Cover Sheet

Title: 2016 Excellence Award Entry

Name of Category: Waste-to-Energy

Name of Entrant Organization: City and County of Honolulu

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Title of Entry: H-POWER: Honolulu Program Waste and Energy Recovery

Jurisdiction: City and County of Honolulu

Jurisdiction Population: 985,000

Cost per Household for the Project: $300 annual operating budget; $90 net revenue returned in electric revenues, tipping fees, recovered metals, and other. Expansion cost was $970 per household (incl. existing facility refurbishment, Sludge, and WAB projects). Original project constructed in 1988 for about $575 per household, sold for $950 per household and bought back in 2008 for $55 per household. Revenue from 1991 through 2015 about $850 per household. All numbers are rounded.

Approximate Budget: Approximately $100 million
Executive Summary
Serving as a critical component to the local solid waste management plan, H-POWER provides invaluable benefits that begin with its uniquely integrated refuse derived fuel and mass burn technology. This includes new municipal sludge receiving, accepting more municipal solid waste (MSW) with nearly complete diversion (including MSW, sludge, bulky waste, and City-generated tires and other combustible waste), and continually examining opportunities for improvement through refurbishments and capital projects for improved performance and profitability.

Highly prized by the community, H-POWER’s municipal sludge receiving, storage and injection facility allows controlled odor-free processing of sludge. H-POWER has pioneered ash reuse and designed the mass burn technology (MBN) for separate or combined bottom and fly ash generation.

Already producing cost-effective renewable baseloaded and dispatchable power, H-POWER will add an extensive solar panel grid as a means of reducing in-house power consumption, thereby increasing the electrical power available for the O‘ahu citizens.

O1 | Facility History
Prior to 1977, the City and County of Honolulu (City) had conducted, commissioned or sponsored a number of studies over an approximate 12-year period in order to find a solution to what was then a growing solid waste problem. At that time, approximately 80 percent of O‘ahu’s refuse was disposed at City-operated landfills, and space at these landfills was rapidly being used.

In 1977, analysis of possible waste disposal solutions was conducted. That analysis recommended the development of a solid waste resource recovery system to address the solid waste issue. The City embarked on a program to implement the recommendations contained in the report. In the summer of 1978, the City issued a Request for Proposals (RFP) for what was referred to as “H-POWER – the Honolulu Program of Waste Energy Recovery.”

In 1982, bidders were asked to submit bid prices. At that time it was hoped to award a contract by the end of December 1983 and to enter full-scale operation by January 1987.

After a series of submittals and reviews a contract for construction was signed on July 3, 1985 with Honolulu Resource Recovery Venture using Combustion Engineering technology for waste processing design and the combustion units. One of the Facility’s very first challenges occurred shortly after signing the construction contracts. Due to changing environmental regulations, the contract was soon amended to incorporate spray dry absorbers (SDA) into the air pollution control design and the facility was one of the first users of this technology for waste combustion service.

In May of 1990 the H-POWER Facility went into commercial operation at its current location in the James Campbell Industrial Park located in Kapolei, Hawaii.

The original H-POWER facility consisted of two 100-tph waste processing trains (the daily processing capacity is 2,160 tons per day (tpd) in a single shift) and two 854-tpd Refuse Derived Fuel (RDF) combustion units. These original units utilized a Detroit Stoker Grate to process the RDF produced by the waste processing trains. Steam generated from the energy recovered from the combustion flue gases is sent to a 59 MW steam turbine to produce electricity. Each combustion unit had a state-of-art SDA and an electrostatic precipitator (ESP) to remove heavy metals, acid gases, and particulate from the exhaust flue gas. In anticipation of tighter regulations on air emissions, the City replaced both of the existing ESPs with reverse air fabric filter baghouses in 2009. The baghouses have provided improved performance with respect to particulate and heavy metal control.

The original operator of the facility was Combustion Engineering. In 1993, Ogden Martin Corporation which later became Covanta, acquired the interests in the project when Combustion Engineering/ABB made a decision to exit the waste-to-energy industry. The City was able to work through these challenging years as well as the financial issues of Ogden Martin. Covanta now operates the facility under the subsidiary Covanta Honolulu Resource Recovery Venture, LLC.

By 2008, the City was again facing the need to address solid waste issues on the island of O‘ahu. The City challenged itself with a commitment to work toward elimination of the island’s only remaining active MSW landfill. The City issued another RFP for an expansion to the H-POWER facility, but for a traditional mass burn (MBN) unit and not for another RDF processing unit. In the same year, proposals were received for the design, construction, and operation of a new 900-tpd Waste-to-Energy (WTE) expansion unit. A unique feature of the MBN unit is its NOx control technology - Covanta’s Very Low NOx (VLNTM). This technology lead the way to lower NOx limits and has since be integrated into the Durham Facility. Refer to Section 2 for further discussion.
Facility Timeline

1977 Analysis of possible waste disposal solutions.
1982 Bidders asked to submit bid prices.
1990 H-POWER Facility went into commercial operation.
2008 Request for Proposal issued for an expansion to the H-POWER Facility. RDF Facility needs refurbishment.
2010 Refurbishment needs identified and the first RDF Unit refurbishment began.
2015 (early) Commissioning of sludge receiving storage and injection system.

The expansion unit construction broke ground in December 2009 and was completed in August 2012, on budget and four months ahead of schedule. Integrating the two unique plant styles into a single facility was challenging but was accomplished by backing the tipping floors up to each other and building out from the center. Throughout the construction period careful steps were taken to ensure the facility would meet or exceed performance guarantees. The City began the first of these RDF unit refurbishment activities in 2010, in parallel with the MBN construction.

The dedication ceremony was held by the mayor of Honolulu and Covanta Energy Recovery on October 9, 2012. The expansion unit is a traditional Martin Stoker Grate MBN. Unlike the original RDF units, the MBN unit does not require any pre-processing of the MSW. In addition to regular MSW, the expansion can also process bulky material which the facility was not able to process with the original RDF units. Similar to the RDF units, the MBN unit is equipped with a SDA and fabric filter baghouse to control emissions. Steam generated by the MBN boiler is sent to a separate 32 MW steam turbine.

At the same time, after nearly twenty years of operation, the RDF facility was beginning to show the need for some extended-life refurbishment projects. As part of the preparation for the next twenty-year contract term, the City wanted to replace key equipment and give the facility a makeover. Necessary projects were identified for continued operation to meet and exceed the contract performance guarantees. These projects were reviewed, and a budget of $48 million was established for continued operation to meet and exceed the contract performance guarantees. The City began the first of these RDF unit refurbishment activities in 2010, in parallel with the MBN construction.

The H-POWER facility has become the first WTE facility in the US with a dedicated sludge receiving, storage, and injection system designed for controlled and complete burnout of sludge. The facility is now processing all used auto tires received at City facilities, treated non-sharp medical waste and contaminated green waste, thereby reducing City handling costs while generating electricity in an environmentally sound manner. In addition, the City has added a second larger capacity bulky shear shredder to increase the capacity of the facility to process combustible bulky waste particularly during semi-annual outages for the MBN unit and during peak receiving periods. Testing programs are underway for ash re-use as well as processing automobile shredder residue (ASR). The RDF boilers have new superheater and bullnose designs intended to extend the useful life while increasing electrical production efficiency. Also underway is a simplification and refurbishment of the RDZ production lines which are anticipated to reduce process residue, eliminate bottlenecks, and improve productivity. The City has started the construction process for more than three megawatts of solar panel capacity that will reduce the facility parasitic load and increase power sales. It has been a very busy two years setting the facility up for a bright future.

