Appendix C: **Service / Agency Highlights**

Army

Adaptation of Intermediate Moisture Food Technology Produces Quality Rations

The team of Jack Briggs, Michelle Richardson, and Dr. Andre Senecal, U.S. Army Soldier and Biological Chemical Command (SBCCOM), Natick Soldier Center (NSC) received a 1999 FLC Award for Excellence in Technology Transfer for achieving a technical breakthrough in developing military rations that look freshly prepared yet can be kept at room temperature for up to three years. Besides meeting Army mobilization requirements, the technology reflects innovations in intermediate moisture food (IMF) technology, which carefully balances moisture, pH, and water binding to give foods soft, moist qualities without promoting microbiological growth. The team's work led to the development of several types of pocket sandwiches.

The team's transfer of IMF technology to industry resulted in the commercialization of the rations with Sara Lee Bakery. Working under two CRADAs, Sara Lee Bakery and NSC are actively producing extended shelf-life bakery items that do not require refrigeration. A second CRADA with GoodMark Foods, Inc. focuses on developing and commercializing the meat-filled sandwich components. The team's success has also resulted in inquiries from other major industrial food organizations.

The technology simplifies shipping, distribution, and handling and increases soldier acceptance, mobility, and consumption. The team's work also demonstrates how Federal lab technology can strengthen the U.S. industrial base—providing synergistic benefits to all partners.

Formulation of a Liposomal Transdermal Vaccine System and Other Novel Pharmaceuticals

MEDICAL TECHNOLOGY and Practice Patterns Institute

In April 1999, U.S. immunologists made a major discovery. Immunization could be induced by simply adding an antigen like influenza, diphtheria, or tetanus to cholera toxin (CT)--a bacterial product commonly used to enhance the immune response, dropping the mixture on the skin, and applying a band aid. This new, needle-free technique successfully induced immunization in a broad range of animal tests; moreover, the technique excelled by producing both blood-borne antibodies and harder-to-achieve mucosal immunity. The technique, called transcutaneous immunization (TCI), received its patent on November 9, 1999.

The TCI discovery, can be credited in part to the Walter Reed Army Institute of Research (WRAIR) through research performed under a CRADA. The CRADA, which initially partnered WRAIR and the non-profit Medical Technology and Practice Patterns Institute (MTPPI), began with developing a vaccine technology to devise an effective, safe, and easily administered delivery mechanism for vaccination. The WRAIR-MTPPI team's first patented needle-free technique was for liposomal transcutaneous vaccination. Under the CRADA, MTPPI licensed the vaccine technology and then sublicensed the technology to a new company, IOMAI Corporation.

The FDA has approved TCI's Investigation of New Drug Application (NDA); this approval opens the way for human trials. Initial key commercial markets may include the influenza and tetanus vaccine markets. WRAIR and IOMAI, in partnership with other immunology specialists, are also exploring TCI applications for possible vaccines against cancer and HIV. The CRADA between WRAIR and IOMAI is continuing.

Vaccines for Infectious Diseases

Ora Vax and Walter Reed Army Institute of Research (WRAIR) are working together in a CRADA to manufacture vaccines for such diverse ailments as peptic ulcers, which can lead to stomach cancer, and Japanese encephalitis. The collaboration focuses on producing products ready for use in Phase I and Phase II clinical trials. WRAIR is contributing the controlled facilities required for this type of production, while Ora Vax is providing the resources and revenue to the WRAIR mission and will work to manufacture and commercialize the vaccines.

Heat Stress Monitor (HSM)

The hand-held miniature Heat Stress Monitor is an electronic device that automatically measures air temperature, wind speed, humidity, solar radiation, and barometric pressure, and uses embedded physiological models to provide tailored guidance on optimal work/rest cycles, maximum safe work times, and hourly drinking water needs. A CRADA between the U.S. Army Research Institute of Environmental Medicine (USARIEM) and Occ-Consult, Australia, entitled: "Production Development of a Hand Held Heat Stress Monitor for Application in Australian Industry," resulted in 30 prototype miniature HSMs being built and tested in deep mine environments in Australia. This development effort leveraged several hundred thousands of dollars in industry funding resources for heat stress management technologies needed to support occupational health and safety in deep mine operations.

Anti-Freeze Proteins

A/F Protein Inc.

Preliminary findings related to the CRADA between the U.S. Army Research Institute of Environmental Medicine (USARIEM), Natick, MA, and A/F Proteins, Incorporated, Waltham, MA, show that the company's proprietary preparation (AFP-1) protects a model of human skin against injury caused by freezing at -8 degrees C. Testing is currently being repeated and if successful, AFP-1 may be included in a skin cream to be tested in its ability to protect soldiers against frostbite during cold weather military operations or recreational activities. If successful in protecting against frostbite, its potential for civilian application in cold-weather recreational activities (e.g., winter skiing, camping, ice-fishing) or commercial enterprises (e.g., winter fishing, mining) is very promising.

