CASE HISTORY OF A 240 TON/DAY REFUSE TO ENERGY PROJECT: 
Vicon, Crane & Co., Pittsfield, Massachusetts

LLEWELLYN E. CLARK 
Vicon Recovery Associates 
Pittsfield, Massachusetts

ABSTRACT

The development of a refuse to energy project in a small city cooperating with local industry is discussed. Highlights are presented of the background, feasibility studies, the consultants role, the energy markets, the negotiated procurement process, financing, disposal and steam sales contracts, permits, design, construction, start-up, shake down, daily operations, and project economics.

INTRODUCTION

Pittsfield, Massachusetts, a city of just over 50,000 people, was certainly not unique when in the early 1970's its need for more landfill space was apparent. There was no “politically acceptable” site in the city, and the expansion of the existing site meant the demise of the city’s only industrial park.

INITIAL FEASIBILITY STUDY

The Solid Waste Commission was appointed by the mayor in 1974 and its primary accomplishment was to negotiate with the business community for six acres of the industrial park for additional space for “turn-around time”. The commission membership was revised in 1975 and specifically charged by the mayor to investigate the alternatives to solid waste disposal other than landfill and the associated costs.

The commission investigated many options including source separation, composting and pyrolysis, but the only two “finalists” with enough merit to pursue in detail were production of Refuse Derived Fuel (RDF) and other salable components and mass firing to produce steam. RDF fell out of the picture when local industry could not be convinced of the technical merit to make the necessary boiler modifications to utilize the RDF. The Solid Waste Commission ended its investigation in 1976 with specific recommendations which included utilization of a modular system of incinerators to produce steam which would be sold to local industry.

There were several political barriers along the way, not the least of which was the word “Incinerator”. A million dollar incinerator built in the 1950's had been in service for only a few years when a combination of maintenance, operational, and environmental problems forced its closing. The other major hurdle was that during the study period, resource recovery in many forms was still having its problems and there were plenty of installations that opponents to the proposal could point to for illustrations of failure. It was also recognized that at least during the initial years of operation, a refuse to energy plant would be a more expensive method of disposal than the existing landfill.

An early attempt was made to involve the entire county in a regional facility. It became apparent that with few exceptions, interest was not adequate. It was obvious that without a landfill crisis facing them, the individual communities would not be interested. The concept was adopted that Pittsfield would “go it alone,” but the capacity of the plant would accommodate: (1) the maximum ability
to sell steam; and (2) the adjacent towns on a firstcome, first-served basis. The project financing and economics would have to be justified on Pittsfield’s refuse alone. A weighing program was instituted at the recommendation of the Solid Waste Commission so that the necessary data would be available for contractual arrangements. The commission concluded its investigation with the following recommendations:

1. A refuse to energy plant would be a feasible disposal alternative.
2. The facility should be privately owned and operated.
3. The City should continue to pay to dispose of refuse. It was assumed that the waste supply would be maintained if there was no cheaper disposal alternative for the haulers.
4. The project should have a reasonable tax impact.

One dollar on the tax rate, which translated to a cost of about $7.00 per ton more than that of landfill was considered a good target. It was recognized that with the increasing value of energy, the net disposal fee should not increase as fast as the cost of landfill. The project was accepted politically on the basis that over the financial life of the project, the total cost of disposal would be less than landfill.

THE CONSULTANT

Having the typical reservations with the findings of a local study committee, the City Council approved $40,000 to engage an engineering consultant to evaluate the project feasibility. In addition to the modular systems identified as being most economically feasible, the selected consultant, Metcalf & Eddy, included in his analysis the application of waterwall incineration and a prepared fuel, spreader stoker fired boiler system. In 1977 the consultant’s report confirmed that a modular, controlled air system would have the most favorable economic impact but cautioned that this type of system had less history of success than the many waterwall systems found in Europe.

The consultant was directed to formulate a request for proposal (RFP) which was issued in the Spring of 1978. The basic elements included information on waste generation and steam usage. It solicited for a private contractor’s involvement for ownership and operation, but left it up to the proposer to carry out the philosophy of a fair three way deal i.e., a “reasonable” tipping fee, a “reason-able” savings by the energy user, and a “reasonable” profit for the operator.

