CapitalBudgetRequest

Construct Undergraduate Science Laboratory	
Overview	
Agency	Virginia Polytechnic Institute and State University (208)
Project Code	none
Project Type	New Construction
Biennium	2016-2018
Budget Round	Initial Bill
Request Origin	Previously Submitted
Building Name	
Project Location	Roanoke Area
Facility/Campus	Blacksburg Main Campus
Source of Request	Agency Request
Building Function	Higher Education Instructional Laboratory -- 100% E&G
Infrastructure Element	Laboratory
Contains significant technology costs? No	
Contains significant energy costs? No	

Agency Narrative

Agency Description

Project Summary:
Virginia Tech continues to grow in undergraduate students, and particularly in STEM-H majors. The university graduates more than twice as many STEM-H majors as any other Virginia institution. From 2004 to 2015, the university grew undergraduate majors to 24,247 from 22,428, or by eight percent. During this period, STEM-H majors grew to 11,111 from 8,514, or by 31 percent. Thus, as the total number of students is expanding, the number of STEM-H majors is growing at faster rate. Looking forward, the university has projected to SCHEV in its Form 2B a plan to grow by 2,000 undergraduates by 2018-19 and a significant portion of this growth is expected to be in the STEM-H areas. Much of this growth will be in engineering, traditional sciences, as well as in new degree programs such as neuroscience.

Meanwhile, during this period of expansion, 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 The university's existing inventory of science laboratory instruction is now too small and generally outdated to accommodate the current demand for instruction spaces by engineering and science majors.

The increase in both the actual number of majors in STEM-H fields and the strategic actions of the university to continue to address the Top Jobs 21 goals for more STEM-H degrees creates significant pressures on existing, science instructional laboratory facilities. For example, since 2004, student credit hours in physics have jumped to 5,961 from 4,077, a 46 percent increase. 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, has increased 56 percent. The university cannot accommodate the class scheduling demands of growing STEM-H courses with the existing inventory.

This project requests authorization to construct a new undergraduate science laboratories facility of 102,000 gross square feet for to accommodate the growing demand for STEM-H degrees at Virginia Tech.

Physical Description of the Facility:
The proposed building is envisioned to be a 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 proposed building site is located on an existing paved parking lot adjacent to the new undergraduate Classroom Building which should be complete by fall 2016.

The program for this building includes two physics laboratories with 100 stations each, one physics lab with 150 stations, six freshman biology laboratories with 36 stations each, two integrated science laboratories with 36 stations each, one 36 station microscopy lab with a scanning electron microscope, lab support/storage space for all the laboratories, four classrooms with 108 seats each, one computer lab with 150 stations, associated faculty offices, graduate teaching assistant workspace, and breakout collaborative areas. The integrated science and microscopy labs are instructional spaces that will approximate advanced research laboratory conditions. Instruction in neuroscience, nanoscience, biomedical engineering, materials science engineering and other advanced programs will involve the use of advanced imaging equipment that requires vibration isolation, electromagnetic shielding and sufficient building infrastructure to support advanced computing associated with this equipment. Program verification is an essential part of the pre-planning phase of every capital project and will inevitably result in modifications to this initial program.

Justification

Program Description:
Virginia Tech graduates more than twice as many STEM-H majors as any other Virginia institution and continues to grow in undergraduate STEM majors. The increase in both the actual number of majors in STEM-H fields and the strategic actions of the university to continue to address the Top Jobs 21 goals for more STEM-H degrees creates significant pressures on existing, specialized instructional laboratory facilities.

The university is confronted with the need to construct new instructional laboratories to support significant enrollment growth. Much of the instruction for these programs is currently housed in older facilities with equipment that is inadequate to support modern instructional methods and limited in the section sizes in which lab courses can be delivered. These buildings are unable to adequately support growing enrollments in STEM-H programs where increased demand for laboratory seats is driving the need for this new instructional lab facility.

