# Commonwealth Research Commercialization Fund

## Advancing Technology and Economic Development in Virginia by Investing in Priority Research and Commercialization Activities

**ANNUAL REPORT**

**July 1, 2017 – June 30, 2018**

Submitted by the Fund Administrator:
Center for Innovative Technology
on behalf of the Innovation and Entrepreneurship Investment Authority

**October 1, 2018**

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## Executive Summary

In accordance with Code of Virginia Sections 2.2-2233.1 G and 2.2-2221 (18), and on behalf of the Innovation and Entrepreneurship Investment Authority (IEIA), the Center for Innovative Technology (CIT) respectfully submits this report regarding the performance of the Commonwealth Research Commercialization Fund (CRCF) in FY2018. The CRCF accelerates innovation and drives economic development in the Commonwealth, while solving important state, national, and international problems through technology research, development, and commercialization.

Economic outcomes reported in FY2018 by CRCF award recipients identified early returns on the Commonwealth's investment and include approximately $108 million in follow-on monies to support further technology advancement, more than $1 million in in-kind contributions, four new companies formed, and more than 60 products or services launched. In support of the Fund's goal to commercialize high-potential technology, annual outcomes reported by awardees often reflect the maturation and evolution of an organization and its technology as they advance toward market entry. Outcomes, as well as several project profiles, are discussed below.

In FY2018, CIT offered one solicitation, which resulted in 34 awards[1] totaling $2.68 million and leveraging the Commonwealth's investment with approximately $6 million in matching funds. These CRCF projects are being performed by companies, universities, and research organizations across the state and align with Virginia's key strategic technology priorities as outlined in the Commonwealth Research and Technology Strategic Roadmap.

The program was supported by a $2.8 million FY2018 General Fund appropriation. Funds available to award reflected CIT's administrative fee and monies from grants that had not been fully expended or had been declined.

## Program Impact

CRCF awards seek to solve current and longstanding global challenges in industries such as biosciences, cyber security, advanced manufacturing, energy, and unmanned systems. CRCF awards, for instance, hold promise in biosciences for innovative early detection and analysis technologies for brain, breast, and pancreatic cancers; prevention technologies and therapeutics for diabetes; and wearable sensors that monitor various health concerns. Cyber security continues to be a critical focus of CRCF projects, from products performing cyber security assessments and identifying malicious activity to solutions that identify and measure security vulnerabilities of organizations' IT infrastructures and secure networks and establish patterns to speed up incident remediation and prevent future attacks. Additional technologies, such as 3D modeling and simulation software for homeland security, energy harvesting

[1] 34 projects were selected for funding, with an additional project identified as a back-up award; one organization declined their award and the back-up project was offered funding

devices, and autonomous vehicle sensing and detection show the reach of Commonwealth innovation. These and other CRCF projects have the potential to have a profound and lasting benefit to citizens of the Commonwealth and to society at large by enhancing quality of life and economic development.

CRCF awards have, primarily, supported technology development at the proof-of-concept or prototype development stages or earlier, setting the technology on a commercialization path and making it attractive for further investment and/or licensing. Milestones along what is often a multi-year path to commercialization include clinical trials; FDA approval; investment from federal, private, or other sources; and beta product releases. Already, however, Fund investments have resulted in companies created, expanded, or acquired; products launched; revenue generated; intellectual property developed and licensed; key personnel recruited; and other outcomes beneficial to Virginia and beyond. FY2018 reports submitted by award recipients demonstrate exciting returns on investment for the Commonwealth, and aggregate figures are outlined below.

- **Additional funding leveraged.** CRCF award recipients reported attracting approximately $108 million in follow-on monies to support research and technology efforts after CRCF projects concluded. Sources of funding ranged from angel and venture capital to corporate partners to grant funding. An additional $1.3 million was leveraged from in-kind support and more than $28 million has been reported as pending.

- **Organizational growth and expansion.** In FY2018, at least four new companies were formed to commercialize or otherwise extend the reach of CRCF-developed technologies, two companies were acquired, and at least 15 organizations expanded or established facilities. Nearly 200 new jobs were reported, including full-time and part-time positions, and with hires ranging from students supporting a specific project to senior-level executives to consultants. More than 170 jobs with a similar spectrum have been retained. CRCF awardees reported more than $30 million in sales revenue over the past year, with six organizations each reporting figures of more than $1.5 million. In fact, three organizations reported revenue greater than $2 million, one organization reported revenue of nearly $5 million, and one organization had total revenue for all sales and services greater than $11 million.

- **Products/services introduced to market.** More than 60 new products and/or services have been introduced to market, as reported by CRCF awardees in FY2018, and more than 44 organizations anticipate releases in the next 12 months. More than 14 additional technologies were reported as under development, including at the beta, demo, or prototype stage, as well as pilot programs.

- **Intellectual property created and licensed.** CRCF award recipients reported 16 patents granted and nearly 65 patents filed or pending; this includes U.S., International, PCT, and provisional patents. Additionally, nine invention disclosures have been reported, along with several trade secrets and copyrights. Several organizations are actively pursuing licensing agreements for their technology.

