**Getting a hydroelectric power plant online quicker using intelligent cabling technology**

# POWERING AFRICA

(by Wolfgang Zosel)

**As an enabler of high-performance Industry 4.0 concepts IO-Link has become indispensable in tool machine engineering and in production facilities. But hydro power plants as well can be wired quickly and efficiently using IO-Link: at the Mount Coffee dam in Liberia an intelligent IO-Link installation connects dozens of sensors and actuators over long distances.**

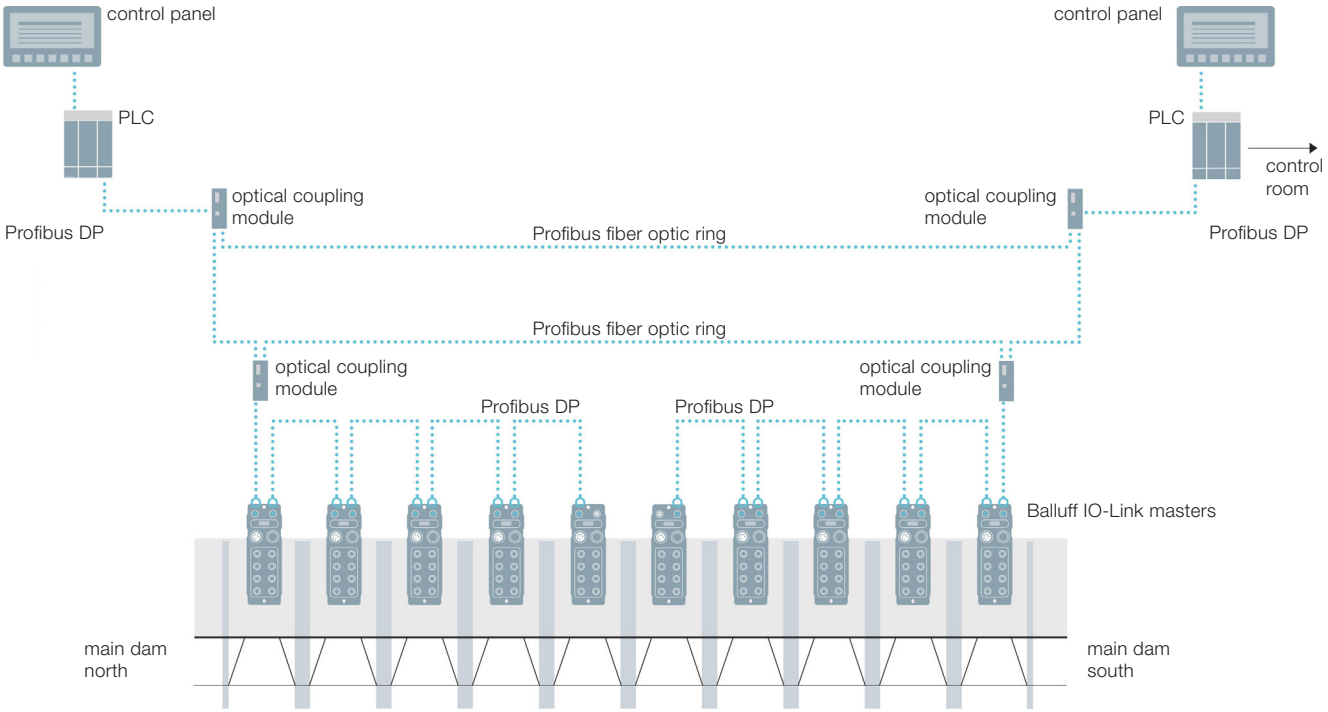
Since the end of 2016 Mount Coffee Dam in Liberia has again been producing electricity chiefly for the metropolis of Monrovia.

Simply while saving time and cost. The power plant operator has already come to appreciate the typical IO-Link benefits when it comes to diagnostics and maintenance as well. The integrated wiring solution developed by project partners Andritz Hydro and Balluff has the potential to be utilized in future power plant projects as well.
By December 2016 the time had finally come: after more than 20 years of interruption the first turbine was started up, and now all four turbines are feeding 22 megawatts each into the power grid. The origins of the Mount Coffee dam, which lies 30 kilometers northeast of the Liberian capital Monrovia, go far back: the former dam was finished in 1966, but was almost totally destroyed during the Liberian civil war from 1989 to 2003. When in June 2014 the Liberia Electricity Corporation (LEC) contracted an international consortium of companies to rebuild the dam, extensive parts of the plant had literally turned to grass.

