PENNSTATE

Office of Physical Plant

The Pennsylvania State University
Physical Plant Building
University Park, PA 16802-1118

DATE: November 13, 2012

SUBJECT: Woodland Building Renovation,
Penn State Abington

TO: BLTa
Environetics
Francis Cauffman
H2L2
Jacobswyper Architects
Perkins+Will
Schradergroup Architecture
Spillman Farmer Architects
Stantec
UJMN

Congratulations, your firm has been selected as one of the firms on a long list for the design of the above referenced project. The Selection Committee will review responses to this Request for Proposals and identify a short list of three firms to be interviewed.

It is necessary that you provide us with the information requested in the enclosed questionnaire no later than **December 10, 2012 at Noon.** Please answer all of the questions in the order requested. This will provide uniform information on all firms for evaluation and ultimate presentation to the Board of Trustees. We encourage you to be as brief as possible without sacrificing accuracy and completeness. A document not exceeding 60 pages should be more than adequate to provide the requested information. Please submit to my office **fourteen** copies of all materials. In order to better understand our goals and the major issues driving this project, we encourage you to visit the site; please contact Dale Hollenbach, Chief Operating Officer, Business Services at 215-881-7305 or dth4@psu.edu to schedule your site visit and arrange a meeting with the appropriate individuals involved in this project (next week would be ideal since students will be on break and the building will be accessible with minimum disruption). Please contact Tom Wojcik, the Project Manager at 814-865-6197 or tmw16@psu.edu for any project management questions and contact me if you have any process or planning questions.

In addition to the questionnaire, in order to help you formulate a response, enclosed you will find block plans of the building and the two studies referenced in the Letter of Interest. Also included is a non-binding fee proposal form for you to fill out; please submit one copy of this form under separate cover; to assist you in filling out this form please assume a construction budget of $5,385,000 and an FF&E budget of $538,500. Finally, you will also find a copy of our Form of Agreement 1-P; please review this agreement to ensure that your firm accepts all terms and conditions as written. In submitting a proposal for this project, you acknowledge that you concur, without exception, with all terms, conditions and provisions of Form of Agreement 1-P.

A decision regarding the firms to be interviewed will be made by December 19, 2012 and posted to our web site. Interviews with the three short-listed firms will be held on the second or third weeks of January 2013. Results of the interviews will be announced at the Board of Trustees meeting on January 18, 2013 and posted to our web site.

We appreciate your cooperation and interest in preparing this material. If the Board selects your firm, we will be looking forward to working with you on the development of this important project.

Please do not hesitate to call me if you have any other questions.

Sincerely,

David Zehngut
University Architect
207 Physical Plant
University Park, PA 16802
(814) 863-3158, fax (814) 863-7757
E-mail dxz3@psu.edu

Enclosures

cc: Selection Committee Members

QUESTIONNAIRE

Woodland Building Renovation,
Penn State Abington

The following items of information must be supplied to the University. We have made no attempt to provide sufficient space below for you to fill in blanks but expect that you will provide the information requested on your own letterhead paper. **Failure to answer all questions will be reason for disqualifying your team from further consideration.** Please provide **fourteen copies** of all material submitted. The deadline for submission is **December 10, 2012 at Noon.**

1. Please describe your approach to this project. Include a description of the scope of work your team will provide.

2. In addition to any further thoughts you might have on the essence of this project, we would like to see further evidence of your firm's ability to translate design intentions into a meaningful project (including the site). Therefore, please discuss in detail, but in no more than one or two pages, an example from your portfolio relevant to our project that best indicates the appropriate resolution of an understanding of the uniqueness of a project, design intentions, and translation of those design intentions into a meaningful and synthesized final solution.

3. Qualifications and experience of the lead design team members, **including consultants**, to be assigned to this project. Provide a clear indication of the roles to be performed by each **individual**. Please be very specific regarding the personal involvement and on-site participation of each lead design **individual.**

4. Consultant firms, if any, proposed for this project:

	Firm	No. of Projects Worked With Your Firm	Total Amt. Value
Structural Engineers			
Mechanical Engineers			
Electrical Engineers			
Landscape Architects			
Interior Designers			
Cost Estimators			
Others			

5. Experience of the firm and any consultants in the design of facilities similar to the ones proposed (college and other), completed or under construction during the past ten years. List for each the completion date, final construction cost and gross square feet provided, and be very specific about the services provided by your firm. Identify those specific projects included in the proposed design team experience listed in #3 above.

6. Experience of the firm and any consultants in the design of college and university buildings (not already included in # 5 above) completed or under construction during the past ten years. List for each the completion date, final construction cost and gross square feet provided, and be very specific about the services provided by your firm. Identify those specific projects included in the proposed design team experience listed in #3 above.

7. Evidence of the team's commitment to sustainable design.

8. List five client references for similar scope projects completed during the past ten years, giving name and telephone number. In order to give us an indication of your cost control track record, please **provide accurate and complete data indicating the gross square foot area, the design estimated cost, bid cost, the final total construction cost and the bid date for each project.** Please explain the reason for any major discrepancies between estimated, bid and final construction costs. Please make sure the telephone number of each client reference is current.

9. Graphic examples of selected projects personally done by **the lead design architect**, including brief description and completion date.

10. Please provide a proposed design schedule for each component of this project in graphic form allowing one week for any necessary Penn State University review. Assume the design process will start in January, 2013.

11. List errors and omissions insurance coverage.

12. Number of personnel in present firm(s): Architects _____ Engineers _____
Interior Designers _____ Landscape Architects _____ Others _____

    Which of the above are professionally registered?

13. Briefly tell us how you address diversity within your team.

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1855

Pennsylvania State University

Abington Chemistry Laboratory Renovation Feasibility Study

NALLS Architecture, Inc.

April 15, 2011; Revised for University Review Comments, June 23, 2011

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Executive Summary

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Executive Summary

PSU Abington identified the chemistry teaching and research laboratories in the Woodland building as areas for potential improvement, and the University contracted with Nalls Architecture, Inc. to complete a study of the existing conditions and potential improvements. The following report documents the findings of the study in the form of a written basis of design, drawings describing the scope of work, the official record of meeting minutes, and a professional cost estimate of the proposed work.

Basis of Design

The basis of design is a narrative the outlines criteria for 7302 SF of architectural, mechanical, electrical, and plumbing improvements to stacked portions the second and third floors and roof of the building. It provides an evaluation of the building infrastructure informed by review of existing documents and field observation to determine capacity that is available to support the renovated labs. Lab functional requirements are addressed based on interviews conducted with lab users and University staff. Mechanical, electrical and plumbing improvements are proposed, and suggestions for further data collection are proposed.

Drawings

The drawings included in the report represent the final plan concept approved by University staff and faculty. The preferred concept for the second floor is a full renovation of the project area that flips the current plan by placing the teaching labs directly adjacent to the corridor. The preferred concept for the third floor also flips the plan, but in this case it to take advantage of the locations corridor openings to provide access to new research labs. The organic chemistry lab is also reoriented from having fume hoods in the center to having hoods on the perimeter to improve both instruction and safety. These plans also represent the scheme that was provided to the cost estimator for use in developing the cost estimate. A sampling of the existing conditions documents is also included for reference.

In order to arrive at the final drawings, the design team reviewed existing visible field conditions and compared them to record drawings of the existing building as provided by the University archives. The design team generated schematic CAD files of existing conditions based on University-provided drawings. Multiple architectural "test-fit" plan concepts were drawn and reviewed with the faculty and administration, and the preferred concept plan was refined to include limited but sufficient detail for the budgetary cost estimate.

Meetings and Process

All throughout the process, the design team coordinated with University and Campus faculty and staff, attended meetings, and documented all important discussions with meeting minutes. The minutes from these meetings are included in the report as a record of the important decisions and topics discussed during the study.

Cost Estimate

This report includes a budgetary cost estimate for the preferred plan concept. The grand total for both floors, including alternates, is $2,330,873. The estimate includes a contingency that accounts for the schematic nature of the documents, and the estimator lists in detail all assumptions, inclusions, exclusions and alternates used in building the cost model.

Note that the revisions to the basis of design resulting from the University review comments add approximately $34,000 to the original estimate bringing the total to $2,364,873. See the cost estimate supplement in the appendix for additional information.

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Basis of Design

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Architectural Basis of Design Narrative

Existing Conditions

General

The Woodland Building was designed and constructed around 1969-76 as a new classroom, library lecture hall building for the "Ogontz Campus". The project was GSA #800-74. A connected lab and classroom building expanded the footprint of the Woodland building also in the early 1970's, but the addition did not change the configuration of the chemistry labs.

The chemistry labs are located on the 2nd and 3rd floors of the south end of the initial phase of the Woodland Building. Both floors of chemistry labs are built in a suite arrangement of 3651 GSF each for a project total of 7302 GSF. Each suite has two connection points to the corridor. Other than these connection points, the suites are separated from the corridor by mechanical chases that connect through to the mechanical room below.

Twelve foot floor to floor heights afford adequate ceiling spaces; however, the light gauge steel truss structure may complicate the installation of HVAC systems and equipment.

Structure

As noted in the existing drawings, the existing building is primarily a steel and CMU masonry bearing wall structure. Floors are typically concrete on metal decking and joists on steel girders. The roof is constructed of metal deck on light gauge steel joists.

Partitions

The existing partitions are typically painted CMU masonry. These partitions define the existing corridors and rooms within the building. In areas to be renovated, existing finishes will be removed and/or modified as required to achieve the desired spatial arrangement.

Windows

The existing windows will remain except on the south wall of the third floor, where they will be replaced with CMU to match the existing exterior wall. These are fixed, aluminum framed windows with insulated glass.

Finishes

Existing finishes within the spaces to be renovated will be demolished. Existing wall finishes that may remain at the perimeter of the space are primarily painted CMU. The existing ceilings are typically suspended acoustical panel ceilings. In areas to be renovated, the existing ceilings will be removed to allow for modifications to the mechanical systems. Floors are typically finished with polished vinyl composition tile, which will be removed to make way for the new room arrangements.

Casework

The laboratory casework in the existing chemistry spaces consists of inset steel cabinetry which matches the layout on the original building drawings. The tops and sinks also appear to be original to the early 1970's era construction and may be asbestos-containing "transite". The University should have them evaluated for possible hazardous materials abatement prior to any modifications.

Architectural Design

Laboratories shall be designed to maximize visibility, openness, and safety. All work must meet the current PSU Design Guidelines.

Handicapped Access

All aspects of the renovation will be designed in accordance with the 2004 American Disabilities Act Accessibility Guidelines (ADAAG).

All new fixed casework in teaching and research labs that are used by students will be designed to have accessible work stations and fixtures. At least one accessible fume hood will be provided in each teaching and research lab that will be used by students.

Architectural Materials and Systems

Demolition

Existing interior masonry partitions and suspended ceilings shall be demolished as indicated on the drawings. Casework shall be removed from the renovated areas.

Partitions

Shafts shall be enclosed by a two hour rated shaft wall system of 2 ½" CH studs, one inch shaft wall liner and double layer of 5/8" rated gypsum wall board.
Corridors shall be enclosed with partitions of 3-5/8" 20 ga. steel studs at 16" o.c., 5/8" gypsum wall board each side of studs, and mineral fiber insulation. Partitions shall extend to structure above.
Laboratories, Offices, Meeting Rooms, Classrooms, Conference Rooms, shall be enclosed with 3 5/8" 20 ga. steel studs at 16" o.c., 5/8" gypsum wall board each side of studs, and mineral fiber insulation. Partitions shall extend to the structural deck above.
Lab Support spaces shall be enclosed with 3 5/8" 20 ga. steel studs at 16" o.c., 5/8" gypsum wall board each side of studs. Partitions shall extend to 12" above the finish ceiling.
Wet spaces shall be enclosed with 3 5/8" 20 ga. steel studs at 16" o.c., 5/8" DensArmorPlus gypsum wall board each side of studs. Partitions shall extend to ten feet above finish floor.
Wall Reinforcement
Laboratory, Support, and Office partitions shall be provided with 18ga. sheet steel wall reinforcement for anchorage of wall cabinets and shelving.

Interior Finishes

Floors
Offices shall have commercial grade carpet, $40/yard allowance.
Laboratory, Support Spaces, and Corridors shall have VCT flooring.
Walls
Walls shall have one coat of primer and two finish coats with satin finish on walls and semi gloss on trim. Offices and Class Rooms shall receive two colors, one being an accent color on one wall.
Base
General; Bases shall be coved rubber in spaces with vinyl finish flooring, and square rubber in carpeted spaces.
Ceilings
Offices and Classrooms
Ceilings shall be a 2'x2' tegular edge lay in ceiling.
Laboratories and Corridors
Ceilings shall be a 2'x4' tegular edge lay in ceiling.
Laboratory Support Spaces
Ceilings shall be a 2'x2' tegular edge lay in ceiling.

