Technology Description and Performance History for the Pioneer Valley Resource Recovery Facility

Introduction

The Pioneer Valley Resource Recovery Facility (Facility) is located on Bondi Island, alongside the Connecticut River, in Agawam, MA. Downtown Springfield is on the opposite side of the river bank. The Facility, a modular resource recovery facility, began operations in 1988.

In 1999, Energy Answers led an investor consortium to acquire the Facility and assumed the management of the Bondi Island Sanitary Landfill. From then, and until October 2007, Energy Answers was responsible for all aspects of the Facility's operation and management. In October 2007, Energy Answers sold the Facility, along with other operating assets, to Covanta Energy Corporation in order to focus upon the pursuit of development opportunities worldwide. Nevertheless, Energy Answers still maintains numerous Resource Recovery patents, such as the Pioneer Plus™ next generation technology improvements, many of which were developed at and incorporated into the Facility.

[*The following description of the Facility, as well as its technology and operation, only pertains to the term of Energy Answers' ownership and operation thereof. Energy Answers cannot verify, and makes no claim as to, current conditions or operations at the Facility.*]

Community Acceptance

Under Energy Answers term of ownership and operation, the Pioneer Valley Resource Recovery Facility was more than just the local waste-to-energy plant where unwanted waste was converted into electricity. The Facility was the cornerstone of a truly integrated waste management system in the Pioneer Valley area; a community learning center, a community coordinator, and a recycling consolidation point. Furthermore, at the Facility, Energy Answers demonstrated that trash can be managed as a valuable resource in an environmentally and economically sound manner.

Working in conjunction with the material recycling facility run by the Commonwealth of Massachusetts, Energy Answers' provided educational tours of the Facility for students from grade three through college. The Energy Answers' staff at the Facility provided these students with a balanced discussion on how resource recovery fits into a local and national integrated system.

While under Energy Answers' operation, the Facility staff worked directly with contract communities to manage their recyclables and waste streams. Additionally, the Facility was a consolidation point for hazardous wastes, including fluorescent tubes, batteries and mercury bearing wastes. Energy Answers assumed the transportation and administration costs of such materials on behalf of the communities and also negotiated reasonable management fees with third parties.

In short, under the management of Energy Answers, the Facility not only provided the community with a safe and environmentally sound disposal site which produced a clean and reliable source of energy, but also educated the community in the proper and integrated methods of handling its waste.

Facility Specifications

The Facility initially started-up in the spring of 1988 and has operated 7 days a week, 24 hours a day, 365 days a year. Unit outages are usually conducted twice a year. A staff of forty (40) full-time and three (3) part-time employees operates the Facility.

The Facility's performance has been stellar in the areas of throughput as well as all environmental and health and safety standards. See ***Table 1*** for Historical Operating Results during the time that Energy Answers owned and operated the Facility.

