medical Waste

Movement of medical waste from respective generation sources to temporary/central storage area should be conducted by specialized hospital workers with cart or carrier destined for such exclusive use. Carts and carriers for such exclusive use should de periodically disinfected. Meanwhile, it shall be prohibited to open sealing lid/cap of

container and to pour medical waste from one container to another, because it will greatly enlarge the risk of workers to be infected in so doing.

c. Central Storage and Temporary Storage at Medical Institutions

Temporary storage area in medical institutions shall be at certain fixed places. In order to lessen the storage time therein as short as possible, intra-hospital collection should be frequently carried out. Medical waste frequently collected at temporary storage area should be moved to the central storage area to store for a certain period but it should also be shorter. Since pathological wastes are perishable, they should be kept at cool storage. Such central storage shall also be disinfected periodically. The central storage area shall be controlled as the restricted area (e.g., such as fencing with entrance locks) and be clearly indicated that only authorized special workers who handle the medical waste and who disinfect area are accessible to this restricted area. Furthermore, medical waste handling procedures and cautions related with the works shall also be expressed there.

Table K-81: Collection Container for Medical Waste

Container		For medical solid waste	For sharps
Carton board container	Structure	2 layers (Plastic bag installed inside the Carton box.)	3 layers (Inner box made of hard paper, plastic liner is on outside of the inner box, and outer box made of Carton box)
	Handling manners	Plastic bag is to be installed inside the carton box.	Most products in market are easily set up following written instructions. Some products require skills for setting up.
	Advantage	Cost is cheaper due to simple structure.	Apt to incineration treatment.
	Disadvantage	It is not apt for sharps and liquid waste.	There are few cases that syringes are penetrable (especially from the box corner).
Plastic container	Structure	• Most products in market consist of a container and an independent lid/cap. • Most products have such a sealing structure that once a lid/cap is closed that can not be opened again.	
	Shape	• Cylindrical bucket type products were prevalent in former time. Rectangular box types are popular recently.	
	Capacity	• Products of 20liter, 25liter, 40liter, 45liter, 50liter are available. • 2-4liter products also used as desktop containers.	
	Advantage	• Since they are plastic molded one-piece products, their application is wide for all categories of medical waste (e.g., for liquid waste, for sharps, etc.). • Product setup troubles are absent unlikely for the cases of carton box containers. • Sealing works are very easy.	
	Disadvantage	• Once the container is used it should be incinerated. Therefore it has an aspect of resource extravagancy. • Production of large capacity products is difficult and requires substantial cost. Consequently such products are not available.	

Source: Handbook on Infectious Waste Management: Nihon Iryo Kikaku Inc. 1993

d. Monitoring of Medical Waste Amount and Movement

It is important to monitor amount and movement of medical waste. Therefore, persons responsible for the monitoring should be nominated respectively for each sections of medical institution so that they should routinely take records for each medical waste category with such as container quantity, weight, etc.

K.4.5.4 Collection and Transport of Medical Waste

a. Separation

- It is prerequisite for appropriate collection and transport that medical wastes are source separated and deposited at appropriate containers respectively.
- To pour medical waste in another container shall be avoided.

b. Containment

- Sharps such as syringes and surgical knives shall be deposited at impenetrable hard containers in order to avoid workers injury and infection.
- Medical solid waste shall be contained in hard containers or durable plastic bags of double layers.
- Liquid or semi-solid medical waste shall be contained in hard and sealing containers to avoid leakage.
- In cases where category separation is not practiced, hard and impenetrable containers with sealing function should be employed in order to avoid leakage of liquid content.
- All containers in general should be of type that scatter or leakage of medical waste be avoided and odor emission be prevented.

c. Indication

- It is indispensable to clearly indicate on containers that medical wastes are contained.

d. Transport

- Medical waste shall be transported by a vehicle of exclusive use (not together with other waste such as municipal waste).
- As a principle, medical waste transport should be made directly to treatment/disposal facilities, i.e., intermediate transfer or storage should be prohibited. In case that medical waste intermediate transfer should be carried out, such transfer station should at least comply with the requirements mentioned above for the temporary storage area inside the medical institutions. Transfer activities in such cases should be in a manner that transfer distance be shorten for example from vehicle to vehicle.
- The transport vehicle should have such a structure that medical waste

containers never fall down.

