Testimony of Anthony J. Fiore, M.P.H.
Chief of Staff, Deputy Commissioner for Operations
New York City Department of Environmental Protection
at a Hearing of the Committee on Environmental Protection
The Council of the City of New York
Re: Intro 534
Monday, June 20, 2011, 1 p.m.

Good afternoon Chairman Gennaro and Members. I am Anthony Fiore, chief of staff to the Deputy Commissioner for Operations of the New York City Department of Environmental Protection (DEP). In my current role I am the lead staffer at DEP heading up the feasibility and implementation of energy projects associated with our facilities, both within the City of New York and upstate in our watershed. With me is James Roberts, P.E., Deputy Commissioner for Water and Sewer Operations for DEP. Thank you for the opportunity to present testimony on Intro 534 regarding hydroelectric power generation using DEP's water supply and wastewater treatment infrastructure.

As you are well aware, New York City's water supply and system are the envy of the world. New York City has been blessed with a robust water supply and DEP, along with its predecessors, have spent the better part of the last 200 years building, improving and refining that system with an eye towards both innovation and longevity. One of the many blessings of our system is that it is mostly gravity fed, which greatly reduces our need for energy in the delivery and distribution of our water. However, during the treatment process, DEP expends massive amounts of energy. As such, DEP has been a pioneer in leveraging its assets to mitigate this expenditure. For example, since the inception of wastewater treatment in the city DEP has captured the gas produced in the anaerobic digestion process and used it to fuel boilers, power engines, and produce electricity. In addition, we capture the heat produced from these operations and use it for process and building heating and cooling needs: DEP was doing cogeneration long before this term came into vogue.

In an effort not only to tighten our own belts in this difficult economic climate, but to also meet the Mayor's goal of reducing greenhouse gases by 30% by the year 2017, DEP is focused on developing new, viable sources of power in an effort not only to reduce costs and greenhouse gases in our operations but for all New Yorkers where possible. One such example is an innovative project at the Newtown Creek Wastewater Treatment Plant. We are partnering with National Grid to process digester gas and inject it into the local natural gas distribution system. The project will supply enough energy to heat 2,500 homes and is equivalent to taking almost 3,000 cars off the road. This project is the first of its kind and will serve as a national and international model for integrating renewable energy in a dense urban environment. Moreover, DEP is studying the implementation of new cogeneration technologies at its North River and Ward's Island wastewater treatment plants. At North River, the current engines are 25 to 30

years old and in need of replacement. Rather than just going to utility power, DEP is evaluating a number of cogeneration technologies to continue its tradition of supplying power and heat from a process-inherent fuel source—digester gas. At Wards Island heat is supplied to the wastewater treatment plant and other municipal customers from a State-run steam plant. Due to downsizing by the State the steam plant is shutting down. In lieu of multiple fuel oil-fired package boiler plants being built, DEP is examining the feasibility of using its digester gas, supplemented by natural gas, to power a cogeneration facility that would serve the needs of many if not all the island's residents. This broad approach would reduce capital expenditures by multiple agencies, and reduce air emissions as well as truck traffic. On the supply side, DEP is also working with other City agencies to bring more renewable energy into its portfolio. We are looking to leverage our assets, namely landfills and large roof spaces at wastewater treatment plants, to site wind and solar installations.

As I mentioned, DEP's water supply is an engineering marvel that conveys water over 125 miles, mostly by gravity, through some of the largest aqueducts in the world and into a distribution system with over 7,000 miles of pipe. Because of this, the system attracts a great deal of attention from both well-established and emerging companies that wish to test their theories and pilot their concepts on our system.

Due to the number of requests we get both in-City and upstate, DEP must consider several factors in determining whether or not to pursue a particular project. First and foremost among our considerations is whether or not a pilot or program will endanger our core mission, which is to provide a safe, reliable supply of drinking water to approximately half the state's population.

DEP has been evaluating its in-City assets. As early as 2004 DEP commissioned a study to evaluate the hydroelectric potential in its wastewater system at North River WWTP. That study showed there was a potential to produce 200 kW—approximately 3% of the plant's demand—that would have a payback period of 27 years. This did not take account of operations and maintenance costs. More recent evaluations conducted in 2010 indicate similar conditions. Our analysis, along with information from the Idaho National Laboratory, which performs work on behalf of the Department of Energy, does not support the conclusion referenced in the introductory language of this proposed bill indicating 40 MW of potential in the wastewater treatment plants alone. However, DEP is not relying on technology alone to reduce its energy demands. We are undertaking a number of operations and maintenance changes to increase our energy efficiency. Some examples include raising the level in our wet wells to reduce pumping needs, turning down blowers at night to more adequately match aeration demands to flows, and instituting an inspection and repair program to reduce recycled flows.

As many here are aware, our infrastructure is generally older than some cities around the country. Approximately two-thirds of our water distribution piping was installed prior to 1970. Design of a system's components, like valves, pipe and other attributes by necessity takes all of the function into account.

Similarly, adding or retrofitting elements to our existing in-City infrastructure would unnecessarily encumber our system. Decision making on either a planned or emergency basis would be forced to take these retrofits into account, thereby decreasing our flexibility and increasing our exposure and liability. Any delay in making system adjustments, responding to water main breaks or additional vulnerability, no matter how incremental, is unacceptable. We work hard to carefully limit the number of points of failure in our systems, especially the size of the conduits that appear to be of greatest interest with regard to these technologies. These strategies serve us well and create much of the reliability and flexibility that allow us to provide some of the highest quality water in the world to the greatest city in the world. The proposed bill would call for installations that encumber and create additional vulnerability to our most critical assets.

Our system, in fact, is already designed to use energy for other functions. For example, we utilize the energy created by the system to operate valves, hydraulic pump stations, educators and piston actuators. These are things the system was designed to do. Further, especially in Queens, Brooklyn and Staten Island, we rely on the available energy, or pressure, to move the water efficiently to the extremities of its reaches. In fact, in some instances pumping stations have to draw water from upstream transmission mains to supply the necessary capacity to downstream sections of the system. Any loss of head from the installation of turbines could in some instances result in insufficient firefighting capacities, posing serious public safety concerns.

While DEP's day-to-day effectiveness might make it seem otherwise, delivering water is a complicated process within our distribution network that balances pressures with volumes and water quality with travel time. At a time when we are concerning ourselves with these balances and compliance with new regulations, like monitoring for levels of "DBP's", or disinfection by-products, it seems imprudent to inject yet another variable, least of all a variable we have no experience with and do not have a clear appreciation for what impacts or concerns it might create.

