

NEWSLINK

FEDERAL LABORATORY CONSORTIUM FOR TECHNOLOGY TRANSFER

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AFRL's ManTech Industry Initiatives Revolutionize Aircraft Production

The well-known "Wild Blue Yonder" song takes on a different tune for the U.S. Air Force today. With its new, sky's-the-limit, innovative approaches to designing and producing air and space systems, the Air Force Research Laboratory's Materials and Manufacturing Directorate is singing great praises for the Air Force's Manufacturing Technology (ManTech) Program.

As an Air Force "corporate" program, the goal of ManTech is to provide superior yet more affordable manufacturing technologies to meet war-fighters' needs. Through its strategic initiatives, the Air Force and industry—including all prime aerospace companies and many sub-tier vendors—develop advanced technologies in manufacturing processes, engineering systems, and industrial practices that improve performance, reduce downtime for repairs, and provide the most cost-effective parts.

Best Engineering Minds

"ManTech has stepped up to the challenge of reducing high costs of Air Force weapon systems by changing the standard method by which we design and build weapon systems, through key affordability programs like the Composites Affordability Initiative (CAI)," says

Dennis Hager, deputy chief of the ManTech Program. These key initiatives help establish partnerships between the Air Force and industry.

Hager explains, "ManTech has broken down barriers to prevent duplicity of technical effort and certification. It's also opened up new paradigms in working together." The best engineering minds in the aerospace industry—including Lockheed-Martin, Boeing, and Northrup Grumman—work together



on common problems of national interest to produce "leading-edge stuff." In a cooperative working environment such as this, competitive companies can share technical data without creating their own databases—in composites, manufacturing, or processing.

CAI Success

Using 50-50 cost-sharing agreements, companies benefit by leveraging their money and ideas, while the government gets the best design possible for aerospace systems at the lowest cost, in addition to prime performance. "Executives in major companies recognize the importance and impact in doing business this way," says Hager.

A watershed program, CAI—with its current three phases—attacks several problems at once and raises the consciousness level and the technical capability of the entire industry as well. Now in Phase II, CAI is one of the largest ManTech initiatives, with \$100 million of government and industry funding. Phase III will award another \$80 million this fiscal year. In composites, the important aspects are weight and part-count plus fail-safe design and performance. CAI has achieved its objective of reducing the

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PPPL Assists U.S. Textile Manufacturers

The textile industry needs a quality control system that is both rugged and cost-effective enough for fiber manufacturers to put into their factories. And U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) technology, developed during fusion energy research, may provide the answer.

In a CRADA in place since 1994 between PPPL and the Textile Research Institute (TRI), PPPL researchers are developing noncontact

optical and spectroscopic techniques to measure the characteristics of synthetic fibers—i.e., nylon and Dacron—during production. The CRADA is a part of the American Textile Partnership (AMTEX)—a government-industry consortium of leading textile and apparel manufacturers put together to help restore the competitiveness of the fiber industry. Once this technology is developed, the fiber industry will be able to monitor the quality of synthetic fibers online as the fiber is being made.

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INSIDE

This issue of NEWSLINK focuses on MANUFACTURING. The March issue will focus on chemical technology.

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FED LABS FLASH

Technology transfer news, notes, and events within the federal lab community

Kammer Retires as NIST Director

Ray Kammer, NIST director since 1997, retired on December 29, 2000, after 31 years in public service. He was appointed as the 11th director of NIST in September 1997 by President Clinton. Kammer also served as deputy director of NIST twice—from 1980 to 1991, and again from 1993 until his appointment as director.

Deputy Director **Karen Brown** is serving as acting director.

For more info: Michael E. Newman, 301-975-3025, michael.newman@nist.gov

NASA Considers Discovery Mission Proposals

In the first step of a two-step process, NASA's Office of Space Science selected three proposals for detailed study as candidates for the next Discovery Program mission. The program provides frequent, low-cost access to space for planetary missions and missions to planets around other stars.

