each type of waste so as to help generators and ISW handling agents understand proper ISWM. This material can be used by public administrators as background information to supervise on-going ISWM as well. Improvement of the on-going manifest system in accordance with the recommendations given in the master plan will help waste generators be more aware of ISWM by providing accurate knowledge on ISW. Moreover, a series of testing procedure established in the master plan for selecting proper treatment and disposal options will be supported by the reference laboratory in the Environmental Center, which is planned to be established in the Province of Santiago.

Consequently, since the master plan gives enough instructions and supporting technical information necessary for its implementation as described above, it is technically feasible enough to realize the master plan in MR.

L.7.3 Environmental Evaluation of the Master Plan

Improvement and conservation of the environment is the principal objective of the master plan in this Study. Moreover, the master plan focused on the improvement of public administration for ISWM such as institutional, organizational, legal frameworks. Therefore, the approach of environmental evaluation should be different from that which is generally conducted for the master plan of facility development projects. Although environmental evaluation is in general conducted to examine negative impacts of implementing the master plan on the environment, in this case the main objective of environmental evaluation is to examine and verify positive impacts of the master plan on the environment. Accordingly, environmental evaluation here is made by identifying the environmental impact which might arise without the master plan in MR. In addition, for better understanding of the magnitude of environmental impacts, some pollution hazard cases in foreign countries are also introduced.

a. Environmental risks of improper flue gas and waste water treatment in factory

As found in the result of the factory survey in the Study, considerable amount of flue gas and waste water are directly emitted and discharged into atmosphere and watercourse in MR. Some of them may contain hazardous substances. It is also implied in the factory survey that such improper control of emission and effluent are mainly due to the lack of knowledge on ISW and its hazardousness. These improper emission and effluent treatment may cause air and water pollution which have serious impacts on human health.

To help understand the magnitude of impacts, the Study briefed two representative cases of pollution occurred in Japan.

aa. A Case in the City of Yokkaichi (SOx pollution)

aaa. Outline

In 1959, a big oil refinery plant started operation in the City of Yokkaichi. While additional two plants were developed up to 1972 and the total oil refining capacity reached 5050 thousand barrels, complaints about asthma from the people living in the neighborhood gradually increased. Air pollution monitoring and public health survey had been carried out since 1960. In 1962, hourly average SO_2 concentration reached 0.5ppm for 3% of the total monitoring hours and sometimes it exceeded 1ppm, which is 10 times of the current environmental standard of 0.01ppm. The Mie University Hospital started free medical examination for pollution related disease patients in August 1962 and Yokkaichi Municipal Government initiated a system to cover all medical expenses for the patients who was recognized as pollution affected patients in May 1965. Despite of these remedies, suicide of patients and deaths of younger people came one after another.

In September 1967, the residents living in Isozu district brought a case before court for claiming damage compensation against the 6 owner companies of the plants. In July 1972, the court judged the illegal act of the accused. The number of patients become around 1200 at its maximum in 1975.

aab. Comparison of damage cost and pollution abatement cost

The Study on Japanese Experience on Environmental Pollution, which was carried out by the Global Environment Economy Research Group, Environmental Agency of Japan (hereinafter mentioned as EAJ Study), estimated the damage and pollution abatement cost regarding the case in Yokkaichi. Table L.7.3a below indicates the result of estimation.

Table L.7.3a Estimated Damage Cost and Pollution Abatement Cost (The Case of Yokkaichi)

Damage cost(1) (million US$/year)	Pollution abatement cost(2) (million US$/year)	Damage cost if no remedial action is taken until the damage extended to the whole city of Yokkaichi(3) (million US$/year)
12.99	144.48	205.15

(1) Damage cost is estimated by the following formula:
(Average annual damage compensation amount) + (Average annual redemption amount of indemnity which was ordered by the court judgement in 1972)

(2) Pollution abatement cost is estimated by the following formula:
(Average annual pollution abatement equipment investment by private enterprises since 1971) + (Average annual cost of monitoring system development and environmental green area development which are covered by public sector)

(3) The anticipated damage cost is estimated based on the assumption that the patients of Yokkaichi Asthma had been broken out at a patient rate of 7.27%, at which rate number of patients was actually reported in Isozu District in 1975, in the whole Yokkaichi in 1975.

The damage cost of about 13 million US dollars would not have been born if necessary remedial actions had been taken earlier. In addition, if no remedial action is taken, the annual average damage cost will reach 205 million US dollars beyond the present average annual pollution abatement cost. This case study result indicates that pollution abatement investment should be carried out before the actual damage occurs so as to minimize the damage to human health as well as to reduce the damage cost.

ab. A Case in the City of Minamata (Inorganic Mercury Pollution)

aba. Outline

It was in 1908 that a nitrous fertilizer production factory was located in the City of Minamata. There are a number of fishermen living in Minamata, but it is a very small city with a population of only 12 thousand at that time. Right after the operation of the factory above, however, the City showed constant socio-economic growth with the expansion of nitrous fertilizer factory and the population reached about 50 thousand in 1956. On the other hand, problems regarding the compensation for fishing had already arisen in 1920. The cause of sea pollution was waste water from the above factory.

The Minamata Disease started from a report on the outbreak of a patient having a symptoms of brain damage in 1956 although the following survey confirmed that there had been some patients since 1953. Minamata disease is a neural disease caused by methyl mercury compounds that were generated from production process of acetaldehyde and discharged into sea. The condition was caused by ingestion of contaminated fishery products. Right after the outbreak of the first patient, Minamata Municipal Government organized the Remedy Committee for the Disease of Unknown Etiology to identify the nosogeny of the disease. However, although the government had stated in 1962 that the methyl-mercury compound is the nosogeny of the Minamata disease, mercury contained effluent was continuously discharged into the sea up until July 1966, when new production process was installed in the factory. The outbreak mechanism of Minamata disease was finally clarified in September 1968 right after the suspension of acetaldehyde production in May 1968. The annual amount of mercury effluent had reached about 11 tons at peak in 1959. Discharged mercury was gradually accumulated in fish and shell-fish. For example, the total mercury concentration in a short-necked clam had been about 80 ppm, although it decreased to 4 ppm in 1971. By the end of March 1991, the number of designated Minamata disease patients reached 2,248, of which 1,004 are dead.

abb. Comparison of damage cost and pollution abatement cost

According to the EAJ Study, there are three types of damages that can be financially estimated i.e., damages on human health, damages due to sediment pollution in the Bay of Minamata, and damages on fishery. Concerning the pollution abatement cost, pollution abatement equipment investment, operation cost, and loan interest payment is included in the estimation. The result of estimation is given in Table L.7.3b below.

Table L.7.3b Estimated Damage Cost and Pollution Abatement Cost (The Case of Minamata)

Damage cost (million US$/year)			Remedy cost (million US$/year)
Damage on human health[1]	Damage on sea bottom sediment[2]	Damage on fishery(3)	
74.91	41.70	6.73	1.20

(1) Damage cost includes average annual compensation amount to be paid by the factory in accordance with the compensation agreement which was concluded with the pollution victims group in 1973.

(2) Damage cost incudes the average annual cost of dredging the mercury contained sediments.

(3) Damage cost includes average annual cost of compensation for fishermen.