- **Regulatory applications and approvals.** Fund recipients reported that 12 clinical trials or studies were completed, underway, or recently approved. Additionally, at least nine awardees are engaged in or on the path to FDA approvals, including device, drug, investigational new drug (IND), and new chemical entity (NCE).

Each year CIT assesses and refines CRCF reportable criteria to best reflect the types of economic outcomes being demonstrated in the Commonwealth. For example, in FY2015, CIT began tracking academic IP, follow-on investment, and jobs. In FY2018, reports indicate numerous awardees engaged in creating and licensing IP. Additionally, since FY2015, awardees have reported more than $500 million in follow-on funding, more than $22 million in-kind support, nearly $57 million sales and revenue, and more than 1250 jobs created and retained.

## Project Samplings

CIT tracks projects during their period of performance – typically six to 12 months – and for five additional years, as economic and technological outcomes are typically realized a few years or more after a project is completed. The majority of projects from FY2012-FY2017 have ended, while projects awarded in FY2018 are just recently underway. Projects showcasing recent and early CRCF awards and their roles in the economic, technological, and well-being of the Commonwealth follow.

- FOUR18 Intelligence Corp., an FY2017 award recipient and a member of the fall 2015 MACH37™ cohort, is developing the first commercial platform to operationalize the promise of cyber community defense. This requires solving the critical gaps in accessing cyber security talent and up-to-date information to analyze and respond to cyberattacks, and the company's unique perspective is to do this organically through gamification and crowdsourcing. The company, which relocated to Virginia in 2016, has developed a working prototype of the first-ever game-based tool that uses collaborative competition to refine users' cyber intrusion analysis and critical thinking skills and that stimulates information sharing on countermeasures. Recognizing both the importance and impact of the vision, the Department of Homeland Security (DHS) has funded a pilot of the platform, which is built upon technology partially developed under CRCF. With the contribution and co-investment of two Virginia-based partners, Gold Brand Software LLC and MAD Security LLC, two games are expected to launch within a year: a single-player cyber analysis skills development and scoring game that is positioned to sharpen and score individual skills in cyber intrusion analysis, and a live, multi-player cyberattack simulation and defensive playbooks crowdsourcing game. FOUR18 Intelligence leveraged the Commonwealth's investment to secure an additional $270,000 in equity and $350,000 in DHS funding.

- Drs. Kenji Cunnion and Neel Krishna of Eastern Virginia Medical School (EVMS), with the support of an FY2016 CRCF award, developed a novel compound, Peptide Inhibitor of Complement C1 (PIC1), to prevent various conditions with immune-dysregulated complemented cascade activation, such as Acute Hemolytic Transfusion Reactions (AHTRs). AHTRs are life-threatening and are most likely to occur in frequently transfused individuals, such as those with sickle cell

disease. Rapid destruction of red blood cells leads to potentially lethal low blood pressure and subsequent kidney failure. Currently there is no medical intervention to prevent or stop AHTRs. During the 12-month project, the team engaged in multi-dose toxicological evaluation, with encouraging results and in the year following project conclusion, has successfully spun out a new company, ReAlta Life Sciences, along with Children's Hospital of The King's Daughters and Eriko Life Sciences Ventures. The company, one of the first spin-out companies for EVMS, already has received ~$3.4 million in start-up investment and created one full-time and two part-time jobs. Additional outcomes realized by the team over the last year include a successful Pre-Investigational New Drug (PIND) filing and response, ~$2 million in grants and contract funding, two new provisional patent filings, and numerous publications in high-impact journals.

- In FY2017, CRCF awarded funding to NanoSafe, Inc., a Blacksburg-based company that helps nanotechnology organizations navigate emerging environmental health and safety issues through consulting, testing, and R&D services. CRCF funding, along with an SBIR Phase I award from the EPA, has supported NanoSafe's development of LeadMAP™, a platform technology for accurate measurement of total lead concentrations in drinking water. The technology, in the form of a hand-held device, is an easy-to-use, low-cost, home-based test that 'Harry Homeowner' can use to reliably detect harmful levels of lead in drinking water. This includes particulate lead, the prevalent sources in elevated lead crises, such as those from corroded lead plumbing or solder. An accompanying mobile application provides enhanced features to simplify the lead measurement experience and expedite the remediation of elevated lead. LeadMAP™ is one area of focus for NanoSafe's larger Mobile Analytical Platform, or MAP™, a novel system for the inexpensive, real-time measurement of waterborne contaminants.

