By having both RDF and MBN technologies on the same site, H-POWER provides unique and innovative waste-to-energy solutions, allowing for more strategic management of the island's wastes.

H-POWER’s innovations in waste-to-energy begin with uniquely integrated refuse-derived fuel (RDF) and mass burn (MBN) technologies, allowing comprehensive management of Oahu’s non-recycled wastes.

H-POWER produces renewable baseloaded or dispatchable power, reducing reliance on expensive imported fossil fuels. It is an industry leader in ferrous and non-ferrous metals recovery. H-POWER’s safety and environmental performance are exceptional, particularly for NOx emissions featuring the first boiler specifically designed with VLN technology.

H-POWER is critical to Honolulu’s solid waste management plan, providing nearly complete diversion of MSW. It has management plans for wastes such as MSW, sludge, tires, ASR, medical waste, C & D waste and bulky waste. The facility has pioneered ash reuse, with the MBN designed for separate combined and bottom ash generation. Achieving exceptional performance, H-POWER is highly prized by the community. H-POWER’s refurbishment and capital projects position the facility to be very profitable for years to come.
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H-POWER is the only operating plant in the United States that combines the best of refuse-derived fuel (RDF) technology (pictured above) and mass burn (MBN) technology.

1. ENGINEERING DESIGN SYSTEMS AND TECHNOLOGIES

The Honolulu Program of Waste and Energy Recovery (H-POWER) is a one-of-a-kind integrated facility (see page 18 for full facility layout). It is the only operating plant in the United States that combines the best of refuse-derived fuel (RDF) technology and mass burn (MBN) technology, allowing the plant to manage more types of waste for the City and County of Honolulu (City).

RDF Facility

The original facility (pictured above) began operations in 1990 and consists of two 100-tph waste processing trains (the daily processing capacity is 2,160 tpd in a single shift) and two 854-tpd combustion trains.

The diagram on page 19 shows the RDF process, including waste processing and preparation, combustion process from furnace to stack, and electrical production. The electrostatic precipitators (ESPs) have since been replaced with semi-dry scrubbers and reverse air baghouses.

Municipal solid waste (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 facility. These items are separated from the waste stream and staged for proper disposal or transport to the MBN unit.

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), drum magnets and two-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, 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 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.

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 58.6-MW Toshiba condensing steam turbine (designated turbine-generator #1 or T/G #1) and a 75 MVA Toshiba A.C. generator (pictured below), and associated support systems. The electricity is sold to the island’s electric utility, Hawaiian Electric Company (HECO) and is considered baseload renewable energy.

The RDF facility is capable of achieving a guaranteed 520 kWh net per ton of waste processed. However it routinely achieves more than 625 kWh net per ton of waste processed. The electrical power produced is very important for the island as one of the few sources of energy that is derived from expensive imported fossil fuels.

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. 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.

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.

The flue gas passes into the air pollution control (APC) equipment for each boiler, which consists of a rotary atomizer type spray dryer absorber (SDA) and the baghouse. An activated carbon system has been installed and is available, but is typically not required to be in operation to meet emission limits. The facility was originally proposed with only ESPs. SDAs were added to the design prior to construction due to a permit remand.

**APC Improvements and RDF Refurbishment**

The City replaced both of the existing ESPs with new reverse air fabric filter baghouses (pictured below) in 2009, 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.

Most of the refurbishment work included replacement of the original boiler 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.

Remaining work includes a modification to the burner arrangement, bull nose, and portions of the front wall, and a possible innovative modification to the superheater arrangement. The boilers have always had difficulty achieving the design superheat temperature after a certain point in the operating cycle. A newly designed superheater will be installed in one of the two boilers to determine if the performance can be enhanced. The new superheater will have a different steam path and more tube rows extending slightly forward of the original superheater. To help protect this design and to improve the gas flow through the superheater, the bull nose arrangement will also be modified. It is anticipated that these changes will have about a one year payback in increased electrical output.

