Customer Case Study

# Machine Building

# Grain Dryer Automation Upgrade

## Summary

- Sukup Manufacturing Company redesigned its automation system for continuous flow dryers

- Sukup used a variety of Phoenix Contact products, including PLCs, power supplies, GSM modem and terminal blocks, in their Quadra Touch automated dryer system

- Sukup has found the new system to be reliable, easy to assemble, easy to maintain, robust, and cost-effective

The Sukup 50/50 split-plenum dryer is capable of full-heat drying, or heat/cool drying when discharged grain must be near ambient temperature.

## Customer Profile



Sukup Manufacturing Company in Sheffield, Iowa, understands the farmers' needs. The company manufactures and sells grain handling equipment such as bins, dryers and conveying equipment. Sukup's dryers are designed to dry many types of grain such as corn, wheat, barley, sunflowers and canola.

## Challenge

Over the years, farms and the equipment for harvesting crops have both dramatically increased in scale. To keep up with the added work, farmers have started harvesting earlier, which usually results in wetter grain. Consequently, farmers need larger grain dryers and upgraded automation systems to improve performance.

Continuous flow dryers can dry grain with moisture level as high as 35 percent. Typically, the ideal moisture content of the grain exiting the dryer is 15 percent, but grain that will be stored for long periods of time requires lower moisture content. The operator decides what the actual moisture content should be and adjusts the setpoint accordingly. Surprisingly, the ideal moisture content for different grains is nearly the same, plus or minus a few percent.

Sukup recently redesigned an automation system for their continuous flow dryers. QuadraTouch is the moniker for the new touch screen dryer automation system, and it comes standard on all of Sukup's continuous flow dryers. The new operator interface display features an easy-to-follow menu, remote operation via Ethernet and built-in data collection.

Sukup designed the new automation system to eliminate the need for customers to monitor their dryers around the clock, as well as to increase productivity and efficiency. The automation system also minimizes large swings in the temperature and moisture content of the discharged grain.

Providing all of these features required a carefully designed automation system, not only in terms of the selected hardware, but also with respect to coding and programming of the entire system.

## Solution

For the upgrade, Sukup chose an ILC150 PLC with various Machine Edition I/O modules from Phoenix Contact. The PLC communicates with the touch screen HMI via Ethernet. The system also uses a Trio regulated switch-mode 24 V DC power supply, terminal blocks, and through-panel Ethernet couplers from Phoenix Contact.

Sukup offers an optional Global System for Mobile Communications (GSM) functionality so that their customers can keep an eye on dryer operation from any cell phone. Customers are automatically notified via text message when the dryer enters a fault condition or needs to be restarted. Customers can also send text message queries to the dryer to get status and relevant data.

The GSM modem, also from Phoenix Contact, provides this add-on functionality. The PLC is already set up to receive the modem, so all they have to do is simply plug the modem into the serial port of the PLC and activate service onto a SIM card to realize instant GSM functionality.

The HMI displays data from the PLC via an Ethernet connection, while the DIN rail-mounted PLC controls the operation and safety of the entire dryer. Relevant dryer information is available



The QuadraTouch control system HMI can be located up to 200 feet from the dryer. It connects to the PLC, which is located in the power box on the grain dryer, via Ethernet.

on the various HMI screens, and advanced users can use this data to spot ways to improve their drying operations.

Data logging is managed by the HMI. The PLC generates one-minute running averages and sends them to the HMI via the Ethernet link, and the HMI records the information on a Compact Flash card or USB drive in an Excel-friendly format.

Sukup uses various I/O configurations depending on dryer size and desired functionality. Safety circuits, emergency stop circuits and various sensors are connected to discrete inputs at the PLC. Digital PLC outputs provide signals to energize relays, motor starters and other components.

The grain drying process requires forced air and heat, with the speed of the fan fixed at 1,750 rpm in most cases. The fan speed is fixed because providing consistent airflow across the grain is essential to the fundamentals of dryer operation. The fan speed is constant, but the rate at which the grain travels through the drying columns varies depending on the grain moisture sensed at the dryer's discharge.

Grain dries faster with higher heat, but can be scorched and damaged by excessive heat, so RTDs sense plenum temperature and feed this signal to analog inputs at the PLC. Sukup uses tuned PID loops to control the temperature to within ±3 degrees F of setpoint by sending analog output signals from the PLC to electronic modulating valves that control gas flow to the heaters. Sukup's AutoBatch feature allows the dryers to be used in either

continuous flow or batch mode. Sometimes, the grain moisture content is so high that using the continuous flow mode at its slowest speed is still too fast. In these cases, the batch mode can be used, essentially holding the grain in the dryer for a fixed period of time.

In the batch drying mode, the PLC calculates the total time the grain was in the dryer, and then records the average discharge moisture. If needed, the PLC can then automatically make proportional corrections to the next batch's drying time.

Phoenix Contact helped Sukup design a software tool that makes it easy for customers to update their application from our web site. This tool also allows customers to restart the PLC from a software-stop mode by using an FTP interface to copy a new program into the PLC. Because this is an Ethernet-based system, security functions such as controlled VPN access are easily integrated.

## Results

Matt Koch, electrical engineer at Sukup, said the company chose the Phoenix Contact system because it's a well-supported and modular solution. "The goal of any design project is to provide a solution that's reliable, easy to assemble, easy to maintain, robust, and cost effective," he said. The Phoenix Contact solution provided the best combination of value and performance in these categories. An abundant product offering was also a deciding factor, as Phoenix Contact offers hundreds of add-on terminal blocks, devices, and I/O options to help support their HMIs and PLCs.

"During the redesign, Phoenix Contact was there to help in a timely fashion, and they helped us to push their components to the limit," Koch continued. "Consequently, Sukup has been able to come up with some pretty impressive solutions to our automation system issues."

Price and productivity were important, and Sukup was able to keep the new automation system components comparatively priced to the ones replaced. However, they are able to produce three times as many automation systems in the same time period with the same amount of labor. Sukup has also been able to reduce the amount of space required by the automation system by 50 percent.
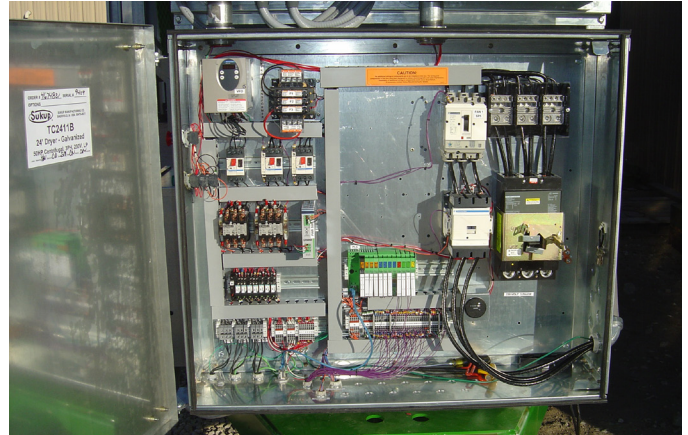


The power box contains the PLC and most of the automation components. The power box includes a through-panel Ethernet connection for the HMI, which allows customers to mount the HMI wherever they choose.

The new automation system is also very easy to troubleshoot as compared to our previous offering. The few problems that occur are easily spotted, which also reduces service hours. Many issues can be resolved remotely, saving the cost and time of a site visit.

"The Phoenix Contact personnel have been very helpful in getting this solution to market, and since switching to the new automation system, we've been able to more than double our grain dryer sales," Koch concluded.