VIRGINIA'S CENTER FOR INNOVATIVE TECHNOLOGY
Accelerating Virginia's Return on Innovation

October 1, 2005

The Honorable John H. Chichester
Chairman, Senate Finance Committee
PO Box 904
Fredericksburg, Virginia 22404

The Honorable Vincent F. Callahan, Jr.
Chairman, House Appropriations Committee
PO Box 1173
McLean, Virginia 22101

Dear Messrs. Chairmen:

In accordance with §2.2-2233.1.E of Title 22, Chapter 22, Article 3 of the Code of Virginia, I am providing you with an annual report on the Commonwealth Technology Research Fund. The Fund became effective July 1, 2001, completing its fourth year of operation on June 30, 2005.

We are very pleased with the progress of this program. Funding was distributed for 12 projects over two different solicitation rounds; five have now been completed and the remaining seven are still underway with completion dates ranging from December 2005 to June 2006.

Sincerely,

Peter J. Jobse
President

cc: The Honorable John M. Bennett
The Honorable Peter A. Blake
The Honorable Eugene J. Huang
Elizabeth B. Daley
Robert P. Vaughn
Amy Sebring
Tony Maggio

2214 ROCK HILL ROAD • SUITE 600 • HERNDON • VIRGINIA • 20170-4228
TEL 703-689-3000 • TOLL FREE 800-3-TECHVA • FAX 703-689-3041
www.cit.org

MEMORANDUM

TO: The Honorable Mark R. Warner
Governor of Virginia

THROUGH: The Honorable John M. Bennett
Secretary of Finance

FROM: Peter Jobse
President, Virginia's Center for Innovative Technology

DATE: October 1, 2005

SUBJECT: **Commonwealth Technology Research Fund: 2005 Annual Report**

In accordance with §2.2-2233.1.E of Title 22, Chapter 22, Article 3 of the Code of Virginia, I am providing to you and the Chairmen of the House Appropriations and Senate Finance Committees an annual report on the Commonwealth Technology Research Fund. The Fund became effective July 1, 2001, completing its fourth year of operation on June 30, 2005.

We are very pleased with the progress of this program. Funding was distributed for 12 projects over two different solicitation rounds; five have now been completed and the remaining seven are still underway with completion dates ranging from December 2005 to June 2006.

cc: The Honorable Peter A. Blake
The Honorable Eugene J. Huang
William H. Leighty

THE COMMONWEALTH TECHNOLOGY RESEARCH FUND:

ADVANCING TECHNOLOGY AND ECONOMIC DEVELOPMENT IN VIRGINIA BY INVESTING IN HIGHER EDUCATION RESEARCH

ANNUAL REPORT
JULY 1, 2004 – JUNE 30, 2005

Submitted by the Fund Administrator:
The Center for Innovative Technology
The Commonwealth of Virginia Innovative Technology Authority
October 1, 2005

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EXECUTIVE SUMMARY

In accordance with §2.2-2233.1.E of Title 22, Chapter 22, Article 3 of the Code of Virginia, this report regarding the Commonwealth Technology Research Fund (CTRF) is respectfully submitted. The CTRF was created to attract public and private research funding for institutions of higher education, in order to increase technological and economic development in Virginia. Awards from the Fund were made to Virginia public institutions of higher education or their associated intellectual property foundations.

A total of 12 grants were made: seven in July 2001, four in January 2002, and one in January 2003, for a total of $24,574,630. Implementation costs (including honoraria for peer reviews) amounted to $45,992, for a grand total of $24,620,622 in expenses under this program. Of the 12 grants, five projects have been completed; three were completed in FY 2004 and two, *Advancing Virginia's Information Security Expertise* (JMU) and the *Cancer Genomics & Development of Diagnostic Tools & Therapies* (VCU), were completed in this report period. Seven projects remain underway, with all currently scheduled to be completed in FY 2006. A summary of each project appears in the next section.

