Straumanis James Hall / Engineering Research Laboratory
Programming Study

Missouri University of Science and Technology

DICKINSON HUSSMAN ARCHITECTS

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Missouri University of Science and Technology

University Project Number: 103516
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I. Executive Summary

In January 2010, Missouri University of Science and Technology commissioned Dickinson Hussman Architects to provide a programming study for Straumanis James Hall and the Engineering Research Laboratory Building. The intent of the study was to identify components that would support renovation and expansion of the two existing research buildings.

Findings within this programming study demonstrate that it is feasible to physically connect the two independent structures by developing a new research building that would be constructed between the existing facilities. This study also identifies the approximate size and the unique characteristics of the new Research Building as well as the anticipated improvements identified for the Engineering Research Laboratory Building and Straumanis James Hall. Lastly, the programming study confirms that the new/renovated three-building complex will fulfill the University's desire to establish a state-of-the-art research facility that would aesthetically anchor the northeast corner of the Missouri S&T campus.

Because the nature of this study is somewhat subjective, a written space program was not developed. Rather, graphic building solutions (floor plans) showing potential for facility development were created and modified. The final solution was based on information developed during six programming meetings. Specific information within this report indicates that a new Research Building of approximately 86,470 gross square feet can be constructed. Given that the building areas of Straumanis James Hall and the Engineering Research Laboratory Building are somewhat fixed, the total area suggested by the merged complex is 162,540 gross square feet.

The anticipated construction cost for the new Research Building is $26,084,703 (approximately $301.66 per square foot). The construction costs allocated for renovation is $11,479,577. The combined total construction cost is $37,564,280. It should be noted that this estimate of probable construction cost is based on present market values and contains a 10% design contingency but no factor for escalation.

II. Purpose and History of the Programming Study

In January of 2010, Missouri University of Science and Technology contracted with Dickinson Hussman Architects to prepare a programming study for Straumanis James Hall (formerly known as the Materials Research Center or MRC) and the Engineering Research Laboratory Building (also known as the ERL Building). The intent of the study was to identify several key components that would support the potential for renovation and expansion of the two existing research facilities.

As the project statement developed, it was determined that the programming study was to respond to three critical components. First, the study was to determine if it was both physically and logically feasible to connect Straumanis James Hall and the Engineering Research Laboratory Building together, through the construction of a new research building, in order to form one cohesive research complex. If the study confirmed that the two existing buildings could be linked together, the second component was to determine how large of a building addition could the site and other related parameters support. The third and final component of the study was to determine if the conceptual solution would validate the University's desire to establish a state-of-the-art research facility that would aesthetically anchor the northeast corner of the Missouri S&T campus.

After the programming study was launched in early 2010, Straumanis James Hall received a grant from the National Science Foundation, which partially funded and ultimately accelerated the building's schedule for renovation. Conceptual, and ultimately final design solutions for the renovation of Straumanis James Hall were developed with the understanding that the facility could, sometime in the future, be expanded to the north and possibly to the west. Construction for the renovation continued throughout 2011 and in the summer of 2012, the facility was re-dedicated and occupied.

While the renovation of Straumanis James Hall helped shape many of the design parameters for the development of the new "connecting link" research building to the north, another very impactful element occurred in 2012 that substantially influenced the design of the potential new facility. As the design team for the University's new Campus Geothermal Project explored location options for the development of supporting structures that would house equipment for the new geothermal system, it was determined that a single-story building attached to the north façade of Straumanis James Hall would best serve the systems' needs.

This decision had a substantial impact on the design of the future Research Building and it became the catalyst for the development of the conceptual design. Now critical components such as the proposed building's site development, structure, fire and area separations, and mechanical / electrical systems had to be explored and determined with certainty and accuracy. Currently, the Straumanis James Hall Geothermal Plant Addition project is under construction.

Conclusions represented in the Straumanis James Hall / Engineering Research Building Programming Study have been shaped by a variety of internal and external events and activities. While this study identifies a specific and unique approach to develop and connect Straumanis James Hall and the Engineering Research Laboratory Building in a successful and positive manner, we believe that the potential for development of additional solutions is limitless.

III. Committee and Team Members

The committee members for this programming study were composed of Missouri University of Science and Technology faculty members and administrators. Team members supporting this study were representatives from McClure Engineering, Trabue, Hansen & Hinshaw, Inc., Cooper Construction Estimating, L.L.C., and Dickinson Hussman Architects.

MS&T Committee Members:

Daryl Beetner / Professor of Electrical and Computer Engineering

Jason Cox / CIES

K. Chandrashekhara / Curators' Professor of Mechanical & Aerospace Engineering

Bill Fahrenholtz / Professor of Ceramic Engineering

Jie Gao / Assistant Professor of Mechanical Engineering

Greg Hilmas / Curators' Professor of MSE

Kamal Khayat / CIES and NUTC Director and Vernon Maralee Jones Professor of Civil Engineering

K. Krishnamurthy, VP Research, Professor of Mechanical Engineering

Ming Leu / ISC Director and Keith and Pat Bailey Distinguished Professor of Mechanical Engineering

Frank Liou / Michael and Joyce Bytnar Professor of Mechanical Engineering and Director of Manufacturing Engineering Program

Scott Miller / Materials Research Center

John Myers / Associate Professor of CArEE

Matt O'Keefe / MRC Director and Professor of Metallurgical Engineering

Ted Ruth / Director, Design & Construction Management

Jag Sarangapani / Rutledge-Emerson Distinguished Professor of Electrical and Computer Engineering

Jeffery Volz / Assistant Professor of Civil, Architectural & Environmental Engineering

Hai Xiao / Associate Professor of Electrical & Computer Engineering

Xiaodong Yang / Assistant Professor of MAE

Reza Zoughi / ECE Department

Consultant Team Members

Steven Vehige, P.E., LEED AP BD+C / McClure Engineering

Philip Wentz, P.E. / McClure Engineering

Kris Bezenek, P.E., S.E. / Trabue, Hansen & Hinshaw, Inc.

