



Clearwater Signals

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Green Building Goals: To Your Health!

by Jerry Ackerman

Pulsed-power embraces the goals of the U.S. Green Building Council (USGBC). In doing so, the technology places itself in support of two major principles: (1) design the building with equipment to measure energy and water performance; and (2) integrate pulsed-power technology to enhance HVAC system performance, environmental sustainability, and energy savings within a total building systems perspective.

Dolphin technology can be implemented to complement and further enhance many credit areas in the USGBC Leadership in Energy and Environmental Design (LEED) program, such as the following.

• **Sustainable Sites.** Dolphin technology supports the goal of using Urban Redevelopment Sites in high-density locations by preventing the migration of chemicals used on HVAC systems and fountains through drift, surface soil residue, and groundwater flow. In a similar way, it reinforces the goal of Brownfields redevelopment by offering an environmentally sustainable technology: one that will not contribute to contamination already existing on a site (or “re-polluting” a Brownfields site that has been remediated).

• **Water Efficiency.** Dolphin technology supports the goal for water-efficient landscaping because water released through blowdown, for example, can often be used as feedstock in the nourishment/preservation of plantings, lawns, and fountains on a site (versus the restricted and expensive regulations for disposing of chemically laden water). The credit for water use reduction is thereby also supported, along with the less water use directly associated with cooling towers and boilers because of increased cycles of concentration. These savings can be verified through estimates of water needs for a building using conventional baselines.

• **Energy and Atmosphere.** Dolphin technology contributes to optimizing energy performance, based on the energy savings from the ASHRAE 90.1 baseline, by eliminating biofilm buildup in cooling towers. Energy savings are based on a *minimum* 5% increase in chiller efficiency due to the total elimination of biofilm. A good strategy overall is to model the energy and water systems to predict savings.

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Dolphin Technology In The Healthcare Industry

• Supporting an Environment for Human Health •

There are a number of ways in which Dolphin System pulsed-power technology serves the healthcare industry. The most essential benefits pertain to pollution prevention and the protection of human health. When hospital cooling towers and HVAC systems are treated with chemicals, chemical residuals are ultimately discharged into the environment where they can contaminate surface water, groundwater, soil, and air. In air, chemical particles can be aspirated directly by people exposed to the mist created by cooling tower drift.

Hospital patients can often have very low immune systems, and it is not unreasonable for healthcare providers to have concerns regarding patient sensitivity to low levels of chemicals.

A Dolphin System application at healthcare facilities alleviates or mitigates such concerns. One, it prevents exposure and migration pathways of hazardous chemicals since the Dolphin System is a chemical-free treatment. The best way to prevent exposure to hazardous materials is to not bring them into the facility.

Legionella control is another concern of hospital cooling systems. These waterborne bacteria have the potential of amplifying from these systems. Although most nosocomial (i.e., hospital-acquired) Legionella infections have been traced to the potable water system, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires—and good practice demands—that the issue be addressed. The Dolphin System has an excellent record of controlling slime layers on cooling systems. Slime layers allow amplification of Legionella. Eliminate the slime layers and you eliminate the risk of Legionella amplification emanating from cooling systems. (See the sidebar article, “Legionella Control in Cooling Towers.”)

Economics, of course, is always a primary concern of hospitals, especially



St. Francis Hospital in Hartford, Connecticut

those depending on contributions for survival. Not only is the Dolphin System environmentally responsible, it is economically viable. Pulsed-power technology saves energy and water while it helps protect indoor-air quality. The Dolphin capital cost is an order of magnitude lower than the continuing operating expense of standard chemical treatment considering life-cycle costs. Payback is often achieved in less than two years.

The following “mini case studies” support these statements.

• **New England.** Two examples of Dolphin System applications in this region are St. Francis Hospital and Medical Center in Hartford, Connecticut, and Lawrence & Memorial Hospital in New London, Connecticut.

As a hub of comprehensive healthcare in its area, St. Francis is committed to



Dolphin System at St. Francis Hospital

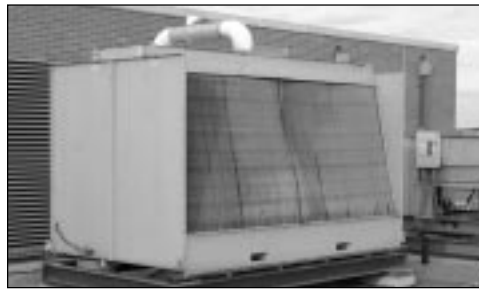
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providing the highest quality care through their physicians utilizing the most advanced and sophisticated technology. The proactive policies at St. Francis to improve services with smarter and more economical management systems dovetail with what Dolphin technology offers in terms of enhancing cooling system performance, improving environmental conditions, saving energy, and cutting costs. Dolphin System Installation Date (DSID): July 2000.

