Prepared by: Homi R. Mullan, Consultant, Hospital & Medical Waste Management -
E-mail mullan@vsnl.com Phone (022) 386 5290 FAX (022) 387 5803

Planning & Selection Guidelines
Hospital Medical Infectious Waste Incinerators (HMIWI)

Subject : The aspects to be considered whilst Planning & Selection of Hospital Medical Infectious Waste Incinerators (HMIWI) for Disposal of Infectious and /or Potentially Infectious waste from Health care facilities.

Objective of this note is to enlighten Administrators and Decision-makers that have decided to install Incinerators but are not fully aware of the problems they hear and fear about the Incineration. Below are some of the findings of the worldwide experiences documented and the experiences observed at various installations in India. These aspects will assist in Efficient Operation of an Incinerator plant.

1.0 SITING OF AN INCINERATOR:

1.1 Plot Plan of Site indicating the Buildings with their heights, Chimneys and any tall structures along with their heights, within the 300-meter radius from the point of location of proposed incinerator at the site location, be prepared. This is to determine whether the minimum required Chimney height of 30 meter is adequate. The plot plan with the proposed Chimney height has to be submitted for initial approval of the prescribed authority for 'Smoke Nuisance Act' in the State.

1.2 Very Remote Distant Location: By and large the Incinerators are located at very remote corners, generally near the morgue. There are certain problems created by such remote and far off location. The road to the far of incinerator location are generally with rough surfacing requiring inflated tiers for the waste trolley to prevent tipping of waste bags. The Security is lax resulting in theft of vital components from control panels to start with and later followed up by thefts of value fetching components are removed. When the incinerator is situated near a morgue, which generally is the case, there is a psychology factor, which plays on the mind of the operators and Security staff.

1.3 Basement Location: The industry experience has shown that siting of incinerators in the Health facility basement is not a recommended practice. Problems, which arise, include air starvation for continuous and sustained combustion. There are fire risks and smoke leakage into common ducting system. Fly ash handling also becomes a problem.

1.4 Main Building Location: Similar risks of air starvation, fire risks, smoke leakage and fly ash problems as explained in (1.3) above could arise.

1.5 Public opinion: Prior acceptance of the residents in the vicinity of the proposed incinerator is of utmost importance.

1.6 Sewers / Drain: Waste water discharge from wet gas cleaning scrubbers, floor cleaning, hand washing etc., is required to be put into a sewer / drain. Open discharge could create problems such as odor, and may be other forms of pollution. The provision for this has to be planned at a very early stage.

1.7 Electricity / Water Utilities: The provision for this has to be planned at a very early stage at the selected site for the incinerator.

Early planning of siting requirements and **prior approvals from prescribed authorized agencies** will save a lot of problems and delays in implementation stage of an Incinerator project.

2.0 INCINERATOR REQUIREMENTS

2.1 Identify the Waste to be Incinerated: The Ministry of Environment & Forest (MoEF), India, in their Bio-Medical Waste (Handling and Management) Rules, 1998, as per its Schedule I (Rule 5) permits disposal by Incineration. This is for **Category No. 1** (Human Anatomical) Waste and **Category No. 2** (Animal) waste as an alternative to Deep burial disposal which is permitted only in cities with population less than 500,000 (half a million). Incineration is also permitted for **Category No. 3** (Microbiology & Biotechnology) waste, **Category No. 5** (Discarded Medicines and Cytotoxic drugs) waste, and **category No.6** (items contaminated with blood and body fluids including cotton dressings, soiled plaster casts, linen, bedding, other materials contaminated with blood) waste. This is as an option to other alternative Treatment / disinfection methods. The aspect of Identifying the waste to be incinerated is important because of varying moisture content in waste, thereby its density, and the varying calorific value (heat content) in different waste streams. Certain waste such as body parts, organs will have high moisture content (75% to 85%) but will have low calorific value (1000 Btu/lb. i.e., 2326 kJ/kg). The cotton dressing, linen, bedding etc., waste will have low moisture (25%) content with higher calorific value (6500 Btu/lb. i.e., 15,119 kJ/kg).; and then there are plastics (non-chlorinated) which could be in high proportion from

selected waste stream has very low moisture content (10%) and very high heat content (8,700 Btu/lb. i.e., 19,771 kJ/kg). The predicted heat release from the incinerated waste is a vital parameter for incinerator capacity design. The problem in incinerator operation and functioning arises is when the incinerators are purchased with stress on its suitability for high (85%) moisture content waste with capacity in terms waste weight in kg per hour to be incinerated. Later on the incinerator is put to use for incinerating low moisture / high heat content waste such as paper, cotton, plastics. The problem arises, as incinerator designed for low heat release can not function when it is overloaded with the high heat release waste feed.