- Between FY2014 and FY2017, four projects were awarded to the University of Virginia (UVA)'s School of Engineering and Applied Science for work on data processing using hardware acceleration for automata processing. The automata paradigm is especially well-suited for complex pattern matching on unstructured data. The impetus for this work comes from Micron Technology Inc.'s Automata Processor (AP), a hardware implementation of a non-deterministic finite-automata computer architecture. Drs. Kevin Skadron and Mircea Stan are recipients of CRCF funding under these awards, with the objectives of developing building blocks to advance the capabilities and programmability of automata processing on the AP and on field programmable gate arrays (FPGAs), another promising architecture for automata processing. Their work in particular focused on association rule mining, machine learning, bioinformatics, and graph processing. As a side effect of this work, in 2018, UVA was tapped to lead a new $29.7 million center to remove the "memory wall" between data storage and data processors. The resulting Center for Research in Intelligent Storage and Processing in Memory (CRISP) brings together ten universities and is part of a $200 million, five-year national program. The results from the work done at CRISP may be realized in important fields such as medicine and national security, where there are significant sets of complex data. CRCF funding played a critical role in UVA's selection for this award under the Joint Universities Microelectronics Program (JUMP), managed by the Semiconductor Research Corporation.

- In FY2012 and FY2013, ClearEdge3D, Inc. received CRCF funding to advance development of their EdgeWise™ product suite, automated modeling software that streamlines previously labor-intensive efforts to create highly detailed, three-dimensional building models of cities and provides federal and local government officials with immediate access to mission-critical data for training, simulation, and operational planning. Over the last five years, ClearEdge has had more than $8 million in total sales, with steady growth each year. In addition, over the past 12 months alone, they doubled their office space in Manassas, added 12 jobs, and introduced a new software line, Verity™, that identifies construction mistakes by comparing point cloud data of recently completed structures with their design or fabrications models. Verity™'s capabilities were bolstered when ClearEdge acquired Texas-based firm Pericept, bringing two strong construction quality assurance and quality control technologies into a single market-leading company. Further strengthening their product offering, in February 2018, ClearEdge was acquired by Topcon Corporation, a Tokyo-headquartered world leader in positioning instruments for survey and construction; ClearEdge plans to remain in Virginia, retain the same staff, and continue to offer its portfolio of market-changing products.

- In 2012, Virginia Tech and the Carilion Clinic recruited Dr. Robert Gourdie, formerly of the Medical University of South Carolina, to Virginia Tech, as the first-ever Eminent Researcher Recruitment award under CRCF. Dr. Gourdie, a recognized leader in heart regenerative medicine and cell biology has demonstrated tremendous ROI for the Commonwealth of Virginia over the last six years. Results seen by the institution – and thus Virginia – because of Dr. Gourdie's recruitment include but are not limited to:
  - **Follow-on funding:** more than $18 million in external funding, from both public and private sources
  - **IP activity:** more than 50 patents filed within the U.S. and internationally, and 12 patents awarded
  - **Clinical trials and regulatory approvals:** four clinical trials initiated or completed, including one drug in Phase 3 clinical trials, along with two regulatory approvals
  - **Publications:** more than 60 publications, including in high-impact journals
  - **Job creation:** the creation of more than 70 jobs, including full- and part-time staff, graduate students, and interns
  - **Company creation:** the creation of a new, Roanoke-based spin-out company, Acomhal Research, Inc. with Dr. Samy Lamouille
  - **Prestigious awards:** Dr. Gourdie's first company, FirstString Research, Inc., won the Tibbett's Award, presented at the White House
  - **Academic opportunities:** created an interdisciplinary biomedical commercialization course and business pitch competition, combining graduate students from Virginia Tech's Translational Biology Medicine and Health program with colleagues and students at the Pamplin School of Business and College of Engineering at Virginia Tech

## Program Overview

Since the inception of the CRCF program in FY2012, 900 applications were submitted from all of the Commonwealth's nine GO Virginia regions and, from these submissions, 307[2] projects were offered funding. These awards total more than $25 million and are being leveraged with more than $66 million in committed matching funds, including federal awards. CRCF projects have covered the following technology sectors: advanced manufacturing, aerospace, communications, cyber security, energy, environment, information technology – including data analytics, life sciences, modeling and simulation, nuclear physics, transportation, and unmanned systems.

Projects funded by CRCF seek to positively impact Virginia's technology future and, per legislative direction, funding for CRCF projects supports technology sectors identified in the Commonwealth Research and Technology Strategic Roadmap. The Roadmap, a comprehensive planning tool Virginia leaders use to help determine research areas worthy of economic development and institutional focus, identifies technology sectors with the most commercial promise that will drive economic growth throughout the state.

CIT leverages its programs to facilitate company creation and growth. In relation to other CIT programs, CRCF is part of a pipeline, working closely with the Federal Funding Assistance Program (FFAP), the GAP family of funds, and the cyber security accelerator, MACH37™. CRCF also complements other funding programs in the Commonwealth, such as the Virginia Biosciences Health Research Corporation (also known as Virginia Catalyst and VBHRC), a translational human health research accelerator program targeting collaboration between Virginia research universities and industry, the Virginia Research Investment Fund (VRIF), a state-created program for universities that seeks to foster economic development and job creation through public-private collaborate R&D and commercialization efforts, and the Commonwealth Health Research Board (CHRB), which supports research efforts that have the potential to maximize human health benefits for Virginia citizens.