Landfill Reduction

As another major step in reducing wastes disposed in the landfill, the City began with focus on the remaining combustible waste streams going to the landfill. By 2011, the City called for the design and construction of a sludge injection system that would be added to the MBN unit. The installation of this system allowed the facility to receive, store, and process virtually all of the island’s wastewater treatment plant (WWTP) sludge that was disposed at the landfill. The system is designed for a capacity of 90 tpd at thirty percent solids sludge. The resulting net energy recovery for the unit when firing the treated sludge is slightly reduced but considering the important benefits of landfill diversion, volume reduction, and the potential offset from certain other waste streams, the benefits far outweigh the performance impacts. The sludge system removes about twenty thousand tons of sludge from the landfill and an equivalent quantity of combustible bulky waste that was necessary to stabilize the landfilled sludge. The H-POWER MBN unit is the only WTE unit in the U.S. to have such a system for controlled sludge processing. While the sludge system was in construction, the City shifted its focus to tires and other wastes. The City and Covanta obtained a variance to the facility permits to address tire processing. Several demonstration tests addressing receipt, handling, mixing with the other wastes, effective burnout, and emissions performance were completed. The result of this program demonstrated the facility was capable of processing whole tires in the MBN boiler with no impacts to the emissions.

In 2015, construction of a Waste Auxiliary Building (WAB) was completed. The WAB is equipped with a bulky material shredder, ferrous magnet, grapple crane, conveyors, and adequate tipping space to sort and manage incoming bulky waste material and deliver the shredded material to the desired boilers. The purpose of the WAB is to provide redundancy and additional capacity for the MBN unit’s bulky shredder and improve handling and processing of bulky wastes, particularly during peak processing periods and MBN facility outages.
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H-POWER: Honolulu Program of Waste and Energy Recovery

The City master plans special waste management through periodic updates to its Integrated Solid Waste Management Plan, which identifies types of special wastes, appropriate management or disposal facilities, and redundant systems for backup, alternative or emergency disposal. A number of other initiatives to utilize H-POWER to achieve the City’s objectives have been completed or are under way to address other suitable materials still received at the landfill. This is further discussed below in Sections 2 and 3.

Today, H-POWER influences the WTE industry by addressing a broader array of wastes than is normally contemplated at a waste-to-energy facility. H-POWER has also been identified and permitted as a suitable facility for sludge, tires, ASR, medical waste, combustible construction and demolition (C&D) waste, contaminated green waste, used oil, expired pharmaceuticals, and limited quantities of explosives including fireworks and flares. Also, the City is changing in other ways to either reduce the amount of process residue generated from the RDF, or to transport the process residue to the MBN for combustion, for additional energy generation and volume reduction. Once these projects are in place, nearly all the post-recycling waste material generated on O‘ahu that has some energy value will be received and safely processed in an environmentally sound manner. Truly, H-POWER and O‘ahu will be more completely self-sustainable from a waste perspective than any other facility and municipality in the U.S.

Other plans to improve the facility efficiency and maintainability for future expansion or refurbishments include:

- Additional warehouse building for storage of equipment and spare parts
- Traffic improvement projects including additional entry/queuing lanes and one-way traffic flow
- Replacement of existing rolling stock (dozers/loaders) that have reached the end of useful life
- Construction of an Education/Visitor Center

The H-POWER facility has been operational for over 26 years, providing reliable service to the City. Over that time period, H-POWER has converted over 16 million tons of refuse into over 9,000 million kilowatt-hours of electric power and saved the importation of over 16 million barrels of oil. H-POWER continues to provide reliable service, cost effective solid waste solutions, and a critical source of renewable energy to the Island of O‘ahu.

H-POWER generates approximately seven percent of O‘ahu’s electricity from a renewable resource, helping Hawaii achieve its goal of becoming more energy self-sufficient by reducing dependence on imported fossil fuels.

02 | Facility Design & Construction

H-POWER is a one-of-a-kind integrated facility (see above for full facility layout). It is the only operating plant in the U.S. that combines the best of RDF technology and MBN technology, allowing the plant to manage more types of waste for the City.

It has been an objective of the City to minimize and eliminate wastes received at the island’s only MSW landfill facility to only those inert materials such as ash that have no other use, and if possible to even eliminate disposal of those materials. The various post-recycling waste streams going to the landfill and available on the island have been reviewed and analyzed.
Starting with the MSW in excess of the capacity of the existing two RDF boilers, various waste streams have been or are scheduled to be removed from the landfill. Expansion with the mass burn MBN Facility increased the types of wastes the combined facility can process such as limited tires, mattresses, carpets and furniture. By incorporating a shear shredder integral with the mass burn waste pit, the MBN gives the City the ability to process additional quantities and sizes of these bulky wastes not possible with the original RDF facility or the MBN alone. Recovering ferrous metal in the RDF process as well as ferrous and non-ferrous metal from the both ash systems not only reduces the quantity of residues going to the landfill, but also pays a dividend.

Adding a state-of-the-art sludge receiving, storage, and injection system provides proper controlled charging of sludge while managing odors and burnout. Being able to receive the sludge has allowed the facility to further increase the quantity of bulky wastes and the H-POWER WAB operations improve the management of these wastes. Each step in the design and construction of the facility has increased the capabilities of the City to reach the goal of one day eliminating their landfill. Since O’ahu is an island a home needs to be found for all non-recyclable wastes. Success stories for some of these materials are presented below and in Section 3.

RDF Facility

The diagram at top right shows the RDF process, including waste processing and preparation, combustion process from furnace to stack, and electrical production. The ESPs, pictured in the diagram, have since been replaced with reverse air baghouses.★

MSW received on the tipping floor and front-end loaders are used to stack the waste. Bulldozers are used to compact the waste in storage piles that optimize the limited storage space in the receiving area. The MSW is examined for bulky materials, household hazardous waste, medical waste, or other waste that is undesirable or unacceptable for the waste processing facility (WPF) and RDF units.★ These items are separated from the waste stream and staged for proper disposal or transport to the MBN tipping floor.★

MSW is then fed to the infeed conveyors of each of the two processing lines at a controlled rate using the front-end loaders. The conveyors elevate the MSW and convey it past a picking station and to the processing system. Each of the two processing lines consists of a primary shredder (flail mill), ferrous magnet and two 2-stage trommel screens.★ The first stage removes process residue (glass, dirt and grit less than one inch) and the second stage removes appropriately sized materials (one to four inches) to send them directly to RDF storage. The trommel overs (or waste larger than four inches) is passed through a secondary shredder, a secondary trommel, and then to the RDF storage building.★

The RDF storage building allows for surge capacity. Normal practice is to store the RDF for a few days because this tends to result in more uniform fuel properties. The storage floor is managed by limiting the amount of time that RDF is on the floor using a type of “first in, first out” system. Front-end loaders are used to stack the RDF and to reclaim the material for feeding the boilers. The reclaim conveyors transport the RDF to the power block facility (PBF).★ The conveyors discharge into live bottom metering bins with five sets of auger screws at the bottom to meter the RDF to the boilers. The RDF is swept into the boiler by an air feed system.

Combustion occurs in a semi-suspension manner as the material is blown to the back of the grate in the furnace.★ Much of the lighter and smaller material is fully or nearly fully combusted above the grate while the larger and heavier particles complete combustion on the grate. The grate slowly travels toward the front of the unit as combustion is completed. The grate is a traveling design with underfire air passing through it from below. The underfire air cools the grate and provides oxygen for complete combustion and burnout of the RDF.