All grantees are required to submit annual progress reports; however, they come in at various times of the year in accordance with the period of performance for each grant. Highlights of achievements and activities since the Fund's inception include the following:

- **Recruitment of Strategic Personnel** – Recruiting and hiring of top candidates in various technology fields; new hires included post-doctoral fellows, promising junior faculty and senior faculty who bring strong reputations and the ability to secure major federally-funded research. Grant recipients report more than 220 students have been supported by the Fund; these include undergraduate and graduate students, as well as post-doctoral research associates, Ph.D. candidates, and M.S. candidate level students.
- **Leveraged Funding** – Approximately $138.6M has been leveraged to date by CTRF grant participants; this is more than a 5.6:1 return. CTRF recipients have won more than 120 federal, private, and foundation grants and have received more than $3M in donated equipment. Leveraging includes a $5M, 5-year commitment from the Air Force Office of Scientific Research for the Multidisciplinary University Research Initiative (MURI) at UVA, a $10.3M award from the National Institutes of Health – National Institute of Allergy and Infectious Disease to the Virginia Bioinformatics Institute, and an $8.2M award from the National Institute for Standards and Technology for the Commonwealth Information Security Center.
- **Industry Inducement** – Relocation of a leading bioinformatics company to Virginia – Incogen invested $2.4 million to relocate from South Carolina as a result of the College of William and Mary Industry Inducement Award. Incogen received a $2M SBIR Phase II award for cancer diagnostics and will be the owner of a building in a new research and technology park planned in Williamsburg.
- **Strategic Partnerships** – Establishment of strategic partnerships with businesses and other organizations to advance Virginia's leadership in technology research, such as

the partnership between VCU, GMU, and INOVA that is working on cancer genomics and related diagnostic tools and therapies. The Center for High Performance Manufacturing delivered more than ten presentations in the Commonwealth in FY 2005 to more than 150 individuals. Recent active membership of the Virginia Modeling, Analysis, and Simulation Center totaled 105 organizations, including 72 industrial members, 13 government members, and 10 academic members.

- **Upgraded Facilities** – Renovation and upgrading of research facilities at UVA's Gilmer Hall and the Virginia Modeling, Analysis and Simulation Center at Old Dominion University.
- **Capital Equipment** – Acquisition of major scientific equipment and computer hardware and software, enabling grantees to enhance their research programs, attract additional funding and new research staff, and enhance education and training.
- **Publications and Presentations** – CTRF award recipients have recorded more than 280 publications and presentations.
- **Intellectual Property** – CTRF award recipients have reported more than 30 disclosures, patent applications, patents received, and licenses.

BACKGROUND

The Commonwealth Technology Research Fund (CTRF) was created in the 2000 Session of the General Assembly to leverage federal and private investment in research at Virginia's public universities. The ultimate goal of this investment is to increase technological and economic development in Virginia. Based on the original legislation and amended legislation of March 2003, the Fund has four components:

- **Strategic Academic Enhancement Program**: This component is based on the evidence that top-ranked departments are disproportionately successful in attracting external research funds. In other words, past success and the reputation it garners for a department breeds future success in attracting external research funds. This program provides funds to help strong departments in Virginia's universities to become world-class research organizations. Funding under the strategic academic enhancement program is typically for recruitment packages for new faculty, purchase of specialized equipment, renovation of laboratories, funding for graduate research assistants, and similar activities.
- **Matching Funds Program**: Under this component, universities apply to the CTRF for matches to federal or private grant proposals they are preparing to submit. These matching funds not only help to qualify institutions for grant competitions, they also reflect on the state's and institution's commitment to the project and influence decision-makers regarding the feasibility of the proposed research.
- **Industry Inducement Program**: This component helps universities upgrade research capacity in key departments in order to attract specific companies to locate or expand in Virginia.
- **Commercialization Program:** This component enhances the capabilities of the universities to commercialize technologies developed through their research.

Awards were to be considered for work in the following disciplines:

- Information technology and communications
- Biotechnology and bioinformatics
- Advanced materials and nanotechnology
- Advanced manufacturing and biomanufacturing
- Aerospace
- Energy
- Environmental technologies
- Transportation

The program was initiated in FY 2002 with $26M in funding; however, during the 2002 Session of the General Assembly (2002 amendments and 2002-2004 biennium), a decision was reached to discontinue funding the program as a part of statewide budget reductions. The Fund was reduced to cover expenditures and commitments made up to that point (~$24,620,600). A total of 12 projects were ultimately awarded grants; a detailed listing can be found on page 10 of this report.