Lawrence & Memorial Hospital is a not-for-profit, general, acute care, private institution licensed for 280 beds. The hospital is situated within a geographical infrastructure where environmental impacts warrant a high level of monitoring for the community. Installing the Dolphin on one of its cooling towers fits in with this sensitivity and the hospital's premise to balance cost and quality issues to provide the highest value of service



Lawrence & Memorial Hospital



Dolphin System at Lawrence & Memorial

possible. Plans have been made to install the Dolphin System on all of the facility's chiller systems. DSID: November 2000.

• **Middle Atlantic States.** The Children's Hospital of Pittsburgh, St. Clair Hospital, and the University of Pittsburgh Medical Center (UPMC) Braddock Hospital are just a few of the many Dolphin System healthcare applications in this area.

As the only hospital in western Pennsylvania devoted solely to the care of infants, children, and young adults, Children's Hospital of Pittsburgh has been named consistently to several elite lists of pediatric healthcare facilities. This recognition includes being listed as one of the top 10 children's hospitals in the country by *U.S. News and World Report* and ranking eighth in funding provided by the National Institute of Health. Several large Dolphin System units were installed on the facility's cooling tower system, resulting in clear water, no odor, no algae, and total bacteria counts of less than 1,000 CFU/ml. DSID: April 2002.

Founded nearly 50 years ago, St. Clair Hospital provides healthcare through seven distinctive Centers of Excellence: Cancer Center; Center for Behavioral and Mental Health; Center for Motion Recovery; Center for Pulmonary Health; Center for Women and Children's Services; Heart Center; and the Emergency Department. Pivotal to these services is the environmental stewardship of the facility. The Dolphin System installation at St. Clair has achieved TBC counts averaging 630 CFU/ml while maintaining



Children's Hospital of Pittsburgh



UPMC Braddock Hospital

a conductivity of 1,000 uS/cm. DSID: March 2000.

UPMC Braddock Hospital, established in 1906, serves the residents of the Monongahela and Turtle Creek regions in western Pennsylvania. Besides providing services in geriatric psychiatry and laser surgery among other specialties (along with general medical care), the hospital offers community education programs, including stroke awareness and controlling substance abuse. A 10-inch Dolphin System was installed on one of the hospital's major cooling towers, along with 3 and 1-inch units for the boiler system. After nearly three years of continual operation following Dolphin System installation, results have demonstrated superior system performance, major environmental benefits, and energy savings. DSID: July 2000.

• **Southeast.** One of the high-profile Dolphin Systems installations in the south is at the H. Lee Moffitt Cancer Center and

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Green Building Goals

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• **Materials and Resources.** Dolphin technology can be easily retrofitted into old systems to enhance their operations and extend their useful life cycles while protecting human health and the environment and saving energy.

• **Indoor Environmental Quality.** Ventilation effectiveness is enhanced with Dolphin technology. With chemical treatment it would be required to design separate exhaust and plumbing systems for rooms with contaminants to achieve physical isolation from the rest of the building. Since there would be no need to store chemicals under Dolphin technology, the technology precludes or simplifies these types of strategies and thereby reduces or eliminates their associated costs.

Dolphin technology is currently contributing to the LEED program as an innovation credit for the largest green building project in the nation. While the Dolphin System's environmental benefits are readily apparent, its superior performance, energy efficiency, and economic savings further strengthen its value in helping to achieve green building goals.



H. Lee Moffitt Cancer Center

Research Institute in Tampa, Florida. The complex houses the work space for more than 280 physicians and 600 research scientists. The Center treats an average of 5,000 in-patients and 135,000 outpatients a year. Dolphin System installations on the steam boilers occurred in November of 2001, with cooling tower applications currently taking place.

• **Midwest and South Central.** The St. Louis Children's Hospital in Missouri, Memorial Hospital of Belleville, Illinois, and the Veterans Affairs Medical Center in Muskogee, Oklahoma, represent some of the Dolphin System installations at healthcare facilities in the Midwest and South Central regions.

