Energy Audit

Summary Report

Bad River Tribal Nation Utility

Bad River Band of the Lake Superior Tribe of Chippewa Indians

Setting Markers In the Path to Energy Independence

September 2010

Don Voigt, P.E.
Systems Engineer
www.equipintegration.com

ENGINEERED EQUIPMENT INTEGRATION LLC
Phone: (414) 940-9281

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We do not inherit the earth from our ancestors; we borrow it from our children.

~Native American Proverb

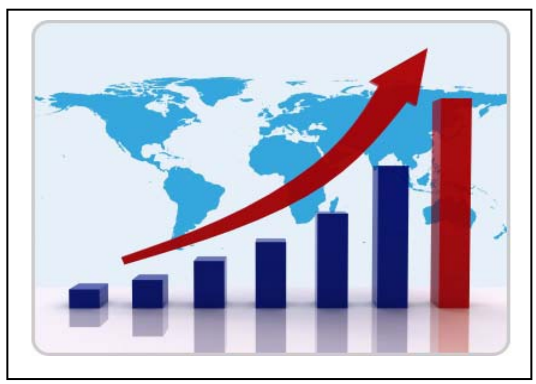
Acknowledgements

An Energy Audit was conducted and this Energy Audit Summary Report was prepared by Engineered Equipment Integration LLC for the Bad River Nation, Tribal Utility, as part of an Energy Assessment Pilot project of the Wisconsin Community Action Program Association's WI Tribal Circuit Rider Program. Funding for this project was provided by the Midwest Assistance Program under a grant from the US Environmental Protection Agency, Region V.

It is particularly recognized, here, that the staff of Bad River Utilities was most helpful in working with us in the very difficult task of identifying so many aspects of their facility. Truly, they are to be commended for expending long hours and time beyond work hours in helping us retrieve the important data for this audit. And, the staff has performed an excellent task of maintaining the very complex equipment and controls found in this widespread and diverse utility network.

Introduction

Providing reliable and safe drinking water and subsequent waste handling and treatment represents a substantial investment in equipment, staff, and associated maintenance cost. With the burdens of simply providing safe and reliable water/wastewater services, it is not surprising to know that energy costs and associated conservation of energy has not been a dominant nor driving issue in the vast majority of utilities throughout the nation. In recent years, however, both the escalating cost of energy and the concurrent awareness of environmental implications have created a strong interest in reducing consumption in all areas of utilities.



Energy, in particular, has become a significant cost. Costs of energy continue to escalate at a much higher pace than inflation. And electrical/gas providing suppliers are changing the rules by which costs are assigned. Examples becoming prevalent throughout other parts of the State are "time of use" tariffs, "demand" and "power factor" tariffs and similar invoicing premiums.

Indian Tribal Nations have had a long history of focusing on environmental issues. Such focus includes the awareness that "what we do in this generation will affect all future generations to come." Forestry practices, lakes and estuaries protection and protection/preservation of wildlife are consistently found as underpinnings to all ventures within tribal nation reservations. Thus, the early interest in innovative approaches to power/energy consumption would be an expected initiative for the Tribes.

With this background and resources provided by USEPA Region V and the Bad River Utility staff an Energy Audit was performed for the Bad River reservation area water and wastewater infrastructure. This 'Pilot Project' team, coordinated by engineers from Engineered Equipment Integration, LLC, consisted of staff from the following:

- Bad River Tribal Administration and Utility Staff
- EPA Region V Water Division
- WI Community Action Program, Rural Community Assistance Program
- US Public Health Service, Indian Health Service

This energy Audit Summary Report was prepared by Engineered Equipment Integration, LLC. with input from the above mentioned team.

The purpose of this audit is to establish an awareness and preliminary base or benchmark of energy consumption at water and wastewater facilities (pumping and treatment) Bad River reservation – from Diaperville to Birch Hill regions.

Objectives:

The study will include a Type I and partial Type II energy audit (see Appendix I). This audit is defined as:

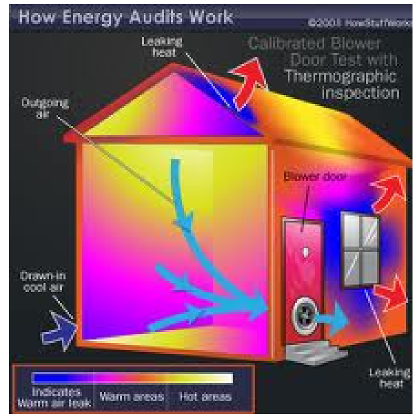
- A "walk through" of the facilities,
- A gathering and review of historical use and cost data, and
- Field measurement of the larger or primary energy consumptive devices/motors within the "public infrastructure" for the multiple "publicly" sewered and watered regions on the reservation.

