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HANDLING OAHU'S WASTE DISPOSAL

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ABSTRACT

Oahu has special needs and requirements when it comes to dealing with solid waste on the island. The City and County of Honolulu has successfully addressed this problem in the past and is working on solutions for the future. Five percent of the island's electrical power has been generated reliably from the 2000 tons per day of waste processed by their H-POWER Waste-to-Energy Facility. The facility has been processing waste for nearly twenty years and the volume of refuse going to the landfill is reduced by 90 percent. Honolulu is considering the best solutions for the island's waste for the coming years. Waste-to-energy works in partnership with recycling to reduce the island's increasing waste volumes. Recycling programs are in place and additional recycling measures are being considered. Landfill space is limited and questions exist regarding the ongoing use of the existing landfill and what will happen when it is closed. In an island setting, some alternatives available to other areas such as long haul to distant landfills are not available to bridge solid waste issues. Therefore practical solutions must be found and implemented in a timely manner. A number of initiatives and plans are in development. Measures are underway to prepare the H-POWER facility for future emission requirements and operation for the next twenty years. Steps have been taken toward expansion of the existing facility. Permitting and negotiations with agencies and utilities are under way. This paper will explore and expand upon these issues showing how they are interrelated to one another.

INTRODUCTION

Each of the islands in the Hawaiian chain is a separate county and the Island of Oahu is the County of Honolulu. The Island of Oahu is dominated by the City of Honolulu. The local residents, military operations and tourists generate about 1.8 million tons of waste per year. A single governmental body called the City and County of Honolulu (City) provides the governmental authority for the Island.

The City has a solid waste department that regulates trash in all its forms. The City owns the largest active landfill on the island, the Waimanalo Gulch Landfill. This is the only landfill permitted to accept municipal solid waste. The landfill is operated by Waste Management for the City. The City also owns the Honolulu Program Of Waste Energy Recovery Facility (H-POWER) having recently repurchased it from a group of investment bankers. The City also promotes recycling, green waste collection and composting and other waste reduction programs. This is very important on the island because of the limited land resources, the limited capacity of Waimanalo Gulch Landfill, and limited alternative means of disposal. The H-POWER Facility and recycling divert about a million tons of waste from the landfill each year. Since the City is so highly dependent on tourism, protecting the island's natural beauty is essential which means tight control of illegal dumping and careful management of the permitted facilities. Continued operation of the landfill has become a political issue due to continued development of the island.

Due to the lack of viable alternatives, waste disposal would be anticipated to be quite expensive. However the tipping fee charged on the island is not exceptionally high when compared to other highly developed areas particularly in the Northeast. The tipping fee is currently about ninety dollars per ton for residential disposal with the same fee charged at the landfill as the H-POWER Facility.

Part of the reason for this reasonable tipping fee is the very favorable electrical sales agreement for the H-POWER Facility. The island chain has no natural fossil fuel energy sources and thus is almost entirely dependent on imported diesel fuel oil. A single coal-fired plant located next to the H-POWER Facility imports coal from Indonesia for power production purposes.

The Hawaiian Electric Power Company (HECO) is the only utility in the state and is interested in diversifying its energy sources so the island will be less reliant on fossil fuels. HECO is encouraging other alternative power generation sources such as wind, solar, wave and ocean current, and ocean thermal, but the cost for these alternatives and some of the difficulties developing and operating a power grid using these sources make them difficult to implement.

WASTE GENERATION ON OAHU

Oahu generates approximately 1.8 million tons of waste annually from all residential, commercial and industrial sources. The island economy is highly dependent on tourism. The state has worked hard to keep hotels filled throughout the year and significant fluctuations in waste generation do not occur from season to season. Little industrial activity occurs on the island; however military operations do influence the wasteshed. Waste is categorized into various waste types depending on the source and nature of the material. The primary category is Type A consisting of garbage, trash, rubbish and refuse normally disposed of by and collected from residential, commercial, military, institutional and industrial establishments within the City. Other significant categories include Types B and C which are generally bulky items collected from residential and commercial establishments. Other categories such as household hazardous waste, carpet, sludge and other materials are also handled.

The waste generated has been increasing at a rate of about 20,000 tons per year and is currently about 1,600,000 tons per year. The City's goal is to minimize landfilling. Available disposal capacity has been exceeded and the City has been evaluating alternatives to address the needs of the island.

