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Application Note

Sandow Power Plant Installs “Drop In” Convection-Cooled Rectifier Bridges for Existing Alterrex Water-Cooled Bridges

The Alterrex excitation system was the product of choice from the 1970s through the 1980s. The Alterrex design consisted of an ac rotating exciter whose ac output was directed into stationary water-cooled rectifier bridges located in a doghouse at the end of the turbine generator. Each rectifier panel was rated for 1200 amps with multiple bridges in parallel to match the generator rotor field requirements of 3500 or more. See Figure 1.

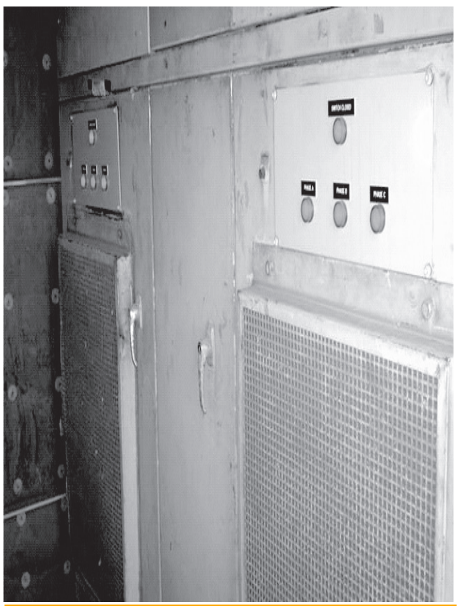

Figure 1: Existing water-cooled bridges prior to replacement

Redundancy of the bridges was a must in the event of failed power semiconductors or water leaks that could otherwise cause a forced outage. Today, 40-50 years later, the water-cooled bridges are experiencing major plumbing issues as worn piping and corrosive water has caused bothersome water leaks.

The Sandow Power Plant had an additional concern. A turbine and generator upgrade required higher output capacity, hence requiring more field excitation for the rotor at rated load. The problem, however, was the existing water-cooled rectifier bridges had an electrical limitation of 3600 amps with no redundancy. In order to achieve their goals, the Sandow Plant would require an expensive replacement of the rotating exciter for a static exciter that would cost substantial dollars.

Convection-Cooled Alternative

As an alternative, Basler Electric offered replacement convection-cooled rectifier bridges for the existing water-cooled bridges. Each of the new bridges were rated for 1600 amps. The current excitation system utilized (3) three water-cooled bridges and the fourth chamber of the doghouse was empty. The proposed solution included (3) three 1600 amp bridges, with a fourth bridge as a backup for redundancy. The new system included disconnect switches that replaced the original manufacturer’s, field current shunts on the positive and negative leads, snubber circuits around the diodes for commutation, and three power fuses with failed fuse indicators at the ac power input.

With new bridges, a new voltage regulation system also was required to replace the existing Alterrex voltage regulator, which was having obsolescence issues. The cost comparison between a complete static exciter verses the replacement of only the water-cooled bridges and a new voltage regulator was fractional to the cost of the complete static exciter replacement.

Figure 2: The Sandow Power Plant

The Final Decision

The decision was made to replace the water-cooled bridges and existing switches for new convection-cooled bridges. Along with that project, a new voltage regulator would be installed to replace the existing Alterrex voltage regulator.

The convection-cooled bridges were designed to operate with only the turbulent air in the doghouse of the generator exciter housing as cooling.

To ease installation, the replacement bridges were designed to be installed using the existing mounting holes of the original water-cooled bridges. A disconnect switch also was provided for each new bridge to electrically isolated the bridge from the ac and dc bus should repair be necessary. The demolition took two days to remove the old plumbing, bridges, switches (See Figure 3) and another two days to install new air-cooled bridges/switches (See Figure 4).

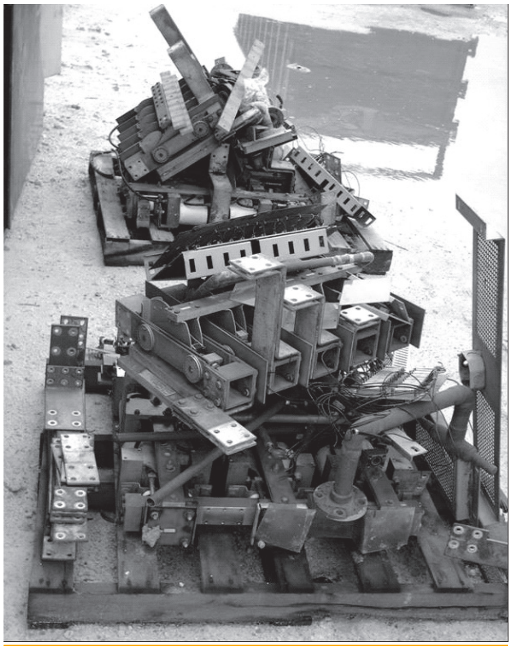

Figure 3: Old bridges and switch on scrap pile

The ac and dc bus connections to the primary bus bar required new links for two of the chambers and the other two chambers required more substantial busing since one of the chambers had no available bus bar. See Figure 5.