In this case, the amount of damage cost is far higher than remedy cost. This is a typical example that indicates the cost efficiency of taking proper remedial actions in the early stages of factory operation. If proper remedy had been taken before operation, the damage cost would not have arisen.

As given in detail above, Japanese experience in environmental pollution implies that pollution abatement remedies should be taken as soon as possible before the damages arise. In this regard, the master plan gave top priority to the proper control of flue gas and waste water in accordance with the formulated legal and regulatory frameworks. In addition, in-factory ISW emission control through manifest system will increase generators' attention to what they produce to the environment besides the products. A series of testing process recommended in the master plan will avoid the diffusion of hazardous substances. Thus, implementation of the master plan will minimize or even prevent the future possible environment pollution by flue gas and waste water if it is carried out on schedule.

b. Environmental risks of improper management of ISW

Presently in MR, there are some improper handling of ISW, such as the disposal of hazardous ISW to the municipal landfill, illegal dumping, unauthorized in-factory disposal of ISW, and so forth. If these improper ISWM is neglected as it is, serious groundwater pollution and soil pollution may break out by the leak of hazardous substances from the ISW disposed. Once groundwater and/or soil pollution occur in MR, the magnitude of damage is unpredictable because hazardous substance will spread extensively through the soil and watercourse. So far, there are very few studies discussing about groundwater and/or soil pollution caused by the leak of hazardous substances from the landfill. Instead, the Study here took one case of soil pollution in connection with a big mining industry in Japan so as to help understand the magnitude of soil pollution by the leak of hazardous substances.

ba. A Case in Kamioka Mine

baa. Outline

Kamioka Mine, which had produced gold since the year 720, became a large mining industry of lead and zinc since 1887. The lead and zinc production had increased year by year and became one of the most famous mines in the world. However, from the beginning of mining operation, considerable amount of heavy metals such as cadmium had been discharged into the upstream of Jinzu River through waste water. At the catchment area of Jinzu River, damages on agriculture had been found in addition to the outbreak of weird disease since Taisho era (1910-1925). The residents living in the catchment area claimed for damage compensation and installation of mineral pollution abatement equipment. Although a sedimentation pond was installed in 1932, the amount of slag and waste water increased successively with the growth of mining production. Due to the accumulation of heavy metals in soil, cadmium concentration in the soil reached 4.85 ppm at maximum and 1.12 ppm on average during 1971-1976 at the agricultural land located in the catchment area of Jinzu River. The concentration in unpolished rice reached 4.23 ppm at maximum and 0.99 ppm on average. The disease of unknown etiology broken out here was called Itai-itai disease and had a symptom of terebration for every part of the body and bones were easily fractured with a slight movement. After extensive research on the nosogeny of Itai-itai disease since 1950, responsibility of the mining factory was finally found in court. By the end of March 1991, 129 peoples were adjudged to be the victim patients (of which 116 are dead).

bab. Comparison of damage cost and pollution abatement cost

In the EAJ Study, damage cost estimation is made for three types of damages i.e., damages on human health and damages on agriculture. Meanwhile pollution abatement cost includes the cost of waste water and smoke treatment and other related remedies. Table L.7.3c indicates the result of estimation.

Table L.7.3c Estimated Damage Cost and Pollution Abatement Cost (The Case of Itai-itai Disease)

Damage cost (million US$/year)		Remedy cost (million US$/year)
Damage on human health(1)	Damage on agriculture(2)	
7.26	17.33	5.88

(1) Damage cost includes the annual average amount of damage compensation and redemption of indemnity.
(2) Damage cost includes the annual average amount of compensation for cancellation of cultivation and restoration of contaminated soil.

As found in other cases of pollution, remedy cost is lower than the damage cost to be born resulting from no remedial action against pollution. Although this example does not discuss disposal site of ISW, similar leak of hazardous materials may occur at present landfill in MR if no measures are taken to improve present improper disposal practices.

However, in order to improve the present ISWM, the master plan formulated overall ISWM supervising system in accordance with the conceptual waste flow of treatment and disposal for each type of waste. Following this ISWM supervising system, improper handling of ISW will be improved and illegal handling practice will be reduced. Consequently, future possible environmental hazard will be minimized and even evaded.

ANNEX M

EXAMINATION OF AN OPTIMUM SYSTEM FOR MEDICAL SWM MASTER PLAN

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ANNEX M EXAMINATION OF AN OPTIMUM SYSTEM FOR MEDICAL SWM MASTER PLAN

This annex provides the background for and the formulation of the Master Plan for medical SW in the Metropolitan Region of Santiago for the period 1996-2010.

The background includes establishment of the planning framework (section M.1), examination of an optimum technical system (M.2) and examination of applicable technical standards (M.3).

The annex hereafter provides rough estimates of the costs and discuss the appropriate financial responsible bodies (M.4). For the implementation of the Master Plan, it is deemed important to prepare a Code of Practice with instructions and guidelines for the handling of medical SW at the medical institutions and at the treatment facilities. A proposal for the contents of the Code is included in section M.5.

The institutional system is examined based on a presentation of the present situation (M.6) and, finally, the Master Plan is evaluated with respect to the protection of the environment, the technical viability and the financial feasibility (M.7).

A plan for implementation of the Master Plan concludes the presentation (M.8).

M.1 Establishment of Planning Framework

The present medical SW management is based on solutions decided upon and implemented by each medical institution with the public authorities involved in control and enforcement only. Although the health sector is partly public, it seems to be the intention to maintain medical SW management as the responsibility of the single medical institution. This policy is adopted by the Master Plan Study as a prerequisite and it's implications are briefly discussed in chapter M.4.2.

M.1.1 Goals

The proposed goals of the Master Plan 1996-2010 are:

- *Improvement of medical SW management facilities and practices at* *hospitals and clinics to observe basic hygienic conditions.*

- *Development of a standardized labeling and packaging system for medical SW of infectious nature.*
- *Development of a low-cost final disposal option based on safe disposal of medical SW of infectious nature at a sanitary landfill for municipal waste (goal for immediate implementation).*
- *Development of co-treatment of medical SW of infectious nature at a thermal treatment facility for hazardous SW (goal for later implementation).*

M.1.2 Targets

The targets of the Master Plan is developed for three periods:

- Short-term targets, 1996-2000,
- Medium-term targets, 2001-2005, and
- Long-term targets for 2006-2010.

The targets are presented in Table M.1.2a.

M.1.3 Strategy

The emphasis on the medical institutions' own responsibility of medical SW management makes supervision and enforcement by the authorities the most important mean to accomplish the goals and targets. Enforcement of proper waste management practices (including a necessary segregation from the municipal SW system) is likely to create a need of privately operated waste management services (collection and treatment), however, this cannot be satisfied by the private sector today.

Although the present waste management costs are insignificant for most of the medical institutions, any increase in costs is likely to meet opposition. As no public financial involvement is envisaged for the future medical SW management, the increased costs must be born by the medical institutions directly. Thus, it will be necessary, parallel to the enforcement of improved standard, to build up environmental awareness and commitment at the medical institutions in order to ensure allocation of sufficient funding.

Thus, the Master Plan strategy shall be based on a combination of enforcement and cooperation with the medical institutions on, firstly, development of a general Code of Practice and, secondly, on the implementation through a combination of guidance and enforcement. The cooperation on preparation of a Code of Practice will be an important tool to create awareness and commitment. Finally, the Code of Practice will be useful for supervision and enforcement by the authorities.

