2016 Excellence Award Entry
Waste to Energy Category
SEMASS Resource Recovery Facility

Organization: Covanta Company of SEMASS LLC
Contact person: Mark Davis, Facility Manager
               email: mdavis@covanta.com
               phone: 508-291-4464
Jurisdiction: Massachusetts
Approx. population: 6.75 million
Approx. population serviced: 1.4 million (535,000 households)
Approx. household cost: $75 per household
Approximate budget: $40 million
Executive Summary

SEMASS completed construction in 1988 and remains one of the largest WTE facilities in the nation, processing approximately 1.1 million tons of MSW and exporting nearly 600,000 MWh annually. SEMASS’s PRF technology provides both benefits, including increased metal recovery, and challenges, such as shredding and conveying waste. SEMASS is one of very few facilities in the nation with completely separate bottom and fly ash.

However SEMASS remains unsatisfied, we continually strive to improve our safety record, reduce environmental impact, refine operations, and grow revenue. The project list to accomplish these goals is extensive; several notable achievements include improving energy efficiency, metal quality and recovery, water utilization, reagent use, and auxiliary fuel diversity. These projects keep SEMASS at the forefront of the WTE industry and assure continued profitability and successful operations for years to come. We encourage you to watch our videos on YouTube, see links on the last page.

Facility History

Description

The SEMASS Resource Recovery Facility (SEMASS) opened in 1988 after approximately 10 years of design, permitting, and construction. SEMASS converts municipal solid waste (MSW) to steam and electricity, and offers MSW disposal for participating communities in Cape Cod, southeastern Massachusetts, and the Boston metropolitan area by truck and rail. The facility is located on a 95-acre site on Route 28 in Rochester, Massachusetts. It is designed to receive, then shred and magnetically separate metals from MSW to produce processed refuse fuel (PRF), which is fired in specially designed waterwall boilers. The facility produces enough energy for approximately 75,000 homes, and this energy is recognized by Massachusetts as Class II Renewable Energy under the Green Communities Act.

The facility was constructed in two phases, the first phase, referred to as the “Base Plant” included Units No. 1 and 2, a 54 MW condensing turbine generator, air-cooled condenser, water-cooled auxiliary condenser, air pollution control equipment, a switchyard, and auxiliary support systems. Unit No. 3 construction began before Units 1 and 2 were completed and is termed the “SEMASS Expansion” plant. The Expansion Plant includes Unit No. 3, a 30 MW condensing turbine generator, air-cooled condenser, air pollution control equipment, a switchyard, and auxiliary support systems. All three Units are Riley boilers rated at 375 MMBtu/hr and share a single, 345-foot stack containing three separate flues. The air pollution control systems for Units No. 1 and 2 consist of spray dryer absorbers followed by electrostatic
precipitators (ESP), activated carbon injection, and a Compact Hybrid Particulate Collector (COHPAC) unit. Unit No. 3 operates with selective non-catalytic NOx reduction using urea, a spray dryer absorber, and a baghouse.

Significant Challenges Overcome
Propane tanks and other hazardous wastes inherent to MSW are a significant challenge. Between 2002 and 2007 valve changes to increase propane tank safety came into effect. During this time the facility recovered approximately 62,000 propane tanks. The facility had 2 major fires during this period caused by improperly disposed tanks. The largest fire occurred on March 31, 2007 and damaged a significant portion of the facility. SEMASS employees and contractors disregarded original estimates that the facility would be offline for approximately 6 months and restored limited facility operations within 18 days and full capacity by May 9th (39 days). SEMASS continued to honor the disposal agreements with all contracted waste during this time. The extensive repairs completed after the fire include 2,000 feet of conveyor belts, 263 conveyor rollers, 47,200 square feet of building roofs, miles of electrical cables, and the complete replacement of the fire, air and lighting systems. There can be no better validation of the facility’s recovery plan than having to implement the plan during a major event such as the 2007 SEMASS fire. In addition to equipment restoration, many systems were improved including redesigning feed conveyors to reduce spillage, replacing fiberglass odor ducts with stainless steel, improving picking platforms, and adding a Resolite roofing system to improve visibility and reduce the need for lighting during the day. Following the event the hindsight analysis did reveal some areas of improvement however the plan did work well. With the help of its employees and contractors SEMASS was able to rise to the significant challenges. The recovery plan is updated annually and one of the changes recently made was to increase waste exchange agreements with other companies. This enables Covanta to divert waste away from SEMASS during the peak summer months or plant downtime when the plant can have too much waste and trade that for waste in the winter when the plant can have too little waste. Our transfer station infrastructure also allows us to divert waste to other Covanta facilities in Massachusetts and Connecticut.