The Lasform SM System

AEROMET™

Using a CRADA, a team of Army Research Laboratory engineers successfully completed a technology transfer of a new laser forming rapid prototyping technology: the Lasform SM process and system. This technology was commercialized by AeroMet, a subsidiary of MTS Systems Corporation, both of Eden Prairie, Minnesota. AeroMet was founded in 1997 with the sole purpose of commercializing the ARL's vision and direction in rapid prototyping. The Lasform SM system is the largest rapid prototyping system in the world. The process is a flexible, one-step method in which a powdered

metal is deposited as molten droplets onto a metallic substrate located beneath the focused beam using computer numerical control instructions. The resulting near net geometry of parts provides many advantages when compared to conventional metal forming systems.

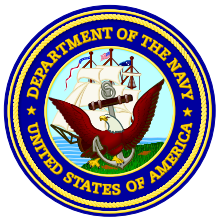
Low Temperature Battery

The U.S. Army Communications and Electronics Command Research, Development and Engineering Center, Command/Control Directorate has developed a low temperature electrolyte battery for the U.S. Army and other government agency use under a DARPA funded Technology Reinvestment Program (TRP). The current commercial lithium battery cannot operate when the temperature falls below –20 C. The Army has pioneered the development of a new leading low temperature electrolyte for lithium battery technology which has opened the door for the electric car to become a reality in the near future. Seventy-three percent higher energy in "D" size cells have been demonstrated at –30 C. Saft America, Inc. not only chose this electrolyte instead of their own electrolytes for their own commercial batteries, but also uses this electrolyte for NASA/Air Force military programs. This low temperature electrolyte has been selected by NASA/JPL for the 2001 Mars Lander/Rover mission. The Air Force has also used this electrolyte to meet their low temperature battery requirements.

Improvements to the Laser Pattern Generator

Rochester Photonics Corporation
DIFFRACTIVE OPTICS SPECIALISTS

Through a CRADA between the U.S. Army Communications and Electronics Command Research, Development and Engineering Center and Rochester Photonics Corporation, improvements were made to the Laser Pattern Generator by writing surface relief structures in photoresist. This work will enable Rochester Photonics Corporation to further develop various head-mounted displays. This CRADA was an additional phase of work in connection with an on going Cooperative Agreement that is focusing on developing varying diffractive optics technology for a variety of commercial and military equipment. The statement of work for the Cooperative Agreement did not anticipate the research necessary to upgrade the equipment to make the newly developed diffractive optic elements. Therefore, a CRADA was selected as the mechanism of choice for carrying out the unanticipated work. The diffractive optical elements, which were made from the improved Laser Pattern Generator, will be incorporated into virtually all of the optical systems or testbeds made as part of an ongoing project, including the full-color, liquid crystal based head-mounted displays, a CRT based head-mounted display, and an IR zoom lens assembly for missile guidance.



Navy

Innovative Flat Panel LCDs Offer Many Military and Commercial Uses

Dr. Ranganathan Shashidar, U.S. Naval Research Laboratory (NRL) received a 1999 FLC Award for Excellence in Technology Transfer for his work in pioneering the development of novel liquid crystal materials for advanced optical display devices and information processing and successfully transferring the technologies to the commercial and military sectors. His work encompasses two critical areas of liquid crystal displays (LCD)—the alignment of liquid crystals and the design of plastic substrates for LCDs.

In 1996, NRL entered a CRADA with Shipley Company and proposed Dr. Shashidar's novel approach to liquid crystal alignment as an alternative to conventional processing of LCDs. The CRADA was so successful that it was extended twice. Under the most recent extension, Shipley was granted a partially exclusive right and license to practice three of the inventions in the field of LCD manufacturing.

In 1997, NRL and Opticom ASA entered a CRADA to select, develop, and build a printing system to apply high resolution patterns of conducting and semiconducting materials onto flexible plastic substrates. This CRADA was recently amended to focus on commercialization.

Commercial applications of the technologies include flat panel displays of all kinds and are expected to significantly affect the $22 billion LCD industry. The technologies could replace the traditional polyimide process in existing manufacturing lines and may open new lines.

Chaos Control Applied to Cardiac Fibrillation and Epileptiform Behavior in the Brain

Dr. Mark L. Spano and Dr. Visarath In, Naval Surface Warfare Center, Carderock Division, received a 1999 Federal Laboratory Consortium (FLC) Award for Excellence in Technology Transfer for their life-saving work on the application of chaos control to cardiac fibrillation and epileptiform behavior in the brain.