It is also important to note that our underground infrastructure is housed in facilities that are very vulnerable to flooding. Power generation, by definition co-mingles the generation of electrical power with potentially flooded chambers. Worker safety would be a serious concern and we risk creating an environment wherein our field personnel would need special training in order to maintain and operate our infrastructure.

Adding these elements to our infrastructure will create additional maintenance and repair concerns. Envision a major trunk main being forced out of service, potentially affecting our distribution system, because of the failure of these systems and, for example, unavailability of replacement elements. We know little about the maintenance and repair requirements and

burdens of this emerging technology. It seems imprudent to experiment with these systems for marginal power benefit with real potential consequence to our service reliability.

Finally, you would be introducing additional infrastructure of a sizeable nature into an already congested and overdeveloped underground. One of the biggest challenges we, and all utilities, currently face is the limited available space for co-mingling our necessary infrastructure. It does not seem prudent to encroach upon and deplete this valuable underground real estate for unproven benefit. Further, you create additional manholes, chambers, etc. that become permanent maintenance responsibilities and liabilities.DEP believes the risks to the security and reliability of the distribution system overwhelm the possible benefits from generation of power at in-City distribution facilities.

DEP has been harnessing the energy associated with its gravity-fed water supply system for some time. There are five hydroelectric plants located along the length of the system from the source waters in the Catskill Mountains to our terminal reservoirs just outside the City limits. These five plants have a combined capacity of over 70 MW. In addition, for the past two years DEP has been studying in depth the viability of developing four additional hydroelectric facilities on some of the upstate reservoirs. These current installations are very much akin to those of Boulder, Colorado referenced in the introductory language of this proposed bill. Unlike, Boulder's system, which has very high head, up to 800 feet, our system has a very gradual slope over many miles thereby reducing the head difference and power potential.

DEP has been more flexible and will continue to be when it comes to the potential for energy to be created on the wastewater side of our operations. However, thus far we have seen little reason to be hopeful that a significant source of energy could be generated. Consultant work to date suggests that even a large facility like Wards Island could only generate 220 kW, the equivalent of two thousand 100-watt bulbs burning for an hour and would require the installation of 17 turbines. That facility in particular has a demand of 15 MW. A one-percent energy return is not promising. However, the installation and operation of energy generation facilities at wastewater treatment plants (WWTPs) does not appear to pose insurmountable operation and maintenance (O&M) obstacles.

Based on our discussions with industry to date, DEP has not identified credible pilot projects for the generation of energy from in-City water and wastewater operations. Despite these not so promising results and safety concerns related to installing turbines in the distribution system, DEP is committed to its culture of environmental stewardship by employing proven methods and exploring novel ideas for reducing its energy demands, power costs and carbon footprint. In fact, as a result of a hearing you, Chairman Gennaro, held this past February, DEP is working with the Department of Energy through the Idaho National Laboratory to perform an in-conduit assessment of the gross hydropower potential in both the water supply and wastewater systems. In addition, we continue to be willing to collaborate with private developers in the hope of understanding where this emerging technology can serve our needs. Based on the extensive work

we have done over the past seven years and which we will continue to do, the infancy of this emerging technology, current market conditions, the risks to the water supply system, the small return in terms of energy generation and likely O&M challenges that would drive up costs, we believe that Intro 534 is premature and would only limit the flexibility necessary to our continuing work in this area.

For these reasons, DEP does not support Intro 534, particularly those provisions that require DEP to undertake three demonstration projects (proposed 24-364(c)) and to implement them if the assessment determines a "cost benefit ratio of 0.75 or better." That provision essentially requires DEP to use public funding for three private research and development projects regardless of their merits. Moreover, it requires DEP to implement hydropower projects based on a cost-benefit analysis without defining that term nor making clear that cost-benefit ratios and payback calculations are just one of the tools used to evaluate the overall merits of a project.

Additionally, the bill as drafted proposes to amend Section 24-364 of the Administrative Code. The State Legislature has included that section in its reservation of rights in Section 1-111 of the Administrative Code. Section 24-364 can only be amended by the State Legislature, not the City Council.

Thank you again for the opportunity to testify. I am glad to answer any questions.

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New York City Council
Committee on Environmental Protection

Int 0534-2011 – Requiring the Department of Environmental Protection to undertake an assessment of the electricity generation capability of the City's water supply, wastewater treatment and bodies of water within the City's jurisdiction

June 20, 2011

Testimony by
Ron Smith, CEO

We are pleased to have this opportunity to speak on matters related electricity generation from New York City's waters and water supply. Verdant Power, headquartered in New York City, is a leader in the development of kinetic or free-flow hydropower technology for commercial projects worldwide. Over the past six years, with the continuous support of the City and State of New York, Verdant Power has worked to develop and demonstrate the world's first array of grid-connected tidal power turbines through its Roosevelt Island Tidal Energy (RITE) Project in the East River. The RITE Project is currently in the final stages of being licensed by the Federal Energy Regulatory Commission (FERC) to provide commercial, grid-connected electricity in New York City as the first commercial demonstration of kinetic hydropower systems in the world. This initial project will ultimately supply in stages up to 1 megawatt (MW) of tidal electricity.

The RITE project is a technology readiness level (TRL) 7/8 project, with 9 being commercially competitive, and as such is not a commercially economic technology but an early demonstration of a technology that could become a viable economic source of energy in the future. Traditionally, cost/benefit calculations are not appropriate to evaluate this technology at this time.

Nonetheless, Verdant fully supports the intent of the proposed legislation in Section 24-364.

<u>Water Power Resource Assessment</u>

Article (b.) requiring:
"an assessment of the city's water supply and wastewater treatment systems and the <u>bodies of water within the city's jurisdiction</u> to determine the potential of these systems and bodies of water to be used to generate electricity. In performing such assessment the department shall examine, but not be limited to examining, <u>rivers</u>, aqueducts, pipelines and other man-made water conveyance systems, the means for transmitting the electricity generated, the need to construct and operate generation-related infrastructure, grid-connection issues, generation system installation and maintenance costs, and the availability of federal or state funds for planning or installing an electric generation system."

Verdant notes that in conducting such an assessment, the experience and applicability of free-flow hydro kinetic renewable energy projects, like RITE, should be included as a potential long-term resource for the City.

Technology Assessments and Demonstration Projects

Verdant also supports the intent of the legislation in articles c and d. requiring:
"In addition to an assessment of suitable hydropower technologies for the department's water and wastewater systems, the department shall also conduct a technological review of in-conduit and free-flow hydropower technologies through the implementation of no less than three demonstration projects. And , the assessment and demonstration projects shall be completed **within eighteen months** of the effective date of this subdivision"

Verdant notes that an implementation schedule of three demonstration projects in eighteen months without identified funding is a significant undertaking, and respectfully suggests that a matching funding mechanism be promulgated to allow these projects to move forward.