Steven Cooper, P.E. / Cooper Construction Estimating, L.L.C.

Heather Grove, LEED AP BD+C / Dickinson Hussman Architects

Donald Hussman, AIA, NCARB / Dickinson Hussman Architects

Brian Nash / Dickinson Hussman Architects

IV. Findings and Observations

Programming information and guiding data was gathered during five independent meetings with Missouri S&T committee members from 2011 to 2012. In addition to information gathered at the committee meetings, a survey of Programming Questions was conducted in July 2012, and the results were tabulated in September 2012 (see Section VII, Appendices).

Conceptual design solutions based on the guiding data referenced above were prepared in late 2012 and were refined after the sixth committee meeting held this past February. Highlights of the guiding data are summarized for Straumanis James Hall, the Engineering Research Laboratory Building and the new Research Building. Please refer to Section V., Graphic Exhibits, for additional information.

Straumanis James Hall

As indicated in Section II, Straumanis James Hall, originally constructed in 1967, was completely renovated in 2011 and was re-occupied during the summer of 2012. Because of the building's recent construction work, only minor alterations will be necessary for the structure to be integrated into the research complex. Connection points in to the new facility will occur at the northwest corner of Straumanis and will be limited to the ground, first, and third floors. Access from the second floor of Straumanis James Hall in to the new research facility will require an occupant to travel up or down one level (via the building's stairs or elevator). Straumanis will maintain its own dedicated main entrance on the west façade and its service entrance on the east façade.

Modifications required to link Straumanis James Hall to the new Research Building will have a negligible impact on its current use and efficiency. The proposed floor plan diagrams indicate some conversion of existing laboratory and administrative space to circulation space (new or extended corridors) but the overall building will remain very efficient with a utilization rate of approximately 31.06%. The ratio of laboratory space verses gross building area will be 36.26% and the ratio of administrative space verses gross building area will be 16.27%.

Engineering Research Laboratory Building

Similar to Straumanis James Hall, the Engineering Research Laboratory Building, constructed in 1970, contains many of the same aesthetic and functional attributes as that of its predecessor. Its construction type (poured-in-place, flat slab concrete) and floor-to-floor dimensions are identical to Straumanis James Hall, with the exception of the ground-to-first floor dimension. Like Straumanis, the shallow floor-to-floor dimension of 10'-8" limits the flexibility of this building for multipurpose research activities. It can, however, provide adequate space for laboratories that do not require tall vertical clearances. As demonstrated by the new floor plan configurations, the ERL building can easily accommodate private offices, conference rooms, instruction areas, and other academic and supporting functions.

In order to maximize efficiency and use, the Engineering Research Laboratory Building will require complete and total renovation. Only the building's structure, its main vertical circulation components (stairs and elevator shaft), and portions of the exterior walls will be retained. All existing mechanical, plumbing, electrical (including the main switchgear), and other related infrastructure systems will be demolished and replaced with new equipment.

Access points in to the building will be modified and the entrance on the south facade will be abandoned. The east façade will no longer have an exterior exposure (the former exterior wall will serve as a fire separation partition between ERL and the new Research Building). The ERL Building will have direct floor alignment with the new Research Building on the ground and the first floor only. The second and third floors will connect to the new Research Building by a new communicating stair that will be constructed on the north façade of the new building. The ERL building will only connect to Straumanis James Hall through the new Research Building.

All interior spaces in the ERL Building will be completely reconfigured and all materials and finishes will be new. The ground floor, which has a floor-to-floor height of 16’-0”, will accommodate laboratory environments that require taller vertical clearances. Three bays located on the ground floor feature an existing 54” thickened floor slab (founded on drilled piers to bedrock). This condition will provide users with additional flexibility associated with floor loading and/or isolation concerns. Upper floor levels currently feature similar layouts, but offer substantial flexibility should laboratory, support, or administrative functions change in the future.

The Engineering Research Laboratory Building’s utilization factor is slightly higher (38.13%) than Straumanis James Hall. This increase is primarily due to wider corridors, which allows for better interior circulation, and a dedicated mechanical penthouse (located on the roof level). Both ERL and SJH have the same ratio of laboratory use (36.26%). ERL has a slightly smaller ratio of administrative use (13.44% vs. 16.27%).

Geothermal Plant Addition to Straumanis James Hall

The 3,515 square foot Geothermal Plant Addition to Straumanis James Hall is an independent support facility that houses equipment for the new campus-wide geothermal system. It is one of two structures that are currently being constructed for the new infrastructure project. The Geothermal Plant Addition has no functional relationship, other than its physical location, to the research activities that will be conducted within Straumanis James Hall, the Engineering Research Laboratory Building, and the new Research Building.