Established over 120 years ago, St. Louis Children's Hospital has been a leading institution in attending to the

emotional and developmental needs of children. Also ranked as one of the best children's hospitals in the nation by *U.S. News & World Report* and *Child* magazines, the hospital's medical and surgical staff includes specialists in all pediatric disciplines. More than 30 pediatric subspecialty departments and divisions provide a complete range of medical services. Dolphin System installations on the hospital cooling towers were just completed in April of this year, with initial results showing a strong reduction in TBC and excellent indications with other parameters.

Memorial Hospital of Belleville is a full-service medical center serving the residents of southwestern Illinois since 1958.



Memorial Hospital in Belleville, Illinois

With a bed capacity of 341, this community-based, not-for-profit organization provides comprehensive in-patient services, emergency services, diagnostic imaging, a convalescent center, a rehabilitation department, home care, a health and sports center, and a sleep disorders center. Dolphin System installation results have been excellent and consistent after nearly two years of operation. DSID: July 2000.

The Veterans Affairs Medical Center, which was featured in the Winter 2002 issue of *Clearwater Signals*, provides a variety of medical and surgical care, with 500 employees serving approximately 128,000 veterans in eastern Oklahoma. The Center's change from chemical

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St. Louis Children's Hospital in Missouri

Legionella Control In Cooling Towers

SIMPLY THE FACTS AND STRAIGHT ADVICE



Amoeba feeding on Legionella (dots)

• **What Is Legionella?** Waterborne bacteria that can cause a type of pneumonia by infection only if the bacteria are inhaled deeply into the lungs.

• **Where Do You Find Legionella?** In many natural waters and in many potable water supplies, including water mains, humidifiers, and cooling towers.

• **How Likely Can You Get Infected?** To get infected, several essential steps need to happen. One, Legionella must be present in a water source. Two, conditions must be available that allow Legionella to grow (amplify). Three, a mechanism must exist for dissemination of the infected water into respirable droplets. Four, inhalation (aspiration) of the colonized droplets has to occur. Five, a susceptible host is required to allow infection, and not all human beings are equally susceptible. If any one step in this chain of events is broken, the infection will be prevented. NOTE: You cannot catch Legionella from another person.

• **How Do Legionella Amplify?** Rapid growth of Legionella requires a temperature between 77-108° F and an active slime layer with protozoa. Water droplets are needed to carry bacteria; water vapor will not carry the bacteria. Water treatment can prevent amplification.



Amoeba host exploding, releasing Legionella

• **What's The Major Cause Of Nosocomial Legionella?** Most often the potable water system, not cooling towers.

• **Why Is Routine Testing For Legionella Not Recommended?** Testing is complex and produces variable results. Also, there are no limits that associate Legionella levels with health risks. There are

liability issues associated with Legionella test data. Periodic chemical shocking can cause corrosion, which can enhance Legionella growth. Legionella can rapidly re-inoculate a tower.

• **What Can Be Done To Prevent Legionella Growth In Cooling Towers?** Do not have people working near tower exhaust, which allows droplets to evaporate. Do not locate air intakes near towers. Keep the tower clean. Monitor for slime formation and higher life forms like amoeba. Perform routine maintenance on drift eliminators.

• **How Does Dolphin System™ Technology Prevent Legionella Growth In Cooling Towers?** The chemical-free Dolphin System for water treatment is the best and safest method to control slime formation. Protozoa need a slime layer to thrive; without protozoa, amplification of Legionella will not occur.

Biological Control in Cooling Towers

[Note: The complete paper was written by Dennis Opheim, Ph.D. (Professor of Microbiology, Department of Biomedical Sciences, Quinnipiac University), and John Lane (Director of Technology, Clearwater Systems). The document addresses the effects of treating three cooling towers with pulsed-power technology. Extensive biological data covering up to 16 months, including the transition period from chemical to non-chemical treatment, is reported. The paper includes the effects of pulsed-power technology on biofilm, turbidity, scaling, and corrosion.]

• **Overview.** Biological control is the foundation of cooling tower water treatment. Biofilm can directly cause corrosion problems (microbial induced corrosion, MIC), pathogen concerns (*Legionella*), increased pump pressure, heat-transfer problems, dermatological effects, and malodors. With the increasing restrictions being imposed at the federal and state level regarding chemical use in cooling towers (CAA, CWA, OSHA, FIFRA), biological control has become much more difficult. A safe and effective alternative to current treatment methods is needed.