Doors and Frames

Doors
Shall be 1 ¾" thick, 3'-0" wide x 7'-0" tall, flush wood. Where double-doors are indicated in laboratories, the primary active leaf shall be 3'-0" x 7'-0" and the inactive leaf shall be 1'-6" x 7'-0".
Vision glass panels shall be provided in doors where needed for safety.
Laboratory doors shall have a glass panel in the top half.
Office doors shall have a full glass light with tempered patterned translucent glass.
Interior Door Frames
Shall have mitered welded frames of 16 ga. shop primed hollow metal and two finish coats of enamel paint.
Door hardware
Shall be institutional grade including heavy-duty locksets with lever handles and removable core mortised locks, heavy-duty surface-mounted closers, ball bearing hinges, and kick plates where subject to damage from equipment.

Windows
Existing windows shall remain. Frames shall be painted. Where required, new windows shall be double hung, insulated, double-pane aluminum framed units to match the existing profiles.

Casework
Laboratory casework will be constructed of wood floor standing units with wood door and drawer fronts. Base casework will include knee spaces that can also be used for floor-mounted equipment such as refrigerators if needed. Under bench base cabinets shall be moveable for adaptability. Bench tops will be epoxy resin. Open reagent shelving will be provided above each bench in research and prep labs. An umbilical for lab services will be provided at the end of each bench with deck mounted quadraplex outlets at the shelf end and mid support structure. At least one handicapped accessible bench shall be provided in all laboratories.

UL listed acid storage cabinets will be provided under, and vented into each fume hood.

Equipment
A typical Fume Hood will be 6' long and constructed of metal. Each hood will have a flammable and acid storage base cabinet, a metal ceiling closure panel, and one cup sink with cold water. Valves will be provided for piped services including gas. At least one accessible fume hood shall be provided in each area used by students, and accessible hoods shall comply with ADAAG 2004 reach requirements for all operable controls and clearances. All fume hoods shall be certified with ASHRAE 110 factory and field testing to confirm proper operation at face velocities between 80 and 100 feet per minute. Sashes shall be single-piece, vertical-acting type with stainless steel chain drive with counterbalance for movement. **Fume hoods shall be restricted bypass type with integrated sash position and occupancy sensors configured for interconnection to the HVAC system to optimize energy savings. Coordinate alarm and airflow indicator device requirements with the building automation system.**

Furnishings
Blackboards, marker boards and tack boards shall be provided in all teaching labs, research labs and in alcoves / vestibules.
Fire extinguisher cabinets and fire extinguishers shall be provided in each lab.
Millwork coat hooks shall be provided in all renovated laboratories, and back pack cubbyholes shall be provided at each teaching lab.

Special Considerations

The following additional items have been identified during the course of the study as topics requiring additional consideration as the project moves into later stages of design. For the purposes of this study, they have been identified and included in the budgetary cost estimate.

Structural Evaluation for Rooftop Equipment

The structure of the roof in the area of the new HVAC equipment will require more detailed analysis in order to determine the extent of dunnage and/or structural reinforcement required to support a 22.5'x31.5' AHU weighing 23,000 lbs. The cost estimate will include a line item to allow for a normal quantity of dunnage for this equipment.

Systems Commissioning

The University will require full commissioning of the M/E/P systems included in the renovations. The cost estimate will include a line item for this service.

Roof Screen for New Equipment

The cost estimate will include a line item for a new rooftop screen wall to visually screen the new rooftop equipment. This item may be carried as a design alternate that may only be included in the project if required for permit approvals.

MEMO

McHugh Engineering Associates, Inc.
550 Pinetown Road, Suite 205
Fort Washington, PA 19034

Phone: (215)641-1158
Fax: (215)641-0194
Email: general@mchugheng.com

Date: March 31, 2011 **(Revised: May 18, 2011)**

To: Richard Linsky - Nalls Architecture

From: Mike Witkowski / Brian Malloy

Re: Penn State University Abington - Chemistry Lab #10.115

We have reviewed the existing conditions, existing drawings and proposed floor plans, dated 3-15-11. The original Woodland Building was designed in 1969 and constructed in the early 1970's. In 2002, the HVAC systems were upgraded. Below is a description for mechanical, plumbing, electrical and fire protection upgrades to supply the new Chemistry Labs on the Second and Third Floors.

MECHANICAL

The existing building consists of a (4) pipe fan coil system with (2) 175 ton indoor Carrier chillers and (3) boilers totaling 9600 MBH. The chillers are located in an addition to the Woodland Building. The boilers are located in the Basement of the Woodland Building. To date, the University is not aware of available capacity on the chillers and boilers. We recommend the University install the appropriate data points and trend the chillers and boilers over the next year to verify available capacity. Our preliminary design estimates require an additional 28 tons of cooling and an additional 158 MBH of heating above the existing connected load for the existing 2nd and 3rd floor class rooms. Due to this difference we may be required to design the 2nd floor unit with a direct expansion cooling coil. Please instruct the estimate to provide a change in cost to do this.

1. Second Floor HVAC
   a. The unit shall be a custom built rooftop unit with heat pipe energy recovery unit, 22 tons cool/ 325MBH heat, chilled water, hot water coil, 5,600 CFM, variable frequency drives, 18' W x 30' L and 16,500 lbs. based on Ingenia Technologies. **Provide a humidifier section to the unit.** (Refer to the attached specifications).
   b. Provide (2) coated steel belt drive high plume dilution fans. Fans shall be 5600 CFM, 5 HP, 31' discharge, variable frequency drives, bypass to maintain 3,000 FPM discharge, lead/lag control based on

M.K. Plastics Corp. Axijet-S Series (Refer to the attached specifications)

c. Provide insulated ductwork to the space with fire dampers at the floor penetration. Exhaust ductwork shall be 316 stainless steel and welded.

d. Provide chilled water and hot water piping from the Main Mechanical Rooms to the rooftop unit.

e. Each laboratory exhaust hood shall have a sash monitor interconnected to a flow control valve (11 valves). Valves shall be pressure independent.

f. All controls shall integrate to the existing Automated Logic Control Building Automation System.

g. The contractor shall demolish the existing systems feeding the space including but not limited to the ceiling mounted fan coils, wall mounted unit ventilators, piping, ductwork, existing hoods, controls, etc.

h. Direct expansion option - In lieu of the chilled water system the unit shall have a DX coil and a roof mounted condensing unit.

2. Third Floor

a. The unit shall be a custom built rooftop unit with heat energy recovery, 51 tons cool/ 649 MBH heat chilled water coils, hot water coils, 12,800 CFM, variable frequency drives, 22.5'W x 31.0"L, 23000 lbs. Based on Ingenia Technologies. **Provide a humidifier section in the unit.** (Refer to the attached specifications)

b. Provide (2) coated steel belt drive high plume dilution fans. Fans shall be 12,800 CFM, 20 HP, 54' discharge, variable frequency drives, bypass to maintain 3,000 FPM discharge, lead/lag control based on M.K. Plastics Corp. Axijet-S Series (Refer to the attached specifications).

c. Provide insulated ductwork to the space with fire dampers at the floor penetration. Exhaust ductwork shall be 316 stainless steel welded.

d. Provide chilled water and hot water piping from the Main Mechanical Rooms to the rooftop unit.

e. Each laboratory exhaust hood shall have a sash monitor interconnected to a flow control valve (22 valves). Valves shall be pressure independent.

f. All controls shall integrate to the existing Automated Logic Control Building Automation System.

g. The contractor shall demolish the existing systems feeding the space including but not limited to the ceiling mounted fan coils, wall mounted unit ventilators, piping, ductwork, existing hoods, controls, etc.

3. Common Work

a. Provide a new generator exhaust fan for new generator. Provide new generator exhaust pipe insulator.

PLUMBING

The existing building consists of a central domestic water heater, sanitary/vent system, acid waste system, distilled water system, compressed air system and natural gas system.

1. Common work
   a. Remove the existing distilled water system located in the Janitor's Closet and provide a new distilled water system.
   b. Provide fuel piping and relief vent for new generator. Provide audio/visual alarms for fill system.
2. Second Floor/Third Floor
   a. Remove the existing utility connections and branch piping serving the existing lab space. All risers and mains shall remain.
   b. Provide new gas connections at casework as required. Gas piping shall be piped to have a manual shut off valve at the main entrance to each classroom/room with (2) or more gas outlets.
   c. Provide distilled water, and compressed air to the lab casework as required. The distilled water piping shall be polypropylene rated for high purity systems (manufactured by Orion). Compressed air shall be galvanized steel Schedule 40.
   d. All new sanitary connections shall connect to the existing acid waste system. Piping shall be Durion, rated for acid waste.
   e. **Provide a domestic CW line to the AHU humidifier.**

FIRE PROTECTION

1. Second Floor/Third Floor - The existing renovated spaces shall be sprinklered in accordance to NFPA-13. Modify and extend existing piping as required to suit new layout. Metallic piping shall be used.

ELECTRICAL

The existing building is powered by a 750 kVA unit substation located in the Basement of the Woodland Building. The existing equipment is original (+/-1970). A newer electronic meter has been installed on the substation but is not operational. The peak demand of this substation is not known. **The meter can also provide power factor information. No power factor correction capacitors were observed.** Distribution to the area of renovation appears to be consistent to the as-built electrical drawings, with a few additional panels and transformers.

1. Second Floor
    a. Panel ‘LP22S’ (480/277 V, 3 ø, 4 W) is to remain.
    b. Panel ‘LP21S’ (208/120 V, 3 ø, 4 W) is to remain.
    c. Panel ‘LP21S-1’ (208/120 V, 3 ø, 4 W surface mount) is to be removed. Provide new recessed panel in similar location. Café circuits are to remain active during the construction period.
    d. Provide direct/indirect lighting in renovated labs and classrooms. Fixtures to utilize T8 lamps with electronic ballasts. Controls to meet ASHRAE 90.1 - 2007 requirements, i.e., multi-scene control **and vacancy detection.**
    e. Provide branch circuits to miscellaneous equipment from existing panelboards.
    f. Provide fire alarm horn/strobes where required by IBC and NFPA requirements.
    g. Provide emergency and standby power for lighting and receptacles as required by owner.
2. Third Floor
    a. Panel ‘LP32S’ (480/277 V, 3 ø, 4 W) is to retrofit for increased breaker space.
    b. Panel ‘LP31S’ (208/120 V, 3 ø, 4W) is to remain.
    c. Remove existing transformer and secondary enclosed circuit breaker. Remove surface mounted load center in existing lab.
    d. Provide 50 Amp 3P breaker in retrofit Panel ‘LP32S’ to feed relocated transformer (trapeze mounted in ceiling space). Provide new Panel ‘LP31S-1’ (125 Amp, Mains, MCB, 10K AIC, panelboard construction, recess mounted).
    e. Provide direct/indirect lighting in renovated labs and classrooms. Fixtures to utilize T8 lamps with electronic ballasts. Controls to meet ASHRAE 90.1 - 2007 requirements, i.e., multi-scene control **and vacancy detection**.
    f. Provide branch circuits to miscellaneous equipment from existing panelboards.
    g. Provide fire alarm horn/strobes where required by IBC and NFPA requirements.
    h. Provide emergency and standby power for lighting and receptacles as required by owner.
3. Basement
    a. Disconnect, remove and dispose of properly the existing 30 kW, **120/240V, 1 ø** natural gas generator, ATS and emergency panelboards.
    b. Provide new **80 kW, 208/120V, 3 ø** diesel generator with subbase fuel tank (8 hr.) Provide 100 A ATS (Life Safety replacement **for existing 150A 1 ø ATS**). Provide new replacement normal/emergency panel and emergency only panel. Provide new

200 Amp ATS **(for standby power)** and new standby power panel (**225** Amp mains, MCB, 10 k AIC, panelboard construction, surface mount, 30 space).

c. Alternate: Weatherproof sound attenuated generator housing.

4. Roof

a. Utilize existing 600 Amp space for a 400 Amp circuit breaker in the main 480V distribution panelboard for feeder to the rooftop HVAC equipment [(2) custom built energy recovery units, (2) exhaust fans and an optional condensing unit]. Provide 400 Amp panelboard in rooftop custom energy recovery unit enclosure or Third Floor space to be determined. Unit feeder as appropriate.

