

A SYNERGISTIC APPROACH

BUILDING FOR TOMORROW

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OXFORD ENERGY SOLUTIONS INC



Climate change is prevalent in today's headlines with most coverage acknowledging the contribution of high energy consumption and its resulting GHG emissions. Government directives and the desire to maintain competitiveness in the global market all suggest industries commit to operations reformation and address energy consumed, and yet the refrigeration industry still falls short. Integrating advanced technologies into equipment design has been conservative, with the sector continuing to focus on refrigerant regulations while maintaining outdated energy standards.

Current refrigeration standards set energy thresholds that are not conducive to achieving climate goals and fail to mandate better design criteria. These thresholds allow systems to be designed to run at a fixed maximum rate, which increases consumption, refrigerant use, and wear on the system rather than mandating better controls. The energy efficiency gains we could achieve are being held back by the architecture of systems today. The problem is the lack of integrated digitalization and smart controls in the genesis of equipment



SENSORI™ CONTROL PANEL

The most critical things to address in refrigeration design are energy consumption, mechanical failures, and the lack of system management. Adopting digital technologies and mandating better controls such as those shown here is the path forward.

design. Applying advanced technologies and control integration will revamp the platform and allow us to start building for tomorrow.

Performance-optimizing algorithms, automation, and artificial intelligence capabilities define modern industries. Companies are discovering solutions with digital technologies that can dramatically increase efficiency by reducing

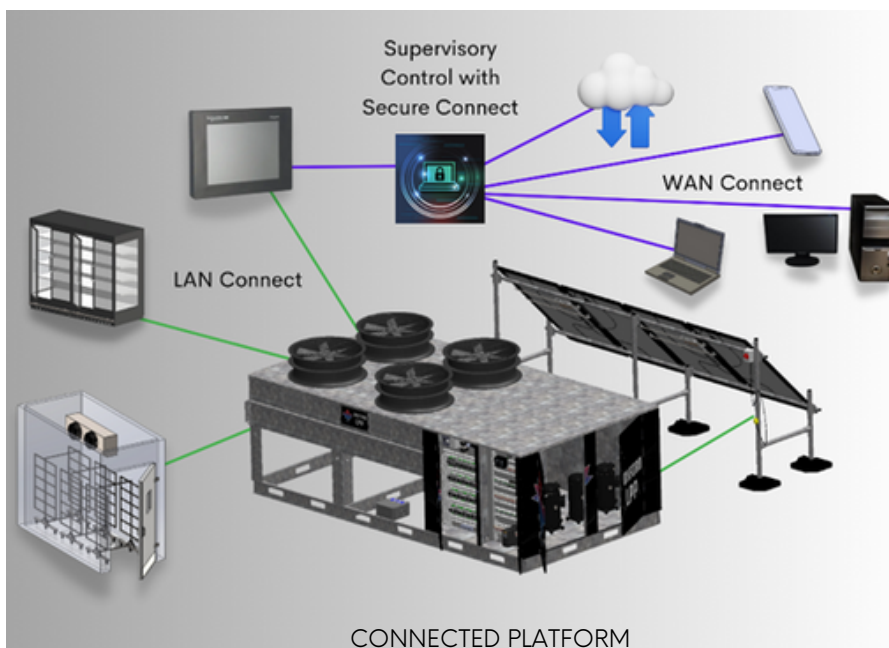
energy-intensive operations and extending equipment life. Thriving with today's technology depends on effective system management. The proper refrigeration control system can use less energy, improve equipment reliability, and drastically reduce maintenance costs.

"Over the years, we have been frustrated by the ever-increasing independent systems functioning within a refrigeration facility. The systems' management is archaic, with analog controls and extremely limited or non-existent remote monitoring or management capabilities," says Ben Kungl, president and owner of Oxford Energy Solutions (OES). "It is unacceptable to pay for inadequately controlled systems; end-users should be getting more for their money spent and more control over their investments."

Finding solutions for better system control has been a focus for the commercial refrigeration company operating out of Woodstock, ON.

Effective improvements for energy consumption and the impact and longevity of equipment involve knowing what is happening inside a system and incorporating advanced control strategies to improve performance. Progressing with today's technology, the company replaces legacy parts such as mechanical/pressure-dependent devices with electronically governed, IoT-connected components to digitalize the system. The company's low-pressure differential platform with adaptive refrigeration management provides sophisticated solutions for system owners and operators.

"The core problem isn't temperature monitoring; it is the heart of the system, the compressors. The engine of what drives these systems – there are hardly any real diagnostics that fully govern and optimize a compressor's operation," says Kungl.