For example, Verdant's RITE project will proceed within the eighteen month timeframe; however at a cost of $3.9 million for a 70 kW tidal demonstrating project Verdant has secured state funding through NYSERDA for $1.7 million but requires matching funding for the balance.

Verdant respectfully requests that in implementing demonstration projects that RITE be included as a kinetic hydropower technology demonstration; and that a NYC contribution to the execution of the RITE project be considered on the order of $250-500,000 would provide for an evaluation of a free-flow tidal energy demonstration project that is capable of supplying localized power to Roosevelt Island, and potentially elsewhere in and around New York City.

Various local groups are now working to establish New York City as a globally recognized urban platform and as a destination for the world to see ground-breaking innovations in clean energy and energy efficiency. Clean energy from the City's waters should be an integral part of the City's clean energy capabilities and its vision for the future.

rentricity

Testimony before the
New York City Council
Committee on Environmental Protection
June 20, 2011

By
Frank V. Zammataro
President & Founder, Rentricity Inc.
Located at the Accelerator for a Renewable Economy (ACRE Incubator)
160 Varick Street, New York City

Regarding
Int. No. 534 - A Local Law to amend the administrative code of the city of New York in relation to requiring the department of environmental protection to undertake an assessment of the electricity generation capability of the City's water supply, wastewater treatment and bodies of water within the City's jurisdiction.

Good afternoon, Chairman Gennaro and Members of the Committee. Thank you for this opportunity to testify regarding Intro 534, a thoughtful and important piece of legislation that will add yet another important component to an already progressive renewable energy plan for the citizen of New York City. Rentricity supports this effort and hopes to help expand New York City's energy recovery hydro activities.

To reiterate from my previous testimony given on February 17, 2011, processing potable water and wastewater is extremely energy intensive, consuming ~4% of the United States electricity production. The cost of pumping and treating water represents about one-third of a water or wastewater facilities' operating budget. New York's aging water distribution infrastructure, much of it over 100 years old, is clearly a candidate for energy recovery consideration as the infrastructure continues to be upgraded and modernized. However, energy recovery and operating efficiencies are generally a lower priority to the basic need of moving clean drinking water. Energy recovery tends to be more discretionary in nature versus the traditional non-discretionary requirements associated with maintaining

transmission lines. A long-term goal of this Committee should be to make energy recovery a non-discretionary consideration for every NYC-related water transmission line or pressure regulator vault upgrade or enhancement.

Rentricity's energy recovery systems consist of integrated and agnostic technology solutions that include one or more micro-turbines, generators, sensors, processors, electronic controls and communications equipment that operate seamlessly and autonomously within water infrastructure.

The installation of such systems in no way impedes the regular operations of pressurized water distribution. Rentricity custom engineers each system for a specific site's operational conditions and constraints, inclusive of all requisite monitoring, control and protective relays. Systems can be stand alone or integrated into the water utilities existing SCADA (Supervisory Control & Data Acquisition System) system and can be fitted with sensors for smart water system monitoring for leakage detection. Rentricity also works with water utility clients to comply with all electrical utility intertie and safety requirements, as well as government permitting and licensing procedures.

Rentricity primarily uses proven, off-the-shelf reverse pump components that water managers see every day in their regular work. Water users enjoy the same services as always, but now the system is more efficient, using a wasted byproduct – excess pressure – to generate a valuable and much-needed resource: clean, renewable electricity.

Rentricity currently has completed two commercial projects in the United States and has another three in various stages of design/construction. The following slides represent a number of Rentricity's activities within drinking water infrastructure, with the largest being a 325 kW single turbine installation in Los Angeles, California due to be completed this year.

[show slides]

Along with this testimony, Rentricty is also providing a case study on its commercial project in the City of Keene, New Hampshire. While Keene is a much smaller city than New York, this project highlights Rentricity's understanding of the site's boundary conditions, the implementation of a complicated process controls, which resulted in a safe and automated energy recovery project that remained transparent to the utility's normal operations. Rentricity will now show a 2 minute video from the ribbon cutting ceremony for this installation.

[Show Video]

It should be noted that the City of Keene's Water treatment Plant is now 100% energy neutral. In fact, they receive a small monthly check from their electric utility for the residual energy.

To sum up, Rentricity utilizes existing; proven technology to take advantage of wasted, gravity fed energy in order to create renewable electricity, all while leaving the operation of drinking water systems untouched. Furthermore, it seeks to do so efficiently and cost-effectively.

I am pleased to report to the Committee, that Rentricity has been in discussions with the NYCDEP since the fall of 2009 regarding energy recovery. Most recently, with the support of the NYCDEP, Rentricity will likely be granted a small set of funds from NYSERDA (the New York State Energy & Research Development Authority) to review energy recovery possibilities at a number of NYC's wastewater treatment facilities, a safe starting point from the NYCDEP's perspective, however, far from a thorough review of the potential hydro resources on the drinking water side of the agencies operations.

As the Council knows at this stage, it is difficult to accurately predict just how much electricity of this sort could be generated in New York City, but given that over one billion gallons of potable drinking water flows through the City's pipelines daily, it could certainly be in the be 10's of megawatt level or greater, perhaps 1% of the City's total energy demand.

Therefore, Rentricity strongly supports New York's Intro 534 to undertake an assessment of the electricity generation capability of the City's water supply, wastewater treatment and bodies of water within the City's jurisdiction. Rentricity would like to recommend the following enhancements to Intro 534:

1. That a technology review be included as part of the initial assessment, instead of part of the demonstration projects. There are many existing turbine technologies that can be used under a diverse range of hydraulic conditions. A review of these technologies in the assessment will make the effort more comprehensive, allowing for economic analysis of the projects to be determined at an earlier stage, prior to an actual demonstration pilot installation; and

2. That select staff of the NYCDEP, as part of the assessment, visit one or more existing energy recovery sites such as the referenced systems in Boulder, CO. and/or Keene, NH., to further understand how these energy recovery technologies are integrated in a transparent manner to normal operational requirements.

In closing, Rentricity has proven that in-pipe energy recovery is abundant, safe, efficient and economically viable. By looking at energy recovery in New York City's water infrastructure, the City Council is helping to provide its citizens with a

buffer from oil and natural gas price spikes and supply interruptions as well as increase the security of New York City's electric supply.

I appreciate your time spent reading and listening, and your inclusion of my testimony in the Committee's deliberations. If you require any further information, please do not hesitate to contact me at frankz@rentricity.com or 732.319.4501. Thank you.