A new light panel, located on the front of each bridge door, indicated health of the power bridge by changing contact status any time a power fuse should fail. See Figure 6.

The new voltage regulator was installed into its own air-conditioned enclosure. See Figure 7.

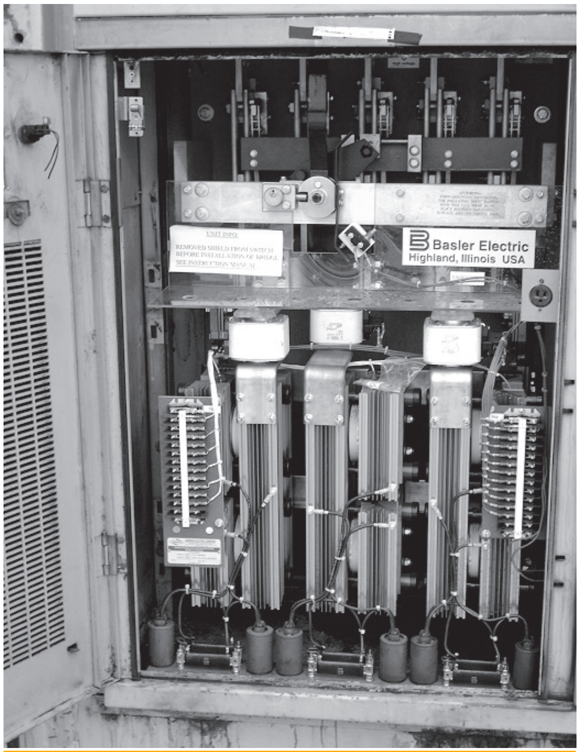

Figure 4: New bridge drop-in retrofit

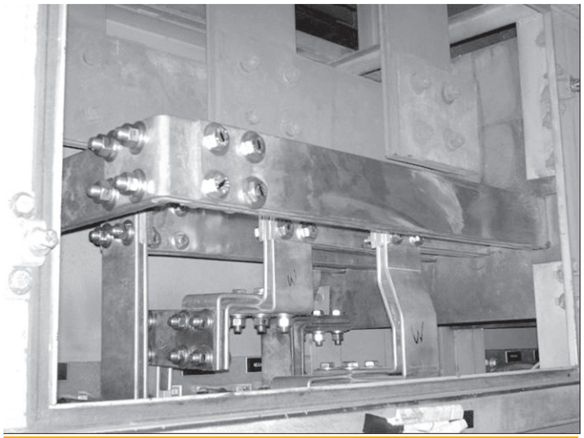

Figure 5: New bussing installed in empty chamber

Figure 6: New light panel for failed semicondictor monitoring

Figure 7: Redundant DECS-400 excitation system

Commissioning

At time of commissioning, the new bridges were monitored for current sharing since no reactors were used to ensure current balance. It was noted that the bridge currents shared within 2.5%, providing excellent performance. The temperature of the bridges was monitored with embedded RTDs, (6) six on each bridge, totaling 24 for all four rectifier bridges. Temperatures indicated the bridges were operating well within the operating limits and in fact, operating very cool at rated load.

The new excitation control system utilized redundant DECS-400s, redundant firing circuits, and redundant 200 amp bridges. A redundant ac feed with an automatic transfer switch was provided to the power potential transformer. In case the primary ac feed is lost, the backup power source would maintain the supply to the bridges. See Figure 9 on page 4.

Each DECS-400 included the 0.25% voltage regulator, manual control (Field Current Regulator), excitation limiters, autotracking, power system stabilizer. Full commissioning tests were performed on the excitation system. A 2% voltage step change was performed yielding 0.2 second rise time and a 0.3 second voltage recovery. See Figure 8.

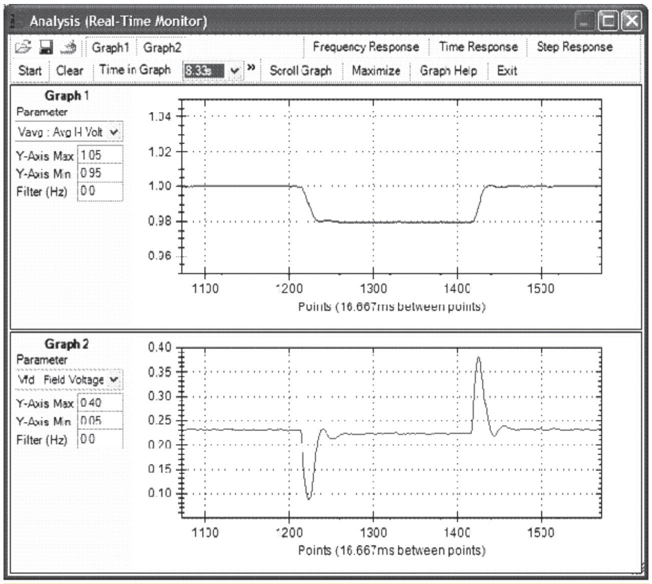

Figure 8: 2% voltage step change offline
0.2 sec rise time, no voltage overshoot.

