NEW INDUSTRIAL OPPORTUNITIES FOR ADVANCED WELDING TECHNOLOGIES

Collaboration with the scientists and engineers of the E.O. Paton Electric Welding Institute (PWI) has proven highly valuable. During a visit by Daniel Allford, President of Arc Specialties, to Kyiv several years ago, a wide range of technologies and applications was observed, many of which were either unknown or underutilized in the United States. Since that time, efforts have been directed toward identifying potential applications for processes and materials developed at the institute. Several industrial sectors have been identified where advanced technologies may provide effective solutions for challenges in manufacturing, energy, mining, and space industries.

The advent of additive manufacturing has renewed interest in high-deposition-rate welding processes, such as electroslag (ESW), which can build parts at a rate several times faster than current wire-arc additive manufacturing. Additive manufacturing of parts from exotic materials poses unique challenges. Frequently, these materials are either unavailable or impractical to produce as wire. These 3D parts are being built using plasma transferred arc welding (PTAW) with powdered metal feedstock.

The Renaissance in nuclear power has created opportunities for thick-section welding using ESW, PTAW, and electron beam welding (EBW). New technologies such as salt-cooled reactors place extreme demands on existing materials and opportunities for new solutions.

In the oil industry, as oil reserves become scarce, wells are being drilled deeper. These high-temperature, high-pressure wells test the limits of current material science and joining technologies. Welded overlays using gas tungsten arc welding (GTAW), ESW, and PTAW are used to apply metallurgically bonded coatings, which combine the strengths and properties of multiple materials to solve corrosion and strength challenges that no single material can address.

The PWI was the first, and to date, the only group to make welds in open space. Welding in space presents unique challenges, but it will be essential as humans build structures both in Earth orbit, on the moon, and eventually on other planets.

Global shortages of tungsten carbide wear-resistant coatings have created opportunities for alternative wear-resistant materials, including chromium carbide, ceramics, and man-made diamonds.

The scientists and engineers at the PWI continue to make innovations in joining, coatings, overlays, and material science, which are essential to maintain and advance the standard of living enjoyed in modern society.

FABTECH 2025: New Horizons cooperation in Welding

By invitation and with the support of the American Welding Society (AWS), as well as personally by its president Mr. Richard Holdren, and with the support of Arc Specialties represented by its president Mr. Daniel Allford, a visit to the United States was carried out by a representative of the PWI of the National Academy of Sciences of Ukraine, Dr. Volodymyr S. Kachynskyi.

The main purpose of the visit was to become acquainted with current trends in the development of welding technologies, automation, and intelligent control systems for welding processes.

During the visit to the United States, Volodymyr Kachynskyi participated in the annual AWS business meeting. The event brought together leading specialists, researchers, and executives from major companies in the welding industry to discuss strategic directions for the development of the field, the integration of digital technologies, artificial intelligence, and sustainable manufacturing.

Particular attention was paid to issues related to the training of a new generation of specialists, the expansion of international scientific cooperation, and the role of AWS as a global platform for the exchange of experience between industry, education, and science.

The annual business meeting of the American Welding Society

From September 8 to 11, 2025, the FABTECH 2025 exhibition took place at McCormick Place in Chicago — the largest industrial event in North America. This year's show set new records: an exhibition area of 82,300 m^2, over 1,700 exhibitors, and more than 50,000 visitors.

FABTECH 2025 demonstrated that the welding industry is confidently moving toward the integration of digital technologies, artificial intelligence, and automation. In addition to traditional welding demonstrations, much attention was given to smart functions, data collection, and adaptive process control. The exhibition also highlighted social initiatives — Emerging Leaders and Women of FABTECH — focused on developing youth and female leadership in the industry.

Welding Equipment Innovations. Miller Electric presented several product premieres reflecting the industry's shift toward mobility, digital control, and environmental responsibility:

- Millermatic 211 PRO — a MIG welder with USB upgrade capability and Auto-Set™ digital control;
- Syncrowave 212 (TIG) — a lightweight TIG unit with auto-setup and optional water cooling;
- Venture 150 S — a battery-powered welding source for field use in manual and TIG applications;
- OptX 1 kW — a portable laser welder designed to reduce distortion and spatter;
- Tregaskiss Atlas Robotic Torch — a new robotic MIG torch with improved accuracy and reliability;
- PerformArc with Intellipath™ — upgraded robotic systems with offline programming support;
- SubArc Hercules — a new high-deposition submerged-arc welding system.