Integration with the Communities Solid Waste Management System
At SEMASS when you discuss the community you should consider all of Massachusetts. Based on the Massachusetts Department of Environmental Protection (MassDEP) 2012 Solid Waste Data Update, Massachusetts has a thriving recycling program where approximately 37% of all solid waste is recycled. SEMASS accepts approximately 1.1 million tons of the remaining 5.4 million tons sent for disposal, therefore SEMASS accepts approximately 20% of all solid waste disposed in Massachusetts.

Each compressed ton of MSW equates to approximately 2.0 cubic yards of landfill space. SEMASS generates approximately 0.27 million tons of ash annually, each ash ton equates to approximately 1.0 cubic yard of landfill space. Annually SEMASS sends approximately 0.17 million tons of bottom ash for reused as daily cover. Assuming that the reused bottom ash would need to be replaced by other cover materials the actual waste ash is 0.10 million tons. Based on the above data SEMASS has avoided the need for approximately 56 million cubic yards of landfill capacity. Assuming a waste height of 200 feet and a 3:1 slope, SEMASS has prevented a minimum of 245 acres of landfill development. This is the primary reason for the facility and continues to hold true today.
Massachusetts has recognized WTE as a Class II Renewable Energy source in the Massachusetts Renewable Energy Portfolio Standard (RPS). The RPS requires electricity suppliers to obtain waste to energy credits for 3.5% of the electricity sold in Massachusetts. In turn, half of the money collected through renewable energy credit sales is returned to the MassDEP to provide grants to promote recycling within Massachusetts. Participation in the RPS program requires SEMASS to hire third party inspectors to inspect incoming waste. These inspectors generate observation reports quarterly for the MassDEP summarizing their observations. A complete waste characterization is conducted biennially to determine the actual contents of waste delivered and reports are submitted to the MassDEP.

Massachusetts has set ambitious recycling goals in its Solid Waste Master Plan. The state’s solid waste regulations of 310 CMR 19.017 reinforce this by banning a number of materials from disposal that can be recycled from the solid waste stream. These "Banned" materials include: lead-acid batteries, leaves & yard wastes, white goods, recyclable metal, glass & plastic food & beverage containers, recyclable paper & cardboard, cathode ray, asphalt pavement, brick & concrete, metal, clean gypsum wallboard, and commercial organics.

SEMASS supports these efforts by inspecting every solid waste load that enters our facility. In 2015 alone, SEMASS observed banned materials in more than 1,700 solid waste loads. The operations team took positive actions to encourage waste haulers and generators to separate and recycle those materials.

SEMASS’ communities lead the day-to-day recycling effort to support the state’s ambitious goals. Typically, SEMASS’ long-term communities achieve solid waste recycling or diversion percentages of 10-50% or more. SEMASS has reinforced and augmented our town’s efforts with our own annual recycling efforts:

- Separation and recycling of thousands of “Banned” items such as lead-acid batteries, tires, CRTs, white goods, and cardboard as well as propane gas tanks
- Recovering tens of thousands of tons of ferrous and non-ferrous metals
- Diversion and beneficial reuse of tens of thousands of tons of SEMASS Processed Bottom Ash (PBA); PBA is approved for use as alternative daily landfill cover or as alternative landfill construction material by the MassDEP
- Reclamation and proper recycling of hundreds of pounds of mercury and thousands of mercury-containing devices (fluorescent lights, thermostats, thermometers, switches, etc.)

**Influence on the Industry**

SEMASS’ availability has averaged over 90% during the last six (6) years as shown in the graph to the left. This represents a very high level of performance for a Refuse-Derived Fuel (RDF) facility. This is the result of careful operations, maintenance, and skilled execution of major and minor boiler outages in a rapid, and cost-effective manner.

**Boiler Tube Technology**

SEMASS has improved boiler superheater tube life expectancy from between 12 and 18 months to as high as 120 months through materials science. The SEMASS boilers utilize a two-stage
pendant type superheater suspended over the boiler’s upper convection slope. There are 43 Low Temperature Superheater (LTSH) assemblies and 43 High Temperature Superheater (HTSH) assemblies. Each LTSH is constructed from a single tube circuit forming sixteen vertical runs. The LTSH original material selection was 2-1/4” 0.150” MWT SA210A material. SEMASS has switched to an Inconel 625 overlay as the most economical solution to corrosion problems. These pendant superheaters are expected to last 10 years and then either be partially rebuilt in place or removed, rebuilt, and reinstalled in another unit. This is nearly a 900% increase in life expectancy.