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Solid system management goes beyond controlling temperatures and considers the management of the compressor with other devices. Governed by fully intuitive automation, Oxford Sensori Control™ delivers the synergy necessary for optimal management with analytics and modern controls. Designed into their platform, OES created a foundation of compressor safety which involves monitoring each compressor (how it operates, temperatures, pressures, oil levels) and providing diagnostics with an adaptive system response.

A connected platform using sensor technology is engineered with the supervisory control and data acquisition (SCADA) and integrated into the equipment design. SCADA is a system of software and hardware elements that allows organizations to control processes locally or at remote locations. The platform allows conventionally independent parts to link together in smart, automated communication.

While sensor technology is not new, its full capability is not being capitalized on. Sensor management added post-design has a limited scope, only gathering information from the individually connected devices. Due to managing isolated components, systems lose the capability to optimize performance and lack intuitive functioning when devices do not communicate.

Sensori Control™ is integrated into the platform so components can incorporate

data generated from other devices in the system to determine their performance. Programmable logic controllers (PLCs) serve as local data acquisition devices that collect, analyze, and draw insights about system performance and set the stage for advanced compressor management and case-control. Sensors connected to all devices gather critical data, while M172, 18 I/O plc is analyzed and makes intelligent decisions through Artificial Intelligence (AI) based on OES-designed algorithms.

Each compressor is designed with an M172, creating a system of individual controllers connected to the main architecture and working together. Compressor safety is achieved with individual M172s, ensuring that if communication is lost through the central HMI structure, there is no impact on the overall operation of the system. Each controller has a set configuration, so repeatability allows seamless integration into one automated system.



Connecting systems at the design level optimizes how refrigerant moves through the system and provides insights into the overall refrigeration process and performance. When the heart of the system – the compressor – has proper control integration, the system can adapt to changing conditions (including load requirements and ambient temperatures) rather than operating at a fixed maximum output. Integrated, VFD-controlled compressors allow the system to float the head pressure with the ambient, take advantage of low compression ratios, free liquid subcooling, and achieve better cooling performance with energy savings.

System analysis is incomplete without knowing how, why, and where energy

is being used. Inadequate information causes most systems today to alarm reactively, risking system instability, higher consumption rates, and the potential for repetitive service. Sensori Control™ enables a proactive response with predictive maintenance, using historical data, trends, and live data to anticipate operation and adapt to optimize the performance of each device in the system. OES's software IP enables Machine Learning to analyze data, generate a pattern of regularities, determine efficient operation, and send alerts through fault detection. Information about potential issues, what to look for, and establishing detailed energy profiles are integral. Self assessment and self-calibration will continually improve refrigeration performance through proactive risk mitigation.

EFFECTIVE ALARM MANAGEMENT PROVIDES CONTROL, ON-SITE OR REMOTELY

Limited visibility and access to equipment while off-premises have negative financial impacts, with downtime and after-hours servicing potentially costing thousands of dollars annually. Digitalized systems offer end-users added value with more control over investments, savings, and equipment reliability. Remote accessibility to machines removes barriers, simplifies servicing, and optimizes efficiency. Of course, complete system management depends on the reliability of the data being generated and the support provided to the operator.

Unlimited by geographical location, a

cloud-based, secure remote access management service that makes linking to equipment possible through any IoT-connected device allows OES to deliver a flexible and reliable platform. Effective alarm management controls facility machines - even when not on site. Maintenance programs that have become typical for end-users are dramatically reduced with notifications and access via LAN IP that enable remotely executed intervention based on real-time information. In addition, remote monitoring allows access to equipment in multiple locations from one device.