- It is preferable that the transport vehicle is cooler vehicle or freezer vehicle.
- The transport vehicle should have such a structure that the containers loaded can not be damaged even in case of the traffic accident of the vehicle.
- If the transport vehicle is destined to carry both medical waste and new empty containers, compartment shall be of waterproof.
- The collection/transport vehicle shall be disinfected periodically.

K.4.5.5 Medical Waste Treatment

a. Common Treatment Methods

The following methods are common for self-treatment by medical institutions and/or entrusted treatment/disposal for medical waste.

- **Incineration:** Incineration at medical institution is conducted in order to avoid risk expansion related with taking-out of infectious medical waste from medical institution. Medical waste incinerator should equip secondary combustion chamber to insure sufficient thermal treatment. Meanwhile, depending on local situation of the incineration site and/or on legal requirements, an advanced treatment on incinerator emission will be required.
- **Slagging:** Higher integrity of treatment than incineration is achieved by slagging. Its final residues (products) are slag (i.e., meltdown substances) of input medical waste. This offers safe and secure treatment, however, its cost is substantially higher than that of incineration.
- **Autoclave:** This treatment is traditional to disinfect and reuse syringes operation apparatus. Autoclave facilities can be categorized into two: one with large capacity and the other with small capacity. The facility with large capacity equips with a vacuum pump that vacuums the chamber before highly pressurized vapor is fed into the chamber. The facility with small capacity, in most cases, feeds pressurized vapor from the ceiling of the chamber and extracts original air from the chamber bottom by taking advantage of gravity difference of vapor and air. Whereas, since there is no appearance change on the medical waste after autoclave treatment, visual confirmation whether the medical waste is already disinfected or not is not possible. Therefore, there remain infection risks when and if untreated medical waste is misinterpreted as already treated medical waste. Hence, medical waste after autoclave treatment at hospital is normally entrusted as "infectious medical waste" to specialized agent for another treatment and disposal.
- **Dry thermal disinfection:** It is difficult for autoclave treatment to visually judge the effect of its disinfection process. In view of that, dry thermal disinfection treatment has been developed. This treatment entails various methods, such as (i) pre-shredding of medical waste and dry thermal disinfection; (ii) fusion and solidification (iii) crushing after solidification. An advantage of this treatment is (a) volume reduction (normally up to 40% reduction) of medical waste subject to

this treatment, and (b) it is clear visually that the medical waste is already treated or not treated yet. Meanwhile, disadvantages are (c) combustible wastes such as paper and cloth materials should not be included since they are burnt out and (d) special container for this treatment is costly.

- **Chemical disinfection:** Advantageous features of this treatment are that special facilities and/or apparatus are not required, hence this treatment is comparatively easy to carry out. This treatment is routinely utilized for disinfecting microorganisms on medical apparatus/cart/carrier and wall/floor of the medical institutions. Some chemicals for this purpose are effective for disinfecting fluid such as blood, urine, stools, or hospital sewage. Chemical disinfection for solid medical waste is only effective on surface of such waste but is not effective in disinfecting inside of such. Therefore, if the solid is crushed into small pieces, chemical disinfection becomes effective. Since there is no appearance change on the medical waste after chemical disinfection, instant visual confirmation whether the medical waste is already disinfected is not possible.

- **Sterilization:** This treatment is normally applied for in-hospital treatment disinfecting medical apparatus for re-use, but not for infectious medical waste. Sterilization should run more than 15 minutes to disinfect the apparatus. This treatment is a simple practice but is not a sure method.

b. Optimum Treatment System

In reviewing current medical waste management system in AMSS, the Study will recommend an optimum system for medical waste treatment as a part of the M/P for the regional SWM in AMSS in order that all medical institutions in AMSS could practice appropriate medical waste management. In this context, reviews on current system and examination for the optimum system to be proposed are detailed as follows.

- As for medical institutions that are going to introduce "separation collection" from now on, the autoclave facility with small capacity could be appropriate for in-hospital treatment only for infectious medical waste. Treatment for medical wastes other than infectious wastes should be entrusted to a specialized agent.