MW/BM:ec

cc: JM

X:\ARCHITECTS CLIENTS - ACTIVE\Nalls Architecture, Inc\Penn State Abington Chem Lab\2011 5-18 REVISED OFFICE MEMO to Richard Linsky .wpd

McHugh Engineering Associates, Inc.
Penn State Abington Chemistry Labs

4/13/2011

Room #	Name	Area (sqft)	Height (ft)	Quantities Based on AC		# Hoods	Quantities Based on Hoods		Unocc .Qty. Based on AC	
				AC	CFM		AC	CFM	AC	CFM
222	Laboratory	1355	8.5	6	1152	3	13	2400	2	384
222A	Prep Room	424	8.5	6	360	1	13	800	2	120
222B	Storage	471	8.5	6	400	0	0	0	2	133
224	Laboratory	1299	8.5	6	1104	3	13	2400	2	368
	Hood CFM	800			**3017**			**5600**		**1006**

Room #	Name	Area (sqft)	Height (ft)	Quantities Based on AC		# Hoods	Quantities Based on Hoods		Unocc. Qty. Based on AC	
				AC	CFM		AC	CFM	AC	CFM
305	Prep / Storage	440	8.5	6	374	1	13	800	2	125
306	Vestibule	126	8.5	6	107	0	0	0	2	36
307	Laboratory	1406	8.5	6	1195	12	48	9600	2	398
308	Lab 2	509	8.5	6	433	1	11	800	2	144
309	Lab 1	353	8.5	6	300	1	16	800	2	100
310	Flex Lab	339	8.5	6	288	1	17	800	2	96
311	Vestibule	122	8.5	6	104	0	0	0	2	35
312	Vestibule	120	8.5	6	102	0	0	0	2	34
	Hood CFM	800			**2903**			**12800**		**968**

Hood flow rates are estimated. The hoods will be 6'-0" long, 18" sash opening, 80 FPM to 100 FPM.

SECTION 15750 - ENERGY RECOVERY HEAT PIPES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Custom built air handling units shall be supplied to meet the performance requirements shown on the equipment plans and specifications. To comply with job site constraints and/or freight restrictions, the units shall be shipped, fully assembled, uni-base, ready for field installation. Shipping details shall be coordinated and included with submittal drawings.

B. Prior to shipping the units from the factory, the units shall be inspected by the consulting engineer, owner or a representative assigned by the owner.

C. The contractor shall be responsible for inspecting the units upon arrival at the job-site or riggers yard. Any deficiencies and/or freight damage shall be documented to the factory within 24 hrs. Rigging, installation, sealing of modules and field start-up work shall be executed by the mechanical contractor as outlined in the project specifications.

D. The manufacturer shall warranty the equipment, parts only, for a period of one year commencing at the date of unit start-up, up to a maximum of eighteen months from the date of shipment.

1.02 REFERENCES

A. The design and fabrication of the units shall be in accordance with the latest standards listed herewith:

1. AFBMA 9 — Load ratings and fatigue life for ball bearings
2. AMCA 203 — Field performance measurements
3. AMCA 210 — Laboratory methods of testing fans for rating purposes
4. AMCA 300 — Test code for sound rating air moving devices
5. AMCA 500 — Test methods for louvers, dampers and shutters
6. ARI 410 — Forced-circulation air cooling and air heating coils
7. ASHRAE — 62-89 ventilation for acceptable indoor air quality
8. ASTM A525 — Steel sheet, zinc coated by hot-dip process
9. ASTM E90-90

10. NEMA MG1 National electrical manufacturers association (Motors and generators)
11. NFPA 70 National fire protection code
12. NFPA 90A Installation of Air Conditioning and Ventilation Systems
13. OSHA Occupational safety and health administration
14. SMACNA HVAC metal duct association
15. UL 900 Underwriters laboratory, (test performance of air filters quality)

B. Drawings shown on project plans and specifications.
C. Equipment schedules shown on project plans and specifications.

1.03 QUALITY ASSURANCE

A. The following parameters define the selection criteria and are to be as specified: Airflow rates, external static pressures, water flow rates, electrical power supply. The following parameters are to be as specified or improved upon: Coil face velocity, filter velocities, internal static pressure losses, cabinet air leakage, electrical power consumption, discharge/inlet and radiated sound power levels.
B. The units shall be produced by a manufacturer whose design and processes are thoroughly documented and verifiable. The quality control program shall ensure the consistency of the product and the effectiveness of the production processes.
C. Components must be sourced from well recognized HVAC manufacturers whose products comply with their product-specific industry standards.
D. Air and sound performance of all air moving equipment shall conform to the AMCA standards and must bear the AMCA certification label.
E. Heating and cooling coil capacity ratings shall be certified in accordance with ARI standard 410. Heat transfer coils shall bear the ARI certification label.
F. Filter media shall be UL listed.

1.04 SUBMITTAL DRAWINGS

A. The unit manufacturer shall provide submittal drawings showing the arrangement of each unit, nominal dimensions, weight of each shipping module and complete technical data for all mechanical and electrical accessories provided with the HVAC units.

B. The drawings shall detail the cross-section of the floor, perimeter structure, panel assembly, sealing between panels and detailing of all components including the material and thickness of all cabinetry components.

C. Fan performance ratings shall have been based on tests and procedures performed in accordance with AMCA publication 211 and AMCA publication 311 and comply with the requirements of the AMCA Certified Ratings Program. The fan operation point shall be clearly indicated including the impact of any system effect factors. For reference purposes, a family of performance curves shall be included for each fan. Sound power levels shall be provided for the fan inlet and discharge at each octave band. Construction drawings for each fan shall be included with the submittal drawing file.

D. Heat transfer coils' selection data for each coil shall be included with the submittal drawing file. The selection must indicate all input & output values as well as the characteristics of the fluids. Construction drawings for each coil bank shall be included with the submittal drawing file.

E. A detailed description of the filters including their "dust spot" efficiency evaluated under ASHRAE standard 52.1-2007 Appendix J, UL class, initial and final pressure losses for each filter bank shall be provided with the submittal drawings.

F. The unit manufacturer shall provide technical data for all other equipment being part of the air handling system. The data shall include: Performance and capacity information; certified drawings, clearly showing the arrangements; electrical interfaces; and weight.

1.05 DELIVERY, STORAGE AND HANDLING

A. The units shall be thoroughly cleaned and inspected before applying a shrink wrapping protective cover. The plastic cover must completely enclose all shipping modules individually.

B. The units must be shipped completely assembled or in modules, as documented in the specifications or instructed by the contractor. The units and/or modules shall be equipped with adequately sized and removable lifting lugs for field rigging and handling.

C. The units must be handled carefully in the field to avoid damaging internal components, cabinet walls and the exterior finish.

D. Store the units in a dry, clean environment protected from the outdoor weather. Factory applied shrink wrap is intended to protect the units while in transit to the job site. The units must not be stored with the factory applied shrink wrap.

E. The units must not be operated, for temporary or permanent purposes, until the official start-up is completed by the mechanical contractor and witnesses by a manufacturer's representative.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. INGENIA Technologies Inc. custom air handling units.

B. The following manufacturers are approved to provide an equivalent product to the specified manufacturer: (EAS, BUFFALO AIR HANDLING, AIR ENTERPRISES)

2.02 PERFORMANCE

A. Provide factory fabricated custom air handling units having overall dimensions as shown on the construction plans. Physical dimensions and unit arrangement are critical for equipment layout and must be as shown on the plans.

B. Refer to the custom air handler schedules to determine the performance of all internal components: Fans, coils, filters, humidifiers, acoustical performance, etc.

C. The indicated total static pressure for each fan must be equal to the sum of the external static and the internal static, including all internal system effects.

D. The fan performance characteristics must be based on the actual elevation and operating temperature.

E. All deviations from the specification must be clearly indicated on the submittal drawings. The contractor shall be held responsible for all additional expenses associated with the substitution of the specified product.

2.03 CABINET DESIGN PRESSURE

A. The cabinet shall be designed to resist either the fan shut-off pressure or a maximum static of 10" w.g., the highest value shall be considered the maximum design static. The maximum panel deflection shall be 1/200 along the panel's length center-line. Air leakage shall not exceed ½ % of the total design air flow at the maximum design static pressure or the cfm allowed for by SMACNA leakage class 3. The greater leakage rate is the acceptable maximum leakage. Refer to the air leak test procedure.

2.04 CABINET CONSTRUCTION

A. UNIT BASE

1. The unit shall be constructed on a galvanized steel base. The base shall be designed to distribute loads properly to a suitable mounting surface and be braced to support internal components without sagging, pulsating or oil canning. The unit will be installed on Enclosed Galvanized steel curb. If the unit is installed on an enclosed roof curb, the unit perimeter frame shall overhang the roof curb by one (1) inch. Otherwise, the unit perimeter frame shall be designed without a (1) inch overhang.
2. The floor perimeter support structure of each air handling unit shall be built with galvanized steel HSS element. Framing members shall be joined with 3/8" tapered head machine bolts. Perimeter corner segments shall be joined with galvanized steel precision machined adjoining corners. All assembly hardware shall be consistent with the basic construction material type: Cadmium plated.
3. The base frame height shall be selected to meet the structural design load. The maximum base deflection shall not exceed 1/200.
4. To minimize thermal gains/losses through the perimeter channel supports, the perimeter frame shall be thermally isolated from the casing. The thermal barrier shall have an R value equal or better then 0.4 per inch.
5. To ensure sufficient height for field installed condensate P-traps, the minimum height of the perimeter channels shall be 5 inches.
6. Each shipping module shall be equipped with a minimum of four (4) removable lifting lugs. The maximum space between the lifting lugs shall be 6 feet.
7. To ensure sustained product life, all structural base components shall be made of galvanized steel material. Painted carbon steel components shall not be utilized unless they are baked powder coated or sand blasted and finished with a baked enamel coating.

The base components are powder coated, the process shall be the following:

I. Paint shall be applied in an electrostatic powder coating system. The electrostatic spraying shall be accomplished by applying an electrical charge to the dry powder particles while the component to be painted is electrically grounded. The charged powder and grounded workpiece create an electrostatic field that pulls the paint particles to the workpiece. The coating deposited on the workpiece retains its charge, which holds the powder to the workpiece. The coated workpiece is placed in a curing oven, where the paint particles are melted onto the surface and the charge is dissipated. The paint system shall be environmentally friendly, therefore eliminating the use of volatile organic compounds (VOC's), hazardous air pollutants (HAP's) and solvents. Individual panels must be painted prior to final assembly to ensure painting of all sheared metal edges and concealed surfaces. The paint coating shall resist 1000 hours to the standard ASTM-B117 salt spray test.

ii. The powder coating process shall include: Pre-washing; Rinsing; Re-washing; Rinsing cycle I; Rinsing cycle II; Oven dry @ 400 deg F; Electrostatic paint application (powder format); Baked finish @ 400 deg F.

B. FLOOR SURFACE – INSULATION – UNDERLINER

1. The internal, visible floor surfaces shall be Diamond plate, 0.125" thick, aluminum.
2. Floors shall be flat/non-drainable. All recessed drainable floors shall have catch basins with removable grates. The minimum size of the catch basins shall be 6" wide x 6" long x 2" deep. A female NPT fitting shall be welded to the catch basin and the threaded end designed to mate with the drain pipe extension.
3. The interstitial floor space shall be sprayed with a 2.5 inches layer of HEATLOKTM foam - Zero Ozone Depletion polyurethane foam. The thermal resistance shall be R-16.25. The panel assembly system shall have an overall thermal resistance equal to 12.0, as tested by an independent lab using the following procedure: ASTM C1363-05 Standard Test Method for Thermal Performance of Building Materials and Envelop Assemblies by means of a hot box apparatus.
4. The underside liners shall be G-90 galvanized steel.

5. All floor opening shall be equipped with a 1 ½” raised floor collar to prevent water migration into the floor opening. Air inlet and discharge openings shall be protected with G-90 galvanized steel flat bar grating.
6. To minimize thermal gains/losses through the floor system, the perimeter frame and all internal cross members shall be totally thermally isolated from the floor and cabinet. The NO-THROUGH-METAL barrier shall have an R value equal or better then 0.4 per inch.

C. UNIT CASING

1. All panels shall be double wall construction, load-bearing and capable of forming the enclosure without additional structural members. All panel joints shall be sealed to provide a permanent air-tight seal. Mullion spacing shall be regulated to eliminate panel pulsation and restrict the maximum deflection to 1/200 at the specified conditions.
2. Individual panels shall be made with two shells inter-connected to each other with High Density Polyethylene (HDPE) in order to ensure a complete NO-THROUGH-METAL assembly.
3. All inner and outer panels shall be galvanized steel.
4. All panels shall be a minimum 2.5" thick and be insulated with polyurethane foam having an R-value equal to 16.25. The panel assembly system shall have an overall thermal resistance equal to 12.0, as tested by an independent lab using the following procedure: ASTM C1363-05 Standard Test Method for Thermal Performance of Building Materials and Envelop Assemblies by means of a hot box apparatus. The foam insulation shall not contain any Zero Ozone Depletion Substance (Zero ODS) and shall be certified by the GREENGUARD environmental institute.
5. Adjacent panels shall be assembled to each other with bolted galvanized steel compression plates. The cabinet shall be air and water tight by individually sealing each panel joint with compressed rubber butyl membranes. The compression plates shall be mounted on the exterior of the units, the assembly bolts shall be exposed to the exterior of the unit. Self-tapping screws are not acceptable due to their inherent inability to maintain torque over the life of the product.
6. To prevent internal cabinet corrosion, all air-side panel joints shall include a SOLID VAPOR BARRIER thereby preventing moisture

migration into the wall space. The internal seal shall be resistant to pressure wash down cycles.