Table M.1.2a Targets of the Master Plan 1996-2010

Short-term targets (year 1996-2000)	
–	Preparation of a Code of Practice as guideline for the medical institutions and as a basis for authorities' enforcement.
–	Preparation of a simple labeling system for immediate implementation.
–	Packing of sharps and pointed objects in unbreakable – not reusable packages at the source of production (also in cases where the waste is subsequently treated internally by incineration or autoclave).
–	Improvement of internal collection points with respect to: . Cleanliness, . Separate storage of waste categories, . Prevention of public access, . Elimination of manual loading procedures for medical SW.
–	Development of safe disposal of medical SW at a controlled landfill for municipal SW (for immediate implementation).
–	Separate collection of medical SW for landfilling.
–	Preparation of project for thermal treatment of medical SW, possibly at a new facility for ISW treatment (co-treatment).
–	Implementation and enforcement of new environmental standard for new waste incinerators at hospitals.
Medium-term targets (year 2001-2005)	
–	Implementation and enforcement of new environmental standard for existing waste incinerators at hospitals.
–	Development of thermal treatment of medical SW, possibly at a new facility for ISW treatment (co-treatment).
–	Continued improvements of standardized collection system, including improvements of collection points.
–	Enforcement.
Long-term targets (year 2006-2010)	
–	Phasing out of landfilling for replacement by centralized thermal treatment (possibly as co-treatment with ISW).
–	Enforcement.

The strategy for treatment and disposal of medical SW should follow the development of three phases:

Short-term (1996-2000): Control of the risks caused by the existing management of medical SW.

- Introduce Code of Practice for medical SW management.
- Introduce classification and packaging of the waste at the source of generation.
- Implement safe landfilling as the main disposal method.

Medium-term (2001-2005): Enforcement of 'up-to-date' standards at existing treatment/disposal facilities for medical SW, including at hospital incinerators.

- Enforce of up-to-date standards.
- Consolidate sanitary landfilling as a main disposal option.
- Develop a thermal treatment alternative, possibly as co-treatment with hazardous ISW.

Long-term (2006-2010): Phasing out of landfilling of medical SW in favor of thermal treatment.

Table M.1.3a outlines the proposed strategy in headlines.

Table M.1.3a The Proposed Strategy in Headlines

Short-term (year 1996-2000)	Medium-term (year 2001-2005)	Long-term (year 2006-2010)
Control the risks caused by the present medical SW management.	Fortify the environmental standards to be applied.	Consolidate the medical SW management
Introduce standardized classification and packaging of the waste at the source of production. Introduce Code of Practice for medical SW management to guide medical institutions and authorities. Implement safe landfilling of infectious waste types. Implement separate collection and transport of infectious waste types. Implement up-to-date standards at new hospital incinerators.	Implement up-to-date standards at existing hospital incinerators. Develop a thermal treatment option for medical SW (co-treatment with ISW).	Phase out the use of landfilling for medical SW. Consolidate use of thermal treatment for medical SW.

M.2 Examination of an Optimum Technical System

This section outlines guidelines for the optimum technical system for medical SW management.

M.2.1 Collection System at Sources of Production

In most cases, the building lay-out of medical institutions hampers an optimum internal handling of SW and in many cases is it impossible to adopt a basic hygienic principle of division of corridors and hallways into clean and "dirty" areas.

At the same time, overcrowding of medical institutions leads to inappropriate storage facilities for the waste.

Any medical SWM system should be based on immediate classification and packaging of the waste at the source of generation.

The choice of receptacles must respect the individual needs of the various wards, hereunder the needs of "*hands off*" receptacles to respect sterilized work routines.

Along with the immediate classification and packaging, provision of unbreakable containers for sharps is indispensable. Today, hard receptacles are widely applied, but often these are without lids and, thus, unsuitable for the purpose. There are relatively cheap containers dedicated for sharps, which would improve the management of sharps and reduce the risks considerably.

The recommendations can be summarized as follows:

- Apply suitable receptacles, bags etc. chosen in cooperation with the staff at the wards in order to accommodate to the specific routines required for sterilization etc.,
- Implement a procedure of immediate classification, packaging and labeling of the waste before it leaves the wards,
- Apply dedicated containers for sharps,
- Empty receptacles daily. Dispose of needle containers when filled (container as well as the contents) without reloading.

M.2.2 Treatment System at Sources of Generation

Except for highly infectious micro-organisms that require sterilization (autoclave) at the source of generation there may not be a demand for internal treatment at the medical institutions. Employment of safe external treatment/disposal methods combined with an appropriate packaging and transport system is satisfactory and in most instances also the most cost-effective.

Sterilization using an Autoclave

Waste containing highly infectious and communicable micro-organisms require immediate sterilization. However, the present reuse of laboratory glassware makes it appropriate to consider sterilization of all biological agents before discharge of the contents and cleaning of the glass. Such procedure could reduce the risk of accidents with splashes and broken glass during cleaning.

Correct sterilization by use of autoclave requires the waste to be accessible for the steam, i.e. it requires that waste is not sealed or in another way packed in steam-tight packages. Thus, autoclave is applied best at the source of production to avoid unpacking of waste or internal transport of inappropriately packed waste.

Autoclave units are operated at temperatures in the range of 121-132 °C. Under ideal conditions, sterilization takes only 2 minutes at 132 °C, but in most cases it is necessary to extent the treatment periods to sterilize solid waste. Exposure periods of 30, 60 and even 90 minutes are not uncommon, but it is advisable at each medical institution to check the actual autoclave equipment in order to determine the correct operation.

Incineration

Local incinerators at medical institutions constitute a problem in terms of observance of a proper environmental standard. Furthermore, the incinerators are often inadequately placed in narrow basements without facilities for automatic feeding of the waste and automatic discharge of the ashes as well as control of combustion temperatures in best cases is simple and inadequate and in worst cases not existing. Thus, in many cases the incinerators are being an occupational hazard for the employees during manual loading procedures and a source of pollution of the environment.

The retention time of flue gasses at high temperatures is crucial for burning out of particles, etc. and thereby for minimization of emissions. The normal requirement for retention time is 2 seconds at a minimum of 850 °C (minimum 6% oxygen) and such demand is difficult to obtain in small incinerators without a designed after-burning chamber.

It could be stated that the contribution to the general pollution from inadequate incineration of medical SW at hospitals is insignificant in the global view and, thus, should not be subject to enforcement of rigorous pollution standards as long as the incinerators are operated without creating nuisances to neighbors. Such a view could be defended for a transition period during which existing incinerators are modernized/replaced to apply modern standards for emissions and operation.

The recommendations can be summarized as follows:

- Sterilization of biological agents is recommended to reduce the risk of accidents during reuse of laboratory glassware.
- Existing incinerators at medical institutions should be monitored in order to identify the magnitude of the pollution problem and to determine a suitable transition period for modernization/replacement of the incinerators. Such transition period should be 5 years (minimum) to allow time for

planning of the actions.

M.2.3 External Transportation

The present widely use of the municipal waste collection service for sharps and infectious waste is of concern as the waste will be exposed during compaction in the collection vehicles and during the unloading/compaction procedures currently used at the landfills. Thus, it cannot be ensured that such waste will not be exposed and impose a risk to landfill staff, staff involved in vehicle maintenance etc.