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Building a Smart & Sustainable Water Grid

rentricity

June 29, 2011

Contact Information:
P: (732) 319-4501 Frank Zammataro frankz@rentricity.com

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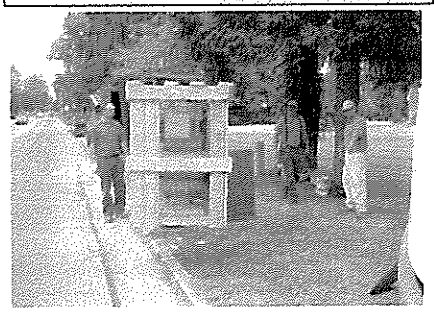
Vertical Turbine Installation



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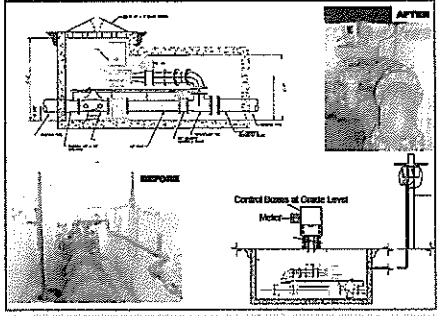
Distribution System PRV Installation



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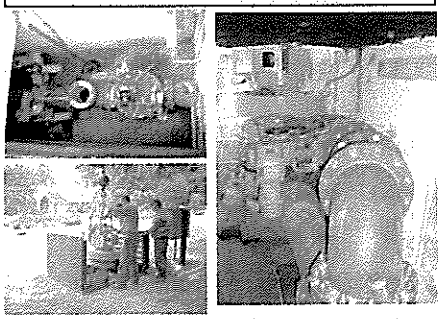
Vertical Turbine Installation



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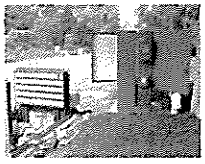
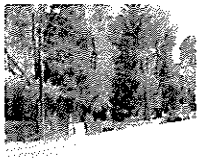
Regulator Vault Street View



Vault and Control Box



Minimal Siting Issues

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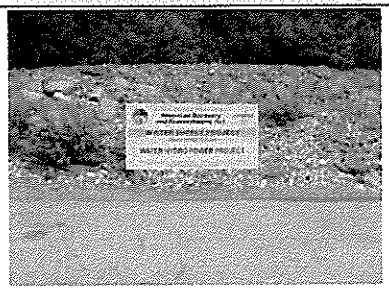
Keene New Hampshire – WTP Installation



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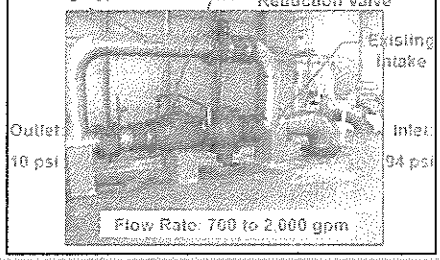
NH WTF PRV Site – Existing Conditions



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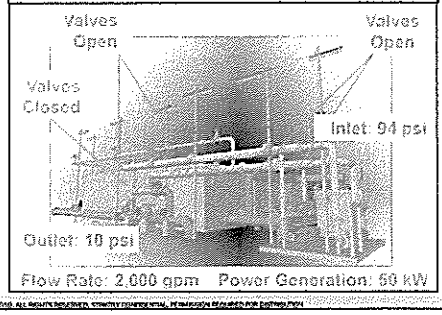
NH PRV - Dual Turbine Design



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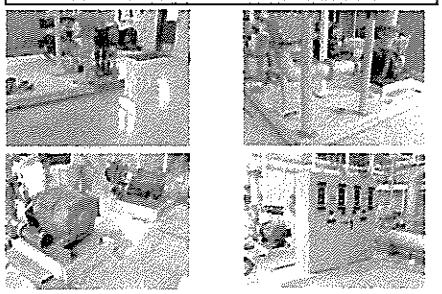
NH Site during Construction



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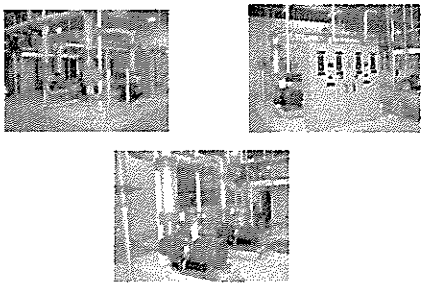
NH Site during Construction



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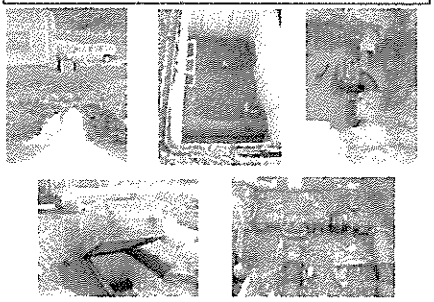
PA Pump Station Vault/Valve Prep.



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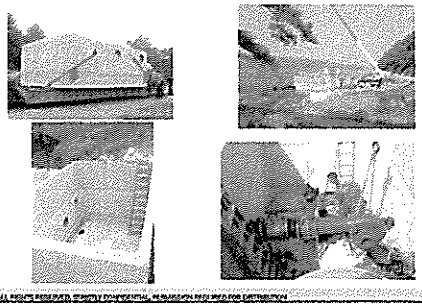
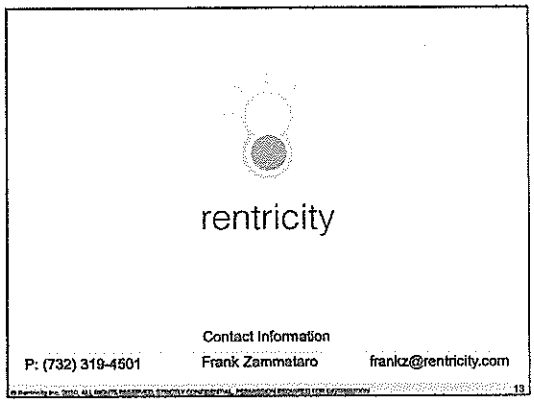
PA Vault Installation

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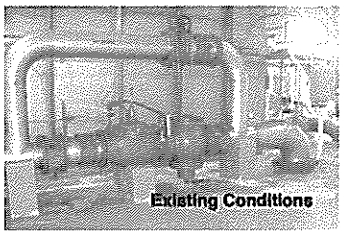
RENTRICITY CASE STUDY
City of Keene Water Treatment Facility, New Hampshire

INTRODUCTION

Rentricity is an alternative energy company that converts excess pressure in piping systems to clean, renewable power. Rentricity provides total system solutions that include design and implementation of turnkey hydrokinetic systems, custom designed to the customer's specific site, operational conditions and constraints, inclusive of all requisite monitoring, control and protective relays. Systems can be stand alone or integrated into the client's existing SCADA system and can be fitted with sensors for smart water system monitoring. Energy can be recovered anywhere within the water distribution system, usually from mandated releases, pressure reduction valves (PRV) and transfer stations. Rentricity also works with clients to comply with all electrical utility intertie and safety requirements, as well as government permitting and licensing procedures.