Flue gas passes through the furnace and into the boiler for heat recovery. The furnace walls consist of Inconel clad waterwall tube sections. A primary and secondary superheater is provided after the flue gas turns into a horizontal section. No screen tubes or generating section is provided ahead of the superheater. The superheater is followed by a generating bank, economizer, and tubular air heater.★

★Key Facility Design Elements
The boiler design is the Combustion Engineering (CE) VU-40 Boiler and is similar to the RDF facilities in Hartford, Connecticut, and Detroit, Michigan. Superheated steam (850 psig/830°F) is sent to a 59 MW Toshiba condensing steam turbine (designated turbine-generator #1 or T/G #1) and a 75 MVA Toshiba A.C. generator, and associated support systems. The electricity is sold to the island’s electric utility, Hawaiian Electric Company (HECO) and is considered baseload renewable energy, however, as noted below, features have been added to the facility to further benefit HECO which allow for partial dispatching of the power generated allowing the Facility to help HECO follow electrical demand.

The steam is condensed using water from the circulating water system and is reused in the boiler system. Heat is rejected at the facility cooling tower (picture 1). A unique caprock well system withdraws brackish water that is used for makeup to the circulating water system. Cooling tower blowdown is then reinjected closer to the ocean. This technique allows for adequate cooling while keeping groundwater under the island from becoming more saline. Other than the blowdown reinjection, the facility has zero liquid discharge (Refer to Section 3 for further discussion).

In addition, the Facility is taking steps to use two grades of reclaimed water purchased from the island’s water utility for the facility. RO water is higher quality reclaimed water that can be further prepared in the Facility’s water treatment plant for boiler makeup. R1 water is lower grade water suitable for landscaping, ash quenching and other uses. By using these grades of reclaimed water, the Facility will be able to reduce its consumption of potable water preserving a valuable and limited resource on the island.

In 2009, the City replaced both of the existing ESPs with new reverse air fabric filter baghouses (picture 2), which have provided improved performance with respect to particulate and heavy metal control.

After nearly 20 years of operation, the RDF facility was starting to need some refurbishment. As part of the preparation for the next contract term, the City wanted to replace key equipment and give the facility a makeover. Projects were identified that would be necessary for continued operation to meet and exceed the contract performance guarantees. These projects were reviewed, and a budget of $48 million was established for the anticipated work. The City began the first of these refurbishment activities in 2010, in parallel with the MBN construction in order to improve the reliability of the RDF units.

The largest single refurbishment work project included replacement of the original boilers waterwall tubes, which has largely been completed. Work began with replacement of half of the waterwall panels in the lower furnace area on both sides and the rear of the unit. The original panels with field overlaid Inconel (fire-side only) were replaced with spiral wound Inconel tubes. Subsequent phases of work have replaced many of the upper panels on the furnaces for both units, parts of the boiler roof and other sections of the boilers.

As part of the refurbishment, an innovative change to the boiler bull nose designed to more effectively distribute flue gas and protect the superheaters has been installed. Since inception, the original RDF boilers have always had difficulty achieving the design superheat temperature after a certain point in the operating cycle and with superheater life. A newly designed superheater has been installed in one of the two boilers to determine if the performance can...
be enhanced. The new superheater has a different steam path and more tube rows extending slightly forward of the original superheater (picture 3). It is anticipated that these changes will have about a one year payback in increased electrical output.

Other refurbishment projects have been completed and a few remain as final tasks. A number of projects are planned for the WPF. The arrangement for the in-feed conveyors and bulky waste grapples for one process line has been upgraded to more effectively control material fed to the primary shredders and the other line will be upgraded soon. The secondary shredders will be replaced with new units. The new shredders are a larger model which will require foundation and building changes but should eliminate a processing bottleneck. The RDF production lines will be simplified by eliminating one of two primary trommels and replacing the second primary trommel with a larger capacity unit. The secondary trommel one each process line will be removed simplifying the system.

A controls upgrade was completed in late 2015. The T/G #1 Woodward Control System has been replaced. The 20-year-old control systems for the waste processing lines and bulk of the facility will also be upgraded to state-of-the-art technology, including necessary repairs to electrical systems, conduits and duct banks and the plant is already enjoying the new system for the boilers.

Other refurbishment projects include:

- Replacement of the boiler gas burners is on the schedule
- The RDF metering bins and distribution chutes have been overhauled
- Replacement of the submerged scraper conveyors is on the schedule
- Replacement of the eddy current separator for increased non-ferrous recovery from the ash is complete
- Replacement of various air conditioning units to increase system reliability and redundancy is underway
- Work on the boiler economizers and ash chute seals designed to improve performance and reduce tramp air is underway

- Work on the scrubbers is done and slakers will be completed soon
- Replacement of the pugmills for better ash wetting will occur soon
- Refurbishment of under grate air plenums is complete
- Repairs to the building siding and roof to give the facility a fresh look for the many visitors interested in the operation is on the schedule

**MBN Facility**

The MBN boiler design is a Martin boiler and six run grate design specifically for the energy efficiency and emission reduction provisions for the unit. Superheated steam (900 psig/830°F) is sent to a 32 MW Siemens condensing steam turbine (designated turbine-generator #2 or T/G #2), and associated support systems.

A second inbound scale was added to the Facility to provide additional capacity for more refuse deliveries. The existing tipping floor and waste disposal area were determined to be inadequate for the additional traffic and waste capacity required for the MBN unit. Therefore, two parallel inbound lanes and two separate, connected tipping floors were designed and constructed. (picture 4) A dispatcher coordinates traffic to ensure that inbound trucks proceed to the correct tipping floor. The MBN tipping floor (picture 5) was designed to accommodate tilt-up trucks, end-dump packer trucks, roll-off containers, and transfer trailers with capacities up to 120 cubic yards. All vehicles delivering bulky materials such as mattresses, carpets and furniture are directed to the new tipping floor or to the WAB. This bulky waste is deposited onto the tipping floor for inspection prior to shredding. Shredded material produced by the bulky shear shredders is directly discharged to the pit and mixed with refuse prior to charging the feed chute.

The MBN includes a three-day refuse storage pit. Refuse is deposited onto the tipping floor for inspection or directly into the pit. Refuse is charged to the feed chute with a crane system. Dual Kone cranes have a state-of-the-art semi-automated control system, allowing the crane operator to press a button to deliver the crane load into a specific zone in the feed hopper with no manual steering required (picture 4). The crane controls are located in the control room over looking the refuse pit. Refuse is then metered from the bottom of the feed chute by hydraulic ram feeders and fed onto the surface of the Martin stoker grate, controlled by the Martin combustion controller. The grate system is Martin reverse reciprocating technology consisting of six grate runs, each 17 grate bars wide. This makes it one of the largest Martin grate systems in the world. The Martin boiler has a vertical radiant furnace, two vertical convection passes, a horizontal superheater section, one vertical superheater section and a vertical economizer.

The MBN contributes a major technology advancement to the WTE field – Covanta’s VLN™ Very Low NOx (VLN™) technology, which lowers NOx generated as well as reduces the overall excess air from a typical Martin stoker boiler while increasing boiler efficiency. The MBN is the first boiler to have the technology built into the design. Prior to construction of the MBN, the only boilers to employ this proprietary technology have been retrofitted units.
VLN™ technology employs a unique combustion air system design, which is in addition to the conventional primary and secondary air systems, features an internal gas recirculation (IGR) injection system located in the upper furnace above the secondary air nozzles. Gas is drawn from above the grate at the rear of the furnace and re-introduced to the upper furnace above the secondary air injection level. Recirculation of the flue gas reduces the need for combustion air for complete combustion in the furnace, resulting in a smaller boiler and APC equipment than in a typical MBN of similar capacity. This technology is designed to reduce capital costs while improving boiler efficiency and reducing NOx levels.