The existing five-cell wooden cooling tower structure was also deteriorating and was totally replaced with a fiberglass frame structure (pictured below). The new design will avoid the issues with the decaying wooden structure. The challenge for this work, however, was how to keep the facility on line at full processing capacity while completing the refurbishment. To complete the replacement, a two-cell tower was added as an early task for the MBN construction. The two towers were then tied together at the basin level and water return, thereby allowing the existing tower to be rebuilt one cell at a time.

Other refurbishment projects have been completed or are planned over the next few years. The main condenser will be upgraded with titanium tubes and tubesheets, which are anticipated to have better performance with the brackish circulating water than the former copper nickel tubes. This project was completed in 2013 in conjunction with a major turbine overhaul. New feedwater pumps have been installed to replace the existing units.

A number of projects are planned for the RDF production lines. New magnets (pictured right) are projected to improve ferrous recovery. The arrangement for the in-feed conveyors and bulky waste grapples will be upgraded to more effectively control material fed to the primary shredders. 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 metering bins will also be improved.

A controls upgrade is also in progress. The T/G #1 Woodward Control System has been replaced. The 20-year-old control systems for the waste processing lines, boilers 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.

Other refurbishment projects include:

- Replacement of the eddy current separator for increased non-ferrous recovery from the ash
- Replacement of various air conditioning units to increase system reliability and redundancy
- Work on the boiler economizers and ash chute seals designed to improve performance and reduce tramp air
- Work on the scrubbers and slakers
• Replacement of the pugmills for better ash wetting
• Refurbishment of under grate air plenums
• Repairs to the building siding and roof to give the facility a fresh look for the many visitors interested in the operation

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Replacement of the pugmills for better ash wetting
Refurbishment of under grate air plenums
Repairs to the building siding and roof to give the facility a fresh look for the many visitors interested in the operation

MBN Facility
The City prepared an RFP and received proposals in 2008 for the design, construction and operation of a new 900-tpd WTE facility. The City chose as the winning bid Covanta Energy’s proposal for an MBN, pictured above.

It has been an objective of the City to minimize wastes received that the island’s only municipal solid waste facility to inert material such as ash. The various post-recycling waste streams going to the landfill and available on the island have been reviewed and analyzed. Starting the excess municipal solid waste 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. Together with the addition of a shear shredder, the MBN gives the City the ability to process additional categories of bulky waste not possible with the original RDF facility, such as mattresses, carpets and furniture. Since Oahu is an island a home needs to be found for all non-recyclable wastes. Success stories for some of these materials are presented below.

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 generates and gathers about 65,000 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.

Covanta has developed a corporate project for beach cleaning and disposal of waste fish netting and gear. In partnership with a local metal processor the netting is cut into manageable pieces and then is brought to the facility for electrical generation. 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.

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 current are disposed in the landfill. Under certain conditions if this material has not been quickly covered, odors may be generated and have resulted in occasional issues at a large resort area located nearby. Final plans are underway for addition of a sludge receiving and processing facility at the MBN. Once complete, up to 90 tpd of 30 percent solids sludge will be able to be received, stored, and metered into the MBN in a manner designed to manage odors by drawing them into the boiler and through a biofilter while feeding into the waste feed chute to avoid exposure. At the landfill the sludge is mixed with equal quantities of bulky waste for stabilization. Once the sludge can be received at MBN, the additional bulkies will also be received.

Because the volume and quantity of bulkies is quite significant, a specialized Waste Auxiliary Building (WAB) is being added to the facility. The WAB will be 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 will be used to shred the bulkies and recover more higher value ferrous metal while reducing wear and tear on the boilers and ash systems. By pre-shredding the bulkies and removing the metals, the bulkies are expected to be able to be processed in either the MBN or the RDF facilities.

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 and emissions questions.

The processing lines for the RDF facility generate about ten percent process residue. The process residue has some residue
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.