THE CHALLENGE

The City of Keene, New Hampshire's water treatment facility (WTF) system consists of a gravity fed system inclusive of a strainer and a pressure reduction valve (PRV) that passes raw water into three filter trains, each controlled by a flow control valve (FCV). Flow rate through each train is set by operator keyboard command to vary between 700 GPM and 1400 GPM. Significant diurnal flow change is experienced daily to support maintenance for one or more of the three filter trains. Filtered water flows by gravity to two hydraulically connected storage tanks with capacities of 1.5 MG and 3.0 MG. The water treatment facility and the distribution system are monitored and controlled by a SCADA system from the central control room with remote dial up access.



The PRV serves the WTF functionally by reducing pressure from the gravity fed line descending from the raw water storage reservoir. The energy released through the PRV was dissipated as heat energy. The City of Keene wanted to recover this source of clean and reliable energy, while maintaining their flow regimes, daily maintenance requirements and other normal operations. Further, the City of Keene wanted the flexibility to be able to utilize the generated power to offset demand inside the WTF and export the excess to the local grid.

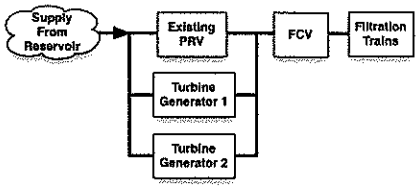
RENTRICITY'S SOLUTION

Rentricity installed two new turbine generators with different capacities in parallel to the existing PRV inside the Keene WTF to maximize flexibility in operations while maintaining complete transparency to their primary mission – providing safe, reliable drinking water.

Start-up of either one or both turbine generators is initiated either by operator selection through SCADA or local control panel. Shutdown is initiated by operator keyboard control (through SCADA), local control panel, or automated by protective devices during loss of utility power. A surge release valve operates in accordance with local conditions to prevent overpressure or water hammer effects in the event of a rapid unplanned turbine shut down. Surge release discharges into a waste drop box that in turn drains into the recycled water storage tanks.

A switchgear cabinet was installed inside the electrical room for interconnect to the WTF electrical distribution system in accordance with the Public Service Company of New Hampshire (PSNH) cogeneration interconnection and net metering requirements.

The turbine generator assemblies can be selected to operate either individually or in parallel under the following approximate operating conditions: Turbine Generator 1 at 720 GPM, generating 17-18 kW power, Turbine Generator 2 at 1440-1470 GPM, generating 36 - 38 kW power, Turbine Generators 1 and 2 operating in parallel at 2,070-2170 GPM, generating 50 to 55 kW power, either or both of the turbines operating in combination with the PRV, or turbine generators non-operational with pressure reduction through the PRV.



RENTRICITY'S RESULTS

The city of Keene, New Hampshire is now recovering energy that was previously lost to a pressure reduction valve. Rentricity's energy recovery system was customized to be transparent to normal operation, configured to recovery energy at variable flow rates and plant operation scenarios so as to not disrupt the plant's mission to provide water to meet the City of Keene's demand. Keene is now producing renewable power, moving closer to a more sustainable and efficient water system.

THE FINANCIAL CASE

Rentricity's energy recovery systems are durable and reliable, designed to last 40 years with little operation and maintenance costs. The rate of return is attractive, with a shorter technology payback period than other renewable energy systems. Federal, state and local incentives, including grants and other subsidies increase the rate of return dramatically. The City of Keene was awarded a grant of over $200,000, for an accelerated payback on the project. The Keene project costs are approximately $0.05/kWh, excluding the grant, and the system provides the City with continuous revenue.

Testimony of Josh Kanagy, Director of Business Development for Lucid Energy Technologies, before the New York City Council Committee on Environmental Protection

Re: Int. No. 534 - A Local Law to amend the administrative code of the city of New York in relation to requiring the Department of Environmental Protection (DEP) to undertake an assessment of the electricity generation capability of the City's water supply, wastewater treatment and bodies of water within the City's jurisdiction.

June 20, 2011

Introduction

Good afternoon Chairman Gennaro and members of the committee. My name is Josh Kanagy, Director of Business Development for Lucid Energy Technologies, LLP (Lucid Energy). I greatly appreciate the opportunity to discuss with the committee the proposed bill and the opportunities this presents to the City. Introduced bill number 534 will move New York City closer to its goals for a 30% reduction in greenhouse gases by 2017 as well as support state clean energy goals.

Testimony in Support of Int. No. 534

As the DEP rightly states in its Strategy Plan 2011 - 2014, "an aggressive energy strategy plan is crucial to...meet the PlaNYC goals of reducing our greenhouse gas emissions by 30%."[1] The Strategy Plan goes on to describe four primary technologies that are seen by the DEP as critical in developing 30 – 50 MW of clean energy supply at DEP facilities. These technologies include; hydroelectric, anaerobic digestor gas, wind and solar. Each of these technologies will play an important role in meeting the administration's aggressive goals for developing a clean energy supply at DEP facilities.

In the DEP's Strategy Plan 2011 – 2014, the department describes hydroelectric power as "a key component of DEP's efforts to create a clean power portfolio, support economic development in host communities in upstate New York, generate revenues for the City of New York, and reduce our overall carbon footprint."[2] The Plan goes on to describe two distinct opportunities for generating hydroelectric power; in the City's impoundment infrastructure, where reservoirs create opportunities for conventional, dam based hydroelectric power and secondly, "multiple hydraulic gradients—such as the effluent from

[1] DEP Strategy 2011 – 2014, p. 54. Retrieved June 17, 2011 from: http://www.nyc.gov/html/dep/pdf/strategic_plan/dep_strategy_2011_sustainability.pdf
[2] DEP Strategy 2011 – 2014, p. 58. Retrieved June 17, 2011 from: http://www.nyc.gov/html/dep/pdf/strategic_plan/dep_strategy_2011_sustainability.pdf

our wastewater processes that sometimes drops into the ambient water from a significant elevation—that we can transform into electric power for our wastewater treatment plants."[3]

It is the latter form of hydroelectric power that my testimony focuses on today, the production of hydroelectric power from "multiple hydraulic gradients...that (DEP) can transform into electric power." In lay terms, multiple hydraulic gradients, means a change in elevation. As water is moved in pipelines by gravity as the result of elevation change, energy in the form of head pressure builds, and this energy can be recovered. Generating hydroelectric power in these pipelines is referred to as "in-conduit hydropower."

