CapitalBudgetRequest

Construct Undergraduate Lab Building

Overview

Agency	Virginia Polytechnic Institute and State University (208)
Project Code	18332
Project Type	New Construction
Biennium	2020-2022
Budget Round	Initial Bill
Request Type	Previously Approved
Project Location	Roanoke Area
Facility/Campus	Blacksburg Main Campus
Source of Request	Agency Request
Infrastructure Element	Laboratory / Classroom
Contains O & M costs? Yes	
Contains significant technology costs? No	
Contains significant energy costs? No	
Possible that project will be used by other than a state or local governmental entity, or for research under sponsored programs (higher education)? No	

Agency Narrative

Agency Description

Executive Summary:

The Construct Undergraduate Laboratory Building (208-18332) project is included in the Detailed Planning Pool appropriated in Item 4 of Chapter 759 of the 2016 Acts of Assembly with an effective date of July 1, 2017. Schematic Designs were reviewed by the Division of Engineering and Buildings in accordance with the state's Cost Review Process. The project scope and costs are within the Six-Year Capital Outlay Plan Advisory Committee funding report recommendation. Preliminary Designs (Detail Planning) are scheduled to be completed in July 2019. After these designs have been reviewed by the Division of Engineering and Buildings, the project will be ready for construction funding at the start of fiscal year 2021.

This science instructional facility is a companion building to the undergraduate Classroom Building (completed in 2016) to address enrollment growth, support innovative instructional approaches of the 21st Century, and meet STEM-H instruction needs, including the core curriculum of all tech talent pipeline students. The university needs a larger inventory of modern instructional laboratories to support prior and current enrollment growth in the STEM-H disciplines. Modern laboratories are necessary for students to work with the latest technologies and participate in interdisciplinary teams to meet the training expectations of industry and government. Without this project, the university cannot provide the necessary training experience for the STEM-H students or be positioned to accommodate the shift in growth for additional STEM-H majors.

This project request is in accordance with category three, noted within the capital budget request instructions, as a new construction project that was previously approved for planning and for which planning will be completed.

Project Description:

The building design includes a 102,720 gross square foot, four-story structure, clad in a combination of Hokie Stone, precast concrete panels and trim, and a combination of curtain wall glazing and punched opening windows. The building site is located at a major entrance to campus and on an existing paved parking lot adjacent to the new undergraduate Classroom Building, which opened in August 2016. Successful design principles from the undergraduate Classroom Building, including 24/7 student space, will be replicated in the Undergraduate Laboratory Building. The building design also includes a strong connection to the site with hardscaping for exterior classroom sections.

The building will house instruction in neuroscience, nanoscience, microbiology, chemistry, biomedical engineering, materials science engineering and other advanced science, technology and engineering programs, which will involve the use of advanced imaging equipment,

specialized labs, and dedicated lab support areas. The facility is designed to support recent enrollment growth in existing programs and new STEM-H degrees.

The program for this building includes 28 teaching labs (16 wet and 12 dry), a discovery suite and instrument lab (each composed of a mix of smaller wet and dry labs), numerous lab support spaces, 6 classrooms, 5 offices, graduate teaching assistant work space, informal study areas, student/faculty collaboration areas, conference rooms, and space for supervised student research projects.

Ground level labs include a high visibility, discovery suite where students work in teams on project based research, a dry assembly lab, an electrical lab, a fabrication lab, and a specialty instrument lab. Second floor labs include two wet labs supporting classes in biochemistry, cell and molecular biology, biomedical engineering, and nano-medicine and instrumentation. The second floor also contains four geoscience focused dry labs, a flex lab with the ability to support either wet or dry lab requirements, and an area devoted to housing a specimen collection. Level three wet (nanoscale synthesis, fabrication and characterization) and dry labs are arranged similar to level two, however, the dry labs on level three are primarily focused on teaching physics. Level four has seven wet labs, four of which are dedicated to teaching microbiology, one for biomedical engineering, and two advanced chemistry labs.