The recommendations can be summarized as follows:

- Sharps and medical SW of infectious nature should not be mixed with general waste similar to municipal SW. Separate collection and transportation without compaction and/or transfer procedures is required.
- Sterilized sharps should be kept separate also in order to avoid any accidents (sharps mixed with any kind of waste are no longer sterile).

M.2.4 Intermediate Treatment

Landfilling of medical SW is the most feasible disposal method, however, a long transportation distance to the municipal SW landfill will add transportation costs.

Implementation of thermal treatment for hazardous ISW will introduce an efficient alternative to landfilling and in most cases modern thermal treatment would be the preferred option to reach a complete destruction of the waste.

The recommendations can be summarized as follows:

Co-treatment (thermal treatment) of medical SW and hazardous ISW at a modern installation should be encouraged in the ISW planning in order to create an alternative to landfilling and in order to phase out landfilling in the long-term perspective.

M.2.5 Final Disposal

Controlled landfill disposal of medical SW is an appropriate alternative to the present waste management system as it will bring the situation under control for the least costs. However, in the long-term perspective a complete destruction by thermal treatment is preferable and should be aimed at.

Landfilling of medical SW requires construction of a separate section of the sanitary landfill prepared for medical SW only. Landfilling of medical SW requires direct unloading into a waste pit, immediate covering with quick lime and soil and careful compaction with heavy-duty equipment.

Leachate from the landfill section for medical SW should be kept separate and monitored prior to co-treatment with leachate from other cells to determine, if special treatment unexpectedly should be required.

The recommendations can be summarized as follows:

- Introduction of safe landfilling of medical SW at a dedicated cell at a sanitary landfill for a transitory period of up to 5-7 years until thermal treatment is available.

M.2.6 Chemical Waste (Hazardous Waste)

The present lack of handling systems for chemicals (hazardous ISW) affects the management of chemicals at the medical institutions. Thus, discharge to the sewer is common, but nevertheless unacceptable.

Proper management of chemicals should be part of the Code of Practice to be developed, however, the optimum management system requires that treatment and disposal facilities for ISW are available as quantities generated in medical institutions are too small for feasible independent management.

M.2.7 Radioactive Waste

Radioactive sources applied at medical institutions and laboratories are in most instances sources with low radioactivity used for examination of human beings and animals and clinical trials in laboratories. At most medical institutions and laboratories, the doses of radioactive materials are so low that the risk is small compared to the risk connected to the handling of chemicals.

Like for medical SW of infectious nature, radioactive waste should be classified immediately after the production by the same personal who made the medical treatment or laboratory analysis.

The typical disposal of solid radioactive waste includes one of the following options:

- Disposal as general waste as the waste is inactive (typically with a radiation below 0.1 MBq/kg (one Bq (becquerel) = one decay per second; MBq = one million decays per second).
- Disposal by incineration. There will be limits for the total radioactivity in each sack (typical maximums are 5-500 MBq depending on the type of nuclide and its dangerousness for human beings (the lowest maximum for the most dangerous type)) and a demand for a maximum dose rate of 5 μSv/h measured on the surface of the packaging (Sv = sievert). Finally, there will be requirements to the transport of the waste, labeling etc.
- Solid radioactive waste that cannot fulfill the above-mentioned requirements immediately or after decay, must be disposed of by special treatment, normally supervised by the national nuclear administration.

Inactive liquid radioactive waste may be disposed of via the sewer. Liquids with a total radioactivity below 5-500 MBq (depending on the type of nuclide) may be diluted and disposed of via the sewer as long as the diluted concentration is below 0.1 MBq/liter. Dilution must take place before the discharge, but not by pouring water in the drain after discharge of the radioactive waste. Liquids not fulfilling the above-mentioned requirements must be subject to special treatment as stated for solid waste.

Information collected at the medical institutions in the Metropolitan Region of Santiago indicates that active radioactive waste is stored until it can be classified as inactive and disposed of together with general waste. In principle, such procedure is acceptable as long as sufficient and applicable storage capacity is available and as long as the safety procedures for the storage and the shipment are satisfactory. However, the JICA Study Team has no confirmation of control of dose rate or total radioactivity being carried out on radioactive waste being disposed of as general waste after inactivation.

M.3 Examination of Technical Standards for the Technical System

Table M.3a (divided on two pages) summarizes the proposed technical system for the waste categories. Based on the table, the appropriate and applicable technical standards are discussed in the following.

M.3.1 Storage

The emphasis on packaging of medical SW requires a change of the existing working routines. At present, use of dedicated packages is rare, but it is a key-recommendation that the medical institutions should purchase dedicated packages for the different waste categories in order to apply a minimum degree of standardization and a minimum quality with respect to strength of the materials, tightness etc.

It could be relevant to define maximum capacities for the different packaging materials and make reference to relevant international or national standards. In Europe, packages applicable for medical SW are approved according to demands defined by the European convention for transport of dangerous goods by roads (ADR).

Table M.3a Summary of Technical System

Waste category	Packaging	Internal treatment	Collection point	External treatment
Pathological waste	Strong plastic bags, plastic buckets, or coated cardboard boxes. Pointed items such as a bone pieces should be packed in unbreakable packaging. Bags, buckets etc. should be sealable.	Incineration in hearth type incinerator to ensure complete destruction and combustion.	Separate storage, if necessary refrigerated (depends on the storage time).	Burial at cemetery or controlled landfilling (short-term). Incineration in hearth type incinerator (long-term).
Human blood and blood products	Sealable plastic buckets, bottles or blood bags.	Infected blood and blood products should be sterilized (autoclave). Small quantities of non-infectious blood can be discharged to the sewer. Large quantities should be landfilled or incinerated.	Separate storage for infectious wastes, if necessary refrigerated (depends on the storage time).	Controlled landfilling or incineration.
Cultures and stocks	Same as human blood and blood products. However, highly infectious microbiological agents must be sterilized immediately at the source of generation.			
Sharps	Unbreakable and sealable containers.	Incineration is applicable depending on the ash discharge system and the disposal method (to avoid lacerations). Infected sharps may be sterilized by autoclave, but it should not change the subsequent safe handling of sharps to avoid prick accidents.	Separate storage for infectious wastes.	Controlled landfilling or incineration.
Infectious waste	Sealable strong plastic bags, plastic buckets, or coated cardboard boxes.	Incineration is applicable.	Separate storage for infectious wastes.	Controlled landfilling or incineration.

The table continues at next page.

Table M.3a Summary of Technical System (Continued)

Waste category	Packaging	Internal treatment	Collection point	External treatment
Animal waste	Sealable strong plastic bags, plastic buckets, or coated cardboard boxes.	Incineration is applicable.	Separate storage for infectious wastes.	Controlled landfilling or incineration. Note, destruction is required for highly communicable animal diseases according to veterinary regulations.
Chemical waste	Sealable strong plastic bags, plastic buckets or bottles etc. depending on the physical and chemical properties. Original packaging also applicable.	No internal treatment.	Separate storage for chemicals (well ventilated storage).	Treatment and disposal facilities for (general) hazardous waste.
Radioactive waste	Sealable strong plastic bags, plastic buckets or bottles etc.	Dilution or separate storage until acceptable radiation is reached. Radioactive liquids may be discharged to the sewer after dilution.	Separate storage. Control of radiation during storage and before shipment to collection point.	Controlled landfilling or incineration.
General (non-hazardous) waste	Plastic bags, containers etc.	Incineration is applicable, but in most cases not cost effective.	Separate storage in containers.	Controlled landfilling (or municipal SW incineration)

M.3.2 Collection and Transportation

The purpose of the careful packaging of the waste is to avoid spillage during collection, storage and collection, to prevent unhygienic conditions and to eliminate the potential occupational hazards created by a.o. sharps.