The audit objective includes providing comparisons to similar utility consumption where appropriate. This summary report includes:

1. A review and presentation of power/energy consumption for primary facilities
2. A series of specific pumping and treatment station summary sheets – defining watt/energy use along with specific observations for these sites.
3. A definition of which facilities are the largest consumers of energy
4. Comparison to other similar facilities (for the largest consuming areas)
5. A list of specific recommendations and associated costs for energy reduction initiatives
6. Equipment maintenance and procedure recommendations for routine lower cost of operation
7. Suggested "requirements" to be included in any forthcoming replacements, upgrades, and expansions where equipment or controls are involved.

Areas outside of the scope of this work (not included) but considered valid and important to reduce energy consumption will include:

- Heating and ventilating audits (these are relatively direct such as infrared "gun" and "blower door" measurements and might best be undertaken in winter months for greater impact and resolution). For a good summary of these types of HVAC audits for other tribal nations, see: http://www.weatherization.org/wxtv/ and the associated videos contained on this site related to "auditing." Though, it is noted, here, that these components of energy consumption are <u>usually</u> relatively minor in comparison to pumps, blowers, and other operating equipment at water and wastewater facilities.



- Water loss and water and wastewater meter accuracy and replacement efforts – these may already be ongoing and will not be considered part of this study and report.

Project Approach:

Energy audits have, historically, consisted of two primary work items – a physical "walk through" of the various sites followed by a review of the power/energy bills and completed by a summary of existing conditions and recommended changes for the areas of obvious need. Our approach contains these elements (termed a "Type I Audit" in the industry) as well as a deeper investigation of specific energy consumption of the larger motors in the utility utilizing a watt meter and/or an amp meter – combined, where appropriate – with pressure monitoring. These latter steps are generally considered a "Type II Audit" and result in documented consumption for individual motors as opposed to simply reading a power meter on the exterior of a building which would normally serve an entire building and multiple uses.

The instruments utilized in this study included the following field devices:

- Allen Bradley Power Pad – a portable instrument which provides a wide range of motor characteristics including watts, phase balance, power factor, and motor amp characteristics.

PowerPad Portable Powermonitor

Overview The PowerPad is a three-phase power quality analyzer that is easy-to-use, compact and shock-resistant. It is intended for technicians and engineers to measure and carry out diagnostic work on one, two or three phase low voltage networks.

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- Fluke portable voltage and amp meter with pressure gage option

The Fluke 87V offers accuracy and diagnostics for maximum industrial productivity in the tool box or on the bench.

The Fluke 87V multimeter has improved measurement functions, troubleshooting features, resolution and accuracy to solve more problems on motor drives, in plant automation, power distribution, and electromechanical equipment.

With its newly incorporated selectable low pass filter, the Fluke 87V allows troubleshooters to take accurate voltage, current and frequency measurements on the output side of the drive at either the drive itself or the motor terminals.

- Digital Camera for the recording of site locations and records of specific measurements and site conditions.
- Tape measure and stopwatch (for the measurement of structures and for the calculation of flow rate via volume displacement in larger stations)

The staff of Engineered Equipment Integration (www.equipintegration.com) consisted of two licensed professional engineers (one of whom is also a Certified Energy Manager) supported by WISCAP field professionals US Public Health Service, Indian Health Service, and EPA staff.

Energy Provider:

The energy providers for electric (and natural gas) for the tribe are as follows (see Appendix II):

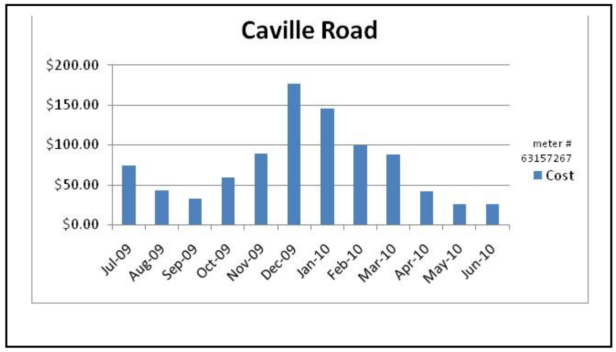
- Bayfield Electric – Jane Nordquist – jane.nordquist@bayfieldelectric.com

- Excel Energy – attention Lorissa – bsc@excelenergy.com

KW/energy charges are simple and rate structures do not involve “demand charges,” power factor premiums, nor time-of-day rate structures changes. For the various utility sites reviewed in this report, the monthly connection charge is approximately $10/mo and the use charge is $0.10/KWH. Complete rate schedules are available on the energy providers’ web site (see above and appendix).

