Case Study: ISI Water Desalination

Custom seawater reverse osmosis system delivers fresh water to resort in the Bahamas

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In the early 1700s, Nassau was the port of origin for countless privateers of the high seas—more commonly known as pirates.

The colony served as a home base for the infamous "Flying Gang" band of pirates, and at one point the Governor of Bermuda claimed Nassau was inhabited by over 1000 pirates, including the infamous Blackbeard.

Once proclaimed a pirate republic, today the area's "cutthroat" economy has transitioned mainly into tourism and offshore banking.

For a small fee, anyone can rent a private beachfront property on or near Nassau and temporarily leave the hustle and bustle of everyday life behind, instead spending days leisurely sipping mojitos on the beach, reminiscent of Hemingway's era of yesteryear.

Today's beachfront resorts have come a long way since Hemingway's day. Stocked full of modern amenities and luxury accommodations, with complimentary WiFi in every room, these beachfront properties offer almost anything the mind and body could desire.

But most importantly, they offer a healthy supply of clean, fresh drinking water—a historically scarce resource in these island communities.

From the early 1600s, the only source of fresh water in Nassau came from rainwater collected from the roofs of houses and stored in tanks, or from open-dug wells.

These sources generally served the needs of the inhabitants for several generations but were not always sufficient. In years of severe drought, freshwater often needed to be barged in from larger islands.

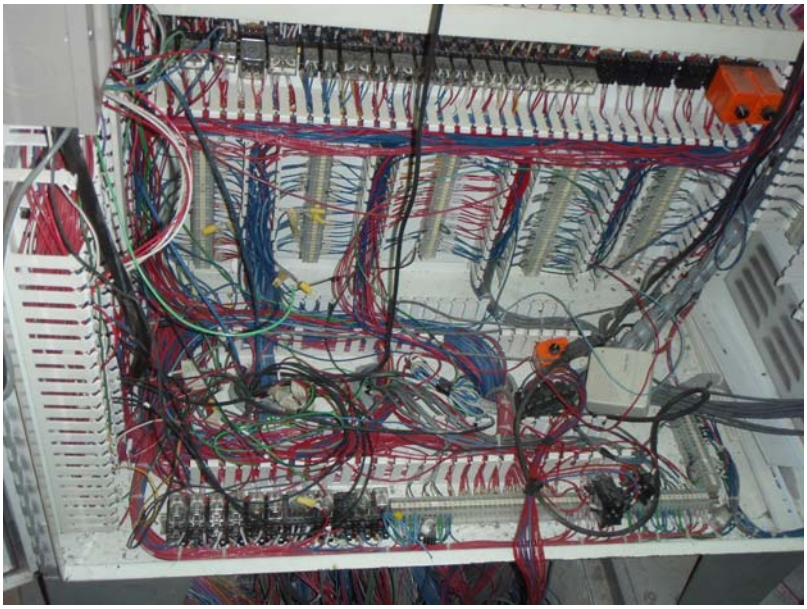
As Nassau and the surrounding area grew from small fishing and sponging villages to destination locations for tourists from around the world, the demand for fresh water increased. Inhabitants continued drilling wells, but the demand for water was greater than the wells could provide.

Today, resorts in the area rely mainly on seawater reverse osmosis desalination. But due to the corrosive nature of seawater, these systems can be expensive to install and maintain.

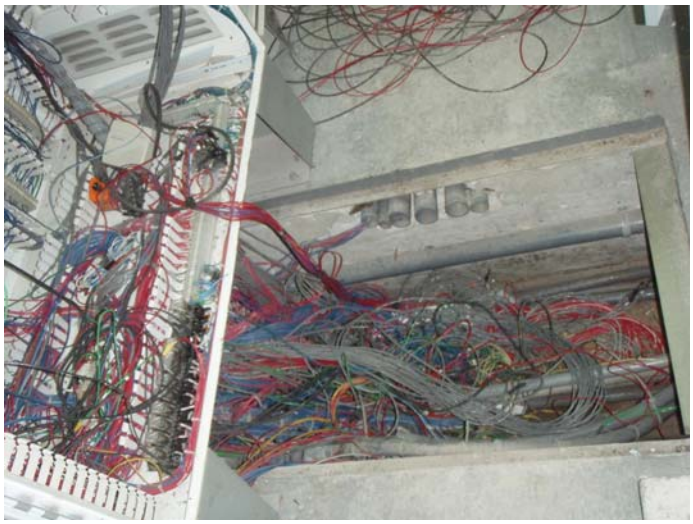
THE CHALLENGE

About two decades ago, a major resort located in the Bahamas installed a reverse osmosis desalination plant to provide its guests with a clean, potable water source.