- Because autoclave treatment does not visually enable to confirm its disinfection performance, the autoclave can not be an absolute and sure treatment method. Therefore, it is suggested that at least some of medical waste should be subject to incineration treatment. On the other hand as the current medical waste management in AMSS, there are no in-hospital autoclave facilities in AMSS and most medical institutions entrust the medical waste treatment for MIDES to disinfect by the autoclave at Nejapa disposal site where waste after treatment is landfilled. Therefore, the disadvantage of visual confirmation inability is not eminent due to the single major flow of medical waste treatment at current AMSS. In this context, this autoclave treatment at a disposal site is effective in medical waste management. However, to rely on the only one treatment system (i.e., autoclave) is not recommended because there are several problems such as follows:

  - Medical waste consists of what suited for autoclave treatment and what not suited for that.

- ♦ In case that the only one autoclave facility has a breakdown or an accident, there is no other choice to alter the treatment of standby infectious waste.

- An optimum system for medical waste treatment should therefore consider a system consisting of plural treatment measures.

- In order to aim to treat all medical waste from all medical institutions in AMSS, the optimum system should be examined from the overall viewpoint consisting of such as collection, transport, treatment and disposal aspects. In practice, if an intermediate treatment facility is localized at more appropriate position such as at a wide premise of a metropolitan large hospital (than at the final disposal site), transportation costs will be significantly reduced. And as that consequence, a beneficial impact to lower overall costs for medical waste management could be brought about.

- In this case, in order safely to dispose treated medical waste at final disposal site, the treatment method should be such that enables visual confirmation on disinfection performance by way of clear identification of waste appearance changes (e.g., through incineration process). Medical waste incineration treatment could be feasible in AMSS with a satisfactory treatment performance where appropriate operation management and exhaust emission control on hazardous substances are implemented.

- As explained above, it is suggested that, in parallel with the currently operated autoclave treatment, medical waste incineration should be introduced to secure the appropriate and safe medical waste management.

- In addition to that, if an incineration plant is designed and operated not exclusively for medical waste but also for incinerating high calorific industrial waste, it will enable co-incineration of medical waste and high calorific industrial waste. Such facilities have merits in attaining cost-effectiveness both in the context of investment costs and O&M costs. Therefore, due attentions should be paid for present and future trends in industrial waste management in AMSS, in order to aim at establishing the optimum medical waste management system.

K.5 Alternatives for Competitive Services (Participation by Private Sector)

K.5.1 Participation by Private Sector (PPS) for Solid Waste Management

a. Introduction

In the last two decades the way of rendering solid waste management services has undergone several changes in developing countries, specially Latin America, where more than 50% of the solid waste collection systems are controlled by the private sector through diverse ways of contract-out.

It is very important not to confuse the method of **Participation by Private Sector (PPS)** with that of **Privatization**. The PPS concept regards several options, among which whether the transfer of assets to the private sector can be taken into account or not. The concept of privatization of state-owned enterprises refers to the case in which a total transfer of assets and income takes place.

In developed countries, such as in the United States, PPS upon municipal SW collection services accounts for 80% of urban services, including commercial and industrial users. PPS is by far limited in the sector of final disposal, since it only accounts for in the order of 7%. In Latin America, most of the sanitary landfills are still handled by some state institution.

It is important to understand that in municipal solid waste management, the collection is a sector in which PPS is relatively more simple than in the final disposal sector. On the other hand, the required capital investment is relatively lower with regards to other natural monopolies, which in turn causes a greater interest by small enterprises and particularly local enterprises to participate into this sector.

Prior to the beginning of a PPS process, a two-phase work has to be designed in order to develop and implement such participation.

Phase I consists of the reviewing of the current system (see Progress Report (1)); the outcome of such analysis will be a list of recommendations and studies (Master Plan), which is focused on improving the current service and identify the possibilities of a PPS.

Phase II contains the PPS forms and its recommendations; the regulatory and institutional framework proposed with the purpose of setting up the regulatory framework to which solid waste management activities must be subject to, protecting public health and maximizing the use of the resources devoted to this activity through the promotion of competition to render these public services to the population, under quality conditions and fair prices.

To allow the rendering of these services and the PPS to be successful and convenient for the users, it is necessary that the authorities and users themselves be aware that the following principles must be complied with.

Political decision

No successful PPS can be achieved without the resolute and firm support by the authorities and political leaders.

The excess of staff resulting from a political nepotism or from the pressure by unions is a problem that cannot be solved without the political support.

Financial autonomy

Financial autonomy of the activities in the service is essential if such services are to be efficiently provided and on a continuous base.

In order to provide the services in a stable and uninterrupted manner, municipal administrators need a direct access to the funds generated by the service itself.