Benchmarking of Energy Consumption for "non-motor-driven" lighting, heating, ventilating, and air-conditioning:

The majority of energy consumption for water and wastewater utilities will, in general, be found in the motor driven pumps, blowers, and related motor driven machinery found inside of the facility building structures. See article in appendix "Save on Energy, Save on Expenditures". Acknowledging this fact, this study did not focus on the non-motor-driven equipment – though their consumption is found to be a significant portion of a number of the watt meters evaluated/tabulated in the appendix ((see adjoining bar graph of Diaperville – Caville Road - water pump station). One reason that these non-motor-driven loads are found in the tabulation of the data is the fact that a number of the buildings utilize electric heat – and, the heaters are frequently not controlled for minimum use and minimum temperature. In a number of locations, heat energy cost overshadowed motor/pump energy costs. A second cause will be the situation where the pumps/motors are not of significant size (low HP) or they are not utilized to a great extent.



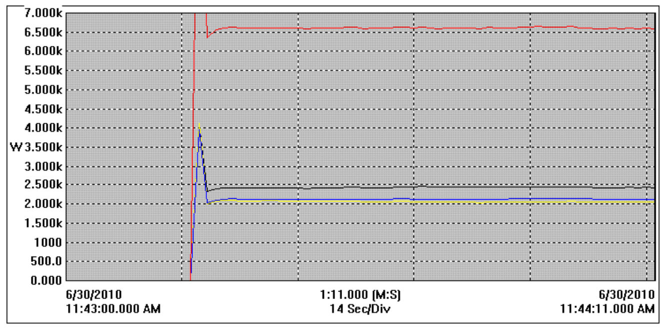
Regardless of the cause for the influence of heaters on the reported consumption, the following is noted:

1. All buildings and pumping structures containing heaters which are primary sources of winter environmental heat should have "smart temperature controllers" installed on the units. These controllers should be set to minimum acceptable/safe temperature levels.
2. All buildings containing heater equipment should be reviewed for the cost to switch from electric to LP gas or natural gas (if gas lines run near the building) since the cost of operation for gas will be in the range of ½ the cost of equivalent BTU's as generated by electric power (see appendix for energy conversion of BTU's to Watts and compare Therms to KWHr charges for your utility to make this comparison).
3. After the stabilization of energy costs for heating/electric lights has been established, a direct way to monitor and control these costs is to compare your building use per square foot with other similar structures through what is called "Energy Use Index" or "EUI." See http://www.energystar.gov/ia/business/evaluate_performance/wastewater_tech_desc.pdf

Lighting in all buildings/structures within the water and wastewater utility structures and utility administration/maintenance buildings was found to predominantly utilize fluorescent fixtures. The fixtures installed are utilizing an inefficient lamp ("T-12" lamps) and associated ballasts. Where the lamps are being operated for more than several hours per day, these should be replaced with "T-8" lamps and associated ballasts (see Appendix III). Such lamps and ballasts fit directly into existing fixtures and consume only about 60% of the power of "T-12" lamps (output of the respective lamps is 110 lumens/watt for "T-8" vs 60 lumens/watt for "T-12").

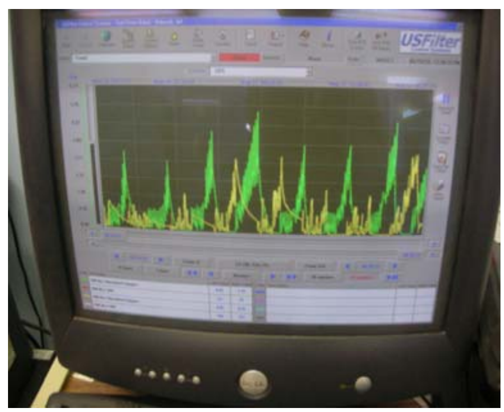
Data Presentation Format:

Field data was acquired during an ambitious 10 hour field visit on June 30, 2010. The field acquired measurements were melded with the "Power Company Provided" data and elapsed time meter data (latter two segments acquired through correspondence/phone calls). The various charts and data are placed in separate Appendices for clarity but the respective appendices have corresponding names and numbers for continuity in your review. Respective appendices will provide information as follows:



Motive pump 2, valves open, Power Factor

I. Appendix IV – Provides a map overview of the reservation infrastructure with respective pumping and treatment locations noted.
II. Appendix V - Provides the cumulative overview of all visited sites
III. Appendix VI - Provides individual specific site data and performance curves (where available) for the various pumping and treatment sites throughout the reservation. These pages also suggest specific changes at their respective sites, where operation and maintenance issues were evident to the auditors (often a "new perspective" discovers issues which the routine maintenance person has become accustomed to seeing and not noting the possible changes).



