THE COMMONWEALTH TECHNOLOGY RESEARCH FUND:

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

ANNUAL REPORT
JULY 1, 2008 – JUNE 30, 2009

Submitted by the Fund Administrator:
Center for Innovative Technology
The Commonwealth of Virginia
Innovation and Entrepreneurship Investment Authority
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EXECUTIVE SUMMARY

In accordance with Section 2.2-2233.1 E of the Code of Virginia, this report regarding the Commonwealth Technology Research Fund (CTRF) in FY2009 is respectfully submitted. In the 2009 Session of the General Assembly, the CTRF was renamed the Commonwealth Research Commercialization Fund (CRCF). For the purposes of this report, the name in effect in FY 2009 will be used.

The CTRF was created in the 2000 Session of the General Assembly 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 could be made to Virginia public institutions of higher education or their associated intellectual property foundations.

This report addresses the FY 2009 progress of the six awards made in FY 2008 and a program created in FY 2009 known as the Virginia Innovation Partnership.

In FY 2008, the Fund invested $1,845,178 in six projects at four universities: Eastern Virginia Medical School (EVMS), George Mason University (GMU), the University of Virginia (U.Va.), and Virginia Tech (VT). The projects involve research in the disciplines of information technology, life sciences, modeling and simulation and nanoelectronics. A Table of Grants is provided in Appendix B. In addition a summary of each report is provided below, and the FY 2009 report for each project is on file with the Fund Administrator.

The Virginia Innovation Partnership (VIP) program was created following discussions between then Secretary of Technology Aneesh Chopra and representatives of Virginia universities serving on the Virginia Research & Technology Commission (VRTAC). Their shared goal was to develop a program to selectively move promising university technologies closer to commercialization in order to interest potential licensees or investors. In April 2009, the Virginia Innovation Partnership solicitation was issued. The academic research community submitted proposals in May, and the proposal review process commenced in June. As of June 30, the review process remained underway. One award was made to the University of Virginia for administration of the VIP review process.

Funds available at the close of FY 2009 totaled $747,772. This reflected the unspent balance of the appropriation, and $287,054 returned from Virginia Tech because its IALR / Corning project terminated early.

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 was to increase technological and economic development in Virginia. The original legislation and amended legislation of March 2003 created the four Fund components:

- **Strategic Academic Enhancement Program**: This component was based on the evidence that top-ranked departments are disproportionately successful in attracting external research funds. This program provided funds to help strong departments in Virginia's universities become world-class research organizations. Funding under the strategic academic enhancement program was typically used 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 applied to the CTRF for matches to federal or private grant proposals that they were preparing to submit. These matching funds not only helped to qualify institutions for grant competitions, they also reflected the state's and institution's commitment to the project and influenced decision-makers regarding the feasibility and value of the proposed research.

- **Industry Inducement Program**: This component helped universities to upgrade their research capacities in key departments in order to attract specific companies to locate or expand in Virginia.

- **Commercialization Program:** This component enhanced the capability of the universities to commercialize technologies developed through their research.

At the outset of FY 2008, the Fund had $3 million available for awards. Of that, $1,845,178 was invested, with $1,000,376 to be spent in Year 1 research, $692,042 in Year 2 research and $152,760 in Year 3. There were no further FY2008 solicitations, as the General Assembly subsequently rescinded the remaining CTRF monies, $1,154,822.

In association with Governor Kaine's October 2008 budget shortfall action, much of the FY 2008 carry over was not re-appropriated. Monies for the five multi-year projects' Year 2 budgets were allocated from the Fund's $1 million FY 2009 appropriation.

2009 HIGHLIGHTS

2008 Award Progress

Job Creation and Retention

- Eastern Virginia Medical School estimated in its proposal that its project with Hampton University will result in the creation of 125 new jobs in Hampton Roads, starting at a minimum average salary of $70,000 per year.
- ContracVac, located in Charlottesville and associated with the University of Virginia's "SpermCheck" project, anticipates hiring at least three new employees in the next year to handle sales and distribution.

Economic Development

- Hampton University projected that more than 2,000 patients a year will seek treatment at the new facility associated with the CTRF project. Visiting patients and family members will contribute to the local economy through hotel room nights, meals, and entertainment.

- To date, $2.0 million in angel investment has been raised by ContraVac and invested in research and development in Charlottesville. ContraVac is U.Va.'s partner in the "SpermCheck" project.