As design criteria for the new Geothermal Plant Addition developed, the facility became an early catalyst for the planning and development of the new Research Building. Because the Geothermal Plant Addition will ultimately be an internal component of the new Research Building, it was necessary to design building systems that would accommodate the needs of both facilities. Through independent meetings with the design team for the geothermal infrastructure project, structural criteria was determined and designed, floor and roof elevations were established, and mechanical / electrical requirements were created so the Plant Addition could accommodate vertical growth and other criteria imposed by the development of the new Research Building.

Construction of the new Research Building will include a five-level addition (including the roof penthouse) to the north of the single-story Geothermal Plant. Due to the unique configuration of the new Research Building, two stories of occupiable space will be constructed above the Geothermal Plant Addition. The roof of the addition will be converted to a floor level and all present roof-mounted equipment (cooling tower, vents, exhaust fans, etc.) will be removed and relocated to the new roof above the third story.

New Research Building

The new Research Building of approximately 86,470 gross square feet will be constructed east of the Engineering Research Laboratory Building and north of Straumanis James Hall. It will incorporate the Geothermal Plant Addition into its structure and it will create a unified research center of approximately 162,540 gross square feet that will aesthetically anchor the northeast corner of the Missouri S&T Campus.

The ground floor level of the new building will align with all of the connecting adjacent buildings, including the Geothermal Plant Addition. This feature will simplify the movement of equipment and materials from the elevated receiving dock to any location in the three-building complex. A large-platform freight elevator, located adjacent to the Receiving area will allow oversized and/or heavy objects to be easily transported from the ground level to the Mechanical Penthouse (located on the roof level). The ground floor level is currently designed to house three large laboratories that could be sub-divided if the need dictated. Clear height (measured from floor to underside of structure) in two of the typical laboratories is approximately 14’-6”. The third laboratory, designated as a high-bay laboratory, will feature a clear height of 29’-6”. If final program requirements dictate the need for a containment area, vibration isolation, or any other unique floor requirement, they would be best accommodated on this level.

The first floor level of the new building aligns with the ERL Building but is slightly more than 5’-5” above the first floor level of Straumanis James Hall. An open stairway, adjacent to the Main Lobby, provides direct access in to the main level of Straumanis James Hall. The main building entrance is located on this level. It is designed as a monumental entrance to signify the point of access from the south. Its strategic location provides similar-length travel distances within the three-building complex and it also provides the building's occupants with convenient access to the landscaped plaza to the south and adjacent parking lot to the west. The main lobby is spaciously arranged and has been structured in a linear form for gallery presentations. Adjacent to the lobby is an administrative suite that has been located for facility management and building security.

The common floor-to-floor height of the new building is 16'-0". This dimension, typically used for research facilities, allows a 14'-6" clear height in all laboratories or other associated rooms where acoustical ceilings are not used.

Another substantial design feature of the new building is the unusual configuration of the north stair. Rather than having stair runs of equal dimensions, the north stair has been designed with unequal runs, thus allowing the intermediate landings to align with the second and third floor levels of the ERL Building. This unusual configuration allows the 16-foot floor-to-floor dimension to be maintained for the new building and yet, only requires building occupants to travel a half flight of steps to access the non-aligned floors (second and third) of the ERL Building.

Layout configurations on the second and third floor of the new facility are identical with the exception of the two non-assigned administrative spaces above the building's main entrance. The second floor features a unique arrangement for potential social interaction and collaboration. It is designed with a small interior conference room that opens onto an outdoor terrace that faces southwest. The covered terrace offers superior views of the Missouri S&T campus. Adjacent to the conference room and outdoor terrace is an informal seating area that can be used for informal gatherings or pre-function events. The third floor is similar but in lieu of an outdoor terrace and support spaces, a special-event conference room that can accommodate large meetings, seminars, or exclusive presentations was developed.

The individual utilization factor for the new Research Building is 43.97% and the average utilization factor for the three-building complex is 37.72%. The individual utilization rate is slightly high due to the amount of space allocated to circulation and the mechanical penthouse. The ratio of laboratory space for the building is 31.95% and the ratio of administrative space is 8.88%. The later figures are subject to change as the space program is developed.

Supporting Technical Information for the ERL Building and the New Research Building

Electrical Systems

Service and Distribution

The building complex will be served by a new S&C Switch and a new 1000kVA 12470:460/277Y Volt 3-phase transformer fed from the existing campus 12470V loop. A 12470V feed will be trenched/routed from the nearest man-hole and spliced into the campus 12470V loop at the existing building splice location.

A 2000Amp 480/277Y Volt 3-phase 4 wire four (4) section piece of distribution gear will service the building's main power distribution needs and be installed in the new electrical room on the ground floor. Digital customer metering will be included in the service entrance switchgear for use by the University. Transient Voltage Surge Suppression (TVSS) will be provided at the service entrance, and at panels serving high electronic equipment loads. Four (4) 208/120Y Volt 1000 Amp Square 'D' I-Line panel-boards will distribute power to the lab power panels.

A 250 kW generator will be provided to supply back-up power to the fire pump, emergency lighting, telcom, and miscellaneous critical lab loads.

Fuses will be used in all switchboards and panelboards serving mechanical equipment. Circuit breakers and aluminum buss will be used for panelboards and switchgear feeding lighting and convenience loads. Copper cable shall be used exclusively.

General Power and Lighting

General power and lighting will be distributed from four (4) 225Amp 84 pole MLO circuit breaker panels per each floor. All general office power in the existing building will be distributed via dual cell surface mounted wire-mold (Wiremold AL4000 or equivalent) installed around the entire perimeter of the office space 18” above the finished floor. General and office lighting control will be via wall switch occupancy sensors. Lab and restroom lighting will be controlled via ceiling mounted occupancy sensors.

