

Great River Energy

V. Bruce Stenswick

From: "Taylor, Dennis GRE/ER" <dtaylor@GREnergy.com>
To: <VBSTENSWICK@HOTMAIL.COM>
Sent: Monday, August 28, 2006 3:47 PM
Subject: FW: Req. for info: Power Plants

Mr. Stenswick,

Your message found its way to my desk. I apologize that no one has responded sooner. We are familiar with WOW and other organic Rankine cycle, and we are continually looking for opportunities to apply them. I agree that this cycle has potential for improving overall generation efficiency.

Our view is that the ORC is particularly well-suited for applications such as combustion turbines driving compressors in natural gas transmission lines. There is plenty of temperature available, 700 – 900°F, plenty of gas flow, and almost continuous operation. We investigated the benefits of a compressor station in our service territory that would produce approximately 6 megawatts. However, we are not in a position to develop such a project since we don't own the compressor station.

Our own combustion turbines are used for peaking purposes and operate approximately 1,000 hours a year. While they produce plenty of gas flow and have enough temperature in the exhaust gas, their limited operation would make their electricity very expensive. The capital and operating cost would result in an electricity cost of something like \$250-300 per megawatt-hour in spite of the "fuel" being free.

Our major coal plants operate with relatively low exhaust temperatures, approximately 350°F. While that may be hot enough to generate some energy with the ORC, the heat exchange surface required be very large. This would increase the energy used by the fans discharging the exhaust gas offsetting much of the benefit. In addition, the required large surface area would increase the cost of the ORC equipment. Further, the heat exchanger would be in a location before the fly ash is removed resulting in a very significant erosion issue. This could be overcome by using heavier heat exchange materials and would probably also require more frequent maintenance than our plants normally experience. Our Stanton Station, for instance, is just finishing a two-year run.

Our Elk River Station has a somewhat higher exhaust gas temperature – 450°F. While this would require a larger heat exchange than for the gas pipeline compressor application, the plant does operate about 7,000 hours per year. But the exhaust gas is very corrosive and the fly ash is very erosive; based on our experience, the materials would have to be heavier to resist the erosion and would have to be made out of more exotic materials to resistant the corrosion – not a good combination.

We continue to watch for opportunities to apply WOW and other ORCs for the production of electricity. Our members always appreciate it when we can reduce their cost of electricity.

If you have any other questions, feel free to call

Dennis Taylor, PE
 Senior Principal Engineer
 763-241-2250

-----Original Message-----

From: V. Bruce Stenswick [mailto:vbstenswick@hotmail.com]
Sent: Sunday, June 11, 2006 4:55 AM
To: Power Plant
Subject: Req. for info: Power Plants

I read the Sierra Club webpage, and it states that you would like to build a new power plant in Rosemount. I would like to know why you cannot use the Organic Rankine Cycle from WOW Energies, or another vendor, to upgrade your current plants and not build any new plants?

Thank you.

V. Bruce Stenswick

952-960-1332
612-385-5531

V. Bruce Stenswick

WOW
↓

From: "Daniel Stinger" <dstinger@alltel.net>
To: "V. Bruce Stenswick" <vbstenswick@hotmail.com>
Sent: Friday, October 20, 2006 8:00 AM
Attach: WOW PressRelease MSW Plant.pdf; WOWClean PilotPlant.pdf; PowerGen-120705-Rev.pdf
Subject: WOWGen Power Plant

See latest press release on our WOWGen MSW power plant.

I have also enclosed info on recent testing performed on our WOWClean system, which is a multi-pollutant reduction system that removes nearly all the emissions from a flue gas. The testing we did in Houston (Pasadena at AES) was on a Petcoke plant (worst fuel on the planet re sulfur content) and the tests we are doing in Maine on biomass demonstrate removal of nearly all the pollutants which was also verified by third party testing. FYI, petcoke has sulfur concentrations as high as 6% - 2 to 5 times what you find in coal.

The plant in Maine has the same temperature flue gas conditions (350F) as described for the coal plants at Great River Energy – 350 F and the plan is to convert this remaining waste heat to power and install our WOWClean system to remove the remaining pollutants in the flue gas stream.