Together with other companies the Austrian firm Andritz Hydro was contracted to rebuild the power plant on the Saint Paul River. As a global supplier of complete electromechanical equipment and services for hydroelectric power plants, Andritz Hydro is one of the largest companies in the market for hydraulic power generation. Andritz Hydro can look back over more than 170 years of experience and employees around 7300 people at various locations worldwide.
The responsibilities of Andritz Hydro included the complete hydraulic steel structures consisting of all the electronics, drive technology and control systems. The company refurbished both the ten radial gates on the dam and the four intake gates for the turbines. The radial gates are used to control the water level on the upstream face of the reservoir and are driven by cable winches. The intake gates bring the water to the turbines and block the inflow (shut-off valve) when a fault occurs such as a break in a pressure line. The drive is hydraulic. This includes electric and hydraulic drive units as well as various supporting systems.
The Mount Coffee Dam, though 160 meters long and having 10 radial gates each 15 meters wide, is by far not the largest of its kind. Nevertheless several dozen analog and digital signals have to be collected across the entire dam over long distances and made available to the control level.

"In terms of the complexity, the numerous tasks to be performed in the peripherals and the required level of networking, the dam is essentially nothing more than a widely distributed industrial system," emphasizes Bernd Schneider, Industry Manager for Energy at Balluff. As far back as 10 years ago the company, which specializes in industrial and factory automation with products ranging from the simple sensor to linear measurement systems to intelligent RFID solutions, recognized that IO-Link is the right standard for overcoming


Balluff IO-Link masters with M12 connectors for sensors and actuators



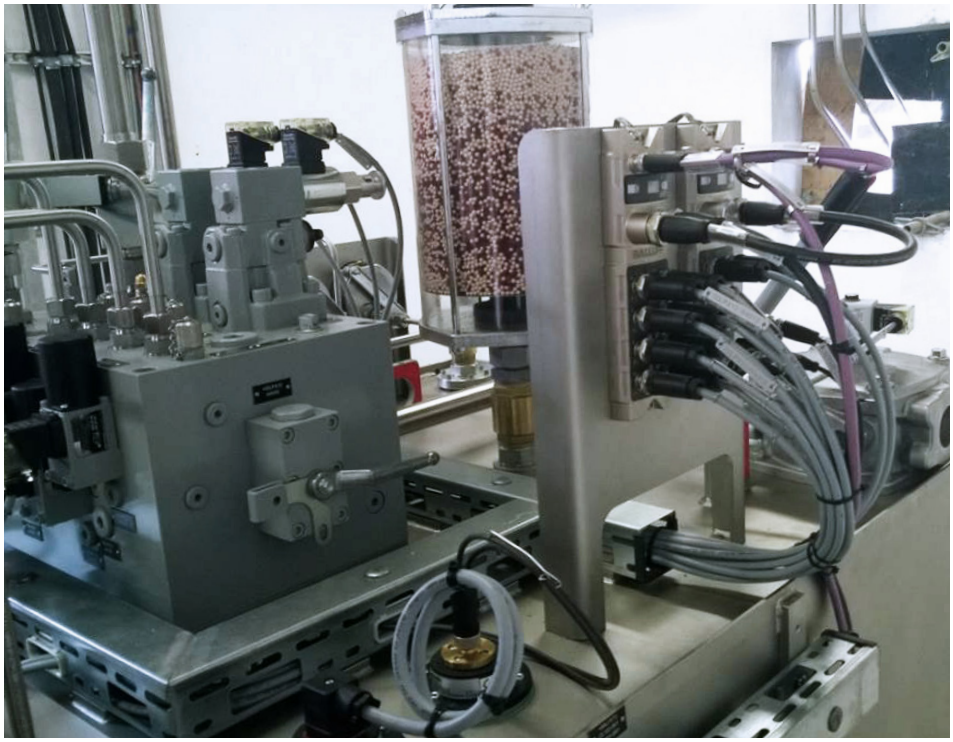

At the Mount Coffee dam in Liberia an intelligent IO-Link installation connects dozens of sensors and actuators over long distances

the communication crisis and wiring clutter between the bus and process levels.
As a point-to-point connection with a high degree of standardization this universal interface is indispensable for Balluff and its customers. Not least when simple wiring, overview and the highest requirements for diagnostics and configuration are so high up on the wish list. And this is almost always the case in today's highly automated systems.