Over time the corrosive nature of seawater took its toll on the system. As control system equipment wore out and began to malfunction, the plant became difficult to operate. The existing control system alerted operators with false and nuisance alarms, the sources of which could not be tracked down and identified.



Before: Inside the original control cabinet



Before and after: The photo above shows the original plant wiring. At right, the ISI-built control cabinet with Opto 22 SNAP PAC hardware.

Increased downtime from erroneous alarms took its toll on plant production. Eventually operators were forced to run the plant manually, using motor starters and drives directly.

Manual operation meant the plant would run, but without the alarm system and safety interlocks provided by the malfunctioning control system. The desalination plant became a dangerous work area, while production decreased.

Because the resort could not face the extended downtime that demolishing and rebuilding the water plant would require, the situation became dire. Unsure of how to move forward, the resort contacted ISI Water of St. George, Vermont, to evaluate the existing plant and recommend a path forward.

THE SOLUTION

ISI Water specializes in Seawater Reverse Osmosis (SWRO) technology. Their systems are capable of producing water suitable for drinking, irrigation, commercial, municipal, or industrial use.

Regardless of the application, ISI tailors each system they build to the specific application requirements of their customers.

In the case of the major resort in the Bahamas, ISI faced two major problems:

First, they had to maintain system uptime as much as possible during the plant upgrade.

Second, the existing system was poorly documented and had been rewired with temporary workarounds, so determining where each electrical connection started and ended became an almost impossible challenge.

After evaluating the project requirements and winning the contract to upgrade the resort's desalination plant, the team at ISI wasted no time in getting to work. At their facility in Vermont, ISI designed and built an entirely new skid-based SWRO system complete with automated controls, alarming, and data logging.

The System

The system consists of two seawater reverse osmosis skids that each produce 750,000 U.S. gallons of drinking water per day, three drilled wells for the seawater intake, cartridge filters, chemical dosing systems, H2S degasifiers and scrubbers, and product transfer pumps. The complete SWRO system is controlled by an Opto 22 control system.

"The reliability of the Opto 22 system impressed us," says Colin Masseau, senior engineer at ISI Water. "In our line of work we see a lot of equipment failures. We deal with very high pressure and highly corrosive seawater, plus high voltage power. And all of this usually in areas that have

Contrast: At left, the state of the RO plant prior to construction. At right, the plant after ISI commissioned the new equipment and renovated the building.

fluctuating power and limited resources. So reliability is key."

ISI choose SNAP I/O modules, which carry a lifetime warranty and have 20 years of field-proven use worldwide:

For all analog sensors used in the SWRO system, ISI standardized on 4-20 mA signals and used SNAP-AIMA-4 input modules to interface them into the plant's control system.

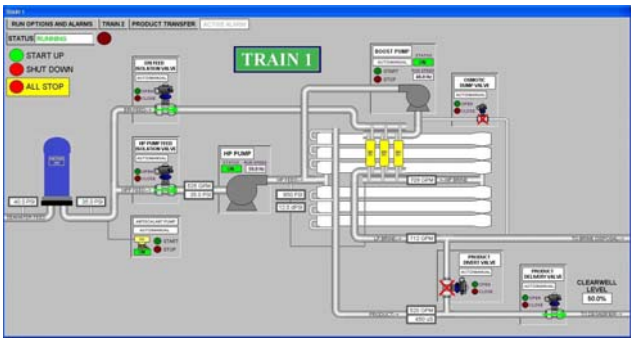
The variable frequency drives and control valves in the plant all run on 4-20 mA outputs for control, utilizing Opto 22's SNAP-AOA-23 modules.