7. To provide a cleanable internal finish and ensure a long product life, all internal wall surfaces shall be painted with a glossy white baked on powder coating.
8. Horizontal retainer angles shall be installed on the interior of the unit at the bottom and top of the panelized system. The angles shall be galvanized steel and bolted with rivet-nut fasteners.
9. The cabinets' external panels shall be 18 gauge solid galvanized steel.
10. The cabinets' internal panels shall be 18 gauge solid galvanized steel.
11. The panel system shall have been tested by an independent certified laboratory using ASTM method Test for Sound Absorption of Acoustical Materials in Reverberation Rooms (ASTM Designation C423-1999), and sound transmission loss obtained using procedures conforming to ASTM designations E90-90, E 413-87.
12. To allow for water drainage form the roof surface, the roof panel system shall be sloped at least ¼" per foot. The roof weatherproofing system shall be independently constructed from the cabinet air seal. The interstitial space shall be vented through a soffit and louvered exhaust outlets. Multiple slopes are required for AHU's having widths larger then 128 inches. All doors shall have individual gutters.

D. ACCESS DOORS

1. Access doors shall be provided as shown on plans. Generally on the side with access to the mechanical drive and piping side of the air handling unit. All access doors exposed to the weather shall have rain gutters to prevent water from running down on the door framing system.
2. Door panels shall be made with two shells inter-connected to each other with High Density Polyethylene (HDPE) in order to ensure a complete NO-THROUGH-METAL assembly.
3. The door panels shall be double wall. To prevent air leakage and provide a rigid design, the external skin shall include all the forming segments of the double gasket base support. The door frame shall be made of a dual heavy gauge galvanized steel and shall be bolted to the cabinet wall panels. To reduce conductivity through the door framing system, the door frames shall have a complete

NO-THROUGH-METAL break consistent with the rest of the cabinet.

4. Each access door shall be equipped with at least two stainless steel hinges and two latches which shall be operable from the inside and outside of the unit. The handles shall be easy to operate and be made of fiberglass reinforced with nylon.
5. The air seal between the door and its frame shall be accomplished with dual neoprene bulb gaskets. The gaskets shall be bonded with a high quality adhesive agent. The dual gasket system is designed to provide two points of a contact providing a high level of thermal resistance. The gaskets shall be continuous with single bonded joints. Single bulb gasket doors shall not be acceptable due to their insufficient thermal resistance and high air leakage.
6. Access door sizes and orientation shall be as indicate on drawings. Doors shall open against pressure; positive-open in, negative-open out.
7. Each door shall include double pane thermal glass window, a minimum of 10 inches x 10 inches, installed at eye level and properly sealed to operate safely against suction or pressure conditions.
8. All access doors shall have built-in static pressure ports for ease of reading static pressure across internal components and limit unnecessary or unauthorized access inside the unit. Pressure test ports shall be Durodyne, type IP2.

E. ACCESS PANELS

1. In order to facilitate maintenance and avoid compromising the structural integrity of the unit, major equipment must be easily removable through side access doors or removable access panels.
2. Access panels shall be provided on the connection side of the heat transfer coil sections to extract the coils for replacement purposes. The access panels shall have the same thickness as the nominal cabinet wall thickness. The access panels shall be sealed to the cabinet with butyl polymer membranes and bolted to high strength compression fittings for the ease of removal.
3. Access panels shall include a NO-THROUGH-METAL break between the inner and outer surfaces, consistent with the wall construction of the unit.
4. Access panels shall be bolted to inserts located within the periphery of the wall opening. The air seal shall be accomplished with rubber butyl membranes and compression plates. Access panels secured to

the wall cabinet by means of self-tapping screws shall not be acceptable.

F. COOLING COIL SECTION

1. Drain pans shall be made of 16 ga. 304 stainless steel, to ensure positive water flow their surfaces shall be multi-sloped and have a depth of 2" for 5 and 6 inch base heights. Floor drain diameters shall be 1 1/4" diameter for 5 and 6 inch base heights. In all cases, the material shall be schedule 40-pipe 304-stainless steel, MPT both ends. The drain extensions shall be securely fastened to a female adaptor welded to the catch basin underneath the drain hub. The drain connection shall be accessible from the exterior of the unit casing.
2. Stacked cooling coils shall have independent multi-sloped drain pans. Secondary “gutter” drain pans shall not be acceptable. The secondary drain pan racking system shall be made entirely of 304-stainless steel.
3. Units up to 30,000 cfm and with secondary drain pans shall have 1” PVC downspouts to drain condensate into the main condensate pan. Units larger then 30,000 cfm shall have independent drain connections extended outside the cabinet. Drain material shall be as indicated under paragraph # 1. Each drain connection requires an independent external P-trap, provided and installed by others.
4. The cooling coil racking system must be designed to allow for the individual removal of multi-stacked or side-by-side coils. Stacked cooling coils shall have independent accessible panels. Therefore, providing the ability to remove individual stacked coils.
5. The interior panels of the cooling coil and humidifier sections shall be solid 304-stainless steel, its thickness and finish shall be consistent with the air handler cabinet.

G. PIPING CONNECTIONS

1. All coil piping connections must be extended to the exterior of the cabinet through neoprene rubber seals. Cooling coils must have double seals and heating coils single exterior seals.
2. Direct expansion coil distributors are to be located inside the coil section downstream of the coils and be turned upward. Refrigerant vapor suction connections are to be extended to the exterior wall access panels.
3. Single horizontal coil units must have all coil connections on the access door side, unless otherwise specified. Double horizontal coil

units must have coil connections on both sides, unless otherwise specified.

H. EQUIPMENT BLANK-OFFS

1. Forced convergence of air streams towards the core area of internal equipment shall be accomplished with blank-off plates. Typical equipment requiring blank-offs are: Coil banks, filters, dampers, etc. The blank-offs must be securely fastened to the internal side walls and adjacent internal equipment. The blank off material shall be as specified under the specific modular segment.

I. FAN SECTIONS

1. Fan and motor assemblies shall be mounted on welded and powder coated integral bases. The entire assembly shall be supported by 2" deflection seismic isolators. The isolators shall be selected to provide an isolation efficiency equal to 95% or better.
2. DWDI fans shall be centered in the cabinet to optimize aerodynamic performance of the airflow into the fan. The minimum distance between the DWDI fan inlet and the inside surface of the cabinet shall be at least 0.65 times the wheel diameter. In order to facilitate maintenance access and airflow clearance between the fan scroll and the upstream section, motors shall be positioned in a W-Z arrangement.
3. To obtain optimum aerodynamic performance, plenum fans shall be centered in the cabinet. To minimize pressure losses due to internal system effects, the minimum distance from the tip of the wheel to the inside surface of the cabinet shall be at least ½ of the wheel diameter. To prevent injuries, access doors shall open against the positive pressure, therefore towards the inside of the fan section. Motor position relative to the fan shaft shall be X-Y and opposite the access door.
4. Medium and high static pressure fans shall be equipped with horizontal thrust limiting restraints to ensure stable operation and also prevent the flexible connecting canvas from tearing.

J. AUXILIARY FLOOR DRAIN PANS

1. Provide Multi-sloped recessed floors with auxiliary threaded pipe drain connections in the air handler floor sections as indicated on the plans. The connection material shall be the same as the internal section floor surface. The drain pipes must be welded to catch basins equipped with removable gratings.

K. MODULAR ASSEMBLY

1. Modular connections shall be the same as panel connections. To minimize field labor, rivet-nut inserts shall be installed at the factory for easy field bolting. Butyl gasket/membrane shall be provided for field installation on the exterior adjoining modules. Cadmium plated bolts shall be provided and field installed around the full perimeter of the connection joint. All modular connections shall be joined at the factory to verify alignment before shipping.

L. ACOUSTICAL PERFORMANCE
1. The acoustical performance of the cabinet panel system shall have been tested by a certified independent acoustical laboratory.
2. The acoustical procedural methods to establish the transmission loss of the panels shall comply with the standards ASTM, E90 and C413.
3. The acoustical procedural methods to establish the absorption coefficients of the panel systems with perforated liners shall comply with the standards ASTM, E795 and C423.
4. The independent laboratory test report shall be submitted to the consulting engineer upon request.

M. INTERIOR AND/OR EXTERIOR POWDER COATING FINISH
1. The exterior surfaces of the air handler shall be powder coated.
   I. The powder coating process shall include: Pre-washing; Rinsing; Re-washing; Rinsing cycle I; Rinsing cycle II; Oven dry @ 400 deg F; Electrostatic paint application (powder format); Baked finish @ 400 deg F. Paint shall be applied in an electrostatic powder coating system. The electrostatic spraying shall be accomplished by applying an electrical charge to the dry powder particles while the component to be painted is electrically grounded. The charged powder and grounded workpiece create an electrostatic field that pulls the paint particles to the workpiece. The coating deposited on the workpiece retains its charge, which holds the powder to the workpiece. The coated workpiece is placed in a curing oven, where the paint particles are melted onto the surface and the charge is dissipated. The paint system shall be environmentally friendly, therefore eliminating the use of volatile organic compounds (VOC's), hazardous air pollutants (HAP's) and solvents. Individual panels must be painted prior to final assembly to ensure painting of all sheared metal edges and concealed surfaces. The paint coating shall resist 1000

hours to the standard ASTM-B117 salt spray test.

2.05 CENTRIFUGAL FANS

A. All fans, single or double width, with or without fan scrolls, shall have backwards incline plenum fan type wheels with diameters corresponding to the fan schedules.
B. The fan diameters and the impeller surface areas shall have been determined and tested according to AMCA® standards.
C. The fan construction shall be in accordance with the class required or specified in the project fan schedule. Fan shafts shall be sized so that the first critical rotational speed is at least 125% of the maximum operating rotational speed for classes I and II, and at least 142% of the maximum rotational speed for classes III and IV.
D. The manufacturer shall certify the sound power level ratings in the eight octave bands. Sound power levels shall be in decibels referenced to 10-12 watts.
E. All fans shall be certified to bear the AMCA® rating seal for air and sound, according to standards 211 and 311.
F. The bearings shall be designed for continuous intensive operation and shall be rated for a (minimum L-10) life (200,000) hours at the maximum speed for its class. The bearings shall be equipped with easily accessible extended lubrication lines to the exterior of the cabinet.
G. The fans shall have been statically and dynamically balanced by the fan manufacturer. An IRD or PMC analyzer shall have been used to measure velocity, the final balanced reading shall not exceed 0.1 inches/second.
H. Fan inlets shall be equipped with removable fan inlet grilles, designed according to OSHA standards.
I. Plenum fan shall have a protective and removable wheel enclosure designed according to OSHA standards.
J. Blow through systems shall include a perforated diffuser plate installed on the septum wall downstream of the fan section to uniformly distribute the air across the face of the component downstream of the fan.
K. The fans shall be manufactured by Twin City Fan, Loren Cook or an approved equivalent.

2.06 MOTORS AND MECHANICAL DRIVES

A. Motors shall be ODP type in accordance with the project specifications. Their efficiency must be in accordance with NEMA Premium Design B.
B. Motors shall be selected for operation with (480 Volts, 60 Hz, 3 phases) power supply.
C. The motors shall be inverter duty and shall conform to the NEMA standard MG-1, section 31. **Provide shaft grounding rings.**
D. Fan motors shall be mounted within the fan section casing on slide bases equipped with dual adjusting screws. The motor mounting bases shall be installed in such a way to ensure proper shafts' alignment.
E. Pullies shall be constant pitch.
F. Pullies and belts shall have been selected with a safety factor of at least 120% of the nominal horse power indicated on the motor nameplate.
G. Mechanical drive systems for motors 5 HP and higher shall be equipped with a minimum of two (2) belts.
H. Mechanical drives shall be protected with belt guards manufactured according to OSHA standards. The belt guards shall include openings facing the fan and motor shafts to allow for tachometer readings.

2.07 HEAT TRANSFER COILS

A. Each coil shall have been air pressure tested up to 250 psig and shall be designed for continuous operation at 200 psig and 220°F.
B. Water or glycol coils shall have Cu-Ni headers and Cu-Ni threaded connections. Drain and vent connections shall be incorporated into the header and extended to the exterior of the casing.
C. COOLING COILS
    1. The coil frame material shall be stainless steel.
    2. The tubes shall be **copper** with a nominal diameter of 5/8" and **0.025''** thick wall**.**
    3. Heat transfer fins shall be aluminum and shall have a nominal thickness of 0.075''.
D. HEATING COILS
    1. The coil frame material shall be galvanized steel.

2. The tubes shall be **copper** with a nominal diameter of 5/8" and **0.025''** thick wall.
3. Heat transfer fins shall be aluminum and shall have a nominal thickness of 0.075''.