Table 1

Historical Operating Results
Pioneer Valley RRF
1999 - 2007

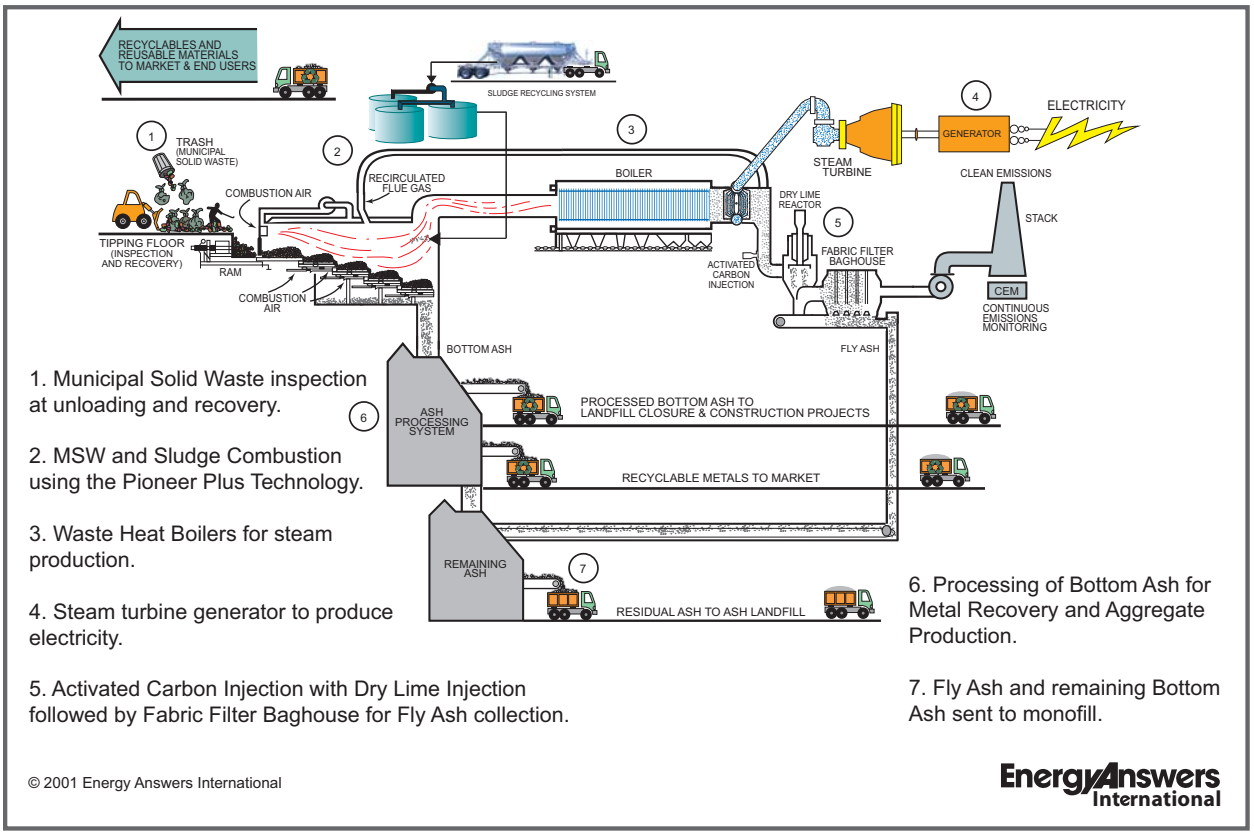
	Waste Quantities		Sludge Quantities		Electricity	Net Generation	Ash Produced		Sludge Data		
Year	Transferred (Tons)	Combusted (Tons)	Wet Sludge (Tons)	Total MSW & Sludge Combusted (Tons)	Sold (MWh)	Rate (kW/Ton MSW Combusted)	Tons	% of MSW	Gal (000)	Tons Wet	Tons Dry
1999	0	125,662	0	125,662	54,100	431	41,396	32.94%	0	0	0
2000	41,339	126,900	0	126,900	51,055	402	42,557	33.54%	0	0	0
2001	48,206	113,407	0	113,407	45,809	404	44,929	39.62%	0	0	0
2002	57,409	120,007	14,849	134,856	45,283	377	54,095	45.08%	3,561	14,849	1,028
2003	58,812	123,063	16,822	139,885	43,816	356	55,308	44.94%	4,034	16,822	1,146
2004	79,101	116,099	11,067	127,166	43,436	374	52,216	44.98%	2,654	11,067	761
2005	69,724	117,417	10,321	127,738	40,636	346	50,671	43.15%	2,475	10,321	522
2006	47,154	117,143	14,537	131,680	42,786	365	42,759	36.50%	3,486	14,537	na
2007	29,002	127,511	18,673	146,184	51,673	405	39,452	30.94%	4,478	18,673	na

While under the ownership and operation of Energy Answers, the Facility:

- Participated fully in promoting and implementing waste reduction, reuse and recycling strategies;
- Received the Safety and Health Achievement Recognition Program (SHARP) award through the Occupational Safety and Health Administration; and
- Voluntarily agreed to adhere to the Massachusetts Department of Environmental Protection's more stringent emissions requirements for large municipal waste combustors, despite being a small municipal waste combustor.