2.2 Understanding of the Type of Incinerator being purchased: More often than not, the operator of the incinerator and the supervisory and administrative authorities do not know the type of incinerator and its limitation whilst operating their incinerator. The three types of incinerators identified are a) **batch** wastes feed type; b) **intermittent** waste feed type; and, c) **continuous** waste feed type. These types are distinguished and governed by the ash removal arrangement / limitation and are linked to their burning capacity rates. In the **batch** type, generally of small capacity (5 to 50 kg/hour), the ash is removed from the chamber on its cooling down after the incineration cycle is over and before commencing with a new batch cycle. In the **intermittent** type incinerator, generally of low to medium burn rate capacity (10 to 500 kg/hour) the ash is pushed / shoveled intermittently into an ash collecting chamber below the combustion chamber. The ash collection chamber is generally of large enough volume for 6 to 10 hour operations at a time before it has to be cooled down for ash removal. In the **continuous** type incinerator, generally of very large burn rate capacities (2 tons to 5 tons and above per hour), where continuous ash removal arrangement is provided along with a continuous controlled waste feed mechanism. Most of the installations of Hospital waste Incinerators in India are of the **intermittent** type, where the waste is to be fed into the incinerator at intervals of 10 to 15 minutes. The incinerator problem starts when the combustion chamber of the incinerator is over loaded and filled with all the available waste, prior to preheating the chamber, and the **intermittent type** is being put to use as a **batch type** incinerator. This gradually leads to ash build up, damaging the burners in case of oil-fired units and heating elements in the case of Electric heating units. Very soon the problems are cascaded to refractory damage, insulation damage, blower malfunction, choking of the gas cleaning system with unburned carbon. Attention is given to the incinerator only when the system ceases to function. Therefore, an understanding has to be reached for the choice of incinerator to be purchased.

2.3 Standby Incinerator: Plan for a standby unit right from the initial stage. A standby unit allows the operator to carry out preventive maintenance to the incinerators. If unexpected additional waste quantity load turns up, two incinerators could be operated simultaneously. If you do not have a second incinerator, have alternate arrangement plan for waste disposal. If in the normal circumstances, the waste is to be sent to off-site plant for treatment and /or disposal, an on-site standby incinerator or alternate treatment equipment may be planed.

2.4 Waste feed Door Opening Dimension: Infectious / potentially infectious waste should reach the incinerator in a concealed disposable bag / container. Either the bags / containers should be of suitable size for easy feed into the incinerator combustion chamber, or the chamber and the waste feed door dimension should be initially planned to be large enough for easy waste feeding. The problem generally arises as there is no prior thinking done which results in a mismatch with bags / containers too big to be fed into the incinerator. The bags / containers are then opened by the operator and loose waste feed is resorted to. Small and medium capacity incinerators, by virtue of its efficient design consideration would have smaller waste feed opening to match the combustion chamber design, and therefore the bags / containers should be appropriately selected.

2.5 Building / Shed: The building / shed should be very freely ventilated in order to provide plenty of air required for complete combustion. The gas cleaning equipment, Induced draft fans, pumps and ancillary equipment should be housed inside the incinerator building to prevent damage and thefts. Adequate water and drain facility for floor cleaning and disinfectant cleaning should be provided. A Concealed room free from rodents should be provided to house surplus waste in waiting.

2.6 Glass / Metal: These are inorganic materials and therefore can not be incinerated. **Glass** is known to create hot spots at a point where it melts and is known to damage the high temperature refractory. The melted glass would seep inside through the damaged refractory cracks and gradually but surely damage the furnace. This damage is crucial in the case of electric heating element furnace. **Metals** also create pollution problems by release of metallic oxides in the emitted gases as well as in the residual ash when thrown in the incinerator. More often, these metal sharps remain undestroyed or partially destroyed as they are insulated from heat by the heap of ash. The workers handling sharps-containing ash are at risk to injuries caused by the sharps.