These developments illustrate the company's strategic focus on intelligent welding, higher energy efficiency, and adaptive control.

Arc Specialties (Houston, Texas) showcased its proprietary robotic welding systems and automated equipment for specialized applications — including pipe welding and complex spatial structures. The company also presented technology for electroslag surfacing of large metallic components.

Robotics and Artificial Intelligence. Yaskawa/Motoman featured a wide range of robotic welding cells — from compact ArcWorld units to hybrid systems integrating additive manufacturing.

Its new Weld Builder interface allows operators to quickly create welding programs via an intuitive control panel, reducing the time needed for robot deployment.

Many of the systems now include built-in analytics: AI-based algorithms predict defects, adjust parameters, and perform real-time diagnostics.

During a visit to ORNL: Dr. Adam Stevens (right), Mr. Daniel Alford (center), and Dr. Volodymyr Kachynskyi

Laser and Hybrid Welding Technologies. Laser and hybrid processes (laser + arc, laser + plasma) attracted significant attention as they combine deep penetration with precise heat control. Portable laser welders, such as the OptX 1 kW, expand the applicability of laser welding to field operations.

Ecology and Safety. A major focus of FABTECH 2025 was environmental responsibility and welder safety. Exhibitors presented modern fume-extraction and air-filtration systems, as well as next-generation personal protective equipment (PPE) — lighter, more ergonomic, and better suited for diverse operators, including women welders.

Key Development Trends. Based on the trends presented at FABTECH 2025, several strategic directions stand out:

- Hybrid processes — combining laser, arc, and plasma methods for enhanced productivity;
- Intelligent adaptation — AI-driven sensor systems for real-time parameter correction;
- Green welding — reduced emissions, improved air filtration, and safer filler materials;
- Mobility and autonomy — increasing use of portable and battery-powered welding sources.

FABTECH 2025 clearly showed that the future of welding lies in intelligent, flexible, and sustainable solutions, where robotics and digital technologies are becoming not an option, but the new standard.

Visit to Oak Ridge National Laboratory: Scientific Collaboration and Knowledge Exchange. At the invitation of Oak Ridge National Laboratory (ORNL) by Dr. Adam Stevens and support by Mr. Daniel Allford, a representative of the Paton Electric Welding Institute Dr. Volodymyr Kachynskyi visited the leading research center of the U.S. Department of Energy, located in Tennessee.

During the visit, meetings were held with ORNL's leading researchers to discuss potential areas of collaboration and to present recent scientific results from PWI. Potential areas for cooperation have been identified as electroslag welding (ESW) and electroslag additive surfacing technology, electron beam welding (EBW) and magnetically impelled arc butt welding (MIAB).

Oak Ridge National Laboratory — a Global Leader in Research and Supercomputing.

Founded during the Manhattan Project, ORNL has evolved into a world-class multidisciplinary science hub — spanning materials science, energy systems, biology, ecology, and computational research. Its most notable asset is the Oak Ridge Leadership Computing Facility (OLCF), home to Frontier (commissioned in 2022) — the world's first exascale supercomputer, capable of performing over 1 quintillion operations per second. These computing capabilities are applied to research in energy, nuclear systems, climate modeling, biomedical innovation, and advanced materials.

ORNL Research Laboratory and Research Results

Research Methods and Directions. ORNL's work combines experimental research with high-performance computing, enabling detailed study of complex physical and technological processes. Key research areas include:

- Modeling and simulation of complex systems — from nuclear materials behavior to climate dynamics;
- Development of new alloys, composites, and nanomaterials;
- Welding and repair technologies for irradiated materials used in nuclear energy.

Welding Research at ORNL. A distinctive research direction involves welding and repairing materials exposed to neutron irradiation. The main objective is to increase the durability and maintainability of structures used in nuclear power plants and thermonuclear installations.

Prospects for Cooperation. Within the framework of the visit, possibilities for joint research in the fields of welding and materials science were discussed, as well as the implementation of collaborative projects.

Today, Oak Ridge National Laboratory (ORNL) represents a unique combination of fundamental science, engineering technologies, and high-performance computing capabilities available to researchers from around the world. Innovative solutions for energy, biology, materials science, and security are developed here, while advanced methodologies in computational science enable the laboratory to maintain leading positions in the global scientific landscape.

Daniel Allford (ARC SPECIALTIES, Houston, USA),
Volodymyr Kachynskyi (PWI, Kyiv, Ukraine)