All office space light fixtures will be 2’x4’ troffer three (3) lamp flanged or 2’x2’ troffer flanged lay in grid mounted florescent fixtures. All lab space lighting fixtures will be 2’x’4’ three (3) lamp troffer surface mounted or 2’x’2 troffer surface mounted florescent fixtures. The restroom lighting and new vestibule lighting will be provided by 6” recessed can lights with the possibility of recessed indirect cove lighting above the vanities.

Exit lighting will be accomplished with LED lamp exit lights with battery back-up.

Lab Power

Power for each lab will be served by dedicated surface mounted 208/120 Volt MLO panelboards located in the lab itself. The panelboards will be required to be either 200Amp or 100Amp depending on the needs of the individual lab as specified by the end-user.

All general lab power needs will be distributed via dual cell surface mounted wiremold (Wiremold AL4000 or equivalent) installed around the entire perimeter of the lab space 48” above the finished floor. For lab spaces with peninsula casework, new power and data drops will be provided in new island stub-ups every 10 feet. Two additional empty 1” conduit sleeves will be installed for future power distribution needs between the split-cell wiremold and the lab panels.

Wiring Methods

All above-grade exposed and concealed wiring will be installed in EMT conduit. Below-grade wiring will be installed in PVC conduit and shall only be utilized for building service entrances. All wiring will be copper. #12 and #10 wire shall be stranded. Low voltage systems will be installed as open-type plenum rated cables unless specified otherwise.

Fire Alarm

An addressable fire alarm system will be installed with audio-visual notification devices meeting building code and ADA requirements. Applicable codes will be reviewed to determine if a voice evacuation system is required as part of the fire alarm system. The system will include a digital dialer. Notifier shall be used as a basis of design. Simplex, Edwards, and Siemens shall be considered equivalents.

A new control panel will be installed.

Data/Telecommunications

Data and telecommunications will be installed per University standards.

All Lab spaces will have a 4-port fully wired RJ45 data/communications drop located every 10’ (unless specified otherwise).

All first floor office spaces will have two (2) 4-port fully wired RJ45 data/communications drops located on opposing walls in the split-cell wiremold.

All first, second, and third floor office spaces will have four (4) 4-port fully wired RJ45 data/communications drops (1 located on each wall of the office space) in the split-cell surface mount wiremold unless specified otherwise.

Wire basket type cable tray located in the central corridors on each floor above the new acoustical drop ceiling will be used to distribute all data/communication cabling. The existing electrical chase will also be used as the data/communication cable chase.

Mechanical Systems

Central Utilities

Chilled and hot water will be supplied from new campus chilled and hot water loops. Parallel building pumps shall be provided for both hot water and chilled water, pumps will be sized for parallel operation with one pump carrying approximately 70% of the load in the event that one fails. The campus chilled water is maintained at 45°F minimum temperature and the campus hot water is maintained at 120°F maximum temperature.

Relocated Utilities

The cooling tower, plumbing vents, chiller vents, and refrigerant exhaust fan are located on the roof of the Straumanis geothermal plant. This mechanical equipment will be relocated to the roof of the New Research Building as a part of this building construction. Phasing of this work will need to be coordinated with the university and timed for an off peak period. Some steel work may need to be installed adjacent to the towers before relocating the tower.

Additional Chiller Capacity

When configuring the Straumanis geothermal plant provisions were made to accommodate a future 400 Ton chiller to provide firm chilled water capacity for the campus. As a part of this project, the chiller, condenser water pump and primary chilled water pumps will be added and an additional tower cell will be combined with the relocated tower cell.

Central HVAC Systems

HVAC Overview

The HVAC systems for this building will be configured to provide ventilation air, sensible and latent cooling, and heating for the offices and laboratory spaces. The volume of air supplied will vary depending on both the space loads and exhaust airflow rates. To minimize the impact on campus utilities, transfer air within the spaces will be utilized to the greatest extent possible. Further, a means of energy recovery will implemented to transfer energy from the exhaust air to the ventilation air.

All HVAC systems will be located in penthouse mechanical rooms, one provided on the existing ERL and the other provided on the roof of the New Research Building.

Ventilation Air Systems

Two central variable volume ventilation/primary air units will be provided, one for the existing ERL and the other for the New Research Building. Outside air will be pre-conditioned two ways. First, an energy recovery system will be provided on the lab exhaust to transfer heat during winter operation and cooling during summer operation. Second, class 2 air from the labs will not be returned and mixed with the ventilation air. Rather, energy will be transferred from the class 2 relief air to the ventilation air using a heat wheel. Separate relief air and exhaust air energy recovery systems will be provided for ERL and the New Research Building.

Laboratory Exhaust and Make-up Systems

Each laboratory space will be served by a series fan powered VAV terminal unit with hot water reheat. The total airflow for this terminal unit will be sized to match the peak exhaust airflow from each lab. Each terminal unit will be configured with an ECM motor configured for variable speed operation. Both the primary air and transfer air to this terminal unit will be sized to range from 0 to 100% airflow.

Each lab hood will be provided with a Phoenix style valve to control and record the exhaust airflow rate.

Each lab space will be provided with a relief air VAV box that will control the pressurization of each room by tracking the difference between the supply air and exhaust airflows.