2.7 **Automation:** Keep things simple, as required to meet Safety and Emission standards. Incorporate automation features such that the operators and maintenance staff can maintain it.

3.0 CHIMNEY REQUIREMENTS (TALL STRUCTURES)

3.1 **Standards:** Plan for chimney Design in accordance with Indian Standards IS 6533 : 1989 'Design and Construction of steel Chimney - Code of Practice, PART 1 Mechanical Aspect, and PART 2 Structural Aspect. Design chimney construction based on gas emission rate.

3.2 **Civil Foundation:** The civil work design of the chimney foundation should be as covered in Indian Standards IS 6533 discussed above. The civil foundation design is dependent on the Chimney weight and the approved soil survey report, to be locally approved by a body such as Municipal Corporation City Engineer, Public Works Department. Soil survey should be carried out.

3.3 **Statutory Approvals:** The detail design with design calculation, material of construction and plans should be submitted for approval to the State Pollution Control Board, Local Governing body such as Municipal corporation and the Civil Aviation authorities. Design and approvals should be sought prior to inviting offers from vendors.

4.0 GAS CLEANING EQUIPMENT:

4.1 There are a wide variety of gases cleaning equipment available. Wet water scrubbers are a recommended choice for pathology waste incineration. Avoid incineration of toxic chemicals and chlorinated compounds in the waste stream, for it will require wet chemical scrubbers and waste water treatment equipment. Decide on the type, design, CAPACITY, and material of construction, prior to inviting offers. A separately designed incinerator should be used for Toxic wastes incineration.

5.0 'FOUR BASIC PRINCIPLES' TO PROCURE A GOOD INCINERATION SYSTEM (REF: US EPA DOCUMENT EPA/625/4-91/030 DECEMBER 1991)

5.1 Incineration technology is more of an art than a science - no textbook formulas can guarantee a successful system.

5.2 There is no "universal" incinerator. Incinerators must be Selected, Designed, and Built to meet each facility's specific needs.

5.3 There is no "typical" application. Even similar types of institutions have wide differences in waste types and quantities, waste management practices, space availability, etc.

5.4 Incinerator manufacturers differ widely in capabilities and qualification.

6.0 'SIX STEPS' FOR IMPLEMENTING A SUCCESSFUL INCINERATOR PROJECT LEADING TO MINIMIZATION OR ELIMINATION OF INCINERATOR DEFICIENCIES, LEADING TO AN INCREASED LIKELIHOOD OF A SUCCESSFUL INCINERATOR SYSTEM INSTALLATION. (Ref: Doucet L. G., State-of-the-art Hospital and Institutional waste incineration: Selection. Procurement, and Operations.)

6.1 **Evaluations and Selections:** (i) Collect and consolidate waste, facility, cost, and regulatory data. (ii) Identify and evaluate options and alternatives. (iii) Select system and components.

6.2 **Design (contract) Documents**: (i) Define wastes to be incinerated- avoid generalities and ambiguous terms. (ii) Specify performance requirements. (iii) Specify *full* work scope. (iv) Specify minimum design and construction criteria.

6.3 **Contractor Selection**: (i) Solicit bids from prequalified contractors. (ii) Evaluate bids on quality and completeness - not strictly least cost. (iii) Evaluate and negotiate proposed substitutions and deviations. (iv) Negotiate payment terms. (v) Consider performance bonding.

6.4 **Construction and Equipment Installation:** (i) Establish lines of responsibility. (ii) Require shop-drawing approvals. (iii) Provide inspections during construction and installation.

6.5 **Startup and Final Acceptance:** (i) Use "punch-out" system for contract compliance. (ii) Require comprehensive testing: system operation, compliance with performance requirements, and emissions. (iii) Obtain operator training.

6.6 **After Final Acceptance:** (i) Employ qualified and trained operators. (ii) Maintain operator supervision. (iii) Monitor and record system operations. (iv) Provide regular inspections and adjustments. (v) Implement preventive maintenance and prompt repairs - consider service contracts.

Note prepared by: **Homi R. Mullan**, 23 Suraj Apartment, 274 Jaojee Dadaji Road, Mumbai - 400 007
E-mail: ~~mullan@vsnl.com~~ Phone: (022)- 386 5290; ~~FAX: (022)- 387 5803~~
mullan@gmail.com call: +91 98 208 11308