The quantity of primary air in the VLN™ technology is adjusted to minimize excess air during combustion of waste on the grate, thereby reducing the overall excess air rate from approximately 100 percent, as used in the design for previous boilers with Martin stokers, to 50 to 55 percent excess air. The combination of the IGR and reduced secondary air extends the combustion zone in the furnace, which in turn inhibits the formation of NOx. The VLN™ technology, combined with an aqueous ammonia SNCR system, reduces NOx emissions by more than 50 percent below the U.S. Environmental Protection Agency’s (EPA) current Maximum Achievable Control Technology (MACT) requirements.

This technology has provided the following direct benefits:

- NOx guarantee of 110 ppm daily and 90 ppm annual mean
- Increased boiler efficiency
- Reduced particulate carry-over
- Reduced boiler fouling rates

MBN steam conditions are 830°F and 900°psig. Steam is transported from the MBN via an elevated pipe rack to the steam turbine. An important aspect of the design allows for the shared production of main steam between the existing and expansion units. Operation of the new and existing T/G sets can be optimized through cross-ties that allow for both independent operation of the RDF and MBN boilers as well as a combined configuration.

The MBN also added a steam bypass dump condenser (DC), which allows for continued operation of the MBN boiler to process waste even when T/G #2 is off-line (picture 6). The main purpose of this system is to reduce the need to divert waste to the landfill if the T/Gs are offline. The DC also assists with increasing the ramp-up/ramp-down rate of the T/Gs. The facility is in the process of adding a second DC sized for the RDF units. The addition of the dump condensers is to help conform to the innovative Power Purchase Agreement (PPA) that has been implemented for the facility. Hawaiian Electric Company, Inc. (HECO) wanted the facility to have the capability of being curtailed if they could not use the electrical production. Obviously the first need for the City is have consistent reliable disposal capacity for the waste generated on the island. The PPA was arranged to allow both of these objectives to be achieved. This is the only PPA known for a waste-to-energy facility that is designed to allow the base loaded to be dispatchable and thus be able to adjust to the electrical demand while still achieving consistent reliable waste disposal. For flues gas treatment, the MBN APC equipment includes SNCR, a semi-dry scrubber, carbon injection, and a pulse jet fabric filter (baghouse). A new stack is also provided.

**Integrated Sludge Processing System & Waste Auxiliary Building**

Municipal sludge is now received and processed at the MBN (picture 7). Up to 90 tpd of 30 percent solids sludge can be received, stored, and metered into the MBN unit. Potential odors caused by the unloading and storage are treated through a dedicated bio-filtration system before venting to atmosphere. Odors from trucks are drawn into the boiler.

Delivery trucks enter the tipping floor using the same inbound ramp as trucks carrying MSW and unload the sludge into a push floor storage bin with automatic bi-fold cover designed as the first step in odor control. Screw feeders will feed sludge to redundant hydraulic wet cake pumps for distribution to the feed chute (picture 8). A header with seventeen pinch valves extending across the chute inject sludge into the MSW at a point below the normal waste plug level before it is loaded onto the feed table. A controller opens each valve in a pattern distributing small quantities of sludge across the boiler for even distribution and complete burnout.

At the landfill the sludge formerly was mixed with equal quantities of bulky waste for stabilization. With the delivery of sludge to H-POWER, the bulky waste is no longer needed at the landfill and is also delivered to H-POWER. A specialized WAB has been added to the facility to help with bulkies management, particularly during MBN outages. The WAB is able to receive all or part of the bulkies allowing for better pit management in the MBN facility. A large shear shredder in the WAB along with a ferrous magnet are used to shred the bulkies and recover more higher value ferrous metal while reducing wear and tear on the boilers and ash systems (picture 9). By pre-shredding the bulkies and removing the metals, the bulkies may be processed in either the MBN or the RDF facilities.
**Innovative Contributions to WTE**

The following is a brief summary of some of the key innovations and contributions H-POWER has accomplished as a good community citizen and representative of the solid waste industry.

**COMBINED FACILITIES**

Other facilities and communities will look to H-POWER to see the benefits of integration of the RDF and MBN technologies, which allow many more components of the post-recycled waste stream to be addressed at one facility.

- Shared production of main steam between units. Operation of each of the two T/G sets can be optimized through cross-ties that allow for both independent operation as well as a combined configuration.
- Two separate but connected tipping floors.
- H-POWER is one of very few VPP facilities in Hawaii (See Section 5, Worker Health and Safety below).
- Brackish water obtained through caprock wells is used for cooling limiting consumption of treated water (See also Section 3).
- Preparing for use of re-claimed water to further reduce potable water consumption (See also Section 3).

**RDF**

- New superheater design that is expected to increase boiler efficiency.
- Bottom Ash Metals Recovery (BAMR) system and Enhanced Ferrous Recovery (FEEN) has been installed and operating since 1999 for recovery of ferrous and non-ferrous metal.
- Air-to-air preheaters are an almost unique feature of the facility. Covanta has installed, tested and optimized modifications to the air preheater to slow cold end corrosion of the air preheater tubes. This modification incorporated a tube-in-tube design which reduces the heat transfer of the first section of the air heater tube, increasing the combustion air temperature while maintaining a tube metal temperature above the acid gas dew point.
- Experimented with various sized openings in the WPF trommels allowing the flexibility of adjusting the characteristics of the RDF and process residue.
- New baghouses have been equipped with bag break detectors at the outlet of each compartment to provide early warning of bag damage (See also Section 3).

**MBN**

- A first of its kind in the US sludge receiving, pumping and distribution system, with a separate odor control system, has been fully tested and keeping about 20,000 tons of sludge out of the landfill each year (See Special Waste below).
- Essentially eliminates MSW and bulky and other combustible wastes delivered to the landfill (See also Section 3).
- Employs VLN™, a new and innovative technology for NOx control (See also Section 3).
- Bypass dump condenser allows for continued operation of the MBN boiler to process waste even when T/G #2 is off-line. With a future DC installed on the RDF facility, this potentially eliminates the need to divert waste to the landfill if the T/Gs are offline and allows for dispatching.
- Provides ability to manage the bottom ash separately as a recyclable by-product should State and Federal regulations change in the future (See also Section 3).
- Bottom ash metals recovery system for both ferrous and non-ferrous metals.

**Facility Appearance**

H-POWER’s location in Hawaii provides a unique oceanside vista rare in the WTE field. The site includes, palm trees, protected native and endangered Hawaiian plants and animals, archeological sanctuaries, and the area immediate includes a beach, coral reef, a Luau, lighthouse, an active harbor, a very large resort, and recreational and commercial marine activities. With the addition of the expansion unit to the H-POWER Facility, the design include similar building paneling and paint color to blend in with the existing Facility.

**03 | Environmental Controls and Regulatory Compliance**

H-POWER provides important environmental benefits to the residents of O’ahu not only for solid waste management, but also with proper air emissions control, fresh water conservation, as management, and metals recycling. The City has conducted several life-cycle studies, using Research Triangle Institute’s (RTI), MSW Decision Support Tool (DST), and triple-bottom-line sustainable return on
investment methodology, to assess H-POWER’s global impacts on waste management, recycling, and greenhouse gas (GHG) emissions.

In every case, the facility has demonstrated substantial cost savings, avoided imports of fossil fuels (about 1 barrel of oil avoided for every ton of MSW combusted), and avoided associated air pollution impacts including avoided greenhouse gas (GHG) emissions. A comprehensive health risk assessment completed with the expansion of the MBN Facility conservatively showed that health risks were well below acceptable limits. These analyses did not even consider the benefits of the reduced emissions from other utility plants and reduced expense and risks from the islands water treatment facilities.