It is a basic recommendation that the central collection points should be improved and equipped with containers, so the waste from the wards is placed in dedicated containers immediately upon arrival to the collection point. The number of containers will depend on the subsequent treatment, but typically the following container types should be available at the collection point:

- Closed drums (or similar) for pathological waste,
- Closed container for human blood and blood products, cultures and stocks, sharps, infectious waste, animal waste and inactivated radioactive waste (type of container will depend on the generated amount),
- Storage drums for chemicals depending on the available treatment facilities,
- Skip-hoist (or similar) container for general non-hazardous waste.

When centralized thermal treatment is introduced, the closed skip-hoist container should be replaced by a system of smaller containers or a system based on packaging in cardboard boxes in order to be able to feed the incinerator directly without loading to a storage pit.

M.3.3 Intermediate Treatment

It is recommended to upgrade internal incineration to an anti-pollution standard comparable to internationally recognized standards for large-scale incinerators for MUNICIPAL SW and ISW. The main emphasis should be put on:

- Continuous operation periods to avoid low temperatures during start and closing-down,
- High operating temperatures,
- Auxiliary burners,
- *Retention time of flue* gasses,
- The total dust emission, and
- The emissions of heavy metals.

Standards for large incinerators include typical emission standards for NO_x and HCl too, but application of rigorous demands for these emissions will in most cases involve excessive costs out of proportion for incinerators at hospitals.

Dioxin and furanes are a major concern too, but yet applicable emission standards are to be recognized internationally.

Another major concern of incineration is the ash quality and possible unburned residues from incomplete incineration and grate sifting, e.g. for incineration of pathological waste, the risk of unburned residues should be eliminated by use of dedicated incinerators like hearth type or rotary kiln type incinerators.

It could be appropriate to implement a high standard for incinerators in steps, so existing incinerators are allowed a transition period before the high standard must be applied, while new incinerators must apply the high standard from the start.

M.3.4 Final Disposal

The concerns related to landfilling of medical SW are connected to littering and scavenging. Once properly buried in the sanitary landfill, medical SW is not supposed to generate leachate of particular hazardousness (or infectiousness) or necessitate other special precautions during operation. Thus, a standard designed sanitary landfill with leachate collection and control system is sufficient for disposal of infectious medical SW.

For operational reasons, disposal of medical SW in a separate cell is advantageous as covering must take place immediately and as mechanical compaction etc. must be made more careful than for ordinary MUNICIPAL SW.

M.4 Estimation of Costs and Examination of Financial Responsible Bodies

M.4.1 Cost Estimation

It is not possible to outline a full budget of the proposed technical system as the final solution concerning the equipment for collection at the wards and the treatment method will be taken by the individual medical institution and therefore depend on the local opinion concerning e.g. use of own incinerator. Thus, this section includes rough cost estimates for the proposed treatment and disposal options only.

For most medical institutions the proposed technical system will require allocation of additional funding for operation of the waste management system. However, a portion of these extra costs is required under all circumstances to introduce acceptable sanitary conditions and, thus, should be characterized as a necessary relief of former negligence. Such costs are connected to the sorting of the waste (classification), implementation of standardized packaging system (purchase of appropriate packages) and upgrading of collection points.

The real difference will be for treatment and disposal, where enforcement of modern standards for hospital incinerators will imply investments in new incinerators or upgrading of existing incinerators and an increase in operating costs. The proposed introduction of disposal of medical SW at a sanitary landfill is the most cost effective solution compared to incineration at the hospitals, however, incineration may be preferred anyway by some hospitals - mainly the institutions with larger quantities.

As a rough guideline the following estimates for the options may be used:

- Sanitary landfilling; twice the average costs of normal waste disposal due to lesser degree of compaction and more demands to the operation, i.e. approximately 3 times US$ 6 per tonne = approximately **US$ 18 per tonne.**

- A modern hospital incinerator with dust filter, automatic feeding of the waste and automatic ash discharge requires an investment of approx. US$ 1.0 million, exclusive of civil works, for a capacity of 300 kg/hour. The annual operating costs will be approx. 5% of the investment or US$ 50,000. The annual capital costs will be approximately 10% of the investment or US$ 100,000. The cost per tonne of waste will depend on the operating time of the incinerator, which at the present incinerators is rather short. Modern incinerators for municipal SW or ISW have a guaranteed performance of operation of up to 8,000 hours per year and such high performance requires sufficient waste supplies. A hospital incinerator will not reach the same number of operating hours, but it is crucial, economically to utilize the incinerator as much as possible. Provided the incinerator is used for 3,000 hours per year (corresponding to 900 tons per year), the average cost will be approximately **US$ 55 per tonne** without capital costs and more than **US$ 151 per tonne**, if capital costs are included.

In case of centralized incineration (possibly as co-treatment), the treatment cost is assumed as estimated for ISW.

For a complete comparison of options, the costs of collection/transportation and packaging must be included. The estimates for collection and transportation of medical SW are based on the costs of municipal SW.

The collection cost for municipal SW at present (with landfills near Santiago) is US$ 15-25 per tonne. The extra transportation cost for municipal SW to the new landfill in Montenegro is assumed to be US$ 6 per tonne based on transfer. For medical SW, which has a lower density and which cannot be subject to transfer operations, the following costs are assumed:

- US$ 40 per tonne for collection and transport inside Santiago (in case of central incineration).

- US$ 6 per tonne for extra transportation to new landfill in Montenegro.

The costs of packaging will depend on the use of internal or external treatment. Although internal transportation requires careful packaging also, there may be some less strict requirements for the material compared to external transportation:

- In both cases, plastic bags of a good quality, buckets, bottles etc. should be employed. Costs of US$ 40 per tonne of waste is assumed.

- For internal transport, containers or simple cardboard boxes may be employed. Costs of US$ 40 per tonne of waste is assumed.

- For external transport, coated cardboard boxes or similar should be employed. Costs of US$ 100 per tonne of waste is assumed.

M.4.2 Financial Responsible Bodies

Medical SW management is assumed to be the responsibility of the medical institutions themselves. Public authorities are supposed to exercise control and enforce a proper standard.

Ministry of Health (MS) has a dual role for public medical institutions as the ministry provides the general budget and enforces standards of hygiene as well. However, it is not the impression that MS links the roles, e.g. by using financial sanctions to enforce hygiene improvements.

The function as budget provider, places the MS in a central position to motivate improvements in the public health sector. It would be beneficial if the MS takes a leading role in improvement of the medical SW management standard through preparation of the Code of Practice followed by negotiation of budget allocation for medical SW management. Thereby, the technical standards will be linked to the financial resources (and vice versa). However, it is strongly recommended to elaborate the Code of Practice in cooperation with representatives for the medical institutions to reach a consensus between the administrators (budget providers and planners) and the daily users.