ISLAND ALTERNATIVES

With no ability to truck waste to distant landfills, alternatives for the island differ from mainland municipalities. Recycling programs have been established and address a significant portion of the waste stream. The H-POWER Facility processes significant quantities of post-recycling waste. Two permitted landfills exist on the island. Waimanalo Gulch Landfill receives municipal solid waste that is not processed at the H-POWER Facility. It also receives residue, fines, and ash from the Facility. The other landfill, Nanakuli is only permitted to receive construction and demolition waste.

With the capacities of existing facilities and programs not able to address the full demand from the island, alternatives have been reviewed to find the best way to address the present and future demands. Alternatives considered included:

- expanding or opening new landfill capacity
- expanding recycling programs
- expanding capacity of the H-POWER Facility
- implementation of one or more alternative technologies
- off-island shipping

The following sections explore these approaches for managing waste on Oahu.

LANDFILL ALTERNATIVES

As noted, Waimanalo Gulch Landfill is the only existing municipal solid waste landfill. It is currently exceeding its permitted capacity and is operating under a conditional permit while the City addresses waste reduction alternatives. The landfill has limited capacity available in existing cells but has additional air space available for expansion. The City has been working on an extension for the Waimanalo Gulch Landfill. While land is available for an expansion, local opposition has been significant enough to get the City to commit to reducing or eliminating the need for the landfill. An extension that would allow the landfill to be operated for an additional fifteen years has been advanced but other alternatives beyond expanded recycling are being discussed. However, the landfill and landfilling in general has become politically unpopular and the City has pledged to reduce the volume of waste received at the landfill in the future.

Potentially another publicly or privately operated landfill could be opened on the island in lesser developed locations. In the island interior areas are available that are not extensively developed. Another major concern on Oahu is protection of the fresh water supply. Adequate water is available however any leak into the aquifer would have a significant detrimental effect. Therefore the City does not support opening a new landfill.

RECYCLING

Recycling on Oahu has been quite effective and above the national average. Recycling programs remove recoverable materials from the waste stream thus reducing the quantity of waste requiring disposal. Programs have grown from recovery of about 100,000 tons of material in 1988 to more than 600,000 tons today. Currently about 31% of the island's waste is recycled. Despite the successful program, measures were reviewed to determine if further improvements could be made to enhance the program, possibly increasing types of materials recovered as well as the quantities. It is expected that the recycling rate will be increased by about 28% to about 40% of the total waste stream but going beyond this level will be very difficult. The City has established:

- Mandatory curbside recycling programs;
- Voluntary community recycling programs;

- Drop-off recycling convenience center/transfer stations;
- Yard waste collection/recycling programs; and
- Hazardous household material collection.

The H-POWER Facility also completes recycling both from the front-end processing system as well as the back-end ash handling system recovering ferrous and non-ferrous metal.

Markets for recovered materials must be available and if strong enough can offset some or all of the cost of collection, sorting, and handling of the recovered materials. With limited industry, no significant local markets or processing capability are available on the island. While location offers an advantage to Asian recycling markets, gathering large enough quantities of recyclables to ship can be problematic. On the island of Oahu recyclable materials cannot be consolidated with truckloads of materials coming from other area markets to a common shipping port to load ocean-going barges efficiently. Maintaining warehouse storage of sufficient space is not practical for the duration required to collect full barges on Oahu and often partial loads must be shipped. Therefore the cost and return for recyclables can be more difficult to balance on Oahu than on mainland USA. While recycling will reduce landfilling demand, it not capable of solving Oahu's growing waste disposal problem.

THE EXISTING H-POWER FACILITY

The H-POWER Facility began commercial operation in May of 1990. Combustion Engineering (CE) designed and built the facility using their refuse derived fuel (RDF) technology. Two 854 ton-per-day RDF waterwall boilers were installed with CE traveling grates. The boiler design is the CE VU-40 boiler and is similar to the two other RDF boiler facilities CE built in Hartford and Detroit. The H-POWER Facility was the third facility built of this type and benefited from some of the early experiences at those facilities. While the basic facility and boiler design is similar, a few design changes were made to address problems identified in Hartford and Detroit.

The boiler design steam conditions are 900 psig and 830^{o}F. A single vertical radiant waterwall pass is located above the traveling grate. 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 before passing to the air pollution control equipment.

