REGIONAL DISTRICTS FOR INCINERATION

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ABSTRACT

There are great advantages to be obtained in forming of regional districts for incineration. Cost data prepared for recent engineering studies indicate substantial savings for utilizing incinerators up to 1200 tons per day capacity and serving populations up to 425,000 persons. The maximum area of an efficient district has been established as that requiring up to 45 minutes for the collection trucks to make a round trip to the incinerator. The size of the service area may be extended through the use of transfer stations. New air pollution control criteria, such as those now applicable to Federal installations, have increased construction and operating costs of incinerators and have accentuated the differential between local and regional incinerators. Site selection remains the most difficult obstacle to be overcome. A factual weighted comparison of available sites produces a method of rationalizing and settling this dispute.

INTRODUCTION

The purpose of this paper is to aid public officials and engineers in their consideration of the advantages of forming regional waste disposal districts, to describe a method for determining the facts, but not to provide any universal answers. It is a strange paradox that although most concerned public officials are aware that the regional approach to incineration offers great savings, very few regional incinerators have been planned and less have been built. Out of the 200 or more metropolitan areas in the United States, classified as Standard Metropolitan Statistic Areas (SMSA) by the United States census, less than a half-dozen have incorporated anything approaching a regional refuse disposal system.

In the meantime, the high costs attendant upon going it alone have had a very restrictive effect on the number of incinerators actually constructed. Commitments for construction lay far behind the number of plants planned. This is evidenced by the fact that less than 10 municipal incinerator plants were constructed in Eastern United States in the last year.

A modest comparison is cited in the following paper between local and regional incineration, as indicated by the estimated per capita costs developed for a municipality of 40,000 persons going it alone or joining in with their neighboring communities to form a district serving 160,000 persons. These, as shown in the following paper, indicate a savings of about 40 percent in favor of the regional solution. The net saving to the average family unit in this case amounts to about $5.00 per year. Greater savings are obtainable with even larger units, as is shown in Fig. 1, but in many sections of the country such concentrations of population do not exist.

The cost of collection of refuse is usually at least equal to the costs of disposal. Savings in collection costs through
the formation of intermunicipal solid wastes districts often are greater than those obtained in connection with disposal.

Village centers, large hospitals, universities and industrial plants often can utilize transfer stations. These may vary from roll-off containers to actual buildings enclosing tractor trailers with capacities up to 75 cubic yards. A description of these costs is given in Fig. 2.

The new air pollution control criteria has the effect of almost doubling the capital cost of the smaller incinerators and of adding at least 30 percent to the cost previously experienced in constructing the larger plants. It is generally agreed amongst designers of incinerators, that existing Federal and proposed State regulations make the use of electric precipitators or medium to high head-loss scrubbers mandatory in new installations. The various trains of equipment and some representative costs are cited in the paper. The high cost of air pollution control equipment has created a more acute awareness of the excess air factor and has almost eliminated consideration of batch-fed furnaces.

The choice of the incinerator site remains one of the most important and difficult decisions confronting the designer and the public official. A careful non-biased inventory should be made of all available sites. A well doc-

FIG. 1 COST OF INCINERATION WITH OPERATION AT DEPENDABLE CAPACITY

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umented comparison should then be made of the criteria governing such a choice. An example taken from a recent report is cited in the paper.

Putting together a successful regional incinerator project involves a careful analysis and exposition of design factors together with a full awareness of probable public response. It is hoped that the material presented in the following paper may be of help to others concerned with this problem.

ENGINEERING PLANNING

Most of us realize that one of the most significant achievements brought about through financial grants and advances of Federal funds has been in providing for better preliminary plans for engineering projects. Prior to this, most clients were anxious to rush into construction plans even though the project often was ill conceived. There was a great reluctance to appropriate funds for preliminary studies. All of these programs now carry the requirement that the particular project must conform to a regional plan. This is very important and in the writer's opinion is the ingredient that has been sadly lacking up to now. The correctly planned regional refuse disposal project is the answer to many of our current problems.

The caption of this section is "Engineering Planning". It is of more than passing interest that recent legislation in one of our populous states carries this same classification. This same state also is well known for the enforcement of engineering registration laws. The combination of these two items means that planning for regional engineering subsidized by state funds must be carried out under the supervision of registered professional engineers. This protects the public who need desperately to have this work done by competent people.

It is germane to this discussion to review briefly what an engineer should be expected to cover in the preliminary planning.

\[ \text{COST IN DOLLARS PER TON} \]

\[ \begin{array}{cccccccc}
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\
\hline
\end{array} \]

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1) Even though his client may be a single municipality, he should review the feasibility of combining with surrounding cities and towns to form an incinerator district.

2) The problems concerned with handling and collection should be included in the study. The costs of collection are usually equal to or higher than those for disposal. Also, the location of the incinerator may be determined by the economics of hauling costs. This sensitivity is illustrated on Fig. 2.

3) An inventory of the present disposal practices in the district will point up the critical needs as they exist.

4) All available disposal areas should be catalogued. These are usually in short supply, or else there would have been little interest in incineration.