THE ENERGY CUSTOMER

It was recognized from the start of the investigation that an energy customer had to be identified and committed to purchase the steam to make the project a reality. Two of the largest local industries were approached, Pittsfield’s General Electric Plant and Crane & Co., a manufacturer of fine paper. The latter was located in Dalton, but its steam distribution system extended into the east edge of Pittsfield to serve the “Old Government Mill,” the facility in which all U.S. Currency Paper was once manufactured.

General Electric received prime consideration because of its strong influence on Pittsfield’s economy (over 8,000 employees in a city of 50,000). Primarily because of the “poor fit” between G.E.’s steam requirements and the ability to produce refuse derived steam (RDS), this alternative was not feasible. The RDS would amount to slightly over 10 percent of their load in the winter but present a bigger problem in the summer when the G.E. load falls to 60,000 lb/hr (27,200 kg/hr). The smallest oil fired boiler at that installation is rated at 100,000 lb/hr (45,300 kg/hr) and the difference of 20,000 lb/hr (9,100 kg/hr) between the anticipated RDS production of 40,000 lb/hr (18,100 kg/hr) would require a new, smaller boiler with better “turn-down” characteristics.

Crane & Co. has an average weekday steam load that varies from approximately 90,000 lb/hr (41,000 kg/hr) in the winter to 60,000 lb/hr (27,200 kg/hr) in the summer. Their four #6 oil fired boilers – 1 at 50,000 lb/hr (22,700 kg/hr), 2 at 30,000 (13,600 kg/hr) and 1 at 20,000 (9,100 kg/hr) – give considerable flexibility to provide the make-up between RDS and production requirements. The “good fit” was readily established, but many reservations concerning the dependability of RDS had to be overcome before the project became a reality. In addition to this basic concern, there was a hesitancy to enter into a long term contract because of the uncertainties in the energy future. Twenty years, a typical amortized life for this type of project, was considered too long; ten years required too rigorous an amortization schedule for project economics. Fifteen years was deemed a practical compromise. An underlying concern on the part of Crane & Co. was the necessity to convert to coal if they were to remain independent. Having converted from coal to oil in
1960, there was a desire to work out other alternatives. If 65-70 percent of their steam requirements could be purchased, the difference to be raised by oil or gas appeared within reason.

During the feasibility studies, the question of electrical generation kept recurring when neither potential user was willing to make a commitment. Using the prices for electrical energy that the local utility was willing to pay at that time (replacement of nuclear fuel cost) quickly demonstrated that the project would not work on refuse to electric energy alone. Since then, of course, the regulations have changed and the utility company is now required to pay the “avoided cost” for this energy. There is little doubt that if the project planning was commencing today, steam would be produced at 600 psi (4,136 kPa) for turbine generators and exhausted at process pressure, 150 psig (1,034 kPa).

**THE NEGOTIATED PROCUREMENT PROCESS**

Responses were received from three firms. The Solid Waste Commission together with their engineering consultant, Metcalf & Eddy, and financial consultant, Paine, Webber, Jackson & Curtis, reviewed the responses for technical and economic merit. One firm was eliminated early on the basis of inadequate financial backing, inadequate demonstrated experience and highest cost. Following an amended proposal, Vicon Recovery Associates was selected (August 1978) on the basis of stronger financial assets and potential lower disposal service cost to the City. This was Vicon’s first venture in the refuse to energy market; the parent firm, Vicon Construction Company has been deeply involved in building municipal sewage treatment plants over the last decade. Vicon affiliated with Enercon Systems Inc., of Cleveland, Ohio, who provided the incinerator design and process equipment specifications. Vicon manufactured most of the furnace components; Enercon provided some of the specialty items.

The negotiated procurement process called for in the RFP stipulated that negotiations with the selected firm would continue until they were no longer considered to be “in good faith”. If that event had occurred, negotiations would have commenced with the alternative bidder, Consumat Systems Inc., of Richmond, Virginia.

The negotiating process took approximately five months. The City added to its list of consultants by engaging a legal consultant, Ropes and Gray, to direct this aspect of the project. Two simultaneous negotiations took place, one between Vicon and the City for the disposal service agreement and one between Vicon and Crane & Co. for the steam sales agreement. Many other legal matters had to be considered such as transfer and ownership of land (formerly belonging to Crane & Co.), but the two agreements were of utmost importance. Following are significant terms of the agreements signed in February 1979.

