A DAY/WEEK/MONTH/YEAR IN THE LIFE OF YOUR TYPICAL LANDFILL GAS PROJECT
(Oherwise Known as "The Good, The Bad, and The Ugly")

Tim Flanagan, Assistant General Manager
Mario Van Cleave, Power Systems Supervisor
William Merry P.E., General Manager
Monterey Regional Waste Management District
Marina, California

INTRODUCTION

The popular TV series, "24", routinely depicts its hero, Jack Bauer, in a variety of extremely stressful and precarious situations all played out within a single 24-hour period. For Jack, this one day usually represents one heck of a lousy day. However, to the best of my knowledge, the next day does not present any of the same circumstances. Jack might get to go home early, watch the game on TV, and relax and not be interrupted by another potential terrorist threat or nuclear explosion. To the average manager of a landfill gas project however, ***every day*** is like the series "24". Maybe without the terrorist's threats. But stressful? That would be a "yes". Precarious? That would be another "yes", Challenging? "Yes" again... Do we see a pattern developing here? The average plant manager typically has a 24 hour/7 day a week responsibility over several million dollars worth of equipment and contract energy sales to be responsible for. It may not be quite as dramatic as Jack Bauer, but they have to do it day in and day out 365 (or 366) days a year.

The Monterey Regional Waste Management District (District) is going to attempt to depict a few of the real world obstacles, challenges, and opportunities it has had presented to it and worked through over the past 12 months or so. Hopefully, you will get the benefit of our mistakes, see what we think we did correctly, and make informed decisions about your own projects learning from our case study.

DISTRICT FACTS

The District is a Special District of the State of California, established to serve the local governments of the central coast of Monterey County, 120 miles south of San Francisco. It is governed by nine local government agency members including seven cities, the county, and a community services district.

Geographically, the District extends from Moss Landing in the north to Big Sur in the south, with the Pacific Ocean on the west and the Salinas Valley on the east, 853 square miles of service area, and a service population of 170,000. The District operates a 1,000 ton per day landfill, which has a remaining capacity of over 40,000,000 million tons or approximately 104 years at the current rate of fill. The site opened in 1966 and accepts only municipal refuse with 300 to 400 customers per day. The site is open six days, 60 hours per week.

The District operates several waste diversion operations on site. Customers entering the site have the opportunity to first drop off items for free at the "Z" wall drop-off recycling center (paper, metals, cans and bottles, etc), donating items at the Last Chance Mercantile, or getting rid of household hazardous waste (HHW) prior to crossing the scale. After crossing the scale and being charged a $43 per ton tip fee, customers are directed to the Materials Recovery Facility (MRF), (which accepts about 400 tons per day) where 60% of the material entering the MRF is diverted from landfllling. Household refuse and wet trash are directed to the landfill for direct burial.

A landfill gas-to-energy plant converts landfill gas to electricity. The District's gas-to-energy plant was the third such project to go on line in the United States in 1983. Since it was one of the first such projects in the country, it has had an opportunity to install a variety of engines and match performance for efficiency and kilowatt (kW) output. Since 1988, the District has been placing refuse on a lined landfill, in compliance with the State of California guidelines, and has been working with its member agencies to reduce the waste stream into the landfill by 25% for 1995 and 50% in 2000. The current diversion rate of the site waste stream is approximately 40% and the diversion rate of the individual cities varies from 45% to over 60%.

deck of Modules 3 and 1, respectively. The piping was upgraded from PVC and realigned in conjunction with development of additional landfill air space by stripping and sliver filling (steepening) of the existing waste slopes. The District minimized LFG-Energy Plant downtime by requesting the piping contractor to connect the new headers parallel with the old using three-way butterfly valve manifolds. The major flow switch-over connections were typically performed with a half-day or less of interruption. The replacement header consists of 12-inch and 18-inch diameter HDPE pipe buried at shallow depth in the northern slide slope. Productive vertical LFG extraction wells and horizontal collectors were reconnected to the replacement header with buried HDPE lateral piping, to allow additional overburden waste filling operations. Smaller HDPE pipes for conveyance of compressed air and condensate discharge were also installed alongside the main LFG headers.

LANDFILL GAS CHARACTERISTICS

The gas produced on site is a medium BTU gas that has proven to be relatively clean. The average gas temperature is 80 to 110 degrees Fahrenheit at the well head, is conditioned at the gas skid to approximately 105 degrees, and delivered to the engines at 86 to 90 degrees. Methane concentration varies seasonally, and from well to well from 50% to 64%. Methane concentration at the engines varies from 49% to 56%.

