

ELECTRIC ENERGY

SPOTLIGHT ON TECHNOLOGY

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NOOTER/ERIKSEN WATER SOLUTIONS OPTIMIZES POWER PLANT COOLING SYSTEMS WITH *HYDROFLOW*

By Shaun Hennessey, Yves Sergile and David Kecec, Nooter/Eriksen Water Solutions

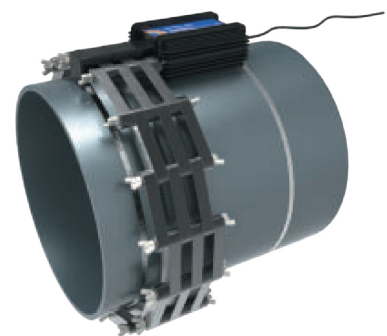
WET COOLING IN POWER and other industrial systems has historically been used to reject waste heat from the process into the surrounding environment. These wet systems have required significant amounts of chemical additives to control aspects such as scaling, corrosion and biological growth within the water. The chemical additives are costly from an operational and maintenance standpoint and can introduce risks to plant personnel as well as the surrounding environment.

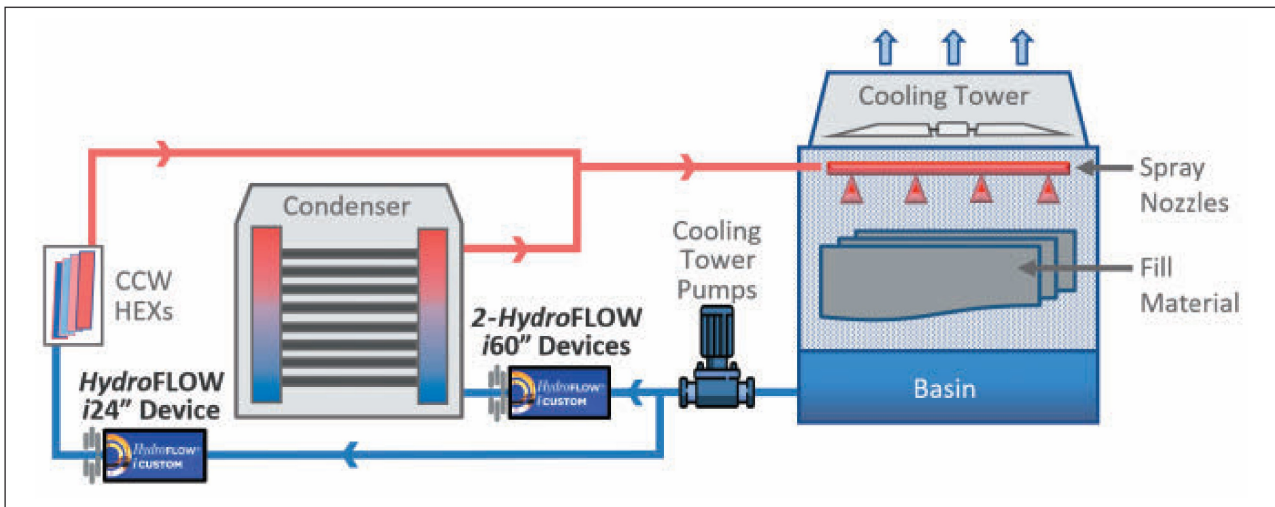
Nooter/Eriksen has been a domestic and world leader in the power industry for over 35 years. Nooter/Eriksen Water Solutions (NEWS) has been created to leverage Nooter/Eriksen's experience in the industry and specifically its expertise in the stringent requirements needed for boiler feedwater into other power and industrial water systems. NEWS is extending this water chemistry expertise into broader water quality management applications at power plants and other industrial complexes. NEWS' goal is to optimize cooling and other water systems in order to reduce operating

costs, but to also substantially reduce waste of water and limit the release of chemical contaminants to the environment.

Power plants and other large industrial facilities often require large amounts of water, with chemical treatment, for cooling and other processing functions. Operation of these water systems is costly and the maintenance of major components like steam condensers and cooling towers is often substantial. Various hazardous chemicals are often required to prevent the formation of different scales, corrosion and the growth of biological organisms. This component fouling can be detrimental to the operational performance of the system, require maintenance that can be difficult and unsafe to perform and pose personnel and environmental safety issues. NEWS offers a safe and sustainable alternative to traditional chemical water treatment at power plants and other industrial facilities in the United States: *HydroFLOW* devices that utilize Hydropath technology.