**DISPOSAL CONTRACT**

Vicon would dispose of essentially everything that traditionally went to landfill. This would exclude hazardous materials (pathological, chemical, radioactive, etc.) and demolition waste (which was not supposed to be going there anyway). Space was to be provided in the existing landfill for residue and a limited amount of bypass material. The City would guarantee to deliver and pay for a minimum quantity of trash weekly (600 tons) and annually (44,000 tons). In keeping with the original philosophy of a cooperative venture in which all three participants (City, operator, and user) would get a “fair deal”, the disposal contract contained a profit sharing clause. A base disposal fee is set at somewhere around $11.50 per ton (based on actual tonnage and amortization payments) which the City pays for all waste delivered including commercial haulers. An additional source of disposal service income is derived from a nominal $2.00/ton surcharge to private haulers. This is in addition to the $11.50 paid for the same load by the City. The other source of revenue is, of course, from the sale of steam. The operating and maintenance records of Vicon are open to audit by the City and the amortization schedule is known. After a management fee ($100,000 in the base year escalated with the Boston Consumer Price Index) is taken, the balance of the profit (total revenue less amortization, operating and maintenance costs) is divided equally between Vicon and the City. This refund is in effect a reduction on the tipping fee. It has been projected that this net tipping fee will decrease to a point that it will be cheaper than landfill would have been in just a few years.

**STEAM SALES AGREEMENT**

Crane & Co. agreed to purchase and Vicon guaranteed to deliver a minimum of 700,000 lb of steam per day (317,500 kg/day) for 240 operating
days per year. Crane agreed to purchase all additional steam which Vicon could deliver and they could effectively use. Process steam is delivered at approximately 150 psi and 475°F (1034 kPa and 246°C). Provision is made for Vicon to make penalty payments if steam interruption on its behalf is the cause of paper machine down time. To decrease this probability, a standby 35,000 lb/hr (15,900 kg/hr) auxiliary boiler (no. 6 oil fuel) was installed.

The payments that Crane makes for steam are based on the price of #6 oil. Replacement cost of the oil which Crane would have used to produce the amount of steam sold is discounted 15 percent during the first year of the steam sales contract. In keeping with the project philosophy of sharing benefits, this discount is to increase to 25 percent over the 15 years.

FINANCING

One of the greatest political objections was the risk of another “white elephant,” in this case another incinerator that would not work. This, along with user reluctance to participate with a city operated steam plant, confirmed the opinion of the Pittsfield Solid Waste Commission and its consultant that private financing was an appropriate solution. An Industrial Development Financing Authority (IDFA) was appointed by the mayor as provided for under statute of the Commonwealth. With the IDFA holding title to the property, tax free revenue bonds guaranteed by the operator could be issued. The bond issue would include construction funds, costs of financing and a one year bond reserve fund for added assurance to the lender. As it eventually turned out, the final bond issue carried a secondary guarantee by the City of Pittsfield in the event that the operator became insolvent. A $6.2 million bond issue was closed in September 1979 from which $4.7 million was available for construction. An additional $3.6 million was subsequently provided through private financing. The amortization schedule for repayment of the $6.2 million IDFA bond issue was based on 15 years with interest at 6 to 7½ percent. The base tipping fee in turn is calculated from the constant amortization payment and the quantity of waste delivered.

THE PERMITTING PROCESS

One aspect of all projects which sometimes does not receive due consideration is the time and effort required to obtain the necessary permits. Scheduling complications can arise which will put regulatory agencies rather than equipment suppliers or plant construction on the “critical path”. A review of the permits required for projects of this nature in the Commonwealth of Massachusetts is presented here. Other states usually have counterpart agencies requiring similar permits.

CITY

Two regulations had to be met at the local level, a siting permit issued by the board of health, and an application for special use of land by a “quasi public utility” had to go before the zoning board of appeals, even though the land was zoned industrial. These are mentioned here primarily as a reminder that in a project development of this nature, acceptance by the eventual “neighbors” is most important, and it takes considerable time and tact to have such a site use accepted without significant public resistance.