Process and Design Information

The following Schematic Process Diagram highlights the process in which recyclable materials and energy were recovered from the Facility under Energy Answers' operation. Although this process was a highly effective system under Energy Answers' management, modifications may have been made by the current owner/operator and some processes may have changed.



Municipal solid waste was delivered to the Facility in trucks. Vehicles were weighed on the truck scale, which generated a weight ticket for the driver and stored the information in a computerized database. The database generated daily, weekly and monthly reports for billings, MSW inventory management, and regulatory compliance.

Trucks left the scale and proceeded to the waste handling area where they dumped either into the receiving pit or onto the tipping floor. An overhead crane mixed waste in the pit and piled waste for short-term storage. A front-end loader moved and screened waste on the tipping floor, and then loaded this screened waste into the municipal waste combustors. The tipping, storage and combustion facilities were located inside a large building, permitting air from the waste receiving and storage area to be drawn into the combustion process to minimize odors.

The Facility had three (3) modular mass-burn refractory lined combustors, each rated at 136 tons per day of MSW. Each combustor had an associated waste heat boiler, rated at 31,528 pound per hour of steam, and a state-of the-art air quality control system (AQCS). The Facility also had a 9.46 mw condensing turbine generator.

Energy Answers' operation of the Facility demonstrated that managing trash as a resource can be accomplished in an environmentally and economically sound manner. The Facility's metals and aggregate recovery system also helped to minimize landfilling requirements associated with ash management.

Technology

Each of the three municipal waste combustors had a primary and secondary combustion chamber, which operated in an excess air mode using a combination of fresh air and recirculated flue gas. The primary combustion chamber had six (6) progressively lower refractory lined hearths resembling steps. Municipal solid waste was fed into the first hearth and tumbled from step to step by the action of hydraulic rams. By the time the MSW reached the final step, the sixth hearth, only ash and other non-combustible materials such as glass, metal and stone remained. This material, collectively termed 'bottom ash', was discharged into a water (i.e., ash) trough. The trough quenched the bottom ash and sealed the combustor from outside air. A drag chain conveyor at the bottom of the trough transported the bottom ash to the ash building. Ferrous material was removed with a drum magnet from the bottom ash conveyance system. This ferrous material, which was approximately 6% by weight of the bottom ash, was sold as scrap. Also, along the bottom ash conveyance system, ash was mechanically separated into an aggregate for uses such as landfill sloping, grading and daily cover. Residuals in the bottom ash, not mechanically separated, were disposed in the Bondi Island landfill.

In each municipal waste combustor 'train,' flue gas flowed from a primary chamber into a secondary chamber, where sufficient time and temperature were provided to assure complete combustion. From the secondary chamber, flue gas flowed into a tertiary chamber, then into the heat recovery and air quality control systems.

The heat recovery system of each train consisted of a water tube, waste heat boiler with a superheater and economizer. Most of the steam was converted into electricity in the turbine generator. Steam was also used for ancillary facility equipment. The air quality control system for each train consisted of a gas temperature controller, an activated carbon injection system, a dry sorbent scrubber, and a baghouse, followed by an induced draft fan.

The GTC maintained the flue gas temperature entering the baghouse within the regulatory limits and an activated carbon injection system removed mercury from the flue gas. A dry hydrated lime scrubber removed acid gases. A baghouse removed particulate matter (PM).

A portion of the flue gas, downstream of the economizer, was recirculated by the flue gas recirculated (FGR) system. This system included a multi-cyclone to remove PM, and provided cool,

low oxygen (O_2) content flue gas to the combustion chamber to inhibit the formation of nitrogen oxides (NO_X) and slag.