The MBN broke ground in December 2009 and was completed in August 2012, on budget and four months ahead of schedule. The dedication ceremony was held by the mayor of Honolulu and Covanta Energy on October 9, 2012. On Oahu, H-POWER is generally well-received and well-visited by school-aged children through civic groups and foreign visitors. The facility is always a stop on the Solid Waste Department’s period Tour de Trash public outreach bus tours.

The MBN includes a three-day refuse storage pit. Refuse is deposited either 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 (pictured right). 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 convection passes, a horizontal superheater section, one vertical superheater section and a vertical economizer.

VLNTM technology employs a unique combustion air system design, which 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 VLNTM 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 VLNTM
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

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.

MBN steam conditions are 830°F and 900°psig. Steam is transported from the MBN via an elevated pipe rack to a new Siemens steam turbine-generator (designated Turbine-Generator #2 - or T/G #2), capable of producing up to 33.6 MW (pictured right). 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. 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 City is currently adding a second DC, which is sized to handle the steam production of both of the RDF units.

The addition of the dump condensers (pictured right) 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.

2. ENVIRONMENTAL IMPACTS AND REGULATORY COMPLIANCE

H-POWER provides important environmental benefits to the residents of Oahu. The City has conducted several life-cycle studies, using Research Triangle Institute’s (RTI), MSW Decision Support Tool (DST), and triple-bottom-line 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.

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.

As part of the requirements for the permit for the facility expansion, a requirement to complete post-construction ambient air quality monitoring. The Department of Health (DOH) did not have a full inventory of emissions information for
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.
- Brackish water obtained through caprock wells is used for cooling limiting consumption of treated water
- Preparing for use of re-claimed water to further reduce potable water consumption

RDF

- 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.

MBN

- Essentially eliminates MSW and bulky waste diversions to the landfill.
- Employs VLN™, a new and innovative technology for NOx control.
- 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.
- Provides ability to manage the bottom ash separately as a recyclable by-product should State and Federal regulations change in the future.
- A unique sludge receiving, pumping and distribution system, with a separate odor control system, is being developed (see Section 5, Special Waste).

3. PERFORMANCE AND PERFORMANCE IMPROVEMENTS

Over nearly 25 years of operations, the RDF facility has consistently achieved 85 percent availability and 525 kwh/ton net electrical production. It processes 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 600 kwh/ton energy efficiency (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
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- 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-pound 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

Ash Management

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 (pictured above). 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 (pictured below).

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 prior to loading into transfer trailers for transport to the landfill.

The City is very interested in rash re-use 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. The MBN ash processing system was designed with the ability to process bottom ash separately or in combination with fly ash. 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.

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 sold to 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. 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.

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 carbon dioxide (CO₂) emissions for GHG monitoring.
The MBN is equipped with APC equipment to control pollutants:

- Covanta’s VLN™ 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 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>
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<tbody>
<tr>
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<td>Emission Limits</td>
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<tr>
<td></td>
<td>Unit 1</td>
<td>Unit 2</td>
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<tr>
<td>SO₂ 24-hr²,³</td>
<td>29 ppmvd</td>
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<td>PM (filterable)</td>
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<td>PM₁₀ (total)</td>
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<tr>
<td>PM₂.₅ (total)</td>
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<td>NOₓ 24-hr²</td>
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<td>CO ²,³</td>
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<td>VOC (as CH₄)</td>
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<tr>
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<tr>
<td>Dioxin/Furan⁹</td>
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Notes:
1. Emission limits shall not be exceeded (except during warmup, startup, shutdown, or malfunction).
2. All emission limits are referenced to 7 percent oxygen (O₂), dry gas basis; ppmvd = parts per million dry volume; mg/dscm = milligrams per dry standard cubic meter; ug/dscm = micrograms per dry standard cubic meter.
3. 24-hour daily geometric average emissions limit.
4. Maximum emissions limit or at least 80 percent reduction by weight or volume (whichever is less stringent).
5. Arithmetic average.
6. Maximum emissions limit or 80 percent reduction by weight for RDF units and limit or 85 percent reduction by weight for mass burn unit (whichever is less stringent).
7. Maximum emissions limit or 90 percent reduction by weight or volume for RDF units and limit or 95 percent reduction by weight or volume for mass burn unit (whichever is less stringent).
8. RDF units have a 24-hr limit and the mass burn unit has a 4-hr limit.
9. Total tetra through octa PCDD/PCDF.