The High Temperature Superheater pendants currently utilize a heavy wall construction (0.340” MWT) of T-22 tube material overlaid with Colmonoy 88 material in all vertical runs. Where these tubes bend we utilize Inconel 625 overlay. These pendants are now on a 48 month replacement schedule tripling the former life expectancy of the HTSH assemblies.

Power Production Efficiency
The facility provides a service for the surrounding communities by disposing of their waste in a clean and efficient way, however the facility’s dry cooled condensers were not adequate to maximize power production during the summer months. SEMASS installed a single cell, wet cooled, parallel condenser in 1999 and completed the installation of a second cell in 2015. These condensers provide more efficient heat transfer during the summer months allowing the facility to recover more energy from MSW combustion. The parallel units essentially float on turbine back pressure and automatically shift load to the water cooled unit as the air cooled unit performance lessens. This second cooling tower upgrade has enabled the SEMASS facility to generate an additional 6,000 to 10,000 MWhrs per year during the summer months when ambient temperatures exceed 70 degrees Fahrenheit (°F) while maintaining a relatively low water consumption.

SEMASS also improved the air cooled condensers in 2014. One air cooled condenser has six fans and the other has twelve fans. The original design utilized 125HP fans to push cool air up through the coils. As part of SEMASS’s continuous improvement program we identified an opportunity to save energy by installing variable speed drives to precisely control fan speed. This project saves energy by operating the fans at their most efficient speed based on the condenser discharge temperature will allow maximum boiler output thus increasing overall system efficiency allowing the facility to export approximately 8,400 more MWhrs per year.

In 2014 SEMASS began a lighting improvement project to reduce electrical demand by replacing older lighting with LED lights. This project is anticipated to reduce the facilities internal electricity consumption by over 3,440 MWhrs per year and is expected to be completed in 2016. In 2016 SEMASS will begin another electricity efficiency project which will concentrate on the facility’s compressed air system. SEMASS hopes to improve system efficiency by troubleshooting the existing delivery system and installing more efficient compressors.

Auxiliary Fuel Project
SEMASS was designed during the low oil prices of the late 1980’s and was constructed to utilize oil rather than natural gas as an auxiliary fuel. In 2013 SEMASS replaced all existing distillate oil...
fired auxiliary burners with new dual fuel fired auxiliary burners capable of combusting natural gas or distillate fuel oil. Natural gas is an inherently cleaner burning fuel which aids the facility in reducing overall facility air emissions and also is currently a less expensive fuel than oil. The oil and gas market volatility over the last 10 years shows that having the capability to combust either fuel improves the plant’s flexibility and profitability. Rather than switching completely to natural gas fuel the facility purposefully retained the flexibility to combust oil.

**Design and Construction**

**Facility Design and Process Limitations**

Being a RDF facility the SEMASS process is much different from a mass burn facility. The SEMASS tipping floor is approximately 3 acres, is entirely at ground level, and does not have a pit. Waste enters the tipping floor through roll up doors and the vehicle is backed into a section of the tipping floor to offload. The waste is stacked using a long reach loader with a 20 yard bucket to approximately 20 feet high. If waste volumes are high waste can be compressed using a bulldozer and the height can be increased to approximately 30 feet.

Waste is pushed to the back of the tipping floor and fed to one of three MSW shredders to begin processing it. Three shredders (one 2,000-hp and two 1,750-hp) are used to process the waste to less than 6 inches diameter. This material is then passed under a magnet which removes metals before combustion. The resulting waste material, called processed refuse fuel or PRF, is either fed directly to the boilers or stacked in a separate section of the tipping floor. Each of the three shredders can process approximately 120 tons of MSW an hour. Shredding usually occurs overnight thus reducing the odor impacts and allowing daytime maintenance to occur.

The requirement to shred waste also limits the material types that can be accepted by the facility. Flammable materials that can catch fire or explode are of the greatest concern. Long stringy materials can form balls inside conveyor hoppers and wrap around shredders, conveyors or drag chains. SEMASS attempts to remove these material types early in the process to prevent more extensive process disruption. In fact the earlier these materials are separated the less effort there is to remove them.