Each selected team will receive \$450,000 to conduct a four-month implementation and feasibility study. NASA will then select one of the three later this year for full development, with a mission launched by 2006.

The selected proposals include the development of a space telescope, a Jupiter orbiter, and an orbiter of Vesta and Ceres, two of the largest asteroids in the solar system.

For more info: <http://discovery.nasa.gov>

DOE Names Two INEEL Technologies Best Consumer Products

Two technological advancements from the DOE's Idaho National Engineering and Environmental Laboratory (INEEL) have been honored by the DOE for work that demonstrates the DOE's commitment to save money and improve the quality of life for consumers.

INEEL's lithium battery solid electrolyte topped a list of over 100 technologies nominated by the DOE laboratories for two special awards. It promises safer, more versatile, and longer lasting rechargeable batteries—as much as 50 percent longer than other electrolytes. Further, waste products derived during production can be converted into a fertilizer.

Also winning an award was the Rapid Solidification Process, a quick method for creating dies for mass production of everything from plastic toys to car parts. **NL**

For more info: Mary Beckman, 208-526-0061, beckmt@inel.gov

AFRL *from p. 1*

cost of composite structures—50 percent so far—by developing large, unitized airplane sections without fasteners. Fasteners add weight and therefore cost. The manufacturing technologies developed through the CAI have clearly laid the groundwork for the increased use of structural composites to replace metal structures.

New Industry Tools

Many CAI technologies are applied in current industry practices. For the Joint Strike Fighter (JSF) program and the new Air Force-Navy Unmanned Combat Air Vehicle (UCAV), CAI used its cost analysis tools, for example. In addition, JSF design trades are being implemented at Boeing Helicopter in Philadelphia; the F-18 production program is pursuing online control for advanced fiber placement; and demonstrations for the UCAV and the JSF are expected to show a 25-percent cost reduction for major structural sections.

Hager adds, "We've seen valuable successes come out of ManTech, real breakthroughs that offer manufacturing options for our current and planned weapon system" to help with the processing and manufacturing of composites. "These are tools that all of industry can use...and we're actively using them in the next generation vehicles.

There's no going back. Companies won't be working on their own anymore." **NL**

For more info: Dennis Hager, dennis.hager@wpafb.af.mil; www.ml.af.mil/divisions/mlm/mlm.html

PPPL *from p. 1*

The fibers originate as a strand, which is pulled like taffy from a molten polymer bath through a showerhead-like fixture called a spinneret. When the fiber is drawn, a stress established along each fiber causes the molecules in the fiber to align along the fiber axis. How well these molecules are aligned determines many of the physical characteristics of the fibers. The PPPL technology uses reflected laser light to analyze the molecular alignment and provide fiber manufacturers with a noninvasive online method of monitoring fiber quality.

Currently, a table-top prototype has been developed, and fiber evaluations have been conducted off-line. A patent has been issued for the technology and is accessible on the PPPL web site.

Lew Meixler, head of the PPPL Technology Transfer Office remarks, "While this technology addresses a specific area for the textile industry, we believe the same basic approach may be applied in other industries, such as fiber optics and the production of polymer films." **NL**

For more info: Lew Meixler, 609-243-3009, lmeixler@pppl.gov; <http://pst.pppl.gov/tt/>

New Wireless Technology to Serve Private Sector

A wireless communication technology capable of tracking items ranging from soldiers to honeybees is the foundation of a new company. **Wave ID** will license proprietary technology developed at **Pacific Northwest National Laboratory (PNNL)** and will be financed partially by **Battelle**, which operates the laboratory for the **DOE**.

Wave ID will develop and sell wireless communications systems based on identification technologies previously developed at PNNL. These systems will include radio frequency tags, which are wireless communication devices that range in size from a grain of rice to a credit card and can be used to identify, locate, or monitor items.

For more info: inquiry@pnl.gov

CERF Training Seminars Available Online

Fifteen training seminars that were presented as part of the **Civil Engineering Research Foundation's (CERF) International Symposium and Innovative Technology Trade Show 2000** are now available online thanks to a recent partnership with **AECdirect.com**. The workshops are presented as slides with audio narration, and certain continuing education credits are available for each seminar taken.