Per the email from Great River Energy I offer the following comments:

1. I met approximately a year ago with Great River Energy to discuss our waste heat recovery and pollution reduction system.
2. The flue gas exiting "any" combustion system has varying levels of particulates and ash. Our heat exchangers are designed to handle these affects and there are numerous technologies you can use to mitigate the corrosion/erosion that are used everyday. The issue is cost. Our waste heat recovery plants are higher by a factor of approximately 30% because we use expensive (exotic) materials to prevent any damage to the heat exchanger.
3. There are many technologies used to remove ash and other particulates from a flue gas, including bag houses, and depending on where you extract the waste heat you have to design for different levels of contamination. However, this is done everyday in every industry. Further, the temperature exiting the baghouse is still in the 350 F to 400 F range so you still have waste heat available, its just how much power you can produce.
4. Heat exchangers sized to recover the heat from a coal plant have to handle the total flow but it's a \$/KW issue, not how big the exchanger has to be. Our \$/KW is around \$1,500/KW which is no different than what they are spending on new coal fired power plants. The key issue is the payback period is much quicker, or alternatively the cost of electricity is cheaper, because you have ZERO fuel costs.
5. Great River Energy references the fact that gas turbines are a better candidate because of the high exhaust temperature, which is correct. However, the reason they operate the gas turbine only 1,000 hrs/year is due to the cost of natural gas and the fact they are throwing all the 900 F waste heat away. The reference to \$250 to \$350/kw as the cost per megawatt-hour in spite of the fuel being free is a specious argument. The reason they say it is "too" high is that they only operate the units 1000 hours per year, which makes the cost look like it is 6 to 8 times what it really is because of the way they operate a peaking plant (there are 8760 hours per year).
6. What they should be doing is running these units 8760 hours per year with waste heat recovery and you would have heat rates considerably better than any coal fired power plant and the cost would drop closer to \$45/megawatt-hour. Further, gas turbines have a very low emission profile compared to coal fired power plants, but of course the cost to the environment, healthcare, etc. is never included in the cost comparison. Further, the reason the coal fired power plant is cheaper to run (in addition to the lower cost of coal/MMBTU) is they already have written off the capital cost of the coal fired power plant whereas adding waste heat to an existing gas turbine will be charged the cost of capital in the rate base, fair as long as you don't have to absorb and/or consider the cost of polluting – that's always a "freebie" for the utility.
7. Another issue is the fact that you can fire up and shut down a gas turbine in minutes whereas you have to keep a coal fired power plant operating or you incur significant operating problems and expense and it can take days (weeks) to shut down and start one back up.

Technology is available today to produce power from waste heat; technology is available to build heat exchangers to handle the flue gas volume and contamination; and technology exists to remove nearly all the pollution from a flue gas. The issue is always the cost. Contrary to the \$250/\$350/megawatt-hour number Great River used, you can produce power from waste heat at zero fuel consumption and remove nearly all the pollutants from an existing flue gas in the process at a cost that is competitive with putting in a new coal fired power plant. Question is "why not try it?"

As you will see from the attached presentation I made at Power Gen last December, if we recovered only 20% of the waste heat available from existing power plants I doubt we wouldn't have to build another power plant for 20 years and maybe never. A key message in this presentation is that the utilities will build solar, geothermal, wind and biomass plants but not waste heat recovery power plants. Why? NO TAX CREDITS! The best thing you and others can do is get the state and federal regulators to classify waste heat as "renewable" energy and everyone will fall all over themselves to get the tax credits because waste heat recovery is the least expensive and least risk of any of the renewable energy alternatives and the waste heat availability is more prolific than all the others put together.

Daniel Stinger
WOW Energy, Inc
Texas Energy Center
Meeting the World's Energy & Environmental Challenges
Direct: 281-340-6722
Tele/Fax: 281-313-9770
Mobile: 713-823-2634
www.wowenergies.com

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V. Bruce Stenswick

From: "Vince Sorace" <vsorace@vrbpower.com>
To: <vbstenswick@yahoo.com>
Sent: Thursday, October 19, 2006 9:28 AM
Subject: RE: VRB Website - Information Request - R#: X08.TWH.D90.KJB

Mr. Bruce,

The cost of large systems is dependant on many variables, including power rating, hours required, location, application, etc. We need much more detail to provide accurate pricing.

We typically do not pursue applications that require only 1 hour of storage as they are generally uneconomic. One of the big differentiators with our technology is that it is capable of many hours of storage, and our "sweet spot" for pricing is in the 4 hours + range.

In general terms, pricing will range from approx. \$400 - \$650 per kWh (considering the above), so a 1MWH plant (broken down to 250kW at 4 hours for example) would cost approx. \$600,000USD. The larger the system and the longer the hours we slide to the lower end of the price range.