**Facility Sighting**

Rochester Massachusetts, the SEMASS host community, has approximately 4,600 residents. SEMASS is sighted on a 95 acre parcel that is set well back from the nearest roadway the facility’s visibility is limited to the stack in most instances. The forest lined entrance road is approximately 1,300 feet long and the smallest forested buffer between the road and the facility is approximately 250 ft. This provides excellent screening to the facility. More than half the facility is surrounded by cranberry bogs and swamplands and the other half is mainly commercial and industrial properties. All of these combine to help the facility meld with its surroundings rather than disrupt them. The extensive buffers help to reduce noise and odor impacts and to fit into an area that is otherwise very rural.
SEMASS stormwater is treated using 3 retention basins for the majority of the stormwater while a small section of the facility (approximately 2 acres) discharges via a swale system. Neither of these systems discharge frequently as the facility design attempts to recharge the groundwater as much as possible rather than discharging to the surface water systems in the area. In addition the stormwater collected in the retention basins is utilized in place of groundwater as described below.

SEMASS’s location precluded connection to a town water distribution system, therefore normal facility operations includes supplying both drinking water and process water. These systems are completely separate and thus different water qualities can be utilized based on the required water cleanliness. Power production is water intensive and the SEMASS Facility is no exception, however the facility design as well as projects completed since the facility’s inception have limited the clean water utilized. The SEMASS facility is located within the Buzzards Bay Watershed and is surrounded by cranberry growers who require clean water for crops. The vast majority of Massachusetts 13,000+ acres occur inside the Buzzards Bay Watershed.

Annually SEMASS utilizes approximately 100 million gallons of water. Between 30 and 50% is supplied by stormwater withdrawn from onsite stormwater basins or wastewater recovered from nearby businesses.

As part of the facility’s continuous improvement program we have reduced lime use by removing high total dissolved solid (TDS) containing wastewaters from use in the pollution control systems. We found dilution water quality greatly affects lime usage. The SEMASS facility is located within the Buzzards Bay Watershed and is surrounded by cranberry growers who require clean water for crops. The vast majority of Massachusetts 13,000+ acres occur inside the Buzzards Bay Watershed. The SEMASS RRF Water Use Schematic:

Water systems

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reactivity in the pollution control systems. SEMASS created four separate wastewater reuse systems in 2011 and improved the system again in 2015 by installing three 25,000-gallon wastewater tanks and piping systems for lower TDS wastewaters, completely separating them from high TDS wastewaters. This has reduced lime consumption by approximately 1/3 without impacting facility air emissions or reducing the overall wastewater use.

An additional benefit to the lime reduction project was realized since 2010. The ash generated by the facility has decreased significantly, mainly relating to the lime optimization project and the reduced use of highly contaminated water in the pollution control systems. The increase in 2013 and 2014 was mainly due to MSW throughput variability during those years.

SEMASS’s location away from town utilities, requires us to be our own drinking water supplier. Recent drinking water quality regulation changes required SEMASS to modify existing treatment systems. The 2009 Ground Water Rule required more intensive responses to Coliform detections while proposed regulations on magnesium would eventually add additional requirements. SEMASS responded by redesigning our drinking water treatment plant to provide drinking water disinfection and manganese removal before the regulation was proposed. These treatment changes required approximately 2 years to design, test, permit, and implement. Since the facility took action well before the new manganese requirements went into effect, only one manganese level was exceeded following the regulation’s release and occurred during the new treatment system’s shakedown period. This treatment improvement also eliminated one drinking water well and thus provided SEMASS with an additional industrial water well without requiring increased water withdrawal permitting.

Environmental Controls and Regulatory Compliance

Odor ducts
SEMASS ducts air from MSW handling and shredding areas for use as boiler combustion air. Maintaining a negative pressure in waste handling areas drastically reduces fugitive odors. Pre-shredding inspection checklists are completed to assure that the proper doors and other openings are closed before any shredding operations are conducted.