This project is designed to meet the laboratory instruction demands of students enrolled in courses that are part of the growing emphasis on physical and life sciences. Within Virginia Tech there is an awareness of the need to transition from the traditional lecture/lab model toward team-based, problem-oriented learning that puts increased emphasis on research-like experience to provide a sense of relevancy, excitement, and engagement in the laboratory. This contrasts with the traditional model of repeating rote lab exercises with known results. Undergraduate science education is moving toward a more unified model of lecture and laboratory that makes 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 also 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 publically display the laboratory activities and generate curiosity and engagement. Laboratories can be departmentally specific or they can be cross-disciplinary, collaborative, and highly interactive depending on the class size and the nature of the investigation. All new laboratories must be highly flexible and adaptable for future instructional needs. Ample computational space is a must as are generous floor to floor heights, sufficient cooling capacity, and abundant electrical power to each student station. Moveable furniture with overhead utility connections is costly but ensures flexibility and cost savings in the future.

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

• Increasing the number of our programs recognized as among the best internationally
• Ensuring competency in data analysis and computational methods as a component of general education for all students
• Developing an appropriate infrastructure for e-learning
• Emphasizing translational research and scholarship
• Building upon existing and emerging strengths
• Pursuing quality-of-life initiatives in support of the university as a vibrant, dynamic, and sustainable workplace
• Supporting a sustainable workplace
• Increase in undergraduate involvement in meaningful research experiences and experiential learning opportunities by adopting a "hands on, minds on" philosophy that promotes connecting real life experience with academic concepts.
• Develop ways to integrate computational science/informatics and digital fluency for managing and analyzing complex data sets across a wide range of disciplines.
• Identify opportunities during construction and renovation to create flexible classroom spaces that fully support e-learning components.

Existing Facilities:
The existing laboratory facilities currently being used to deliver instruction include Derring Hall, Engel Hall, Robeson Hall, and McBryde Hall. 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 constantly in use, from 8:00 am until 6:00 pm Monday through Thursday, with several sections held on Friday, leaving 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 safe, healthy laboratory environment in which 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 reconfigurations as well as wireless transmission.

The new building will provide new instructional space serving undergraduate science programs, undergraduate science 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 these existing buildings to return them to their highest potential use. Future renovation projects for these 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.

Options Considered:
Options considered but not pursued include major renovations to Derring Hall, Engle Hall, Robeson Hall, and McBryde Hall. These efforts were not pursued because efforts to upgrade these facilities to accommodate the modern technology and laboratory settings involved in teaching STEM-H courses are encountering major obstacles, including structural barriers and limitations, such as low floor-to-floor heights and bearing walls interfering with space reconfigurations. In each of the four buildings, the building systems - mechanical, plumbing and, in many cases, electrical infrastructure - are inadequate to provide a safe, healthy laboratory environment in which to deliver instruction. The conclusion reached is that even with major renovations, the buildings will not provide a physical envelope to support state-of-the-art STEM-H instruction. The only practical option is to construct a new science laboratory facility and renovate and reprogram in turn Derring Hall, Engle Hall, Robeson Hall and McBryde Hall for less intensive non-laboratory uses.

Alternatives Considered

Costing Methodology

The method for estimating costs includes: 1) using unit costs in the Bureau of Capital Outlay Management's Construction Costs Database updated April 2015 with a regional market multiplier and a multiplies for softs costs; and 2) comparables as shown in the CR-3. Both methods are escalated to a construction midpoint of 2019 at three percent

On a total project cost basis, inclusive of design, construction, and equipment, the unit costs are $733 per gross square foot. The unit construction costs of the project are $578 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 Bureau of Capital Outlay Management's Construction Costs Database.

The program description justifies classification of this project as a medium-range research lab. Our project cost estimate is 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. Our estimates also include the cost of technology, specialized instruction, and energy efficiency goals of the institution.