Intellectual Property

- A patent on "Self-Cleaning Systems" was issued in June 2009 related to George Mason University's Self-Cleaning Intrusion Tolerance project. Three patents are pending.
- GMU and SCIT Labs agreed on a term sheet for an exclusive license of the SCIT technology to SCIT Labs.
- A patent is being filed related to U.Va.'s Spintronic project, and an invention disclosure is being prepared.
- Invention disclosure forms have been filed at Virginia Commonwealth University and Virginia Tech related to their joint project, A Radiolabelled Carbonaceous Nanomaterials Center.

As of June 30, 2009, award recipients reported expending a cumulative total of $940,496, of which $885,858 was spent in FY 2009.

A summary of each award follows.

The Development of BioEclipse, the First Biologically Optimized Treatment Planning System for Proton Radiotherapy, Eastern Virginia Medical School
Partners: Hampton University and Varian Medical Systems
Fund Component: Strategic Enhancement

Dr. Richard Britten, Principal Investigator, Eastern Virginia Medical School, was awarded $487,910 from CTRF for this three-year project. The goal of the project is to develop a biologically-based treatment planning strategy to maximize the therapeutic effectiveness of conformal proton treatment. Proton treatment represents the most advanced form of radiation treatment for cancer patients in the United States and is a rapidly expanding treatment modality worldwide. The newly commissioned Proton Treatment facility at Hampton University (HUPTI) will bring this treatment option to Hampton Roads.

The study is designed to obtain the relevant data on the biological response of tumor and blood vessel cells at various positions along the proton beam, and to use that data to develop a modified version of Varian Medical Systems' Eclipse treatment planning system, BioEclipse. BioEclipse will configure proton treatment plans that take into account the variable biological properties of protons at different depth doses. This will be the first biological based treatment planning system that takes into account both cell killing and radiation-induced ischemia.

In FY2009, key activities included model development, equipment design and purchase, measurements calibrating the requisite equipment and establishing beam parameters, and biological depth-dose profile determination for the Hep2 cell line. The team also prepared to perform in-beam cell culture measurements with additional cell lines at the Midwest Proton Research Institute/Indiana University Cyclotron Facility in August 2009.

The investigators on this proposal submitted a patent application in March 2007 for the concept of biologically based proton treatment planning. This has been approved (United States Patent 7,550,752).

As of June 30, 2009, CTRF expenditures totaled $169,026, with $155,785 spent in FY 2009.

Self Cleansing Intrusion Tolerance-Next Generation Security Technology (SCIT), George Mason University
Partner: Northrop Grumman Corporation
Fund Component: Technology Commercialization

Dr. Arun Sood, Principal Investigator, George Mason University was awarded $86,013 from CTRF for this one-year project, which was completed in May 2009. The goals of this project were to test SCIT's ability to protect large business and government (LBG) information technology environments from attacks on their networks and the systems that run on them, and to commercialize the SCIT for the LBG market. The collaboration with Northrop Grumman Research and Development network provided the ability to test SCIT servers in close to real world LBG settings.

Self Cleansing Intrusion Tolerance (SCIT) servers focus on limiting the losses that can occur because of an intrusion. This was accomplished by limiting the servers' exposure time to the internet. The SCIT approach achieves sub-minute exposure time for servers without service interruption. SCIT is not a replacement technology but, instead, complements and adds to existing approaches.

Dr. Sood's firm, SCIT Labs Inc., was incorporated in September 2007. GMU and SCIT Labs agreed on a term sheet for an exclusive license of the SCIT technology to SCIT Labs.

Based of the results of the SCIT server testing and the enthusiastic support of the NGC testing team, NGC and GMU will build a joint presentation that highlights the importance of this project to NGC business units and customers. Business sectors identified by NGC that could deploy SCIT effectively include commercial data centers hosting web sites or e-commerce; government customers hosting web sites or e-commerce, critical infrastructure e.g. emergency preparedness web sites, and database server protection.

The project received a patent from the U.S. Patent and Trademark Office; three patents are pending. The project also received substantial media coverage and other recognition, including via Computer World, Network World, Sciencedaily.com, and PC World.

SCIT's next steps include identifying companies that may want to license SCIT technology to include in their products, building channels for distributing SCIT products, confirming the scalability of SCIT, extending SCIT technology to other DMZ servers, such as email servers, developing a framework for future product development, and building business plans and approaching investors for funding of SCIT Labs.

As of June 30, 2009, expenditures totaled $86,013, with $77,636 spent in FY 2009.

