CapitalBudgetRequest

Construct Neuroscience Research and Instruction 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 and Classroom -- 100% E&G
Infrastructure Element	Classroom / Laboratory
Contains significant technology costs? No	
Contains significant energy costs? No	

Agency Narrative

Agency Description

Project Summary:
In response to demand for undergraduate degrees in neuroscience and nanoscience, the university, working through the State Council of Higher Education in Virginia, has recently implemented new undergraduate degrees in both neuroscience and nanoscience. These degrees, both of which are new and cutting edge for undergraduate populations are proving very popular for incoming students. The programs were announced late summer 2015, and several hundred incoming students enrolled fall 2015, with only a few months of notice to incoming students. Based on current demand, the university anticipates enrolling up to 1,000 undergraduates in these programs by 2019. These enrollments are new and part of the current and project overall enrollment growth projected over the next several years

Of the expected 1,000 students that the two programs will enroll at steady-state, approximately 800 will be neuroscience majors. Because of this size, and because neuroscience has deep connections with programs in every college at Virginia Tech, the discipline will be organized as a School of Neuroscience, housing 20-25 extramurally funded faculty with a significant research footprint.

Meanwhile, the university is confronted with an aging inventory of science laboratory space that is inadequate even with significant renovation to support the new protocols and instrumentation the latest micro- and nano-scale investigations require. Thus, the university's existing inventory is too small and outdated to support growth in these new STEM-H fields. Examples of space that is lacking in the on-campus inventory include clean rooms for mass spectrometry, vibration-free stable rooms for high resolution microscopy, and shielded rooms for high pressure and temperature experiments and delicate brain-imaging technologies. Precise room temperature control, required by many types of analytic devices, is difficult, and in certain cases impossible, thus jeopardizing millions of dollars of equipment.

This new building is needed to provide the sophisticated, state-of-the-art classroom and research laboratory space that is required by the technologies used in expanding research science fields, of which neuroscience and nanoscience lie at the horizon. This project will complement the general assignment laboratories in the university's other undergraduate science laboratory project requested in this capital plan.

This request is for an 80,000 gross square foot science laboratory building to house the faculty, teaching laboratories, and research laboratories for the new programs. Without this project, the university will not have the necessary infrastructure to support demand for these programs beyond 2020.

Physical Description of the Facility:
This request is for an 80,000 gross square foot science laboratory building. The building program includes dense high performance wet laboratory spaces, neuroimaging laboratories, nanoscale imaging laboratories, and nanoscale characterization laboratories, supported by high-intensity computational facilities. Specialized equipment requirements include strong electromagnetic shielding and vibration control. The building is envisioned as a four story structure. The facility location is the Blacksburg campus on the west section known as the life sciences precinct.

The building program includes approximately 8,000 square feet of instructional laboratories, 17,000 square feet of neuroscience research laboratories, 5,000 square feet of nanoscale imaging and analysis space, and 7,500 square feet of specialized wet labs with hoods. The facility will also include 12,000 square feet of faculty and staff offices. Another 2,500 square feet will be dedicated to building support functions. With an assumed 65 percent building efficiency this program approximates an 80,000 square foot facility.

The imaging and analysis function of the building will require extraordinary design and construction methods to provide power and HVAC, in addition to the stability and isolation considerations described above, for the specialized equipment to be used. These are anticipated to include scanning electron microscopes (SEM), transmission electron microscopes (TEM), microprobes, x-ray diffraction, mass spectrometers, functional magnetic resonance imaging (fMRI), magnetoencephalography (MEG), positron emission tomography (PET), multiphoton laser scanning microscopes, diaode array scanners, super-resolution time resolved microscopes, magnetic resonance spectroscopy, electro-encephalograph, patch-clamp technology, and other equipment. Purchasing and upfitting these specialized pieces of equipment into the building will also require a larger than average equipment component for this capital project.

Justification

Program description:
This building will support instruction and research in the emerging areas of neuroscience and nanoscale science and technology. Neuroscience is the study of the brain and the entire central nervous system, and how they react to and are affected by the many stimuli they encounter. Nanoscience is the study and manipulation of materials at the 1 billionth of a meter scale.

The university has recently approved and implemented new undergraduate degrees in both neuroscience and nanoscience. These degrees, both of which are new and cutting edge for undergraduate populations, are proving very popular for incoming students. We anticipate enrolling up to 1,000 undergraduates in these programs by 2019. This building will be the home for the faculty who teach in these programs as well as specialized laboratories for instruction and research in these areas.

Of the expected 1,000 students that the two programs will enroll at steady-state, approximately 800 will be neuroscience majors. Because of this size, and because neuroscience has deep connections with programs in every college at Virginia Tech, the discipline will be organized as a School of Neuroscience, housing 20-25 extramurally funded faculty with a significant research footprint. The average research laboratory will be approximately 1,000-1,200 net square feet. Critical to the success of these highly interrelated faculty is that they be working in close proximity to one another, a requirement which cannot be met with the university's current space inventory.