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. The Virginia Tech Board of Visitors has directed that all new building projects and expansion projects built on the Blacksburg central campus must use Hokie stone as the predominate building material on all building facades. Brick, metal panels, and siding materials are not permitted as substitutions for Hokie stone. In maintaining the random ashlar stone pattern of our collegiate Gothic buildings, the university has explored a wide range of contemporary stone erection means, methods and systems. The most efficient system tested that meets erection, insulation and moisture protection requirements utilizes 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, meeting our requirement for a 50-100 year enclosure life expectancy. Because the university owns the stone quarry, the quarrying and stocking of all the cut stone is carried as a project (soft) cost, and the construction budget carries all erection, final stone dressing, installation and intensive quality assurance inspection costs.

Mechanical equipment and building automation systems will be designed to maximize energy efficiency and minimize operations and maintenance costs. Mechanical equipment will be located inside and screened from view to maximize student use of the campus landscape. Electrical systems will support current academic technologies and increased student use of individual technology equipment. Effective use of exterior and interior glazing will enhance energy efficiency lighting fixtures for an improved academic experience. Ceiling heights must be a minimum of 16 feet for sound attenuation in large lecture and assembly environments as required for effective pedagogy. Design priorities will include flexibility in classrooms and interior spaces to maximize the long-term programmatic functionality of the building. Building location and site design will focus on maintaining and creating that sense of place that is unique to Virginia Tech.

Virginia Tech produces the most STEM-H graduates of any university in the Commonwealth. Our role as the leading producer of STEM-H degrees relies upon a system of classrooms and instructional laboratories that support technology driven instruction in engineering, physical sciences, life sciences, and advanced mathematics. All buildings must have high-capacity wireless networks to support multiple devices (laptop computer, tablet computer, smartphone) used simultaneously by students to retrieve information and to communicate within the classroom and to connect digitally with instructional sites around campus and around the world. The use of electronic equipment in the classroom by student participants also requires dedicated power outlets corresponding to the seat/station count and power outlets in common areas. Raised floor systems are needed to accommodate these and future developments in technology and classroom configuration. As the largest university in the state in terms of full-time equivalency enrollment, Virginia Tech relies on classroom technology to support effective and efficient instruction of large class sections. This requires automated audiovisual and classroom lighting controls, which also rely on wireless networks. Specialized degrees in engineering and sciences require specialized equipment specific to those fields and sometimes shielded or vibration protected areas in which to operate this equipment. The university operates its own communications network using primarily internet connectivity which requires accessible, climate controlled server rooms in lieu of the traditional phone closet. Because the communications infrastructure is installed by our own university operated auxiliary it is carried as a project (soft) cost outside of the normal construction budget.

Site development costs may need to address floodplain and storm water management mitigation measures, and deep foundations required in this region. This project will also require replacement of parking spaces at the planned site. Construction Manager at Risk is the intended delivery method for this project. Project costs are estimated to the mid-point of construction using three percent escalation in accordance with the instructions for developing the Six-Year Capital Outlay Plan.

Summary of Undergraduate Science Laboratory Building Other Costs:
1. Hokie stone used as primary exterior building envelope material.
2. Building design features to accommodate building design requirements within a flood plain.
3. Building foundation deep caissons or piers to remediate unsound subsurface foundation conditions
4. Extensive subsurface rock excavation and removal
5. Raised flooring systems throughout laboratories for flexible use of electronic equipment
6. Specialized building laboratories designed to eliminate ground vibration interfering with sensitive scientific equipment

Agency Funding Request

Phase	Year	Fund	Subobject	Requested Amount
Construction	2017	0100 - General Fund	2322 - Construction, Buildings	$74,800,000
			Total	$74,800,000