Regards,

Vince Sorace

-----Original Message-----

From: VRB Power Website [mailto:info@vrbpower.com]
Sent: October 19, 2006 6:05 AM
To: info
Subject: VRB Website - Information Request - R#: X08.TWH.D90.KJB

 VRB POWER SYSTEMS INCORPORATED

Subject: VRB Website - Information Request
Form Name: GI_Form (version 1.0)
Recipient: "mailto:info@vrbpower.com"
Reference: X08.TWH.D90.KJB
Timestamp: Thu Oct 19, 2006 at 6:04:46 AM Pacific Time

Sender was visiting:

URL: <http://www.vrbpower.com/contact/general.html>
 on: ADNET Primary Server Grid
 via: cpe-72-131-100-110.mn.res.rr.com
 (72.131.100.110)
 IP Country: United States
 ISP Region: Illinois
 ISP City : Chicago
 ISP Name : Road Runner Holdco Llc

ISP Domain: rr.com

using: Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1; .NET CLR 1.1.4322; .NET CLR 2.0.50727)

Known Keys:

(201) emaillist: [1]
(206) other_specify: [5]
(207) Other_Spec: [Private citizen]
(211) salutation: [Mr.]
(215) firstname: [V. Bruce]
(216) lastname: [Stenswick]
(217) company: []
(218) email: [vbstenswick@yahoo.com]
(219) webpage: []
(220) address1: [9551 Woodridge Circle]
(221) address2: []
(222) city: [Eden Prairie]
(223) province: [MN]
(224) country: [United States]
(225) postal: [55347]
(226) phoneac: [612]
(227) phonenum: [385-5531]
(228) faxac: []
(229) faxnum: []
(230) comments: [What is the cost of your systems? I am lobbying against building any new power plants, and know of generating capacity that is used for frequency/voltage regulation that could be freed up if flow batteries were used for voltage/frequency regulation. Could you give the cost for a system with a power rating of 1 MW and an energy storage rating of 1 MWH? I am an amateur, so if I did not specify this correctly, could you correct me?]
(241) awarespec: []
(243) aware2spec: []
(245) aware4spec: []
(247) aware5spec: []
(248) aware6other: [yes]
(249) aware6spec: [Uncertain]
(250) ws_appearance: [Excellent]
(251) ws_content: [Excellent]
(252) ws_structure: [Excellent]

Unknown Keys:

submit: [Submit and Send Request Form]

This form's information can also be viewed at the URL:

http://www.vrbpower.com/s/LiveUpdate/ListFormSubmissions.asp?id=87143&_FormName=GI_Form&_FormVer=1.0

RECEIVED

06 OCT 23 AM 10:39

ADMINISTRATIVE
HEARINGS

9551 Woodridge Circle
Eden Prairie, MN 55347
October 21, 2006

Barbara L. Neilson
Administrative Law Judge
Office of Administrative Hearings
100 Washington Avenue South, Suite 1700
Minneapolis, MN 55401

Re: Big Stone II

Dear Ms. Neilson:

I am writing in regards to Big Stone II. It is unnecessary and a waste of money. I am an amateur, but I will outline my understanding of electrical power generation. Power generation is often divided into four categories, baseload, peaking power, spinning reserve, and voltage/frequency regulation. The proposed Big Stone II plant would be a baseload plant. As of two years ago, Xcel Energy had 60 MW of generating capacity, I believe at Sherco, that was being used for voltage/frequency regulation. This is 60 MW of capacity that already exists. This could be freed up at a cost of \$24 million to \$39 million by using flow batteries from VRB Power Systems of Vancouver, BC, Canada. This is a cost of \$400 - \$650 per kw. The cost of new power generation at Big Stone II is \$2800 per kw. This electricity could be sold to the group that wishes to build Big Stone II. They also may have generating capacity that could be freed up.

The above suggestion is an interim solution. For a longer term, the utilities in Minnesota should be required to install a system from WOW Energies of Sugar Land, TX to monitor its performance and reliability. WOW Energies has a system that uses the Organic Rankine Cycle to convert waste heat to electricity. Contrary to comments given at the 1 PM hearing on October 16 in St. Paul, this system does NOT violate any laws of thermodynamics. There are erosive and corrosive issues that I am not qualified to address (I have a B. Sc. In Chemistry and an M.A. In Physics). Those issues are addressed in attached emails. WOW Energies claims that the cost of installation of their system is \$1500 - \$1800 per kw, versus \$2800 per kw for Big Stone II. The payback is also quicker since no additional fuel is consumed to generate the electricity. The first plant converted should have its cost spread out over all ratepayers in Minnesota, since everyone will be benefitting if this technology works as they claim. I would also like to point out that rather than having to make a \$1.8 billion decision to build a new power plant, a \$100 million decision can be made to upgrade a power plant with this, and should it work, a series of decisions could be made over the span of several years to upgrade other power plants. I understand that any one utility might be reluctant to install a new technology, so I would urge you to somehow spread the cost over all ratepayers in Minnesota, if that is

within your or the PUC's authority. Eventually, I think the coal plants have to be shut down due to carbon dioxide emissions, but we may have only wasted \$100 million upgrading a power plant, rather than \$1.8 billion building a new power plant.