All new laboratories must be highly flexible and adaptable for future instructional needs. Providing mobile lab furniture in some areas is costly but ensures flexibility and future cost savings. Ample computational space is also necessary as are generous floor-to-floor heights, sufficient cooling capacity, and abundant electrical power to each student station.

The project scope, site development, and building configuration shall be consistent with the 2018 master plan update and adhere to universal, accessible design principles as appropriate.

Justification

Program Description:

Virginia Tech continues to grow in undergraduate students, particularly in STEM-H majors. In the 15 years from fall 2004 to fall 2018, the university's on-campus undergraduate majors grew 30 percent, from 21,330 to 27,729. During this same period, undergraduate STEM-H majors grew 60 percent, from 8,041 to 12,866. Thus, as the total number of students is expanding, the number of STEM-H majors is growing at a faster rate. Another enrollment surge for fall 2019, accentuated by STEM-H majors, is accelerating the needs for laboratory instruction space.

Virginia Tech graduates a much larger percentage of STEM-H majors each year than any other Virginia institution and also leads the state overall in STEM-H degree production, with over 4,600 degrees awarded annually. This represents 54 percent of Virginia Tech's total degree production and 24 percent of the statewide STEM-H degree production in public universities.

Looking forward, the university expects to grow further on-campus undergraduates further through fall 2023. A significant portion of this growth is expected to be in the STEM-H areas and support degrees associated with the tech talent pipeline. This growth will largely be in engineering, data sciences, computer science, traditional physical and life sciences, as well as in new degree programs such as neuroscience, nanoscience, packaging, biomedical engineering, and public health.

The increase in the number of STEM-H majors and the strategic actions of the university to address the Top Jobs 21 goals and the tech talent pipeline create significant pressures on existing science instructional laboratory facilities. For example, in the years from 2004 to 2017 (the last full year for which data are readily available), lab student credit hours in physics have jumped 45 percent, from 4,094 to 5,936. Physics is a key service discipline for engineering and other physical science majors. Likewise, biology laboratory credit hours, a key service discipline for the broad range of life science majors at Virginia Tech, increased 51 percent.

The university last constructed an undergraduate laboratory facility in 2004 for instruction in chemistry and physics. The university's existing inventory of science laboratory instruction is now too small and generally outdated to accommodate the current and growing demand, instrumentation and integrated nature of instructional spaces for advanced engineering and science majors.

Much of the instruction for these programs is currently housed in older facilities with equipment that is inadequate to support modern instructional methods and limitations on the section sizes in which lab courses can be delivered. Unable to accommodate the demands of growing STEM-H programs with the existing inventory, the university is confronted with the need to construct new instructional laboratories. This project is designed to meet the laboratory instructional needs of faculty and their students enrolled in courses that are part of the growing STEM-H emphasis.

Within Virginia Tech, instruction is transitioning from traditional lecture/lab model toward team based, problem oriented learning that emphasizes research like experience to provide a sense of relevancy, excitement, and engagement in the laboratory and provide real world skills needed for successful science and engineering careers. This contrasts with the traditional model of repeating prescribed lab exercises with known results. With a focus on experiential learning, the new undergraduate laboratory facility will provide space for upper-division undergraduate instruction, research projects, experiments, group study space, and collaboration with faculty.

Undergraduate science education is moving toward a more unified model of lecture and laboratory to make use of Technology Enhanced Active Learning (TEAL) and Interdisciplinary Problem Based Learning (I-PBL). TEAL and I-PBL, while first applied to classroom design, are beginning to have significant impact on lab design. This new approach to how science should be taught also has important implications for the design of instructional laboratories. Laboratories should be visually transparent, incorporating glass partition walls wherever possible, to

publicly display the laboratory activities and generate curiosity and engagement. Laboratories are cross-disciplinary, collaborative, and highly interactive depending on the class size and the nature of the investigation.