One solicitation was offered in FY2018 and included five programs: Commercialization, Eminent Researcher Recruitment, Matching Funds, SBIR Matching Funds, and STTR Matching Funds. Applications were invited from academia, federal labs, other nonprofit research institutions, university research consortia, and the private sector.

- **Commercialization Program**
  Supported high-potential commercialization activities for products in the proof-of-concept or prototype development phases that had a reasonable probability of enhancing the Commonwealth's national and global competitiveness. Eligible companies could have received no more than: $5 million in combined outside private investment and cumulative sales revenue over the last five years, eight SBIR and/or STTR awards, and two prior CRCF awards.

[2] 307 projects were offered funding since CRCF's inception; 17 awards have been declined

- **Eminent Researcher Recruitment Program**
  Supported public colleges and universities seeking to acquire or enhance research superiority in qualified technologies through the recruitment of a top scholar to its faculty.

- **Matching Funds Program**
  Enabled public and private higher education institutions, federal labs and other nonprofit research institutions in Virginia, and university research consortia that include Virginia college and university member institutions to leverage federal and private funds designated for the commercialization of high-potential qualified research or technologies.

- **SBIR and STTR Matching Funds Programs**
  Advanced high-potential technology commercialization and development efforts by Virginia-based technology businesses that had recently won a Phase I and/or Phase II Small Business Innovative Research (SBIR) or Small Business Technology Transfer (STTR) award; awards could, for example, fill the gap between Phase submissions and/or assist with commercialization activities not supported by the federal award. Eligible firms could have received as many as five SBIR or STTR awards if applying to CRCF with a Phase I award and/or as many as eight SBIR or STTR awards if applying with a Phase II award, among other eligibility criteria.

Six technology sectors were eligible for funding in FY2018: biosciences/medtech, cyber security, energy (clean energy), environment (water quality), information technology (data analytics), and unmanned systems.

In FY2018, CIT received 118 applications from 94 discrete organizations and 117 discrete Principal Investigators. Applicants requested nearly $8 million and spanned all programs and industry sectors, and eight of the nine GO Virginia regions. Thirty-four awards were announced for $2,680,299; one award recipient declined funding. A back-up award had been approved to accommodate this scenario, and overall awarded funding for FY2018 did not change. The recipient declined the award because of a wholesale change in project direction and location of the work to be performed. Awarded projects represented seven of the nine GO Virginia regions and all eligible industry sectors.

FY2018 CRCF awards, along with awards made since the program's inception, address a breadth of critical research areas. Awards to the private sector and universities and research organization alike support robust and diverse biosciences-focused projects. Work ranges from hydrogel treatments to films that can prevent infections to biofabrication technologies for musculoskeletal repairs to novel solutions for crop protection. Data analytics projects seek to automate the due diligence and contract editing and negotiations processes, eliminating manual and time-consuming steps. Funding for clean energy supports the development of new sensors for monitoring industry efficient clean power generation systems, harvesting radio waves as usable energy, and the automation of a cost-effective battery recycling process, among other energy-related goals. Cyber security projects continue to have game-changing potential, including wireless cyber intrusion detection and the recruitment of premiere

scholars in the industry to bolster the cyber security programs at two of Virginia's major research institutions. Projects supporting unmanned systems and water quality also will be validated through FY2018 projects.

CRCF awards were approved by the CIT Board of Directors following a multi-step review process that included funding recommendations made by the Research and Technology Investment Advisory Committee (RTIAC). The RTIAC is a legislatively-established body comprised of representatives drawn from higher education, economic development, research institutes, venture capital firms, and technology corporations. The list of FY2018 RTIAC members is included as Appendix B.

A brief overview of each project announced for award in FY2018 is provided in Appendix A.

## FY2018 Program Administration

Administrative activities in FY2018 included overseeing the solicitation and RTIAC, outreach, and award management for projects funded in FY2012 through FY2017. The fee for Fund management was $318,741.

As Fund Administrator and with the support of the RTIAC and Office of the Secretary of Technology, CIT developed the approach for the FY2018 solicitation, including program guidelines, review processes, and use of an online grants management system, CyberGrants, to facilitate application submissions and reporting. Following the review of 214 Letters of Intent (LOIs) and subsequent proposal submissions, CIT led a multi-step proposal review process. CIT performed an internal compliance review to determine which applications advanced to examination by subject matter experts. These subject matter experts, including individuals from industry, academia, government, and the venture capital community, evaluated and rated proposals. Those that advanced were reviewed by the RTIAC. The RTIAC assessed projects and recommended to the CIT Board of Directors those that should be funded. The CIT Board made final award decisions, after which awards were announced.

CIT maintains information on the Fund, including solicitations and awards, on its website. In FY2018, press releases announced the request for proposals and, subsequently, award recipients. Outreach and communications also included social media, email announcements, webinars, and speaking engagements. Outreach was enhanced by additional communication networks, including CIT's GAP and MACH37™ teams; Virginia's regional technology councils; individual colleges and universities, research organizations, and federal labs; the Virginia Biotechnology Association (VABIO) and numerous other professional societies and trade associations; the Virginia Economic Developers Association (VEDA); the Virginia Economic Development Partnership (VEDP); and the Administration.

