IGEM Grant Report

☑ Progress (due Jan. 1)   ☐ Annual (due Jul. 31)   ☐ Final (due Aug. 31)

IGEM Grant # __23-001_____   Principal Investigator __Michael Haney___

Submission Date___1/2/2024_____   Primary Institution __University of Idaho____

Section 1: Summary of project accomplishments for the reporting period and plans for the upcoming reporting period.

"Library of Reconfigurable Immersive Attack and Defend Scenarios for Cybersecurity Research and Workforce Development"

The University of Idaho and Idaho State University are in our second year of collaboration to build a new Reconfigurable Attack-Defend Instructional Computing Laboratory (RADICL) at the University Place campus in Idaho Falls.

Our focus during this reporting period has been twofold: building, configuring, and integrating a wealth of research and training equipment, and expanding our partnership and planning with industry and education partners.

Continued efforts, including two initial workshop meetings, have resulted in further discussions with industry partners and new partners at area K-12 schools. We are forming a more formal partnership in eastern Idaho to expand access to cyber-physical systems and cybersecurity training using our immersive and engaging environment. This is further discussed in Section 3.

We continue to engage a number of UI and ISU students and faculty which has led to multiple grant proposals and research papers submitted. Plans for the upcoming reporting period include a first new graduate research course developed in this environment offered Spring of 2024, and plans for teacher training and K-12 school visits with our mobile lab components (see Section 2) this spring. We continue to advance towards our goal of creating, operating, and sustaining a state-of-the-art research and training facility for the benefit of all Idaho academic institutions and industry partners.

Section 2: High-level summary of budget expenditures for the period just completed.

- Funding of $700,000 for FY24 is split between UI and ISU co-PIs to manage ($300,000 to ISU as sub-award, $400,000 allocated to UI).
- Overall this project is on schedule and on budget.
- Focus during this initial grant reporting period has been on acquisition of equipment, materials, supplies, and renovation of available facilities, having expended or encumbered almost $470,000:
  - Private cloud computing
  - Cyber Shooting Gallery
  - Operations Technology (OT) training modules for advanced manufacturing (ISU).
  - Information Technology (IT) training workstations
  - Large-scale electric grid simulation and research platform.
- Student and faculty support, post-doctoral fellow search, and related human capital expenses are on target.

Per our expenditure plan, this reporting period is front-loaded with equipment acquisition. Some of this has been the expansion or increased quantities of components and supplies that we were able to prototype and test during the first year of funding.

Facilities, materials, and equipment under this HERC IGEM grant specifically fall under one of several categories. In order to support the backbone of our "cyberspace" environment, we have created a private cloud environment that will support the reconfigurable virtual spaces for cybersecurity and energy research and training. We have now doubled the computing capacity of our private cloud environment from the previous year's acquisitions. We have also expanded our networking capacity and are continuing the work in progress to connect all of the associated lab spaces in the Center for Higher Education building in Idaho Falls, and significantly upgrade our ability to connect with the Idaho Cyber Range. Combined, the current spending to date on our private cloud computing environment is over $300,000.

We have now significantly grown the footprint of the "Cyber Shooting Gallery". This environment consists of 24 target platforms of small-scale cyber-physical systems for students to design, attack, defend, and reconfigure. We have engaged students across our campuses and with a local CTE high school, designing and offering a new course to attract and facilitate more students, all to help us brainstorm and then create the different platforms.

Another major component of this grant effort is on the design, acquisition, and implementation of the larger scale "Nuclear Balance of Plant" equipment. As proposed, each year of our effort we will focus on a different primary critical infrastructure sector, and in the first year of funding for a number of reasons, we shifted our focus from the nuclear balance of plant efforts to advanced electric grid distributed control efforts as documented in our previous report. The second half of this funding year we will continue developing capabilities for cybersecurity research and training on nuclear power plants simulators. Completion of this element is now scheduled for the spring and summer of 2024, and will include the faculty and student support expenses to build and deploy this major component during the summer months.

The balance of our expenditures to date are on budget and in accordance with the HERC IGEM requirements and the UI's Office of Sponsored Programs. At this time, the budget numbers available and summarized in the Section 6 attachment reflect two anomalies. The first is that the ISU sub-award has not been billed between ISU and UI. ISU co-PIs have procured training equipment from our vendor as per the proposed budget and schedule. The second reflects that we have categorized some purchases as small equipment rather than capital expenses, but we are reporting here on functional groups (e.g. Private Cloud versus Shooting Gallery versus Nuclear Balance of Plant). The Section 6 attachment reflects current tracking in UI's Office of Sponsored Programs.

Section 3: Demonstration of economic development/impact:

- Multiple journal and conference papers published regarding work to date.
- Multiple external funding opportunities currently submitted or in development, with over $4m under review.
- Multiple engagements with private sector partners as well as other academic and research institutions.
- Post-doctoral fellowship positions created to be filled in future reporting period.

During this funding period in order to support the sustainability of these and related efforts in the years ahead, the University of Idaho's College of Engineering created the Intermountain Center for the Cybersecurity of Critical Infrastructure (IC3I) naming the PI as Director. The .development, and technology commercialization in support of the cybersecurity of our regional critical infrastructure's cyber-physical systems. We believe these grant efforts are core to the establishment of the Center, and that the Center is core to the direct economic impact of these efforts across our region.