The Fund was initially administered by the Department of Planning and Budget (DPB) with policy guidance provided by the Virginia Research and Technology Advisory Commission (VRTAC). In March 2003, the enabling legislation (§2.2-2515 of the Code of Virginia, Chapter 22, Article 3) was reenacted and amended to add a fourth component to support the efforts of the universities in commercializing technologies resulting from their research. At that time, administrative responsibility was also amended, naming the Innovative Technology Authority (ITA) in lieu of DPB, and the transition to ITA's operating arm, Virginia's Center for Innovative Technology, occurred at the end of June 2003. No new funds were appropriated; therefore, this report covers activities related to the initial 12 grants only.

PROJECT SUMMARIES AND HIGHLIGHTS

Advancing Virginia's Information Security Expertise (SE2002-01)

Researchers at James Madison University, George Mason University, Hampton University, and Virginia Tech established the Commonwealth Information Security Center (CISC), which addresses escalating attacks on computing systems and has built a robust R&D program focused on infrastructure and information assurance. The universities partnered with numerous large and small corporations as they pursued research and sought commercial applications. CISC successfully solicited $8.2M in federal funding to support its Critical Infrastructure Protection (CIP) Program.

The strong connections built through the Commonwealth Information Security Center have allowed JMU to develop and implement the Institute for Infrastructure and Information Assurance, which now serves as the integrative force behind JMU's efforts within cyber and physical security.

Bringing the Future of Bioinformatics to Virginia (IN2002-03)

The Institute for Computational Genomics, Inc. (INCOGEN) moved its facilities to Williamsburg, VA from South Carolina in order to collaborate with the College of William & Mary and the Virginia Bioinformatics Institute at Virginia Tech (VBI) in the creation of a cooperative bioinformatics program. New courses have been created as a result of this grant. Additionally, INCOGEN collaborates with Eastern Virginia Medical School and the James Madison University Governor's School for Science and Technology. INCOGEN received a $2M Phase II award from the National Institutes of Health – National Cancer Institute to continue its research program in cancer diagnostics. In addition, INCOGEN will be the owner of a building in New Town, a mixed-use development in which the research and technology-focused Discovery Business Park will anchor the development.

Cancer Genomics and Development of Diagnostic Tools and Therapies (SE2002-02)

Virginia Commonwealth University, George Mason University, and Inova Health Systems joined together to explore the role genes play in cancer. The research is helping develop more cost-effective means of diagnosing and treating cancer. Researchers apply emerging technology to the health care field and work closely with technology companies in the Commonwealth.

Within the overall goal of creating infrastructure to productively support research, specific objectives included establishing a tissue bank, data base development, isolating RNA and performing gene expression microarray analysis on each specimen, data analysis, and development of diagnostic biochips. Considerable data has been generated addressing crucial aspects of quality control of microarray data, which is critical if these techniques are to be useful for real-time testing of patients for diagnosis and monitoring of disease.

Center for In-vivo Hyperpolarized Gas MR Imaging (IN2002-01)

With the CTRF grant, researchers at the University of Virginia were able to continue their investigations into the possible uses of hyperpolarized Helium-3 and Xenon-129 in medical imaging. UVA remains the world leader in polarization and imaging technology for human applications of hyperpolarized helium-3 and xenon-129. These pharmaceuticals show great promise for improved imaging of lung diseases including asthma, emphysema, and cystic fibrosis. UVA forged a partnership with Nycomed Amersham, a world leader in in-vivo diagnostic imaging, to explore the possibilities these pharmaceuticals possess.

Achievements in FY 2005 included the award of a $2.4M, four-year NIH grant to *Develop Improved Methods of Hyperpolarized-Gas MRI of the Lung*. Studies are also being done to assess secondhand exposure to smoking as well as lung maturation in children.

In addition, the increased sensitivity and specificity offered by hyperpolarized-gas magnetic resonance imaging (MRI) may enable pharmaceutical companies to reduce both the number of subjects enrolled in FDA clinical trials and the time required to establish an observable change in lung status. Currently, clinical trials for new respiratory therapy drugs can cost as much as $100M per drug. Both of these factors will contribute to significant cost-savings for FDA

clinical trials of respiratory-therapy drugs. This is a major reason for the growing interest of pharmaceutical companies in the new technology of hyperpolarized-gas MRI.