E. HEAT PIPES

1. Air-to-air Energy Recovery Heat Pipes to be supplied by HPT to exchange heat/cooling between two air streams for summer and winter operation without changing the physical attitude of the Heat Pipe to accommodate both summer or winter operation. The Heat Pipes shall be inside and integral to the equipment cabinet or located in the duct work in a horizontal plane. Any deviation from the specifications must be approved by the engineer no less than ten days prior to the project bid date. No consideration of alternates will be given after that time.
2. The tubes shall be copper, of specific design for Heat Pipe application, permanently expanded onto the fin collar to form a firm, rigid, and complete pressure contact at all operating conditions. Aluminum tubes will not be allowed.
3. The fin surface shall be continuous plate type aluminum of specific design to produce maximum heat transfer effectiveness for Heat Pipe applications. Airside pressure loss shall be as given on the schedule or otherwise specified. Fin density and the number of rows of tubes shall be as specified. The Heat Pipe modules shall have an optional corrosion resistant coating.
4. Heat transfer fluid shall be selected on the basis of operating temperature and compatibility with tube material and shall be classified as Safety Group A1 in ASHRAE Standard 34-1992.
5. Heat Pipe capacities, entering and leaving dry and wet bulb temperatures and face velocity shall be as specified.
6. The frames and mounting structure shall be minimum 20 gauge galvanized steel. The supply and exhaust air streams shall be isolated from each other by a foam filled double separating partition. Cross contamination between the air streams is not acceptable.
7. Heat Pipe interconnecting piping and circuitry shall be as specified by HPT design. Each circuit shall be individually processed, charged, and hermetically sealed.

8. The entire heat pipe and fins shall be electro-fin coated.

2.08 FILTERS

A. Filter types, efficiencies and quantities shall be provided according to the project specifications. In order to minimize filter inventory, the only pre-filter and final filter dimensions acceptable to the owner are 12” x 24” and 24” x 24”.

B. Filters and pre-filters shall be front loading whenever an accessible section is available upstream of the filter section. The filter frames shall be 16 gauge galvanized steel and shall include sealing gaskets and holding clips.

C. The filters and pre-filters shall be side loading whenever an accessible section is not available upstream of the filter section. The filter slide tracks shall be fabricated with aluminum profiles. The filter side access doors shall be constructed with same features, including the thickness of the door, as the HVAC unit.

D. Supply and factory install, for each filter bank, pressure differential manometers manufactured by Dwyer under the brand name Magnahelic Series 2000.

E. CARTRIDGE PRE-FILTERS
1. Pre-filters shall have a minimum efficiency rating of at least (MERV-8).
2. Pre-filters shall be 4’’ deep.
3. The cartridges shall be disposable and shall be fabricated of reinforced synthetic fibers bonded to a resistant water resistant and incombustible carton frame.
4. Pre-filters shall be manufactured according to the standards established by UL class II. Minimum efficiency shall meet the ASHRAE 52.1-2007 standard appendix J.
5. Acceptable products: AAF or approved equivalent.

F. SECONDARY FILTERS
1. The filters shall have a minimum efficiency rating of 85%.
3. The filters shall be 6’’ deep.
4. The cartridges shall be disposable and shall consist of reinforced synthetic fibers mounted in a galvanized steel frame system.
5. Pre-filters shall be manufactured according to the standards established by UL class II. Minimum efficiency shall meet the ASHRAE 52.1-2007 standard appendix J.
6. Acceptable products: AAF or approved equivalent.

G. The unit manufacturer shall supply and install all filters at the time of shipment. The unit manufacturer shall supply one additional set.
H. Filter shall be AAF or approved equivalent.
I. The unit manufacturer shall supply and install all filters at the time of shipment. The unit manufacturer shall supply one additional set.
J. Filter shall be AFF or approved equivalent.

2.09 MULTI-BLADE DAMPERS

A. Mixing boxes and economizers shall be equipped with parallel blade dampers. The damper blades shall be positioned to orient the air streams against each other to promote air mixing within the section.
B. The dampers' maximum air leakage rate shall be certified by AMCA standard 511.
C. The damper frames shall consist of pre-fabricated aluminum extrusions.
D. The damper blades shall be airfoil type, double wall and be made of aluminum extrusions.
E. Air seal gaskets shall be made of synthetic rubber type TPE and EPDM.
F. All drive shafts shall be located out of the air stream and it shall be possible to install the actuators inside the cabinet without interference to the air flow.
G. Outside air, exhaust and isolation dampers shall be thermally insulated dampers manufactured by Tamco series (9000).
H. Recirculation and zone dampers shall be manufactured by Tamco series (1000).

2.10 AIR MIXERS

A. As shown on the plans, provide air mixers to reduce air stratification downstream of the mixer sections.
B. The air mixers shall be manufactured by a well established manufacturer who has thoroughly tested and documented performance information data.
C. The air mixer blades shall be fixed and made of heavy gauge aluminum.
D. Air mixers shall be Blender Products or approved equivalent. The air mixers shall be installed in the unit according to the manufacturer's recommendations.

2.11 FACE AND BYPASS DAMPER

A. The bypass damper shall bypass air around the supply side of the Energy Recovery Heat Pipe for freeze protection. Damper shall be of low leakage design.
B. Blades and frames shall be made of roll formed galvanized steel, minimum 16 gauge. Frames shall be constructed with hat shaped channels, reinforced, or with welded corners.
C. Axles shall be plated steel. Dampers shall be incorporated with face linkage or concealed linkage in the frame to interconnect all the blades.
D. The damper shall be equipped with a modulating motorized actuator package. The motor shall operate on ? 24 VAC Hz with a minimum torque of 133 in-lb. Actuator motion shall be modulated by a 2 to 10 VDC proportional output from an adjustable proportional temperature control responding to a temperature sensor in the exhaust leaving air stream. Actuator shall be mounted internal to the airstream.

2.12 ELECTRICAL

A. Fluorescent fixtures: Light fixtures shall be “EMERGI-LITE” IPETM series IP65Surface mounting vapor-tight, 1.2 m (4’) long fixture with two 32 watt lamps (T8), rapid start high efficiency electronic ballasts, CSA certified. The body and lens shall be constructed of UV stabilized industrial grade vandal resistant polycarbonate. A durable formed gasket shall be provided between the enclosure and the lens and shall be designed specifically for hostile environments. The reflector shall be made of highly specular material and formed to maximize light output efficiency. All parts shall be corrosion resistant. A metal plate used to retain the ballast and reflector also serves to dissipate heat, therefore lengthening ballast life.
B. Switches: Hubbell RC109W, CSA certified, 15 amps, 120 volt AC. Single pole Switch, illuminated pilot light, self grounding, side wire termination. Unless otherwise shown or specified, connect all air handling unit lighting fixtures to one switch. Junction box shall be “THOMAS & BETTS” universal FSU – 2 3/8” deep, cast aluminum and supplied with close-up plugs. Cover plate shall be made of stamped aluminum.
C. GFCI Receptacles: Hubbell GF15WL, duplex, CSA certified, heavy duty, white, 15 Amps, 125 volt AC. Two poles, 3 wires, flashing red LED signals loss of GFCI protection, steady on red LED signals ground fault condition. Back and side wire terminations accept up to #10 AWG wire.
D. Factory Scope of Work: **Two** point power connection with a 120 V for GFCI receptacles and A 480 Volt disconnect for all other components.

E. Wiring and Conduit: The unit wiring shall be stranded copper wire sheathed in a THHN covering, which will be distributed through the unit in EMT conduit; the use of aluminum wire or BX cable is prohibited. To allow for adjustment of fan motors, a 3'-0" section of weatherproof flex connect shall be provided at each motor. A separate ground wire for each motor shall be connected to a terminal in the disconnect switch. In addition to the requirements herein, wiring shall comply with NEC requirements. Inter-modular wiring shall terminate in a coiled configuration at the end of each module. The contractor shall pull the cables through the modules to complete the system wiring.

F. Control Conduit: Provide two (2) 1-1/4" conduit raceways along the entire length of each unit with junction boxes in each compartment section, to allow for routing of automatic temperature control wiring and tubing through the unit.

2.13 FACTORY AIR LEAKAGE TESTING

A. Unit is to be factory tested in the manufacturer's facility after assembly and prior to shipment. Prior to testing, the manufacturer shall submit a detailed test plan including facility and test equipment qualifications to the Engineer for review. Provide two weeks advance notice of testing to Engineer and Owner. Engineer and Owner reserve the right to witness testing and/or bring in an independent testing agency to verify factory testing results.

B. The cabinet shall be designed to resist either the fan shut-off pressure or a maximum static of 10" w.g. for 2.5" wall panel cabinet the highest value shall be considered the maximum design static. The maximum panel deflection shall be 1/200 along the panel's length center-line. Air leakage shall not exceed ½ % of the total design air flow at the maximum design static pressure or the cfm allowed for by SMACNA leakage class 3. The greater leakage rate is the acceptable maximum leakage.

C. Test Procedure: Seal intake and discharge duct openings in the air handling unit and connect to an external fan capable of developing the necessary positive or negative static pressure. The CFM of this fan is to be read using an approved air flow measuring device. The fan CFM is to be considered the casing leakage.

END OF SECTION

SECTION 15821 - COATED STEEL BELT-DRIVE HIGH PLUME DILUTION FANS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. High-Plume Dilution Laboratory Exhaust Fans

1.02 RELATED WORK

A. All sections, drawing plans, specifications and contract documents.

1.03 REFERENCES

A. AMCA -99 Standards Handbook.
B. AMCA 210-99 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
C. AMCA 211-05 - Ratings Program - Product Rating Manual for Fan Air Performance.
D. AMCA 300-05 - Reverberant Room Method for Sound Testing of Fans.
E. AMCA 311-05 - Certified Ratings Program.
F. AFMBA - Method of Evaluating Load Ratings of Bearings (ASA - B3.11).
G. AMCA 204-05 - Balance Quality and Vibration Levels for Fans.
H. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
I. SMACNA - Medium Pressure Plenum Construction Standard.
J. ANSI Z9.5 - Laboratory Design.
K. ASHRAE - Laboratory Design Guide.

1.04 QUALITY ASSURANCE

A. Fans shall be tested in accordance with AMCA Standards 210 and 300, and performance ratings shall be submitted in conformance to AMCA Publications 211 and 311. Fans must be Licensed to bear the AMCA Certified Ratings Seal for Air and Sound Performance. Acceptable manufacturers whose equipment is not licensed to bear the AMCA Certified Ratings Seal for Air and Sound Performance must submit air and sound performance tests conducted in accordance with AMCA Standards 210 and 300, in a registered AMCA test facility, and certified for accuracy (stamped) by a registered professional engineer.

B. Classification for Spark Resistant Construction Conform to AMCA 99.

C. All fans prior to shipment shall be completely assembled and test run as a unit at the specified operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204 “Balance Quality and Vibration Levels for Fans” to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained and a written copy shall be available upon request.

1.05 SUBMITTALS

A. Provide dimensional drawings and product data on each high-plume dilution laboratory exhaust fan assembly.

B. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted.

C. Provide nozzle velocity of exhaust fan, total exhaust flow, and discharge plume height at specified wind velocity.

D. Strictly adhere to QUALITY ASSURANCE requirements of AMCA CERTIFICATION, as stated in section 1.04.A of this specification, and provide QC certificate as stated in section 1.04.C of this specification.

PART 2 - PRODUCTS

2.01 GENERAL

A. Base fan performance at standard conditions (density 0.075 Lb/ft3).

B. Each fan shall be belt driven in AMCA arrangement 1, 9 or 10 according to drawings.

C. Fans to be equipped with lifting lugs.

D. Fasteners to be 304 stainless steel.

2.02 CORROSION RESISTANT COATING

A. All fan and plenum components shall be corrosion resistant coated with a two part electrostatically applied, baked, corrosion resistant, Plastifer™ Polyester powder coating system. Standard finish color to be M.K. Plastics light gray.
B. All steel surfaces shall be cleaned and prepared using a multi-stage process that includes phosphate washing to increase corrosion resistance, surface area and improve paint adhesion.
C. Coatings shall consist of a 70% zinc rich polyester primer and a polyester powder resin top coat that shall be electrostatically applied and cured. Final coating thickness shall be a minimum 4-6 mil for superior corrosion resistance, and shall include UV inhibitors to prevent chalking from sunlight.
D. Note that fan housings that have 8-10 mil thick liquid coating are more subject to running or sagging, manually applied have a non-uniform coverage over the surface, final finish is less durable and is environmentally unfriendly due to the emission of volatile organic compounds (solvents).

2.03 FAN HOUSING AND OUTLET

A. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
B. Fan housing shall be of heavy gauge, continuously welded construction. Housings with lock seams or partially welded construction are not acceptable. Housings shall be suitably braced to prevent vibra¬tion or pulsation. Housings shall have spun, aerodynamically designed inlet cones or inlet venturies for smooth airflow into the wheels.
C. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before coating. Refer to specification section 2.02 for corrosion resistant coating.
D. A bifurcated fiberglass reinforced plastic (FRP) discharge nozzle shall be supplied by the fan manufacturer and be designed to efficiently handle an outlet velocity of up to 7,000 FPM. The discharge shall include a venturi and fiberglass wind band to induce ambient air up to 270% of fan capacity. All fiberglass parts shall include UV inhibitors in the resins to prevent chalking from the sunlight.
E. Fan assembly shall be either AMCA type C or AMCA type B spark resistant construction, when noted on the schedule.