All of the seminars relate to the construction and design industry, and focus on a variety of topics relevant

to industry professionals. Case studies are presented to reinforce concepts and suggest ways to turn theory into practice. Presenters are recognized professionals from the international construction and design industry and academia.

For more info: Janet White, 202-626-7510, jwhite@aia.org; or www.aec.direct.com

FLC Southeast Region Names New Coordinators

The **FLC Southeast Region** is starting the new year with a new Regional Coordinator, **Art Stephen**, and a new Deputy Coordinator, **Kelly McGuire**.

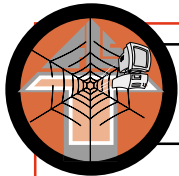
For more info: Art Stephen, 803-725-5500, arthur.stephen@srs.gov
Kelly McGuire, 256-876-8743, kelly.mcguire@rddec.redstone.army.mil

NASA, Carnegie Mellon Tap Partners

Carnegie Mellon University has teamed with **NASA Ames Research Center** and a sampling of today's foremost information technology companies to eliminate failures in critical computing systems.

High Dependability Computing Consortium partners include such companies as **Adobe, Compaq, Hewlett Packard, IBM, Microsoft, Sun Microsystems, and Novell. NL**

For more info: www.wtonline.com



Technology Transfer on the World Wide Web

Advanced Materials and Processes Technology Information Analysis Center (AMPTIAC)

<http://amptiac.iitri.org>

AMPTIAC has the broad charter to support the **Department of Defense (DOD)**, other federal departments and agencies, and the U.S. industrial base by acquiring, analyzing, archiving, and distributing scientific and technical knowledge associated with advanced materials and processes. AMPTIAC's engineering staff can help identify and interpret customer needs in material technology, and then provide off-the-shelf materials advice and solutions. AMPTIAC maintains a growing knowledge base of over 210,000 technical reports developed primarily by the DOD research and engineering community and DOD contractors over the past 50 years.

No other single library has as many documents associated with the development and application of advanced materials for defense applications. Many of the library's collection of documents are searchable online through the web site, although certain documents are limited in distribution because of export control or other restrictions. Customers who need advanced access may do so through AMPTIAC's Inquiry services.

National Materials Information System (NAMIS)
<http://namis.iitri.org>

Published by AMPTIAC, this integrated system provides technical information to the materials community. NAMIS serves as an information system for design engineers and materials professionals involved with materials selection for component designs. Three modules—Virtual Libraries, Material Property Data, and Conference Modules—are available through limited or full subscriptions.

By subscribing to NAMIS, you receive access to the information and technologies contained in the site, including an infrared materials database where you can find test data and citations to relevant technical reports.

Another database module addresses electromagnetic window materials. Part of its Conferences & Workshops area, this module provides online access to technical papers submitted at the biannual Electromagnetic Windows Symposium. Many other technology areas are contained in NAMIS. To obtain full access, all you have to do is subscribe! **NL**



TECHNOLOGY WATCH

Federal laboratory technologies available for technology transfer



Numerous Applications Await Air Force Microtube Devices

Last September, the latest in a series of microtube patents was issued to two researchers at **Edwards AFB**. Titled "Microscopic Tube Devices and the Method of Manufacture," it describes devices composed of at least one microscopic hollow tube with a wall thickness of at least one nanometer and a diameter of at least five nanometers.

These microtubes can be made from almost any material and are so small that hundreds can fit into the diameter of a single strand of human hair. In contrast to tubing currently available on the market, they can be crafted inexpensively in a variety of precise cross-sectional and axial shapes from almost any material, with precisely controlled composition, diameter, and wall thickness in a range of lengths. Tubes ranging in sizes from 0.5-410 microns have been made from materials such as copper, gold, and platinum, ceramics such as carbon, sapphire, and silicon nitride, glasses, polymers, alloys, and layered combinations. The tubes become channels in a monolithic or composite body, and the channels can have a random or ordered orientation if the space between the tubes fills. In addition, the interior of the tube walls can be coated with a desired material such as a catalyst and may also have depressions or elevations therein that are imparted to the fibers on which the tubes are formed.