The gas has been analyzed and found to be relatively clean. Volatile organic compounds, while present in concentrations ranging from 150 parts per billion (ppb) to 300 ppb, have not been a problem in engine operation. Sulfur concentrations have increased over the years to nearly 50 parts per million (ppm), at the high end of the normal range for landfill gas. This increase in sulfur may have resulted from increased volumes of municipal wastewater treatment plant sludge mixed and disposed with the refuse, etc.

To date, gas volumes and quality have not been an issue in operating the engines due, in part, to a surplus of gas.

THE PLANT

Gas is delivered to the District's plant located 400 feet north of the administrative and shop maintenance areas. The 3,200 square foot facility and adjacent equipment includes a four-bay engine room and control room for related switchgear and controls. The gas skid and 5-MW transformer are located outside of the building.

The gas pipeline header leads into a gas skid which features two multi stage centrifugal blowers, an inlet condensate knock-out with a 10 microndemister/filter, a gas to air heat exchanger with automatic temperature control, an automatic bypass surge control, and a gas discharge coalescing 1 micron filter with 99% removal efficiency of liquid and solid particulates. The skid adjusts the gas flow temperature to 105 degrees for more efficient use by the engines. Gas flow is metered after the skid and prior to entry into the building.

The control room is the heart of the operations housing most of the controls, the breakers, relays, and metering to monitor the ongoing operation. Metering is set up to monitor production by each engine, consumption by District administrative and ancillary facilities, consumption by the material recovery facility, and export to PG&E. Controls include standard on/off synchronization switches for the Caterpillar engine and Dia-ne monitors and controls for the Jenbacher engines. A series of Schweitzer relays and a dial up connection to PG&E allows remote monitoring and resetting of the re-closer upon a utility trip.

One other benefit from the plant system design is a heat exchange system which transfers waste heat from the engine cooling system through a series of loops, which then supplies heat and hot water for the MRF. In 2002, the District expanded this system to include the maintenance shop, Last Chance Mercantile, and HHW facility, utilizing more of the waste heat and allowing the District to move away from using natural gas to heat these facilities.

THE ENGINES

The District currently operates four engines; a CAT G3520C at 1.6 MW, and three Jenbacher JGS-320, which are rated at 1 MW respectively. With the purchase of the new CAT engine, the District was able to get comparative operational abilities for each engine. The District's operating goal is to operate the engines at 100% rating as much as possible.

Software coordination and third party interface issues were some of the most problematic. Being a new engine, a number of the software defaults and warnings were unknown to the field technicians assigned to the install. CAT corporate would not allow for systems support to be given by them until a number of "hoops" were jumped through by the field personnel - sometimes several times for the same issues. Component parts for a new model were not always available, and sometimes not even locatable.

As with any new product, some "R&D" in the field is expected. The complexity of the technology of the new engines, with the aggressive air emission standards required, makes for a very narrow margin of error, and for extremely tight control processes to be overlaid on any engine. That being said, the District's "Jack Bauer style" staff, had their work cut out for them. Fortunately, our field representatives from our local Quinn dealer and Quinn Power (who stayed with us through the entire install), and our consultants from Mill Construction and TMAD Taylor and Gaines got us through this installation.

Maintenance and Overhauls – What To Do When You Can't Just Go To Kragen For Parts

The District has had a long history supporting Jenbacher engines in its LFG project. The District had the first landfill Jenbacher model 320 in the United States. Since then, however, several changes have occurred that have made the continued operation and functions of these engines a challenge. In 2005, Jenbacher was purchased by GE. During the time frame of 2005 and 2006, the District has experienced a noticeable decline in parts availability, service responsiveness, and technical support for the three engines we have installed.

As technology has changed rapidly over the past several years in these engines, there is a challenge to keep adequate parts and technological support for engines that are between six and eight years old. Parts manuals change, part numbers change, and experienced personnel leave and take with them the institutional knowledge learned trouble shooting issues in the field. All of these factors contribute to a lack of an effective and timely response to maintenance and service.