SEMASS has developed a shredding schedule that maximizes the waste throughput during mid-week overnight hours, thereby decreasing the opportunity for odor. Implementing this schedule in conjunction with monitoring wind and temperature data from an on-site meteorology station has significantly decreased facility fugitive odor issues. SEMASS has found that limiting the odors that escape the facility reduces the odor impact without adding odor and volatile organic emissions in the form of perfumes which can have the opposite effect.
Compliance with Local, State and Federal Regulations

The facility reduces its emissions through good operating practices and emissions control equipment. Emissions recorded during last 3 tests (shown in the table to the right) demonstrate that the facility is operating well below the permitted emissions limits. SEMASS achieves this through proper maintenance and operating practices. Massachusetts facilities are required to test emissions every 9 months rather than every 12 months which means that the boilers condition changes based on how long since the boiler had its annual outages. The last 3 tests occurred in April 2014, January 2015, and October 2015 and represent one test shortly after our March outages and the others a significant distance from the outages.

SEMASS has made great progress in complying with its air permit conditions, as can be seen in the graph to the right. The facility has reaffirmed its commitment to environmental compliance by setting a no environmental exceedances goal and altering operations, procedures, and training to reflect this goal. Although we have not achieved a year without an exceedance we came close in 2014 with 354 days between exceedances.

Climate Change Impact

WTE is an internationally recognized source of GHG emissions mitigation. Numerous international governments, NGOs, and researches recognize the climate benefits of WTE, including the U.S. EPA, the Intergovernmental Panel on Climate Change (“IPCC”), the European Union, and others.

WTE contributes to GHGs reduction in three ways:

- Generating energy that would likely be generated by fossil-fueled facilities
- Diverting solid waste from landfills where it would have emitted methane for generations
- Recovering metals for recycling, thereby saving the GHGs and energy associated with the production using virgin materials

The U.S. EPA has determined that WTE facilities reduce GHG emissions by one tonne CO2 equivalents (CO2e) for every MSW tonne diverted from landfills. This is mostly achieved by reducing emissions that would have otherwise occurred at the landfill in the form of methane. This means that WTE is the only major electricity source that actually reduces GHG emissions.

In addition to this SEMASS has taken steps to increase power production efficiency, reduce parasitic load, and reduce GHG emissions were possible. Examples of this include the cooling tower and lighting projects discussed previously and the recent replacement of a rechargeable SF6 breaker with a sealed SF6 breaker. This eliminated emissions and removed the need to recharge SF6, a gas with a CO2e value of 34,900 over 500 years and a lifespan of 3,200 years.
Ash and Metals Management
Starting in 2012 SEMASS has completed 3 major changes that have increased metals recovery tonnage as well as increased recovered metal quality. SEMASS recovers approximately 85% of its total ferrous metals before combustion. Pre-combustion recovery increases total metal recovery by reducing losses during combustion.

The first change converted one MSW shredder into a second pass metal shredder which cleans the metal from both pre and post-combustion ferrous recovery systems. SEMASS also added a zero bleed air classifier to separate light and heavy solids using induced airflow within the system. However unlike many air classifiers the system reduces the air escaping thus nearly eliminating air emissions.

The shredder and air classifier improve the produced metals quality and allows combining the back end and front end ferrous as one product. It is difficult to quantify the change because the material before the change contained a significant MSW contamination. However the project affected the metal value and the facility has increased revenues by $1-2 million per year when adjusted for metal prices.

The second change improved non-ferrous metals recovery in the bottom ash plant. SEMASS installed a second eddy current separator (ECS) to separate metals that are less than 3/8 inch which had previously had been included with the bottom ash. This improvement increased non-ferrous metal recovery by approximately 1,500 tons annually and prevented the equivalent amount of bottom ash generation.

SEMASS has always received waste from Cape Cod by rail. This has limited the traffic impact across the bridges that span the Cape Cod Canal. The third change was to improve the existing rail system and allow rail cars to be loaded with outgoing metals helping reduce metals shipment cost and increase the viable marketing area for this product.

Special Waste
SEMASS participates in Covanta’s Prescription for Safety Program (Rx4Safety). Covanta developed the Rx4Safety to provide safe, free disposal of medications collected at community sponsored drug take-back programs. Covanta’s Waste to Energy (WTE) facilities provide safe, environmentally sound destruction that protects water resources and reduces the risk of drugs reaching unauthorized users. SEMASS also aids area police departments by destroying evidence that is no longer needed including illegal drugs and firearms.

SEMASS receives special wastes including contaminated petroleum cleanup debris and off-specification products and raw materials from various clients. SEMASS also receives wastewaters for reuse in onsite processes. All of these materials go through an extensive characterization process which assures that the materials will meet permit requirements but also not cause undue hazards to equipment, personnel, or the public. This process includes an extensive characterization by the client, similar to what is expected for hazardous waste disposal profiles, to
determine if the waste can be accepted. Before liquid wastes can be accepted for reuse, volatile organic compound analytical testing is required to ensure that the facility’s air permit conditions are met. Clients are required to update analytical data periodically and the approval system assures that this is done in a timely manner.

