Enhancing the Energy Efficiency of Wastewater Aeration – Phase 2 (focus on Bartlett,TN, WWTP)

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Background

- 5-10% of all electrical consumption in the United States is water and wastewater related
- Economic growth follows the sewer lines not the electric lines
- Community infrastructure concerns are increasingly important to business and industry

Approximate Plant Budget Breakdown

- People – 33%
- Electricity – 30 to 40 %
  - 80 % of electricity is used in pumps/motors (~ 25% of budget)
  - Lights
  - Building HVAC and ventilation
- Miscellaneous
  - Chemicals – 15 to 20 %
  - Telephone, Federal, Federal Insurance, Tax, etc.

Activated Sludge Power Demand

- Typical systems use 1,300-2,400 kWH per million gallons treated
- Aeration equipment consumes almost half of this amount
- EPA and EPRI published guidelines in the mid-1990s on more efficient aeration systems

Aeration and Energy

- Efficient automated aeration controls have reduced electricity demand for some facilities by 15-40%
- However, many small to mid-size systems manually control their aeration systems
- Manual controls are normally set to handle expected maximum daily loadings

Project Goals

- Help plants save energy and improve process stability
- Demonstrate the use of optical luminescent or fluorescent technology-equipped dissolved oxygen (DO) probes and variable speed drives (VSD) among small to mid-size wastewater utilities

WEF Aeration Efficiency

- The WEF Manual of Practice No. FD-2, Energy Conservation in Wastewater Treatment Facilities (1997) contains the following range of values:
- Energy used per million gallons treated (279-928 kWh/MG)
- Percent of total plant energy used for secondary treatment only (29-48 %)

2002 PG&E Benchmarking Study

- Energy used per pound of BOD removed (0.4-2.6 kWh/lb BOD)
- Energy used per million gallons treated (508-2,428 kWh/MG)
- Oxygen transfer efficiency (2.6-83 %)
- Percent of total plant energy used for secondary treatment only (27-60 %)

InsiteIG DO & ABB VSD Demo Facility

Memphis Light, Gas & Water – City of Bartlett, TN

John Harris – MLGW; Jennifer Brogdon – TVA; and Larry Gamblin – City of Bartlett

Bartlett WTP-Background Conditions

- 2 Oxidation ditches
- Design capacity 2 MGD, current flow 1 MGD
- Each ditch has 3 rotor aerators, each driven by a 60 hp motor
- Operated 1 rotor in each ditch continuously and activated 2nd rotor during estimated peak flows with timers