Currently, this excess energy in the form of head pressure is simply burned off by pressure reduction valves (PRV) in the form of heat and noise. PRVs are not inherently bad or problematic technology, in fact they protect the water system from building dangerous levels of pressure and they indicate the presence of excess pressure that can be recovered in the form of electric energy from the City's water supply and waste water systems.

This forward thinking policy statement by the DEP regarding hydroelectric power is validated by the actions of other major US water utilities, such as the San Francisco Public Utility Commission, Portland Water Bureau, Metropolitan Water District of Southern California and the Dallas Water Utility. These utilities are all taking steps to assess and install in-conduit hydroelectric power systems aimed at recovering excess energy found in their water systems. Numerous other cities have in-conduit systems installed within their water systems.

There are other indications that support the DEP's Strategy Plan and its call for utilizing in-conduit hydropower. Recently, the US Department of Energy (DOE), issued a funding announcement for the express purpose of studying and developing advanced hydropower systems, specifically naming in-conduit hydropower devices.[4] The Federal Energy Regulatory Commission (FERC) has issued hundreds of conduit exemptions, an alternative to FERC licensing afforded to in-conduit hydropower due to its lack of environmental impacts and lack of threats to fish and wildlife. These federal activities affirm the role of in-conduit hydropower as a valuable tool in assisting the City to lower its greenhouse gas emissions by 30% by 2017.

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[3] DEP Strategy 2011 – 2014, p. 58. Retrieved June 17, 2011 from:
http://www.nyc.gov/html/dep/pdf/strategic_plan/dep_strategy_2011_sustainability.pdf

[4] US Department of Energy, DE-FOA-0000486, p. 9, April 5, 2011.

Northwest PowerPipe™

Northwest PowerPipe™ is a tool that the DEP could study for the purpose of generating clean energy in its water system and facilities. PowerPipe is a unique, in-conduit hydropower system and is my firm's core technology. Its vertical axis, lift based turbine captures excess kinetic energy within water systems. The PowerPipe technology is based on the same principles utilized by wind turbines, where the movement of a fluid – in this case water, creates lift on a turbine. This is the principle that allowed for my air travel this morning in order to participate in this hearing, it is both proven and known.

PowerPipe is modular and easily scalable so that a system can be designed to extract excess pressure without a significant impact on water distribution. In other words, our technology can generate power from a pipeline without impeding the operator's ability to move water to the consumer or through a waste water collection system.

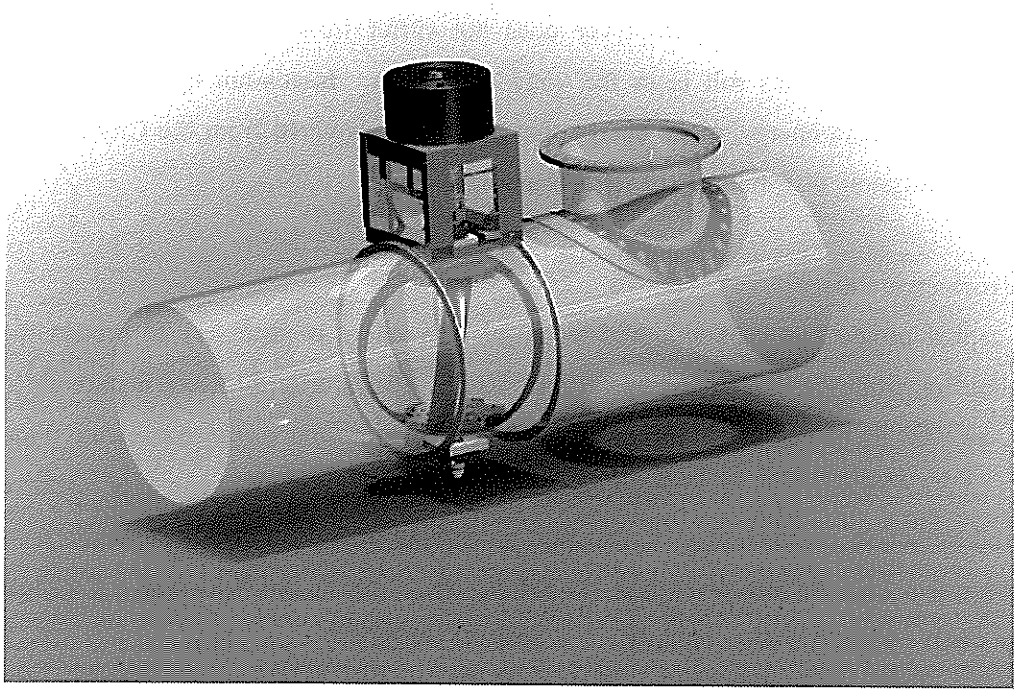

Figure 1: Northwest PowerPipe™

The amount of excess pressure required for the use of a PowerPipe system is very low compared to conventional hydropower technologies. PowerPipe allows for power extraction across a wide range of pressure conditions and fills a gap in the matrix of conventional hydropower, allowing for gravity-fed systems to generate power where it had not been previously possible.

Like a wind turbine, PowerPipe operates across a wide range of flow conditions, as the velocity of the water increases through the system, so does the amount of clean energy generated. Unlike conventional hydropower devices, PowerPipe operates across a wide range of flows, combined with the low pressure extraction, PowerPipe is truly unlike any other device yet it relies on engineering principles that are proven and reliable. Further, extracting clean energy from the excess pressure in pipelines or at industrial and waste water effluent outfalls is neither a new nor an unproven concept.

My firm, Lucid Energy Technologies, has already received upwards of $1,000,000 from the DOE for the purposes of developing such technology. The funding is helping to drive down the cost of our American-made technology. Currently PowerPipe enjoys a levelized cost of energy (LCOE) of under $.09/kWh and Lucid Energy's goal is to be at $.07/kWh by the end of 2012. This will put this in-conduit technology on par with coal fired power, as well as renewable sources like solar and wind.

Unlike solar and wind power, in-conduit hydropower does not suffer from the same problems of intermittent power supply as the clouds roll in or the wind dies down. In-conduit hydropower is a predictable, stable source for clean energy, clean energy that could be recovered from the City's water system throughout its transmission, distribution and waste water facilities.

Assessment for Hydroelectric Power

As with any major capital project, an economic and technical assessment is necessary to protect the interests of all stakeholders, from the rate-payers to the DEP itself. This is true for more mature clean energy technologies, as well as newer clean energy technologies. For instance, the American Wind Energy Association's (AWEA) guidelines for citing wind turbines suggests a minimum one-year resource assessment be undertaken before commencing construction on a wind energy project.[5] Solar projects require a careful assessment of solar resources and substantial modeling in order to create the most efficient and effective clean energy systems. Hydroelectric projects are no different.