The H-POWER Facility has two 100 tons per hour processing lines designed to provide fuel for the boilers. The daily processing capacity is 2,160 tons per day in a single shift. The RDF processed is used to produce up to 57 MW of electricity for export to HECO. A single condensing turbine-generator is installed at the Facility. Originally, the Facility was outfitted with spray dryer absorbers (SDA) and electrostatic precipitators (ESP) for control of emissions. Activated Carbon Injection (ACI) was added as a Maximum Achievable Control Technology (MACT) facility upgrade. Emission performance generally has been very good, however on-going concerns related to particulate and lead emissions existed. To address this issue the Facility has permitted the installation of new fabric filters and induced draft fans. This upgrade is currently underway. It will be completed in series and construction for the first boiler has begun.

The Facility is nearing the end of its twenty year service agreement. Some of the Facility components are showing their age and a capital improvement program is in development to address some of these concerns. In particular the outages due to waterwall tube leaks have increased significantly. The furnace largely consists of carbon steel tubes with Inconel overlay. Over the years numerous patches to the overlay have been completed. A plan is in place to complete a major replacement of much of the furnace waterwall. Certain other components will also be repaired including an overhaul of some of the ash handling system, re-build of the cooling tower and refurbishment of the existing control room. The total scope of the upgrades to be completed over about five years is underdevelopment and is designed to position the Facility for continued operation for the next twenty years.

With H-POWER at capacity with no significant ability to process additional waste and further recycling possibilities limited, the City began to look at alternatives to help reduce landfilling volume. Currently recycling and the H-POWER Facility divert more than a million tons of waste from the landfills annually. The H-POWER Facility processes more than 2000 tons per day of waste into electricity for more than 60,000 homes. This is about 4 to 5% of the total electrical generation for the island. About 18,000 tons of ferrous metals and 2,500 tons of non-ferrous metals are also recycled at the Facility.

ALTERNATIVE TECHNOLOGY REVIEW

A proposal was received from Covanta to expand the H-POWER Facility adding an additional processing train. The City had received numerous proposals and invitations to consider other technologies to address their waste needs. Questions were raised regarding whether the use of twenty-year old technology was prudent or whether advancements have been achieved since that time that would be more advantageous for the City. The City Council requested that a study be completed to determine if there were better alternatives.

Several objectives were established regarding the feasibility of various alternative technologies to divert waste from the landfill. These included:

- The technology must be capable of processing materials being disposed in Waimanalo Gulch Landfill
- The technology must be operating at full scale and processing the amount of material expected at the landfill
- The net cost of the technology must be no greater than the fee paid for disposal after accounting for any revenue streams.

A survey of available systems was completed. A two-tiered screening process was used to pare down the list of potential technologies to consider further. The first stage cut the list to seven technologies and a second cut took the list to three. At this point, a detailed pre-conceptual plan was developed for each of the technologies so a better analysis could be completed. One of the three technologies, a plasma gasification technology, was known to not pass the economic criteria but still was analyzed due to some of the other advantages it promised.

None of the alternatives achieved all of the City's objectives. All failed the cost objective. All were considered effective in diverting waste from the landfill and all were expected to be capable of implementation without major changes to the City's waste management system. The plasma gasification technology claimed the ability to process as much as 90% of the waste being sent to the landfill. The only major waste stream not diverted would be the ash from the H-POWER Facility. A claim that 300kWh/ton of electricity for sale was possible improved the economics for the gasification technology but not enough to overcome the economic hurdle. No large plasma gasification systems were identified and this would be a new application for the types and quantities of wastes proposed. The other technologies were a metals recovery and a gypsum recovery technology. These alternatives were only capable of diverting a small percentage of the waste from the landfill and thus would not fully meet the City's needs. Thus it was determined that none of the technologies considered had a proven track record or was capable of achieving all the needs of the City. The study took about two years to complete.

ALTERNATIVE TECHNOLOGY PROPOSAL

The City decided to seek proposals for Alternative Technologies that could process excess waste on the island. The proposal was broad enough to allow a variety of technologies to consider bidding but had strict requirements for performance. It was anticipated that the facility would be located on property adjacent to the existing H-POWER Facility. A number of different alternatives were considered. The request for proposals allowed various technologies including some innovative technologies and alternatives meeting certain criteria to propose.

A request for proposals for an advance thermal treatment technology was developed. Proposals were received from three vendors all proposing proven mass burn or RDF processing technology. Evaluation had begun when the City determined that addition of an expansion unit on the existing site would offer certain advantages. It was decided however that the expansion unit should utilize mass burn technology. This would allow the addition of a shear shredding operation and the ability to accept additional categories of waste the H-POWER Facility was not capable of processing. A sole source proposal was requested from Covanta for the facility expansion.