These funds must be separated from the municipality's flow of funds.

The adoption of appropriate fees or tariffs and methods for the identification of customer and efficient collection systems, particularly for large generators and industrial and commercial customers, must be strongly promoted as the means to provide a viable and equitable financial administration.

Integral planning

Municipalities have to regard the storage, discharge, collection, sweeping haulage, transfer and final disposal within an integral planning context.

This view must incorporate all the aspects of solid waste management process, including elements such as the following: recycling, legislation, regulation and execution. This is important if any portion of the system goes to PPS, it should be able to assure that those portions by private sectors are complemented with the municipal service and are backed up by a general administration program.

Financial responsibility

A thorough knowledge of the real costs of the service rendered and the magnitude of the financing resources required to make them sustainable are the prerequisite for any PPS plan. It is essential to know the costs without subsidies in order to promote these services for both the municipality (in negotiation and assessment of contracts) and the private enterprise (to calculate expenses and markups).

Municipal responsibility

Municipalities must face PPS under a strong position. They cannot elude the total responsibility for solid waste management to the private activity, but in turn they have to establish their duties precisely in the contracts and in the careful monitoring of their performance. Otherwise, if a firm municipal control and a real competition is absent, a powerful monopoly or cartel may appear, which would result in an uncontrolled exploitation of the municipality and the public.

K.5.2 Different Forms of PPS in Solid Waste Management

There are different forms of PPS, and their selection depends on the type of market, characteristics of the particular situation of the system and on the objectives by the regulator. Therefore, some forms of PPS in other sectors (e.g., drinkable water) differ from PPS related to solid waste sector in their concept, scope and applicability.

It is important to analyze and review the models implemented, both in developing and developed countries and learn from those experiences. The selection of the optimal PPS model is defined by several elements such as the following:

- Market size and type;
- Objectives of the client and/or regulator, such as equity VS efficiency;
- Long-term objectives;
- Level of rent-seeking activities of the system;
- Levels of the existing human assets;
- Institutional capacity to regulate; and
- others.

Before selecting the best model that fits the characteristics of the municipalities of AMSS, the institutional structure, free-riding activities level, auditing system, legal

sanctioning system, information and control systems, level of the trained staff for regulation, the public perception of a private operation, etc., should be analyzed.

Table K-82 summarizes the most common forms of participation by the private sector in solid waste management.

Table K-82: Options for Participation by Private Sector in Solid Waste Management

Forms of PPS	Assets owned by	Investment	Operation/ Management	Commercial risk	Price fixing	Quality of service
Contract of service	Private	Private	Private	Public	Bid	Regulated
Contract of operation						
Competitive prices (lump sum or unit prices)	Public	Public	Private	Public	Bid	Regulated
Cost-Plus	Public	Public	Private	Public	Verified	Regulated
Contract of administration						
Fixed payment (lump sum)	Public	Public	Private	Public	Bid	Self-regulated
Fixed payment +incentives	Public	Public	Private	Public	Bid	Self-regulated
Franchise						
Competitive prices	Private	Private	Private	Private	Bid	Regulated
Regulated prices	Private	Private	Private	Private	Regulated	Regulated
Concession						
Competitive prices	Private	Private	Private	Private	Bid	Regulated
Regulated prices	Private	Private	Private	Private	Regulated	Regulated
Non-regulated franchise or license (exclusive or non-exclusive)	Private	Private	Private	Private	Free price	Regulated or not (as desired)
Open regulated competition (no license is paid)	Private	Private	Private	Private	Regulated	Yes
Open regulated no competition or informal markets	Private	Private	Private	Private	Free price	No
BOT – Direct or Inverse BOOT-Direct or Inverse BOO – Direct or inverse	Private or public	Private or public	Private or public	Private or public	bid	Regulated

Source: Madrid-Aris (1999).
Notes: BOT: Build, Operate and Transfer
BOOT: Build, Operate, Own and Transfer
BOO: Build, Operate and Own

It should be noted that competitive prices can be attained by the lump sum mode, or by means of unit prices.

In economic regulation theories, PPS forms are considered by means of bids such as "optimal regulation". The bid corresponds to a competitive bid in a closed envelope. This type of regulation is optimal, since the bid process is competitive (there is no collusion and the number of participants for the bid is high), efficient prices are obtained easily and without a high regulation cost.