Towards Establishment of an Industry-State-Federal National Center in Nanoelectronics: Quantum Dot Spintronic Systems, University of Virginia
Partners: Micron Technology and the Nanoelectronics Research Initiative
Fund Component: Strategic Enhancement

Dr. Stuart Wolf, Principal Investigator, University of Virginia, was awarded $425,542 from CTRF for this two-year project. The goals of this project are to demonstrate working prototypes of spintronic switches and to establish, in Virginia, the foundations of a new industry based on the development of new memory and logic devices, based primarily on the spin degree of freedom of the electron. In particular, this project is helping to support the development novel spin based magnetic switches that have the potential for very dense, low power logic.

In this past year, Dr. Wolf's team proposed new ways to make these magnetic switches. Work at Virginia Tech on multiferroic nanopillar and composite thin film heterostructures supported, in part, by this project turned out to be a very desirable path for the development of logic devices. A patent on the team's "Reconfigurable Array of Magnetic Automata (RAMA) intellectual property was being filed as of the writing of the report. In addition, a disclosure was being prepared for in-plane crossovers for magnetic cellular automata.

The team received federal funding for related work, including awards from the Army Research Office, the National Science Foundation, and the Air Force office of Scientific Research.

Discussions with the Nanoelectronics Research Initiative (NRI) have been undertaken regarding locating a research institute at UVA that will be a focus for electronics that are beyond CMOS. Project progress to date includes initiation of contact with Micron, Intel and NRI and the preparation of a white paper as the initial step toward the establishment of an NRI Institute based in Virginia.

As of June 30, 2009, expenditures totaled $209,913, with $205,399 spent in FY 2009.

Precision and Clinical Testing of SpermCheck® Immunochromatographic Devices, University of Virginia
Partner: ContraVac, Inc.
Fund Component: Technology Commercialization

Dr. John C. Herr, Principal Investigator, University of Virginia, was awarded $194,700 from CTRF for this fifteen-month project. The goal of this project is to gain regulatory approval from the Food and Drug Administration for three SpermCheck® immunochromatographic devices for home testing of male fertility.

The Virginia biotechnology company, ContraVac, was formed to advance this technology. With matching funds from the firm and manufacturing costs underwritten by Princeton BioMeditech of Princeton, NJ., this project undertook preclinical and clinical development of three point-of-care devices, SpermCheck Vasectomy (SCV), SpermCheck Fertility (SCF) and SpermCheck Contraception (SCC). These are immunochromatographic devices for detecting sperm. The devices are designed to offer convenience, cost savings and privacy in the evaluation of male fertility in the home setting.

SpermCheck Vasectomy completed sensitivity and precision testing, clinical and consumer trials, and received FDA approval for marketing. Sales of SpermCheck Vasectomy began in May 2009; it is the only FDA approved product for post-vasectomy sperm monitoring. The team is seeking regulatory approval in Canada and Europe.

Prototypes of SpermCheck Fertility were manufactured and underwent preclinical sensitivity testing for accuracy and reproducibility. After successful configuration of the device, 2,000 devices were produced and employed in clinical and consumer trials. FDA approval of SpermCheck Fertility is expected in August 2009.

SpermCheck Contraception. In January 2009 the Contraceptive Development Branch of the National Institutes of Health decided to include a SpermCheck Contraception device with a cutoff of 1 million sperm/ml in their multicenter trial of a long acting progestin/androgen combination male contraceptive [Nesterone + Testosterone Trial]. Male contraception represents one of the main objectives of SpermCheck technology: to create a companion diagnostic test to accompany a male contraceptive and improve the overall future acceptability of male contraception.

ContraVac anticipates hiring at least three new employees in the next year to handle sales and distribution. As sales of these products grow they are projected to fund development of a manufacturing plant by Princeton BioMeditech in Charlottesville's North Fork Industrial Park.

To date $2.0M in angel investment has been raised by ContraVac and invested in research and development in Charlottesville. Five individuals have been employed in the Charlottesville area in connection with the program.

As of June 30, 2009, expenditures totaled $159,551, with $138,749 spent in FY 2009.

A Radiolabelled Carbonaceous Nanomaterials Center (RCNC), Virginia Tech
Partners: Virginia Commonwealth University, Carillon Clinic, and IBA Molecular
Fund Component: Strategic Enhancement

Dr. Harry Dorn, Principal Investigator, Virginia Tech, was awarded $200,000 from CTRF for this two-year project. The goal of the project is to establish a Radiolabelled Carbonaceous Nanomaterials Center (RCNC) for preparing new diagnostic and therapeutic radiolabelled samples that will lead to commercial development and improved capabilities in cancer diagnosis and treatment. The tumors to be addressed first by the new technology are gliomas, which are the most common primary brain tumors and are currently incurable.