H-POWER meets or exceeds requirements in its environmental permits, which include solid waste, clean air and water. The facility consistently passes ash TCLP testing and stack performance testing.

The facility was honored as a U.S. EPA National Environmental Performance Track site until the program was terminated by EPA. Performance Track recognized facilities that had a strong record of environmental compliance, set three-year goals for continuous improvements in environmental performance beyond their legal requirements, had internal systems in place to manage their environmental impacts, engaged in community outreach and consistently reported results. H-POWER has been addressing local and corporate sustainability programs through Covanta’s Clean World Initiative and Sustainable Coastlines.

**Ash Management**

The City has as a long term objective the total closure of the island’s only municipal landfill. Thus, the City is very interested in environmentally safe ash re-use for some or all of the ash generated from the H-POWER Facility and elimination of landfilling. H-POWER has completed a number of studies of ash characteristics and demonstration tests for use in roadways and other applications advancing the industry knowledge and experience. All of the studies to date have been within site boundaries for the construction of select roadways due to regulatory limits. Today, H-POWER recovers more than 20,000 tons of ferrous metal and 1,000 tons of non-ferrous metal each year. The City is also researching innovative techniques for recovering more types of metals and other minerals from the ash streams looking for new uses.

**MBN**

Bottom ash from the MBN is discharged from the grate using two ash dischargers and is conveyed past a grizzly scalper to remove large items and recycle large metal objects (picture 11). The undersized bottom ash is then conveyed over a drum magnet and eddy current separator for ferrous and non-ferrous recovery, respectively, within a new ash residue loadout building (picture 12).

Fly ash is collected at the following collection points: convection pass, superheater, economizer, and APC train. It is then combined via screw and drag chain conveyors and conveyed to a fly ash silo in the ash residue building. From there, fly ash is blended with bottom ash after metal recovery, improving the quality of the metals, and prior to loading into transfer trailers for transport to the landfill.

The MBN ash processing system was designed with the ability to process bottom ash separately or in combination with fly ash blending the two streams in any ratio. The purpose of this design was to have the ability to sell the bottom ash as a recyclable by-product should state and federal regulations change in the future while maintaining ash toxicity characteristics for any ash that must be disposed in the landfill.

**RDF**

The RDF facility has always recovered ferrous metals from the MSW during processing and metals recovered from the bulky waste. The early 1990s facility was an early adapter of bottom ash metals recovery (BAMR), with a system installed to recover ferrous and nonferrous metals from the ash using drum magnets and an eddy current separator, respectively. The recovered metals are cleaned and sold to a local recycler. The bottom ash is combined with fly ash and transported to the landfill in transfer trailers.
Emissions Control
The RDF facility operates under a Covered Source Permit and is considered a major source. The MBN has a separate Covered Source Permit. The requirements differ between the two facilities due to the technology employed and construction date. Both facilities operate well within their specific performance requirements which are closely aligned with the performance requirements of the New Source Performance Standards for Large Municipal Waste Combustors (40 CFR 60, Subpart Eb). The MBN has a few requirements that are more restrictive than the EPA requirements. The table below summarizes the emission limits for both the RDF and MBN and presents representative results from testing completed last year. As evidenced by the results, for most pollutants all units operate at a fraction of the permit requirements.

The original RDF design included ESPs. However, prior to construction, this design was enhanced to include SDAs for control of acid gases. More recently, the ESPs have been upgraded with new reverse air baghouses as a means of improving emissions performance. Each of the RDF units also has good combustion control and continuous emissions monitoring system (CEMS) for reporting carbon monoxide (CO), sulfur dioxide (SO2) and nitrous oxides (NOx). Neither a carbon injection (CI) system for control of dioxins and mercury nor SNCR system for NOx control is needed on the RDF units to achieve the required performance.

More recently, provisions have been completed to measure and report carbon dioxide (CO2) emissions for GHG monitoring. With the addition of the MBN unit, the City went through nearly all the steps to complete validation of the GHG emissions reduction potential to document the CO2 reductions resulting from the operation of the expansion unit. Potentially the facility could generate GHG emission reductions based upon the reduction in GHG emissions would the MSW processed have been disposed at the landfill and the methane collected there and the electricity produced be generated from the local utility boilers.

The MBN is equipped with APC equipment to control pollutants:

- Covanta’s VLNTM technology and SNCR for the enhanced control of NOx
- Semi-dry scrubber for the control of acid gases such as hydrochloric acid (HCl) and SO2
- Activated carbon injection for mercury (Hg) control
- Pulse jet fabric filter for particulate and particulate-related emission removal
- Good combustion control of combustion-related pollutants

The test results indicate that the emission requirements for each unit can be achieved with margin for testing variation. For particulate-related pollutants, the performance of the RDF units equipped with reverse air baghouses does not appear to be substantially different from the performance of the MBN with its pulse jet baghouse. The CI system on the MBN may have improved dioxin emission performance over the RDF. However, all test results are well within their respective requirements.

### H-POWER Facility Emissions Performance

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Existing RDF Units</th>
<th>Expansion Mass Burn Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emission Limits1,2</td>
<td>Percent of Limit</td>
</tr>
<tr>
<td>SO2 24-hr*</td>
<td>29 ppmv</td>
<td>0.5 2%</td>
</tr>
<tr>
<td>PM (filterable)</td>
<td>6.85 mg/dscm</td>
<td>7.02 26%</td>
</tr>
<tr>
<td>PM10 (total)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NOx 24-hr</td>
<td>250 ppmv</td>
<td>172 69%</td>
</tr>
<tr>
<td>CO2</td>
<td>200 ppmv</td>
<td>69 35%</td>
</tr>
<tr>
<td>VOC (as CH4)</td>
<td>21 ppmv</td>
<td>1.92 9%</td>
</tr>
<tr>
<td>Ammonia (NH3)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>400 ug/dscm</td>
<td>6.3 2%</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>35 ug/dscm</td>
<td>0.754 2%</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>50 ug/dscm</td>
<td>&lt;0.7 &lt;2%</td>
</tr>
<tr>
<td>HCl</td>
<td>26 ppmv</td>
<td>11.6 40%</td>
</tr>
<tr>
<td>Dioxin/Furano</td>
<td>20 mg/dscm</td>
<td>21.1 70%</td>
</tr>
</tbody>
</table>

### Water Management
On an island surrounded by salt water the value and availability of fresh water can become much more acutely understood. The City has acknowledge that re-use of water and management of this resource is very important. When the H-POWER Facility was just a concept the design incorporated provisions to withdraw brackish water from wells located on the inland side of the facility for use for service water cooling and evaporative cooling tower uses. The blowdown from this system is then re-injected in deeper wells on the ocean side of the plant. This caprock system is designed to conserve fresh water while minimizing or eliminating encroachment of brackish water on these resources. Millions of gallons of fresh water are conserved every year. Use of this brackish water also allows extraction of chloride from the water itself for water treatment, reducing the need for importing water treatment chemicals.

In addition to the caprock system, the H-POWER Facility is tapping into two re-used water sources that have been developed on the island. The City’s water treatment facilities clean the spent potable water by passing the water through a reverse osmosis (RO) system. The RO water will be used by the plant for boiler makeup and other treated water uses in the plant thus allowing the plants to reuse the treated water. The blowdown from the RO system is then re-injected in deeper wells on the ocean side of the plant. This caprock system is designed to conserve fresh water while minimizing or eliminating encroachment of brackish water on these resources. Millions of gallons of fresh water are conserved every year. Use of this brackish water also allows extraction of chloride from the water itself for water treatment, reducing the need for importing water treatment chemicals.