Also in the longer term, flow batteries should be investigated as a means of firming up wind farms so that they can act more like baseload plants. VRB Power Systems recently sold a system like this to a wind farm in Ireland.

I would also like to point out the utilities probably also have spinning reserve that could be freed up by flow batteries. Within a few years, Beacon Power will have a system out that can be used by the utilities for voltage/frequency regulation, freeing up generating capacity currently used for voltage/frequency regulation.

I would also like to suggest that the Public Utilities Commission require the utilities to justify why they cannot use a plan similar to the Iowa Stored Energy Project as baseload electric power generation. It is being used in Iowa as a peaking plant, but in conjunction with enough wind turbines, it could be used as baseload generating capacity, keeping the bulk of the dollars in Minnesota, and not shipping it to coal miners in Wyoming.

I am enclosing emails that I have received from Great River Energy concerning the Organic Rankine Cycle, a response to their concerns from WOW Energies, and an email from VRB Power Systems. Thank you.

Sincerely,

A handwritten signature in cursive script that reads "V. Bruce Stenswick".

V. Bruce Stenswick

RECEIVED

06 OCT 23 AM 8:40

ADMINISTRATIVE
HEARINGS

9551 Woodridge Circle
Eden Prairie, MN 55347
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Steve M. Mihalchick
Administrative Law Judge
Office of Administrative Hearings
100 Washington Avenue South, Suite 1700
Minneapolis, MN 55401

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Great River Energy

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V. Bruce Stenswick *WOW*

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Daniel Stinger
WOW Energy, Inc
Texas Energy Center
Meeting the World's Energy & Environmental Challenges
Direct: 281-340-6722
Tele/Fax: 281-313-9770
Mobile: 713-823-2634
www.wowenergies.com

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V. Bruce Stenswick

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To: <vbstenswick@yahoo.com>
Sent: Thursday, October 19, 2006 9:28 AM
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Vince Sorace

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Sent: October 19, 2006 6:05 AM
To: info
Subject: VRB Website - Information Request - R#: X08.TWH.D90.KJB

VRB POWER SYSTEMS INCORPORATED

Subject: VRB Website - Information Request
Form Name: GI_Form (version 1.0)
Recipient: "mailto:info@vrbpower.com"
Reference: X08.TWH.D90.KJB
Timestamp: Thu Oct 19, 2006 at 6:04:46 AM Pacific Time

Sender was visiting:

URL: <http://www.vrbpower.com/contact/general.html>
on: ADNET Primary Server Grid
via: cpe-72-131-100-110.mn.res.rr.com
(72.131.100.110)
IP Country: United States
ISP Region: Illinois
ISP City : Chicago
ISP Name : Road Runner Holdco Llc

ISP Domain: rr.com

using: Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1; .NET CLR 1.1.4322; .NET CLR 2.0.50727)

Known Keys:

(201) emaillist: [1]
(206) other_specify: [5]
(207) Other_Spec: [Private citizen]
(211) salutation: [Mr.]
(215) firstname: [V. Bruce]
(216) lastname: [Stenswick]
(217) company: []
(218) email: [vbstenswick@yahoo.com]
(219) webpage: []
(220) address1: [9551 Woodridge Circle]
(221) address2: []
(222) city: [Eden Prairie]
(223) province: [MN]
(224) country: [United States]
(225) postal: [55347]
(226) phoneac: [612]
(227) phonenumber: [385-5531]
(228) faxac: []
(229) faxnum: []
(230) comments: [What is the cost of your systems? I am lobbying against building any new power plants, and know of generating capacity that is used for frequency/voltage regulation that could be freed up if flow batteries were used for voltage/frequency regulation. Could you give the cost for a system with a power rating of 1 MW and an energy storage rating of 1 MWH? I am an amateur, so if I did not specify this correctly, could you correct me?]
(241) awarespec: []
(243) aware2spec: []
(245) aware4spec: []
(247) aware5spec: []
(248) aware6other: [yes]
(249) aware6spec: [Uncertain]
(250) ws_appearance: [Excellent]
(251) ws_content: [Excellent]
(252) ws_structure: [Excellent]

Unknown Keys:

submit: [Submit and Send Request Form]

This form's information can also be viewed at the URL:

http://www.vrbpower.com/s/LiveUpdate/ListFormSubmissions.asp?id=87143&_FormName=GI_Form&_FormVer=1.0