F. Provide housing drain attached at the lowest point for condensation and rainwater removal.

G. A bolted access door shall be supplied for impeller inspection and service.

2.04 FAN IMPELLER

A. Sizes 2450 and smaller shall have airfoil-shaped, backward curved extruded aluminum blades. Sizes 3000 and larger shall have die-formed airfoil, backward curved steel blades with the option of extruded aluminum blades. All hollow blade wheels shall be continuously welded around all edges. All wheels shall be statically and dynamically balanced on precision electronic balancers to a Balance Quality Grade G6.3 per ANSI/AMCA 204 or better.

B. Fan impeller shall be coated with a minimum of 4-6 mil electrostatically applied baked polyester powder coating. Refer to specification section 2.02 for corrosion resistant coating.

2.05 FAN INLET ELBOW/PLENUM

A. For variable volume systems, an inlet elbow/plenum shall be provided as shown on drawings. The elbow/plenum shall be equipped with a bypass air damper(s) and fiberglass reinforced plastic (FRP) weather cowl and birdscreen, for introducing outside air at roof level upstream of the fan. The plenum shall be constructed of galvanealed steel, comply with specification section 2.02 for corrosion resistant coating and be mounted on an insulated curb. An optional combination integral fan platform plenum curb shall be provided by the fan manufacturer, if shown on the project drawings.

B. Inlet elbow/plenum to be attached to the fan inlet by a flexible FPVC connector, provided by the fan manufacturer.

C. Bypass air damper(s) shall be opposed-blade, airfoil design, extruded aluminum with a clear anodized finish (salt water resistance), with linkage hardware installed in the side frame. All aluminum linkage hardware parts shall be clear anodized and all non-aluminum linkage hardware parts shall be type 316 stainless steel. Dampers shall be suitable for applications up to 10 inches wg. in extruded aluminum. For higher pressures up to 20” wg., the damper blades and frame shall be heavy duty H.R. steel and polyester coated. Each bypass damper shall be housed inside a fiberglass reinforced plastic (FRP) weather cowl and birdscreen, to prevent the possibility of rainwater entrainment.

D. Fan isolation damper(s) shall be parallel-blade, airfoil design, extruded aluminum with a clear anodized finish (salt water resistance), with linkage hardware installed in the side frame. All aluminum linkage hardware parts shall be clear anodized and all non-aluminum linkage hardware parts shall be type 316 stainless steel. Dampers shall be suitable for applications up to 10 inches wg. in extruded aluminum. For higher pressures up to 20" wg., the damper blades and frame shall be heavy duty H.R. steel and polyester coated. Each isolation damper shall be housed inside a fiberglass reinforced plastic (FRP) damper enclosure, bolted to the bypass air plenum with a round slip connection at one end for fan inlet attachment.

E. All dampers shall have an extended control shaft for electronic or manual control actuation.

2.06 FAN MOTORS AND DRIVE

A. Motors to be premium efficiency, standard NEMA frame, 1800 RPM, TEFC with a 1.15 service factor. A factory mounted NEMA 3R or 4X disconnect switch shall be provided for each fan. Motor maintenance shall be accomplished without fan impeller removal or requiring maintenance personnel to access the contaminated exhaust components.

B. Fans submitted that use 900 RPM, 1800 RPM, or C-Face motors, shall include one spare motor per fan system, in accordance with ANSI Z9.5, section 4.14.7.4, CRITICAL SERVICE SPARES.

C. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.

D. Motor sheaves shall be cast iron, variable pitch on applications 5 HP and smaller, and fixed pitch on 7.5 HP and larger.

E. Shaft to be ANSI C-1045 steel, and shall be coated with a black asphalt protectant.

F. Bearings shall be heavy duty, grease lubricated, spherical roller or adapter mounted anti-friction ball, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-10) in excess of 200,000 hours at the maximum fan RPM.

G. All shaft bearings and non-permanently lubricated motors shall have extended lube lines with zerk fittings.

H. Motor shall include shaft grounding ring.

PART 3 - INSTALLATION

A. Install fans as indicated on the contract drawings.
B. Install FPVC flexible connections with stainless steel straps, provided by the fan manufacturer, between fan inlet and bypass plenum. Insure that the flexible connection is at least 6 inches wide.
C. Pipe housing drain to the nearest drain.
D. Fans shall be mounted on seismically restrained spring vibration isolators, provided by the fan manufacturer, selected based on fan size, loading conditions and deflection requirements per the fan schedule and specification.
E. Install fans in accordance with manufacturers instructions, applicable specification and code requirements.

PART 4 - ACCEPTABLE MANUFACTURERS

A. M. K. Plastics Corporation, model Axijet-S Belt-Drive High Plume Dilution Fan.
B. Approved equal.

END OF SECTION

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Drawings

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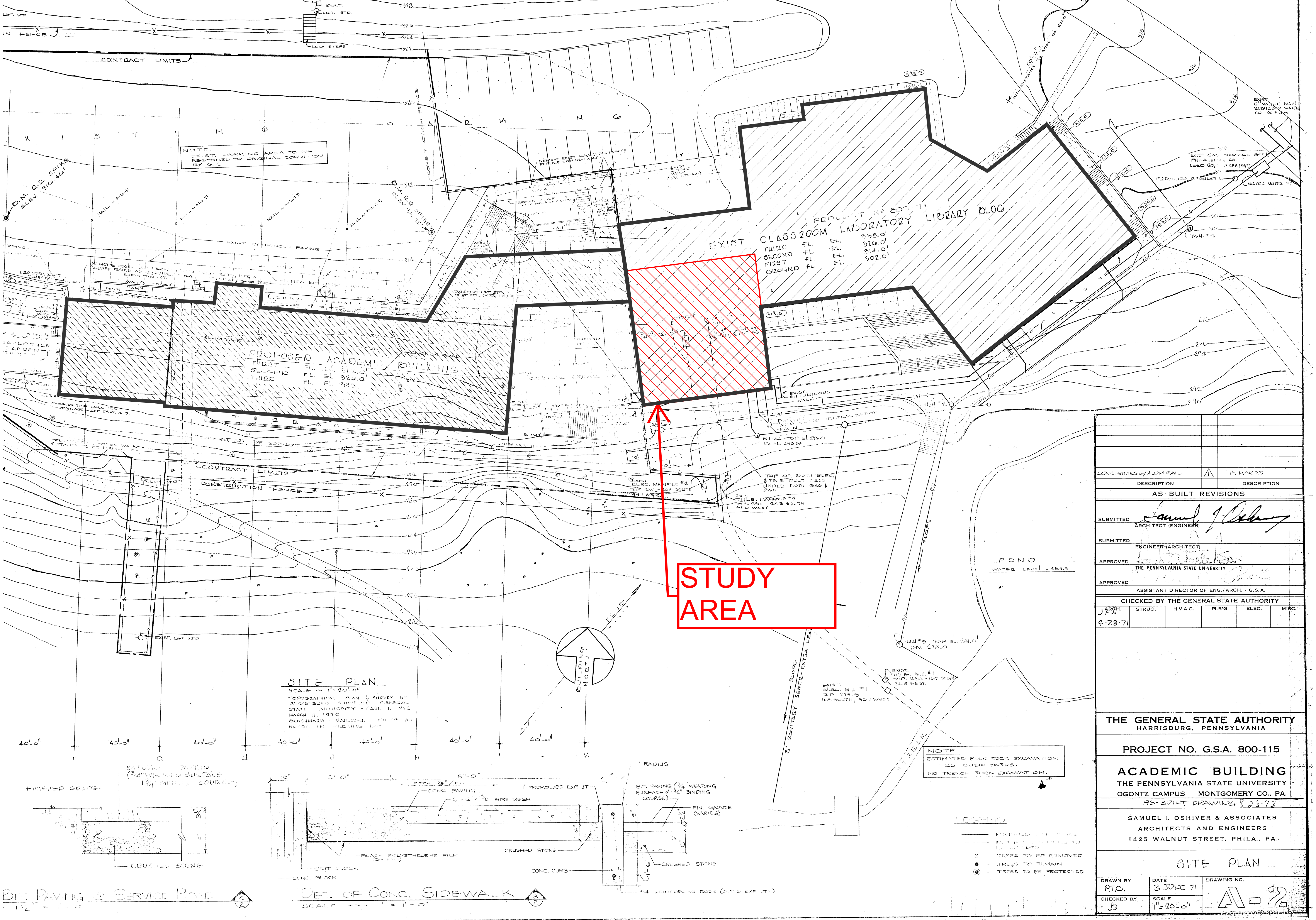
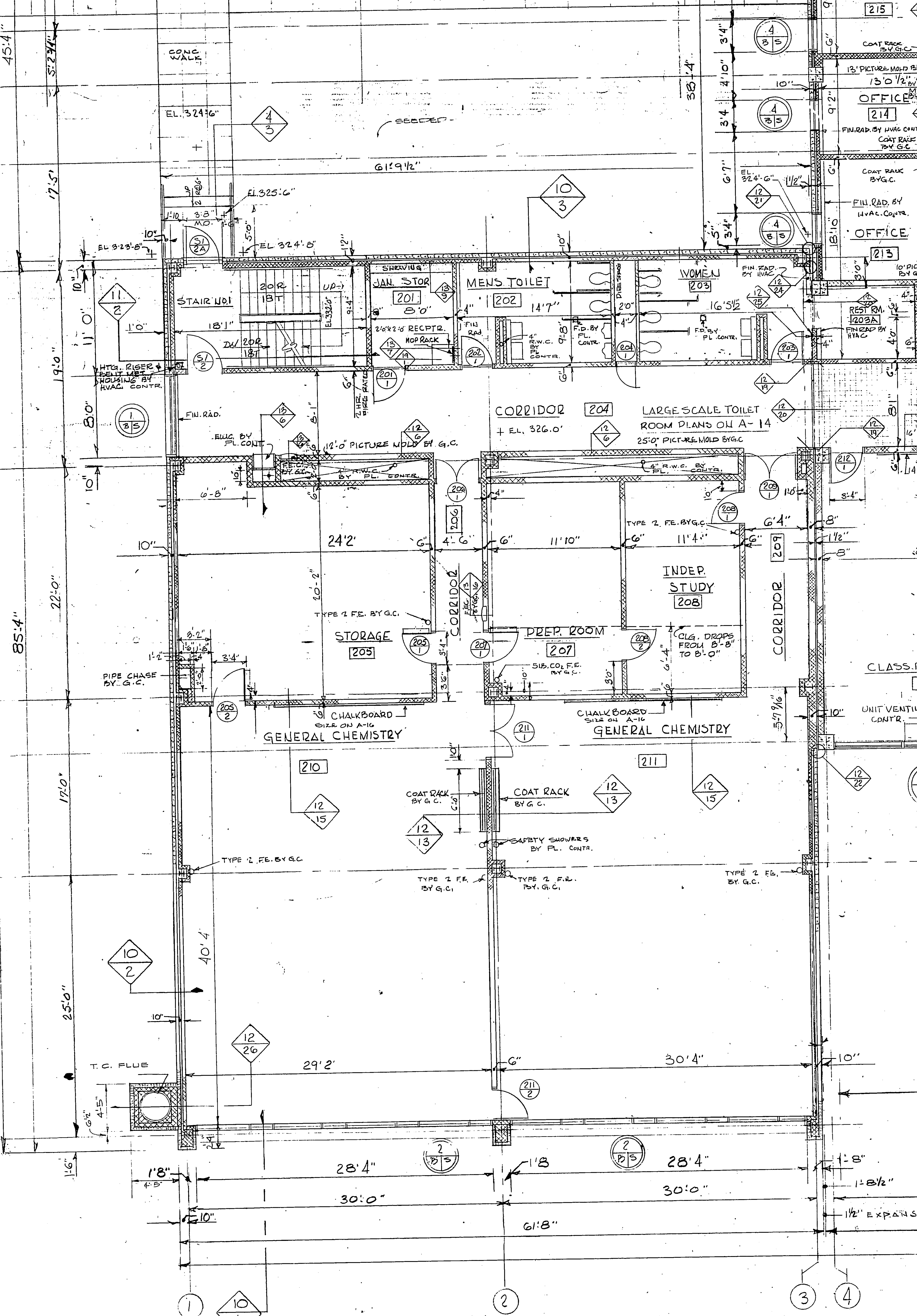
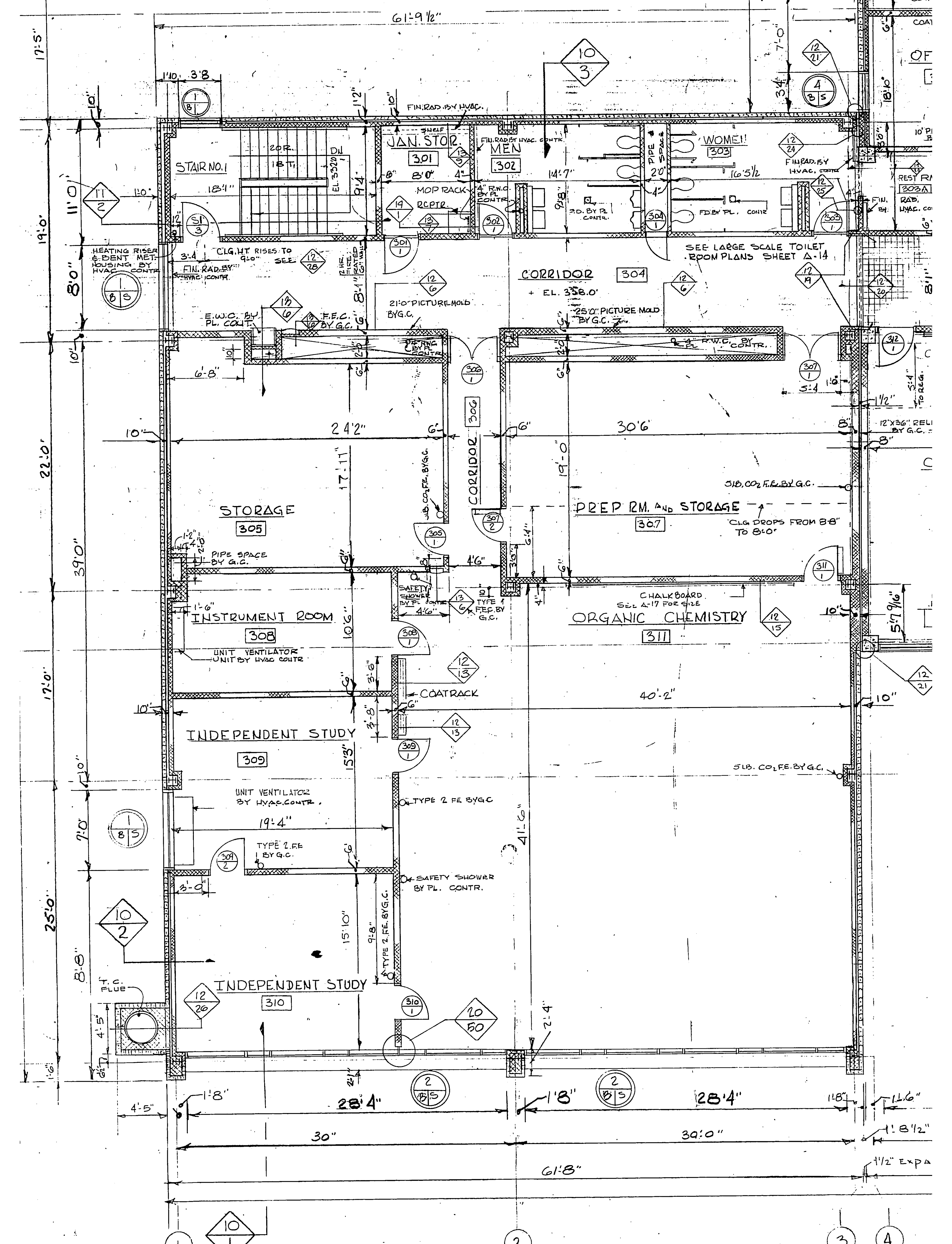
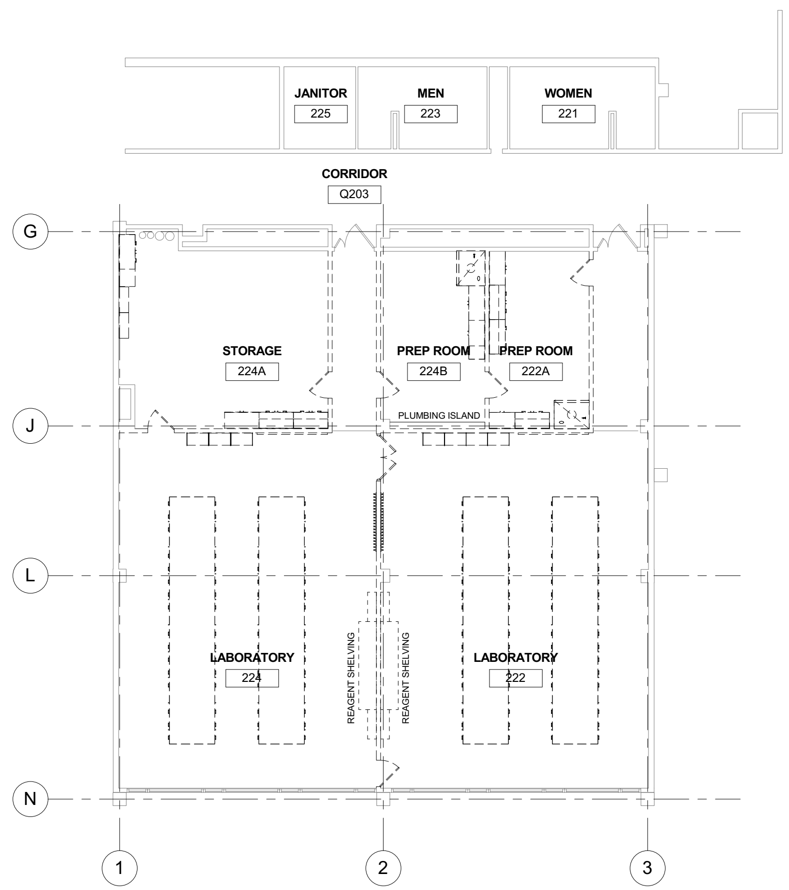