The plant is a zero water discharge facility other than the caprock reinjection. This includes all plant wastewater including sanitary discharges. The original facility was designed with a leach field for the sanitary water management. When the MBN unit was added, it was determined that the facility could be designed with its own treatment works allowing proper treatment and reuse of even this grey water for certain low quality applications within the plant (picture 13).
Special Waste

The City master plans special waste management through periodic updates to its Integrated Solid Waste Management Plan, which identifies types of special wastes, appropriate management or disposal facilities, and redundant systems for backup, alternative or emergency disposal. As an island these needs are very acute with only very expensive alternatives for management. This situation played into the decision to expand H-POWER with an MBN unit at an RDF facility. The use of both technologies allows the processing of more types of combustible wastes. For H-POWER special wastes not only include pharmaceuticals, illegal drugs, and industrial product disposal, it also includes shipping industry wastes, military wastes, hospital wastes, tires, bulky wastes, municipal waste water sludge, contaminated green waste, food wastes, auto shredder residues (ASR) and nearly every other kind of combustible waste that is generated. For those materials that cannot be recycled, largely and more every day, H-POWER is or is becoming the location of material and energy recovery. The City has spent more than ten million dollars on special systems for the management of sludges and bulky wastes.

Refer to the article link below regarding H-POWER’s corporate project for beach cleaning and recovery and destruction of derelict fishing nets and equipment protecting our marine life. H-POWER was the first Covanta facility to establish a Marine Debris Disposal Program, called “NETS to ENERGY,” a special program designed to address disposal of derelict fish netting and gear. As part of NOAA’s Nets to Energy Program and in partnership with a local metal processor the netting is cut into manageable pieces and then is brought to the facility for electrical generation. H-POWER has helped adapt and refine this program into “Fishing for Energy” at other facilities. Every year the facility employees complete beach cleanings and manage tons of misplaced trash supporting the island’s reputation as a pristine tourist destination for the U.S. and the world. The program and facility was documented on CNN (http://www.cnn.com/videos/#/video/world/2013/04/01/lab-eco-nets-into-energy.cnn). Outreach events with the Army Earth Day, and World Oceans Day with local community groups have recently been completed. H-POWER received an award in 2014 from the Coral Reef Task Force for their support of the Marine Debris Program.

About 200 tpd of bulky wastes that could be detrimental to the RDF processing system and normally bypassed at other waste-to-energy facilities in the U.S. are now routinely received and processed at H-POWER. The City sanitation department generates and gathers about 10,000 tires per year. These tires formerly were bundled and shipped to overseas cement kilns or other disposal sites. By processing the tires at H-POWER, the costly shipping and sometimes questionable emissions controls concerns have been avoided. The tires significantly increase the electrical production of the MBN facility reducing the island’s reliance on costly imported oil used at HECO’s utility plants. Even expired or damaged fireworks and flares from the fishing industry are safely processed in the facility.

Discussions have been underway with the island’s various medical facilities and clinics. By keeping sharps separate from other wastes, much of the wastes generated at these facilities can be prepared and then received by H-POWER for safe and more secure disposal than at the landfill.

Some digested municipal sludge and Synagro pellets were disposed in the landfill. Under certain conditions if this material was not been quickly covered, odors may be generated and have resulted in occasional issues at a large resort area located nearby. Sludge is now received and processed at the MBN. Up to 90 tpd of 30 percent solids sludge can be received, stored, and metered into the MBN. Odors are managed by drawing them into the boiler and through a biofilter while feeding the sludge into the waste feed chute to avoid exposure. At the landfill the sludge is mixed with equal quantities of bulky waste for stabilization. Since the sludge is received at MBN, the additional bulky is also received and processed there.

A specialized Waste Auxiliary Building (WAB) has been added to the facility to help with bulky wastes management, particularly during MBN outages. The WAB is able to receive all or part of the bulks allowing for better pit management in the MBN facility. A large shear shredder in the WAB along with a ferrous magnet are used to shred the bulks and recover more higher value ferrous metal while reducing wear and tear on the boilers and ash systems. By pre-shredding the bulks and removing the metals, the bulks may be processed in either the MBN or the RDF facilities.

The sludge system utilizes the existing MBN tipping floor for access to the storage bin. Sludge received in the bin is fed to the MBN boiler utilizing the redundant sludge pumps (refer to Section 2)

Auto shredder residue (ASR) is also being considered for processing at the facility. Tests are being completed on both the RDF boilers and MBN to evaluation handling, performance, and emissions questions.

The processing lines for the RDF facility generate about ten percent process residue. The process residue has residual heating value and is being considered as additional feedstock for the MBN. These fines may also contain quantities of ferrous and non-ferrous metal that may then be recoverable.

Today H-POWER actively addresses a broader array of wastes than is normally contemplated at probably any other waste-to-energy facility and is adding more wastes in a concerted effort to fulfill a promise to close their landfill. Once these projects are in place, nearly all the post-recycling waste material generated on O’ahu that has some energy value will be received and safely processed in an environmentally sound manner. Truly, H-POWER and O’ahu will be more completely self-sustainable from a waste perspective than any other facility and municipality in the U.S.

O4 | Coordination & Relationship with the Community

This application was prepared by the City and County of Honolulu Refuse Division, which is responsible for all aspects of integrated solid waste management on the island of O’ahu, including H-POWER, recycling, landfills, transfer stations, and refuse collection. Local municipal and private waste professionals manage, supervise, consult, and coordinate all aspects of the facility, including administration, engineering, refurbishment, future planning, environmental compliance, waste deliveries, and ash and residue disposal. They also interface with other stakeholders such as the Board of Water Supply (BWS), Wastewater System, and Hawaiian Electric Company, Inc. (HECO).
H-POWER is irreplaceable to the integrated waste management for the island of O‘ahu. It accepts all the post-recycled MSW, bulky waste, municipal sludge, and special wastes. If the facility did not exist, the only other means of disposal would be the Waimanalo Gulch Sanitary Landfill. Off-island shipping of waste was previously proposed, but was proven to be too costly and controversial. With the landfill site constrained by a canyon environment, its remaining life would be severely limited to less than 10 years if all the MSW on the island were diverted there. The costs and controversy of permitting and constructing a new landfill could prove siting a new landfill infeasible.

Although a landfill is required for redundancy and emergency purposes, **H-POWER has made possible the consideration to close the landfill.** H-POWER, sited on a small footprint of 25 acres, has saved more than 500 acres of landfill space since its inception by reducing the volume of waste by 90 percent and will save more area in the years to come. With land costs on O‘ahu easily approaching $1 million per acre, H-POWER has provided significant savings by reducing the footprint of waste management on the island.

**Community support and engagement efforts?**

- On an island with no fossil fuel resources that is forced to import all oil and coal used for electrical generation, costs for electricity are very high (residents pay an average 37 cents per kwh). H-POWER generated up to 10 percent of the island’s electrical needs, and that value is not lost on the community. HECO is developing significant solar and wind generation, which makes H-POWER even more valuable to the utility considering that the facility is firm dispatchable baseload power with high availability of 85-90 percent with the ability to be curtailed compared to the as-available generation of wind and solar which have less than 50 percent availability. By using its installed expansion bypass condenser the electrical production of the facility can quickly be adjusted from nearly 70 MW to less than 35 MW net output if requested by HECO. Addition of another bypass condenser will increase the flexibility of the facility to make this adjustment while continuing to provide waste disposal services.