• **Background: Pulsed-Power Technology in the Food Industry.** Pulsed-power technology (PPS) is an FDA-approved electronic process for the pasteurization of pumpable fluids. A recent FDA report describes in detail the successes with these systems as a low energy method of pasteurization. Although there are only two commercially available systems for pasteurization, PurePulse (a spin-off of Maxwell Laboratories) and Thomson-CSF, many different processes have been successfully tested. These processes all involve a pulsed electric field delivered to the fluid at a high power level. An adaptation of this technique, The Dolphin System™, is being used on the open loop of cooling towers in many parts of the country.

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Dolphin System at the VA Medical Center

treatment to chemical-free treatment on cooling towers and boilers was driven primarily by a federal executive order that makes the head of each executive agency responsible for ensuring that all necessary actions are taken for the prevention, control, and abatement of environmental issues with respect to federal facilities and activities under control of the agency. Dolphin System operational results are embracing these goals. DSID: Aug. 2001.

West Coast. Good Samaritan Hospital is a 225-bed, non-profit, acute care facility that, through its clinics covering its service area, constitutes a comprehensive com-



Sideview of Good Samaritan Hospital

munity healthcare system. The active medical staff, including 250 physicians, provides high-quality health services (with an emphasis on compassion) to communities in Puyallup and surrounding areas south of Tacoma, Washington. Initial results from the Dolphin installation at this facility have been excellent. DSID: December 2001.

Conclusion. While a number of these hospitals also have Dolphin System installations on steam boilers throughout their facilities, this article focuses on cooling tower applications because of the factors regarding *Legionella* control. The sidebar article, “*Legionella* Control in Cooling Towers,” offers some insight into this issue. The following table, showing the results of extremely low total bacteria counts (TBCs) in hospitals with Dolphin System applications, indicates how pulsed-power technology helps prevent *Legionella* growth in cooling towers. □

Some Dolphin System Installations
on Cooling Towers in Healthcare Facilities

HEALTHCARE FACILITY	Operational Results To Date					
	pH	Water	Odor	Algae	Scale	TBC (CFU/ml)
New England: St. Francis	~8.3	Clear	None	None	No new	~230
New England: Lawrence & Memorial	~8.3	Clear	None	None	No new	~1,000
Mid-Atlantic: Children's Hosp.-Pittsburgh	N/A	Clear	None	None	N/A	N/A
Mid-Atlantic: St. Clair Hospital	~8.4	Clear	None	None	No HTL	~630
Mid-Atlantic: UPMC Braddock	~8.4	Clear	None	None	No HTL	~1,000
Southeast: H. Lee Moffitt Cancer Center	N/A	Clear	None	None	N/A	N/A
Midwest: Children's Hospital-St. Louis	~8.5	Clear	None	None	No HTL	~980
Midwest: Memorial Hospital-Belleville	~8.4	Clear	None	None	No HTL	~480
South Central: Veterans Affairs-Muskogee	~8.3	Clear	None	None	No new	~230
West Coast: Good Samaritan-Washington	~8.5	Clear	None	None	No new	~1,000

Note: No HTL= No heat-transfer loss, high energy efficiency. N/A= data not yet available (recent project).

Biological Control in Cooling Towers

(Continued from page 4)

• **Installations.** The evaluations reported in the paper were performed on two cooling towers at a large industrial plant and on one cooling tower at a skating rink; all towers are located in Connecticut.

• **Results: Biofilm Control.** Visual inspections and data points on the PPS-controlled towers indicate that no observable biofilm is present. Pre-existing biofilm that was present under the chemical period appears to slough off a short time after the PPS is installed.

• **Results: Turbidity.** The change in turbidity is the most immediate and visibly obvious difference with the cooling tower under pulsed-power control as compared to chemical control. The measured turbidity confirms what is visible to the eye; the water becomes much clearer soon after the PPS is installed.

• **Scale Prevention.** Under PPS treatment, precipitation will occur in the bulk solution as a powder rather than as a surface-nucleating scale.

• **Corrosion Protection.** All of these towers under pulsed power control operate at saturation with calcium carbonate, which is a cathodic corrosion inhibitor.

• **Conclusion.** PPS controls bacterial concentration in cooling towers without any chemical treatment whatsoever. The formation of algal mats was significant in chemical-treated towers, especially during the summer months, whereas there was little to no algal mats in the PPS-treated towers. ▣

Offering of Free Report. For a copy of the complete paper, *Biological Control in Cooling Towers Treated with Pulsed-Power Systems*, which contains detailed data points and analysis, contact Jerry Ackerman at Clearwater Systems. Phone: 860-767-0850. Fax: 860-767-8972. Email: jjja@clearwater-dolphin.com

Physical Water Treatment

by John E. Dresty, Jr.