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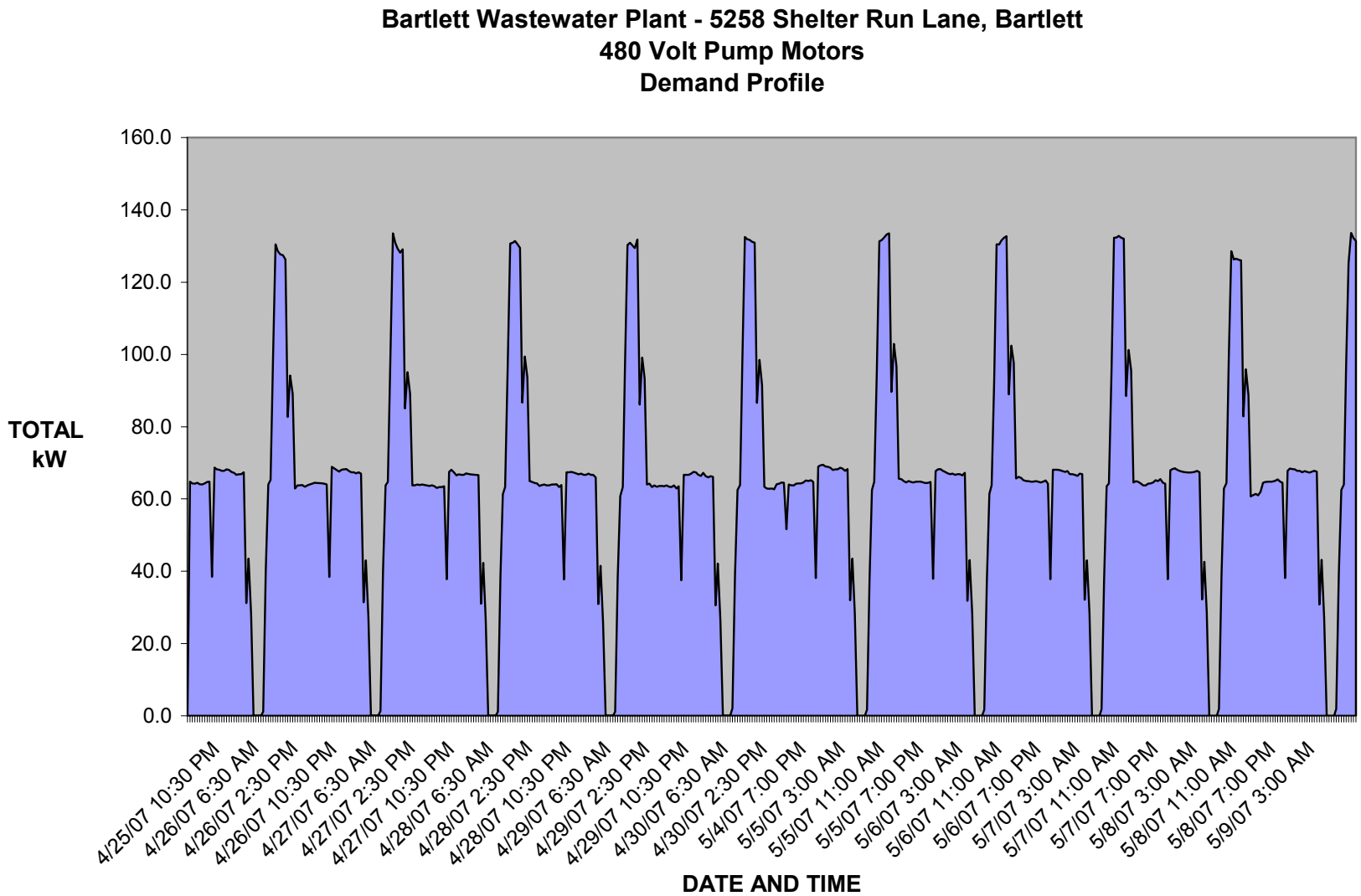
Facility Process Monitoring

- Electrical metering - TVA CSC & MLGW
  - 1-2 weeks prior to equipment installation
  - Allow process to stabilize for 2-4 weeks
  - 1-2 weeks after process stabilization
- Sample influent and effluent wastewater
- Determine relationship between the peak and daily wastewater loadings and the peak and daily electricity demand

Bartlett Background



Bartlett WTP-Equipment Demonstration

- Added InsiteIG dissolved oxygen system to provide continuous, accurate readings of dissolved oxygen in each ditch
- Added ABB variable speed drives to take the DO 4-20 milliamp signals and ramp one motor per ditch up and down to maintain an optimum DO level