Project Costs

Cost Type	Total Project Costs	Requested Funding	DGS Rec
Acquisition Cost	$0	$0	
Building & Built-in Equipment	$45,153,000	$45,153,000	
Sitework & Utility Construction	$7,717,000	$7,717,000	
Construction Cost Total	**$52,870,000**	**$52,870,000**	
DESIGN & RELATED SERVICE ITEMS			
A/E Basic Services	$5,214,000	$5,214,000	
A/E Reimbursables	$120,000	$120,000	
Specialty Consultants (Food Service, Acoustics, etc.)	$365,000	$365,000	
CM Design Phase Services	$772,000	$772,000	
Subsurface Investigations (Geotech, Soil Borings)	$109,000	$109,000	
Land Survey	$23,000	$23,000	
Archeological Survey	$0	$0	
Hazmat Survey & Design	$0	$0	
Value Engineering Services	$0	$0	
Cost Estimating Services	$42,000	$42,000	
Other Design & Related Services	$375,000	$375,000	
Design & Related Services Total	**$7,020,000**	**$7,020,000**	
INSPECTION & TESTING SERVICE ITEMS			
Project Inspection Services (inhouse or consultant)	$1,356,000	$1,356,000	
Project Testing Services (conc., steel, roofing, etc.)	$395,000	$395,000	
Inspection & Testing Services Total	**$1,751,000**	**$1,751,000**	
PROJECT MANAGEMENT & OTHER COST ITEMS			
Project Management (inhouse or consultant)	$991,000	$991,000	
Work By Owner	$78,000	$78,000	
BCOM Services	$10,000	$10,000	
Advertisements	$0	$0	
Printing & Reproduction	$0	$0	
Moving & Relocation Expenses	$94,000	$94,000	
Non Built-In Data and Voice Communications	$991,000	$991,000	
Signage	$52,000	$52,000	
Demolition	$0	$0	
Hazardous Material Abatement	$0	$0	
Utility Connection Fees	$0	$0	
Utility Relocations	$2,503,000	$2,503,000	

Commissioning	$730,000	$730,000	
Miscellaneous Other Costs	$2,398,000	$2,398,000	
Project Management & Other Costs Total	**$7,847,000**	**$7,847,000**	
Furnishings & Movable Equipment	$4,255,000	$4,255,000	
Construction Contingency	$1,057,000	$1,057,000	
TOTAL PROJECT COST	**$74,800,000**	**$74,800,000**	

Capacity

Cost Type	Unit of Measure	Units	Cost Per Unit
Acquisition Cost		0	$0
Construction Cost	GSF	102,000	$518
Total Project Cost	GSF	102,000	$733

Operating and Maintenance Costs (Agency)

Cost Type	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
GF Dollars	$0	$0	$1,214,833	$1,251,278	$1,288,816	$1,327,481
NGF Dollars	$0	$0	$0	$0	$0	$0
GF Positions	0.00	0.00	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
01-CR-3 Undergraduate Science Laboratory Building.xls	625,664	Rob Mann	6/13/2015	CR-3 ConstructUndergraduate Science Laboratory

Workflow History

User Name	Claimed	Submitted	Step Name
Rob Mann	05/18/2015 05:00 PM	05/18/2015 05:00 PM	Enter Capital Budget Request
Rob Mann	05/18/2015 05:00 PM	05/18/2015 05:05 PM	Continue Drafting
Rob Mann	05/21/2015 10:04 AM	05/21/2015 10:42 AM	Continue Drafting
Rob Mann	05/25/2015 09:45 AM	05/25/2015 10:05 AM	Continue Drafting
Rob Mann	05/25/2015 10:23 AM	05/25/2015 10:28 AM	Continue Drafting
Jennifer Hundley	06/12/2015 03:27 PM	06/12/2015 05:41 PM	Continue Drafting
Rob Mann	06/12/2015 05:41 PM	06/12/2015 06:02 PM	Continue Drafting
Rob Mann	06/13/2015 08:50 AM	06/13/2015 08:50 AM	Continue Drafting
Rob Mann	06/13/2015 08:56 AM	06/13/2015 09:00 AM	Agency Review Step 1
Rob Mann	06/13/2015 12:30 PM	06/13/2015 12:30 PM	Agency Review Step 1
Rob Mann	06/13/2015 12:43 PM	06/13/2015 12:43 PM	Agency Review Step 1
Rob Mann	06/13/2015 02:57 PM	06/13/2015 06:57 PM	Agency Review Step 1
Bob Broyden	06/14/2015 02:18 PM	06/14/2015 02:18 PM	Ready for DPB Submission
			DPB Review