Fume Hoods

It is anticipated that the fume hoods would be 2-Position type. In this case the hoods will operate at constant volume but switch between two modes, occupied and unoccupied mode. During occupied mode, the hood exhaust will be set to maintain 100 fpm at an 18" sash height, while during unoccupied mode, the hood exhaust shall decrease to a minimum, non-zero air flow (which is based on providing a lower face velocity, 60 fpm, at the an 18" sash height). The hoods shall be provided with control panels which will indicate unsafe hood exhaust operation: a light that is on will indicate an air exhaust velocity of <90 fpm while a buzzer will indicate an air exhaust velocity of <50 fpm.

General Exhaust

The general exhaust system for each lab will be controlled to 6 air changes per hour (ACH) when occupied and 3 ACH when unoccupied. Occupancy for the general exhaust will be determined by a general room occupancy sensor, which will also control the lighting. The exhaust system will be designed for no return air from any lab.

The lab supply valves will modulate to maintain space temperature set point and make-up air for the hood(s) and general exhaust requirements, whichever is greater. The system will accommodate typically 4 watts/square foot of heat producing equipment (including lighting) in each individual lab space. The supply and general exhaust valves will modulate together according to the hood cfm requirements to maintain negative lab pressurization (except where noted on the drawings) with respect to the corridor at all times. Each laboratory space will have a purge cycle, controlled manually, that will provide full air supply and exhaust to clear odors or contaminants in case such a need would arise as a result of an abnormal operation in the lab. The corridors will be supplied with constant volume make-up air from the lab AHU to allow for the lab pressurization.

Non-Laboratory Spaces Systems

The non-laboratory spaces will be served by conventional VAV boxes with reheat supplied by a dedicated rooftop AHU. In lieu of return air, all supply air will be transferred to the corridor return air plenum where it will be transferred to the lab spaces.

Perimeter spaces will also be served by finned tube radiation heaters.

Basement mechanical, electrical, and receiving rooms will be served by dedicated ceiling-mounted fan coil units for heating and cooling as appropriate.

Piping and Ductwork

Vertical utility chases will be coordinated for both piping and ductwork. Horizontal duct mains shall extend throughout each floor and single duct VAVs with reheat shall be provided for both the offices and laboratory spaces.

New hot water heating distribution piping required to supply the reheat coils at the VAV boxes, perimeter finned tube radiation, and the pre-heat coil in the air handling unit will be routed up the vertical utility chases from the basement mechanical room and then distribute horizontally on each floor as required to the to the reheat coils.

Process Chilled Water System

A central laboratory water cooling system will be installed consisting of a process chilled water heat exchanger, circulating pump, expansion tank, and make-up water system. The laboratory cooling water system main piping will be routed up from basement mechanical throughout the facility.

Controls

A new direct digital control (DDC) temperature control system will be installed. The system will control the operation of the new central air handling unit, the individual office spaces and the central heating hot water and chilled water systems. A Phoenix-type control system will be installed for the laboratory spaces and will be tied into the central building DDC system for reporting and monitoring.

Plumbing

Due to the limited city water pressure a domestic cold water booster pump package will be provided.

The existing restroom groups shall be renovated in total with new water closets, urinals, lavatories, etc. Plumbing shall be provided for the new restrooms on each floor of the New Research Building.

Storm drainage shall be provided throughout to collect rainwater.

Utilities shall be piped from the central mechanical to each lab space. These utilities shall include natural gas, non-potable cold water, non-potable tempered water, compressed air and a central water purification system.

Each lab space will be provided with an emergency show. A dedicated emergency shower tempered water system will be provided and routed to each lab.

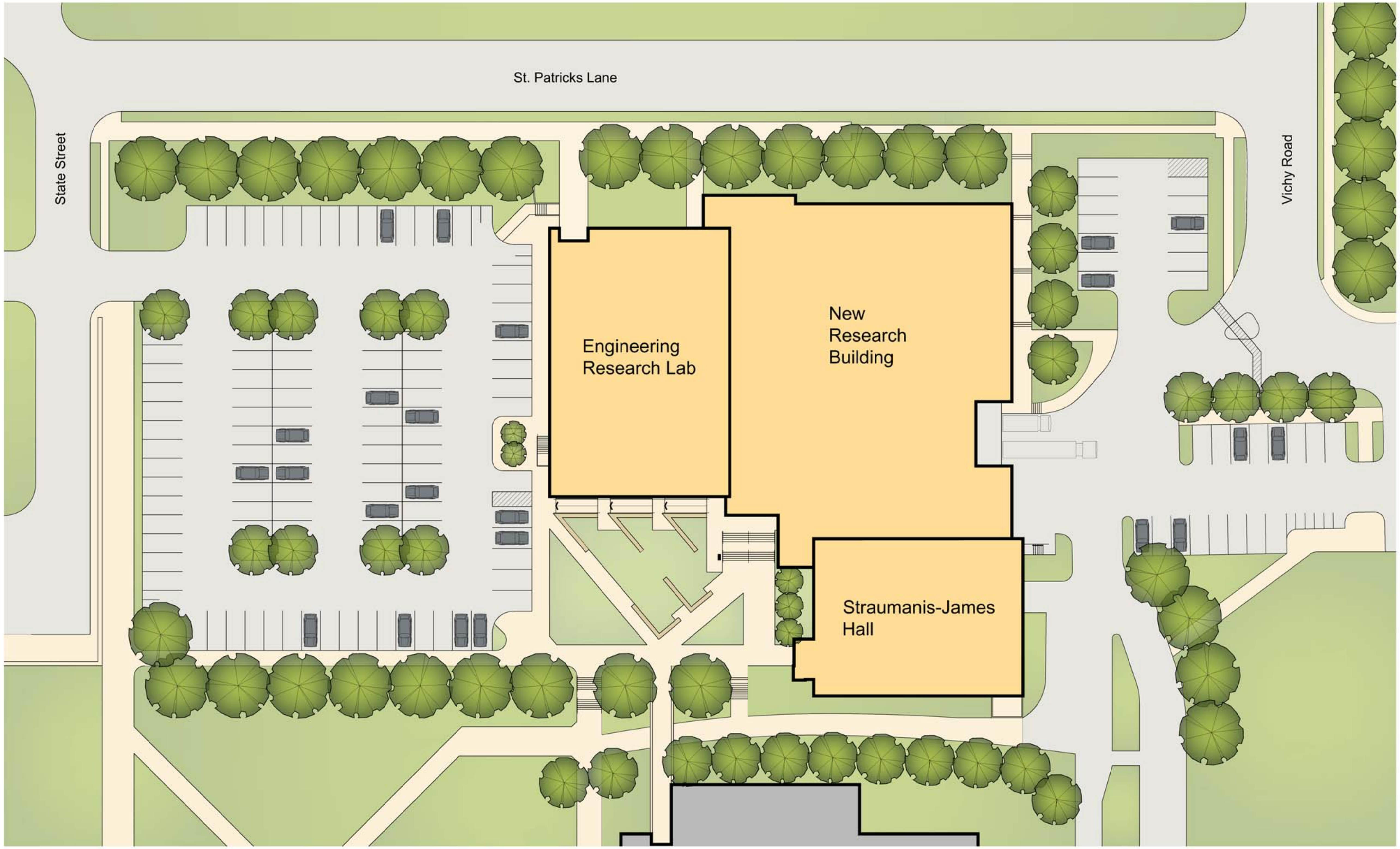
Domestic hot water shall be provided from a new gas fired domestic hot water system with central mixing valve.