This project requests authorization to construct a new undergraduate science laboratories facility of 102,720 gross square feet to accommodate the growing demand for STEM-H degrees at Virginia Tech.

This project supports several principal strategies of the university's strategic plan including:

• Increase excellence in research, discovery, and creativity.
• Increase teaching and learning excellence for a holistic education.
• Increase institutional impact and visibility. Achieve top US public land-grant ranking by 2024.
• Increase the four-year graduation rate for all undergraduate students to 70 percent as well as the three-year graduation rate for all undergraduate transfer students to 75 percent.
• Reduce the student average student loan debt per graduating senior to $25,000 by 2024.
• Increase representational diversity, cultural competency, and address critical societal issues impacting humanity and equity.
• Attract, retain, and develop the talents of students, faculty and staff prepared to serve both the local and global communities while also supporting lifelong engagement and learning.
• Continue to develop the physical campus and technology infrastructure.
• Increasing the number of programs recognized as among the best internationally.
• Ensuring competency in data analysis and computational methods as a component of general education for all students.
• Increasing undergraduate involvement in meaningful research experiences and experiential learning opportunities.
• Ensure 100% of majors have a required experiential learning component by 2024. Identifying opportunities during construction and renovation to create flexible classroom spaces that fully support e-learning components.

Existing Facilities:

The existing laboratory facilities used to deliver instruction include Derring Hall (FCI=50%) and Robeson Hall (FCI=34%), and the new Classroom Building. With the exception of the Classroom Building, these buildings are reaching the age when a major retooling of their building systems is required.

The existing laboratory capacity in these buildings is not sufficient to meet the scheduling demands for courses. Physics teaching laboratories, for example, are in use constantly, from 8:00 am until 6:00 pm Monday through Thursday, with several sections held on Friday. This leaves almost no time for regular maintenance, time to refresh experiment set-ups, or time for students to rework an unsuccessful lab project. Similarly, introductory biology and other undergraduate integrated science laboratories are heavily scheduled.

Building systems - mechanical, plumbing and, in many cases, electrical infrastructure - are inadequate to provide a productive and healthy laboratory environment to deliver instruction. Efforts to upgrade these facilities to accommodate the modern technology involved in teaching science courses are encountering major obstacles, including structural barriers and limitations, such as low floor-to-floor heights and bearing walls interfering with space reconfiguration, as well as wireless transmission.

The new building will provide new instructional space serving undergraduate science programs and laboratories, laboratory support services, and flexible classroom space. A new laboratory building will provide sufficient instructional space to allow the university to begin renovations and upgrades in existing buildings and return them to their highest potential use. Future renovation projects for the existing facilities are envisioned in the university's long-term capital outlay plan.

Funding Plan:

The program of this project is entirely Educational and General instructional programs; thus, the funding plan calls for 100 percent General Fund support for the $90.5 million Undergraduate Laboratory Building. Escalation will be addressed as part of the state's normal capital design review process.

Detailed Planning for this project was authorized in Item 4 of Chapter 759 of the 2016 Acts of Assembly with an effective date of July 1, 2017. Schematic Designs have been completed. Preliminary Designs (Detail Planning) are scheduled to be completed in July 2019 and will be reviewed by the Division of Engineering and Buildings. The project will be ready for construction funding at the start of fiscal year 2021.

Options Considered:

Options considered include major renovations to existing science laboratory facilities. These facilities include Derring Hall and Robeson Hall. The university has future plans to modernize each of these facilities as part of its long range capital improvement plan. Renovations to these facilities will not address the underlying need for additional instructional laboratories to meet the enrollment growth in STEM-H disciplines. Order of magnitude cost estimates to renovate these facilities include Derring Hall at $115.3 million and Robeson Hall at $49 million.