Rick Davis, InsiteIG, and dissolved oxygen probe

InSiteIG DO control box

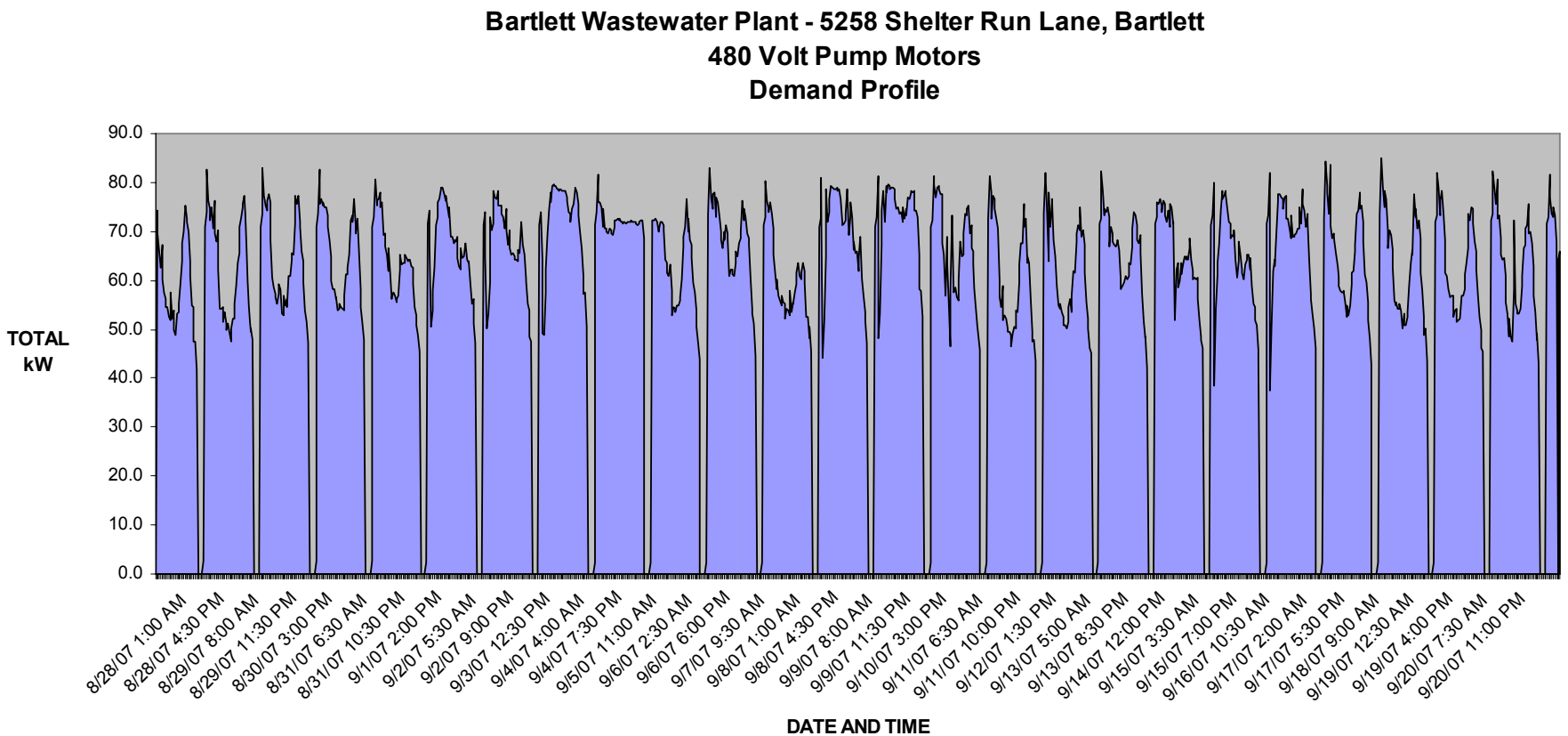
Bob Zurolo, ABB, and variable speed drives

Rick Davis & Larry Gamblin with PLC

Results at Bartlett

- 1 rotor in each ditch ramped up and down by DO probe/VSD combination
- Plant never needed 2nd rotor in either ditch
- Reduced peak demand 39% from 130 kW to 79kW
- Reduced kWh 13% from 1,550 to 1,350 kWh/day

Bartlett Demonstration



Results - continued

- Original Control with Timers
  - 1553 kWh/day; cost/year = $28,342
  - 130 kW; cost/year = $14,227
- DO probes only
  - 1521 kWh/day; cost/year = $27,758
  - 110 kW; cost/year = $12,038
- DO probes + VFD's
  - 1356 kWh/day; cost/year = $24,747
  - 79 kW; cost/year = $8,646

Costs & Payback

- DO Probe system cost - $3,500
- VFD's cost - $10,000
- Total cost - $13,500
- Yearly savings – Probes only = $2,773
  - Payback = 1.26 years, save over $10,000 in 5 years
- Yearly savings – Probes + VFD's = $9,177
  - Payback = 1.47 years, save over $32,000 in 5 years

Manufacturing Partners

Rick Davis, Insite IG

- DO probes
- tel: (985)639-0006
- rdavis@insiteig.com
- http://www.insiteig.com/

Bob Zurolo, ABB

- VSD
- tel: 704-560-3592
- bob.zurolo@us.abb.com
- www.abb-drives.com

Ultimate Deliverables

- "Best Practices" guide describing the state of the art for optical luminescent, or fluorescent DO probes
  - including performance, reliability, and costs (capital and O&M) data
- Screening tool to help assess a plant's suitability for this technology

Funding Partners

- Tennessee Valley Authority
  - Customer Resources
  - Research & Technology Applications
- American Public Power Association, Demonstration of Energy-Efficient Developments (DEED) Program

Questions?

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