Also as Fund Administrator, CIT managed awards announced in prior years and produced the FY2017 Annual Report. This included assessing project performance on an ongoing basis. Additionally, CIT provided support to external organizations, state agencies, and researchers from academia, industry,

and other members of the technology community that desired information about the Fund and future solicitations. Throughout the year, CIT provided oversight to ensure compliance with the CRCF guidelines and other requirements.

## Preparations for FY2019

The General Assembly and Administration appropriated $2.8 million to CRCF for FY2019, and CIT began planning for a new solicitation early in the fiscal year.

The Fund Administrator will continue to monitor projects and will report on them for five years after their period of performance ends in order to capture commercialization results and economic outcomes, including job and company creation, and new revenues.

## APPENDIX A: FY2018 Award Details

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| **COMMERCIALIZATION PROGRAM** | | | | | | |
| AgroSpheres Inc. | *AgroSpheres Enhanced Crop Protection* | With the goal of protecting farmers and consumers, reducing environmental contamination, and sustainably growing the global food supply, CRCF funding will be used to help create a more specific and selective targeted bioparticle for the delivery of crop protectants. | 06/18/2018-06/24/2019 | Dr. Mark Kester | $50,000 | $50,000 |
| AVEC, Inc. | *Noise Reduction of a Continuous Miner Scrubber Fan System Using an Acoustic Liner* | This project targets hearing loss prevention for underground mining workers by reducing noise from the scrubber fan systems using an acoustic liner on the wall of the fan. | 06/16/2018-03/16/2019 | Mr. Kyle Schwartz | $50,000 | $50,046 |
| BEAM Diagnostics, Inc | *BEACON: A Commercial Tool for Clinicians to Assess Alcohol Reinforcer Pathology with Behavioral Economic Tasks* | BEAM Diagnostics aims to develop a validated, theoretically guided tool to provide clinicians with information beyond alcohol use disorder (AUD) symptoms in an effort to define the underlying functional dynamics of AUD instead of using symptom-based tools as biomarkers for the disease. | 06/16/2018-12/31/2018 | Dr. Sarah Snider | $14,720 | $14,725 |
| Blue Point Materials Research LLC | *Development of a Material for Reduction of Infections in Orthopedic Implants* | In this project, the team seeks to demonstrate the ability of their surgical grade material to decrease biofilm formation, to meet initial biomechanical requirements for orthopedic fracture-fixation implants, and to be processed by additive manufacturing. | 07/01/2018-06/30/2019 | Dr. Ratna Prakash Kolli | $50,000 | $58,032 |

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| Bonumose LLC* | *Enzyme Production for Rare Sugar Manufacturing* | Bonumose will use CRCF funding to scale-up and optimize its enzymatic manufacturing capacity in Virginia. | 06/16/2018-12/16/2018 | Dr. Daniel Wichelecki | $50,000* | $200,000* |
| Clockwork, LLC | *1st Diligence* | Clockwork will use CRCF funding to create a system to automate the management and manual tasks associated with the due diligence process to inform market insights and generate overall smarter investments. | 06/16/2018-06/15/2019 | Mr. Alexander Goodman | $50,000 | $483,000 |
| DeepSig Inc. | *Wireless Cyber Intrusion Detection* | DeepSig is developing a wireless cyber intrusion detection program by adapting its wireless spectrum awareness product to detect changes in the emissions of Internet of Things and other wireless devices, thus warning of cyber intrusion, malicious use, and compromise. | 07/02/2018-05/25/2019 | Mr. Benjamin Hilburn | $25,000 | $72,267 |
| Embody LLC | *Biofabrication of Telocollagen-Based Regenerative Medical Devices for Ligament and Tendon Repair* | Embody is using biofabrication technologies to develop a portfolio of products for musculoskeletal repair and replacement. CRCF funding will allow the team to perform proof-of-concept graft production using advanced manufacturing methods, laying groundwork for FDA approval and commercialization. | 06/18/2018-06/18/2019 | Dr. Michael Francis | $50,000 | $100,000 |
| Iconovast | *Janus Nanoparticles for the Detection and Treatment of Cancer* | With CRCF funding, Iconovast will advance the Janus nanoparticle technology for treating pancreatic cancer through proof-of-concept studies that demonstrate the feasibility of targeting and killing cancer cells *in vitro*. | 06/16/2018-06/16/2019 | Dr. David Green | $50,000 | $50,000 |
| MR Technologies | *The Cytogenetic Diagnostic Tool: PRECYSE* | MR Technologies will automate user-intensive functions of the PRECYSE Molecular Scanner, a diagnostic tool that detects and characterizes genomic translocations of diagnostic and prognostic | 06/16/2018-05/31/2019 | Dr. Jason Reed | $49,963 | $60,099 |