Numerous applications for these microtubes have been identified in the aerospace, automotive and medical industries, and they work equally well for high and low temperature materials. They appear to have almost universal application in areas as varied as optics, electronics, medical technology, and micromechanical devices.

For more info: Kristin Schario, 937-255-3428, kristen.schario@wpafb.af.mil



Thin is in: Several microtubes are superimposed over a human hair with a width of 100 microns.

Improved Manufacturing Process Reduces Aircraft Radar Component Costs

Under a contract with the **Air Force Research Laboratory Materials and Manufacturing Directorate, Northrop Grumman Corp.** has developed an improved manufacturing process for F-22 aircraft radar components that could save nearly \$87 million on a planned production run for the aircraft.

The F-22's APG-77 electronically scanned array antenna is composed of several thousand transmit/receive modules, circulators, radiators, and manifolds assembled into subarrays and then integrated into a complete array. The baseline design used thousands of hand-soldered flex circuit interconnects between the components that make up the subarray. By replacing these with ribbon bonding interconnects, eight different part numbers are eliminated, and the interconnects can be readily programmed in response to changes in subarray design.

In addition, before the process improvement, APG-77 radar subarrays averaged more than three defects per subarray requiring rework. With the new interconnect process, defects requiring rework have been reduced to less than one defect per eight subarrays, and the process for reworking a defective ribbon bond is much simpler.

For more info: Walter Spaulding, 937-904-4365, walter.spaulding@wpafb.af.mil

FLC Web Site

We continually update our web site with new technologies categorized into 15 industry topic areas—agriculture and food processing, assistive technology, automotive, biotechnology and medicine, chemical, computers and software, electronics, energy, environmental, law enforcement, manufacturing, materials, photonics, sensors, and transportation. Simply go to www.federallabs.org and click on TECHNOLOGIES. New entries are added weekly!

Have a suggestion for a tech transfer web site?
Send an e-mail with the URL to flcnews@utrsmail.com

Attention Universities and Colleges!

Have you asked for your free subscription to *EduLink*—the FLC's newsletter highlighting federal technology transfer programs with universities and colleges? The debut issue was inserted in the September 2000 issue of **NEWSLINK**.

To subscribe: Send an e-mail to flcnews@utrsmail.com and type "Subscribe EduLink" in the subject line.

Possibly World's Smallest Robot Being Developed by Sandia

At 1/4 cubic inch and weighing less than one ounce, what may be the world's smallest autonomous untethered robot is being developed by researchers at the DOE's Sandia National Laboratories.

Powered by three watch batteries, it rides on track wheels and travels about 20 inches a minute. The robot consists of an 8K ROPM processor, temperature sensor, and two motors



Pocket change: Mini-robot turns on a dime and parks on a nickel.

that drive the wheels. Enhancements being considered include a miniature camera, microphone, communication device, and chemical microsensor.

The robots may be capable of relaying information to a manned station and communicating with each other and, like insects, would work in swarms.

They may also be asked to perform difficult tasks that are done with much larger robots today—such as locating and disabling land mines or detecting chemical or biological weapons.

The ultimate size of the miniature robot will be dictated by its power source—three watch batteries. Decreasing battery size while increasing battery life remains a major issue for the researchers at Sandia.

In 1996, a 1-cubic-inch robot was unveiled. By eliminating the packaging of electronic parts and using electronic components in dye form, the size of the robots was reduced considerably. With additional new techniques in wheel design and body material, the robots were eventually shrunk to 1/4 cubic inch.