Further, the co-PIs of this grant are all involved in the ongoing development efforts of the Idaho Cyber Range to make the Idaho Falls-based laboratories and equipment interoperable with research laboratories and training facilities across the state, including at the Idaho National Laboratory's Cybercore Integration Center and the Center for Advanced Energy Studies. Additionally, we are now working with Montana State University on the development of training and education curriculum for hands-on cyber-physical systems security. During the next period, we plan to formally establish the Center's Industry Advisory Board with the partners we have so far fostered.

Section 4: Number of faculty and student participants as a result of funding, and brief description of student efforts.
- 3 Master's students directly funded during first half of FY24,
- 1 new student recruited to be directly funded in next reporting period (Spring 24).
- 14 additional undergraduate and graduate students directly involved in supporting initial project efforts.
- 7 principle investigators supported by this grant.
- Future HERC IGEM funding will substantially shift from equipment and materials acquisition to student education and research involvement by directly supporting multiple graduate students and a post-doctoral fellow during the third year.

This grant effort is by design both multi-disciplined and collaborative. We have set out to create a state-of-the-art research and training facility for advanced cyber-physical systems security. Together, over 20 faculty and students from both UI and ISU have been working together on multiple facets of this grant effort: from selection of components and shopping for available new or refurbished equipment, to designing network architecture and cyber-physical systems platforms, working with vendors and contractors, IT support, university procurement, and facilities personnel, installing and configuring software, running wiring and connecting gadgets, building up, tearing down, and building up again the various platforms and elements to support our vision. Their contributions both small and large have been innumerable and invaluable.

It is also through this diverse group of participants and especially students that we have improved and expanded on the mobile aspect of this work. As a result, we have identified three focused efforts for three of the Master's students to complete their thesis, with several papers in draft at the time of this writing. The condensed version is that we are now building a mobile unit of the RADICL lab that will include 16-20 laptops, three mobile cyber-physical systems platforms (mini-Shooting Gallery), networking gear sufficient to not require a local site's Internet, and the necessary private connections back to our campus network to access our private cloud and the full Cyber Shooting Gallery utilizing our cameras to see the physical results of actions-at-a-distance. We are very excited about the possibilities for broader impact

of our work and see paths for commercialization of this training mode and methodology.

Section 5: Updated details and/or progress on the long-term sustainability plan for the project and description of future plans for project continuation or expansion.

- Multiple federal and state grant proposals submitted, under review, or planned (currently *over $4 million* under review)
- Multiple levels of engagement with private industry partners for workforce training
- Establishment of the IC3I and alignment with the East Idaho Cybersecurity Alliance.

Our current development of the RADICL and related research laboratory and training facilities are designed to enable sustained education, research, and workforce development in Idaho Falls. This will come with significant engagement with our industry partners, the Idaho National Laboratory, and the campuses across the state of Idaho connected via the Idaho Cyber Range, as well as through current and planned external funding from federal and state funding agencies. Initial plans for sustained growth and expansion of our capabilities include several grant proposals recently submitted or currently under development.

Additional grant proposals in development and expected to be submitted in the upcoming reporting period include grants led by Dr. Roberson to the Department of Energy's Nuclear Energy University Programs (NEUP) program (invited proposal for $800,000), as well as the DoE's Office of Cybersecurity, Energy Security, and Emergency Response (CESER), by Dr. Kolias to the NSF's Computer and Information Science and Engieering (CISE) Directorate, and Dr. Haney's proposals to the Department of Commerce (NIST CSRC) and Cybersecurity and Infrastructure Security Agency's (CISA) programs. The team led by Dr. McBride also has current and planned proposals to the Department of Labor and Department of Education for ongoing workforce development efforts. Details of these and other proposals will be forthcoming in the next reporting period.

The model for our Idaho Falls facilities and capabilities centers on our engagement with the community and industry partners here and across the region. The initial funding has enabled multiple engagements and workshops with current industry partners, With the development of our multiple spaces on campus, our private cloud computing environment, our shooting gallery, and the data created and collected for running multiple reconfigurable cyber wargame scenarios, we expect to engage and train a wide variety of industry professionals in different roles and vertical critical infrastructure industries. And now, with the expanded mobile capabilities, we can bring this environment anywhere we can drive. This industry and school engagement will allow for development of a revenue stream designed not for profit but to sustain our staff, equipment, software licensing and other operating expenses indefinitely. Discussion for commercialization paths is nascent, but on the agenda for the upcoming year.

Section 6: Expenditure Report

The attached summary represents best information at the time of this report of acquisitions and expenditures of materials, supplies, and equipment, faculty and student salaries and post-doctoral expenses. Expenditures to date are on schedule and in accordance with HERC IGEM funding guidelines and the policies and procedures of the University of Idaho's Office of Sponsored Programs.

Library of Reconfigurable Immersive Attack and Defend Scenarios for Cybersecurity Research and Workforce Development

	Budget	Spent	Remaining
Idaho State University	$300,000.00	$0.00	$300,000.00
Salary	$40,122.74		$32,235.14
Faculty		$0.00	
Graduate Research Assistantship		$7,887.60	
Fringe	$13,862.20		$13,665.01
Faculty		$0.00	
Student		$197.19	
Temp Help Student (Summer)	$56,966.00	$0.00	$56,966.00
Operating Expenses	$21,303.06	$3,538.94	$17,764.12
Capital Expenses	$180,000.00	$85,116.36	$94,883.64
Small Equipment	$62,000.00	$63,838.04	-$1,838.04
Tuition & Fees for GRA's	$25,746.00	$6,389.00	$19,357.00
Total	**$700,000.00**	**$166,967.13**	**$533,032.87**