Power Generation: Assurance Monitoring System

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A manufacturer of advanced shaft grounding systems for power generators saw an opportunity to reach new markets with an advanced but competitively priced monitoring system. Having used our electronic design services on a previous project, they asked us for a proposal. Working in partnership with them we tied down the details and designed the product they needed, now being manufactured and used successfully.

The Application.

Cutsforth, Inc. (www.cutsforth.com) manufactures innovative, patented conductive ropes (brushes) and grounding systems for the shafts of utility power generators. Rotating generators, through both magnetic induction and static electricity, can generate large unwanted voltages on their shafts. Left ungrounded, these can cause serious damage to bearing surfaces and other areas. The rope systems provide a safe current path to ground, bypassing the bearings.

The ropes, of course, wear continuously against the rotating shaft. Over time the ropes and/or shaft will become worn, reducing the effectiveness of the ground path. The generator itself may also degrade, producing higher and higher shaft voltages and currents. The voltage, current and rope condition must be monitored if catastrophic bearing failure is to be avoided.

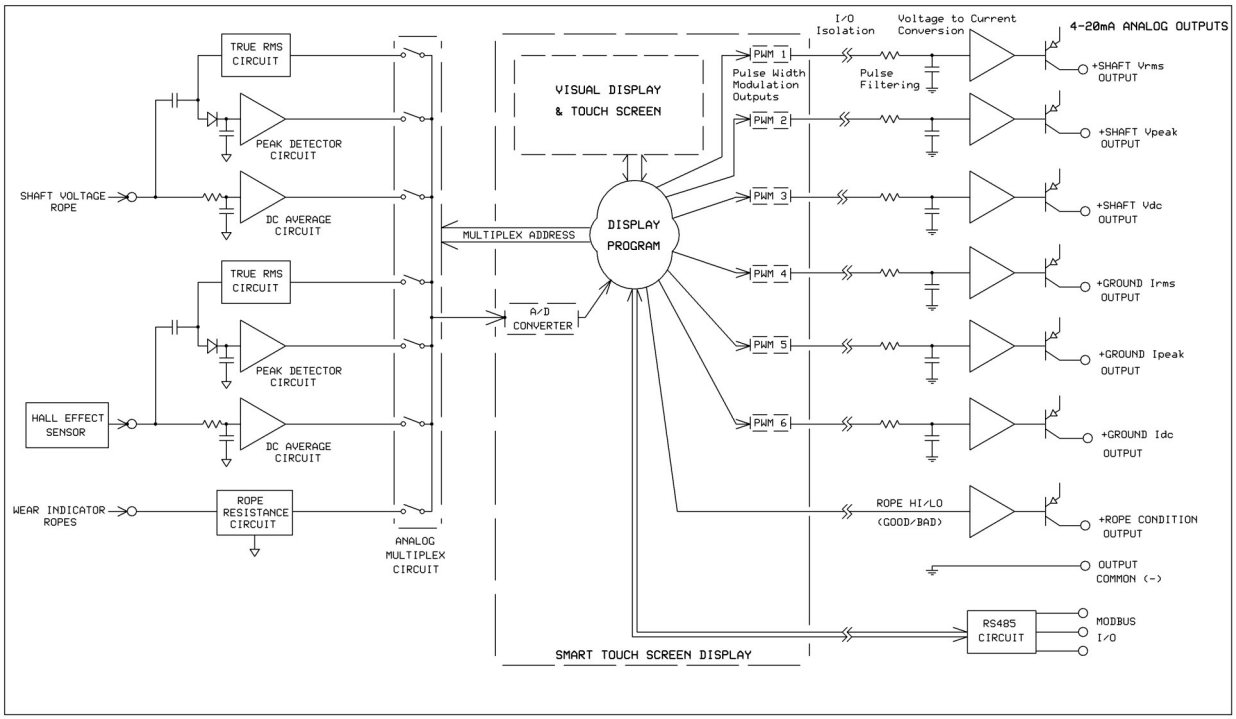
Preventive maintenance requires, at a minimum, that periodic readings be taken. Cutsforth provides a Remote Meter Point to facilitate walk-up inspections using portable meters. Portable oscilloscopes sometimes also are used to look at the voltage and current waveforms, especially for large spikes. This requires some labor but minimizes system investment, a valid tradeoff for small operations. For large operations Cutsforth offers a high-end continuous Premium Monitoring System.

The Need.

Manual monitoring, in addition to taking time, raises the possibility of undetected rope contact failures between inspections. The premium system is continuous but may not be economically justifiable for smaller operations such as, especially, wind turbines. The new product's goal was a more affordable system providing the assurance of continuous monitoring but without some of the high-end features of the premium system, such as built-in oscilloscope waveform displays and downloadable historic data. Its name? The *Assurance* Monitoring System.

The Project.

Shaft voltages and currents can be both AC and DC, the latter primarily from static electricity. Both increase as generators age and rope contacts wear; also, with wear the waveforms may show high voltage spikes even though their average levels are low.



Like the Premium, the Assurance Monitoring System monitors AC rms, AC Peak and DC Average values of both the shaft voltage and the rope's ground current. Both systems also monitor rope resistance, indicating failure if it gets too high. Our electronic design experience, especially signal conditioning and process measurement design, was valuable when designing the input measurement circuitry.

A touch screen display shows seven readings: three each for shaft voltage and ground current plus the rope condition. It also shows the date the rope was replaced. Using the touch screen an operator can reset the rope fault indication after rope replacement and update the replacement date. We had recently completed a touch screen design for another client and were able to use the same display in this project. The display's capabilities (gen4 from 4D Systems – www.4dsystems.com.au) are such that we were able to program the entire operation in it – no separate microprocessor needed.

The Assurance Monitoring System does not include data storage but does provide seven analog 4-20mA current loop outputs. These can be fed to a datalogger or other data acquisition and/or display system. Once again our signal conditioning design experience came into play: we've designed *lots* of 4-20mA outputs! In this design the gen4 display provides six pulse-width -modulated outputs, one for each reading. Our analog circuitry filters the pulses and converts the resulting averages to proportional current outputs.

The system also includes RS485 Modbus data communication. Our design included the RS485 circuitry but we were unable to program the Modbus functions in the time needed. Cutsforth worked with another programming consultant to add Modbus to the display's program.

Conclusion.

The Cutsforth Assurance Monitoring System is in production and has been successfully installed in several applications. In the design phase we partnered with JH Technology, an industrial instrument manufacturer (www.jhtechnology.com). JH Technology now produces the electronics for the system and will soon be doing the complete assembly, including the rugged NEMA 4X enclosure.