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| | | significance in hematologic and other malignancies. | | | | |
| Quest Knight Enterprises | *Unmanned Systems Platform Sensor Workforce Development* | QKE will develop a UAS system to perform human operations such as grasping, lifting, and carrying on job/mission sites in industries such as offshore oil and gas, agriculture and forestry, and national security. | 06/16/2018-04/16/2019 | Mr. Timothy Tingler | $48,635 | $70,528 |
| Sentek Instrument, LLC | *Ultra-High Temperature Sensors for Clean Power Generation Systems* | Sentek Instrument aims to develop a sapphire-based fiber optic ultra-high temperature sensor for high-speed simultaneous measurement of pressure and temperature that can be used by the power industry to monitor energy-efficient clean power generation systems. | 07/23/2018-07/19/2019 | Dr. Bo Dong | $50,000 | $50,000 |
| Service Robotics & Technologies | *SRT's Map-Building Robot for Creating Visual Facility Maps* | In this CRCF project, SRT will develop a map building software product that will process a robot-built "map" data set and transform it into a user-readable facility map, providing facility managers with a dynamic digital map of their facility overlaid with actionable sensor data from throughout the building. | 06/18/2018-05/31/2019 | Dr. Gregory Scott | $50,000 | $90,084 |
| Tympanogen | *Manufacturing Feasibility of a Gel Patch for Nonsurgical Eardrum Repair* | Tympanogen has developed an innovative and highly regenerative gel path for nonsurgical tympanic membrane repair. With CRCF funding, the team will determine the manufacturing feasibility of the product. | 07/01/2018-12/31/2018 | Dr. Elaine Horn-Ranney | $50,000 | $131,870 |
| **TOTAL COMMERCIALIZATION PROGRAM AWARDS:** | | | | | **$588,318** | |
| **TOTAL COMMERCIALIZATION PROGRAM MATCHING FUNDS:** | | | | | **$1,280,651** | |
| **EMINENT RESEARCHER RECRUITMENT PROGRAM** | | | | | | |
| George Mason University | *Recruiting Eminent Cybersecurity Researcher* | Mason, along with private sector partner Lockheed Martin, will use CRCF funding to recruit a highly accomplished eminent | 07/01/2018-06/30/2020 | Dr. Kenneth Ball | $250,000 | $300,000 |

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| | | researcher of national and international standing in cyber security and with extensive expertise in cyber-physical security. | | | | |
| Virginia Tech | *Cybersecurity for the Internet of Things* | Through CRCF funding and matching funds from partner CACI, Virginia Tech will supplement the start-up package for a senior faculty member working in cyber security for the Internet of Things at the university's Northern Virginia campus. | 08/10/2018-08/09/2020 | Dr. Charles Clancy | $250,000 | $250,000 |
| **TOTAL EMINENT RESEARCHER RECRUITMENT PROGRAM AWARDS:** | | | | | **$500,000** | |
| **TOTAL EMINENT RESEARCHER RECRUITMENT PROGRAM MATCHING FUNDS:** | | | | | **$550,000** | |
| **MATCHING FUNDS PROGRAM** | | | | | | |
| College of William and Mary | *Developing Acoustic Technology to Reduce Birds' Risks of Collision with Wind Turbines: Expanding Wind Energy Opportunities in Virginia* | CRCF funding will allow W&M to further develop a commercially viable technology that mitigates bird strikes with wind turbines or other large structures using acoustic "warning sounds". | 08/01/2018-07/31/2019 | Dr. John Swaddle | $99,711 | $99,730 |
| Commonwealth Center for Advanced Logistics Systems (CCALS) | *Addressing the Logistical Challenge of Medication Reconciliation in Emergency Medicine Settings* | CRCF funds will be used on a mass spectrometry-based analytical approach to directly identify medications in a patient's bloodstream in a timely manner, particularly in ER situations. | 07/01/2018-06/30/2019 | Dr. Dayanjan Wijesinghe | $100,000 | $100,005 |
| Commonwealth Center for Advanced Logistics Systems (CCALS) | *Development of Secure Compartmentalized Automated Refrigerated Storage (SeCARS) for Controlled Medicines* | CCALS seeks CRCF funding for the development of a secure, controlled, automated, refrigerated storage (SeCARS) for controlled medicines, as there currently are limited options for secure refrigerated storage of medicines that require restricted access. | 07/01/2018-06/30/2019 | Dr. Thomas Roper | $100,000 | $100,000 |
| George Mason University | *From Unidentifiable and Undruggable to the Future of Pharmaceuticals: Protein Painting Reveals High-* | Protein-protein interactions are an exciting new field of drug discovery. CRCF funding will be used to formulate protein painting – a novel approach to quickly and | 06/18/2018-06/14/2019 | Dr. Lance Liotta | $99,586 | $99,586 |