Particulate matter, referred to as fly ash, was collected from the multi-clones and the baghouses via hoppers and conveyors. The fly ash was mechanically conveyed to the ash house and mixed with bottom ash.

A continuous emissions monitoring system (CEM) indicated performance relative to permit limits for SO_2, NO_x, and CO.

The turbine generator had two uncontrolled steam extractions at nominal pressures of 150 psig and 40 psig. The 150-psig extraction mode primarily supplied steam to the feedwater heater. The 40 psig extraction mode supplied steam to the deaerator. The generator was rated at 9.46 megawatts.

Facility Modifications

Major repairs and modifications were performed by Energy Answers at the Facility in 2007 to increase availability and throughput and to reduce expenses. Highlights of the modifications follow:

- Improved tracking and alignment of the ash transfer ram (ATR) carriages for reduced air infiltration and jamming.

- Poured and sprayed refractories in the combustors for lower operating and maintenance costs.

- Improved ATR sealing to reduce air in-leakage and ash accumulation.

- Adjusted the speed limit on the variable frequency drives of the induced draft fans to reach motor full load amps. This resulted in a waste throughput increase of 3.6%, and a steam production increase of 2.9%.

- Set up the speed control on the ID fans to maintain a constant motor current during process changes. This resulted in a slight increase (i.e., 0.5%) in waste throughput and steam production.

- Improved FGR distribution on units #1 and #2 – installed new ductwork to supply the under fire flue gas recirculation fans. This improved the FGR distribution and temperature control. As a result, steam production and waste throughput increased by 3%.

- Incorporated an automatic bias controls to balance and maintain draft in combustors #1 and #2 with varying FGR flows. This helped to maintain consistent steam flow and draft, and resulted in a slight increase (i.e., 0.5%) in waste throughput and steam production.

- Fine tuned loops to optimize temperature and oxygen set-point control. This resulted in a slight increase (i.e., 0.5%) in waste throughput and steam production.

- Air Quality Control System:
  - Internally re-clad the baghouses with stainless steel, to eliminate leakage, improve process control, and increase the 'life' of the baghouses.
  - Replaced and upgraded the scrubbers and gas temperature controllers to:
    1. Further reduce air infiltration
    2. Cool and/or control the flue gas temperature
    3. Increase feed-water temperature
    4. Reduce lime usage
    5. Increase ID fan margin

  These AQCS upgrades increased steam production by 2%, and reduced lime consumption by 50%.

- FGR fan improvements – installed chromium carbide liners, balanced fans, and set variable fan drives to operate motors up to full load amps. This helped to meet the anticipated increase in FGR demands.

- Modified the bottom ash system to produce an ash aggregate for daily cover, and sloping and grading of landfills.

As a result of these modifications, throughput in 2007 set an annual record (i.e., over 146,000 tons of MSW, liquid sludge, and fats, oils, and greases (FOG).

Management History

The Pioneer Valley Resource Recovery Facility was subjected to numerous mandated controls and limits. Most significant of these were constraints detailed in air emission permits, which had become increasingly stringent over the years. The Facility operates under the 1999 Federal Title V Program, which made air emissions and operational restrictions federally enforceable, and also certified demonstration of compliance with mandated air emissions tests. Since the inception of this program, air emissions have been below mandated threshold impact levels. The Facility voluntarily switched over to the regulatory requirements for large municipal combustors, even though by federal law the Facility is a Class I (i.e., small) municipal waste facility. As such, the Facility operated under even more restrictive emission limitations. Nevertheless, the limitations were met through diligent operation, preventive maintenance, source separation, and planned capital investments under Energy Answers' management.

The Facility had continued to meet or exceed its goal of operating with over 90% availability. Furthermore, Energy Answers' innovative staff was able to permit a transfer station at the Facility that has allowed the communities to continue tipping their waste during Facility outages, rather than incurring additional transportation and disposal costs at a distant landfill.