4.) COORDINATION AND COOPERATION WITH WASTE SUPPLY ORGANIZATION

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 Oahu, 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.

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.

5. FACILITY PLANNING

H-POWER is irreplaceable to the integrated waste management for the island of Oahu. It accepts all the post-recycled MSW, bulky waste 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 Oahu easily approaching $1 million per acre, H-POWER has...
provided significant savings by reducing the footprint of waste management on the island.

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 on 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 will soon be developing significant solar and wind generation, which makes H-POWER even more valuable to the utility considering that the facility is firm 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.

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.

The City has planned a sludge receiving station at H-POWER. It will allow the MBN to receive, store and process virtually all the island’s wastewater treatment plant (WWTP) sludge currently being disposed at the landfill. The system is designed for a capacity of 90 tpd at 30 percent solids sludge. Delivery trucks will enter the tipping floor using the same inbound ramp as trucks carrying MSW and unload to a push floor bin with automatic bi-fold cover designed as the first step in odor control. Screw feeders will feed sludge to hydraulic wet cake pumps for distribution to the feed chute. A row of pinch valves in succession across the chute will inject sludge into the MSW at a point below the normal waste plug level before it is loaded onto the feed table. Potential odors caused by the unloading and storage are to be treated through a dedicated bio-filtration system before venting to atmosphere. The net impact of mixing sludge with MSW is expected to reduce the overall heating value of the fuel by 230 Btu/lb, or 4 percent, an insignificant impact considering the important benefits of landfill diversion and volume reduction. The facility is gearing up for construction of the sludge receiving, storage and processing system.

The facility has also be getting ready for construction of the Waste Auxiliary Building (WAB) to provide redundancy and improve handing and processing of bulky wastes.

Today H-POWER addresses 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 tires (pictured right), automobile shredder residue (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 considering a Covanta proposal 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 Oahu that has some energy value will be received and safely processed in an environmentally sound manner. Truly, H-POWER and Oahu 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:

- Superheater and bullnose modifications for improved energy recovery
- Ash residue building improvements to improve availability and reduce maintenance of the bottom and fly ash handling systems
- Rooftop solar generation project (up to 1 MW)
- Additional warehouse building for storage of equipment and spare parts
- Traffic improvements project including additional entry/queuing lanes and one-way traffic flow
- Pilot-scale waste conversion technology demonstration projects on-site
- Replacement of existing rolling stock (dozers/loaders) that have reached the end of useful life
- Office trailer purchase for library / visitor center
- See Section 1 (RDF Refurbishment) for projects in progress
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. H-POWER has addressed many landfill-related and water treatment concerns, including:

- Sludge odors at the landfill to be mitigated by diverting sludge to the planned sludge receiving facility
- Landfill disposal overall to be reduced by diverting MSW, bulky waste, and special waste to H-POWER

6.) 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.

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.

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.

Standard Operating Procedures (SOP), job walkthroughs, 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. Employee safety meetings are held and 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.

H-POWER 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.

7. ECONOMICS AND COST EFFECTIVENESS
The City have 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 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 $0.20/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 in excess of $30 million net revenues annually through tipping fees, the sale of electricity and recovered metals.

8. PUBLIC ACCEPTANCE, APPEARANCE AND AESTHETICS

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 Oahu. 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.

Such studies include:

- H-POWER Expansion Project (MBN) Environmental Impact Statement (EIS)
- Material Separation Plan (MSP)
- Air Permit hearings
- Environmental Assessment (EA) for Sludge Receiving

Covanta partnered with Schnitzer Steel Hawaii Corporation and formed a marine debris management program or Nets-to-Energy. Covanta staff have formed an E-Club who identify areas in the facility and in the community that need improvement and propose solutions.