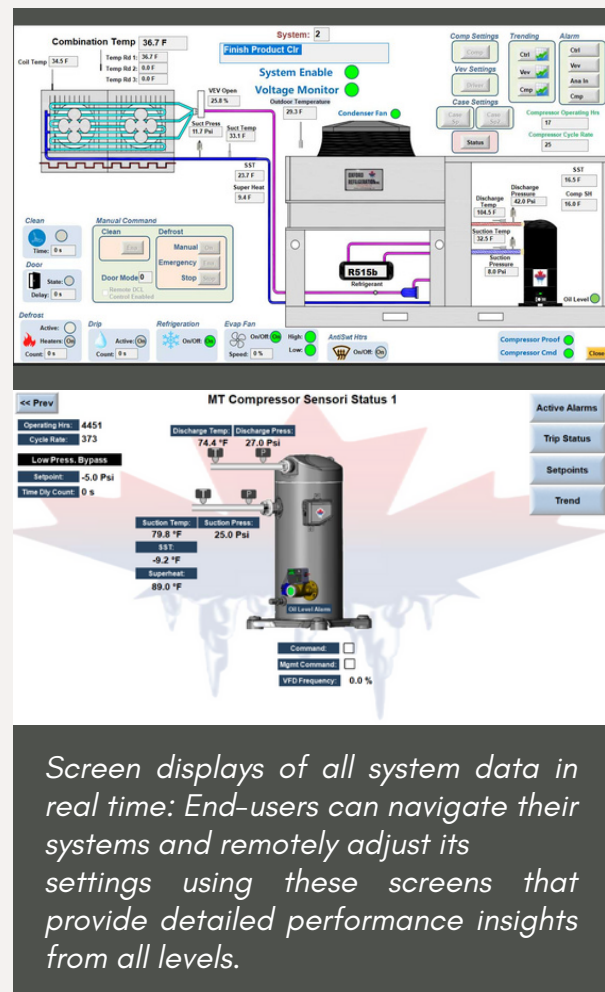
END-USER INTERACTIVITY

OES integrates an additional layer of monitoring, centering on the operators' ease of use and interactivity. Equipment tracking and management give insights into the machine architecture, maintenance, and performance. All operations and activities performed on equipment are logged with documentation and task management in one location, improving maintenance planning and quality.

Owners, operators, and team members can visualize machine-generated data and performance in real time with customizable dashboards using universal symbols, illustrating the program's inclusive user-friendliness. The graphical display provides detailed performance history and trends for interactive system management and requires no specialized skills to use effectively.

RESULTS

Visibility and accessibility to machines are essential to solid control strategies for end-users who require reliable refrigeration systems. Like other industries, the food industry has extensive programs to protect products, requiring diligent inspection of quality, safety, and preservation. High maintenance costs and inefficiencies prompted one of North America's largest produce suppliers to adopt OES' advanced system management as a practical, long-term solution. In addition to

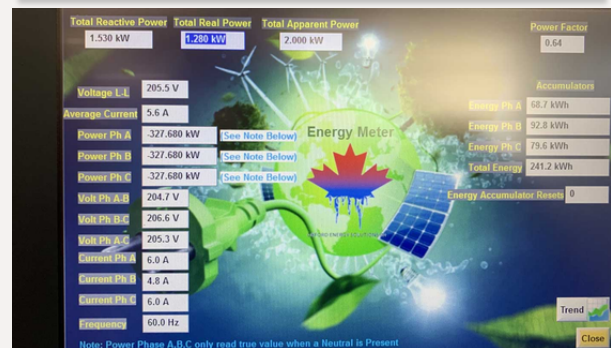
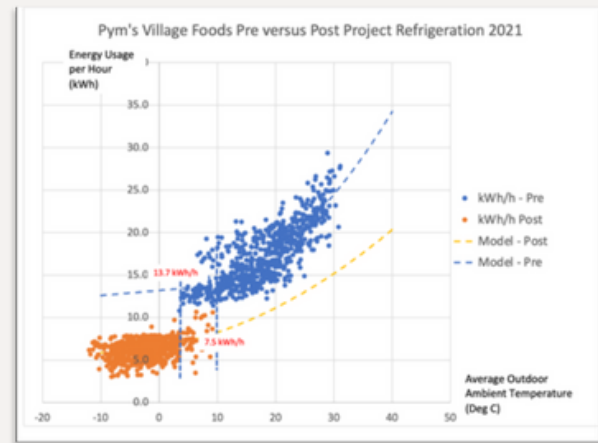


requiring updated systems, they needed better control measures to address refrigerant leaks and high energy consumption, both financially and environmentally taxing.

Sensori Control™ provides the company with complete and secure system management with streamlined data about its machines and products throughout all production points. They replace labour-intensive monitoring by team members and eliminate troubleshooting by

accessing and managing comprehensive machine data locally and remotely. Performance profiles enhance maintenance programs, improving predictability and reducing product losses.

By taking advantage of digital technology and AI-enabled machine learning, the company has gained transparency and control, with the capability to incorporate system management into its cold chain. Information gaps in temperature and quality as products leave the facility are of significant concern to food processors. Connectivity through the same Cloud-based system provides the option for transport temperature tracking to ensure safety throughout cold chain processes. Linking seamlessly to each truck, it auto-populates data into the system upon return to the facility, guaranteeing product quality and safety.



With detailed energy profiles, end-users can easily visualize consumption and identify trends or anomalies

NEW, EMERGING TECHNOLOGY IS THE PATH FORWARD

"The most critical things to address in refrigeration design are energy consumption, mechanical failures, and the lack of system management – and new, emerging technology is the path forward," notes Kungl. Investing in digital technologies and mandating better controls will require OEMs to design systems capable of achieving better energy profiles and equipment longevity. Machine data can be leveraged to maximize efficiency and optimize performance by digitizing the system with smart controls and AI. Designing

advanced control strategies into the architecture creates a synergistic approach that delivers better results that exceed current energy standards and provides customers with effective management solutions that support their business goals.

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