



PURATE™ application at Florida Power & Light - St. Lucie Nuclear

NALCO Water
An Ecolab Company

CASE STUDY - POWER

CH-2160



INTRODUCTION

The Nuclear Industry is currently going through a transition period, with the Nuclear Promise guiding all decisions and strengthening the industry's commitment to excellence in safety, reliability and efficiency improvement, allowing nuclear facilities to be fully recognized for their value.

Among other priorities, nuclear plants face an enormous pressure to increase automation on site and reduce labor costs, while maintaining safety and reliability standards. Other issues, such as the need to address regulatory feeding and discharge limits, increasing corrosion rates across the process and bleach pump

system problems can negatively impact customers' profitability.

In answer to those industry demands, Nalco Water developed its proprietary PURATE™ Technology. It is an on-site chlorine dioxide generation technology, a best-in-class biocide program that not only significantly decreases the labor needs for bleach truck deliveries and manual work, but in addition, helps eliminate corrosion issues, while improving reliability and ensuring safety. The program includes operator training, on-site service and year-round online monitoring and hands-on maintenance of the system.

CUSTOMER IMPACT



ECONOMIC RESULTS

Reduced costs due to reduced biocide consumption and operational charges



COSTS

\$154,000/year

Improved condenser performance and maximized asset life, by reducing corrosion on titanium metallurgies



ASSETS

\$300,000/condenser anticipated per year (\$600,000 in total for two units with PURATE implementation)

Enhanced safety, by moving from the old manual biocide dosing system, to an innovative automated ClO₂ generator with monitoring capabilities



SAFETY

87% reduction of medium risk off-loads

Improved environmental footprint, by respecting the discharge limitations, while maintaining optimal feed levels



WATER

eROI is our exponential value: the combined outcomes of improved performance, operational efficiency and sustainable impact delivered through our services and programs.

SITUATION

The customer, Florida Power & Light (FPL) - St. Lucie Nuclear Power Plant, is a major contributor to the area's clean energy future, and generates enough power to supply the annual needs of more than 1 million homes. They are fully committed to safeguarding their status as a safe and reliable producer of electricity, and to preserving the natural environment they operate within and protecting its wildlife, by adhering to a biocide feed limit of two hours per day.

FPL - St. Lucie Nuclear Power Plant is also committed to providing low-cost energy and strives to utilize leading-edge technology to ensure its operations are streamlined, efficient and cost-effective.

The local Nalco Water sales team, with deep knowledge of the customer's operations, together

with engineering and consulting firm ChemStaff, completed an extensive study of the site's microbial program and its impact on overall plant performance. The site was utilizing bleach as oxidant biocide in once-through condensers with seawater as the cooling source. While bleach was a low-cost alternative, FPL recognized the potential benefits of further optimizing their microbial water management program and improving the overall system performance, as well as increasing the safety of the application.

SOLUTION

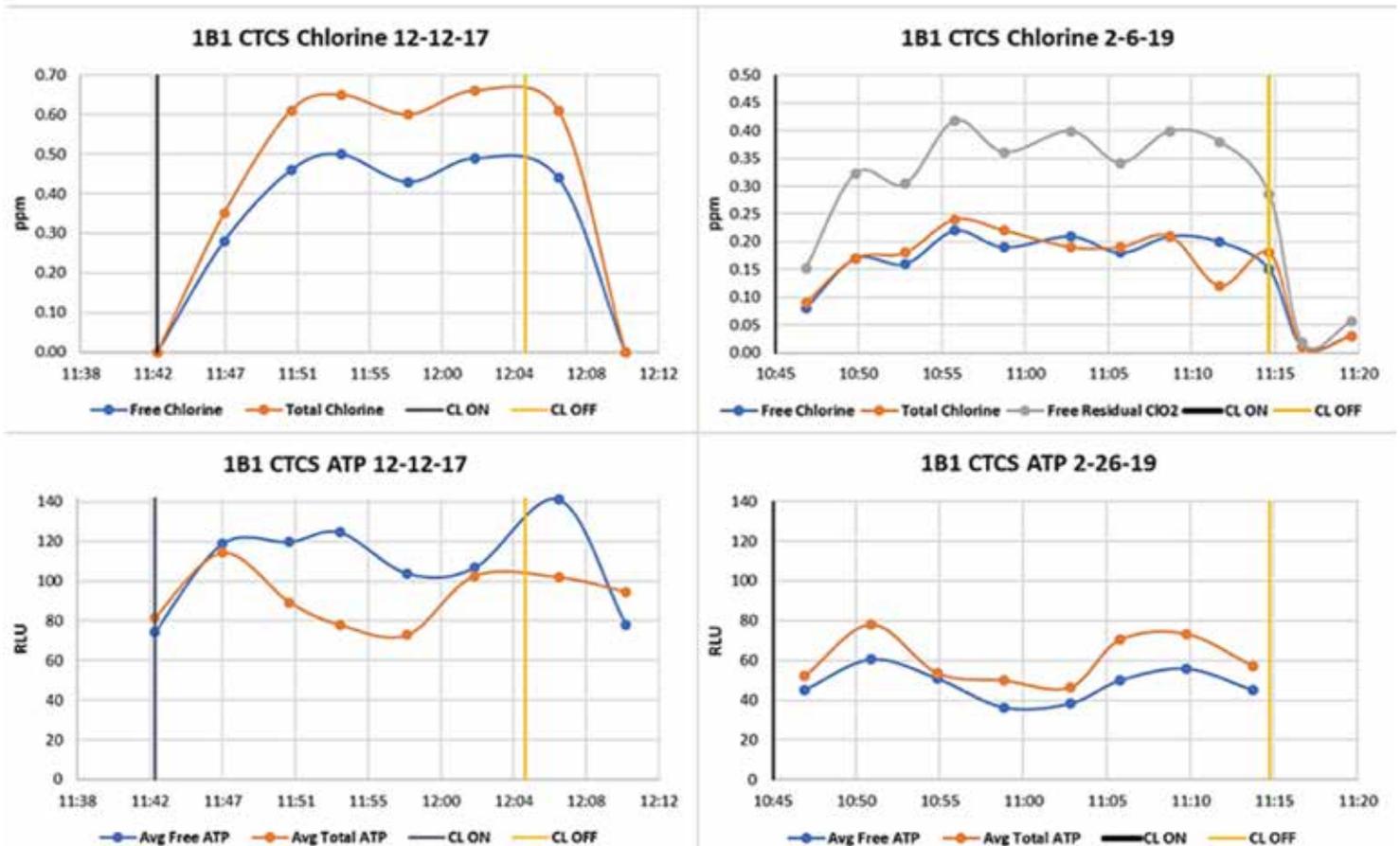
After the system evaluation, Nalco Water recommended the innovative PURATE technology for onsite chlorine dioxide generation. The PURATE system feeds the precise amounts of PURATE precursor and sulfuric acid to a reactor designed