Developing countries should pay attention to this type of regulation, as there exist important restrictions (lack of human resources, a high level of rent-seeking, lack of resources to monitor and control prices, unstable regulatory frameworks, inefficient information and control systems, etc.) to efficiently regulate.

Normally people tend to analyze Table K-82 and correlate the ownership of assets and investment with the respective levels of risk of PPS forms. It is worth mentioning that the risk in a privatization and/or regulation process not only depends on the form of PPS (ownership of assets, investment and operation), but to the fact that PPS is directly linked with the "conceptual regulatory and tariff framework".

For instance, if a concession is granted with a tariff framework that allows for the alternative of "force majeure" revision of prices or tariffs prior to the regular period of price revision; in other words if the "regulatory lag" is reduced, risk is not only being totally borne by the concessionaire or private party, since part of such risk would be passed on to the public sector or, more specifically, to the consumers.

On the other hand, normally a tariff structure has an indexing system or automatic readjustment of the fees, which can be of a single or polynomial type. In general terms, if a polynomial index is used, it should include intrinsic variables related to the efficient production cost. Therefore, the existence of external variables as part of such index could be passed on to the consumers through the tariff readjustment.

In other occasions, the private party requests for a state guarantee for the investments; therefore, some of the risk (investment) is passed on to the public sector. Therefore, regarding the risks in PPS, the regulatory problem is quite complex and is not only limited to the analysis of Table K-82, as many assume so.

K.5.3 Description and Analysis of the Different Forms of PPS in Solid Waste Management

The diverse forms of PPS in solid waste management are described and analyzed next.

K.5.3.1 Contract of Service through Competitive Tender

a. Definition of Service Contract

The service contract is a broadly utilized form in developing countries to allow PPS in solid waste management.

This mode has replaced the traditional direct municipal operation. It incorporates PPS through a competitive public tender system, as in the contract-out of public works. This means that the client and/or regulating authority (municipality in AMSS) pays, monthly or every 3 or 6 months, the contractor for the collection of solid wastes (in weight or volume or estimate), or per a fixed amount defined in the contract.

The service contract is the simplest form of PPS, by means of which efficiency can be achieved and thus reduce operation costs. In general, the service contracts are applied intensively for functional activities that do not require an important amount of capital. Therefore, the collection and sweeping system and the operation of sanitary landfills are viable categories to apply this type of PPS.

This PPS mode generally does not create significant regulation costs, reason why the regulating entity reduces the risk of falling in information lag, as in the case of concession or franchise. The services contracts system are very demanded when the public sector wishes to have some control of the system, but at the same time it is required to increase the efficiency of such systems. In this form of PPS, the public sector can be or cannot be in charge of the commercial management.

Typical services contracts for the solid waste sector are as follows:

- Street sweeping
- Collection, haulage and transfer
- Collection of hospital wastes
- Tree trimming and park cleansing
- Operation of sanitary landfills
- Invoicing and collection (commercial system)
- Management and maintenance of the customer database
- Monitoring and auditing
- Others

b. Regulation of prices: Unit Price VS Lump Sum

In general terms, prices can be arranged by means of unit prices or lump sum in the "services contracts". Generally, in this type of PPS prices are not regulated, as they are fixed by the competitive proposal presented at the moment the tender is open.

In other words, competition is generated in the tender, it is called a competition "for the product" or "for the market". It is to say, the price corresponds to a price-cap type, be it as a unit cap price or as a lump sum, according to how prices were presented at the proposal or bid.

In developing countries there is the great problem of awarding contracts by unit prices (i.e., per ton collected or disposed of), due to the following factors:

- Under this regulation of prices, the private operator has the great incentive to perform free-riding activities, specially those aimed at forging (increasing) the volume collected or disposed of. Generally, this is carried out by putting additional weights on the truck, soaking the wastes, fixing the weighbridges, etc. Due to the aforementioned, the auditing and monitoring problem gets complicated and regulation costs increase considerably
- This type of price regulation also creates incentives for rent-seeking activities, the most common activities are corruption in the inspection and/or weighting process.

Aiming the private party to bear the business risk and really get incentives to become efficient and thus cut costs (enough to implement a reduction policy), many countries (specially Chile and Argentina) have adopted contracts for the provision of collection services in lump sum.