The initial phase of this work involved the design and engineering of a metallofullerene generator, including the development of separation and functionalization protocols for the radiolabelled particles. Key achievements include the first trial (non-radioactive) experiments successfully conducted at Virginia Tech in May-June 2009. Following the trials, the unit was moved to VCU in June 2009.

The quartz prototype generator was completed in August, shortly after the FY 2009 reporting period. The team plans to conduct its first radioactive experiments in FY 2010, after installation of the new quartz reactor and establishment of safety measures. This represents a major step forward in this project. Based on these initial trial radiolabelled experiments and others during the fall 2009, the team will initiate *in vivo* studies.

IBA Molecular is interested in commercializing this technology. The team discussed commercialization with several other firms and individuals to help finance this effort.

Invention disclosure forms have been filed at both VCU and VT for work related to this research.

As of June 30, 2009, CTRF expenditures totaled $152,034, with $144,330 spent in FY 2009.

Glass Extrusion Process Analysis and Optimization Research, Virginia Tech
Partners: Institute for Advanced Learning and Research and Corning Inc.
Fund Component: Industry Inducement

Dr. Ronald Moffitt, Principal Investigator, Virginia Tech (VT) and the Institute for Advanced Learning & Research (IALR), was awarded $451,013 from CTRF for this two-year project. The goals of this project were to enhance the understanding of the characteristics and related production processes for specialty glasses produced at Corning's Danville, VA manufacturing

Corning Danville announced in March 2009 that it would close the plant. This award terminated for that reason.

CIT terminated the project since the project scope of work could not be performed as originally proposed. During the ten-month project performance period between May 1, 2009 and March 23, 2009, work was directed toward the procurement of computer systems and associated software for computational fluid dynamics (CFD) modeling, formal training in the use of these software tools, and the development of finite element models (FEMs) for process analysis. By the time the project was terminated, a preliminary working FEM of Corning's proprietary glass sheet extrusion had been developed and was ready for validation in isothermal mode.

While the regional economic development objectives for this project were not met due to the closing of the Corning Danville plant, the project research activities performed during the ten-month period were beneficial for several reasons. First, the project exposed two Virginia Tech post-doctoral scholars and one research associate to the technical inner workings of a large-scale, commercial manufacturing facility. These individuals gained valuable insight into the application of their engineering education and expertise to an industrial challenge of regional economic importance. The Institute for Advanced Learning and Research gained computer resources and CFD software capabilities that may be applied broadly for polymer process troubleshooting in other Southside Virginia polymer processing companies.

Cumulative and FY 2009 CTRF expenditures were $163,959. Remaining monies were returned to the Commonwealth.

Virginia Innovation Partnership Program

The Virginia Innovation Partnership (VIP) program was created after discussions between then Secretary of Technology Aneesh Chopra and representatives of Virginia universities serving on the Virginia Research & Technology Commission (VRTAC). Their goal was to develop a program to selectively move promising university technologies closer to commercialization in order to interest potential licensees or investors. A Proof of Concept model was introduced at the March 2009 VRTAC meeting.

The FY 2009 solicitation set a goal of building value for the Commonwealth by creating Virginia-based start-up companies, attracting established corporations to invest in Virginia, and enhance the licensing potential for technologies. The team's expected outcomes included enhanced creation of new intellectual property at the rate of at least twenty new disclosures per year, with at least 50% converting to licensing deals.

With U.Va. managing the program's review process, U.Va., Virginia Tech, and SRI International in the Shenandoah Valley partnered to administer an annual fund that included monies from CTRF and matching funds from collaborating organizations. The intention was to award $1 million in CTRF FY 2009 monies and $1 million in matching funds.

Following an April 2009 solicitation, researchers from eight Virginia universities submitted sixty-seven applications in May. Grant applications were evaluated by a seven-member VIP Review Board coordinated by the VIP's three-member Governing Committee in June. Finalists were required to present in person before the VIP Review Board. The Innovative Technology Authority or its successor, the Innovative Entrepreneurship and Investment Authority, was to review the recommendations of the VIP Governing Committee and make final award decisions. Criteria associated with proposal review included the following:

- Merit-based awards were to be provided to faculty for innovative research, including translational research.

- Proposals required the collaboration of two co-principal investigators, each of whom were to be from different academic disciplines, in order to stimulate interdisciplinary and intra-institution collaborations.

- Projects or investigators who had formed a company, controlled the primary IP rights, and had professional management/CEO were not eligible to apply.