Fire Protection

Due to the limited city water pressure a fire pump package will be provided.

A sprinkler system shall be extended from the geothermal plant fire service. A new zone valve shall be provided and extended throughout the New Research Building in compliance with NFPA requirements.

V. Graphic Exhibits



Site Plan

Scale: 1" = 50'-0"

North

New Research Building

Missouri University of Science and Technology

Legend:

- Circulation
- Laboratory
- Administrative
- Support
- Geothermal
- Infrastructure

Building Areas (This Floor):

Engineering Research Lab	11,010 SF
Straumanis-James Hall	7,500 SF
Geothermal Plant	3,515 SF
New Research Building	18,150 SF

Building Areas (Total):

Engineering Research Lab	45,885 SF
Straumanis-James Hall	30,185 SF
Geothermal Plant	<3,515 SF>
New Research Building	86,470 SF
Total	162,540 SF

Ground Floor Plan

Scale: 1" = 30'-0"

North

New Research Building

Missouri University of Science and Technology

Legend:

- Circulation
- Laboratory
- Administrative
- Support
- Geothermal
- Infrastructure

Building Areas (This Floor):

Engineering Research Lab	10,925 SF
Straumanis-James Hall	7,685 SF
New Research Building	18,875 SF

First Floor Plan

Scale: 1" = 30'-0"

North

New Research Building

Missouri University of Science and Technology

Legend:

- Circulation
- Laboratory
- Administrative
- Support
- Geothermal
- Infrastructure

Building Areas (This Floor):

Engineering Research Lab	11,010 SF
Straumanis-James Hall	7,500 SF

ERL / SJH Second Floor Plan

Scale: 1" = 30'-0"

North

New Research Building

Missouri University of Science and Technology

Legend:

- Circulation
- Laboratory
- Administrative
- Support
- Geothermal
- Infrastructure

Building Areas (This Floor):

Engineering Research Lab	11,010 SF
Straumanis-James Hall	7,500 SF
New Research Building	21,595 SF

Second Floor Plan

Scale: 1" = 30'-0"

North

New Research Building

Missouri University of Science and Technology

Legend:

- Circulation
- Laboratory
- Administrative
- Support
- Geothermal
- Infrastructure

Building Areas (This Floor):