Competent service partners are difficult to find – that is understood. But parts and component availability for engines already sold and in the field should be maintained. Basic part availability (for example, filters) should be on hand. For those of us who have engines between eight and ten years old, who need "obsolete" parts, and who have to keep them running, these hurdles are probably the same you have already faced. These are issues that can and should be addressed early by you – before you have one engine out for scheduled maintenance, one unexpectedly down for repair, and an engine undergoing testing and certification as we did this year. We would suggest that possible purchasing cooperatives between like "engineed" facilities be explored, and that long-term part and service support agreements be in place as part of the purchase contracts with any vendor. The "hair you save may be your own" so you do not have to pull it out when you hear "we do not have an oil filter in the Unites States".

Our learning experience this past year would have District staff strongly recommend that future overhauls not be initiated until ***all parts*** you will need are on the ground and accounted for by your personnel.

Utility Coordination Issues And Challenges Or "How To Work With Power Utilities When You Do Not Have The "Power" Make Them Work With You To Sell (Or Connect) Any Power"

We all know what the word "assume" is made up of right? Well, 2006 proved to be a very challenging environment in our coordination with our utility. The District, prior to this period, while always having to go step-by-step with the utility (PG&E), had never been as effectively stymied in coordinating its connection agreements with PG&E. We can probably share a fair part of the responsibility as we did not actively seek out, prior to our application, what new standards or performance criteria may have changed. Additionally, we had the challenge of working with *four* different project managers, each of whom had their own interpretations of their guidelines, metering standards, and settings to be applied to us.

The new standards and setting that PG&E established for us had the undesirable effect of prompting a far greater number of utility trips. These hard trips, combined with the new engine install and major engine retrofits we were performing, has proved to create a vicious cycle, of trips,

ACKNOWLEDGEMENTS

The District would like to acknowledge the key plant personnel who run our facility and perform at the "excellent" level we earlier discussed. **Mario Van Cleave** is our Power Systems Supervisor. Mario has played a tremendous role in developing and sustaining the excellent record level for plant operations during his 10 years at the District. **Bryan Wynn**, our Power Systems Technician, has proven to be an invaluable addition to the team this year. Bryan had a number of years of experience in the maritime industry that he has brought to bear here at the District. **Ernie Mangubat,** our District Power Systems Maintenance Technician, who handles a number of tasks related to our power system and electrical generation system

The District, with its long and rich history in the LFG field, has had several other long-term key personnel involved with the project. **William Merry**, General Manager, has been here and overseen the project development from its inception. **Rick Shedden**, Senior Engineer has tackled a majority of the permitting and regulatory compliance issues over the past 20 years. **Richard Petitt**, Site Manager, has been responsible for the LFG collection system and placement and coordination of the gas lines movement and installation. The District would also like to thank its LFG engineering support partner **Shaw Environmental** for the past several years of dedicated service to the District.

CLOSING AND SUMMARY - LESSON LEARNED

Last year the District tackled a number of difficult projects. We had some successes, some failures, and some challenges that are still in front of us. The common thread through each success, failure, and challenge is that basic project planning and management skills, good communication, a willingness to acknowledge the need for assistance, and a sense of everyone is in this together is what ultimately makes for success programs. As you watch "24", you see Jack Bauer and his team work through incredible circumstances. Here at the District, we might not have issues as spectacular or life-threatening as Jack does, but we still have to keep the place running 24 hours a day, 7 days a week, 365 days a year.

Remember to say "please" and thank you to your staff, your vendors, and your family who put up with you. Share and spread the credit around, take responsibility, and act accordingly. We have a great team at the District - I am positive you do as well. Let us make sure they know we appreciate their work for the betterment of the environment.

Table 1 MRWMD Gas Generation Curve

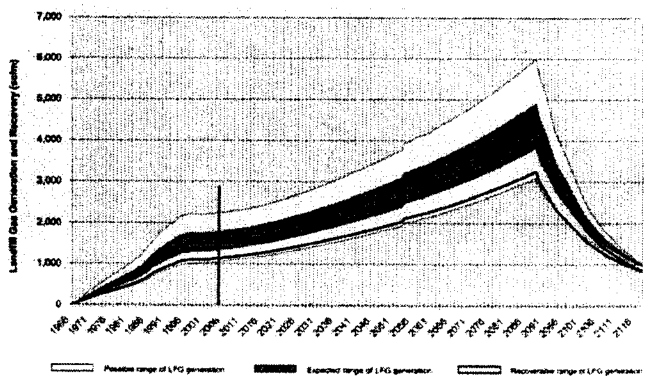

Table 2 Monterey Regional Waste Management District Annual Production of Energy Delivered