Full renovation of the existing facilities have not yet been pursued because efforts to upgrade the older facilities to incorporate the modern technology, equipment, and pedagogy required to teach STEM-H courses face major obstacles. These obstacles include barriers such as low

floor-to-floor heights, column grids, and bearing walls interfering with space reconfiguration. In each of the buildings, the building systems - mechanical, plumbing and, in many cases, electrical infrastructure - are generally inadequate to provide a productive and healthy laboratory environment. The conclusion is that full building refurbishments may be necessary to create the physical environment to support state-of-the-art STEM-H instruction.

The only practical option to accommodate demand and allow for other science lab renovations is to construct a new science laboratory facility and perform major renovations to Derring Hall and Robeson Hall for laboratory use. Construction of a new facility will expand the current inventory of science instructional space and provide modern instructional space without interrupting current undergraduate science instruction.

Methodology

Cost Explanation and Methodology:

A. Methods Used to Estimate Costs:

The method for estimating costs for the Undergraduate Laboratory Building project includes: 1) using unit costs in the Division of Engineering and Building's Construction Costs Database updated March 2018 with a regional market multiplier and a multiplier for soft costs; and 2) comparables as shown in the CR-1. Both methods are escalated to a construction midpoint of 2021.

On a total project cost basis, inclusive of design, construction, and equipment, the unit costs are $881 per gross square foot. The unit construction costs of the project are $665 per gross square foot, including self-performed construction work. The building types in this request reflect a combination of science wet laboratory, dry laboratory, and research laboratory spaces in the Division of Engineering and Building's Virginia Construction Costs Database.

The university's project cost estimates are derived from a database of on-campus construction costs of comparable project types. Virginia Tech building construction reflects the high level of quality, durability, and tradition that makes Virginia Tech a distinctive and memorable place for students. The estimates also include the cost of technology, specialized instruction, and energy efficiency goals of the institution.

Skanska has been selected as the Construction Manager at risk for this project.

B. The proposed costs include the following critical considerations to ensure the project fully meets the needs of the program and the university:

1) The building envelope will be comprised primarily of Hokie Stone with precast concrete accents consistent with university standards as affirmed by the Board of Visitors. Brick, metal panels, and siding materials are not permitted as substitutions for Hokie Stone. The stone is a four-inch thick nominal stone thickness with a two-inch nominal air barrier over moisture resistant sheathing. Stainless steel anchoring straps and load bearing shelf angles and stainless steel flashings comprise the structural support and flashings system. The university owns the stone quarries and provides the cut materials to the building; thus, the material costs along with intensive quality insurance inspection costs are carried in the Other Costs section of the proposed budget, while the construction budget carries all erection, final stone dressing, and installation costs.

2) Mechanical equipment and building automation systems are designed and selected to meet performance requirements and to optimize total costs of ownership inclusive of energy costs and operations and maintenance costs. System selections are justified based on a 30-year economic life cycle analysis. Mechanical equipment will be covered and secured to maximize equipment life and service.

3) Academic buildings include interior glazing for energy efficiency, lighting for academic work, and to enhance pedagogy.

4) Ceiling heights will be appropriate for proper sound attenuation in large lecture and assembly environments as required for effective pedagogy.

5) Building structural support systems will accommodate large open and unimpeded interior spaces to maximize long-term programmatic functionality and adaptation to new program space and technology arrangements. The structure is additionally designed to reduce vibrations that would negatively impact scientific research.

6) High-capacity wireless networks to support multiple devices (laptop computer, tablet computer, smartphone, and other WIFI devices) used simultaneously by students and faculty to retrieve information and to communicate and to connect digitally with sites around campus and around the world. Testing can utilize online applications requiring the capacity for an entire classroom to be connected simultaneously.

7) Power outlets corresponding to the seat/station count and power outlets in common areas will exceed the minimum code requirements by approximately 30 percent.

8) Automated audiovisual and lighting controls are included for all classroom and class laboratory spaces.