"Major impact" changes recommended:

In the course of audits, certain equipment/systems generally stand apart as the most likely candidates for sharp energy reduction based – in most cases – on the size and/or complexity of the motor driven equipment being operated. In the case of the Bad River audit, two specific recommendations are made, here, which offer the largest and shortest financial returns, as follows:

- Re-evaluate the operation of the SBR treatment plant in the design sequence recommended by Siemens/Jet Tech. At the time of this site survey, the influent holding/blend tank was not being operated, blowers were cycling approximately every 15 minutes and the diffusers in the aerated sludge holding tank were broken ("coarse bubbling" and surging occurring). These items may have been found to be functional but – from a process point of vey – may have been operated differently. Often, these operational issues are difficult to change since the staff has not been "process trained" in SBR systems. Comparison should be made to a similar facility which serves both residential and casino needs – such as the Hannahville Tribe near Escanaba Michigan

(Appendix VII). They operate a similar size plant under similar loads and with similar effluent standards and process design (including screening, digester storage and UV). Expected power reduction for change in sequence/operation of the SBR plant - $10,000/year. Estimated cost – $15,000 (including training and software implementation). Payback for straight-line return on investment = 1.5 years

- Operate all heaters at minimum temperatures and provide set back thermostats in all areas of the plant – cooling down at night and warming up for daytime workers.
  Estimated cost – $500 installed. Estimated annual savings - $2,000. Payback for straight line return on investment = several months.

Recommended policy changes

The following changes are predicted to bring a minimum of 10% savings of total annual energy cost (based on data on provided by the ***Alliance to Save Energy***):

No Cost (for implementation) Changes:

- Designate an internal "energy program manager" who is 1. Interested in energy reduction/planning, and, 2. Wishes to tie some level of her/his compensation to the savings and/or improvements in energy costs which result from changes made (Appendix VIII). Bring this manager into the entire tribal buildings department – including the casino and health center facilities. And, include an energy committee where each department is made aware of new improvements and is able to brag/boast of improvements made in her/his department. Present an annual award at a festive function – honoring the accomplishments of the person most improved in energy reduction etc.

- When changing motors due to upgrades or when specifying new motors for expansions, require "premium efficiency" motors be supplied. These are a minor increase in cost over historical "high efficiency" motors but offer lifetime savings estimated at 5% of operating costs (Appendix IX).
- Bring in your outside utility/power provider energy coordinator and review the multitude of meters in your water and wastewater system, name the meters at each site in a logical and sequential fashion so that all meter lists correlate and identify the appropriate site (now, meters have many names by various departments and it adds to the confusion of responsibility). Then, request that all utility bills related to this infrastructure sites be sent as a single compilation (or, have your accounting department do this) to the utility manager's office and track/graph these bills (and the total) against previous year's costs/bills. This – alone – is projected to save 10% by

virtue of simple tracking/awareness as reported by multiple reports on this practice (http://www.equipintegration.com/Reports/feedback-energy-consumption.pdf).

Low Cost Changes:

- Install occupancy sensors and "setback" thermostats in each building
- Install proximity sensors or motion sensors on outside lighting in the building areas – and in rooms or conference areas where people are only occasionally occupying the room/area.
- Replace all fluorescent lamps with T-8 lamps and T-8 rated electronic ballasts – using same fixture bodies.
- Replace all electric heaters in "above grade" buildings with gas or LP heaters (gas heat is approximately ½ the cost per BTU/heat provided vs electric heat).
- Install elapsed time meters in each control panel. At the SBR plant, find the location in the software which provides elapsed time for each pump and record/track these and compare to similar other plants at other tribes (Hannahville tribe?).
- Repair/replace broken diffuser header in digester. Install fine bubble diffusers in the digester – being sure to check this change for appropriate sheave change on the digester blower. Estimated cost (installed) – $5,000 to 10,000. Estimated savings – $2,000/year. Payback will be 2 to 5 years (contact your consulting engineering firm for design or our firm for additional details).
- Retain a local HVAC contractor to conduct an energy survey of the buildings for infrastructure using "blower door" and Infrared instrumentation/equipment. Then, seal and insulate as suggested by this study.