Sanitary landfill admittedly is less costly than incineration but it uses up land for final disposal at a rate at least four times greater than incineration and can be considered only where adequate land area is available within a reasonable hauling distance. Incinerator residue occupies only 1/12th the land volume of the equivalent unburned refuse [1].

5) The use of per capita waste production figures and cost per ton for incineration has caused much embarrassment to some engineers and public officials when projects reached the construction bidding stage. It is essential that actual measurements and representative weighings be made of solid wastes being disposed of in the proposed district. Industrial wastes should not be neglected and many times it is necessary to analyze the combustion characteristics of these materials.

6) A topographical survey with earth borings and test pits should be made of the recommended incinerator site.

7) Elevations, floor plans, and equipment layouts in preliminary sketch form, together with definite outline specifications and detailed construction cost estimates, are all necessary. Labor, utilities and maintenance costs should be estimated for annual budget purposes.

8) Plans should be outlined for informing the public on the proposed undertaking and its benefits.

9) Last, and perhaps most important, the means of financing the project should be detailed. The recommended relationships between the host community in which the incinerator is constructed and the other communities served, should be carefully explained. This should include recommended charges to commercial and industrial haulers.

The foregoing partial description of required preliminary engineering considerations make it apparent that the preliminary data necessary for decision making cannot be obtained for a few hundred dollars. Nonetheless, money spent for preliminary engineering is vital to the success of any project.

We sometimes receive well-deserved criticism from architects and planners that engineers are concerned too much with the nuts and bolts and miss the overall aspects of the problem. More collaboration with others, including public relations people, public works officials, traffic engineers, city planners, recreation experts and regulatory agencies is necessary throughout the planning stage, if these criticisms are to be avoided.

SIZE OF DISTRICT

The figures cited in this paper are merely one set of answers based upon particular raw data. The 1400 pounds of refuse per capita per year is a true figure for some limited sections of New England. It does not hold true for example, in Connecticut or in many other locations where the figure is much higher. The 45 minute round trip from the end of the collection route to the incinerator applies to Greater Boston, an area that can be economically serviced by such routing, but it may or may not apply elsewhere. The size of a district served by a 1200 ton/day incinerator in the city of Boston would encompass 27 square miles based upon their average population density of 16,000 persons per square mile. This could be serviced easily within the 45 minute round-trip time limitation.

The annual costs cited for incineration include amortization of capital cost and allowances for labor as well as other operating costs. These are based upon selected incinerators either completed or now in final design.

The determination of the proper size of district in the case of the Boston area was a matter of selecting the available incinerator sites and then by cut and try methods, fitting in the service area. This is an admittedly crude approach.

Systems have been developed to utilize computers in such studies. These permit a more exact balancing of the larger incinerator efficiencies with the increasing costs of longer hauls and also possible use of transfer stations. Two of the local universities developed individual mathematical models. These should be very helpful but as far as is known to the writer at this time, neither of these system approaches has proven to be successful.

Probably the major lesson learned thus far is that the districting can best be determined on a large regional or even a state-wide basis.
EFFECTS OF NEW AIR POLLUTION CONTROL STANDARDS

Incinerators now in the planning stage are more complicated and more costly because of new or contemplated air pollution control regulations. The Presidential Directive to all Federal installations has been assumed by many to be the same limits which most states will adopt. It has therefore become necessary to plan to control emission of fly ash to less than 0.35 pounds of fly ash per thousand pounds of flue gas corrected to 50 percent excess air.

Electric precipitators have demonstrated a capacity to meet these limits in Europe. The cost of these units is almost directly proportional to the volume of flue gas which they will be required to handle. Estimating prices vary from about $1.00 per cubic foot per minute (C.F.M.) for large incinerators to over $2.00/CFM for incinerator furnaces in the 150 ton/day range.

Cooling is accomplished best by waste heat boilers or by water wall furnaces followed by boilers and economizers. Use of water sprays and/or ambient air for cooling usually adds substantially to costs for the precipitators. Expensive, atomizing-spray, cooling towers have been used satisfactorily in Europe instead of waste heat boilers. In rare instances steam may be sold to industries adjacent to the incinerator. Such a factor may, of course, influence the design decision.

The estimated annual costs of an incinerator incorporating electric precipitators and waste-heat steam generation may be of interest. For a capacity of 840 tons per week, or about 170 tons collected per day, an annual cost per capita served of about $4.45 can be expected. This is based upon a district population of about 60,000 people or a total of $267,000. A breakdown of the total cost follows.

ANNUAL COSTS

<table>
<thead>
<tr>
<th>Construction Costs — (including Engineering &amp; Contingencies)</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Improvements</td>
<td>$165,000.</td>
</tr>
<tr>
<td>Incinerator Building</td>
<td>800,000.</td>
</tr>
<tr>
<td>Incinerator Equipment and Chimney</td>
<td>1,000,000.</td>
</tr>
<tr>
<td><strong>Say $2,000,000 Capital Cost</strong></td>
<td><strong>$1,965,000.</strong></td>
</tr>
<tr>
<td>Average Annual Charges for Interest and Principal Payments (20 yrs. @ 4¼%)</td>
<td><strong>$145,000.</strong></td>
</tr>
</tbody>
</table>

Operating Costs

- Labor — 6 men including Supt. on single shift, 5-day week, plus 5 men on a second shift including weekend maintenance and 25 percent allowance for vacation, sick leave, etc. $93,000.
- Maintenance and Repairs 15,000.
- Power, Water and Fuel 14,000.