For more info: Doug Adkins, 505-844-0611, dradkin@sandia.gov

Structural Integrity Tests to Be Developed for Auto Assembly Lines

In today's typical U.S. automobile manufacturing plant, production components are pulled off the assembly line at regular intervals and torn down for inspection. Not only is this a time-consuming and costly procedure, it is also only a random statistical sampling and not an inspection of every component that is manufactured. Researchers at the Lawrence Berkeley National Laboratory's Engineering Division are developing new nondestructive evaluation (NDE) imaging techniques for the assembly line that will immediately spot component problems and flaws.

These techniques offer the promise of testing 100 percent of all production components in real-time with the ability to spot problems immediately. In addition to monitoring product quality, online NDE can also be used to monitor the production process and identify areas in which the process can be improved, e.g., production efficiency and waste reduction.

For use in an automobile manufacturing plant, NDE must be able to reliably operate under hot, dusty, and noisy conditions. Diagnostics must also be performed quickly and accurately. Researchers in the Engineering Division have been working to develop NDE sensors and data processing and modeling tools. To date, they have experimented with a wide range of NDE methods, including acoustics and infrared thermography.

Lightweight composite materials must be adhesively bonded, which means that traditional tear-down safety inspections of spot-welded steel structures cannot be used. Using more lightweight metals (aluminum and magnesium) and composite materials in place of steel in the components of automobile bodies could reduce overall vehicle weight by 40 percent or more and make the dream of 80 miles per gallon of gasoline an industry standard. These techniques will be needed if such vehicles are ever to become a commercial reality.

For more info: Shanshan Taylor, 510-486-6461

Foaming Soy Adhesives Could Help Soybeans Bond with Lumber Industry

Agricultural research scientists at the National Center for Agricultural Utilization Research (NCAUR) in Peoria, Ill., are using soy to replace animal blood protein in plywood glue formulas. The search for alternative protein extenders (substances added to an adhesive to reduce the amount of resin required) addresses concerns



Super Glue: Research associate Mila Hojilla-Evangelista prepares a sample of soy-based plywood adhesive to test its foaming ability. The glue is designed to be applied by foam extrusion.

about animal blood's limited supply and about health issues. This has also given the plywood industry faster production at lower cost.

Soy flour, at 22 cents per pound, is 50 cents per 100 kilograms cheaper than conventional formulations. Soy flour makes

up 3.5 to 5.5 percent of the glue mix, with the adhesive resin being the primary component.

The plywood glues were designed to be applied by "foam extrusion," which is one of four conventional ways the industry applies glue to wood. Because soy flour contains less protein than animal blood, it cannot be used one for one in place of blood protein. Researchers found that increasing the amount of soy flour produced glue that foamed better at an even lower cost.

Other benefits of the foamed soy-based glue are that it requires less drying time, uses less water, and produces less waste than conventional plywood glues.

The new glue could create an additional domestic market for nearly one-half million bushels of soybeans annually. Pacific Adhesives Co. of Portland, Ore., is testing the three soy-based glue formulas in pilot trials.

For more info: <http://www.nps.ars.usda.gov>, 309-681-6350

TECH WATCH *continued*

Army Tank Technology Diagnoses Hypertension

The Army Research Laboratory (ARL) is field testing a diagnostics system for hypertension patients. The technology was originally developed to help mechanics find and fix problems with the turbine engine diagnostics (TED) system of the Abrams tank.

The Remote Medical Evaluation and Diagnostics (RMED) system couples an adapted commercial off-the-shelf blood pressure monitor with an advanced decision support system to collect, monitor, and analyze patient data from remote locations. The RMED reads a patient's blood pressure from home and automatically downloads it by modem to medical personnel for diagnosis and treatment. Home monitoring saves patients and medical staff time and money, and provides more frequent and accurate readings. New information forms a database to assist in treating patients with similar problems.

For more info: Dave Davison, 301-394-2302, ddavison@arl.mil

Wool and Cotton Can Now Dye Together

A process to make cotton more chemically similar to wool so the two fibers can be combined into an easily dyed fabric blend has been developed

by scientists at the Agricultural Research Services' (ARS) Eastern Regional Research Center in Wyndmoor, Pa.