HydroFLOW devices induce a patented electrical signal directly into water piping systems that prevents the formation of scale, helps to prevent





corrosion and controls bio growth, significantly reducing the need for chemical feeding. The signal can also remove existing calcium carbonate (CaCO₃) scale and biofilm over a period of time. The NEWS optimization process is designed around the integration of these *HydroFLOW* devices, as well as installation of wireless remote monitoring and stringent water chemistry and plant operational data analysis. With the NEWS system in place, plants can optimize chemical and water usage, maintenance and operating performance of the system.

HOW DOES HYDROFLOW WORK?

Installation of the *HydroFLOW* device is non-invasive. It is strapped onto the piping and requires no welding to system components. For

conditioning of recirculating cooling systems, the devices are typically installed on inlet piping to the condensers. If required, a device can be installed on the closed loop cooling water heat exchangers. Once installed, the facility simply needs to provide standard 120-volt power to the unit's main electrical junction box which is located on or near the *HydroFLOW* unit.

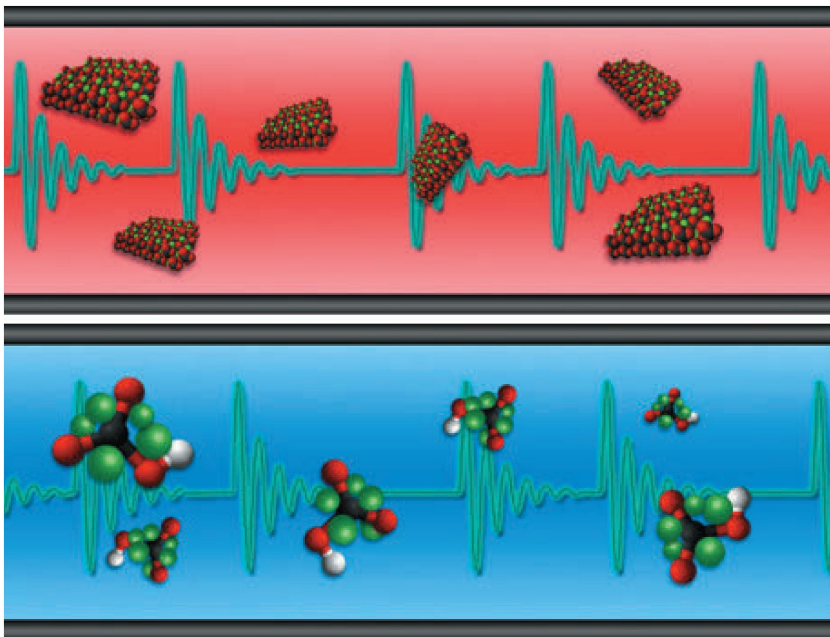
The *HydroFLOW* water conditioning device, utilizing patented Hydropath Technology, induces an electrical signal, a random decaying sine oscillation of +/-150kHz, into the entire water system. A signal generator and ring of ferrites are used to induce the signal into the flowing liquid and, if the pipe is metallic, into the pipe as well. Due to this method of induction, this system also works on non-metallic piping such as concrete and PVC

as long as there is a continuous liquid phase (pipe is full of water). The signal persists in the liquid water whether or not there is flow.

This signal alters the arrangement of dissolved ions in solution, causing them to cluster together in proximity but not yet in solid/precipitated form. Changes in temperature or pressure that would normally result in solids scaling out on the piping and heat transfer surfaces now result in formation of precipitates within the flowing liquid.

When used on metallic piping, carbon steel for example, the signal helps to minimize corrosion. On metal surfaces the electrical current flows along and near the outer diameter of the pipe wall; this "skin effect" interrupts the electron exchange needed for corrosion to take place along with encouraging protective magnetite growth on the steel surfaces.