The City may start off-island shipping of a portion of the waste stream. Off-island shipping would allow reduction in the waste shipped to Waimanalo Gulch during construction and could be continued as needed. Ash could possibly be shipped to the off-island landfill as well. This alternative could involve a landfill in Northwestern continental US. Barges of waste would be loaded in Hawaii and offloaded and trucked to the landfill. Barges would carry baled waste. The bales would be shrink-wrapped for the trip. To prevent the spread of the Mediterranean Fruit Fly the bales would need to be irradiated prior to shipping.

DESIGN

The H-POWER Facility expansion as noted will be a mass burn processing unit. The single unit will have a capacity of 900 tons per day or nearly 300,000 tons per year. It will utilize Martin grate technology and boiler design. The existing H-POWER Facility had space reserved for another RDF boiler and processing line. This space was evaluated and determined to be incompatible with a mass burn unit. Several alternative arrangements were considered on the site before a final alternative was selected. A facility site layout is shown in Figure 1.

The existing H-POWER Facility has an inbound scale facility and from there waste trucks advance to an elevated tipping floor. The scale facility will be expanded with an additional scale to provide the needed capacity. The existing tipping floor and waste disposal area was determined to be inadequate for the extra traffic and waste capacity required for the mass burn unit. The final alternative selected is arranged to have parallel inbound lanes to two separate but connected tipping floors. Trucks can be directed to either floor. All vehicles with bulky processible materials such as mattresses, box springs, and sofas will be directed to the new tipping floor where they will be shredded with a bulky waste shredder. Additional MSW will be processed up to the limits of the new mass burn unit.

The mass burn expansion unit will have a three day storage pit. MSW will be deposited onto the tipping floor for inspection or directly into the pit. Bulky waste to be shredded will be

deposited onto the tipping floor for inspection prior to shredding. The shredded bulky waste and MSW will be mixed prior to charging in the boiler.

Waste will be charged from the pit to the feed chute by the two redundant refuse cranes. The grate system will be the Martin reverse reciprocating design. The Martin boiler will have a vertical furnace with a horizontal superheater section and a vertical economizer. The unit will be designed for Covanta's Very Low NOx (VLN) technology. This unit will be the first boiler design with the VLN technology built into the design instead of being added as a retrofit for the facility.

The air pollution control systems will include Selective Non-Catalytic Reduction (SNCR) a spray dryer absorber, carbon injection, and a fabric filter. A new stack will be provided for the expansion unit. The VLN technology coupled with the SNCR will allow NOx control well below that required by the EPA Maximum Achievable Control Technology (MACT).

Steam will be produced at 830^{o}F and 900psig matching the conditions of the existing H-POWER Facility. The steam will be shipped from the boiler to the existing steam header where it will be mixed with the steam from the H-POWER rdf boiler boilers. Steam will then be used in the existing turbine generator and a new turbine generator to produce electricity.

Bottom ash from the expansion unit will be discharged from the grate using an ash discharger and will be conveyed past a grizzly to remove bulky residue. The undersized bottom ash will then be conveyed to ferrous recovery and non-ferrous recovery. The ash will then be mixed with fly ash collected from the air pollution control equipment and directly loaded into residue trailers. This residue handling system will be separate from the ash handling system for the existing RDF processing units.

PROPOSED EMISSIONS

Draft permit applications have been submitted for the expansion facility. A summary of proposed permit limits is attached as Table 1. As noted above, the proposed NOx limit is substantially lower than the MACT limit for large municipal solid waste processing facilities. A number of other limits are also lower than the MACT limits as well. These proposed limits are equivalent to the limits for the expansion for the Hillsborough, Florida facility.

CONTRACTURAL ARRANGEMENTS

Construction agreements are currently be negotiated. A limited notice to proceed to complete permitting has been implemented to allow that phase of the project design to advance. Air permit applications and the draft Environmental Impact Statement (EIS) has been submitted and are in review by applicable agencies. A limited notice to proceed to complete design to support permits required for construction has also been completed. Release for design of major equipment is also included. Major equipment includes items such as the turbine generator, boiler, grate, and air pollution control equipment These releases were completed to accelerate the construction schedule and bring the expansion unit on line as quickly as possible in order to alleviate the island's landfill demand.