9) Climate controlled technology server rooms, 10 feet by 10 feet, on each floor of the building.

10) Communications infrastructure, both wired and wireless, is installed by a university operated auxiliary; thus, these costs are shown in the

Other Costs section of the proposed budget.

11) Site development costs in this region are historically in the medium to high range and require generally significant subsurface rock excavation and removal and deep foundations. This site may require extensive subsurface rock excavation and removal.

12) Utilities (power, chilled water, domestic water, sanitary sewer, natural gas, technology, and storm water infrastructure) do not terminate at the building site and their extension or on-site provision is anticipated to be a sizable cost driver for this project.

13) Restricted site access in a dense and active part of campus will increase mobilization and site logistics costs. Limited material lay-down areas increase material costs and risks due to necessitating just in time delivery and/or off-site storage.

14) Code and regulation are updated over time. Following are some changes that have occurred that were not in place on the comparable projects that were used to provide the parametric estimate for this project:

• DEQ increased the storm water management requirements in 2014. Extensive BMP's and off-set credits are required to be installed and/ or purchased to comply with this Federal regulation.
• ASHRE 90.1 energy code stipulates that buildings use less energy with each successive issuance of the code. The most recent change requires 18.5 percent decrease in energy usage. This translates into increase capital costs.
• The state mandated High Performance Building Act provides three options for compliance. Virginia Tech utilized LEED V4 which mandates energy savings beyond the requirements of energy code, ASHRE 90.1. This increases the capital construction costs.
• LEED additionally requires the commissioning of the energy savings components. The costs are on the order of 0.75-1.3 percent of the construction costs. The services are provided by a third party and are captured in the Other Costs section.

Funding Request

Phase	Year	Subobject	Fund	Amount
Full Funding	2021	2322 - Construction, Buildings	01000 - General Fund	$90,500,000
			Total	$90,500,000

Project Costs

Cost Type	Requested Funding
Acquisition Cost	$0
Building & Built-in Equipment	$68,337,685
Sitework & Utility Construction	$0
Construction Cost Total	**$68,337,685**
DESIGN & RELATED SERVICE ITEMS	
A/E Basic Services	$5,708,027
A/E Reimbursables	$228,020
Specialty Consultants (Food Service, Acoustics, etc.)	$0
CM Design Phase Services	$153,474
Subsurface Investigations (Geotech, Soil Borings)	$83,965
Land Survey	$0
Archeological Survey	$0
Hazmat Survey & Design	$0
Value Engineering Services	$0
Cost Estimating Services	$633,274
Other Design & Related Services	$0
Design & Related Services Total	**$6,806,760**
INSPECTION & TESTING SERVICE ITEMS	
Project Inspection Services (inhouse or consultant)	$622,581
Project Testing Services (conc., steel, roofing, etc.)	$578,806
Inspection & Testing Services Total	**$1,201,387**
PROJECT MANAGEMENT & OTHER COST ITEMS	
Project Management (inhouse or consultant)	$652,080
Work By Owner	$907,539

BCOM Services	$191,356
Advertisements	$4,476
Printing & Reproduction	$47,559
Moving & Relocation Expenses	$142,678
A/V Cabling	$0
IT Cabling	$0
Telephone Cabling	$0
A/V Equipment	$0
IT Equipment	$1,474,340
Telephone Equipment	$0
Signage	$110,998
Demolition	$0
Hazardous Material Abatement	$0
Utility Connection Fees	$256,448
Utility Relocations	$2,334,139
Commissioning	$910,113
Miscellaneous Other Costs	$279,761
Project Management & Other Costs Total	**$7,311,487**
Furnishings & Movable Equipment	$5,655,441
Construction Contingency	$1,187,240
TOTAL PROJECT COST	**$90,500,000**

Size and Scope

Cost Type	Unit of Measure	Units	Cost Per Unit
Acquisition Cost		0	$0
Construction Cost	GSF	102,720	$665
Total Project Cost	GSF	102,720	$881