By their very nature, neuroscience and nanoscience examine scientific processes at the microscopic and sub-microscopic level. To study the activity of ion channels, for example, 1 micrometer micropipettes must be placed at 1,000x magnification with robotic manipulators onto cells that are barely 10 micrometer in diameter. The isolation from any possible vibrations of the floors is essential. This is possible through floating isolation tables; however, these tend to be very heavy requiring an exceptionally sturdy floor structure. Measuring neural signals require 10,000-100,000-fold amplification and, as a result, are easily distorted by electromagnetic fields produced by common signals in the environment including phones, antennas, and motors. Accordingly, the building design must minimize sources for electromagnetic interference, and if present must provide shielding. Renovations of existing buildings to meet these requirements, were sufficient space available, would be difficult and costly.

The university's strategic plan includes the following principle strategies that will be supported by this project:
• Creating new academic organizational frameworks – "faculties" – initially in health sciences and potentially in computational/information sciences.
• Ensuring competency in data analysis and computational methods as a component of general education for all students.
• Developing an appropriate infrastructure for high performance computing.
• Building upon existing and emerging strengths.
• Maintain growth in research expenditures toward a target of $680M by 2018.
• Increasing undergraduate involvement in meaningful research experiences and experiential learning--hands-on, minds-on.
• Developing ways to integrate computational science/informatics and digital fluency for managing and analyzing complex data sets across a wide range of disciplines.
• Identifying opportunities during construction and renovation to create flexible classroom spaces that fully support e-learning components.

Existing facilities:
The University is confronted with an aging inventory of science laboratory space, much of it built in the 1970's and before, that is inadequate even with significant renovation to support the new protocols and instrumentation the latest micro- and nano-scale investigations require. This new building is needed to provide the sophisticated, state-of-the-art classroom and research laboratory space that is required by the technologies used in expanding research science fields, of which neuroscience and nanoscience lie at the horizon.

Because most of the university's inventory of nanoscale characterization assets are located off-campus, the opportunity for undergraduate students to interact with the faculty and researchers and their use of this kind of equipment is limited. Likewise, though the university has strength in neuroscience research at the Virginia Tech Carilion Research Institute in Roanoke, it currently has no research-level neuroscience laboratories or equipment on the Blacksburg campus. Both the neuroscience and the nanoscience degrees have significant undergraduate research components that can be accommodated only at very limited levels with currently existing facilities.

Examples of space that is lacking in the on-campus inventory include clean rooms for mass spectrometry, vibration-free stable rooms for high resolution microscopy, and shielded rooms for high pressure and temperature experiments and delicate brain-imaging technologies. Precise room temperature control, required by many types of analytic devices, is difficult, and in certain cases impossible, thus jeopardizing millions of dollars of equipment.

Funding Plan:
The program of this project is for instruction and research programs; thus, the funding plan for the $59 million project calls for $47.2 million of general fund support for 100 percent of the instruction costs and 50 percent for the research costs and $11.8 million of nongeneral fund support for 50 percent of the research costs. The overall cost split is based upon 60 percent of the space being allocated to instruction and 40 percent being allocated to research.

Options considered:
The options considered include deferring the project, leasing space, and retrofitting an existing building.
(1) The project has been a high priority for the academic program for several years. The project has been deferred since 2009 because private gifts did not materialize as expected and the university is now in position to fully fund the nongeneral fund component. Because the project supports growth of key STEM disciplines and is critical to advancing the science program, further deferring the entire project is not supported;
(2) Leasing space is not a viable option because the local inventory does not include suitable facilities that meet the performance specifications of a science laboratory; and
(3) Retrofitting an existing building is not a viable option because the university is operating with a deficit of science laboratory space and non-laboratory space does not accommodate the mechanical systems required the proposed laboratories.

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 $738 per gross square foot. The unit construction costs of the project are $583 per gross square foot, including self-performed construction work. The building types in this request are wet laboratory, dry laboratory, and classroom spaces in the Bureau of Capital Outlay Management's 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. 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 is necessary for energy efficiency lighting for academic work. 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.