The United States Department of Labor

Occupational Safety and Health Administration

This is to certify that

located at

meets the requirements of the Consultation Safety and Health Achievement Recognition Program

SHARP

and participation is hereby approved for the term

In 2002, the Facility became a member of OSHA's prestigious Safety and Health Achievement Recognition Program. SHARP is

an alternate voluntary compliance program for companies which have too few employees to fall within the Voluntary Protection Program.

Sludge Recycling System

The Pioneer Valley Resource Recovery Facility was the first facility in the United States, and perhaps the world, to successfully combust municipal and industrial liquid sludge in a MSW combustor. The process is unique and is patented by Energy Answers. The Sludge Recycling System (SRS) has been operating commercially since April 2002. Since that time, the Facility has combusted tens of millions of gallons of liquid sludge, ranging from municipal treatment facility waste activated sludge, to FOG. The operating permit, issued by the Massachusetts Department of Environmental Protection, allows the Facility to displace up to 5% of MSW tonnage with dry sludge solids.

The SRS was successful at the Facility due to several important design innovations that set it apart from previous attempts at sludge co-combustion. Past industry attempts at co-combustion with MSW resulted in serious odor issues, combustor operating difficulties, and incomplete burnout of the sludge.

Energy Answers' SRS tackled the Facility's odor issues head on by keeping the entire sludge handling process, from truck unloading to injection, enclosed. Many earlier attempts at co-combustion simply sprayed the sludge on top of the MSW in the pit, with malodorous consequences. Innovative piping design on the SRS and the use of negative pressure storage tanks with carbon canisters, combined to contain odors.

Integrating the SRS controls into the existing Facility distributed control system (DCS) minimized combustion equipment difficulties. By linking injection rate to the combustor primary temperature, the controls do not inject any more sludge than the combustor can handle. Therefore, as temperatures rise more sludge can be injected, acting in a manner similar to the recirculating flue gas system. Integration of the system controls into the DCS has also ensured that the Facility continuously meets the stringent standards for air emissions and ash quality.

Complete sludge particle burnout was ensured by the use of a dual fluid steam atomizing nozzle that used high pressure super heated steam to break the sludge up into very small particles as it was injected into the combustor(s).

Since the start up of the SRS, emissions data demonstrated a positive correlation between the volume of sludge combusted and the level of nitrogen oxides emissions. The data also indicated a similar relationship with the level of particulate matter emitted. These indications have been reported to the industry in papers presented at NAWTEC 10 and NAWTEC 12, which can be downloaded from the Energy Answers' website at: www.energyanswers.com/technologies. Through the start up and commercialization of the SRS, and related research and development work, Energy

Answers' staff at the Facility presented a significant contribution to the industry that could have an important impact at nearly any MSW, or solid fuel, combustion facility.

Environmental Performance

The Title V air permit issued to the Pioneer Valley Resource Recovery Facility required frequent and extensive testing and monitoring of air emissions. The Facility was equipped with a CEM that constantly records SO_2, NO_x, CO and other parameters. During the term of Energy Answers' ownership and operation, emissions from the Facility have been within prescribed limits for all parameters and the Facility has never been fined for environmental issues.

Process wastewater was discharged to a municipal wastewater treatment facility. The quality of this effluent waste was consistently well within acceptable limits.

The Facility was instrumental in creating and encouraging recycling programs for automotive and household batteries, button batteries, mercury-bearing wastes, and other recyclable materials.

Facility Economics

The Pioneer Valley Resource Recovery Facility is a merchant facility, meaning that it is privately owned and operated, with third party arms-length contracts for waste disposal and a customer for the purchase of produced energy. During Energy Answers' term of ownership and operation, the Facility was always financially sound, primarily through its long term (MSW and sludge) disposal contracts with varied municipalities and private haulers. Such long term contracts are clear evidence of the continued economic viability of the Facility as compared to other available energy or solid waste disposal options, and an affirmation of the Facility's customer satisfaction.

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