Coordination and Relationship with the Community

Responses during a State of Emergency
In 2015 SEMASS facilitated changes to its local and state solid waste permits to allow the facility to automatically extend waste acceptance hours and increase waste receipt days based on the governor’s declaration of a state of emergency. This flexibility allows SEMASS to respond to emergency events that prevent waste collection or increases waste volumes without requiring a short term approval from the state or town. This allows SEMASS to respond to the communities’ needs quickly without interrupting state and town officials who have greater concerns during an emergency.

Odor Control
Odor control is a challenge faced by all waste facilities including SEMASS. In spite of the technological disadvantages shredding waste has regarding odor, SEMASS continues to have success controlling fugitive odors. This success is attributable to a variety of factors including: good process controls, emphasis on waste inventory management, engineering controls for odor mitigation, operational flexibility, and close interaction with the facility’s residential neighbors. SEMASS provides an odor hot line to facilitate direct communication between operations and the community. Members of the community can contact the facility at any time by dialing into the hot line and then can choose to talk to control room staff directly or leave a message. The control room staff checks messages periodically throughout the day and responds to complaints by halting any possible odor producing operations and facility staff ensure doors are properly closed. This communication is vital to reduce the impact of the facility on our neighbors.

Truck Traffic
Another local community concern is truck traffic. SEMASS distributes hauler pamphlets annually describing the facility’s designated hauling route and monitors the route using video surveillance at the main entrance. Letters are sent periodically to haulers that violate the hauling policy and additional action such as banning drivers or hauling companies can be taken for frequent offenders.

Mercury Diversion and Collection
SEMASS identifies and safely diverts mercury and mercury containing products before they can be discarded as part of the Mercury Separation Program (MSP). Mercury-containing products collected include: glass thermometers, fluorescent lights, high-intensity discharge (HID) lights, thermostats, industrial switches, button cell batteries, barometers, medical blood pressure cuffs (sphygmomanometers) and elemental mercury. SEMASS annually spends approximately $340,000 in MSP support and has recovered thousands of equivalent elemental mercury pounds. Mercury-containing products collected in 2015 through cooperation with municipalities, regional recycling organizations, and businesses are as follows:
• 285,000 linear feet of straight fluorescent lamps
• 28,000 other fluorescent lamps (i.e. circular lamps, U-tube lamps, compact lamps, and HID lamps)
• 2,450 thermostats (residential & commercial)
• 413 fever or laboratory thermometers
• 1,378 industrial mercury switches
• 8 medical blood pressure cuffs
• 8 weather or laboratory barometers
• 81 pounds of liquid elemental mercury

Fishing for Energy
Fishing for Energy is a partnership between the NOAA Marine Debris Program, Covanta Energy Corporation, National Fish and Wildlife Foundation (NFWF), and Schnitzer Steel Industries, to prevent and reduce the impacts of derelict fishing gear in the marine environment. The program, which is modeled after Hawaii’s Nets to Energy, provides the fishing community no-cost options for disposing of old or unwanted gear, and the old nets, line, and ropes are converted into energy. Although the SEMASS facility cannot accept much material generated under this program due to our processing technology, SEMASS personnel routinely donate time to promote the program since the nation’s most profitable fishing port, New Bedford, MA, is within our waste shed. Recognizing the benefit to the local area, SEMASS has helped publicize the program and personnel regularly staff booths at the New Bedford Working Waterfront Festival to encourage the use of the local collection sites for derelict gear.

WTE Industry Promotion and Awards
Covanta is a major contributor to the Energy Recovery Council (ERC) and the associated website www.keepmercuryfromrising.org. The Energy Recovery Council is the national association representing companies, organizations, and local governments engaged in the waste-to-energy sector in the United States.

Participation and promotion of programs such as the Mercury Separation Program, Rx4Safety and Fishing for Energy promote the WTE industry as a solution to environmental, health and safety problems and help people and town agencies at a local level. This beneficial local involvement cannot be undervalued as a source of industry good will.