The high goals of the City have resulted in a recycling rate of **nearly forty percent and rising**. Close cooperation and significant subsidizing of the island’s recycling program allows for more efficient collection of aluminum and other recyclables. Despite the excellent recovery of recyclables, H-POWER **has the ability to separate additional items** such as white goods and propane tanks and deliver them to the appropriate recycling facility. For the metal that is not captured at the curbside, magnets remove ferrous metals from the RDF process and from the ash. Non-ferrous metal is also captured from the ash stream and subsequently returned to mills for reuse. The plant has **consistently achieved high recovery rates for the available metals (3.2% ferrous and 0.2% non-ferrous as a percentage of the incoming waste).**

**Describe community concerns and how you responded to them.**

- Community concerns directly related to H-POWER are rare, and the facility consistently receives positive feedback. As a public works project, it is one of the few that generates substantial revenue for the City. This aspect is well understood and respected on the island. When a concern is raised, the City and Covanta work together with other stakeholders to look for solutions. An example is a recent traffic study and plans to modify traffic queuing increasing and simplifying lanes and adding an early warning system to help avoid occasional peak hour tipping delays during outages. H-POWER has addressed many landfill-related, water supply, and water treatment concerns, including:
  - Sludge odors at the landfill mitigated by diverting sludge to the sludge receiving facility
  - Landfill disposal overall reduced by diverting nearly all combustible MSW, bulky waste, and special waste to H-POWER
  - Eliminate the need for a new landfill
  - Potable water consumption to be reduced dramatically by use of recovered water obtained from BWS for boiler makeup and process uses.

Because of its quiet, reliable service to the island, **H-POWER has earned a strong public acceptance and its value is noted in the community.** The two recent newspaper articles attached are fairly typical for the facility demonstrating the publics understanding of the importance of the facility to O‘ahu.

Public hearings and neighborhood board presentations as well as countless tours held over the years for H-POWER related environmental impact studies were consistently met with strong public support. **A fun and educational long running event in Honolulu is the annual Tour de Trash. Buses are sponsored by the Department of Environmental Services (ENV) and take all interested residents and groups on a rolling tour of various businesses, ENV facilities and other locations to help educate residents on how their trash is managed and where it goes.**

H-POWER is a frequent stop on the tour. Opala means waste in Hawaiian and The Green Channel provides virtual tours, including H-POWER (http://www.opala.org/solid_waste/media/Green_Channel.html).

Covanta partnered with Schnitzer Steel Hawaii Corporation and formed a marine debris management program or Nets-to-Energy with NOAA. The netting is cut into manageable pieces and then is brought to the facility for electrical generation. The program and facility was documented on CNN ([nets-into-energy.CNN](http://nets-into-energy.CNN)) or read the [article in Section 3](#).
Covanta and Refuse Division staff sponsor, participate, and present at nationwide professional associations conferences, including NAWTEC, WASTECON, SWANA, WTER, Asia Pacific Clean Energy Expo, and energy briefings at the State Capitol. Numerous past presentations have been completed for the facility and the only sludge receiving and processing system on a WTE plant in the US will be featured at this year’s NAWTEC conference. The facility has received numerous awards over the years most notably: SWANA gold and silver awards in 2014 and 2013 respectively and the ASME Facility of the Year in 2012 for the expansion of the WTE facility. The H-POWER Facility is a Second Round Finalist for the 2016 City Livability Award and is still competing in that award process.

What are your community outreach and engagement efforts? The Facility gives back to the community as well. Beach cleaning campaigns completed periodically also generate materials while supporting the island’s reputation as a pristine tourist destination for the U.S. and the world. Covanta staff have formed an E-Club who identify areas in the facility and in the community that need improvement and propose solutions. Some of the organizations, events, and groups that have been supported include:

- Boy Scouts of America, Aloha Council
- City & County of Honolulu’s Discover Recycling Fair
- Campbell Local Emergency Action Network (CLEAN)
- Hawaii Food Bank’s Annual Food Drive
- Kapolei Elementary, Middle and High Schools
- Kapolei Rotary Club
- Leeward District High Schools
- Makakilo/Kapolei Neighborhood Board
- Performing Arts Center of Kapolei
- Science Screen Reports for Hawaii’s public schools
- University of Hawaii Leeward Community College

H-POWER’s location in Hawaii provides a unique oceanside vista rare in the WTE field. The site includes, palm trees, protected native and endangered Hawaiian plants and animals, archeological sanctuaries, and the area immediate includes a beach, coral reef, a Luau, lighthouse, an active harbor, a very large resort, and recreational and commercial marine activities.

**05 | Worker Health & Safety**

H-POWER has demonstrated a commitment to health and safety through its programs, as is evident from the many awards it has to its credit. In 2008, H-POWER was awarded First Place-Excellence in Safety and Health by the American Society of Safety Engineers and Hawaii occupational Safety and Health. Since 2007, H-POWER has been an OSHA Voluntary Protection Program (VPP) Star Facility and has proudly flown its VPP flag. Even during construction of the expansion MBN unit and the sludge receiving and processing facility the facility was able to maintain its VPP status. Currently H-POWER stands with Monsanto (two sites), Chevron, and the Pearl Harbor Shipyard, as the only 5 VPP Facilities in Hawaii.

The facility was recognized in 2006 as a SHARP (Safety & Health Achievement Recognition Program) for the programs in place.

Covanta conducts Step-Up for Safety training for all employees. Covanta’s on-site Quick Response Team (QRT) is trained in First Aid, CPR and AED use by the Honolulu Fire Department and HeartStart. The QRT can respond immediately to any medical emergency. H-POWER now has a Confined Space Rescue Team The Safety Health and Environment (SHE) WIN program is designed to communicate potential issues so they can be addressed and to keep safety as a primary focus.

Covanta reports safety statistics to the City monthly, including Total Case Incidence Rate (TCIR), Incident Index, OSHA recordables, non-OSHA recordable on-site/off-site first aid, contractor incidents, and near-misses. Covanta staff complete safety & health communication forms and job/task analysis cards to clearly document and communicate safety issues and procedures. Last year the Facility achieved:

- Total Case Incidence Rate (TCIR) – 1.79
- Incident Index (II) – 42.89
- Days Away, Restrictions and/or Transfers (DART) – 1.19
- OSHA Recordable Accidents - 4
- Non-OSHA Recordable/off-site First Aid Incidents - 5
- Non-OSHA Recordable/on-site First Aid Incidents - 1
- Near-miss Incidents - 1
- Contractor Accidents – OSHA Recordable - 1
- Contractor Non-OSHA Recordable/off-site First Aid Incidents - 2
- Contractor Non-OSHA Recordable/on-site First Aid Incidents – 3

To keep focus sharp and workers safe, when there is a sense that renewal is needed certain days are designated as Safety Work Order Days. As a means of cross-pollinating experiences, monthly Regional Safety A (RSA) calls and Employee Safety Committee meetings are held to review current issues.

**SAFETY AWARDS**

2006 – Recognition as a SHARP (Safety & Health Achievement Recognition Program)

2007 – Designated as an Occupational Safety and Health Administration, Voluntary Protection Program (VPP) Star Facility. Currently H-POWER stands with Monsanto, Chevron, the Pearl Harbor Shipyard, and the Makewao Post Office, as the only 5 VPP Facilities in Hawaii.

2008 – Received first place for excellence in safety and health by the American Society of Safety Engineers and Hawaii Occupational Safety and Health.