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| | *Value Protein-Protein Interactions as Drug Targets* | simply identify the interaction surfaces between proteins and a signaling pathway – as a simple-to-use kit. | | | | |
| James Madison University | *Sustainable Energy from Radio Waves* | JMU proposes to develop and assess the performance of capacitive harvesting devices and fabricating readily marketable prototypes. The devices will be capable of harvesting radio waves from the environment and transforming them into readily usable energy. | 07/01/2018-12/31/2019 | Dr. Giovanna Scarel | $59,533 | $59,533 |
| Old Dominion University | *Cyber Risk Scoring and Mitigation* | This ODU team will use CRCF funds to test and evaluate the effectiveness of their Cyber Risk Scoring and Migration (CRISM©) tool in Sentara Healthcare's IT environment. CRISM© employs advanced threat assessment techniques to identify and measure the security vulnerabilities of an organization's IT infrastructure. | 07/01/2018-06/30/2019 | Dr. Sachin Shetty | $100,000 | $100,000 |
| Old Dominion University | *Highly-Transmissive Colored Coatings for Architectural Photovoltaic Panels* | CRCF funds will be used to design and evaluate processes for producing commercially significant volumes of selectively reflective light-transmissive particles with high yield and at low cost. | 07/01/2018-06/30/2019 | Mr. Hani Elsayed-Ali | $100,000 | $100,000 |
| University of Virginia | *Anti-Icing Surfaces for Wind Energy Turbine Blades and Energy Savings in Refrigeration Systems* | The goal of this project is to advance the surface microtexture technology developed at UVA to generate water repellent surfaces for anti-icing and corrosion protection for wind energy systems. | 07/01/2018-12/04/2019 | Dr. Mool Gupta | $100,000 | $100,000 |
| University of Virginia | *Nano-Enhanced Vaccine for Melanoma* | CRCF funds will be used in the development of a peptide-based vaccine for melanoma patients, as well as *in vitro* and *in vivo* studies, thus generating data to support a phase I clinical trial. | 07/01/2018-06/30/2019 | Dr. Craig Slingluff | $100,000 | $100,000 |

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| University of Virginia | *Optimizing Anemia Dosing Algorithms by Leveraging EMR Data to Improve Outcomes in End Stage Renal Disease* | UVA researchers will develop with CRCF funding a predictive dosing algorithm that leverages existing electronic medical record (EMR) data to enable better-informed dosing decisions and substantially improve care for patients with end stage renal disease-related anemia. | 07/01/2018-06/30/2019 | Dr. Brendan Bowman | $99,944 | $101,487 |
| Virginia Commonwealth University | *Development of a Click Hydrogel Carrier for in Situ Delivery of Bioactive Agents* | VCU has developed *in situ* gelling injectable biodegradable hydrogels that retain biologics locally, enabling their release over time. The team will use CRCF funding for proof-of-concept demonstration of stimulation using rodent models for rapid screening of different compositions of bone morphogenetic protein 2 (BMP2). | 07/01/2018-06/30/2019 | Dr. Barbara Boyan | $100,000 | $100,000 |
| Virginia Institute of Marine Science, College of William & Mary | *Progeny Tests of Triploids to Establish Additive Advantages from Tetraploid Parents for Commercial Oyster Culture* | The project expects to enhance the profitability of oyster aquaculture. CRCF funding is sought to reveal the nature of the genetic relationship between traits in triploids by adding triploid progeny testing: rearing triploid families alongside their corresponding tetraploid half-sib families to demonstrate how typical commercial traits translate to the triploid, as well as determine how "triploid mortality" may be related to the tetraploid parent. | 08/01/2018-08/01/2020 | Dr. Standish Allen, Jr. | $83,207 | $100,000 |
| Virginia Tech | *An Automated and Cost-Effective Lithium-Ion Battery Direct Recycling Process* | The goal of this project is to develop an automated and cost-effective battery recycling technology that takes advantage of automated processes and a scalable electrochemical flow system to directly yield resalable battery-grade cathode | 06/16/2018-06/15/2019 | Dr. Zheng Li | $100,000 | $100,000 |