Recirculating water in a cooling tower should be considered as “another industrial material” such as steel, aluminum, or plastic. Just like any other industrial material, recirculating water has properties, limitations, strengths, and weaknesses. Properties of industrial materials can be changed by *chemical means*, such as adding alloying elements to metals or adding chemicals to water. Properties of industrial materials can also be

changed by *physical means*, such as the heat treatment of metals or electronic treatment of water.

While the physical treatment of metals is an engineering discipline that is well established, the physical treatment of water has been severely neglected, with its scientific processes largely ignored. The overall disregard for physical water treatment can be blamed on the manufacturers of physical water treatment equipment. These manufacturers have developed a reputation for promising much more than their products could deliver, resulting in frequent problems... problems not overlooked by the established (i.e., chemical) water-treatment providers. However, the physical treatment of water has also had remarkable success, with pulsed power being the premier technology.

To improve both manufacturer and consumer understanding in this regard, Drexel University recently formed a Center for Physical Water Treatment. As envisioned at Drexel, Physical Water Treatment (PWT) will encompass many methods of changing the properties of water by non-chemical means. These methods include precipitation induction devices like our Dolphin System, as well as some magnetic devices.

One of the severe limitations of magnetic PWT devices is that they could not treat the entire system on which they were installed, such as a cooling system. Although, when properly applied, the devices can limit scaling, they have no effect on biological growth and end up being combined with chemical biocidal treatment, thereby questioning the value of the device in the first place. Also, the biocides are often corrosive, requiring that the system be protected by the addition of more chemicals as corrosion inhibitors.

The Dolphin System is based on pulsed-power technology, which has its origin in the food pasteurization industry. Pulsed power is an FDA-approved technique to sterilize food without using heat. Pulsed-power treated cooling systems routinely maintain substantially lower microbial activity than the typical chemically controlled tower.

Combining the ability to control scaling and microbial activity means that Dolphin System-treated cooling towers can operate without any chemicals. The Dolphin Systems operate at saturation of calcium carbonate, at a pH of 8.5, with very low microbial activity, with no slime formation, and with no scale formation. Under these conditions, steel exhibits very good corrosion resistance and copper excellent. The recirculating and discharge water contain no added chemicals and simplify many discharge issues. These advantages, like the water we treat, are very clear. ▣



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UPCOMING • Conferences • Seminars • Trade Shows • Expositions • UPCOMING

<i>Event</i>	<i>Date & Location</i>	<i>Points of Contact</i>
<p>Energy Management Congress. Energy efficiency is actively promoted to commercial, industrial, institutional, and governmental end users as a strategy for reducing energy costs, improving the environment, and increasing system reliability. www.aeecenter.org/shows</p>	<p>June 6-7, 2002 Anaheim Convention Center Anaheim, California</p>	<p>West Coast EMC 2002 P.O. Box 1026 Lilburn, GA 30048 Questions: 770-279-4390 Fax: 770-381-9865</p>
<p>American Society for Healthcare Engineering (ASHE). 39th Annual Conference & Technical Exhibition. www.ashe.org</p>	<p>July 29-30, 2002 (Exhibition) July 29-31 (Conference) Nashville Convention Center Nashville, Tennessee</p>	<p>ASHE 75 Remittance Drive Suite 1272 Chicago, IL 60675-1272 Questions: 312-422-3813 Fax: 312-644-0575</p>
<p>2002 Environmental Innovations Summit (EIS). Strategies and best practices for improving environmental performance.</p>	<p>September 18-20 2002 Hilton Crystal City Hotel Arlington, Virginia</p>	<p>EIS 2002 Environmental Performance Institute 311 North Washington St., Suite 200 Alexandria, VA 22314 Questions: 703-519-6271 Fax: 703-519-6271</p>
<p>First Annual Green Building International Conference and Expo. A showcase for leading-edge green technologies and an educational program on energy-savings and environmentally sustainable buildings. www.usgbc.org</p>	<p>November 13-15, 2002 Austin Convention Center Austin, Texas</p>	<p>U.S. Green Building Council 1015 18th Street, NW, Suite 805 Washington, DC 20036 Questions: 202-828-7422 Fax: 202-828-5110</p>