Future Changes (more costly while these might be incorporated into planned improvements):

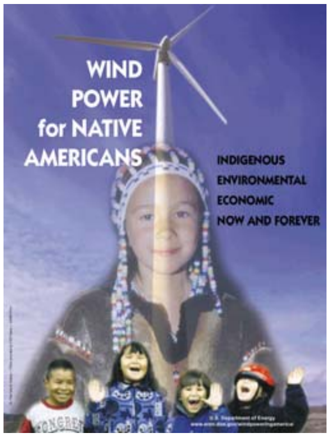
- SCADA improvements – install watt meters at larger sites on larger motors (over 5 hp) and tie watt meters and elapsed time meters (and flow, where available) into SCADA and have integrator "build" charts to provide a "dash panel" view on the SCADA which indicates energy consumption overall and by site.
- Define a routine Operation and Maintenance Improvement plan similar to that described on pages 68 and 69 of the Philippine Islands' USAID report – Appendix X

Long Range Planning:

When contracting for new systems of any kind which may have implications of energy consumption, set up a set of guidelines by which proposed systems will be valued/judged as acceptable. Include the following (examples but there will be others):

- New buildings shall be constructed to a LEED (http://en.wikipedia.org/wiki/Leadership_in_Energy_and_Environmental_Design) building standard of construction (even though you may not wish to obtain full certification). Building according to LEED standards costs little extra and pays large returns in energy savings/recovery. Lighting, HVAC, building materials and insulation are all very well defined for highest efficiency when LEED standards are stipulated/required. This standard fits well pump houses, lift station buildings, and – of course – housing and buildings of all types.

- Any motors which have failed or which need to be added/changed should be required to be "premium efficiency" and sized according to load – not over sizing them nor under sizing them. Motors are at maximum efficiency at about 75% load and their power factor (see Appendix IX) should be 0.8 or higher.
- Pumps and blowers – likewise – need to be evaluated for life cycle cost of maintenance with energy costs integrated into the evaluation (see Appendix XI). It is not unusual for the operating costs of such pumps/blower to be 10 times the initial capital costs and higher. Thus, a careful standard needs to be set forward when such equipment is selected/specified/purchased.
- Passive solar heat (hot water and building/premises) along with solar panels and wind energy continue to becoming increasingly competitive (and, allow for Tribal independence) as compared to traditional energy sources (see Appendix XII). Wind, in particular, should be re-evaluated. A recent seminar indicates that the department of energy has new "test" or demonstration towers which are available to re-examine viability of wind for the higher points of land on the reservation. A study of the feasibility of wind may require a $20,000 study but may be justified in light of recent technology changes.



- Team up with Casino management and other building maintenance managers throughout the reservation and consider proposals from Engineering Service Contract Providers (ESCO's) where the provider offers a competitive contract to reduce energy consumption/costs with the payback/cost sharing in the energy savings (see Appendix XIII).
- Contract with an energy engineer to provide an Energy Star Performance rating for your water and wastewater utility (Appendix XIV) in which your facility is routinely compared to similar facilities worldwide and where your utility will receive continuous updates and assistance in improving energy efficiency on a routine basis.

Closing Thoughts

The rising cost of energy is becoming a greater and greater percentage of the operating budget for public utilities. This energy audit is a preliminary step to address this issue and to plan a course for the future. We have identified short and long term suggestions to help reduce existing energy costs which will become more and more important as time goes by.

Suggestions for immediate action / consideration are:

Wastewater SBR

- Repair/replace broken aerator in the SBR's sludge holding tank.
- re-evaluate process operation including use of influent holding tank est. cost $15,000 potential savings $10,000/yr.

Drinking Water

- Install set back thermostats ("smart temperature controllers") in all pump houses est. cost $500 potential savings $2,000/yr.

Overall applicability

- assign specific name or numbers to all utility energy meters so that energy use can clearly be identified and results tracked.
- Designate an energy manager important for maintaining savings and to direct long term projects.

Additional support – Future actions

Energy initiatives suggested in this report are based on approximate values for the various component and construction cost. Additional supporting information is certainly offered at any time. A more rigorous cost and detailed design layout can be provided at a nominal cost. For help and support of this nature, contact the author:

Donald R. Voigt, P.E., CEM
Engineered Equipment Integration
434 N. Wisconsin St
Port Washington, WI 53074

don@equipintegration.com
414-940-9281 (Universal Phone Access)

Funding for additional work may be available through:

Joe Cantwell, P.E.
Wisconsin Focus on Energy
1845 Derrin Lane
Brookfield, WI

cantellj@saic.com
262-785-8221