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| | | materials from end-of-life lithium-ion batteries. | | | | |
| Virginia Tech | *Ultra-Miniature Ultra-High Temperature Sapphire Sensor for Power Generation* | Virginia Tech researchers will develop an ultra-miniature, ultra-high temperature sapphire-fiber (U2S) sensor and a transformative fabrication technique to minimize sensor size, lower cost, and streamline production. Sensors with these capabilities are sought for use in harsh turbine environments characterized by extreme temperature and chemical aggression. | 07/01/2018-06/30/2019 | Dr. Yizheng Zhu | $100,000 | $100,000 |
| **TOTAL MATCHING FUNDS PROGRAM AWARDS:** | | | | | **$1,341,981** | |
| **TOTAL MATCHING FUNDS PROGRAM MATCHING FUNDS:** | | | | | **$1,360,341** | |
| **SBIR MATCHING FUNDS PROGRAM **** | | | | | | |
| Adaptive Aerospace Group, Inc. | *High-Integrity Safe Autonomy Flexible Innovation Testbed (SAFIT)* | Adaptive Aerospace Group is developing and certifying a high-integrity flight management system and ground control station for safe operation of single and multiple autonomously maneuvering fixed-wing unmanned aerial vehicles across a wide range of commercial and research missions, including Beyond Visual Line of Sight (BVLOS) operations. | 06/16/2018-12/15/2018 | Mr. Jesse Couch | $50,000 | $124,654 |
| BlackBoiler, LLC | *Automatic Contract Editing in Two Party Negotiation with Lexical Decomposition and Deep Learning Based Semantic Understanding* | The BlackBoiler team will develop a prototype system that learns to review and revise contract language in multi-round negotiations, potentially eliminating or automating previously necessary rounds of negotiations. | 07/01/2018-12/31/2018 | Mr. Jonathan Herr | $50,000 | $225,000 |
| Pancopia, Inc. | *Commercialization Testing of Low Cost Nitrogen Removal Technology* | Pancopia plans to design, pilot, and commercialize the U.S.' first mainstream deammonification system that can remove organic carbon and nitrogen for the same | 07/02/2018-01/31/2019 | Mr. William Cumbie | $50,000 | $810,333 |

| Award Recipient | Project Title | Project Description | Period of Performance | Principal Investigator | CRCF Award | Match |
|---|---|---|---|---|---|---|
| | | cost as current systems that can only remove organic carbon. | | | | |
| WynnVision LLC | *Antimicrobial Catheters with Cell and Tissue Compatibility* | With CRCF and matching SBIR funding, WynnVision will establish feasibility for a new approach for eliminating catheter associated urinary tract infections, using thin film "overcoats" for conventional catheters that are antimicrobial but harmless to human cells such as the tissue lining the bladder and urethra. | 06/16/2018-05/31/2019 | Dr. Kennard Brunson | $50,000 | $1,491,266 |
| **TOTAL SBIR MATCHING FUNDS PROGRAM AWARDS:** | | | | | **$200,000** | |
| **TOTAL SBIR MATCHING FUNDS PROGRAM MATCHING FUNDS:** | | | | | **$2,651,253** | |
| **STTR MATCHING FUNDS PROGRAM **** | | | | | | |
| BrachyFoam, LLC | *Development and Validation of Delivery System for Commercialization of Self-Expanding Hydrogel for Pelvic Brachytherapy* | To improve the clinical care of patients receiving brachytherapy for gynecological cancers, the team will refine and validate the prototype design of a hydrogel delivery system, an important step of preclinical testing and accelerating commercialization, by providing the complete product needed for FDA review. | 06/16/2018-06/15/2020 | Dr. Timothy Showalter | $50,000 | $150,000 |
| **TOTAL STTR MATCHING FUNDS PROGRAM AWARDS:** | | | | | **$50,000** | |
| **TOTAL STTR MATCHING FUNDS PROGRAM MATCHING FUNDS:** | | | | | **$150,000** | |
| | | | | | | |
| **TOTAL CRCF FY2018 AWARDS:** | | | | | **$2,680,299** | |
| **TOTAL CRCF FY2018 MATCHING FUNDS:** | | | | | **$5,992,245** | |

## FY2018 Funding Totals

| PROGRAM | FY2018 AWARD COUNT | FY2018 AWARD TOTAL | FY2018 MATCH TOTAL |
|---|---|---|---|
| Commercialization Program | 13 | $588,318 | $1,280,651 |
| Eminent Researcher Recruitment Program | 2 | $500,000 | $550,000 |
| Matching Funds Program | 14 | $1,341,981 | $1,360,341 |
| SBIR Matching Funds Program | 4 | $200,000 | $2,651,253 |
| STTR Matching Funds Program | 1 | $50,000 | $150,000 |
| **ALL PROGRAMS** | **34** | **$2,680,299** | **$5,992,245** |

* Indicates declined award; not counted toward totals in any section of Appendix A

** Matching funds provided toward the CRCF project are the federal SBIR/STTR awards and may include additional awardee-contributed match

## APPENDIX B: RTIAC Members

In FY2018, the following individuals were members of the Research and Technology Investment Advisory Committee (RTIAC), the group responsible for making award recommendations to the CIT Board of Directors.

- **Steve Clinton,** former Vice President and COO – Sebesta, Inc. (*retired*)
- **Morris Foster**, Vice President for Research – Old Dominion University
- **Cheryl Giggetts,** Principal Consultant – CTA Consultants, LLC
- **Yvonne Harris,** Vice Provost for Research and Scholarship – James Madison University
- **Bob Kahn**, Chairman, CEO, & President – Corporation for National Research Initiatives
- **Frank Macrina**, Vice President for Research and Innovation – Virginia Commonwealth University
- **Dennis Manos**, Vice Provost for Research and Graduate/Professional Studies – College of William and Mary
- **Steven Moret**, President and CEO – Virginia Economic Development Partnership
- **Venkat Rao,** Director, Chem-Bio Programs – Parsons
- **Scott Tolleson,** Managing Director – NRV