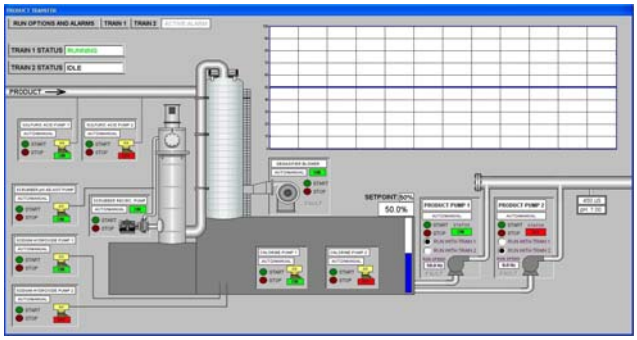
All buttons, switches, relays, and other digital inputs to the control system are wired to SNAP-IDC5 modules, using 24 VDC power for each control loop.

All digital outputs to drives, motors, valves, and lamps are wired to SNAP-ODC5-i modules, driving small relays to isolate the control system hardware from the field circuits.

The PAC Control software program (called a strategy) that operates the plant runs on a SNAP-PAC-S1 controller, which is wired to SNAP-PAC-EB2 I/O processors (brains) on 16-module I/O racks.

ISI used PAC Display, an HMI software program, to log data from the SWRO system and move it to Excel, where plant operators can easily graph the data and compare historical readings on the plant's productivity.





The HMI provides system insight to operators at the resort.

System Security

To increase system security, ISI used a PC with two Ethernet network cards to isolate the control network from the Internet. The PC, controller, and brains are all wired to an Ethernet switch dedicated to the control network. While the PC's factory network card is configured for Internet access, its second network card is set to a static IP address for exclusive use with the Opto 22 control system.

"The versatility of the Opto 22 control hardware and software allowed us to custom tailor the controls to the client's exact needs," says Masseau.

"Whenever the client has any requests for control modifications, we can log in remotely and take care of their requests within minutes. The PAC Control software is so easy to use, it makes customization and troubleshooting a breeze."

The following year, the ISI Water team was called back to the Bahamas to build a second identical desalination plant across the street for the same client. This project was nearly identical in that it involved replacing an existing outdated SWRO system that was failing.

ISI was able to easily tie the two Ethernet networks together using an Ethernet switch. Ethernet connectivity allows the operators to monitor and control both plants from a single location.

The workplace is now safe, any alarms are accurate, and water production is reliable.

"In the 6 years that this plant has been in operation, they have not had to change even one Opto 22 control component." says Masseau.

ABOUT ISI WATER

ISI Water specializes in Seawater Reverse Osmosis (SWRO) technology. ISI SWRO systems are capable of producing water suitable for drinking, irrigation, commercial, municipal, or industrial use.

Regardless of your application, ISI offers SWRO systems tailored to exact application needs and ensures that the system runs properly once installed. Visit the ISI website: https://isi-water.com/.

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- Colin Masseau, ISI Water

ABOUT OPTO 22

Started in 1974 by a co-inventor of the solid-state relay (SSR), Opto 22 has always built products on open standards, not proprietary technologies.

Famous worldwide for its reliable industrial I/O, the company in 2018 introduced *groov* EPIC® (edge programmable industrial controller). EPIC has an open-source Linux® OS and provides connectivity to PLCs, software, and online services, plus data handling and visualization, in addition to real-time control.

All Opto 22 products are manufactured and supported in the U.S.A. Most SSRs and I/O modules are guaranteed for life.

The company is especially trusted for its continuing policy of providing free product support, free training, and free pre-sales engineering assistance.

For more information, visit opto22.com or contact **Opto 22 Pre-Sales Engineering**:

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OPTO 22 www.opto22.com
43044 Business Park Dr. Temecula, CA 92590-3614

SALES sales@opto22.com
800-321-6786 • 1-951-695-3000

SUPPORT support@opto22.com
800-835-6786 • 1-951-695-3080