As an additional benefit, the device actively controls bacteria such as legionella, algae and biofilm. As the single cell organisms pass through the device's ferrite ring, they take on a surface charge. The charged bacteria are quickly surrounded by pure water where osmotic pressure due to the salt concentration gradient forces water into the cell, causing it ultimately to burst. The cells can also be ruptured by cell lysis and irreversible electroporation resulting from the electric signal itself. On metallic piping the signal travelling along the



HydroFLOW devices induce a patented electrical signal directly into water piping systems that prevents the formation of scale, helps to prevent corrosion and controls bio growth, significantly reducing the need for chemical feeding.

pipe agitates any biofilm, causing it to release from the pipe's surface.

These actions greatly reduce the ill effects of scale and biofouling. All of this occurs from the low power, high frequency, patented Hydropath Technology signal that is harmless to humans and the equipment in the cooling tower system.

BENEFITS

NEWS' cooling system optimization utilizing HydroFLOW provides many benefits. One of the primary benefits is to allow for the significant reduction, and in some cases elimination, of scale and corrosion inhibitors. The "signal" performs two functions in this case. First, it allows the precipitation of ions to occur in the liquid and not on the heat transfer surfaces. Second, with steel piping, the signal disrupts the electrochemical reaction necessary for corrosion to occur.

As stated above, the HydroFLOW signal minimizes biofouling by controlling the growth of pathogens in the cooling water. This reduces the need for biocides and in many cases, dechlorinating chemicals.

Since precipitates are formed in the liquid, there are many cases where the operating cycles of concentration can be increased, often 2-3X or more the original target value. In these cases, there can be a significant reduction in blowdown water usage, often greater than 50%.

Reducing chemicals can be a large cost savings and also has benefits for personnel safety. Reduction in scale, corrosion and biofouling leads to better performance and lower maintenance of equipment. Minimizing blowdown water usage can result in large cost savings from the reduction of supply and sewer fees, energy required for pumping and costs associated with clarification systems and other processing of incoming and discharge water.

Finally, there are the environmental benefits. Many local, state and federal agencies are incentivizing and, in some cases, demanding reduced use of chemicals and water. NEWS helps plants meet these goals.

OPTIMIZATION PROCESS

The NEWS optimization process is built around continuous data collection and analysis. NEWS employs a network of wireless sensors for

monitoring purposes and standardized requirements for chemistry sampling and plant operating data. NEWS will guide the plant through a series of incremental changes to operation, regularly evaluating key parameters to ensure the cooling or process water system is performing accordingly. NEWS will provide periodic performance reports that highlight the savings delivered and other key success factors identified by NEWS and the plant.

SUCCESSES

NEWS has already successfully installed and evaluated units at US combined cycle power plants and provided operational guidance for cooling system optimization using HydroFLOW. These plants showed significant reductions in water usage and water treatment chemicals. NEWS is in a position to bring similar optimized performance to plants across the US.