The doctors investigated controlling atrial fibrillation by altering and regulating local electrical activation of the high right atrium during atrial fibrillation—the most common arrhythmia requiring treatment. They also tried to regularize the electric spiking of the brain during epileptic seizures. In a CRADA with the Georgia Institute of Technology and Emory University, they began a course of experimental investigations that led to the successful application of chaos control.

Dr. Spano led his group in aggressively pursuing academic and commercial involvement in marketing applications of chaos control. This led to an innovative marketing agreement between UCLA and the Navy, which resulted in a license for the initial cardiac work to Medtronic, Inc. and Control Dynamics, Inc.

These techniques are now being applied to ventricular fibrillation—a severe heart dysfunction that is the leading killer of adults in the U.S. If this effort is as successful as the previous work, many lives could be saved.

Malaria Genome Project

The Naval Medical Research Center (NMRC) collaborates with a number of companies in an effort to produce vaccines and vaccine applications relevant to both DoD and the commercial sector. NMRC's CRADA with The Institute for Genomic Research (TIGR) involves the use of cutting edge technology in order to determine the DNA sequence of two human malaria parasites. Malaria is a disease which traditionally has exerted a large negative impact on DoD field operations. Discovery of the malaria parasites' DNA sequences will increase understanding of the parasites and may lead to the development of better therapeutics and vaccines.

Some successes have already been attained. As published in the November 6, 1998, edition of *Science* Magazine, the NMRC-TIGR partnership resulted in the complete DNA sequence of Chromosome 2, the sequence for 1 million of the nucleotide base pairs under investigation. Naval Commander Daniel Carucci, principal investigator on the project for NMRC, stated that this success was the first of many and would not have been possible without the CRADA mechanism. The CRADA mechanism will hasten the development of new intervention strategies against malaria by partnering cutting genomic sequencing technology with the Navy's prestigious malaria vaccine program.

Vice Admiral Bowen Award

This past year, Erich Baitis and Dennis Woolaver were recognized by the Chief of Naval Research (CNR) for their invention that allows a ship to perform its motion-sensitive warfare tasks by reducing these motions with the rudders while simultaneously steering the ship as well or better. This use of the rudder for simultaneous steering and roll stabilization was patented. Mr. Baitis and Mr. Woolaver were presented with the Vice Admiral Bowen Award, which is named in honor of Vice Admiral Harold G. Bowen, who was the first CNR. The award honors one patent annually that is determined to have had a significant impact upon the sailor and the Navy.

The invention, called the Rudder Roll Stabilization (RRS), uses the rudders to compensate for wind- and wave-induced roll motions. The RRS invention provides substantial roll reductions without negatively affecting either the ship's steering or the reliability of the steering machinery. Since every ship has to have a steering system, the use of this system to simultaneously stabilize the ship in roll and thus increase the ship's seakeeping qualities has provided the U.S. Navy with a cost-effective method of improving ship's capabilities to perform assigned missions in heavy weather.

The RRS function was incorporated into the DDG 51 production steering system by integrating it directly into the autopilot. This full integration into the steering system then deleted the additional steering redundancy featured in the patented system. A 20% to 30% operational gain using rudder roll stabilization was observed in rough weather seasons. In a combat situation, this could translate into the difference between successfully defending the ship or losing the ship. As a direct result of the experience on the first four ships of the DDG 51 Class, the decision was made to outfit the entire ship class with the RRS system as an integral part of the ships' steering controllers.

The U.S. Navy currently deploys 26 RRS systems, with one system in DDGs 51 through 77. Furthermore, each of the follow-on ships will have the RRS system installed as a component of the normal steering system. The use of the RRS in future naval combatants will increase as the ships are built. Plans are being made to outfit the DD 21, and the follow-on CVs with RRS as part of their autopilot systems.

The Coastal Systems Station Issues a Non-exclusive License for Fire Helmet Communications

In 1994, three Pittsburgh Firemen lost their lives in what should have been a routine fire. The NASA Mid-Atlantic Technology Applications Center (MTAC) collaborated with the Chief of the Pittsburgh Fire Department to search the Federal laboratories for technologies that would be applicable to the fire fighting community in order to prevent such tragic incidents from occurring.

In November 1997, CSS demonstrated its capabilities in head contact microphone technology (HCM), originally developed for the Navy Seals), to the Pittsburgh Fire Department. Benefits of the HCM include: hands-free communication, interoperability, waterproofness, and increased voice clarity/ambient noise rejection. CSS was asked to put together an initial prototype showing how the HCM could be adapted to a fire helmet and demonstrate it to members of the Pittsburgh Fire Department Administration (PFDA). The PFDA supplied CSS with a fire helmet to construct Bench Prototype II.

