



## Arc Position Sensing

### Opportunity

The Department of Energy's National Energy Technology Laboratory (NETL) is seeking collaborative research and licensing partners interested in further development and implementation of an innovative technology for arc position sensing. The technology employs a method known as the Electric Current Locator (ECL). The ECL utilizes magnetic field sensors oriented to a sensing plane and provides current vector location based on the solution of Biot-Savart equations formulated for the specific electrical device. Basically, an ECL can determine positions of arcs within an electric arc furnace in real time. No other measurement technique can give this kind of information. Knowing the locations of electric arcs is a first step toward devising and developing position controls for electric arcs within the furnace.

### Overview

Vacuum arc remelting (VAR) is a process used to refine alloys with the advanced properties and performance needed for certain applications in the aerospace, power generation, defense, and medical and nuclear industries. A VAR melt occurs within a crucible typically made of copper with a water jacket that cools the metal being formed. The control between the heat transfer and remelting is critical to producing defect-free material. The problem is that VAR, an expensive procedure, sometimes produces an ingot that must be rejected because of defects and/or lack of uniformity.

Present controls of the remelting process rely on system current and voltage, which cannot reliably show what the electric arcs are doing and what causes ingots to sometimes be defective. Without knowing when problems occur, it is impossible to devise ways to fix them. However, with arc position sensing technology utilizing the ECL, variations in arc positions (and hence energy distribution into the molten metal) can be visualized. This information is a crucial first step toward devising control methods that will permit VAR to produce consistent defect-free ingots.

### Patent Details

U.S. patent number 8,111,059; issued 2/7/2012; titled "Electric Current Locator." Additional information about this technology is available in the Oregon State University Doctoral Dissertation, "Arc Distribution and Motion During the Vacuum Arc Remelting Process as Detected with a Magnetostatic Approach," 2010.

Inventors: Paul E. King and C. Rigel Woodside

### Significance

- ECL is the only present method for locating the position of electric arcs within VAR furnaces in real time.
- With ECL locating the electric arcs within the furnace, operators know immediately if the current becomes constrained (which can lead to defects in the ingot being reformed).
- Knowing exactly where the current is located in real time makes it possible to begin devising ways to control the current and keep it from being constrained; thus, the ECL is a first step toward better quality control of VAR ingot production and avoidance of defective ingots.

### Applications

- Arc position sensing technology using the ECL has utility for VAR furnaces designed for producing specialty metals, and for other electric arc furnaces.
- Arc position sensing technology using the ECL can pave the way for creation of controls to eliminate production of defective ingots.

### Contact

NETL Technology Transfer Group  
[techtransfer@netl.doe.gov](mailto:techtransfer@netl.doe.gov)