Operating and Maintenance Costs

Cost Type	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
GF Dollars	$0	$1,427,241	$1,470,058	$1,514,160	$1,559,585	$1,606,372
NGF Dollars	$0	$0	$0	$0	$0	$0
GF Positions	0.00	8.05	8.05	8.05	8.05	8.05
NGF Positions	0.00	0.00	0.00	0.00	0.00	0.00
GF Transfer	$0	$0	$0	$0	$0	$0
GF Revenue	$0	$0	$0	$0	$0	$0
Layoffs	0	0	0	0	0	0

Planned start date of new O&M costs (if different than the beginning of the fiscal year):---

Supporting Documents

File Name	File Size	Uploaded By	Upload Date	Comment
+HECO-2_208-18332_ UG Science Lab Bldg_9.25.2017.pdf	419,892	Cassidy Limer	7/23/2019	
PPS - Schematic Cost Review Approval_DEB_18332-UG Lab Building_12.4.18.pdf	131,026	Cassidy Limer	7/23/2019	
UGSL ZGF Program Color Plans_1-16.pdf	879,945	Cassidy Limer	7/23/2019	
01- Undergraduate Science Lab Program Chart.pdf	18,698	Cassidy Limer	7/25/2019	
01 - CR-1e USLB - VIRGINIA TECH -State Version.xlsx	620,044	Cassidy Limer	7/29/2019	

Workflow History

User Name	Claimed	Submitted	Step Name	Submit Action
Cassidy Limer	07/11/2019 04:35 PM	07/11/2019 04:35 PM	Enter Capital Budget Request	Continue Working
Cassidy Limer	07/11/2019 04:35 PM	07/24/2019 11:10 AM	Continue Drafting	Continue Working
Cassidy Limer	07/24/2019 11:21 AM	07/24/2019 03:04 PM	Continue Drafting	Continue Working
Cassidy Limer	07/25/2019 08:32 AM	07/25/2019 12:44 PM	Continue Drafting	Submit for Agency Review
Rob Mann	07/25/2019 04:47 PM	07/25/2019 04:48 PM	Agency Review Step 1	Return for Further Data Entry
Cassidy Limer	07/25/2019 05:20 PM	07/25/2019 05:21 PM	Continue Drafting	Continue Working
Cassidy Limer	07/25/2019 05:37 PM	07/26/2019 12:30 PM	Continue Drafting	Submit for Agency Review
Rob Mann	07/26/2019 01:25 PM	07/26/2019 01:46 PM	Agency Review Step 1	Ready for DPB Bulk Submit
Rob Mann	07/26/2019 02:17 PM	07/26/2019 02:17 PM	Ready for DPB Submission	Submit to DPB
Anne Smith	07/26/2019 03:42 PM	07/26/2019 03:42 PM	DPB Review	Return to Previous Submitter
Rob Mann	07/29/2019 10:04 AM	07/29/2019 10:04 AM	Agency Review Step 1	Return for Further Data Entry
Cassidy Limer	07/29/2019 11:43 AM	07/29/2019 12:53 PM	Continue Drafting	Submit for Agency Review
Rob Mann	07/30/2019 12:33 PM	07/30/2019 12:33 PM	Agency Review Step 1	Return for Further Data Entry
Cassidy Limer	07/30/2019 04:43 PM	07/30/2019 04:43 PM	Continue Drafting	Submit for Agency Review
Rob Mann	07/31/2019 10:29 AM	07/31/2019 10:33 AM	Agency Review Step 1	Ready for DPB Bulk Submit
Rob Mann	07/31/2019 03:44 PM	07/31/2019 03:44 PM	Ready for DPB Submission	Submit to DPB
Anne Smith	07/31/2019 05:26 PM	07/31/2019 05:26 PM	DPB Review	Continue Review
			DPB Review	