Spang Power Electronics™

PROJECT PROFILE

New Power Supply + Existing Furnace = Great Investment

Spang Power Electronics was awarded an order to provide an AC Inverter Power Supply and control system upgrade for an existing casting furnace.

The customer is a worldwide leader in the production of kitchen & bath fixtures. They required the replacement of an aging, obsolete power supply and automation system for their Herman Foundry BBC Crucible Holding Furnace. While the customer reused the existing furnace and voltage matching transformer, Spang supplied a new AC inverter power supply including automation hardware and software. The Spang power supply is based on our 950 Digital Power Control Platform utilizing IGBTs to provide the necessary high frequency single-phase AC output to power the furnace's graphite heating element.

Spang and the customer worked closely together from initial budgeting to detailed design through installation, and startup of the power supply and automation equipment. Close electrical, mechanical, and process control coordination was critical to ensure a quick change over to the Spang solution. Within the planned process outage, the team successfully commissioned the equipment and returned the holding furnace to full production.

Background

The Herman Foundry BBC Crucible Holding Furnace was originally installed in the 1980s by the Brown Boveri Corporation. The original system was an SCR based 200Hz single phase inverter power supply. At the time, SCRs were the only technology available that could regulate the necessary power to do the job. The problem, SCR based inverter power supplies are complicated. Since an SCR can only be gated on and not off, the controls required additional hardware to commutate (force) the SCR off. Not only does this complicate the power supply, but it is also less reliable and more prone to failure.

IGBT stands for Insulated Gate Bipolar Transistor. The IGBT represents the latest in power transistor technology capable of being gated on as well as off. Therefore; it is not necessary to apply reverse voltage to commutate an IGBT off like is required for an SCR.

The customer needed a reliable power supply based on the latest in IGBT transistor technology and digital control that was capable of delivering controlled power 24/7 to the critical process.

Crucible Holding Furnace

AC Inverter Power Supply

Basic Specification

Power:	320KW
Input:	480VAC/3 Phase/60Hz
Power Supply Output:	630VAC/1 Phase/200Hz
Heating Element:	Graphite Rod
Coupling:	9:1 Voltage Matching Transformer
Load:	70VAC/1 Phase/200Hz
Regulation Mode:	Power

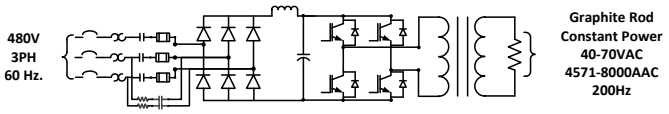
System Details

The power supply uses a balanced three phase AC input power to supply single phase AC output power to a graphite heating element through a step down (9:1) voltage matching transformer. As the graphite heating element ages the resistance increase due to oxidation, so the power supply must constantly adjust the output to maintain constant power in the furnace.

When the graphite rod is new the power supply output starts at 360VAC and 890AAC correlating to 40VAC and 8000AAC at the load. After the graphite rod is fully aged, the power supply output voltage increase to 630VAC and 508AAC correlating to 70VAC and 4571AAC at the load.

The heart of the inverter power supply control comes from Spang Power Electronics 950 Series Digital Power Controller and its proprietary firmware. The 950 is a multifunctional Digital Signal Processor (DSP) based power controller that includes all of the necessary hardware interfaces required to properly gate the IGBT modules, accept voltage and current feedback from the process and interface with the I/O required to operate the power supply.

950 Series Digital Power Controller

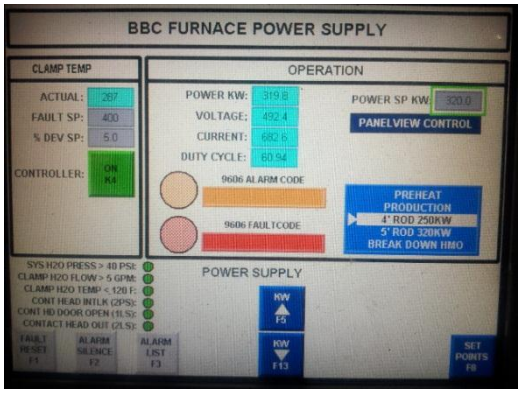


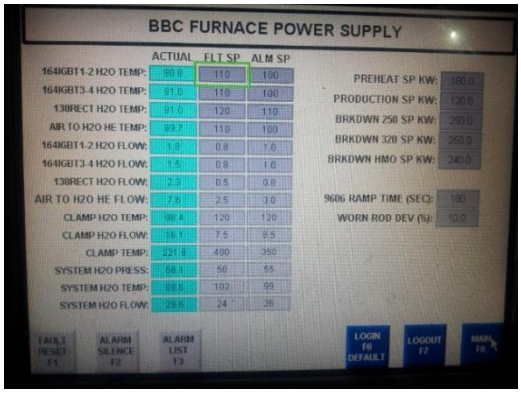
Power Schematic

In addition to the power supply, Spang Power Electronics was responsible for supplying the Allen-Bradley ControlLogix and PanelView automation hardware and software required to monitor and control critical power control and process related digital and analog I/O. The system components, including the 950 Control Amplifier, PanelView Plus and ControlLogix remote rack all interfaced with a central ControlLogix PLC through an Ethernet/IP interface.

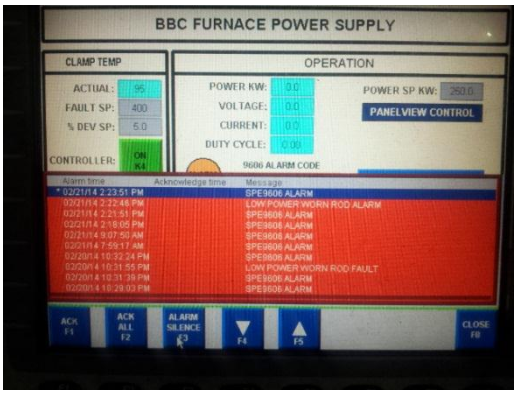
The ControlLogix PLC handled all software required for power supply enable/disable and power set point references; power supply and transformer cooling system temperature, flow and pressure monitoring; graphite heating element clamp temperature and all permissives.

The PanelView Plus graphics terminal is the user's window into the power supply process. An overview display is used to monitor critical operating parameters including: power supply voltage, current & power, clamp temperature and permissive status. The overview display is also used to set the operational mode for Preheat, Production, Standby with a 4 foot 250KW rod or Standby with a 5 foot 320KW rod. A set point input screen is used for monitoring the cooling system temperature, flow & pressure. The set point input screen is also used to configure alarm and fault set points, operational mode power set points, ramp rate and worn rod deviation set point.





Faults and alarms are timed stamped and stored into historical buffers that can be easily accessed for troubleshooting purposes.



The addition of a digital control system provides the operator with operational information about the process which translates into a more efficient and reliable production process. It also provides maintenance and engineering with better diagnostic information to troubleshoot and maintain the system and minimize downtime.

Power Supply Enclosure

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