

# ALUMINUM

## Project Fact Sheet



## INTELLIGENT POTROOM OPERATION

### BENEFITS

- Energy savings in the control of the aluminum refining process which could save an estimated  $5.01 \times 10^8$  kWh per year in the U.S.
- Decreased emissions of an estimated 270 metric tons per year of perfluorocarbon (PFC) greenhouse gases
- Increased efficiency of the Hall-Héroult refining process by an estimated 0.3 percent
- Reduced average cell voltage by 0.03 volts

### APPLICATIONS

Intelligent Potroom Operations can be universally applied to the aluminum refining process. The designs will exploit and enhance the existing aluminum industry infrastructure.

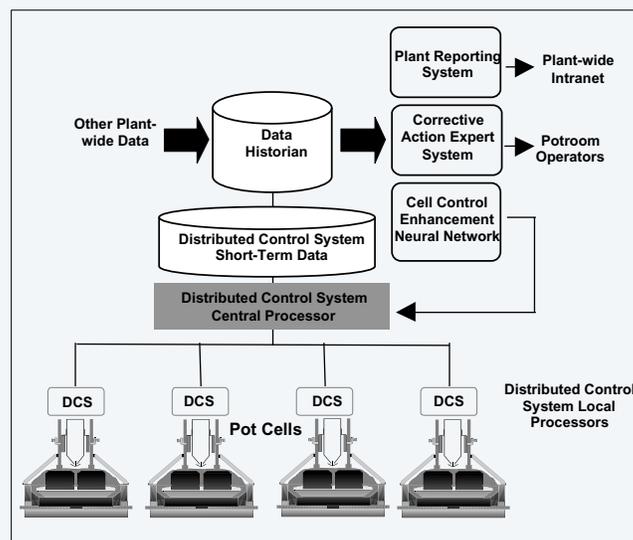
## NEW OPERATION SYSTEM IMPROVES EFFICIENCY OF HALL-HÉROULT PROCESS AND REDUCES CELL VOLTAGE

Operators in aluminum smelters typically have 40 or more cells to oversee. Modern aluminum refining cell controllers attempt to optimize cell efficiency by controlling the concentration of alumina in the bath. Unfortunately, no direct measure of alumina concentration is yet possible and close scrutiny of each cell on a regular basis is not possible. The ramifications of miscalculating alumina concentration are significant from an environmental and energy efficiency standpoint.

One major product of this research will be the development of a Corrective Action Neural Network (CANN). Its function will be to monitor and analyze data from the pots on a continuous basis, looking for cells whose performance is deteriorating. It will anticipate which cells are about to slip into degraded or out-of-control operation and dispatch the operator to intervene before trouble begins.

Eventually, a closed-loop Cell Control Enhancement Module (CCEM) will be added to the individual cell controllers. The CCEM will use an enhanced instrumentation package and powerful data analysis techniques to provide a more complete picture of instantaneous cell status to the CANN. The CANN and CCEM will work in concert to continuously improve the database on each cell, and the knowledge base on control and remediation techniques.

### CELL CONTROL SYSTEM



**New operation system integrated with potroom operations will enhance control and efficiency in aluminum refining.**



## Project Description

**Goals:** The goal of this project will be to improve the efficiency of the aluminum refining process through a new approach to intelligent potroom operations. It will be based on advanced data analysis and process modeling using equipment and techniques which are cost-effective and easily adaptable to existing potline equipment. This project is in direct response to two of the high priority research needs listed in the *Aluminum Industry Technology Roadmap*. The work is projected to increase the current efficiency of Hall-Héroult refining cells and reduce average cell voltage.

## Progress and Milestones

### Year One:

- The research and development activities for the CANN will be completed
- Initial Correlation studies will be made using archival data, and a detailed experiment plan will be made for determining the makeup of the enhanced suite for the CCEM.
- The data acquisition and archiving hardware for cell data will be constructed and installed at Century Aluminum.

### Year Two:

- A wireless LAN infrastructure will be developed and deployed which includes operator training, refinement of the diagnostic system, and integration of the real-time feedback into the CANN database.
- Data analysis, testing, and verifying models for the CCEM will be completed.

### Year Three:

- The CCEM and the CANN will be integrated so the enhanced cell status information constructed by the CCEM can be used in the neural network.
- The CANN diagnostic and data acquisition LAN will be tested in full operating conditions, and data quantifying its effectiveness will be gathered and published.
- The hardware and software for the CCEM will be finished and demonstrated in the laboratory. Following successful demonstration, the CCEM system will be installed on two pots in Century Aluminum's plant. The effectiveness of the controller will be tested, and the refinements to the algorithms will be completed.
- CCEM will be outfitted with an interface to the wireless LAN and data from the CCEM will be fed to the CANN.
- The entire Intelligent Potroom Operation system will be demonstrated.

## Commercialization Plan

Advanced Industrial Solutions, partnering with Century Aluminum and West Virginia University, will provide the commercialization path. The Advanced Industrial Solutions plan is to both market directly as well as use the Gensym sales distribution channel to identify opportunities where this technology could be employed.



### PROJECT PARTNERS

Applied Industrial Solutions LLC  
Morgantown, WV

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Gensym Corporation  
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### ALUMINUM PROGRAM

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February 2001