Instead of individual wiring only standardized cables need to be connected

Although Andritz Hydro and Balluff have a long-standing partnership in the field of turbine construction, IO-Link was not yet in use in the company. Time and increasing cost pressures are also a central topic in power plant construction. There also it is presumed that systems integrators will thoroughly test their components themselves during a pre-commissioning before they are installed in the shortest possible time far from home, where they have to function smoothly and error-free within the overall system.
"It's a fact that in many areas of the industry copper cable and junction boxes are still used all the way up to the control level – representing a huge investment in materials and time," says Berthold Wiesinger, lead electrical engineer at Andritz Hydro.
An IO-Link presentation made by Balluff sealed the deal: Andritz Hydro together with the engineers from the Austrian subsidiary of Balluff developed a coherent electronics concept with the goal of simple wiring, standardization and modularity. Two Balluff IO-Link masters are installed in a switch box at each of the 10 radial and 4 inlet gates to collect up to 20 different signals in the field. These signals originate from inductive or mechanical limit switches, sensors for determining the rotation direction of the radial gates, control-, regulating- and shutoff valves, signal lamps and illuminated switches. Two IO-Link masters each are installed at the hydraulic stations for linking the involved sensors and actuators there as well. Without exception all the components in the field are connected using one and the same 3-wire standard cable type and uniform M12 connectors. Where analog signals from a particular sensor cannot be directly processed, a compact Balluff adapter plug converts the analog signal into a noise-immune digital signal. Stub lines from a Balluff IO-Link master carry the data to the control level via Profibus DB. Because the system is redundant the weir is devided in two sections, a maximum of 75 meters of cable are required.

"The benefits become soon evident: because we are using standardized cable and connectors instead of individual wiring, cabling took just half the usual time. With IO-Link you can test



Balluff IO-Link masters collect the signals at the hydraulic station

each module in advance at the factory and just have to plug them in, which noticeably reduces costs," as Berthold Wiesinger emphasizes. Wiring mistakes are virtually precluded, while the IO-Link philosophy also saves space and provides a clear overview. Internationally active companies especially appreciate the advantage that IO-Link can be used essentially with any bus system: the complete structure beneath the bus level always remains the same, only the bus nodes need to be adapted for a particular country.

The bi-directional communication standard provides greater perspective in other ways as well: IO-Link diagnostics information that enables quick localization for fault and error correction which in turn reduces unnecessary downtimes. "For some reason we had a problem with a sensor hub in the startup phase, but it was easily replaced and reinstalled by a colleague. The hub gets its data then from the IO-Link master, which contains the relevant parameter values. After just a short interruption the system was back up and running," says Berthold Wiesinger. This is a benefit wherever systems aren't located close by and a specialized personnel are not available for the majority of the tasks that arise. Thanks to IO-Link remote maintenance all the way down to the process level is possible. In addition to clear diagnostics and targeted actions and action instructions when a fault occurs, preventive maintenance concepts are easy to implement.
Berthold Wiesinger even goes a step further: intelligent sensors will continue to improve system availability in the future.

"Sensors which measure oil temperature and oil moisture, monitor highly stressed motors for temperature and bearing condition and autonomously notify of service intervals will become indispensable to our sector in the future as well."

The offering of universally applicable IO-Link products continues to grow. For the user this brings with it further opportunities for optimization in wiring, diagnostics and configuring. "Balluff for example offers an analog hub that can be used among other things for connecting thermocouples and similar devices to a module. Using the new safety concept "Safety over IO-Link“ IO-Link and Profisafe can now be used to directly connect safety auxiliary equipment. The advantage: in the future this standardized wiring concept will require just one infrastructure for both automation and safety technology. And with the highest level of safety up to PLe/SIL3“, emphasizes Mario Ober, who had local responsibility on the part of the Austrian Balluff subsidiary.

Since the end of last year the Mount Coffee Dam in Liberia has again been producing electricity chiefly for the metropolis of Monrovia. For Berthold Wiesinger there is no question that IO-Link will find increasing use both in new construction and reconstruction projects. Especially as facilities continue to age and modern control and electronics concepts will be demanded.

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