Lower Cost Alternatives

The solution, of either replacing only the stationary rectifier bridge or a combined solution of the voltage regulator and stationary rectifier bridge offers a lower cost practical remedy to aging problems in lieu of a major replacement of the
Alterrex ac exciter and associated equipment for a complete static exciter system. For more information, see Application Notes EX-ALT3 and EX-ALT_BRDG.

For More Information

For information on Basler's complete range of exciter solutions, visit the download section at www.basler.com to access product documentation, Application Notes, and Technical Papers.

To discuss your application, consult Basler at the factory at 618.654.2341.

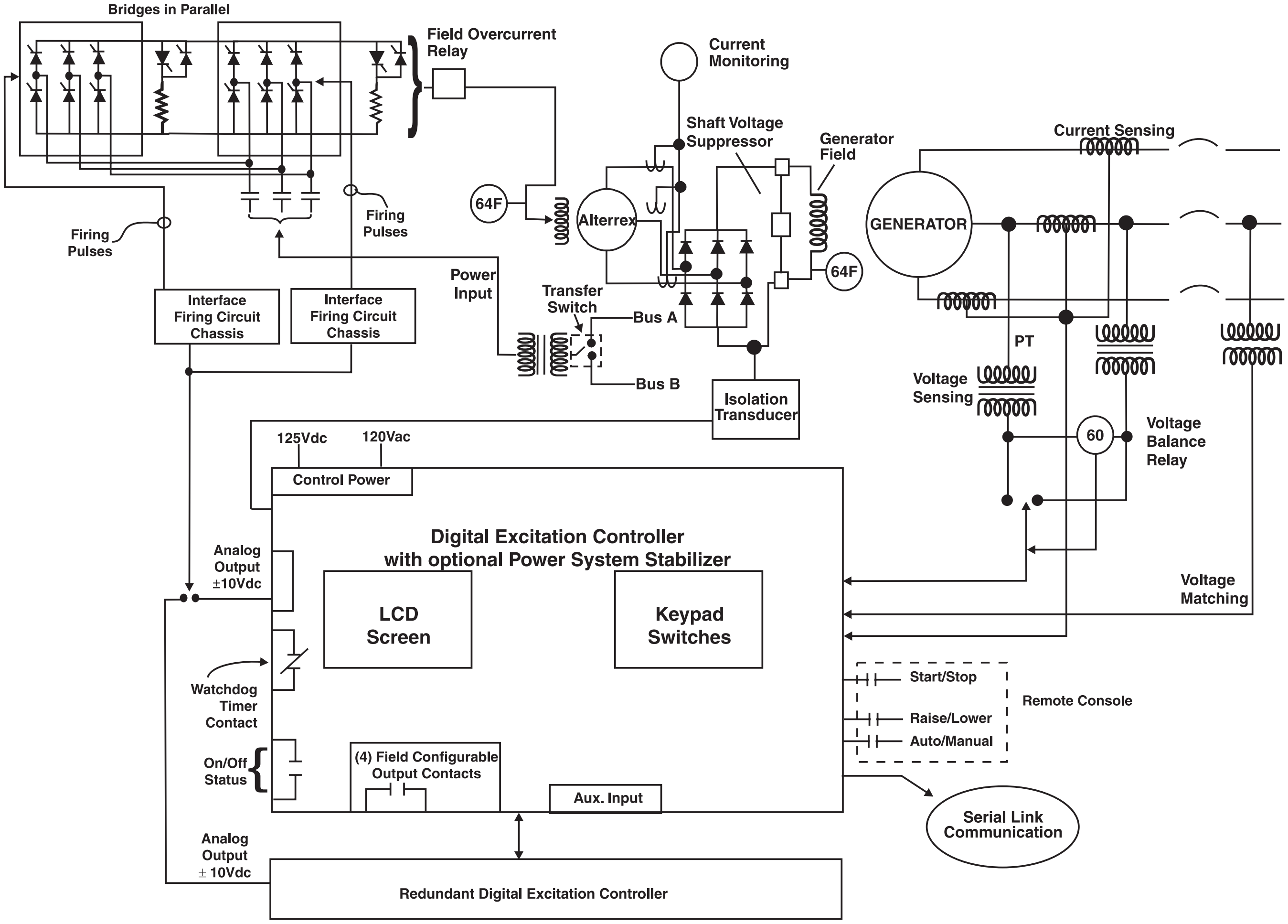

Figure 9: Block diagram of replacement excitation system

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