This new single-bath dyeing procedure, called union dyeing, is for wool/cotton blends. Normally, when wool and cotton are blended together, two separate dye baths are required.

Before the new process was developed, dyeing a cotton/wool blend was difficult because the two fibers have different chemical makeups, leading to uneven coloring. Wool takes up most of the dye, while the cotton is left mostly undyed.

ARS's simple approach is to reverse the chemical charge of cotton from negative to positive before dyeing so both fabrics are positively charged. (Wool is already positive.) The scientists use positively charged compounds called cationic fixatives, which are typically applied after cotton is dyed to help it retain color.

Since the dye is negatively charged and opposites attract, the cotton and wool dye to a uniform shade because the dye is attracted equally to both fibers. This one-step union-dyeing process can be done with one dye, in one bath, under one set of conditions.

Experimental textile treatments such as this may broaden the market for cool-weather garments made of wool and cotton blends. This technology could cut textile dyeing costs—passing the savings to

consumers seeking versatile garments for spring and fall.

For more info: William N. Marmar, 215-233-6585, wmarmar@arserrc.gov

Don't Just Fight Tooth Decay... Reverse It!

By understanding how tooth enamel forms and dental caries occurs, researchers at the **Paffenbarger Research Center** in Gaithersburg, Md., in a collaboration between the **American Dental Association Health Foundation** and the **National Institute of Standards and Technology**, are developing remineralization therapies—a form of tissue engineering—to help teeth regenerate. One possibility now undergoing clinical trial is adding calcium phosphate—naturally present in saliva—to toothpaste, chewing gums, and mouth rinses.

Researchers also are looking into the development of a "smart material" for fillings that could prevent cavities from recurring. When decay-producing acid starts to build up around the tooth or filling, cavity-fighting ingredients would be released to neutralize it. New materials also could reduce the need for root canals. Placing a sticky remineralizing material on the exposed pulp could speed up the natural repair process. **NL**

For more info: Pamela Houghtaling, 301-975-5745, pamelahoughtaling@nist.gov

A Look Back in Time...

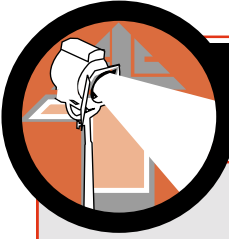
As the 21st century "officially" begins, **NEWSLINK** looks back in time to 1991. The official FLC newsletter, aptly titled *The FLC News* since its debut in April 1985, was renamed *News Link* beginning with the January 1991 issue.

The front page story discussed, among other items, the expanded role of federal laboratories in education. Summer training programs for middle school teachers in New Mexico and Native American secondary schools in New Mexico and Arizona were developed. Other partnerships with federal labs and local school systems at the middle school, high school, and collegiate levels were developed to varying degrees; some introduced children to science programs, while others gave students the opportunity to further their skills while working with volunteers from federal labs.

Meanwhile, processes to create silicon-carbide fibers from polymers and to recycle chromium waste from leather production were introduced. Additionally, a method was found to accurately map planar geological features in deep underground mines where metal routinely interfered with previous methods.

Researchers also developed new ways to remove nitrous oxide from concentrated waste combustion gas streams. Finally, the Air Force agreed to pursue and share technologies with the **Iacocca Institute** at **Lehigh University**. **NL**





SPOTLIGHT ON SUCCESS

Success stories from the federal lab community

Russia – DOE Kansas City Plant Partnership Has Potential to Save Millions of Children

A team of Russian bioengineers and Felton Medical, Inc. have signed a Cooperative Research and Development Agreement (CRADA) with the DOE's Kansas City Plant to facilitate a new partnership that could save millions of lives.

This CRADA will yield innovative needle-free inoculation technology that could remove one of the key barriers to immunizing children in Third World countries and save the lives of more than one million children each year.