STATUS

The H-POWER Facility expansion is currently in the permitting and design engineering process. It is expected that permits could be available around the end of the third quarter of 2009. Contract negotiations and development are also in progress and should be completed prior to the conclusion of permitting. Once all required permits have been obtained, full notice to proceed can be granted to allow construction to begin. This will be the beginning of the end of years of work completed by the City of Honolulu to reduce the demand for landfilling on the Island of Oahu.

Figure 1
Facility Site Plan

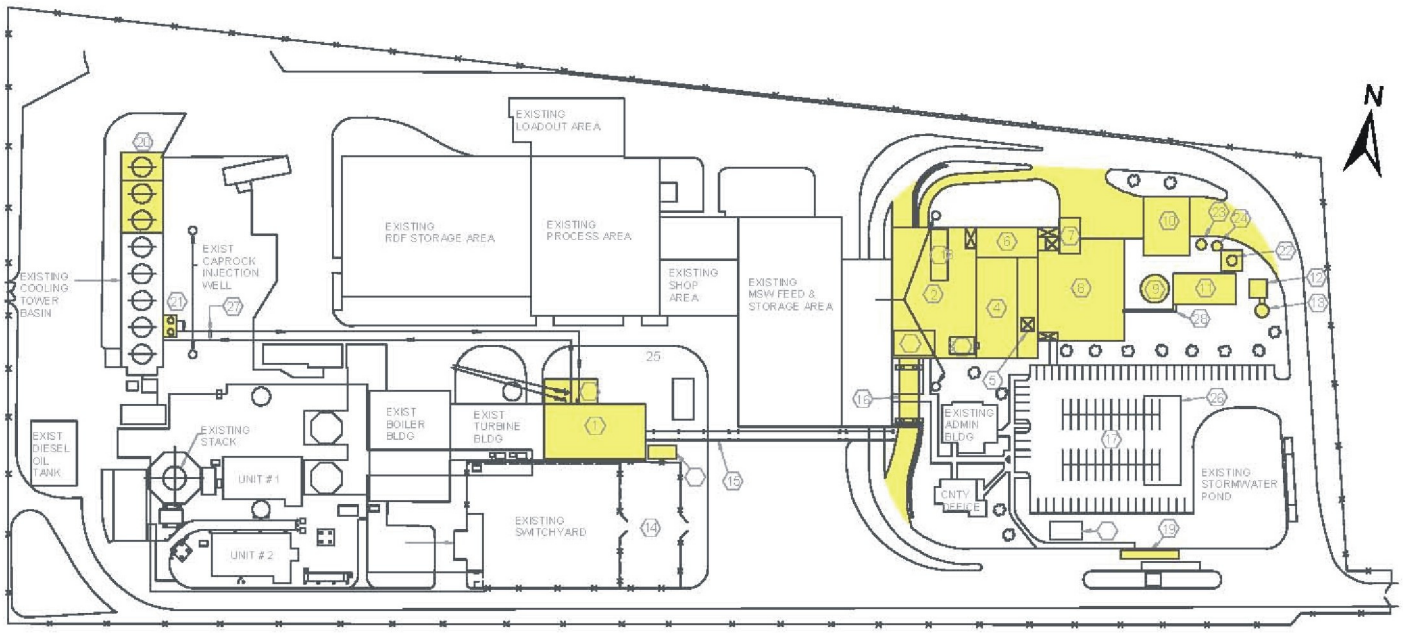

Table 1

2006 Large MWC MACT Rule and Expansion Unit Proposed Emissions

NSPS (Subpart Eb) Emission	Requirement	Proposed Permit Limits	Comments
Dioxin/furan (ng/dscm)	13	13	Total Tetra – Octa
PM (mg/dscm)	20	12	
PM-10 (mg/dscm)	NA	32	
PM-2.5 (mg/dscm)[1]	NA	30	
Cd (ug/dscm)	10	10	
Pb (ug/dscm)	140	140	
Hg (ug/dscm)	50	28	Whichever is least stringent
Hg (%)	85	85	
HCl (ppmv)	25	25	Whichever is least stringent
HCl (%)	95	95	
SO2 (ppmv)	30	26	Whichever is least stringent
SO2 (%)	80	80	
CO (ppmv)	100	100	
NOx (ppmv)	150 NA	110 90	24-hour daily arithmetic average Annual average

NA – Not Applicable
All concentrations corrected to dry 7% O2.
1. Total particulate as measured by EPA Method 5. PM-10 and PM-2.5, as measured by EPA Methods 5 and 202.