The Prototype II was demonstrated in March 1998 at the Pittsburgh Fire Department Training Center. Industry companies were invited to a public demonstration during a live fire test. MTAC referred Radio Ear to CSS for potential licensing and commercialization of HCM to the fire fighting community. A nonexclusive license was issued in April of 1999.

Intellectual Property Management Information System (IPMIS)

The Office of Naval Research has developed the Intellectual Property Management Information System (IPMIS) to track all of the Navy's inventions and licensing activities. The invention tracking portion of IPMIS is in operation and nearly all eighteen of the Navy Offices of Patent Counsel are currently using it to track all of their inventions. IPMIS tracks inventions from the disclosure of the invention through the filing of any applications for patent in the United States Patent and Trademark Office. IPMIS also tracks the issuance of a patent including payment of fees. It is planned that IPMIS will track the licensing of all Navy inventions. ONR currently has an internal tracking system for the Navy's licensing efforts.

1-800-NAVYTEC

For the last several years ONR has maintained a 1-800 line (1-800-NAVYTEC) at the National Technology Transfer Center via which it attempts to match the technology needs of civilian firms with the technologies and technological expertise of the Navy laboratories.

Air Force

Highly Reliable Heterojunction Bipolar Transistor (HBT Circuits)

The team of Chris Bozada, Charles Cerny, Greg DeSalvo, Ross Dettmer, Jack Ebel, Tom Jenkins, Jim Gillespie, Kenichi Nakano, 1Lt. Carl Pettiford, Tony Quach, Jim Sewell, G. David Via, 1Lt. Ryan Welch, Air Force Research Laboratory (AFRL) Sensors Directorate won a 1999 FLC Award for Excellence in Technology Transfer for successfully transferring AFRL's patented thermally-shunted heterojunction bipolar transistor (TSHBT) technology to industry – specifically to Northrop Grumman's Electronic Sensors and Systems Division. TSHBT is a high-performance electronic device that has state-of-the-art performance for microwave power amplification.

The achievement was recognized by a large number of domestic and foreign companies that actively sought information and collaboration to benefit from the team's work. Efforts with Lockheed Martin, Hughes, Epitronics Corporation, Motorola, MA/COM, and M-Pulse ranged from information exchanges to working side-by-side to learn the detailed fabrication process. M-Pulse was able to produce a new product line based on this combined effort.

The team was competitively selected to transfer the technology to industry under the Federal Defense Laboratory Diversification (FDLD) program. The Northrop Grumman/Epitronics team was chosen to transfer and develop dual-use microwave products and a MMIC foundry process based on the Air Force technology. After FDLD programs were cancelled in 1996, the strength and success of the program were significant enough to continue the transfer under the Dual Use Applications program.

HBT technology has become the device of choice for cellular phone power amplifiers. The most tangible benefits of the technology are the simpler and cheaper design for cellular phones and longer operating times due to decreased power drains. The impact of this market is immense, and the breakthroughs of this technology will benefit the cellular phone industry through improved power, gain, linearity, and efficiency.

Performance-Enhancing Refrigerant Additive Reduces Energy Consumption

Joseph Gottschlich, Air Force Research Laboratory (AFRL), Propulsion Directorate won a 1999 FLC Award for Excellence in Technology Transfer for QwikBoost—a recent AFRL spin-off. QwikBoost is a low-cost refrigerant additive that increases the performance of air conditioners, heat pumps, refrigerators, and freezers using new, environmentally friendly, hydrofluorocarbon (HFC) refrigerants. Mainstream Engineering Corporation developed QwikBoost under an Air Force Phase II SBIR program.

Mr. Joseph Grottschlich formed a government interagency heat pump working group composed of representatives from NASA, the U.S. Army, and the U.S. Air Force through which he learned of a hybrid cycle heat pump. He obtained additional funding for the effort and used the SBIR program to put the technology on contract in a timely manner.

This technology, QwikBoost, transitioned from a promising concept to a commercial product in less than three years.

QwikBoost improves performance by effectively increasing the latent heat of the working fluid. A single application of QwikBoost increases cooling performance for the life of the system and reduces wear on the compressor. QwikBoost, which became available for auto air conditioners in early 1998, will debut in home appliances by 2000 and in residential air conditioners by 2003. The product will save consumers 10% to 20% on heating and cooling costs, while saving the nation billions of dollars in energy costs per year.

1998 General Ronald W. Yates Awards for Excellence in Technology Transfer

The General Ronald W. Yates Award for Excellence in Technology Transfer honors General Yate's numerous and lasting contributions to the Air Force Science and Technology Program. As the first Commander of Air Force Materiel Command (AFMC), this award was established as a tribute to his achievements and support of technology transfer. One individual and one team award are presented annually to personnel who work within AFMC and have made significant contributions to technology transfer.