STUDY AREA
CONTRACT LIMITS
CONSTRUCTION FENCE
PROPOSED ACADEMIC BUILDING
EXIST CLASSROOM LABORATORY LIBRARY BLDG
POND
SITE PLAN
SCALE ~ 1" = 20'-0"
DET. OF CONC. SIDEWALK
BIT. PAVING @ SERVICE RD.
NOTE
ESTIMATED BULK ROCK EXCAVATION – 25 CUBIC YARDS.
NO TRENCH ROCK EXCAVATION.
AS BUILT REVISIONS
CHECKED BY THE GENERAL STATE AUTHORITY
THE GENERAL STATE AUTHORITY
HARRISBURG, PENNSYLVANIA
PROJECT NO. G.S.A. 800-115
ACADEMIC BUILDING
THE PENNSYLVANIA STATE UNIVERSITY
OGONTZ CAMPUS MONTGOMERY CO., PA.
SAMUEL I. OSHIVER & ASSOCIATES
ARCHITECTS AND ENGINEERS
1425 WALNUT STREET, PHILA., PA.
SITE PLAN
A-2



NOTE:
LARGE SCALE PLANS OF SECOND FLOOR
LABORATORY APPEAR ON SHEET A-16



NOTE:
LARGE SCALE PLAN OF THIRD FLOOR
LABORATORY ON SHEET A-17



1 EXISTING DEMO PLAN
1/8" = 1'-0"

2 PROPOSED FLOOR PLAN
1/4" = 1'-0"

Second Floor, Option 1						
Number	Name	Area (NSF)	Number of Students	Assigned Bench per Student	Total Bench Length	Number of Fume Hoods
222	LABORATORY	1355	24	4' - 0"	108' - 0"	0
222A	PREP ROOM	424	0		84' - 6"	1
222B	STORAGE	471	0		84' - 0"	0
224	LABORATORY	1299	24	3' - 0"	72' - 0"	0
Grand total		3550			348' - 6"	1

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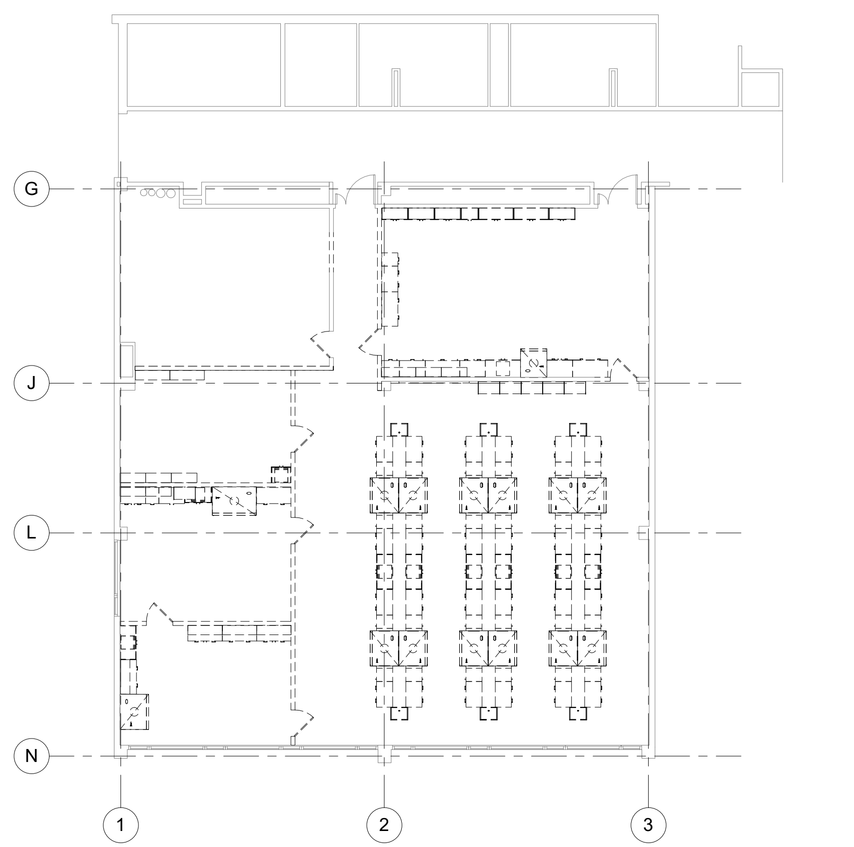
PENNSTATE

SECOND FLOOR PLAN

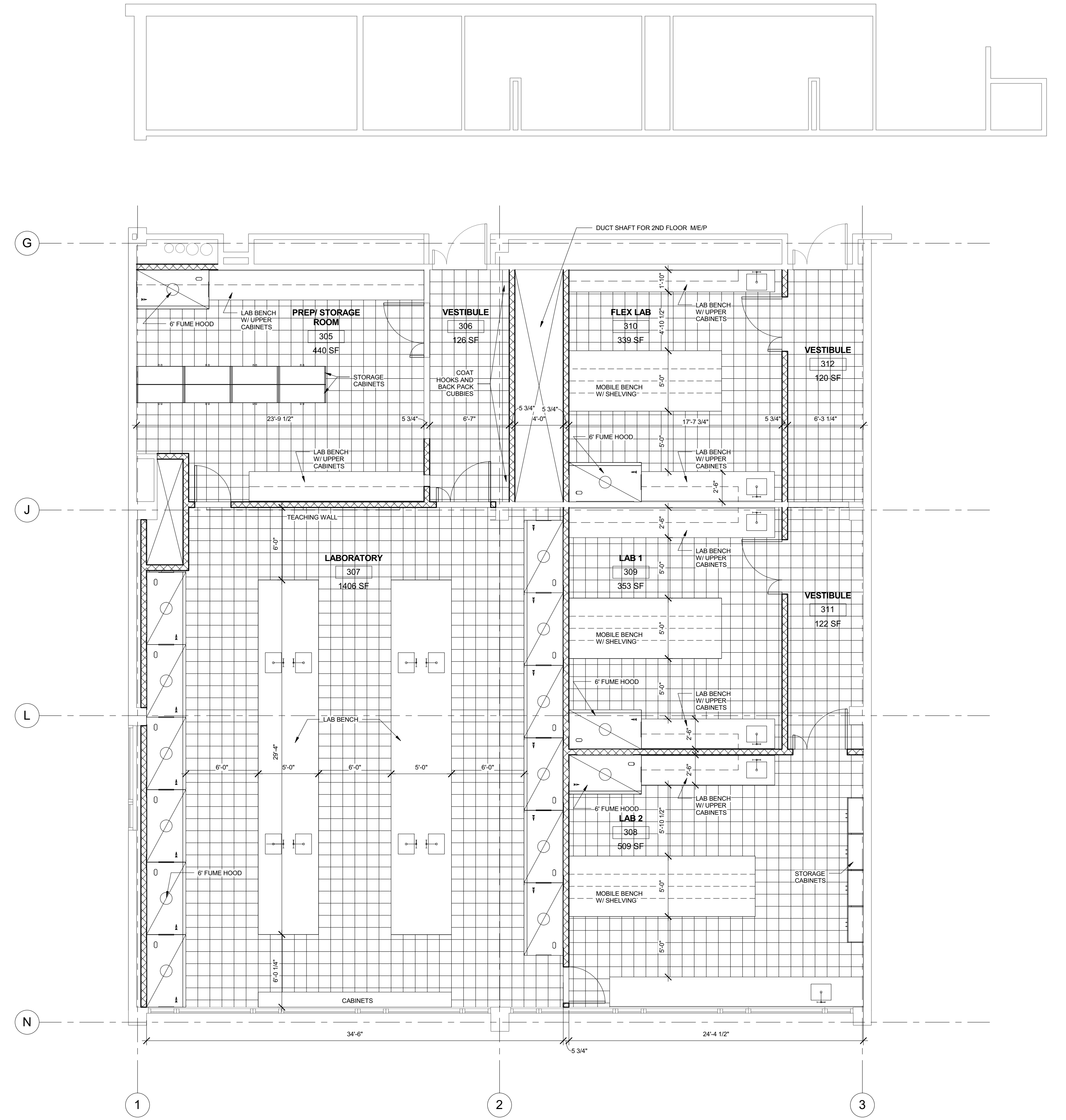
PSU - ABINGTON

CHEMISTRY LAB RENOVATION DESIGN STUDY

MARCH 15, 2011



1 EXISTING DEMO PLAN
1/8" = 1'-0"



2 PROPOSED FLOOR PLAN
1/4" = 1'-0"

Third Floor Proposed Plan

Number	Name	Area (NSF)	Number of Students	Assigned Bench per Student	Total Bench Length	Number of Fume Hoods
305	PREP/ STORAGE ROOM	440				1
306	VESTIBULE	126				
307	LABORATORY	1406	24	3' - 0"	118' - 0"	12
308	LAB 2	509			44' - 0"	1
309	LAB 1	353			44' - 0"	1
310	FLEX LAB	339			48' - 0"	1
311	VESTIBULE	122				
312	VESTIBULE	120				
Grand total		3415			254' - 0"	16

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THIRD FLOOR PLAN

PSU - ABINGTON

CHEMISTRY LAB RENOVATION DESIGN STUDY

MARCH 15, 2011

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Meeting Minutes

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NALLS Architecture, Inc.