H-POWER staff provide several public tours every week, for a wide range of interested parties, including middle school, high school, and college student groups, engineers, professional associations, civic organizations, government officials, and foreign dignitaries.

Covanta and Refuse Division staff sponsor, participate, and present at nationwide professional associations conferences, including NAWTEC, WASTECON, SWANA, WTERT, Asia Pacific Clean Energy Expo, and energy briefings at the State Capitol.

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.
SUPPLEMENTAL MATERIALS: FACILITY SITE LAYOUT
SUPPLEMENTAL MATERIALS: THE H-POWER PROCESS

Step inside the HPower facility and you can feel the energy.

Here, 24 hours a day, 365 days a year, ordinary household garbage is converted into environmentally sound, renewable electricity that powers thousands of Oahu households. In the process, precious landfill space is preserved, 800,000 barrels of imported oil per year are saved, and the beauty of our island home is protected.

The HPower Process:

1. Trucks deliver municipal solid waste
2. Primary shredders open and spread waste
3. Electromagnets remove metals for recycling
4. Screens remove dirt, sand and glass
5. Secondary shredder processes remaining waste
6. Waste is combusted in boiler producing steam
7. Steam drives turbine to generate electricity
8. Air pollution control equipment cleans exhaust gas
9. Ash is hauled to landfill for disposal
10. Renewable electricity powers 45,000 Hawaii homes

SUPPLEMENTAL MATERIALS: THE H-POWER PROCESS
Trash-fueled HPOWER still a treasure

(Honolulu Star-Advertiser) Sandwiched between an oil refinery and a coal-fired power plant in Campbell Industrial park sits Hawaii's largest producer of electricity from renewable energy.

The often overlooked facility doesn't have any solar panels or wind turbines. A steady stream of garbage trucks lining up to disgorged their loads reveals the facility's fuel source: trash.

The city's HPOWER waste-to-energy project converts more than half of Oahu's municipal solid waste into electricity, reduces the pressure on the island’s crowded landfills and cuts the amount of imported fossil fuel needed to keep the lights on in the nation's most oil-dependent state.

The plant took a step forward in 2012 when the city expanded the capacity and upgraded the equipment at HPOWER, making it one of the nation's leaders in waste-to-energy.

HPOWER is a key piece of Honolulu's “integrated solid waste program” designed to keep the island's flow of trash under control, said Manny Lanuevo, chief of the city's Refuse Division.

“HPOWER and our recycling program compliment each other to make sure we minimize, if not eliminate, things going to the landfill,” he said.

The plant is run by a subsidiary of New Jersey-based Covanta Energy, which operates more than 40 waste-to-energy facilities around the world.

The biggest criticism of HPOWER is its emissions, which are regulated by the Environmental Protection Agency and the state Department of Health.

But the benefits of waste-to-energy far outweigh the downside of emissions from the plant's stacks, said Covanta's Gail Godenzi, business manager for the plant.

“The benefits are you reduce what goes to the landfill, you recover metal and you reduce the amount of greenhouse gasses by not producing methane, which is what is given off when municipal solid waste decomposes at a landfill,” she said.

The carbon dioxide emitted by burning waste is less harmful to the environment than the methane that would have been produced otherwise, Godenzi said, adding that the plant has never been cited for an emissions violation since it began operating in 1990.

From the perspective of electricity utility ratepayers, Hawaiian Electric Co. is able to buy electricity produced by HPOWER at a price below what the utility pays for power generated from wind energy projects and by burning oil. And the fact that HPOWER produces consistent power gives it an advantage over wind and solar, which suffer from issues of intermittency.

HPOWER, which is recognized as a renewable energy source under the Hawaii Clean Energy Initiative, last year generated enough electricity to power 50,000 homes at an average price of 17 cents a kilowatt-hour. A revised power purchase agreement that went into effect in January 2013 resulted in a reduction from the average price of 21.5 cents a kilowatt-hour paid by HECO in 2012.