The guidelines provided that the disciplines enumerated below were eligible for awards. The Chairman of the Innovative Technology Authority (ITA) could authorize awards in other disciplines, provided that such action was reported as required by legislation.

Biotechnology	Information Technology	Energy production and conservation
Environmental technology and sustainability	High performance manufacturing	Bioengineering and Medical Devices
Nanotechnology	Modeling and Simulation	Healthcare and Biosciences
Microelectronics	Security and Safety	Information Assurance

The proposal review process commenced in June and as of June 30, the review process remained underway. In June 2009, the University of Virginia received a $75,000 award for its administration of the VIP review process.

Administering the Virginia Innovation Partnership (VIP) Review Process, University of Virginia

Dr. Thomas Skalak was awarded $75,000 from CTRF for U.Va.'s administration of the VIP review process. The period of performance, April 27, 2009 – June 30, 2010, encompassed the timeframe for proposal solicitation and review as well as for award management and assessment. The award to U.Va. was made in June 2009, and no funds had been spent by fiscal year-end.

ADMINISTRATION

Administrative activities in FY 2009 focused on support to FY 2008 award recipients regarding administrative and financial matters, and assistance in developing, launching, and managing the Virginia Innovation Partnership program. In addition, the Fund administrator engaged throughout the year with the general research community about CTRF activities and opportunities. CIT also provided support to state agencies that required information about the Fund, and collected, reviewed, and assessed annual reports from award recipients in order to develop the Fund Administrator's Annual Report. Throughout the year, CIT provided oversight to ensure compliance with Fund's guidelines and other requirements.

In early FY 2009, CIT assistance to universities primarily addressed the processes required to obtain funding via the Department of Planning and Budget. As the year progressed, Principal Investigators (PI) and administrative personnel requested support from CIT on such issues as rebudgeting, subcontracting, and periods of performance. CIT also received input throughout the year from PIs regarding technology development and other project-related progress and recognition. In March and throughout the rest of the fiscal year, CIT provided support to Virginia Tech related to the termination of the Corning project.

In response to a Freedom of Information Act (FOIA) request made to the Innovative Technology Authority, CIT performed research and provided information regarding grants made in FY 2008.

CIT worked closely with Secretary of Technology, the Office of the Attorney General, and U.Va. to develop and implement the Virginia Innovation Partnership (VIP) program. CIT coordinated with these parties and provided extensive information to U.Va. on its prior CTRF procedures and

experiences to ensure that the VIP solicitation, review, and management procedures complied with the Code of Virginia and other requirements.

Throughout the year, CIT maintained information about the Fund on its website. Furthermore, CIT responded to questions from academia and industry regarding upcoming solicitations and requests to support academic research, including those from organizations that provided extensive information on their proposed projects and remained in regular contact.

APPENDIX A

Title	Period of Performance	Lead Institution	Principal Investigator	Total CTRF Award	Academic Match	Private / Other Match	Total Match*
Towards Establishment of an Industry-State-Federal National Center in Nanoelectronics: Quantum Dot Spintronic Systems	2/1/2008 – 1/31/2010	University of Virginia	Stuart Wolf	$425,542	$215,978	$210,000	$425,978
Precision and Clinical Testing of SpermCheck® Immunochromatographic Devices	2/1/2008 – 4/30/2009	University of Virginia	John C. Herr	$194,700	----	$194,700	$194,700
Self Cleansing Intrusion Tolerance-Next Generation Security Technology (SCIT)	3/1/2008 – 2/28/2009	George Mason University	Arun Sood	$86,013	$1,013	$85,000	$86,013
The Development of BioEclipse, the First Biologically Optimized Treatment Planning System for Proton Radiotherapy	4/1/2008 – 3/31/2011	Eastern Virginia Medical School	Richard Britten	$487,910	$150,000	$338,000	$488,000
A Radiolabelled Carbonaceous Nanomaterials Center (RCNC)	2/1/2008 – 1/31/2010	Virginia Tech	Harry Dorn	$200,000	$399,399	$75,000	$474,399
Glass Extrusion Process Analysis and Optimization Research	5/1/2008 – 3/23/2009; terminated on 3/23/2009	Virginia Tech / Institute for Advanced Learning and Research	Ronald Moffitt	$163,959*	$110,982	$53,928	$164,910
Administration of the VIP Review Process	4/27/09-6/30/10	University of Virginia	Tom Skalak	$75,000	$75,000	----	$75,000
Totals				$1,920,178	$1,083,382	$1,111,721	$2,195,103

* Award as originally authorized totaled $451,013, with $241,992 academic match and $209,021 private match.