SEMASS received an American Society of Mechanical Engineers (ASME) honorable mention for large waste to energy facility in 2007. The 2007 application focused on improvements made before 2007 such as upgrades to the facility’s Distributed Control Systems, propane tank collection as well as some of the items discussed herein however without the additional improvements SEMASS has made in the interim. This 2016 application has attempted to concentrate on improvements made since 2010 to avoid taking credit for efforts that have already been recognized.
Worker Health and Safety

Safety is a very important part of operating any waste to energy facility and is made even more important at a RDF facility. The 32 MSW conveyors and 31 (18 bottom ash, 13 fly ash) ash conveyors move materials around the site. The longest MSW conveyor is 425 feet and delivers waste to the 6th floor of the boiler building from the tipping floor.

Training is provided on a weekly, monthly, quarterly, and annual basis depending on the program and requires that the facility train 130 SEMASS personnel and 600 outside contractors. Most of the contractor training is conducted during the major outages in March.

Three separate training programs are utilized to assure that personnel are adequately trained. The safety program focuses on informing operators of possible hazards and educating operators to recognize and eliminate hazards. The environmental training program focuses on the proper operation of the facility relative to the operator’s assignments and where operators can reduce their environment impact. Both the safety and environmental programs train employees on a multitude of programs where training is required by regulations. The operations training program focuses on the operator’s knowledge and troubleshooting skills.

SEMASS has received Safety awards for injury rates 50% below the Classification rates for 2013 and 2014 and hopes to return to that type of performance in 2016.

SEMASS has an incident index of 41.8 for 2015. However the two previous year’s incident indexes were 17.3 and 14.2 respectively. SEMASS recognizes the slip in the incident index and is reaffirming the facility’s safety commitment. To do this we initiated a program to heighten employee’s hazard awareness by performing more audits, conducting daily job reviews and performing hazard analysis on new equipment and procedures. The facility has also maintained an extremely low incident rate during outages. During the 2015 outages SEMASS employees worked 33,525 man-hours and 50,400 contractor hours and had 1 recordable and 6 first aid injuries, which was in line with previous year’s outages.

The current facility safety initiative is to eliminate brute force tasks. Brute force tasks are tasks which require operators to use physical force to complete a task. By redesigning the equipment or area where the task is performed the brute nature of the task can be eliminated. Over the last year the facility has successfully eliminated 3 brute force tasks.

SEMASS safety personnel and facility staff perform weekly safety audits to measure employee performance in relation to safety requirements. The facility’s Safety and Environmental (S&E) Committee conduct equipment audits on a monthly basis attempting to find equipment or processes deficiencies. Employees are required to submit two near misses a month which encourages employees to stay observant and aware of their surroundings.

The employee S&E Committee has a program to recognize the best near miss of the month. The S&E Committee chairman appoints a member each month to review each near miss submitted and select the best safety and environmental near miss to receive recognition. All personnel have access to an online employee recognition program called “I-Lift” which provides all employees with a mechanism to award and formally thank each other for tasks that deserve recognition. This system has many different recognition levels and the awards vary accordingly. The employee’s
supervisor will review the submission and depending on the recognition level selected it can be elevated all the way to Corporate Management.

Performance, Economics and Cost Effectiveness

Primary Indicators of Performance

The primary metrics that SEMASS uses for performance are turbine availability, boiler availability, steam generated per hour and total steam generated, total net power sold, total tons PRF combusted, and total metals recovered.

Turbine availability is the percentage of time that a given turbine is “on line” and generating power. SEMASS has two steam turbines that both generally achieve 97% to 98% availability except during major overhaul years when the percentage is closer to 94%.

Boiler availability is the percentage of time that a particular boiler is “on line” or combusting MSW. This percentage typically runs between 91% and 92% as shown in the graph in Influence on the Industry.

Steam generated is measured in both an average steaming rate in thousand pounds of steam per hour (kpph) for each of the three boilers and total steam generated by the facility on an annual basis. Each boiler typically averages approximately 280 kpph for the entire year. Total steam generated by the facility runs about 7.5 million pounds of steam annually (kppy).

Net power sold averages between 580,000 to 600,000 MWhrs/yr. Total tons of PRF averages approximately 1.1 million tons per year. Both of these metrics are included in a graph in the Executive Summary.

Total metals recovered typically averages 32,000 tons per year after cleaning to 99% purity. A graph of metals production is included in Ash and Metals Management however values prior to 2012 represent periods before the projects discussed therein.