Engineering Research Lab	1,930 SF
New Research Building	19,225 SF

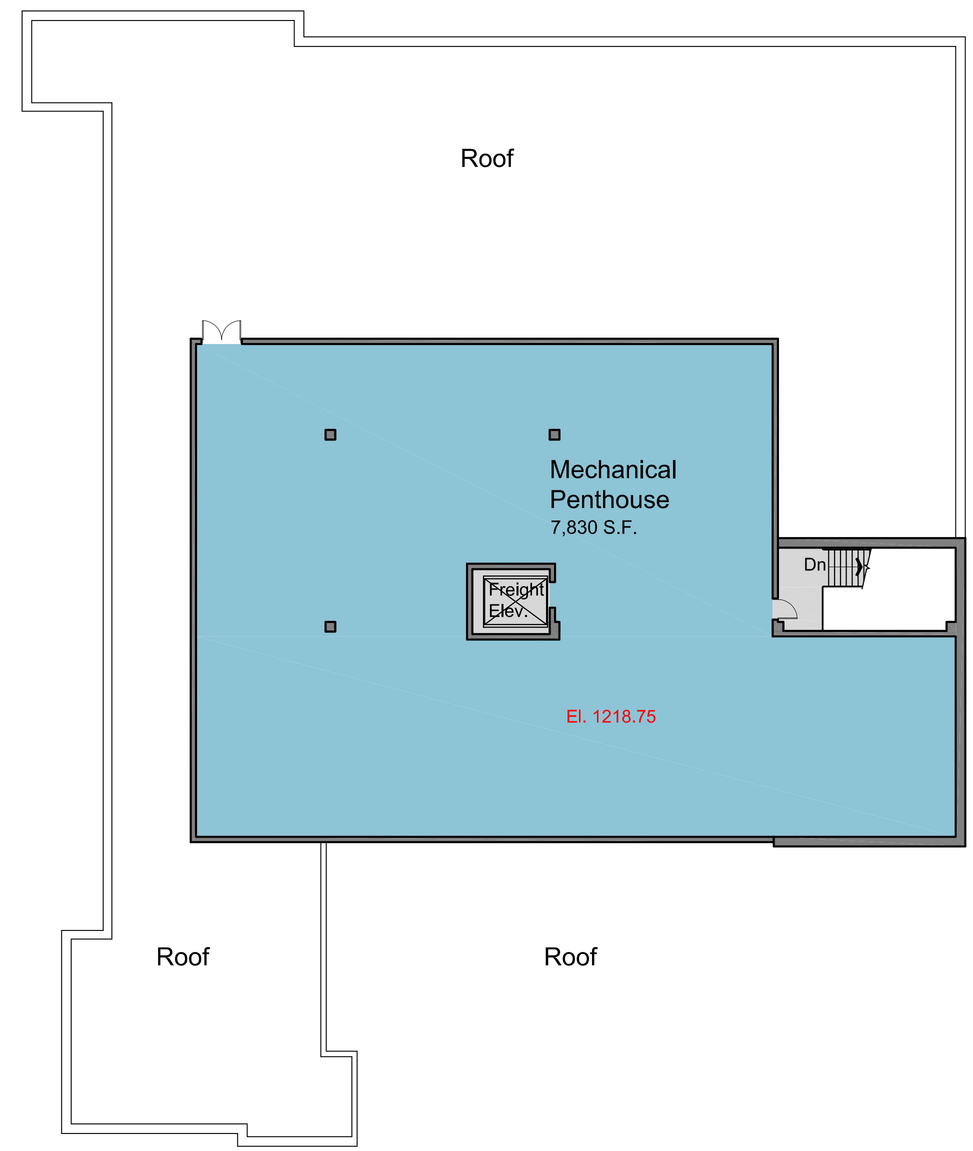
Third Floor Plan

Scale: 1" = 30'-0"

North

New Research Building

Missouri University of Science and Technology



Legend:

- Circulation
- Laboratory
- Administrative
- Support
- Geothermal
- Infrastructure

Building Areas (This Floor):

New Research Building 8,625 SF

Roof Plan

Scale: 1" = 30'-0"

North

New Research Building

Missouri University of Science and Technology

Perspective View at Southwest Corner

New Research Building

Missouri University of Science and Technology

Perspective View at Northeast Corner

New Research Building

Missouri University of Science and Technology

VII. Appendices

Programming Questions - Summary of Response

Straumanis-James Hall and Engineering Research Laboratory
Programming Study 103516
Programming Questions / Summary of Response

Respondent		Beetner	Chandrashekhara	Fahrenholtz	Gao	Hilmas
1.	Is outdoor building storage required?	No	No	Yes	No response	Yes
2.	Is a receiving area (indoor or outdoor) required?	No	No	Yes	No response	Yes
3.	Is a loading dock required?	No	No	Yes	No response	Yes
4.	Is a heavy-duty freight elevator required?	No	No	Yes	Yes	Yes
5.	Is a minimum floor area required for your prototypical laboratory?	Area for the prototypical lab was not defined. 10,000 u.s.f. of total area was requested.	Area for the prototypical lab was not defined. 5,000 s.f. of total area was requested.	1,200 s.f. to 1,500 s.f.	1,000 s.f.	1,500 s.f.
6.	Is a minimum clear height required for your prototypical laboratory?	Standard ceiling height	15 feet in at least one lab.	See #7 below	11'-6"	20'-0"
7.	Do you have the need for high-bay space?	Yes, one lab would require a 2' floor depression and 20' clear high for semi-anechoic chambers	No	Yes, 20' clear	No	Yes, 20' clear
8.	Would you prefer natural light (windows) in your prototypical laboratory?	Yes	No	Either condition is acceptable	No	Yes
9.	Should your prototypical laboratory include heavy-duty floors for excessive dead or live loads?	No	No	No	See question #10	No
10.	Should your prototypical laboratory incorporate vibration isolation?	No	No	No	Yes	No
11.	Should your prototypical laboratory incorporate any unusual wall construction?	No	No	No	No	No
12.	Are any specific environmental conditions required for your prototypical laboratory?	No	No	No	No	No, but furnaces need appropriate ventilation
13.	Are any specific electrical power requirements required for your prototypical laboratory?	No. 220 v. is sometimes preferred	Yes (not defined)	Yes, 100 amp, 3 phase 240v. and single phase 220 v. (30 amp)	No response	Yes, 240/208v. or 480v.
14.	Do you have any specific requirements for staff offices?	No	Offices near labs	No, not at this time	No	No
15.	Do you have any specific requirements for graduate student offices?	Large open area of approx. 3,000 s.f. for 50 students	Offices near labs	Locate 8 to 10 grad students in common office	No	No
16.	Do you conduct more computer modeling than experimental work?	Equal amounts of both	More experimental	All experimental	Experimental	Experimental
17.	Do you require a clean room with low particle counts?	No	No	No, not at this time	Yes	No
18.	Identify other unusual facility requirements?	None at this time	None at this time	Equipment (furnaces) need access to chilled water for cooling	No	Equipment (furnaces) need access to chilled water for cooling