[5] Brower, Michael, PhD. Getting it Right: Guidelines for Assessing Wind Energy Projects. Retrieved June 17, 2011 from: http://www.awea.org/_cs_upload/events/7286_1.pdf

Conducting a resource assessment for the impoundment based projects is a relatively straightforward process. The DEP issued a Request for Expression of Interest (RFEI) on these impoundment sites in November 2010. DEP estimates puts the combined potential power generation at approximately at 15MW of clean energy.

What is not known, is the potential for producing power downstream of these impoundments in the City's water transmission, distribution and waste water facilities. The potential appears to be significant to those that understand the size and nature of the City's water system. By conducting an assessment of this system, private industry, in partnership with public agencies such as the DEP, could begin to understand the significant opportunity for generating clean energy and lowering GHG emissions. Many stakeholders would be poised to support such an undertaking. It is certain that technologies such as PowerPipe and other hydropower devices could generate significant amounts of clean energy for the DEP and the City.

I urge the this committee, the Council, its members and the administration to support the undertaking of an assessment of the City's hydroelectric potential, and for that assessment to include the entirety of the water system, from the upstate reservoirs downstream to the waste water systems that return clean water to the watershed. Such an assessment would fit both Council and Administration goals, as well as the goals of the rate payers of this City to limit GHG emissions and find sources for clean energy.

Contact Information

My contact information is provided below for members of this committee or their staff that would like to receive additional information.

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Testimony for NYC Council
Committee on Environmental Protection

June 20, 2011

Introduction

I appreciate the opportunity to offer my thoughts on developing hydropower for New York City and the proposed legislation intended to advance this development.

I am Dr. David Torrey, Chief Technology Officer of Advanced Energy Conversion, LLC, a small business in Schenectady, NY. I am an electrical engineer by training, with specialization in electronic power conversion, embedded control, and motors and generators, and the application of these technologies to interesting energy conversion problems. I have had a long interest in clean energy technologies, and in recent years my company (AEC) has developed some experience with alternative hydroelectric technologies that represent a different approach from very large traditional hydroelectric plants. This work has been funded by private industry, NYSERDA, and the US Department of Energy.

My previous testimony was supportive of exploring hydroelectric power within the NYC water system and the natural waterways under the jurisdiction of the City in the production of clean energy from the flow of water. As my testimony, and that of others, indicated, there are multiple good reasons for exploring hydropower, including:

- Hydropower can leverage the existing and substantial infrastructure of the public water supply system.
- Hydropower represents local electricity generation from a clean energy source.
- Hydropower positively addresses the issue of securing the energy supply.

It was my recommendation that New York City undertake a resource assessment that identifies not only where there are hydroelectric energy resources within its control, but also where that energy could be used if it were made. Energy generation without local consumption hurts the economic viability by increasing cost without increasing the energy capture.

In parallel with the resource assessment, it is worth undertaking a technology assessment that identifies emerging alternative hydroelectric technologies that may offer solutions in particular circumstances. There is a lot of activity within this space, producing a lot of new ideas that merit consideration but proper vetting through demonstration and independent review.

The Pending Legislation

The pending legislation is motivated by generating power from the flow of water, thereby capturing energy that would otherwise be lost. Specifically mentioned are in-conduit, pressure control, sewers, and wastewater treatment facilities as opportunities for energy capture within the existing NYC infrastructure. Natural bodies of water are also mentioned.

My read of the pending legislation would require four things:

1. The NYC DEP to perform an assessment of the City's water supply, wastewater treatment systems, and bodies of water within the City's jurisdiction to determine the hydroelectric potential of these resources.

2. Perform a technological review of suitable hydropower technologies consistent with the available resources through three demonstration projects.
3. Completion of this work with eighteen months, with a report to the mayor and the city council.
4. Implement hydropower projects for electricity generation at sites with a cost benefit ratio of 0.75 or better.

Comments About the Proposed Legislation

A thorough assessment needs to collect a lot of data. These data need to effectively map flow, pressure (or head), nearby electric utility connection points, channel (conduit, pipe, etc.) size, accessibility, etc. Armed with this information, it will be possible to calculate how much power is available at different locations within the system, and how easy it will be to inject the generated power into the electric utility system. Given that the City has over 6,000 miles of pipe under the streets, hundreds of miles of aqueducts, 14 large wastewater plants, dams, and other sites where hydroelectric power may be harvested, this is a sizeable undertaking. Depending on the level of existing instrumentation, this may require a large team, armed with instrumentation and other technology to facilitate data collection and analysis. I am not sure to what degree the required information exists, but I suspect it is not already assembled.

A detailed mapping of the NYC water system is the first step in identifying where energy capture makes sense. The instrumentation used to create the map can also help with diagnosing system problems and system control. With the addition of turbine/generators to the system, it is possible to envision the ability to efficiently route flow through the system in ways to minimize leakage, reduce stress on pipes, allow for periodic maintenance, etc., much like how electric utilities control the flow of electric power through the grid. On the longer distribution lines and at dams, there may be opportunity for installation of microhydro systems that will not involve major environmental permitting and costly engineering work. Benefits will include better ability to meet stream flow requirements, better management of pressure in the system, etc. You do not need major projects to go a long way to the goals.

My understanding is that the NYC DEP is already looking for ways to capture energy within the public water supply system. The recent request for expressions of interest in connection with adding another 15MW of hydro power within the reservoir system is an example. I have had discussions with NYC DEP over the last three years regarding the installation of turbine/generator systems within wastewater treatment plants. While the pending legislation would require the assessment and demonstrations in these and possibly other locations throughout the water system, the necessary resources may be significant.

There is nothing inherently risky about undertaking either the resource assessment or the technology assessment, so long as sound engineering practices are followed. Proper diligence will ensure that water quality and system control are maintained throughout the effort. Again, this means that adequate resources must be available to do the job right.

It should be understood going into this legislation that the energy to be captured is likely to be modest in comparison with the 55MW of hydroelectric power already being generated within the reservoir system and the additional 15MW under consideration. Despite this, the resource and technology assessments are still worthwhile undertakings; ultimately the appropriate direction needs to be data driven to ensure future actions are technically sound and economically feasible. The legislation cites a calculation by the US Department of Energy that suggests almost 40MW of generation is available within wastewater treatment facilities. I believe this

estimate misrepresents the amount that can be practically generated. My own calculations suggest the most easily available power at NYC wastewater treatment facilities to be closer to 1.5MW[1].