We have targets for each parameter monitored and strive to exceed those targets annually. We watch these parameters continuously and compare current performance to historical performance both quarterly and annually. If any shortfalls become evident we investigate causes and develop performance improvement plans to address them. In fact, the number of projects discussed far exceeds the number of projects completed and, as can be seen by the projects included throughout this document, opportunities are proposed and analyzed frequently. Project feasibility is determined by a joint team of specialists in business, marketing, and operations to assure a projects success. This collaboration involves both SEMASS and Covanta team members.
Financial Metrics

Revenue is predominately derived from tip fees with the remainder coming from metal and power sales. Our operating expenses fall within the range of expectations. Most years we exceed the goals established, however some years are better than others. In poor performing years we investigate the specific reasons for the shortfall and develop a plan to turn around performance. However SEMASS’s point of view is that improvement is not something to examine only in poor performance years.

We have a contractual host agreement with the Town of Rochester, an ash disposal agreement with Bourne Landfill, a metals recycling agreement with WTE, Inc. and Schnitzer Metals Recycling and an agreement with CMW Refuse District which is made up of the towns of Wareham, Carver and Marion. We also have direct contracted municipal waste which accounts for 10.5% of the annual waste volume, contracted commercial volume accounts for 36.5% of waste acquired, 45.1% comes from inter-company transfer stations and the remaining 7.9% of the annual waste acquired is spot volume.

66% of our MWh’s are contracted at a fixed price with Eversource until 2017, the remaining is variable according to market fluctuations. Covanta has recognized that the power market is changing and fixed price power contracts have already expired at several facilities. Covanta is currently investigating contract options with municipal lighting plants and using point-to-point power sales where the market allows. These types of agreements will limit our exposure to volatile electrical market prices. In addition, hedging the market through short term power deals has provided stability in an otherwise volatile marketplace.

Predictive and Preventative Maintenance

SEMASS has a world class maintenance team employing personnel with a myriad of technical ability and utilizing the latest in predictive maintenance technology. Monthly vibration, quarterly oil sampling, infra-red thermography, acoustic data, motor electrical signature data, and most importantly, actual operating experience are all tools the maintenance department uses in assessing critical asset health. Maintenance staff are able to execute a variety of tasks including preventative maintenance, significant boiler piping and power projects, rotating equipment installation and alignment, and all facets of facility construction from excavation and concrete form work to steel erection.

At SEMASS, all equipment inspections and repairs as well as preventative and predictive maintenance are scheduled through a computer-based maintenance system and are written based on manufacturer’s recommendations, historical equipment failures, and companywide experiences. The first step in planning and executing reactive maintenance activities is to write a work order. Tasks are then assigned to specific employees such as maintenance mechanics or instrumentation technicians. Approximately 300-500 work orders are initiated each month at SEMASS. Maintenance activities include:
• Planning, executing and coordinating major boiler outages, boiler washes, shredder rebuilds, equipment rebuilds, etc.
• Maintaining, troubleshooting and repairing major equipment
  o Fuel side includes conveyors, shredders, ferrous systems, rail tipper, fire systems, etc.
  o Power Side includes tubes, grates, quench tanks, air pollution control systems (ESPs, COHPAC units, SDAs), Water Treatment operations, etc.
  o Ash Plant includes silos, conveyors, pugmills, etc.
• Instrumentation, controls or electrical issues including switchyards, all instrumentation and controls, and electrical systems that support facility equipment.
• Proper maintenance of all mobile equipment including loaders, tractor-trailer trucks, and support equipment (sweeper, vacuum truck)

Links for More Information

SEMASS Video
• Video of the SEMASS facility with description of the process
  https://www.youtube.com/watch?v=VhJRuiEId9Y

“Energy Train” Video
• Video of waste traveling by rail from Cape Cod to SEMASS and the operation of the SEMASS Rail Car Tipper
  https://www.youtube.com/watch?v=BQyh6LMrVc0

Mercury Management Video
• Provides guidance on managing mercury containing materials for our member towns
  https://www.youtube.com/watch?v=IrlztOoYftc

Covanta Sustainability Page
• Describes our company’s sustainability goals and provides access to Covanta’s Sustainability Report

MassDEP SEMASS Information Page
• Includes links to Annual Compliance Reports, Waste Characterization Reports, and Mercury Material Separation Plans
• Includes links to facility semiannual and annual compliance reports, compliance test data, startup and shutdown emissions, and CEMS downtime data
  http://public.dep.state.ma.us/MWC/default.aspx