Collaborative Research in Bioinformatics (SE2002-04)

The Virginia Tech Department of Computer Science and the Virginia Bioinformatics Institute (VBI) forged a partnership to create the infrastructure for and implement world-class research, graduate education, and economic development in bioinformatics. To date, more than $43.6M in leveraged funding has been achieved, and VBI has received more than $2.8M in donated equipment.

Additional achievements include: 1) expanding the graduate curriculum with specialized courses in bioinformatics and computation biology; 2) an operational interdisciplinary doctoral degree program; 3) the creation of a high performance / high capacity computational infrastructure, and 4) new faculty producing significant research publications and attracting external research funding. VBI has worked with federal labs as well as U.S. and international companies and research institutes.

The Development of an Environmentally Compliant, Multi-functional Coating for Aerospace Applications Using Molecular and Non-Engineering Methods (MF2002-01)

The University of Virginia, joined by researchers at Ohio State University, the University of Cincinnati, the University of New Mexico, Arizona State University, and the US Naval Academy, received a $5M, five-year grant from NSF for a Multidisciplinary University Research Initiative (MURI). The $728,000 CTRF Matching Funds grant was instrumental in obtaining this award. The grant is scheduled to run through May 2006 but may require an extension based on period of performance agreed to by the federal government.

Researchers have made technical progress in developing and demonstrating capabilities of this coating that include the ability to sense corrosion and mechanical damage and initiate mitigating responses, change color on demand, provide corrosion protection and adhesion using environmentally compliant materials, and improve the fatigue resistance and mechanical integrity of the fuselage.

Development of the VMASC Battle Lab Facility (SE2002-05)

Researchers at Old Dominion University's Virginia Modeling, Analysis and Simulation Center (VMASC) augmented their programs through better and more modern infrastructure improvements – allowing the conduct of world-class research, graduate education and economic development in this field, the results of which have both military and commercial applications. VMASC's expanded capabilities allow it to address such problems as larger and more complex simulations, reducing cost and development time, modeling human behavior, and homeland security. Other highlights include expanded interactions with the U.S. Joint Forces Command that led to three task order contracts with a contract ceiling totaling $65M and an enhanced modeling and simulation community in the region. Lockheed Martin, for instance, is constructing a $35M visualization center, and General Dynamics and SAIC have committed to establishing offices.

Enhancing Virginia's Research Infrastructure for High Performance Manufacturing (SE2002-03)

Researchers at Virginia Tech, James Madison University, and the College of William and Mary partnered with manufacturing firms to establish the Center for High Performance Manufacturing. This project assists Commonwealth manufacturing firms in becoming high performance producers by providing a "one-stop source" of manufacturing research in strategy design and analysis for new products and facilities or re-engineering existing manufacturing systems. It also enhances manufacturing research competitiveness of Virginia universities. The universities have partnered with dozens of manufacturing firms and organizations across the nation for this project. Eight semi-annual meetings, more than 75 presentations, and several Center-designated and company-designated projects have been successfully carried out. In addition, 24 graduate students have been supported and nine disclosures have been made.

CHPM will apply in October 2005 to be an Industrial Assessment Center in the U.S. Department of Energy's Industrial Technology Program. If awarded, CHPM will receive an annual budget of $180,000 for five years.

Gilmer Hall Laboratory Renovations: Cell and Molecular Biology Labs (MF2003-01)

The University of Virginia secured a federal grant ($2M) for renovation of a portion of Gilmer Hall to provide laboratories for research in cell and molecular biology. The new research groups occupying the space complement existing strengths in the areas of morphogenesis, cellular motility, and differentiation; they also relate to areas of strength in the School of Medicine. The new space is an integral component of UVA's development of an Institute for Developmental Biology and Regenerative Medicine. In addition to lab space, the renovations will include research support space, equipment rooms, and such interactive space as conference rooms. The research space is central to the recruitment of four new faculty members, two of who have been hired; the other two searches are underway. As with the MURI, this federal grant would not have happened without the CTRF Matching Funds Award. Renovations remain underway.

