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Warrick Conductivity Level Controllers Series 3H

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Changing the World's Energy Future

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Warrick Conductivity Level Controllers Series 3H

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INTRODUCTION

In my efforts to support INL's Mission, "To discover, demonstrate and secure innovative nuclear energy solutions, other clean energy options and critical infrastructure." I was tasked with creating level controlling devices for different systems that we are working on to support the electrolysis testing that we conduct to produce clean energy.

What is electrolysis? Electrolysis is the process of using electrical current to split water also known as H2O into Hydrogen and oxygen gases. The hydrogen produced through electrolysis can be used in fuel cells. Through electrochemical reactions we can generate electricity. In a fuel cell the hydrogen gas is fed into the anode side (negative side) this splits the protons and electrons. As the protons pass through a membrane to the cathode (positive side) the electrons travel down an external circuit this creates an electric current. At the cathode side where all these electrons and protons have met up at combine with the oxygen in the air to form water H2O. This process releases heat and produces water and electricity, which completes the electrochemical reaction.

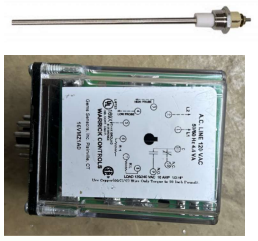
Problem

Tank levels getting too low in supply tanks and boilers, causing equipment damage (pump burnout, boiler heaters burnout), and the potential to create a dangerous pressure event within the boilers. Tank levels getting too high, causing potential spilling water damage to surrounding equipment and potential slipping hazards.

Resolution

One way to manage the level on water tanks and boilers is reliable and accurate level sensing. Previously, the Hydrogen & Thermal Systems group has experienced unreliable level sensing with float levels on a Chromalox boiler. To make level sensing more accurate on boiler systems as well as water supply tanks, a closed loop level sensing system was installed. To keep the process a closed loop system (meaning the process will not run once and then shut off), the pump will continuously turn on and off as needed to allow the process to continuously run. This requires controls that respond based on feedback to create this closed loop system. To accomplish this, Warrick relays were used for the level controls. Additionally, a low-water cutoff was installed on an Electro-Steam boiler to protect from potential overpressure events. This protects the overpressure event from happening by shutting the heaters down and turning them off when the water level gets to low. One will also later be installed on the 500-kw system to provide the same safety futures.

Systems with Upgraded Level Sensing



150 kW Deionized Water Supply

Allows the tank to fill up to a certain height and then shut off to prevent overfills and spills, as well as underfilling which allows the pumps to not burn up if water level gets to low. Also, this could affect other systems as well that are relying on the deionized water for their own processes. For example, the deionized water gets pumped into the boiler where the heater coils turn the water into steam.

Boiler Level Controls on 150 kW system

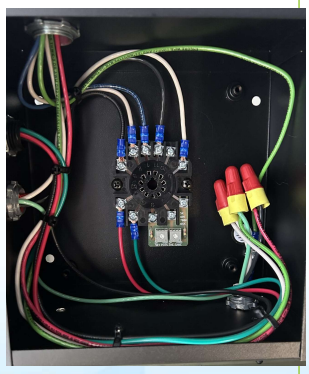
The boiler level controls allow us to keep the boiler water level at a certain height within a few inches between its high and low point. If the boiler gets too full it cannot boil the water to produce steam. If the boiler level gets too low, then the boiler will burn up the heating coils, or worse increase the pressure in the boiler beyond its pressure rating. This is why a low water cutoff switch was installed on the Electro-Steam boiler. This switch determines when the water gets too low. When it does, the low water cutoff will tell the heating coils in the boiler to shut off. Doing this not only protects equipment, but it also avoids accidents that could be fatal such as gradual overpressure events or sudden evaporation and pressure events caused by water contacting overheated surfaces in the boiler.

Pump Down level Control On 500 kW system

In the electrolysis support system known as the 500-kW system there is a large tank on which high and low water level sensors were also installed. This water level sensing system is slightly different than the 150-kW water level sensing system. The 500 kW level sensing system works in the following way: (a) when water reaches the high level sensor, it sends a signal to the relay, (b) this relay, which energizes a set of contacts, then allows a pump to turn on (c) the pump then removes water from the tank until the water level reaches the low-level sensor, and (d) the low-level sensor then sends a signal that turns the pump off and allows the water level in the tank to rise. From there, the water level again rises until the high-water level receives its signal again, repeating the process. This creates a closed loop system that allows for feedback and systems to run continuously.

TESTING PROCESS

Initially I tested and wired up all the relays to verify that they work correctly and identify how they are supposed to be wired. This allowed me to test solenoids that would also need to be wired into the relay to allow water flow into or out of the tanks. It also allowed me to verify my pump-down relay was correct and was different than the pump-up relays. I had to simulate the tanks using a manifold. This allowed me to install the level sensors, and wire everything to the relay to test for performance. When the water touches the level sensor probes it changes the resistance that the relay can pick up on to determine the level of the tank. If the relay could not pick up the resistance change, I can adjust the resistance pack that gets installed on the relay to adjust its sensitivity to the change that the level sensor probes put off.



REFERENCES: Warrick Conductivity Level Fittings and Probes | Gems Sensors

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