The HPOWER pricing compares favorably with the 20.8 cents a kilowatt-hour HECO pays for electricity from the Kawaiola Wind project on Oahu's North Shore and the roughly 22 cents a kilowatt-hour it pays to generate electricity from low sulfur fuel oil at current prices. Planned utility-scale solar projects will produced power for an estimated 16 cents a kilowatt-hour.
H-POWER: Honolulu Program of Waste and Energy Recovery

2014 SWANA Excellence Award Entry, Waste-to-Energy | City and County of Honolulu

SUPPLEMENTAL MATERIALS: ASME WTE FACILITY OF THE YEAR AWARD

The American Society of Mechanical Engineers
Materials and Energy Recovery Division
Waste-to-Energy Facility of the Year
Honolulu Program of Waste Energy Recovery
(H-POWER)
Owner: City and County of Honolulu
Operator: Covanta Honolulu Resource Recovery
April 23, 2012

20th North American Waste-to-Energy Conference (NAWTEC–20)
April 23, 2012
Holiday Inn By The Bay
Portland, Maine

CITY’S H-POWER PLANT WINS TOP AWARD

(Tues., June 26, 2012) – Mayor Peter Carlisle today announced that the City’s H-POWER waste-to-energy plant received the Facility Recognition Award at the 20th North American Waste-to-Energy Conference, and an expansion of the facility will soon be operational.

“H-POWER was a wise investment for the City and is helping keep opals out of our landfill while providing a reliable source of electricity,” Carlisle said. “It’s great to have these efforts recognized by experts in the field.”

The plant has been in service since 1990 and is operated for the City by Covanta Honolulu. It utilizes two refuse-derived fuel processing trains that each combust approximately 300,000 tons of municipal solid waste annually. The expansion project, often referred to as the third boiler, will handle an additional 300,000 tons per year.

With the expansion, H-POWER will produce eight percent of Oahu’s power – enough to power 75,000 homes – while diverting nearly 80 percent of the island’s non-recyclable household opals from the landfill.

H-POWER also recovers approximately 20,000 tons of ferrous (steel) and non-ferrous (aluminum alloy) metal for recycling each year.

The award, presented by the American Society of Mechanical Engineers (ASME), recognizes contributions by solid waste processing facilities for both combustion and material recovery. The Facility Recognition Award is the conference’s highest honor.
H-POWER: Honolulu Program of Waste and Energy Recovery
2014 SWANA Excellence Award Entry, Waste-to-Energy | City and County of Honolulu

SUPPLEMENTAL MATERIALS: DEDICATION PROGRAM & H-POWER FACTS

Mayor Peter B. Carlisle and Covanta Energy
present the

H-POWER
3rd Boiler Dedication

H-POWER FACTS

1. **H-POWER** stands for Honolulu Program of Waste and Energy Recovery.

2. **H-POWER** produces electrical energy, saves landfill space, recovers metals, and is the only proven method of large quantity waste disposal for Oahu.

3. **H-POWER** is a renewable energy source.

4. **H-POWER** is a base-load facility that can produce up to 75 megawatts of electricity for utility use, which is enough to power 65,000 homes every day.

5. **H-POWER** can save one million barrels of imported oil every year, reducing greenhouse gas emissions.

6. **H-POWER** environmental controls are excellent and meet the EPA's most stringent requirements.

7. **H-POWER** has saved over 500 acres of landfill space, and is a major reason why 80 percent of Oahu’s waste is being diverted from the landfill.

8. **H-POWER** recovers and recycles 20,000 tons of ferrous and non-ferrous metal each year with its Magnets and the Bottom Ash Metals Recovery System. These metals are delivered to local metals recyclers.

9. **H-POWER** also recovers other items such as tires, white goods, and propane tanks.

10. **H-POWER** is kept running day and night by 170 local employees, and the expansion has added another 25 full-time jobs.