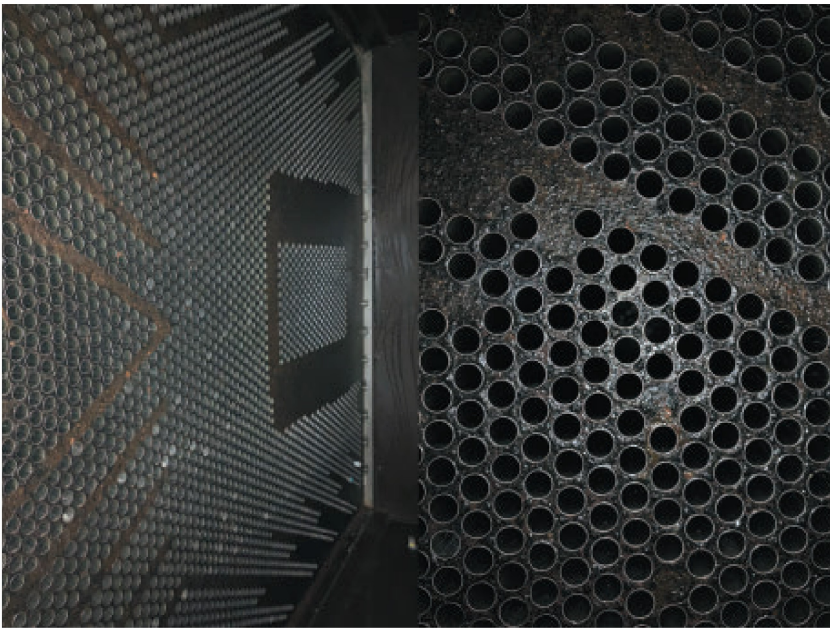
**COMBINED CYCLE PLANT—
MIDWEST, US**

The first plant to incorporate NEWS is a 500 MW combined cycle plant in the US

Midwest region that has a recirculating cooling system with an 8-cell cooling tower. This plant utilizes large amounts of well/city water for cooling along with large quantities of chemicals to control biofilm, scale and corrosion. The plant has high costs associated with purchasing water and chemical treatment. Additionally, availability of water is becoming a more apparent risk to the plant's future operation. As part of the optimization process, there is an evaluation/assessment period typically from 8-12 weeks. During this period the plant saw significant savings with no negative impact to cooling system performance.

By the end of the evaluation/assessment period the plant was able to operate at a conductivity of 3150 $\mu\text{S}/\text{cm}$, up from 1800 $\mu\text{S}/\text{cm}$ with the cycles of concentration going from 5.5 to 9.7. This resulted in a 48.6% reduction in blowdown water usage and expected savings of 60 million gallons of water per year. Scale and corrosion inhibitor were reduced by 74.0%. Finally, biocides and dechlorinator were reduced by 72.7% while maintaining biological activity CFU counts well below the acceptable range.





During the post-evaluation period inspections there were no indications of biofilm or hard limescale formations seen in the condenser or cooling tower fill and basin. Also, there was no degradation to cooling system performance. Temperature differential of cooling water and vacuum pressure of the condenser remained unchanged when compared to past periods of “like” days.

“According to our cooling tower inspector, the cooling tower fill was one of the cleanest he

had ever seen”—testimony from a very pleased project manager at the site.

COMBINED CYCLE PLANT— GREAT LAKES, US

Another plant to incorporate NEWS is a 700 MW combined cycle plant in the US Great Lakes region that has a recirculating cooling system with a 10-cell cooling tower. This plant utilizes large amounts of water along with large quantities of chemicals to control fouling like

the previous plant. This plant also has high costs for purchasing water and chemical treatment. For these reasons, NEWS was brought in to help optimize the performance of the cooling system using *HydroFLOW* technology along with remote data monitoring and analysis. The goals for NEWS optimization was to reduce blowdown water use, reduce chemical use for water treatment and maintain or improve cooling system performance and condition of equipment. Once again, the plant saw significant savings with no negative impact to cooling system performance.

By the end of the assessment period, the plant was able to operate at a conductivity of 4000 $\mu\text{S}/\text{cm}$, up from 2000 $\mu\text{S}/\text{cm}$ with the cycles of concentration going from 3.0 to 6.0. This resulted in a 60.0% reduction in blowdown water usage and expected savings of 200 million gallons of water per year. Scale and corrosion inhibitor were reduced by 75.5%. Finally, biocides and dechlorinator were reduced by >70% while maintaining CFU counts well below the acceptable range.

No indications of biofilm or hard limescale formations were seen in the condenser or cooling tower during plant-performed inspections. Also, there was no degradation to cooling system performance. Temperature differential of cooling water and vacuum pressure of the condenser remained unchanged when compared to past periods of “like” days.

For a typical combined cycle plant, this would be an estimated annual cost savings of \$350K. After the conclusion of the evaluation period the plant manager stated: “I would recommend everyone at least have the [NEWS] team look into *HydroFLOW* to see if it has any benefit to their site.”

CONCLUSION

Normal operation of power plants and industrial facilities often means heavy water usage and injection of chemicals to ensure valuable equipment is protected. There are other issues impacted by water and chemical usage like operating efficiency, maintenance, the environment and health and safety. Nooter/Eriksen Water Solutions can provide a sustainable alternative to traditional chemical water treatment that provides relief for these issues: *HydroFLOW* electronic water conditioning powered by sophisticated, data-centric processes.

NEWS will work with clients to formulate a purchase agreement and optimize your cooling system with Nooter/Eriksen Water Solutions and *HydroFLOW*. **EE**