It is the impression that private medical institutions have better financial possibilities for improvements, but the present waste management may not improve due to a general negligence of waste management. The enforcement of standards is the only possibility to improve the situation and here the recommended Code of Practice will be an important reference point.

M.4.3 Cost Recovery Methods

Cost recovery - or more relevant for medical institutions *cost allocation*, requires motivation and commitment at the management of the medical institutions. As stated earlier, the commitment to ensure even in-expensive improvements seems low today and it is probably the main obstacle for introduction of improvements.

A boosting of the commitment requires supportive actions from MS to ensure allocation of the necessary budgets, eventually , for the public medical institutions, through an increase of the general budgets dedicated to waste management.

M.5 Code of Practice

The proposed Code of Practice is deemed the key tool to obtain an applicable modern standard for medical SW management as well as to obtain consensus and ease the implementation through the process of preparation of the Code where representatives of involved parties should participate.

This section outlines the relevant participants in the preparation of the Code of Practice and, furthermore, forward a proposal for the list of contents.

M.5.1 Participants

The Ministry of Health (MS) is the obvious responsible body for preparation of the Code of Practice. Furthermore, participants should be selected among - but not limited to, the following relevant institutions and specialists:

- Sanitary inspection (e.g. SESMA)
- Occupational health inspection (Ministry of Labor)
- Air pollution inspection (e.g. PROCEFF)
- Environmental authorities (CONAMA)
- Health authorities (e.g. 'Instituto de Salud Pública de Chile')
- Epidemiologist
- Representative of doctors
- Representative of nurses
- Representative from a public hospital
- Representative from a private hospital or clinic
- Representative from a microbiological laboratory
- Waste collection company
- Waste treatment company.

M.5.2 Proposed List of Contents

The following list of contents indicates the proposed contents of the Code of Practice:

1: Introduction

- 1.1 Introduction
- 1.2 Scope of Code
- 1.3 Target group (primary health sector - secondary health sector)
- 1.4 User guide to the Code of Practice

2: Legal background

- 2.1 Legal reference for the Code of Practice

2.2 Other relevant legislation to be observed

3: Medical waste

3.1 Potential sources of generation
3.2 Risks
3.3 Waste classification
3.4 Definition of waste types, including infectious waste types
3.5 Waste generation key-data

4: Planning of handling systems for medical waste

4.1 Regulations
4.2 Internal waste handling manuals for hospitals
4.3 Possibilities for waste minimization and recycling
4.4 Education

5: Source segregation, packaging, internal collection and storage

5.1 Pathological waste
5.2 Sharps
5.3 Other infectious waste types (excluding of animal waste)
5.4 Animal waste
5.5 Chemical waste
5.6 Radioactive waste
5.7 General non-hazardous waste
5.8 Internal collection point

6: External collection and transport

6.1 Pathological waste
6.2 Sharps
6.3 Other infectious waste types (exclusive of animal waste)
6.4 Animal waste
6.5 Chemical waste
6.6 Radioactive waste
6.7 General non-hazardous waste

7: Treatment and final disposal

7.1 Sanitary landfilling (standard)

7.2 Incineration (standard)
7.3 Other treatment options
7.4 Pathological waste
7.5 Sharps
7.6 Other infectious waste types (excluding of animal waste)
7.7 Animal waste
7.8 Chemical waste
7.9 Radioactive waste
7.10 General non-hazardous waste

8: Checklists

8.1 Checklist for general medical waste management system
8.2 Checklist for waste management system at the individual medical institution
8.3 Checklist for supervising authorities.

M.6 Examination of an Optimum Institutional System

M.6.1 Current Situation

Conflicts of ministerial competencies are not evident because all regulations concerning waste produced from medical and paramedical activities are under the Ministry of Health. Within this Ministry, there is duplicity at the level of "recommendations" for the MR between the Health Services (Servicios de Salud) and SESMA - Environmental Health Service.

Supreme Decree no. 161 of 06.08.1982 approves the "Regulation concerning Hospitals and Private Clinics", whose art. 25 - letter d determines that "the establishment must allow the storage of wastes until their adequate disposal."

The Health Services of the Ministry of Health, through the Offices of Medical and Paramedical Professions, establish rules for hospitals, clinics, pharmacies, clinical laboratories, etc., be they public or private. Among these rules, regulations for the management of waste could be included.

The National Commission of Intra-Hospital Infections (CNIIH) located in the Epidemics Department of the Ministry of Health, coordinates the Committees of Intra-

Hospital Infections (CIIH) located in the Medical Board (Dirección Médica) of each hospital. These committees supervise the management of waste, considering that it *constitutes a means of spreading infection.*

Internally, in each hospital, a General Service carries out the cleaning services (usually subordinated to the Chief of the Physical Plant, authority of an Administrative Office (Dirección Administrativa)), while the internal Health Service in charge of occupational health often helps in this task too.

The Chilean Commission of Nuclear Energy (COENNU) has the exclusive responsibility of directing and managing radioactive materials, including wastes.

The Municipality, in charge of external waste collection and disposal services, regulates the said services by means of Municipal Ordinances.

SESMA/PROCEFF regulate and control the emissions of boilers and incinerators.

SESMA's Basic Sanitation Program supervises the management of domestic and hospital waste. At a higher level, SESMA's Technical Department issued, in 1990, the document of Basic Sanitation in Health-care Establishments, which "presents a description of basic sanitation characteristics that Health-care establishments should have"..., in relation to potable water, waste water and management of solid waste, among others.

As a general procedure, hospitals manage their solid wastes in accordance with their resources and administrative directives, considering the precepts of occupational health and, mainly, of the CIIH. This results in procedures very similar to those recommended by SESMA's Technical Department, but adapted to local situations.

Paramedic services (pharmacies, laboratories, etc.) manage wastes according to their own criteria, in general the same that apply to domestic waste.

M.6.2 *Recommended System*

Even though the environmental effects of solid waste produced from medical and paramedical activities are controversial, their close link with hospital infections is indisputable. An adequate internal management prevents direct effects and the propagation of infecting agents inside and outside the hospital. This is why it deserves *priority attention.*

Medical and paramedical establishments, like all waste generators, are responsible for the waste they generate, their social effects and costs.

The current institutional organization is coherent regarding such considerations, except for the following revisions that are here recommended:

a. **Legal Support:** the Sanitary Code is sufficient.

b. **Regulation:** a Ministry of Health act is necessary to establish directives in accordance with the technical system outlined in the previous sections, enforcing the following subjects:

i. Internal Management of the Wastes -

- Segregation in classes defined as proposed in section 5;
- Packaging in suitable package (bag, receptacle, ...) and labeling at the sources;
- Sterilization of highly infective and communicable biologic agents, as near as possible to the source;
- Storage (waiting for collection) in suitable room.

ii. Collection and Disposal -

- External transportation, treatment and final disposal should obey requirements for hygiene, operator's safety and minimum environmental impact.

iii. The Health Services will establish the technical instructions for the adequate execution of this Regulation in their respective regions. They will also enforce its fulfillment and apply sanctions provided for in the Law.

iv. SESMA will establish the adequate technical instructions for the execution of this Regulation in the MR, control its fulfillment and apply sanctions provided for in the Law, in all the MR.

v. The technical instructions referred in items iii. and iv. should comprise the internal management of the generating establishment, and also external transportation, thermal processing, and the disposal of waste in sanitary landfills and cemeteries.

vi. - Through its Department of Environmental Programs the Ministry of Health will coordinate the preparation and dictate a Code of Practice, which will consolidate the requirements to manage M.S.W. in Chile.

c. Competent Authorities and Institutional System

The organization chart that follows (Figure 6.1a) depicts the existing links and the proposed changes.