In this case, the tender basis or estimated volume delivered by the studies should be verified by the bidder prior to presenting the bid, and this risk of additional waste generation will have to be borne entirely by the bidder.

For AMSS it is recommended to make contract-out by lump sum through a public tender or known as competition for the product. It is also recommended a participation of at least 5 price bids in the opening process of the price bids, in order to ensure that the contract is competitive and the most economically-efficient price is obtained.

Taking into account the technical fundamentals previously explained and considering the specific conditions in San Salvador, the awarding of service contracts by means of lump sum is recommended instead of unit prices.

c. Other Regulation Elements for the Service Contracts

Terms

The term in this type of contracts depends on the type of services to be rendered. In general, this contract is frequently used for waste collection activities (that include haulage and/or transfer to the sanitary landfill).

In this case, the term depends on the capital account, which is mainly defined by the accountable depreciation rate allowed by the law or by the service life of the equipment. Empirical experience shows that these contracts last around 4 to 7 years.

On the other hand, evidence shows that the service life of trucks in AMSS is in the range of 7 years.

Therefore, the recommendable term to award a service contract for AMSS should last 7 years. Under this term, the useful life of the equipment is maximized, as well as the tariff impact is reduced, since the capital account of the collection trucks is discounted in 7 years.

Price adjustment or automatic price indexing

The automatic indexing of tariffs is used to allow a progressive adjustment that shows the variations in costs that affects the rendering of the service. In order to protect the services provider from the risks of increases in the production costs, indexing systems are generally utilized, such as unit indexing (consumer price index, wholesale price indexes, price indexes for imported products, etc.) or polynomial indexes (these should reflect the service's cost structure).

Normally speaking, production costs are mostly correlated to the producer price index than to the consumer price index (CPI). From a technical viewpoint, the producer price index shows the cost structure of production in a better manner than the consumer price index.

"Force majeure" revision and cost transfer

The "force majeure" revision is considered as a mechanism not widely used that allows the adjustment of tariffs under circumstances regarded as exceptional and/or significant, totally out of the control by the service provider and by the client (e.g., climatic events such as an earthquake, hurricane or any other element) that generates an additional amount of wastes not considered in the bid price.

It is recommended to perform a "force majeure" revision or costs transfer, only in the event of a climatic happening whose occurrence is greater than a return period of 50 years (calculated through an hydrological analysis and utilizing a statistical distribution function such as a common logarithm or Gumbell type), and it should also be proven that additional excessive amount of wastes were generated as a result of such climatic happening.

K.5.3.2 Operation Contract

a. Definition of an Operation Contract

The contracts of operation of solid waste management are not very common in developing countries, especially in Latin America.

This type of contract is common during the transition from a public service to the private sector. This is basically a service contract, where the private party does not provide the capital but the entire operation and administration of the system; i.e., the ownership of the trucks belongs to the public sector in collection.

In the specific case of AMSS, if the municipalities would like to keep on having the control of the collection assets, PPS would be introduced without their having to provide the assets (for instance, collection trucks) to run the system.

This system incorporates PPS by means of a pubic tender, such as those for the contract-out of public works. This means that the client or regulating authority (municipality in the case of AMSS) pays monthly or every 3 or 6 months, the contractor for the solid wastes collected (in weight, volume or estimate), or as per the fixed amount set forth in the contract that corresponds to the operation expenses. The private operator is not paid for the costs of capital account (depreciation and capital cost), and it just receives the costs from the O&M account.

This form of PPS can generate significant regulation costs, which depend mainly on the forms of regulating prices.

The prices for the operation contracts can be set as forms of: (i) lump sum; (ii) unit prices; (iii) cost-plus.

(i) Operation Contract with Lump Sum

The price to be paid to the private operator or the service provider is defined in the economic proposal presented at the moment of the tender in this regulation form. Therefore, the price presented by the operator includes its profits and the risks in the volume changes. This is the price regulation mode whose regulation cost is less.

(ii) Operation Contract with Unit Prices (or per volume)

The price to be paid to the operator is defined in the economic proposal, but based on ton collected by the operator. In general terms, in developing countries there is the great problem of awarding such contracts per volume; i.e., per ton collected, due to the following factors:

- This type of contracts increases incentives for "rent-seeking" activities.
- The private operator has the great incentive to forging or increasing the volume collected. Due to the aforementioned the auditing and monitoring problem gets even more complicated and the regulation costs increase.