Respondent		Khayat	Leu	Liou	Myers	O'Keefe/Miller
1.	Is outdoor building storage required?	Yes	Yes	Yes	Yes	Yes
2.	Is a receiving area (indoor or outdoor) required?	Yes	Yes	Yes	Yes	Yes
3.	Is a loading dock required?	Yes	Yes	Yes	Yes	Yes
4.	Is a heavy-duty freight elevator required?	Yes	Yes	Yes	Possibly, depending on layout	Yes
5.	Is a minimum floor area required for your prototypical laboratory?	Area for the prototypical lab was not defined. 20,000 s.f. of total area was requested.	2,000 s.f.	2,000 s.f.	No response	2,500 s.f.
6.	Is a minimum clear height required for your prototypical laboratory?	20'-0" to 35'-0"	13'-0"	Standard ceiling height	20'-0" to 24'-0"	16'-0"
7.	Do you have the need for high-bay space?	Yes	No	Yes	Yes	No
8.	Would you prefer natural light (windows) in your prototypical laboratory?	Yes	Yes	Either condition is acceptable	Yes	No
9.	Should your prototypical laboratory include heavy-duty floors for excessive dead or live loads?	Yes, including inserts rated at 100kips	Yes	Yes	Yes, with floor inserts rated at 100kips	Yes
10.	Should your prototypical laboratory incorporate vibration isolation?	Yes, see response #17	No	No	Yes	Yes
11.	Should your prototypical laboratory incorporate any unusual wall construction?	No	No	No	No	Yes, partitions should consider blocking sound and electrical/RF
12.	Are any specific environmental conditions required for your prototypical laboratory?	Yes, one 500 s.f. lab w/ 50% RH and 72+/-3 deg. F and one 500 s.f. lab w/ 100% RH and 72+/-3 deg.	No	No	Maintain temperature variance of no more than 3 deg. F	Constant temperature and humidity, low particle generation, and low noise exhausting for pumps
13.	Are any specific electrical power requirements required for your prototypical laboratory?	Yes, some equipment requires 550v., tri-phase.	Yes, 240v.	Yes	Yes	Yes, isolation of power between instruments, back-up power for outages
14.	Do you have any specific requirements for staff offices?	No (2 offices for technical staff and 12 offices for grad students)	No	Offices near labs	No	At least 2 staff offices
15.	Do you have any specific requirements for graduate student offices?	See above	No (open office desired)	Offices near labs	No	Provide conference / gathering area to work with students
16.	Do you conduct more computer modeling than experimental work?	Experimental	Experimental	Equal amounts of both	Experimental	Experimental initially but changing to 50/50 split in the future
17.	Do you require a clean room with low particle counts?	Yes, some equipment requires a dust-free and vibration-free environment	No	Yes	No	No, but would prefer low particle counts
18.	Identify other unusual facility requirements?	No	None at this time	None at this time	None at this time	None at this time

Respondent		Sarangapani	Volz	Xiao	Yang	Zoughi
1.	Is outdoor building storage required?	Yes	Yes	Yes	No	Yes
2.	Is a receiving area (indoor or outdoor) required?	Yes	Yes	Yes	Yes	Yes
3.	Is a loading dock required?	Yes	Yes	Yes	Yes	Yes
4.	Is a heavy-duty freight elevator required?	Yes	Yes	Yes	Yes	Yes
5.	Is a minimum floor area required for your prototypical laboratory?	1,500 s.f.	400 s.f.	3,000 s.f.	1,000 s.f.	Similar to current lab (ERL 210)
6.	Is a minimum clear height required for your prototypical laboratory?	Standard height	8'-0"	10'-0"	11'-6"	Standard height
7.	Do you have the need for high-bay space?	No	No	No	No	No
8.	Would you prefer natural light (windows) in your prototypical laboratory?	Yes	Yes	No	No	Yes
9.	Should your prototypical laboratory include heavy-duty floors for excessive dead or live loads?	Yes	No	Yes	Yes	No
10.	Should your prototypical laboratory incorporate vibration isolation?	Yes	No	Yes	yes	No
11.	Should your prototypical laboratory incorporate any unusual wall construction?	Yes, some RH shielded	No	No	No	No
12.	Are any specific environmental conditions required for your prototypical laboratory?	No	No	Yes, 208v. or 220v. - three phase	No	No
13.	Are any specific electrical power requirements required for your prototypical laboratory?	440v. - 3 phase	No	Yes	No	Yes, 240v.
14.	Do you have any specific requirements for staff offices?	Private offices	Shared offices	Standard office	Any are OK	Similar to ERL
15.	Do you have any specific requirements for graduate student offices?	Cubicles	Cubicles	No response	Any are OK	Similar to ERL
16.	Do you conduct more computer modeling than experimental work?	Experimental	Experimental	Experimental	Experimental	Equal amounts
17.	Do you require a clean room with low particle counts?	No	No	Yes	Yes	No
18.	Identify other unusual facility requirements?	Provide one large room (120 seat cap.) and one small room that has video conferencing capability	Ample storage areas	Control of temperature and humidity for femtosecond lasers	None at this time	None at this time

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