**Annual Operating Costs $122,000.**

**TOTAL AVERAGE ANNUAL EXPENDITURE $267,000.**

It will be apparent to engineers familiar with incineration that the cost of the equipment is increased greatly over that of previous designs. The difference is due partially to the new air pollution control requirements, refinements in the entire facility design, and to general cost increases.

The incinerator described, while consisting of 2-120 ton/24 hour furnaces, is rated on Fig. 1 as having a dependable capacity of only 168 tons per day. This allows for one furnace being out of service for repairs and the other operating three shifts per day seven days a week during the repair period. This would produce 840 tons per week at rated capacity of 168 tons per day, based on a normal 5 day week. If more refuse than this were to be committed it would soon overflow the storage pit and require outside storage or diversion to another disposal facility during a prolonged repair period. There would be little need for operating this 240 ton incinerator plant for more than 2 shifts for the nominal capacity of about 160 tons per day.

SITE COMPARISONS

The inventory of available sites for regional incinerators can be shown usually on overlays of U.S. Geological Survey quad sheets. A commentary on the economic desirability, the existing and future land uses, pollution of ground or surface water supplies is always necessary.

The real trouble arises when people inquire as to why the incinerator has to be in their locality instead of across the railroad tracks or in another town. A scoring of available sites on an impartial basis has been found to be very helpful. An example of such a summary, as shown below, served to secure approval of the best site for a current project.
### PLANT LOCATION STUDIES
#### UNION STREET SITE COMPARED WITH THE OTHER SITES

<table>
<thead>
<tr>
<th>Site</th>
<th>Ownership</th>
<th>Zoning Classification</th>
<th>Accessibility</th>
<th>Adaptability</th>
<th>Compatibility</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Union Street</td>
<td>Town</td>
<td>Industrial</td>
<td>Excellent</td>
<td>Excellent</td>
<td>*Excellent</td>
<td>1</td>
</tr>
<tr>
<td>Arnold Meadows</td>
<td>Private</td>
<td>Residence B</td>
<td>Good</td>
<td>Fair</td>
<td>Fair</td>
<td>2</td>
</tr>
<tr>
<td>Cranberry Pond Area</td>
<td>Private</td>
<td>Industrial</td>
<td>Poor</td>
<td>Fair</td>
<td>Fair</td>
<td>3</td>
</tr>
<tr>
<td>Echo Lake Area</td>
<td>Private</td>
<td>Residence B</td>
<td>Fair</td>
<td>Fair</td>
<td>Poor</td>
<td>4</td>
</tr>
<tr>
<td>Fore River - Citgo</td>
<td>Private</td>
<td>Industrial</td>
<td>Poor</td>
<td>Poor</td>
<td>Fair</td>
<td>5</td>
</tr>
</tbody>
</table>

*Use is compatible with Massachusetts Bay Transportation Authority, who plan to use adjacent site.

### IMPLEMENTATION

Enabling acts have been passed in some states authorizing the formation of incinerator planning districts. Any municipality can appoint three members and make a small appropriation to a district. A few of these have been formed in Massachusetts, some comprising as many as eight cities and towns.

The group, soon after forming, reviews the qualifications of consulting engineering firms and selects one to submit a formal proposal for an engineering report. If satisfactory arrangements cannot be made with their first choice of engineers they then negotiate with another consulting firm.

The foregoing arrangement has not produced a regional incinerator as yet. Plans founder on the inability of the towns and cities to agree on either the incinerator site or on the method of apportioning the charges.

A more practical solution is for one town simply to build an incinerator and to enter into contract arrangements with neighboring towns, commercial haulers and industries for the disposal of their refuse. This host town concept is simple and direct. The major problem, thus far, has been the inability to obtain firm commitments from the other towns prior to final planning and construction phase. The need has not been acute in all of the towns. Some are still operating open dumps at very little out-of-pocket cost. The step to incineration is a big one for the tax payers to absorb.

As argued in this paper the regional or state approach to the problem offers perhaps the best solution. The background for much of this paper was obtained from studies performed in furnishing technical assistance to the Metropolitan Area Planning Council. This covered about 100 cities and towns in eastern Massachusetts.

The solution proposed in this case was to construct sanitary land-fills in the suburban districts and incinerators in the urban districts. Several of the urban districts no longer have any areas for disposal of even incinerator residue. It was recommended that this material be hauled to the suburbs to furnish a part of the cover material needed for the sanitary landfill.

The implementation of this M.A.P.C. plan is before the legislature at the time of this writing and it is estimated that the initial construction cost is about 60 million dollars. The waste disposal problem has reached almost crisis proportions and it appears that something along the lines proposed must soon be done.

### REFERENCES