to produce chlorine dioxide (ClO₂) with an average minimum efficiency of 95%. The system also has the advantage of remote monitoring and automatic control, and it runs on a timer with built-in flushes after each dosage, to avoid leakage of ClO₂ in the pipes.

The site, along with Nalco Water's support, performed a three-month trial that showed impressive results. The project took nine months from initial discovery to trial results, with ChemStaff's expertise expediting the process significantly.

First and foremost, by moving from the old manual biocide system that involved a lot of human labor for truck deliveries, to the automated on-site generator, medium risk chemical off-loads were reduced by 87%, minimizing labor requirements and health and safety risk exposure.

Figure 1: Performance comparison between bleach and chlorine dioxide





Florida Power & Light - St. Lucie Nuclear plant uses PURATE Technology for maximized results and optimized costs.

In addition, ClO_2 is highly effective at removing stubborn biofilms that reduce heat transfer, while at the same time it does not cause corrosion issues that were evident when bleach was used. This change is anticipated to improve the condenser's performance and create heat efficiency savings of \$300,000/condenser.

Lastly, due to its low reduction potential, ClO_2 is not consumed by the majority of organic contaminants that may be present in the cooling water. Consequently, the dosage required for microbiological control is much lower than traditional biocides, such as bleach (see Figure 1). This has major benefits for the site: Due to environmental regulations, the site was only allowed to feed chlorine for two hours per day before reaching the environmental discharge limit. With the lower dosage that PURATE allows, the site can now feed the optimal amount of ClO_2 over a longer period of time and address issues that would have occurred when the incumbent system would have otherwise been down, while respecting the discharge limitations.

DISCUSSION

In Figure 1, the free and total chlorine and ATP data is presented graphically, with the bleach data on the left and the corresponding ClO_2 data on the right for comparative purposes. Each

column depicts the chlorine levels followed by the ATP levels for each individual condenser waterbox.

The efficacy of the program is determined by the convergence of the Free and Total ATP readings. This is the point at which all of the ATP present in the water system is not due to microbial sources (the microbes are dead and have released their ATP to the water). The total ATP is the part that includes living microbial ATP, so an effective kill is achieved when the ATP curves converge. If the Free ATP and the Total ATP levels do not eventually converge, this would indicate there is a population of microbes that have not been killed by the biocide feed.

In general, the sodium hypochlorite ATP values ranged from 60 - 150 RLU, while the ClO_2 ATP values ranged from 30 - 80 RLU, indicating that the ClO_2 was significantly more effective in eliminating the microbial presence and consistently achieved a better biological kill than bleach.

In addition to the lower free and total ATP values, it should be noted that the free and total residual chlorine levels resulting from the bleach feed were significantly higher than those resulting from the ClO_2 feed, yet the ClO_2 generated the lower ATP levels. This demonstrates that the ClO_2 is a more selective and effective biocide compared with bleach, since the ClO_2

achieved a more complete biological kill with a lower residual chemical concentration. These values also confirmed the initial demand study done by Nalco Water that showed a ClO_2 demand of 0.2 ppm and a sodium hypochlorite demand of 0.8 ppm.

Another indication of the effectiveness is whether, and how quickly the free and total chlorine curves converge. This indicates that the system demand has been satisfied and the remaining chlorine in the system is in the active form and can most effectively serve as a biocide. In many cases with the bleach feed, the free and total chlorine curves did not converge prior to the end of the chlorination period. Conversely, the free and total chlorine curves with the ClO_2 injection converged much more quickly, often around 15-20 minutes into the feed cycle, indicating an effective and complete biological kill.

CONCLUSION

Florida Power & Light (FPL) - St. Lucie Nuclear Power Plant confirmed that Nalco Water's PURATE Technology enabled the plant to optimize their microbial water management program, while automating a very labor-intensive process, enhancing safety, maintaining regulatory compliance and increasing plant efficiency. Overall, the St. Lucie plant achieved:

- 0.6% anticipated increase in condenser efficiency
- More automated processes that reduce labor needs by 4 FTEs
- 87% fewer chemical deliveries
- Better microbial performance
- Compliance with regulations regarding feeding time and discharge levels

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