High-Speed Electronic Imaging (Individual Award)

Mr. Donald R. Snyder, U.S. Air Force Research Laboratory Munitions Directorate was awarded the 1998 General Ronald W. Yates Award for Technology Transfer for his outstanding efforts to research, develop, and transfer high speed imaging technologies. The technology for electronic high-speed imaging and high-density storage has become a pervasive underpinning for the aerospace, Defense, and manufacturing community. The ability to convert to online digital high-speed imaging has been estimated to have billions of dollars in impact to the manufacturing community and has provided the technology base for next generation "brilliant" autonomous weapons; bridging the gap from television to scientific sensor with output rates capable of supporting the most challenging instrumentation or scientific applications.

The technology developed for high-speed imaging has spun off at least 10 commercial products with applications in medical imaging for cytology and neurology; automated inspection of advanced semiconductor/computer manufacturing; sports science/ medicine; astronomy; laser radar for collision avoidance; and flow diagnostics for research into advanced supersonic/hypersonic civilian and military aircraft.

Technology transfer to the medical arena includes Henry Ford Hospital adopting a high-speed imaging technology for real-time X-ray imaging of heart and other critical organ motion during airbag-crash testing. Walter Reed Institute of Research has employed technology for laser scanned imagery for precise 3-D mapping of head and dental features for construction of the physical features of military members with head injuries. Commercially, Hoffman-LaRoche and Teledyne Brown are exploiting the technology for high-speed automated inspection of slides for cancer cell detection.

Another current use of this imaging technology is the Naval Research Laboratory In-flight Oil Analysis System for real-time monitoring of particle growth in jet turbine engines which uses imaging technology developed by Mr. Snyder. This system is projected to save millions of dollars in both commercial and military jet engine maintenance costs and provide real-time warning and prediction prior to catastrophic engine failure.

+100 Jet Fuel Thermal Stability Enhancing Additive (Team Award)

The 1998 General Ronald W. Yates Team Award was awarded to Mr. Robert w. Morris and Mr. George Buchhalter Sr. for the Air Force Research Laboratory, Propulsion Directorate for their work on increasing the high temperature thermal stability of jet fuel by 100°F. The additive package acts like a "fuel injector cleaner" to inhibit the formation of gums, varnish, and coke in jet engine fuel injectors, manifolds, and afterburner components. In tests of fighters, trainers, helicopters, and cargo aircraft, the Air Force found reductions in fouling/coking and reductions in the maintenance required to replace and clean the fouled components.

In January of 1998, the Tampa Police Department contacted the Air Force Research Laboratory Propulsion Directorate to determine if the "+100" additive package would work in the jet A fuels used in police helicopters to reduce maintenance. The Tampa Police Department has been cleaning fuel nozzles weekly (approximately every 35 hours) and the Hillsborough Sheriffs Department cleans nozzles every 100 hours to allow uninterrupted use of their helicopters.

The team of Mr. Morris and Mr. Buchhalter coordinated with the police departments, Allison Engine Company, BetzDearborn (additive manufacturer), and Hammond (manufacturer of additive injection equipment) to contact and evaluate the additive. The goal of this effort was to extend the cleaning interval from less than 100 flight hours (weekly) to as many flight hours as possible before cleaning.

Since late January 1998, the Tampa Police Department has been able to increase the time between cleaning fuel nozzles from 35 hours to over 70 hours and Hillsborough has not had to clean a fuel nozzle for approximately 1000 flight hours. In addition, during this time no helicopter has experienced a reduction in power during flight, a major problem associated with fouled nozzles. The police department expects to save several thousand dollars per year by avoiding maintenance manhours and reducing the number of replacement parts. As an added benefit, the engine combustor hardware and engine exhaust appear to be cleaner with less smoke and soot being released into the atmosphere. The Air Force will realize a reduction in the cost of the additive as a result of the increased economy of scale in the production of the additive.

Office of Technology Transfer for Education (OTTE)

The Office of Technology Transfer for Education (OTTE) manages education outreach activities for and is jointly funded by the Air Force Research Laboratory/Space Vehicles Directorate (AFRL/VS) and AFRL/Directed Energy Directorate (AFRL/DE). The local neighborhood of OTTE is the State of New Mexico and surrounding areas.

The basic philosophy of OTTE is to foster and encourage partnerships which leverage resources, capabilities, and talents of schools and other education outreach providers. This list includes the Professional Aerospace Contractors Associations (PACA), Challenger Center for Space Science Education, New Mexico Technet Inc., Mathematics, Engineering and Science Achievement (MESA), NASA, Sandia National Laboratories, New Mexico Department of Education, New Mexico Tech, and other Federal and state agencies.