Governor's Blue Ribbon Commission for a Review of Virginia's Research and Graduate Programs (SE2003-01)

Virginia Tech coordinated the commissioning of a panel of nationally recognized experts to examine the strengths and weaknesses of Virginia's nationally ranked research and graduate programs. This effort involved all the research universities in a significant effort to catalogue and evaluate programs, creating a basis for future investments.

Following the October 2003 Governor's Research Review, seed funding of $10,473,337 was invested in 2004-06 to strengthen higher education. The funding supports research programs that participated in the peer review process and reflects an increased investment in graduate student financial aid.

The Commission completed the majority of its work in the fall of 2003, but requested that the grant be held open through FY 2006 in order to conduct additional analyses with remaining funds.

Mucosal Therapy of Infectious & Autoimmune Diseases (SE2002-06)

Researchers at the University of Virginia, Virginia Commonwealth University and Virginia Tech partnered with biotechnology companies to develop mucosal therapeutics through biotechnology. Their work was influenced by September 11, 2001 events, and several pathogens relevant to biodefense have expanded the scope of this project.

VCU's key role is to apply genomics and informatics technology to discover potential targets for immunotherapy or chemotherapy. UVA's primary role is to study the mechanisms of regulation of mucosal immune responses, while Virginia Tech's focus is developing edible plant vaccines and mucosal delivery systems. By bringing their unique strengths to the project, the three universities are establishing a world-class resource for the development of pharmaceuticals.

Virginia Bioinformatics Consortium (IN2002-02)

Researchers at George Mason University, the University of Virginia, Virginia Commonwealth University and Virginia Tech have engaged in groundbreaking developments in the field of bioinformatics, increasing the quality and quantity of bioinformatics research in the Commonwealth. This project has included negotiating standards for data management, developing shared data analysis resources, scaling up laboratory facilities at each university, and conducting collaborative research projects. The Virginia Bioinformatics Consortium (VBC) has created a venue for Virginia universities to work together on state-of-the-art research and allows individual members of the group to maximize research capabilities at their respective institutions.

Key accomplishments include the following: 1) VCU established one of the most comprehensive training programs in the country, 2) for GMU, UVA, and VCU, CTRF support led directly to more than $40M in new R&D funding, and 3) new software programs that UVA developed for computation biology / biological sequence companies and the GEOFF gene expression database are now standard tools for bioinformation research across the country.

ACTIVITIES TO DATE

Leveraged Funds To Date

Project	Leveraged Funds Received	Value of Donated Equipment
Advancing Virginia's Security Expertise	$8,516,060	$86,675
Bringing the Future of Bioinformatics to Virginia*	$5,340,735	
Cancer Genomics and Development of Diagnostic Tools and Therapies	$14,535,446	
Center for In-vivo Hyper-polarized Nobel Gas MR Imaging	$4,913,994	$200,000
Collaborative Research in Bioinformatics	$43,717,740	$2,805,706
Development of an Environmentally Compliant Coating for Aerospace	$711,687	
Development of the VMASC Battle Lab Facility	$24,139,566	
Enhancing Virginia's Research Infrastructure for High Performance Manufacturing	$ 943,834	
Gilmer Hall Laboratory Renovations	$1,906,652	
Governor's Blue Ribbon Commission	*Direct pursuit of leveraged funding was not an objective	
Mucosal Therapy of Infections & Autoimmune Diseases	$15,037,092	
Virginia Bioinformatics Consortium	$18,879,187	
Total Federal, Private, and Foundation Leverage	$138,641,993	$3,092,381

According to the individual project reports, a large portion of the Fund went to infrastructure investments. The equipment purchased with CTRF monies improved research capabilities and attracted additional faculty. The instrumentation includes new genomic and analytical research equipment, an ABI 3100 *Avant* automated DNA sequencer, a phophorimager, a real-time PCR, a confocal microscope system upgrade, the development of the Bioinformatics Computational Core Labs, and sequencing, gene expression, and proteomic equipment.