The University's role as the leading producer of technology intensive degrees relies upon a system of classrooms and instructional laboratories and research spaces that support technology driven work 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 and faculty to retrieve information and to communicate and to connect digitally with sites around campus and around the world. The use of electronic equipment by students and faculty requires dedicated power outlets corresponding to the seat/station count and power outlets in common areas. This requires automated audiovisual and classroom lighting controls, which also rely on wireless networks. 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 in this region are historically in the medium to high range and require deep foundations. This project may also require relocation of parking spaces at the planned site. 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 Neuroscience and Nanoscience Laboratory Other Costs:

1. Hokie stone used as primary exterior building envelope material.
2. Specialized building slabs designed to eliminate ground vibration interfering with sensitive scientific equipment
3. Building foundation deep caissons or piers to remediate unsound subsurface foundation conditions
4. Extensive rock excavation and removal.
5. Raised flooring systems throughout classrooms and laboratories for flexible use of electronic equipment

Agency Funding Request

Phase	Year	Fund	Subobject	Requested Amount
Construction	2017	0100 - General Fund	2322 - Construction, Buildings	$47,200,000
Construction	2017	0303 - Indirect Cost Recovery	2322 - Construction, Buildings	$11,800,000
			Total	$59,000,000

Project Costs

Cost Type	Total Project Costs	Requested Funding	DGS Rec
Acquisition Cost	$0	$0	
Building & Built-in Equipment	$36,400,000	$36,400,000	
Sitework & Utility Construction	$5,400,000	$5,400,000	
Construction Cost Total	**$41,800,000**	**$41,800,000**	
DESIGN & RELATED SERVICE ITEMS			
A/E Basic Services	$5,500,000	$5,500,000	
A/E Reimbursables	$110,000	$110,000	
Specialty Consultants (Food Service, Acoustics, etc.)	$275,000	$275,000	
CM Design Phase Services	$620,000	$620,000	
Subsurface Investigations (Geotech, Soil Borings)	$80,000	$80,000	
Land Survey	$21,000	$21,000	
Archeological Survey	$0	$0	
Hazmat Survey & Design	$0	$0	
Value Engineering Services	$0	$0	
Cost Estimating Services	$35,000	$35,000	
Other Design & Related Services	$250,000	$250,000	
Design & Related Services Total	**$6,891,000**	**$6,891,000**	
INSPECTION & TESTING SERVICE ITEMS			
Project Inspection Services (inhouse or consultant)	$1,200,000	$1,200,000	
Project Testing Services (conc., steel, roofing, etc.)	$310,000	$310,000	
Inspection & Testing Services Total	**$1,510,000**	**$1,510,000**	
PROJECT MANAGEMENT & OTHER COST ITEMS			
Project Management (inhouse or consultant)	$750,000	$750,000	
Work By Owner	$65,000	$65,000	
BCOM Services	$10,000	$10,000	
Advertisements	$0	$0	
Printing & Reproduction	$0	$0	
Moving & Relocation Expenses	$70,000	$70,000	
Non Built-In Data and Voice Communications	$650,000	$650,000	
Signage	$30,000	$30,000	
Demolition	$0	$0	
Hazardous Material Abatement	$0	$0	
Utility Connection Fees	$0	$0	
Utility Relocations	$1,300,000	$1,300,000	
Commissioning	$650,000	$650,000	
Miscellaneous Other Costs	$1,238,000	$1,238,000	

Project Management & Other Costs Total	**$4,763,000**	**$4,763,000**	
Furnishings & Movable Equipment	$3,200,000	$3,200,000	
Construction Contingency	$836,000	$836,000	
TOTAL PROJECT COST	**$59,000,000**	**$59,000,000**	

Capacity

Cost Type	Unit of Measure	Units	Cost Per Unit
Acquisition Cost		0	$0
Construction Cost	GSF	80,000	$523
Total Project Cost	GSF	80,000	$738

Operating and Maintenance Costs (Agency)

Cost Type	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
GF Dollars	$0	$0	$951,122	$979,656	$1,009,045	$1,039,317
NGF Dollars	$0	$0	$237,781	$244,914	$252,261	$259,829
GF Positions	0.00	0.00	5.56	5.56	5.56	5.56
NGF Positions	0.00	0.00	1.39	1.39	1.39	1.39
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
05-CR-3 Neuroscience Research Laboratory.xls	625,664	Rob Mann	6/13/2015	CR-3_Neuroscience Research Laboratory

Workflow History

User Name	Claimed	Submitted	Step Name
Rob Mann	05/18/2015 11:21 PM	05/18/2015 11:21 PM	Enter Capital Budget Request
Rob Mann	05/18/2015 11:21 PM	05/18/2015 11:22 PM	Continue Drafting
Rob Mann	06/08/2015 05:39 PM	06/08/2015 05:39 PM	Continue Drafting
Jennifer Hundley	06/12/2015 04:31 PM	06/12/2015 05:43 PM	Continue Drafting
Rob Mann	06/13/2015 08:47 AM	06/13/2015 08:50 AM	Continue Drafting
Rob Mann	06/13/2015 12:44 PM	06/13/2015 12:52 PM	Agency Review Step 1
Rob Mann	06/13/2015 07:10 PM	06/13/2015 07:18 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