REGIONAL

In Massachusetts the governing agency for the approval of construction and operations of this type of plant is the State Department of Environmental Quality Engineering (DEQOE). After receiving notice from the local board of health that a site assignment has been approved, an extensive application must be made to the regional office of DEQOE which includes the facility & equipment design, operating procedures, an explanation of the project, and an air impact analysis. Stack discharge from new facilities must conform to 0.05 grains of particulate per standard cubic foot of flue gas corrected to 12 percent CO2. The primary concern is the method and reliability of the pollution control equipment.

STATE

Completion of the Massachusetts Environmental Notification form was necessary for preliminary evaluation. Based on the size of the facility, the anticipated emissions, and other effects on the environment, a decision is made by the Massachusetts Environmental Protection Agency (MEPA) as to whether or not a complete Environmental Impact Statement is required. It was ruled that this was not necessary for this project.
FEDERAL

Close scrutiny of the Federal Register indicated that an application for Prevention of Significant Air Quality Deterioration (PSD) would not be necessary. However, because of little history of controlled air refuse burning systems and questionable interpretation of referenced installations, Region I of the Federal EPA required that a PSD application be filed (Fall 1979). Several conferences demonstrated that this necessity was not clearly defined and even though this permit application was finally approved (Fall 1980), the EPA finally notified Vicon in 1981 that it would be eligible to apply for a rescindment of this PSD application. In March 1981, an application was made for this rescindment, and this action has since been taken.

FACILITY DESIGN & EQUIPMENT FUNCTION

During the Spring and Summer of 1979, while the permitting processes were being executed and financing was being arranged, the design and specification of process equipment and facility were progressing.

PROJECT SITE

The traffic flow pattern was designed to separate commercial traffic from private vehicles, providing safer access for private vehicles and a means
of weighing the aggregate quantity received from noncommercial sources. Provision was made for disposing of source-separated items, such as cans, glass, and aluminum by providing a depressed area to accommodate bins for disposal by the citizens.

**PROCESSING BUILDING**

The processing building, which houses the receiving area and process equipment, was constructed of precast concrete components (see Fig. 1); the building is approximately 30,000 ft² in area and 31 ft high, with six doors to receive incoming trucks. The waste is either deposited into a 500 ton capacity storage pit or onto the tipping floor. Waste from the pit is transferred to the tipping floor for charging using a 5.5 ton traveling bridge crane. The entire system is controlled and maintained by an operator in a controlled-climate room with a clear view of all doors, the pit and tipping floor. The flow of waste into the system is directed by the operator through radio communications with the scale clerk and front-end loader operator.

**PROCESS EQUIPMENT**

Although there are three furnaces rated at 120 tons/day, the plant is designed to run with two furnaces on line, and one on standby. Refer to Fig. 2 which is an isometric illustration of one process line. Figure 3 shows how the system of furnaces and waste heat boilers are connected.

**FURNACES**

Features of the furnaces include controlled overfire and underfire airflow, large loading ram, and water cooling of steel components. Dual fuel burners, accepting gas or oil, located in the primary chambers provide initial ignition of refuse. These are turned off after the fire is established. The burners at the end of the secondary chamber can be used to maintain constant temperature of the gases going to the WHB. Energy input from fossil fuel has been negligible to date.

**MANIFOLD OR TERTIARY CHAMBER**

This chamber receives hot gases from the furnaces and connects to the WHB. Guillotine dampers serve to isolate each furnace, boiler and bypass stack. The normal flow is from any one furnace to either WHB, or from any two furnaces to both WHB’s. In an emergency such as loss of power or

![FIG. 2](image-url)
water, heat is automatically dumped through the bypass stack.

**WASTE HEAT BOILERS**

These boilers were manufactured by Bigelow of New Haven, Connecticut, and rated at 35,000 lb/hr (15,900 kg/hr). Each is designed to operate with flue gases entering at a temperature up to 1,700°F (927°C), and generate superheated steam at 250 psi (1,724 kPa). Vertical water tubes at the entrance and exit thirds of the boiler connect the horizontal steam drum with the mud drum. Saturated steam driven off the steam drum enters the horizontally tubed superheater section located midway in the WHB. Flue gas entering temperature is diluted in the tertiary chamber with recirculated flue gas to 1,500°F (815°C) and is cooled to about 450°F to 470°F (232°C to 243°C) as it passes through the boiler. Compressed air soot blowers are installed with automatic controls.