2008 – Honored as a U.S. EPA National Environmental Performance Track site - Performance Track recognizes facilities that have a strong record of environmental compliance, set three-year goals for continuous improvements in environmental performance beyond their legal requirements, have internal systems in place to manage their environmental impacts, engage in community outreach and consistently report results.
To support the facility safety performance Covanta has implemented a number of other programs for monitoring, reporting and correcting safety concerns. These include:

- Total SHE (Safety, Health and Environment) Communication Forms completed – average 220 – 250 per month
- JOB/Task Analysis Cards completed – minimum two per supervisor per month
- Safety Work order Days are completed monthly
- Regional coordination regarding safety is completed monthly
- Safety Orientations completed – average 5 – 10 per month
- FSC Snapshots – monthly
- NESO (New Employee Safety Orientation) completed – more than twenty completed in the past two years
- Training Sessions – monthly training and QRT training
- Fit Tests – maintained current for all required employees
- Tailgates – completed weekly

Standard Operating Procedures (SOP), job walkdowns, lockout tag out procedures, signage, near miss reviews, and numerous training classes, tailgates, orientations and programs are used to address all aspects of worker and facility safety and environmental control. Chemicals on site are limited and listed in available logs. Outside support and review completed for constant improvement. The facility has a practice of cleaning up job sites promptly, sweeping and washing down the facility to maintain a clean work environment. Special efforts are taken to avoid worker and visitor exposure to fugitive ash, hot surfaces, and traffic hazards.

All ash systems are totally enclosed. The facility has taken measures to beyond the minimum for example by installing canvas enclosures on two sides of the baghouse and scrubber for the MBN as a secondary enclosure and wind stop. Worker health and safety is a serious concern at H-POWER.

How did you address safety issues during planning and designing your facility?

As part of the design review for the facility during the construction of the MBN unit and the addition of the sludge receiving and processing facility a review for potential health and safety hazards was completed. Specifically assigned safety personnel from Covanta, the general contractor, and subcontractors coordinated efforts assessing construction progress and issues as they develop. Near the completion of construction as part of the walk down prior to placing equipment into service corporate safety personnel were brought to the site to identify areas that needed to be addressed. The effectiveness of the program was evidenced by the ability to bring the MBN facility into VPP compliance soon after construction was complete.

6 | PERFORMANCE, ECONOMICS AND COST EFFECTIVENESS

Over 26 years of operations, the RDF facility has consistently achieved 85 percent availability and 525 kwh/ton net electrical production. This high efficiency demonstrates the attention paid to the original facility design. Historically, it has processed on average 600,000 tons MSW annually, significantly exceeding the performance guarantee of 561,600 tons per year.

The MBN passed its seven-day acceptance test, achieving commercial operations on August 4, 2013. The MBN is outperforming its contract guarantees, including demonstrated 1,000-tpd capacity (900 tpd guaranteed) and routinely achieves more than 625 kWh net per ton of waste processed (559 kwh/ton guaranteed).

For the combined H-POWER facility, Covanta guarantees and consistently meets or exceeds the following contract performance standards:

- Energy: RDF – 520 kWh/ton; MBN 559 kWh/ton
- Throughput – 840,825 tons/year capacity
- Metals
- 80% recovery of all ferrous metals which would not pass a 1” screen
- 60% recovery of all non-ferrous metals which would not pass a 3/8” screen
- Ash quality standard: no more than 3% unburned carbon by wet weight; no more than 30% water
- Reagents
- Pebble Lime – no more than 25-pounds Pebble Lime consumed per ton MSW
- Carbon – no more than 2.25-pound Carbon consumed per ton MSW
- Ammonia – no more than 3-pound dry ammonia consumed per ton MSW
- Meet, at a minimum, all requirements specified in all permits

The financing of H-POWER facility was studied and planned carefully to ensure financial success. Initial construction started in the late 1980s and H-POWER (with Boilers 1 & 2) became commercially operational in May 1990 at a cost of around $150 million using general obligation bonds. The City & County of Honolulu (CCH) sold the facility to Ford Motor Credit Company (FMCC) in January 1991 for $312,485,532. FMCC made an initial cash down payment of $80 million; an Installment Sale Agreement and Mortgage and Security Agreement was executed for the remainder of the purchase price ($312,485,532 - $80,000,000) or $223,485,532 for 20 years @ 8.04% mortgage note. FMCC bought the facility to avail of then applicable federal tax benefits (both a 6% investment tax credit and accelerated depreciation). Simultaneous with the sale, a lease (Facility Lease Agreement) was executed between FMCC and Honolulu Resource Recovery Venture (HRRV) whereby all rights and responsibilities with respect to the facility operation were transferred to HRRV. The CCH used of the facility was provided through a Service Agreement between the CCH and HRRV, whereby HRRV agreed to provide waste disposal services to the CCH for a term of 20 years (May 1, 1990 to April 30, 2010). The site of H-POWER facility was not part of the sale, so access to the site was provided through a Ground Lease Agreement between the CCH and FMCC, a 20-year term for $3,222,669 per year. In summary, under the various agreements discussed above: a) FMCC makes installment sale payment (via mortgage payments) and ground lease payments to the CCH; b) HRRV makes lease payments to FMCC; and c) the CCH makes service payments to HRRV for waste disposal. These general relationships (agreements as underlined above) with the CCH, FMCC and HRRV were prescribed in a Participation and Assignment Agreement executed on Nov. 1, 1989. The CCH bought back the H-POWER Facility in October 2008 for over $43 million. In late 2009, the construction of Boiler 3 began and was completed in late 2012 at a cost of over $302 million using general obligation bonds. The CCH realized income from H-POWER operation from 1991
The City has had amazing success economically with the facility. The RDF facility was conceived in the late 1980s and constructed for $150 million, plus an additional $40 million to provide scrubbers due to environmental change in law. Taking advantage of the Tax Recovery Act of 1986, this depreciable asset was sold for a healthy return to the pension program of Ford Motor Company for $312.5 million, was operated under a lease-back arrangement. After 17 years was bought back by the City for a residual value of only $18 million – a great deal for the residents of the island. The RDF facility is currently within a six-year refurbishment and replacement schedule with a total value of $48 million.

The MBN facility was conceived in the mid-2000s, was constructed using $320 million of public financing (GO bonds), was completed on budget and achieved commercial acceptance on August 4, 2012 – four months ahead of schedule.

The combined H-POWER facility has an annual operating budget of up to $100 million, which funds service fee payments to Covanta, ash and residue disposal, landfill development and operations, provides recycling funds, and debt service. H-POWER’s unique island location profoundly affects its economic performance, contributing a number of factors that make a waste-to-energy facility a sound investment for the City, including high electric rates, high tip fees, and limited availability and high cost of land. The City has conducted several life-cycle analysis using RTI, MSW DST, and triple-bottom-line sustainable return on investment methodology. All the studies showed that H-POWER provides significant global economic benefits, including cost savings and development of a skilled professional workforce.

Tipping fees at H-POWER are $45/ton municipal and $81/ton commercial, the same as the landfill. Tipping fees generate up to $40 million annual gross revenues for the City.

The additional electrical production from the combined H-POWER facility required an amended and restated Power Purchase Agreement (PPA) with HECO. The new PPA was approved by the Public Utility Commission (PUC) on January 17, 2013. On average, the City receives $0.1750/kwh, of which Covanta receives 18.5 percent capped at $0.165/kwh. Electric revenues generate up to $85 million annual gross revenues for the City.

Recovered ferrous and non-ferrous metals generate up to $5 million annual gross revenues, of which about half is shared with Covanta.

Accounting for all costs, H-POWER returns to the City about $30 million net revenues annually through tipping fees, the sale of electricity and recovered metals.

**Supplemental Materials**

**Links to other articles and materials:**


The Green Channel: [http://www.opala.org/solid_waste/media/Green_Channel.html](http://www.opala.org/solid_waste/media/Green_Channel.html)

Turning Nets Into Energy: [nets-into-energy.CNN](http://nets-into-energy.CNN)

Do your results meet or exceed the goals established?