The aim is not to alter medical institutional structure, but to strengthen the authority and competency of the establishment's executive entity, which will be under diverse supervision, at the same time that it will be controlling external services to third parties. The Master Plan proposes a reduction in the sources of "orientations" -- which will be reduced to a regulatory one, as Resolution of the Ministry of Health, and to those specific for radioactive and chemical waste, and emissions. A Code of Practices will consolidate legal and technical norms at an operational level understanding. The medical structure should "advise", when solicited, the executive entity, particularly with regard to intra-hospital infection and occupational health aspects.

This system is applicable to hospitals, medical and dental clinics, first-aid posts, clinical laboratories, pharmacies that manipulate drugs -- that is, all medical and paramedical service establishments.

The general regulation, at ministerial level, should be elaborated by the Department of Environmental Programs and approved by Supreme Decree. It will be complemented, without delay, with technical instructions of the regional authority (SESMA), which consider local realities. Furthermore, the Code of Practice will better supply the needs of the MSWM. To be acceptable and representative, the preparation of this Code will involve several entities, as proposed in M5.1, coordinated by the Department of Environmental Programs of the Ministry of Health. In the structure of the Ministry of Health, the Subsecretariat of Health is the authority over the Health Services, which in turn all have a Medical Subdirectorate with a Department of Environmental Programs -- and this will be the supervisory entity in the area of action of each Service. In the MR, meanwhile, the Health Services are many, and environmental issues are concentrated in SESMA which will assume the functions of technical instructor and supervisor of waste management.

In conclusion, the main points are summarized below:

- The Medical Institution in the MR manages the MW (through the General Services Department) according to the regulations dictated by the Ministry of Health and oriented by SESMA's technical instructions and the Code of Practice;
- General Services should be internally advised by the Committee of IHI, which is functionally vinculated to the National Committee (CNIIH);
- The Municipality manages or controls the external services of collections/disposal contracted by the Medical Institution;
- SESMA and CCHEN enforce, monitor and assist on environmental aspects;
- Health Services enforces and controls medical and professional activities of the Medical Institution.

Additional resources will not be required, except those necessary for the monitoring action of the SESMA Basic Sanitation Program to become more effective. The PROGRESI - Industrial Waste Management Program, has its proposal for creation elsewhere in this Master Plan.

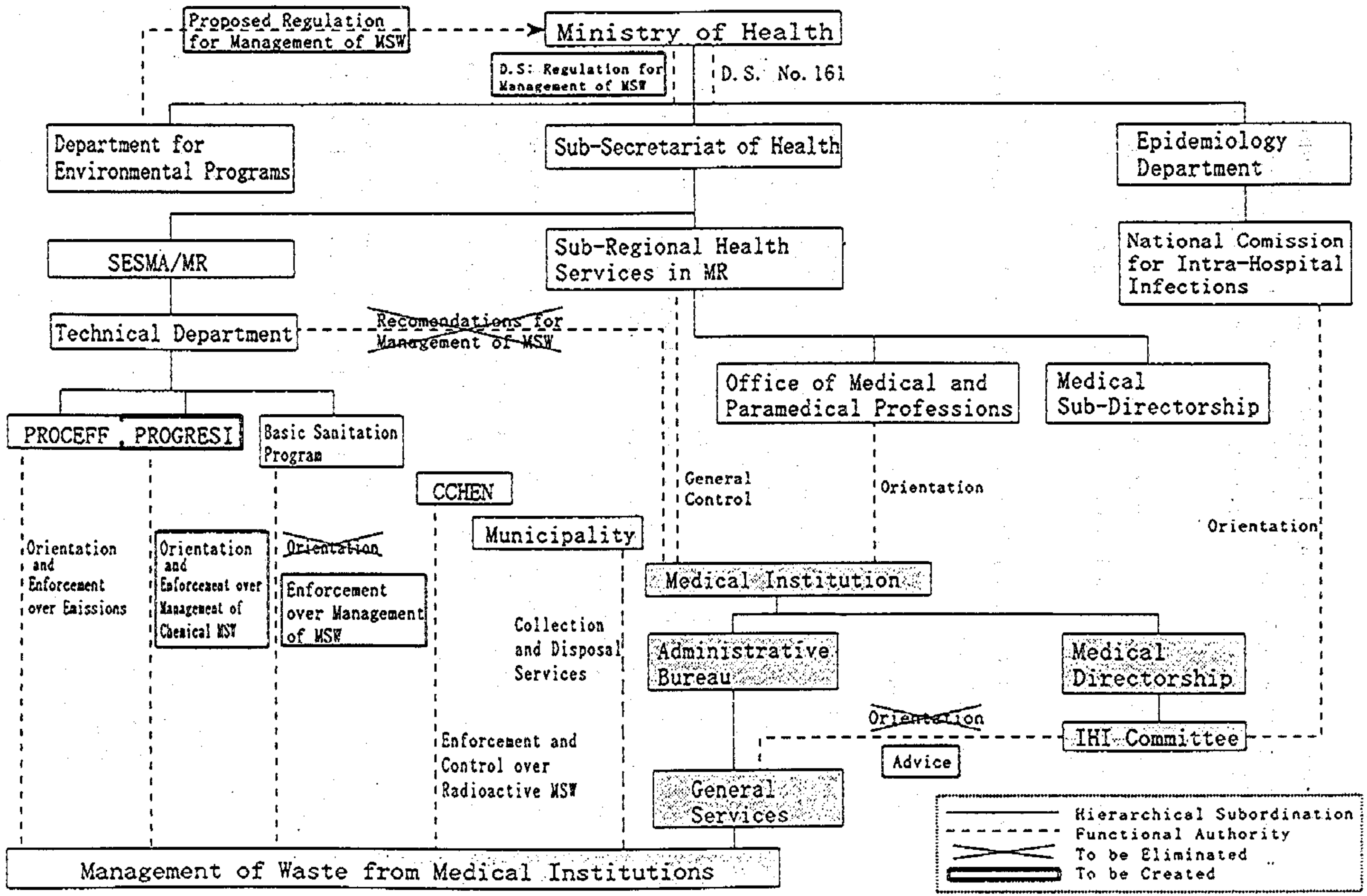

Figure M.6a Proposed Organizational Development Related to Medical SWM

d. Training Personnel for Medical Waste Management Internal Services

SESMA should coordinate, through the Basic Sanitation Program and PROCEFF, a training group aiming to make understandable the legal and technical norms on medical SWM, emphasizing the internal procedures in hospitals, medical and odontologic clinics, laboratories, etc.