Within the OTTE model, AFRL provides mentors, equipment, access to technology, and training for teachers. Schools provide the expertise in teaching, classroom management, and long range educational goals and objectives.

Applications are encouraged from applicable schools through the State of New Mexico and surrounding areas. This includes participation by private schools and home school associations. OTTE also strives for the fullest participation by all students, including students with special needs, and students in alternative schools settings, such as Homebound and School on Wheels.

In FY 95, OTTE added an education component for elementary school students called Marsville®. Marsville® was developed by the Challenger Center for Space Science Education and was chosen because of its close tie into the laboratory's space technologies. Marsville® was piloted in the greater Albuquerque area with inclusion of two schools from Clovis, NM. In FY 96, OTTE began planning for state-wide expansion of Marsville®. In FY 98, Senator Domenici requested that the laboratory develop a program which would, through technology-based tours and mentoring, encourage middle school students who do not see themselves pursuing careers in mathematics, science or engineering to consider such careers. In collaboration with Albuquerque Public Schools, OTTE designed the Providing Engineering and Technology Experiences for Students (PETES) project. The PETES concept calls for developing these students as mentors for younger students and integrates character education philosophy into the process.

Through the efforts of Senator Domenici's office, in FY 98, partial funding of PETES and Marsville® was provided by NASA through the NM Space Grant Consortium. This funding was used to help offset costs for development of the PETES pilot project (FY 98 and FY 99) and expansion into one rural link-up site in FY 98 and three rural link-up sites in FY 99.

In FY 99, the number of schools participating in OTTE projects has significantly increased. The number of Marsville® schools increased by 130% from 18 in FY 98 to 39 in FY 99 and included the addition of three link-up sites at rural locations. At the Carlsbad Link-Up Site, the Mayor of Carlsbad read a proclamation declaring that day, April 8 1999, to be the Air Force Research Laboratory Phillips Research Site Day.

The Alliance for Photonic Technology (APT)

The Alliance for Photonic Technology (APT), is a partnership formed by the Los Alamos National Laboratory, Sandia National Laboratories, the University of New Mexico's Center for High Technology Materials, and the Air Force Research Laboratory – Phillips Research Site to enhance the global competitiveness of U.S. industry in the critical technology area of photonics by accelerating transfer of federally funded technology developed by APT's R&D participants to industry. APT's mission is to strengthen photonic technology related to products, markets, and services by working in partnership with U.S. industry to create a competitive advantage in the world market place. By leveraging the world-class photonic technology base of the R&D partners, APT facilitates collaborative research, development, and technical assistance with its industry partners. During FY 99, APT continued to support the New Mexico Industry Association (NMOIA) Cluster which connects some 50 optics and photonics companies within the state.

APT facilitated the successful partnership between Indigo Medical, Inc. and the APT R&D partner that led to the implementation of a new medical procedure. Through a CRADA, the Air Force Research Laboratory, Sandia National Laboratories, Los Alamos National Laboratory, and the private firm of Indigo Medical Inc. produced a unique laser system that offers an alternative to America's most prevalent in-patient surgery – the correction of benign prostate enlargement.

All Composite Truck Box

The Automotive Composites Consortium under the umbrella of USCAR (a consortium of Ford, General Motors, Chrysler, and the Department of Energy) has contracted with the National Composite Center (NCC) to develop the manufacturing process that will allow the economical production of an all composite pick up box. The major goal is for the composite structure to be cost competitive with the welded steel structure it replaces.

The NCC was a catalyst for the successful transfer of technology between the government and private industry. This technology transfer is an example of "spin-on" from the USCAR sponsored pick up box program that is utilizing a proprietary glass fiber preform process. The Air Force is building upon the technology developed for the pick up box and expanding it into stronger carbon fiber technology. The USCAR program will benefit the Air Force project as they seek to develop cost effective carbon structures.

This composite truck box is currently in production and will replace the old steel pick up bed and liner. The box is made from fiberglass/polyurethane, is 30% lighter than conventional steel plus liner, is cost competitive, takes 4 minutes to produce preform robotically, takes 4 minutes to infuse, and is sponsored by the big three U.S. automotive makers.

Forced Air Aircraft Deicing

The Air Force Research Laboratory Air Vehicles Directorate (AFRL/VA) and Aviation Environmental Compliance Inc. entered into a CRADA to investigate using a high speed jet to blow snow and ice from aircraft wings. The Air Force received a more efficient deicing system which reduces glycol usage by 70-90% and reduces deicing time by 50%. The industry partner received an improved, less expensive, and more efficient air delivery line configuration and a more effective nozzle.