Summary and Conclusions

I support the spirit of the legislation in seeking to find ways to more completely leverage the sizeable existing infrastructure of the New York City public water supply. I see many areas of opportunity for exploring hydroelectric generation in and around New York City, within both the public water supply and natural bodies of water. It may be possible to conduct pilot studies in cooperation with NYSERDA, NYPA, EPA, and DOE. This activity can help create employment opportunities, especially if New York based technologies are employed.

By enacting the legislation, the City Council is identifying hydropower to be worthy of city resources, attention, and priority, thereby acknowledging the need to find the financial resources necessary to implement the legislation.

I believe the NYC DEP also has interest in capturing energy throughout the public water supply, and my experience with their approach suggests that they understand that this effort needs to be continuous, through constantly monitoring available resources and emerging technologies to identify opportunities that are both technically and economically sound. I believe the DEP is already moving in the right direction. I cannot speak to what the DEP has done with regard to natural bodies of water, but certainly there have been demonstration projects there as well.

I am not sophisticated in the internal politics associated with the working relationship between DEP and the Council. If legislation is required to make the hydropower assessment an imperative, then perhaps it is appropriate. Otherwise, I would be reluctant to legislate something that is in the common interest of both parties.

Thank you for your consideration.

David A. Torrey, Ph.D., P.E.
Advanced Energy Conversion, LLC
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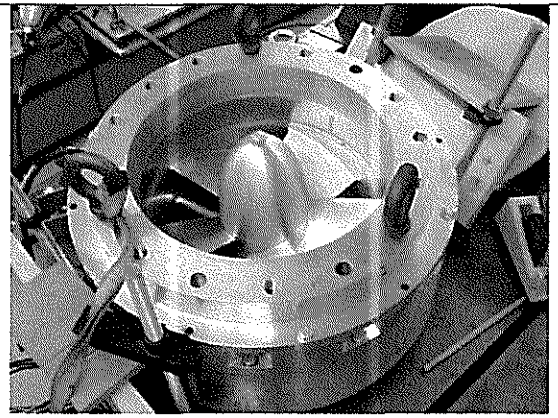
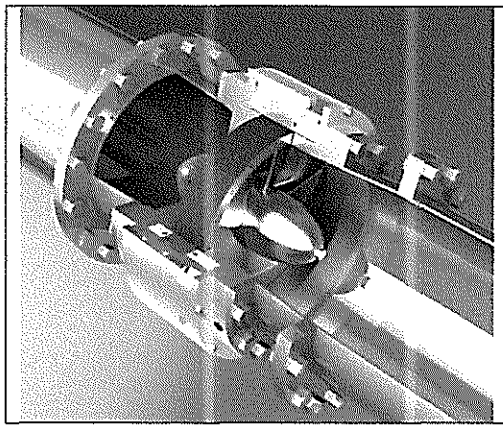
Schenectady, NY 12305
518-382-7800, x11
DavidTorrey@AdvancedEnergyConversion.com

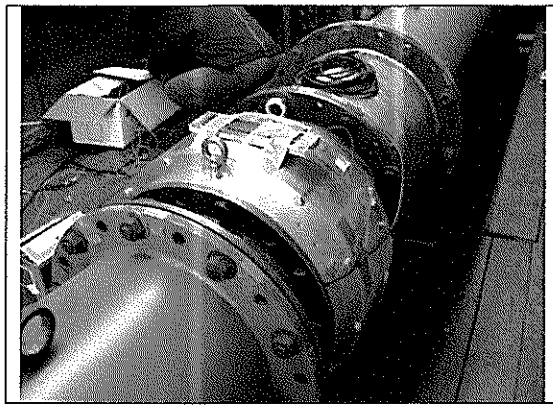
[1] My calculations assume a flow of 1.3 billion gallons of water per day (http://www.nyc.gov/html/dep/html/wastewater/index.shtml) and a head of 3m (generous), giving an available power of 1.675MW. The actual power collected will be less, due to equipment efficiencies; an efficiency of 85% makes the captured power 1.42MW, enough for about 700 homes.



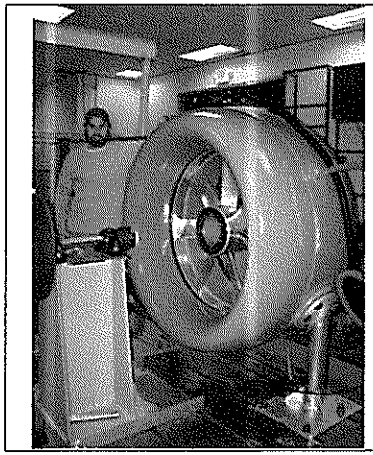
The prototype AEC integrated turbine/generator, which is intended to install in a section of standard sewer pipe. The outside diameter is approximately 28 inches. The generator is located around the periphery of the turbine.



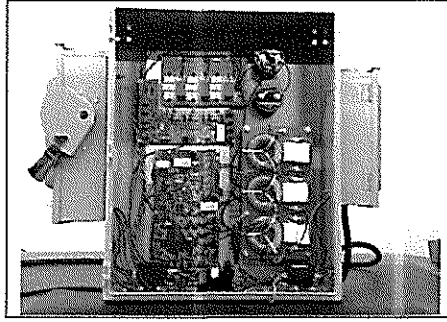
A cutaway view of the AEC turbine/generator installed in a flanged section of pipe, suitable for installation in a public water supply.



The AEC integrated turbine/generator installed in a section of pipe for hydraulic testing at the Alden Research Laboratory in Holden, MA.



A hydrokinetic turbine being prepared for test at AEC. The turbine was designed to produce 15kW of power in a flow of 4m/s.



The electronic controls for AEC's integrated turbine/generator. These electronics provide high quality power to the utility, while controlling the generator to extract maximum power.

THE COUNCIL
THE CITY OF NEW YORK

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☑ in favor ☐ in opposition

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Address: SCHENECTADY, NY

I represent: ADVANCED ENERGY CONVERSION

Address: SCHENECTADY, NY

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Name: Josh Kanagy

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I represent: Lucid Energy Technologies

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I represent: _____

Address: _____

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Name: Ronald F. Smith

Address: _____

I represent: Verdant Power Inc.

Address: 888 Main St. New York, NY 10044

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Name: Frank Zammataro

Address: 160 Varick St. NYNY

I represent: Rentricity Inc.

Address: _____

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(PLEASE PRINT)

Name: Anthony J. Fiore

Address: 59-17 Junction Boulevard Flushing

I represent: NYC DEP

Address: SAME AS ABOVE

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(PLEASE PRINT)

Name: Anthony Fiore

Address: DEP w/ DC James Roberts

I represent: at witness table

Address: _____

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