**ECONOMIZERS**

These serve to heat water before it enters the boilers, while reducing flue gas temperature to 400°F to 420°F (204°C to 215°C).

**INDUCED DRAFT FANS**

Driven by 250 hp motors, they provide suction to pull gases through furnaces, boilers and economizers, and force gases through electroscrubbers.

**ELECTROSCRUBBERS**

As designed by Combustion Power Equipment Co., a subsidiary of Weyerhaeuser, flue gases pass through a circular bed of ¼ in. gravel. The gravel bed has an electrostatic grid to enhance the capture of submicron particles. The gravel is pneumatically conveyed to the top of the scrubbers, cleaned and then returned to the top of the gravel bed, where it is exposed again to the flue gases. Cleaned gases leave through the middle stack of the circular gravel bed and up the stack.

**RESIDUE**

The residue is conveyed from the bottom of the water quench trough, up the incline, into the dumpster, and then transported to the landfill. Final volume is less than 10 percent of what enters the plant. Quench water used in the trough comes from the continuous blowdown, so that City make-up water for quench, and overflow to the sewer, is negligible.

**AUXILIARY GENERATOR**

This generator, driven by V-16 diesel engine and rated at 500 kW, is designed to carry one furnace, WHB line and auxiliary equipment in the event of a utility power failure.

**CONSTRUCTION**

With the construction funds available by mid September 1979, excavation was started with the hope of being “out of the bottom” before the Berkshire winter set in. This was not the case because the DEQE did not give final approval and allow construction to commence until November 2; however, an open winter permitted foundation work to proceed until completion by the end of February. The precast concrete building (manufactured by the Lakewood Precast Division of Vicon) was erected in five weeks and site improvements and utilities were in place before equipment started arriving in August 1980.

**EQUIPMENT INSTALLATION**

**FURNACES**

The loading hoppers were first installed as a unit under the suspended tipping floor slab. This arrangement provided excellent access for installation and maintenance of the equipment as well as good space for tools, equipment, hydraulic pumps and shop area. The hearth fabrications were then installed, followed by precast wall and roof panels. The bottom 4 ft of the furnace walls and hearths were bricked at the site. Cooling water for steel elements was piped up and combustion air ducts were installed after the furnaces were in place.

**WASTE HEAT BOILERS**

The 47 ton boilers were transferred from a nearby rail siding and located in less than 2 days each. Mechanical work including the steam line, piping all boilers, furnace cooling water, compressed air and support systems was on going as various equipment arrived at the site.
ELECTROSCRUBBERS

Erection and fitting of the electroscrubbers was facilitated by prefabrication of most elements by the manufacturer. Slight modifications have since been made to improve the performance in this first MSW application.

START-UP AND SHAKEDOWN

FURNACE

Just over 15 months from the start of construction, the first furnace was fired on February 6, 1981. Several trial burns were conducted while checking out cooling water systems and completing the WHB piping and controls. Minor problems were experienced with the hydraulic controls which required different pressures for different functions. This system has been simplified and improved.

STEAM GENERATION

A few short boiler runs were made in March to identify problem areas before one system was put on line the last week of March. Steam production during April, resulted in a steam sales of about 12,000,000 lb or the replacement of about 100,000 gal of oil. Since that time the plant has run continuously except for the planned shutdown in July. The landfill was closed on April 13 as called for in contract and to date no organics have been bypassed except for two days during the July shutdown. All scrap iron goes to a local scrap dealer. As yet there is no "rear end" processing but this is being evaluated.

ECONOMICS

The economics of the project were established on the basis of the City of Pittsfield alone and the contracts discussed previously. Other towns are presently negotiating with Vicon which will bring the plant up to design capacity of 240 tons per day. Rather than report at this time on the projected economics, or speculate on the basis of limited operations, this aspect of the project will be discussed in detail at the annual meeting.

CONCLUSION

The solution to Pittsfield's waste disposal problem is extremely satisfactory thus far. The landfill which had an estimated life of only 2 years should now last for 20 years. A local industry will have a renewable energy supply equivalent to 2.5 million gallons of oil per year at an annual savings of about $300,000. As the surrounding communities are forced to close down their landfills, an environmentally satisfactory method of disposing of their solid waste is now available.

Key Words
Incinerator
Pittsfield
Refractory
Regulations
Sanitary Landfill
Steam
Waste Heat