Interactions related to this research fund have resulted in a wide variety of collaborations. Many have developed between universities, such as the collaboration between Dr. Pearson (UVA) and Dr. Buck (VCU) in the publication of the genome *Cryptosporidium hominis* in *Science* magazine. Dr. Houpt from the University of Virginia is working on validating a test at Kilimanjaro Christian Medical Centre (KCMC), Tanzania, a collaborative site, which has developed under CTRF funding. His initial KCMC study, which suggested there may be important differences in the natural history of Cryptosporidium infection in HIV-infected persons depending on parasite species, was published in the American Journal of Tropical Medicine and Hygiene. This collaboration represents one of many between the academic and private sectors that the fund has initiated. There were also many intra-university collaborations initiated by this fund. For instance, the University of Virginia identified additional investigators for the Mucosal Therapies of Infectious and Autoimmune Diseases project at the university. CTRF funds were competed for by UVA investigators, and those investigators that received awards worked together to advance the understanding of infectious and autoimmune diseases of the digestive tract.

ADMINISTRATION

Administratively, activities in FY 2005 focused on managing the Fund. This included rolling over unused funds from FY 2005 to FY 2006, processing no-cost extensions in those instances where the work could not be completed in the originally proposed period of time, and following up with the Principle Investigators with respect to progress and final reports.

Copies of recent progress reports for each project are on file with the Fund administrator (CIT) and are available upon request. Once all projects have been completed, a full accounting of the impact of the Commonwealth's investment will be presented in a final report.

TABLE OF GRANTS

Award No.	Current Period of Performance	Principal Investi-gator	Lead Institution	Title	Total CTRF Award	University Match	Federal Funds	Other Match	Total Proposed Match
Strategic Enhancement Program									
SE2002-01	7/1/2001 - 6/30/2005	Noftsinger	JMU	*Advancing Virginia's Information Security Expertise*	$4,092,769	$2,770,554	N/A	$2,554,961	$5,325,515
SE2002-02	7/1/2001 - 12/31/2004	Torr	VCU	*Cancer Genomics and Development of Diagnostic Tools*	$3,000,000	$3,000,000	N/A		$3,000,000
SE2002-03	7/1/2001 - 3/31/2006	Chen	VT	*Enhancing Virginia's Research Infrastructre for High Performance Manufacturing*	$4,339,577	$4,614,107	N/A	$500,000	$5,114,107
SE2002-04	7/1/2001 - 6/30/2006	Kafura	VT	*Collaborative Research in Bioinformatics*	$2,500,201	$2,814,229	N/A	$1,262,486	$4,076,715
SE2002-05	1/1/2002 - 10/31/2003	Mielke	ODU	*Development of the VMASC Battle Lab Facility*	$452,199	$452,199	N/A		$452,199
SE2002-06	11/1/2001 - 12/31/2005	Petri	UVA	*Mucosal Therapy of Infectious and Autoimmune Diseases*	$1,800,000	$1,800,000	N/A		$1,800,000
SE2003-01	7/1/2002 - 6/30/2006	Steger	VT	*Governor's Blue Ribbon Commission*	$100,000		N/A		$0
Matching Funds Program									
MF2002-01	7/1/2002 - 5-15-2006	Scully	UVA	*The Development of an Environmentally Compliant, Multi-functional Coating for Aerospace Appication Using Moledcular- and Nano-Engineering Methods*	$728,000	$728,000	$5,500,000		$6,228,000
MF2003-01	1/1/2002 - 12/31/2003	Hornberger	UVA	*Gilmer Hall laboratory renovations: cell and molecular biology laboratories*	$1,000,000	$1,000,000	$2,000,000		$3,000,000
Industry Inducement Program									
IN2002-01	7/1/2001 - 6/30/2006	Brookeman	UVA	*Center for In-Vivo Hyperpolarized Gas MR Imaging*	$1,809,983	$1,945,670	N/A		$1,945,670
IN2002-02	7/1/2002 - 6/30/2004	Plank	UVA	*Virginia Bioinformatics Consortium*	$1,500,000	$1,580,404	N/A		$1,580,404
IN2002-03	11/1/2001 - 6/30/2006	Manos	W&M	*Bringing the Future of Bioinformatics to Virginia*	$1,087,196	$1,038,171	N/A	$2,663,730	$3,701,901