Regarding the training program, the Group should develop technical-administrative information to motivate and educate directors, administrative and medical staff on medical SWM.

e. Profile of the Personnel to be Used in the Waste Management in Medical Establishments

ea. Cleansing Service Head

The Head of the Cleansing Service will be responsible for organizing, operating and controlling the operation of the different components of the cleansing service in a medical establishment. Specifically the Head will be responsible for the internal and external cleansing of the establishment including the cleansing and sweeping of rooms and infirmaries, halls, waiting rooms and public areas, lavatories and administrative offices as well as the collection and haulage of waste from the generation source to the storage room and treating infectious waste and conditioning all the waste to be collected by the municipal service.

The Head's responsibilities will also include the organization of a separate collection for infectious waste, selecting the operation personnel and supervise their training. The Head will also request to the Administration Department the necessary funds for the operation of the cleansing service.

The Head shall have an education equivalent to that of a sanitation technician or environmental engineer. Specifically, the Head shall be knowledgeable in the following fields:

- Public health
- Basic cleansing
- Sanitary vector control
- Drinking water
- Sewage
- Solid waste

Regarding the Head's practical training, the following aspects shall be considered:

- Operation of a waste incinerator
- Operation of solid waste compactors
- Operation of autoclaves and other sterilization dispositives
- Maintenance and disinfection of receptacles and storage centers
- Cleaning of floor surfaces
- Application of domestic insecticides and other vector control dispositives and materials

eb. Cleansing Services Operators

The operative personnel of a medical establishment's cleansing service shall carry out the internal waste collection work, respecting the areas and the collection circuits; transportation of waste from the generation points to the storage room; storage in the corresponding areas according to waste type; compaction and incineration according to type of waste. The operation personnel shall also carry out the hospital's internal and external cleaning and sweeping work.

The operative personnel shall have, at least, completed the basic education and shall be skilled in the specific area of work to carry out. The operative personnel shall have training, as the case may be, in the following fields:

- Sweeping, cleaning and surface and floor disinfection techniques
- Loading and transporting infectious waste from the generation sources to the storage area
- Operation of waste compactors
- Operation of waste incinerators
- Cleaning and disinfection of containers

ec. Head of the Inter-hospital Infection Prevention and Control Committee

It would not be suitable to set a profile of the Head of the Inter-hospital Infection Prevention and Control Committee according to the Head's responsibilities regarding the supervision of the cleansing service, perhaps only make sure that he is familiar with the design of the hospital solid waste management system and the operation manuals.

ed. Doctors, Nurses and Medical Assistance Personnel

Doctors, nurses and assistants shall receive training regarding waste management in the generation sources, specifically for the on-site storage, classification and marking of infectious waste and sharps. They shall also be instructed in the use of autoclave equipment to use it immediately on high risk waste.

M.7 Implementation Plan

The Implementation Plan presented in figure M.7a includes the most important activities according to the proposed phased approach of the Medical SW Master Plan. The following explanatory comments are relevant.

The Implementation Plan is - as the Medical SW Master Plan - based on the idea of controlled landfilling being environmentally acceptable and attractive economically. Incineration is by many the preferable solution, but the fact is that incineration is far more costly and the likely high fees may make it difficult to attract either the investor or the medical institutions. In time, as the medical institutions are being acquainted with use of an external waste service, incineration and the higher costs may be introduced without a major risk of drop-out.

Preparation of the Code of Practice is scheduled for 2 years (1996 and 1997). It could be prepared faster, but it is recommended to allocate at least 1.5 years for the work as it will be the important foundation for the upgrading of the Medical SW Management. It is suggested that all relevant institutions are engaged in the work from the very first discussions, which will make the preparation work more time consuming, however, which will ease the subsequent implementation.

As the competent authority, the Ministry of Health, through its Department of Environmental Programs, should take a leading role in the preparation.

Parallel to preparation of the Code of Practice, standards for landfilling and incineration of Medical SW should be prepared (at national level too) - either as an integrated part of the Code of Practice or as separate activities. The standard for landfilling is being the far less complicated and it should be possible to complete the work in less than one year. The standard for waste incineration will require more time for preparation a.o. because it would be beneficial to prepare this as a general standard for waste incineration.

The JICA Study Team proposes 1999 to be the year where the new standard for incineration is introduced for <u>new incinerators</u> and 2001 the year for application for <u>existing incinerators</u>.

The Implementation Plan is based on the institutional assumption that the public authorities exercise approval of facilities and enforcement of the permissions only. Thus, it is assumed that the public authorities will not engage in investment or operation. With respect to implementation of the Master plan, such arrangement is not optimum as the speed of implementation may be slower and the implementation may be subject to more uncertainty e.g. concerning financing and fee structure.

In order to ensure a reasonable speed of implementation and to eliminate the uncertainties as far as possible, the public authorities (here CONAMA-RM) should take a leading role in provision of adequate landfill capacity and provision of a collection and transportation system for Medical SW - the main element of the technical Master Plan.

Thus, it is proposed that CONAMA-RM conducts negotiations with relevant landfill operator(s) in the Metropolitan Region concerning establishment of landfill capacity adequate for disposal of Medical SW and with relevant haulage contractors for provision of an appropriate collection and transportation system.

In these negotiations, CONAMA-RM will not be able to guarantee quantities for landfilling, to guarantee the number of medical institutions to join a collection service or in any way to participate in the financing of investments and operation. The waste quantity and the enrolment rate will depend entirely on decisions taken by the medical institutions themselves, which obviously will depend on the promotion of the services, the economic viability of the solutions and the enforcement of standards by the public authorities. The financial risks must be borne by the private operators and included in the fees.

Thus, the following three basic conditions for successful implementation of the Medical SW Master Plan are identified:

- CONAMA-RM ensures through negotiations - and if applicable also the approval system, that landfill capacity is made available by the private sector (at reasonable fees).

- CONAMA-RM ensures through negotiations that a collection/transportation system is made available by the private sector (at reasonable fees).

- SESMA ensures through enforcement of the upgraded Medical Solid Waste Management that standards defined by the Code of Practice are implemented.

Implementation of centralized incineration of Medical SW is made dependent on implementation of incineration for ISW and, thus, also being depending on the implementation schedule for this. The period 1999-2001 is proposed for development of a solution with the companies engaged in ISW management and a solution may be available from year 2002. Obviously, the phasing out of landfilling of Medical SW must be adapted to the implementation of incineration. A five-years transitory period (as minimum) is proposed in the Implementation Plan.

	SHORT-TERM					MEDIUM-TERM					LONG-TERM				
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 -
Preparation of Code of Practice	■	■													
Preparation of standard for landfilling of Medical Solid Waste	■														
Preparation of standard for incineration of Medical Solid Waste		■	■												
Legal implementation of standard for Medical Solid Waste incineration for new incinerators				■											
Legal implementation of standard for Medical Solid Waste incineration for existing incinerators						■									
Negotiations on landfill for Medical Solid Waste	■	■													
Landfill for Medical Solid Waste in operation			■	■	■	■	■	■	■	■	■				
Negotiations on collection and transportation system for Medical Solid Waste	■	■													
Collection and transportation system for Medical Solid Waste in operation			■	■	■	■	■	■	■	■	■	■	■	■	■
Development of centralized incineration for Medical Solid Waste (co-treatment with ISW)				■	■	■									
Centralized incineration for Medical Solid Waste (co-treatment with ISW) in operation							■	■	■	■	■	■	■	■	■
Phasing out of landfilling of Medical Solid Waste							■	■	■	■	■				

Figure M.7a Implementation Plan for Medical SW Master Plan

JICA