Electro-Optic Tunnel Gauge

Measuring the inside diameter of tubes and holes has often been expensive and requires frequent and costly recalibration. The Air Force Research Laboratory Sensors Directorate under a CRADA with Gauge & Measurement Technologies, Ltd. (GMT) of Dayton, Ohio, developed a laser based device called the Tunnel Gauge for measuring interior dimensions of tubular or hollow structures. A broad range of tubular structures from several feet in diameter to less than one inch in diameter with accuracy to 0.002 inch.

Ohio produces more tubing and extrusions than any other state in the U.S. An estimated $20 million market for this device is anticipated over the next four to five years. This device allows for more accurate tubing with less scrap and rework resulting in lower costs.

CRADA Between Nichols Research Corporation and the Munitions Directorate

A CRADA was established between Nichols Research Corporation and the Air Force Research Laboratory Munitions Directorate (AFRL/MN) in FY 96. The objective for this ongoing agreement is to advance the technical scope and public and/or private awareness and use of the government-sponsored Irma Model. Nichols and AFRL/MN will benefit from the continued private use of the now Multi-sensor Modeling and Analysis Irma Model. Through this CRADA, AFRL/MN has been able to extend information on the

enhanced Infrared Modeling and Simulation Code to a wide user group through a unique educational method. Nichols Research has been instrumental in formulating course materials and presenting training classes to a wide user base. The CRADA was initially written for 36 months, but is being extended to 48 months to allow for additional training sessions.

Munitions Directorate Patents

The Air Force Research Laboratory Munitions Directorate in partnership with Gulf Coast Alliance actively marketed two patented AFRL/MN technologies in FY 99.

Tape Type Microstrip Patch Antenna

Microstrip antennas are conventionally fabricated from printed circuit board materials. These antennas cannot be manufactured in mass production for low cost, and they cannot be quickly and easily mounted on different types of non-planar surfaces and are subject to failure from flexing. This invention provides an antenna which is simple and easily adaptable to various mounting conditions. The antenna is omnidirectional and can easily be attached with structural tape adhesives to munitions ranging in size from a baseball to the size of 2000 lb. munitions. It is able to withstand severe environmental conditions including temperature, wind, forces, and vibration. The concept of the peel and stick antenna was a spin-off of the subminiature telemetry program.

Wide Bandwidth Microstrip Patch Antenna

Conventional printed antennas use thin films of good conductors such as copper and gold which are deposited, printed or etched onto thin, low loss dielectric substrates, which are usually backed by another good conductor. This disadvantage of currently available microstrip patch antennas is their narrow radiation bandwidth. This invention provides a microstrip patch antenna, which substantially increases the bandwidth of the antenna by modifying the region near the radiating edges of a conventional patch shape with dielectric overlay strips attached along the edges of the patch and onto the substrate. The resultant sandwich structure forms a highly flexible, low profile, low cost, rugged conformal antenna which can be dispensed from a roll of generic patch antenna devices. After testing, the antenna can easily be removed with a solvent. Possible applications include machinery status monitoring, instrumentation, logistics and supply monitoring, remote control, and environmental monitoring.

Low-Cost Advanced Instrument Controller

Management Sciences, Inc.

The Air Force Research Laboratory Space Vehicles Directorate and Management Sciences, Inc. have joined together in a CRADA to conduct research and development of low-cost Advanced Instrument Controller (AIC) microsystems. This CRADA addresses the development and application of lower cost AIC systems for widespread application within the government and industry.

Reducing the cost of AICs make them attractive for use in a wide variety of military applications. Preliminary work has identified potential applications ranging from shipping containers to helicopters. It provides the ability to infuse processing into many locations within a system that was previously impossible. Such insertion makes autonomous systems much more capable, and reduces ten- to hundred-fold the size, weight, and power necessary to do ordinary functions of data acquisition and intra-platform communication. Many new possibilities in smart systems will exist through the advent of the AIC. Lower cost versions of AIC improve the affordability of the basic AIC capability.

Interaction with a wider application base serves to provide a wealth of information for further improvements to the AIC. One such example is the ability of the AIC to operate directly from JAVA language specifications. The forces that drive AIC interest in aerospace and commercial applications permit useful refinements, consistent with the dual-use model.

