State of the Art Control

Stabilizing building temperature and humidity while cutting energy costs

Executive Summary

Works of art can communicate messages from generation to generation and express ideas that transcend cultural boundaries, but these unique messengers can degrade or be lost over time if artwork is not properly preserved. Valuable artwork that is often hundreds of years old is very susceptible to stresses caused by an unstable climate environment. Without proper and consistent climate control the messages conveyed in artistic treasures can suffer gradual damage.

Shreveport Louisiana, home of the R.W. Norton Art Gallery, experiences extreme weather changes and a constant battle with humidity. Maintaining consistent temperature and humidity levels within the Norton Art Gallery's exhibit spaces is a challenge. The museum hired PC Automation who partnered with ASI Controls to provide a customized solution to satisfy the demands for a specifically stable environment within the gallery. PC Automation was responsible for installing and programming the climate and energy management system provided by ASI Controls. The museum's owner noted that the new system allows him to control the building's temperature and humidity while providing improved efficiency and reduced energy usage.

Background

The R.W. Norton Art Gallery of Shreveport, Louisiana houses an impressive collection of over 8,000 works of fine art and artefacts spanning 40 centuries with over 400 American and European paintings and hundreds of sculptures, tapestries and other artworks, and over 10,000 volumes available to researchers. The reserved collection includes a rare Double Elephant folio edition of John James Audubon's "The Birds of America". Site temperatures range from below 20° F in the winter to over 100° F through the summer, with daily average Relative Humidity (RH) varying from a dry 33% to a sticky 93%.

The original core section of the museum was built in 1959 with what was then a state of the art pneumatic control system to protect the treasures inside from these local weather extremes. The South (1990) and North (2003) wings were added later, each equipped with updated climate control technology to keep the collection in optimal condition.

ASI Controls
Reliability • Performance • Value

The Problem

Azaleas in bloom at R.W. Norton Art Gallery. About 15,000 azaleas bloom together each spring when conditions are just right. The gardens are enjoyed by many guests during these 3 weeks. Credit: http://rwnaf.org/gardens

While top of the line when each wing was constructed, the building control systems were having difficulty maintaining the desired, stable temperature and humidity for optimal preservation conditions of these cultural treasures. With the frequently changing and challenging local weather, the temperature and humidity in the art galleries sometimes fluctuated slightly despite constant environmental conditioning.

Maintaining consistent temperature and RH within specific ranges is vital to the preservation of art because the works can be stressed by even small repeated changes in environmental conditions. Artworks combine materials such as pigments, clay, fabric, metal, etc. and each material has a different rate of expansion, absorption, and base moisture content. Small repeated changes in RH and temperature can stress the artwork as each substance adjusts independently to environmental changes.

In his role as steward of the collection, Mr. Lewis Norton works to make sure future generations will also be able to fully enjoy these cultural resources. The R.W. Norton Gallery freely provides access to the gallery to an appreciative local community, and worldwide audience.

Mr. Norton, who actively manages the facility and art collection, carefully monitors conditions with facility supervisor Mr. Taylor Devers. Mr. Norton explained that “one of the biggest things we noticed was we had a lot of pressure differentials.”

> *Site temperatures range from below 20° in the winter to over 100° F through the summer, with daily average Relative Humidity (RH) varying from a dry 33% to a sticky 93%.*

Negative pressure differentials are useful for moving air to a return plenum but the differentials can also cause RH changes inside a building due to mass transfer in air. Negative pressure differentials compared to the outdoors invites moisture infiltration through outside walls, or potentially through porous floor where open spaces like the Central Plant and other mechanical rooms are sited beneath a gallery. Positive pressure differentials can lead to exfiltration of conditioned air, requiring extra energy to condition new air.

A control system has to respond with speed and precision to manage all the challenges, including strong exterior winds causing temporary pressure differentials inside the building.

As the building control systems were unable to maintain sufficiently consistent optimized conditions, Mr. Norton was concerned about the potential long-term effects of environmental stress on the unique artworks within the gallery. As a result, Mr. Norton and Mr. Devers led the search for a new solution to control gallery climate conditions more tightly. After considering many options, they asked Mr. Ken

ASI Controls
Reliability • Performance • Value

Cooksey with local environmental control specialists PC Automation to deliver an HVAC and Energy Management system that could meet the challenge.

Francis Chapman of ASI Controls (left) and Ken Cooksey of PC Automation (right), with ASIC/1 VAV and Heat Pump controllers behind

ASI Controls and PC Automation Solution

Mr. Ken Cooksey, Controls Division Manager at PC Automation, set out to satisfy the requirements for a stable conditioned environment within tight specified ranges.

Mr. Cooksey stated that "the first phase at the Art Gallery required us to control hydronic cooling and heating systems and a lot of different HVAC equipment including chillers, boilers, very large multi-zone air handlers, conventional hydronic air handlers, dehumidifiers, steam generators and pumps."

To do so, Mr. Cooksey selected ASI Controls' ASIC/1 VAV and Rooftop unitary controllers and ASIC/2 Energy Management controllers to implement the detailed extensive programming required. The controllers were programmed and installed along with an ASI WebLink software front end that enabled Mr. Cooksey to remotely monitor environmental conditions. Mr. Cooksey observed and adjusted the control strategy to ensure conditions were consistently within desired ranges.

Mr. Cooksey also explained how he wanted to do more than just meet the challenging requirements. "Before starting this project we spent a considerable amount of time surveying the facilities requirements while also trying to determine ways we might conserve energy. What we came up with is to install Variable Frequency Drives (VFD's) on all motors and test out what HVAC equipment we could throttle back and still maintain building requirements. We found that slowing down the air handlers and dropping the discharge air temperature enabled us to keep humidity more consistent. The slower discharge airflow strategy also delivered significant electricity cost savings."