"Together, this international team of engineers, scientists and medical equipment specialists will further refine devices that can safely inoculate up to 600 children per hour," explained **Alan Felton**, founder and CEO of Lenexa, Kansas-based Felton Medical. "This is a remarkable project that has come together through extraordinary circumstances. I can only hope that our ultimate outcome will be as extraordinary and that we can help children around the world have a healthier start in life." Currently, more than one million children in developing countries die each year from measles because they cannot be safely and effectively immunized. Needles are expensive and difficult

to handle in challenging environments. In extreme cases, caregivers must choose between inoculating a child and potentially transmitting bloodborne diseases by reusing a needle.



Pictured left to right: Alan Felton, founder of Felton Medical; Beth Sellers, Area Manager, DOE Kansas City Area Office; and Russian Yuri Shipulin, vice president of Chemical Automatics Design Bureau. Inset: This needle-free injector has the potential to safely inoculate up to 600 children per hour.

Felton Medical, a distributor of medical devices for livestock, has purchased the intellectual property rights for this needle-free technology from the Chemical Automatics Design Bureau (CADB), the Russian rocket-engine laboratory that developed it. The needle-free devices use high-speed propulsion to administer medications.

CADB's unique technology includes a protective barrier that prevents the transfer of pathogens between patients. Several models have been developed, including single- and multi-dose units.

The **World Health Organization (WHO)** has confirmed the need for this type of device. WHO, along with the **Centers for Disease Control, Johns Hopkins University School of Medicine, the Program for Appropriate Technology for Health, and the University of Florida**, has contributed funding, research, or testing to this project. **NL**

For more info: Jack Quint, 816-997-2514, jquint@kcp.com

For more success stories, visit the FLC web site at www.federallabs.org



COMING ATTRACTIONS

<p>April 5-6, 2001 Manufacturing Productivity Growth in the 21st Century Washington, DC</p> <p>The conference program includes a keynote address from a leading corporate executive on the revolution in U.S. manufacturing, panel discussions on the evolution and future of U.S. manufacturing sectors and the economy, including sponsored presentations from technology vendors, and policy discussions on the impacts of the Bush Administration and the 107th Congress.</p> <p>Bryan Borkik, 202-216-2743</p>	<p>April 24-25, 2001 Northwest Measurement Control and Automation 2001 Portland, OR</p> <p>Sponsored by the Portland and Pacific sections of the International Society for Measurement and Control, this conference will provide information and technology related to devices, software, and services for the measurement, control, information, and automation markets.</p> <p>503-720-7893, jh@nwmcia.com, or www.nwmcia.com</p>	<p>April 24-26, 2001 Process Industries Exposition (PIE) Houston, TX</p> <p>More than 5,500 chemical processing Industry (CPI) representatives from all sectors of the CPI industry will attend this meeting. Subject areas to be featured include safety and environmental issues, process control and automation, and maintenance and retrofit issues. Visit the FLC at Booth 1418!</p> <p>www.processexpo.com</p>
<p>April 29-May 1, 2001 AGA Operations Conference and Biennial Exhibition Dallas, TX</p> <p>Sponsored by the American Gas Association, this show features products offered for the operating functions of gas utility and transmission companies.</p> <p>410-997-0763, aga@epponline.com</p>	<p>April 30-May 4, 2001 2001 FLC National Meeting Burlington, VT</p> <p>With a theme of "FLC and Beyond," this year's meeting is unique because the FLC is partnering with the Transatlantic Technology Forum (TTF) to offer attendees a variety of educational sessions focused on tech transfer practices and processes from around the world—offering the chance to learn new ways of conducting tech transfer. Basic and advanced training will be offered.</p> <p>Sherry Nacci, 856-667-7727 or www.federallabs.org</p>	<p>June 12-13, 2001 Technology Showcase Aberdeen Proving Ground, MD</p> <p>A comprehensive exposition of the diverse technology resources available within the Aberdeen Proving Ground (APG) is planned. The two-day program will showcase the diverse testing, engineering, training, and research ongoing at APG.</p> <p>410-278-4639, ssanders@atc.army.mil</p>



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