Pressure Infiltration Casting May Revolutionize Manufacturing Processes

A manufacturing technology effort supported by the Air Force Research Laboratory Materials and Manufacturing Directorate, working with Metal Matrix Cast Composites (MMCC), Inc., has resulted in the successful development of a manufacturing process that could help revolutionize and mature metal composite parts fabrication. The "Advanced Pressure Infiltration Casting Process" (APIC™) developed by MMCC, Inc., allows computer-aided-design (CAD) drawings to be turned into high quality finished products in a matter of days. The process expands rapid prototyping to where new design concepts demanding lightweight, low profile, stiffer materials can be quickly manufactured and evaluated. Durable parts for engines and brakes can be manufactured with a longer life, at just half the weight and at much lower cost. The APIC™ process has also extended its capabilities to serve the national defense, space, and supporting industries such as telecommunication space satellites, aerospace electronic devices, and military armor.

The current market demand for developing complex vehicles in less time at reduced costs, with an emphasis on increased performance, high quality, and safety, has created major challenges for designers, engineers and manufacturers. One impact has been an increasing trend in the aerospace and Defense industries towards reducing the cost of parts manufacturing, even in low production volumes, while producing components that weigh less and are of technically superior quality. The trend is especially noticeable in the composites manufacturing sector, where non-recurring expenses such as prototype design, tooling, and production can be very high. Conventional approaches to part development are being replaced with emerging net shape rapid prototyping technologies.

A manufacturing technology effort supported by the Air Force Research Laboratory's Materials and Manufacturing Directorate, working with MMCC, Inc., has led to expanded successful development of MMCC's APIC™ process which achieves uniform dispersal of particles and incorporates selective tailoring of the part being cast. Unlike conventional casting processes, APIC™ has the ability to reinforce a multitude of aluminum and copper alloys with many types of materials and architectures, which produce a broad range of choices for designers and engineers. APIC™ related research and development is also being supported by the Navy, the Defense Advanced Research Projects Agency (DARPA), and the National Air and Space Administration (NASA). Current and prospective applications include connecting rods for two-stroke outboard marine engines, brake calipers, water-cooled brake discs for heavy trucks working stop-and-go routes, and aircraft tow vehicles, brake caliper pistons, brake rotors and circuit board heat sinks. APIC™ has also been used to fabricate push rods and racing bicycle pedal cranks. APIC™-fabricated components are about half the weight of the components they replace, which means they're increasingly useful in the quest for lowered operating costs.

The APIC™ process offers a highly effective means for developing cost-competitive, metal matrix composite products that can be used to replace steel and other high-density materials.

1-800-203-6451

The Air Force Technology Management Team manages the Air Force "Tech Connect" service (1-800-203-6451). Tech Connect receives telephone and e-mail inquiries from potential outside partners and searches for the Air Force technical experts in the laboratories and centers who can best answer the customer's technical questions. This coming year Tech Connect will continue to expand and improve its network of Air Force technical contact points. The Air Force Technology Transfer Management Team will work with the technology transfer focal points in developing and implementing technical assessment methodologies to proactively focus their transfer activities to target industry (i.e. medical, automotive, assistive technologies, etc.).

Intellectual Property Management Information System (IPMIS)

The Air Force implemented the Intellectual Property Management Information System (IPMIS) in coordination with the Navy who initiated development of the system. The system has been installed at five Air Force sites where input from the field is being collected to further refine the system. IPMIS will provide the Air Force with an improved method of managing and tracking patent activity at the local level.

Defense Advanced Research Project Agency

DARPA's Unconventional Pathogen Countermeasures Program

The Unconventional Pathogen Countermeasures (UPC) Program within DARPA has the primary goal to develop novel, broad-spectrum countermeasures against bacterial and viral pathogens and toxins that are versatile enough to eliminate both known and unknown biological threat agents, whether from natural or engineered sources. This program promotes the development of cutting-edge technologies that industry may otherwise not pursue due to their high-risk nature.

DARPA-funded UPC projects must progress through a rigorous process where the technologies are matured to the point where their chances of achieving Food and Drug Administration (FDA) approval is significantly higher than other high-risk technologies being developed in industry. In the past, FDA clinical trials typically took 5-15 years to complete. Currently, clinical trials take 1.5-5 years, which is a significant improvement. During the clinical trial and approval period, industry funded projects generally have a success rate of 1%, while it is projected that the DARPA/UPC projects will have a 50% success rate. The relatively high DARPA/UPC success rate can be attributed to the defined "funnel" or path a project takes from initial research to being transitioned for FDA approval. Once the FDA approves a technology, it can be transitioned for further development to a Department of Defense laboratory, pharmaceutical company, biotechnology company, or national laboratory/institute.

Dr. James Baker, with the University of Michigan and a Principal Investigator in the UPC program, has developed a composite material that will serve as a pathogen avoidance barrier and post-exposure therapeutic agent that is to be applied in a topical

manner to the skin and mucous membranes. Under this program Dr. Baker patented this topical lotion that effectively kills anthrax spores. This patented technology is currently being transitioned into the pharmaceutical/biotechnology industry.