VFD's also deliver critical control features like smoothing flow surges, dampening swings and reducing pressure differentials with soft start capability and fast, precise ramping. Incidental benefits included electrical energy and demand savings, reduced motor wear, and extended equipment service life.

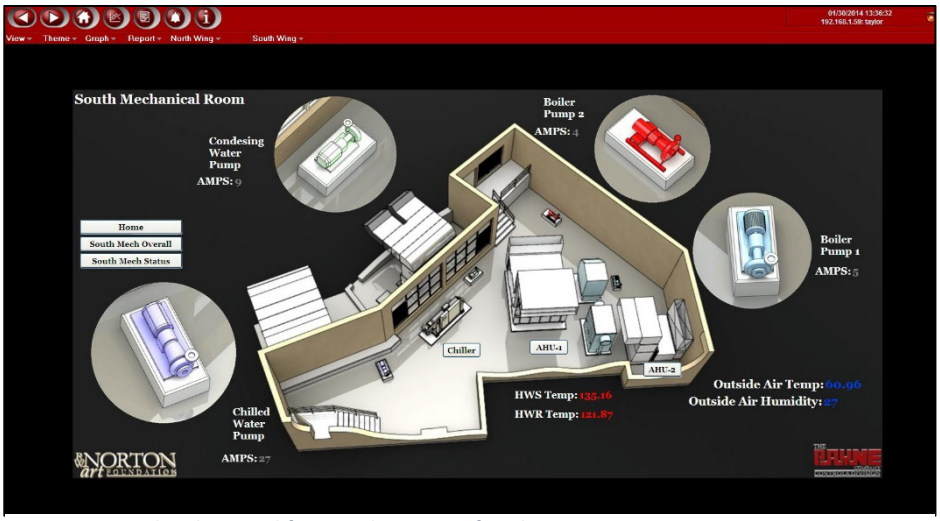
> "By implementing an ASI WebLink front end in the early stages we were able to track both the outdoor and indoor conditions and adjust the programming whenever needed. Fine tuning created cost savings because when the VFD's ran a motor below 100% we reduced energy costs."
>
> Ken Cooksey, PC Automation

Mr. Cooksey continued, saying that "by implementing an ASI WebLink front end in the early stages we were able to track both the outdoor and indoor

ASI Controls
Reliability • Performance • Value

conditions and adjust the programming whenever needed. Fine tuning created cost savings because when the VFD's ran a motor below 100% we reduced energy costs."

After reviewing the archive of temperature and RH data and seeing the benefits of energy cost savings in areas controlled by the new system, it was an easy decision for Mr. Norton to direct PC Automation to extend the ASI Controls energy management and control system to the remaining galleries.



Custom ASI WebLink control front end user interface by PC Automation.

Variable-Frequency Drives and ASI Controls Systems

In the case of the Norton Art Gallery, the ASI digital control system processes many environmental variables to decide the control strategy for optimal space conditioning. Temperature, RH, the number of visitors and other custom inputs are all factored into the equation. When the control system commands a fan, motor, or pump to a specific load it communicates to the VFD using Modbus and the VFD then precisely drives the device to the desired level.

When driving a fan, motor, or pump to a specific load level a VFD can adjust output with more precision and speed than a throttling valve. The ability to electronically control the ramping rate smoothes flow surges and reduces pressure differentials, this benefits the artwork because precise control of the rate of change helps to eliminate over-shooting and see-sawing around target conditions. The VFD also prolongs equipment life and significantly reduces electrical energy consumption (kilowatt-hours) and demand (kilowatts).

Saving time and energy

According to Mr. Norton, "The system gives us much more control of the building's temperature and humidity."

In addition, Mr. Taylor Devers noted that while energy costs were reduced, the system also made his job much more efficient. According to Mr. Devers, "The system has saved us some money, and the system is much easier to control now."

He also added that "the system saves 3-5 hours every week" in labor hours as the old system needed to be set manually.

ASI Controls
Reliability • Performance • Value

The Results – Environment Stabilized and Reduced Maintenance Labor Hours

How does a control system maintaining consistent conditions around the clock every single day deliver both superior performance and cost savings?

The power equation for VFD's shows the ratio of power required for a motor to run at load level A versus at level B is a cubic relationship: $P_A / P_B = (Speed_A / Speed_B)^{\wedge 3}$

In other words, if a VFD sets fan or pump speed to 90% the motor will use 27% less energy. At 80% speed, it uses about half of the energy than it does at full speed.

The synergy between advanced automation and control strategies implemented by PC Automation, the reliability and consistency of ASI Controls hardware, and highly efficient and precise equipment control with VFD technology all worked together to deliver the climate and stability required (with unexpected cost savings).

When the work had been completed by PC Automation, the R.W. Norton Art Gallery had an extremely capable, flexible and efficient energy management system. According to Mr. Norton, "The system gives us much more control of the building's temperature and humidity." In addition, Mr. Taylor Devers noted that while energy costs were reduced, the system also made his job much more efficient. According to Mr. Devers, "The system has saved us some money, and the system is much easier to control now." He also added that "the system saves 3-5 hours every week" in labor hours as the old system needed to be set manually.

PC Automation team (from left to right): Travis Pruett, Tristen Cooksey, Dustin Kelley, Neil Macvier, Ken Cooksey, Kyle Payne.

Mr. Cooksey and the PC Automation team now look forward to new challenging projects because they know they can rely on VFD technology and consistent control from an ASI Controls Energy Management system to exceed customer expectations.

www.asicontrols.com
info@asicontrols.com

2202 Camino Ramon
San Ramon, CA 94583-1339
United States
Phone: (925) 866-8808
Fax: (925) 866-1369