MEETING MINUTES

DATE:	November 1, 2010
MEETING MINUTES:	#1
PROJECT:	PSU Abington Chemistry Lab Renovation Design Study
NAI PROJECT NUMBER:	10114
MEETING DATE/TIME:	October 22, 2010, 9 am – 11 am
LOCATION:	Woodland Bldg., Room 246
PURPOSE:	Design Workshop 1 - Inorganic Chemistry

IN ATTENDANCE:

Name	Initials	Department/Organization	Email
Leah Devlin	LD	PSU Science & Engineering	cld5@psu.edu
Judy Ozment	JO	PSU Science & Engineering	o96@psu.edu
Hae Won Kim	HWK	PSU Science & Engineering	kuo@psu.edu
Frank Szymkowski	FS	PSU Abington Physical Plant	fbs3@psu.edu
Robert Nalls	RN	NAI	Nalls@nallsarch.com
Richard Linsky	RL	NAI	Linsky@nallsarch.com
Mike Witkowski	MW	McHugh Engineering	mwitkowski@mchugheng.com

COPIES TO:

All attendees			
Tom Wojcik	TW	OPP/Commonwealth Services	TMW16@nw.opp.psu.edu

GENERAL DISCUSSION:

Action by:

1.01 NAI presented a brief PowerPoint on lab design and casework concepts.

1.02 General Items:
- A. Mobile modules/lab tables were discussed.
- B. Concerns for lab safety, particularly emergency showers, were discussed.
  1. How to get students out if floor is flooded by an emergency shower located near an exit.
  2. How to address a potential flood from emergency shower water that is now mixed with chemicals from a spill.
- C. Lab Prep space was discussed.
  1. The concept of a window to transfer materials out of Prep to the lab was discussed.
  2. It was also discussed that the opening shouldbe configured in such a way that students are not distracted.

1.03 Space Concerns / Requirements:
- A. Current labs are limited to 24 students max.
- B. Most labs are 2 person teams
- C. There is a need to have some kind of ventilation in the lab
  1. The students need to learn about and use Amonia.
  2. There is not currently much work done in fume hoods.
- D. Usage of rooms is approaching full capacity (i.e. limited opportunity to schedule additional classes in the labs)
- E. CHEM 113 & 111 use groups
  1. Lots of post lab recitation
  2. Could be modular – i.e. smaller, possibly movable student lab stations

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3. Chem 101 also uses the space

F. The labs may work with two different casework plans

G. Need some of 224A for third floor storage

H. Need sinks over movability of stations

1. Need a sink for each group or pair of groups of students

I. Use a lot of distilled water

1. Don't need ultra-pure
2. Don't need distilled water at every sink, but need it in the lab

J. Need student locker cabinets.

K. No above bench shelving on the tables in the center.

L. Need natural gas in the Prep room

1. Could use gas at a teaching station or one part of/back of the room

M. Compressed air would be nice, but the existing system is dirty and not used.

1.04 Laboratory Equipment Discussed:

A. Use UV-Vis Spectrometers

1. Currently stored in the teaching lab
2. Could be stored in a Prep lab/room

B. Balances are needed in the teaching lab

1. They are fast enough to use 4-5 for the whole class
2. Like having them in the lab vs. in a separate room
3. Balances to be peripheral to the room

C. Students may use laptops at lab stations

D. Vernier systems used in the labs

1. Need a printer for Vernier output

E. Spectrometers, pH meters and volt meters are stored in Prep and brought out for experiments

F. Ring stands are the largest/bulkiest piece to be stored in cabinets in the lab

1.05 The next meeting will be scheduled for a date to be determined in November. TW

The minutes above represent Nalls Architecture, Inc.'s understanding of the meeting's discussions and decisions. If corrections to these minutes are not received within 7 days of issuance, they will be considered an accurate representation of the meeting's content.

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NALLS Architecture, Inc.

MEETING MINUTES

DATE:	November 1, 2010
MEETING MINUTES:	#1
PROJECT:	PSU Abington Chemistry Lab Renovations Design Study
NAI PROJECT NUMBER:	10114
MEETING DATE/TIME:	October 22, 2010, 2 pm – 4 pm
LOCATION:	Woodland Bldg., Room 246
PURPOSE:	Design Workshop 1 - Organic Chemistry

IN ATTENDANCE:

Name	Initials	Department/Organization	Email
Leah Devlin	LD	PSU Science & Engineering	cld5@psu.edu
Kevin Cannon	KC	PSU Science & Engineering	kcc10@psu.edu
Guiin Lee	GL	PSU Science & Engineering	ltg10@psu.edu
Robert Nalls	RN	NAI	Nalls@nallsarch.com
Richard Linsky	RN	NAI	Linsky@nallsarch.com

COPIES TO:

All attendees			
Frank Szymkowski	FS	PSU Abington Physical Plant	fbs3@psu.edu
Tom Wojcik	TW	OPP/Commonwealth Services	TMW16@nw.opp.psu.edu

GENERAL DISCUSSION:

Action by:

1.01 NAI presented a brief PowerPoint on lab design and casework concepts.

1.02 General Items:
- A. Research & prep hoods are on different blowers than the main lab
  1. They run full time
  2. Teaching lab blowers only run when the lab is in use
  3. Teaching lab is used about 20 hour/week through year
- B. Lab section size
  1. Max = 24 students (12 hoods @ 2 students/hood)
  2. Currently the Organic labs are limited to 18 students max.
- C. Organic chemistry lab can be held a maximum of 2 days/week through year leaving other time free to schedule other labs,

1.03 Space Concerns / Requirements:
- A. Transparency of the fume hoods
  1. More important than energy efficiency (if they can be turned off when not in use)
- B. Would need vacuum in both Organic and Inorganic to replace water aspiration. — NAI
- C. Question regarding hoods on window wall. NAI will review the possibility of locating a fume hood or hoods on the exterior wall.
- D. Options discussed for plan arrangement:
  1. Research spaces at the corridor
  2. Research spaces on the left and teaching lab on the right
- E. Could there be a biochemistry lab?
  1. Maybe have a flexible lab on west half (323 B, C & D) for other classes
  2. Biochemistry lab max size would be 20 students.
- F. Given the choices, hoods against the perimeter walls are better than in the center.

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G. Fume hoods are needed in all of the labs, at least 1 each in the Inorganic Chemistry Labs.

H. Chemistry recitations could be run in the lab on M, W & F if the lab had clear tables for visibility and a teaching station.

1.04 Space Program Discussed:

A. 24 Student (max) Organic Teaching Lab

B. Prep Lab

C. Flexible Teaching Area (+Instrument Room?)

D. Research Lab Space

1. Equipment/instrument space one side (a 4' biosafety cabinet would be nice, a large refrigerator would also be needed)
2. Lab bench other side

1.05 The next meeting will be scheduled for a date to be determined in November. TW

The minutes above represent Nalls Architecture, Inc.'s understanding of the meeting's discussions and decisions. If corrections to these minutes are not received within 7 days of issuance, they will be considered an accurate representation of the meeting's content.

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MEETING MINUTES

DATE:	Wednesday, February 23, 2011
MEETING NUMBER:	4
PROJECT:	PSU Abington Chemistry Lab Study
NAI PROJECT NUMBER:	10114
MEETING DATE/TIME:	Monday, January 24th, 2011, 1 pm – 3 pm
LOCATION:	PSU Abington, Library Conference Room
PURPOSE:	Design and Engineering Review

IN ATTENDANCE:

Name	Initials	Department/Organization	Email
Dale Hollenbach	DH	PSU Abington – Admin.	dth4@psu.edu
Terry Roman	TR	PSU Abington – Admin.	Tpr2@psu.edu
Leah Devlin	LD	PSU Abington – Science & Eng.	cld5@psu.edu
Tom Wojcik	TW	PSU OPP/CS	TMW16@nw.opp.psu.edu
Robert Nalls	RN	NAI	Nalls@NallsArch.com
Richard Linsky	RL	NAI	Linsky@NallsArch.com
Mike Witkowski	MW	McHugh Engineering	mwitkowski@mchugheng.com

DISCUSSION ITEMS: (Action By:)

4.01 LD reviewed the preferred 3rd floor plan option with comments:

- A. Option 1 is preferred, but the faculty would like to divide the research/flex lab into 3 similar labs: 2 for faculty research and one for student / flexible research space.
- B. The flex lab could be a 3rd faculty research lab in the future.
- C. It was agreed that NAI would attempt to layout 3 similar research labs that could serve the immediate and future space assignments.
- D. LD noted that the teaching lab layout was acceptable except that it would be preferable to align the lab benches in the center parallel to the fume hoods. The faculty also requested sinks on the center benches and storage underneath.
- E. LD presented NAI with a drawing with additional detailed comments for later review. — NAI

4.02 LD reviewed the preferred 2nd floor plan option with comments:

- A. Option 1 is preferred.
- B. The diagonal tables should represent movable tables.
- C. A 6th table was requested in the diagonal-table lab. NAI will study the layout to determine if it can be accommodated. — NAI
- D. A door will be added between the two teaching labs for secondary egress.
- E. The lab with long rectangular benches will have fixed benches with sinks on one or both ends as space allows.
- F. It was discussed that it may be desirable to reduce the size of the prep room slightly in order to create a fume hood room that can be shared between both teaching labs for the few occasions that they need to use chemicals that require a hood. NAI will revise the plan accordingly. — NAI
- G. It was noted that the perimeters of the teaching labs should be filled with cabinets and shallow counter tops for balances. Also, the prep room should have space for carts.
- F. LD presented NAI with a drawing with additional detailed comments for later review. — NAI

4.03 It was agreed that NAI write the basis of design to include metal casework with wood fronts for the purpose of the cost estimate.

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4.04 Engineering Concepts were discussed:

A. MW presented a range of AHU unit sizes being studied.
B. TW noted that MW's preliminary questions had been forwarded to Scott Rhoads and Bill Dreibelbis for review.
C. The exhaust fans were discussed. The size is a concern if they will be visible from neighboring residences.
D. It was noted that it would be useful and informative to have a list of the chemicals used in the teaching and research labs. LD
E. It was agreed that NAI/McHugh will include the replacement of the distilled water system with a new deionization system in the cost estimate. This item can be split out as a separate line item. NAI/MW
F. Emergency/Stand-by power was discussed. The Campus is currently evaluating a new emergency generator. It was agreed that MW will only evaluate the size required for the chemistry labs as part of this study. MW
G. It was noted that the current fire alarm vendor is Simplex. TR/PSU
H. It was agreed that PSU Abington would search for utility bills related to the Woodland building.

4.05 The next meeting is scheduled for 2/24/11 at 9 am.

The minutes above represent Nalls Architecture, Inc.'s understanding of the meeting's discussions and decisions. If corrections to these minutes are not received within 7 days of issuance, they will be considered an accurate representation of the meeting's content.

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MEETING MINUTES

DATE:	Monday, March 14, 2011
MEETING NUMBER:	5
PROJECT:	PSU Abington Chemistry Lab Study
NAI PROJECT NUMBER:	10114
MEETING DATE/TIME:	Thursday, February 24, 2011 9am
LOCATION:	PSU Abington, 116 Woodland Building
PURPOSE:	Design and Engineering Review

IN ATTENDANCE:

Name	Initials	Department/Organization	Email
Dale Hollenbach	DH	PSU Abington – Admin.	dth4@psu.edu
Terry Roman	TR	PSU Abington – Admin.	Tpr2@psu.edu
Frank Szymkowski	FZ	PSU Abington – Admin.	fbs3@psu.edu
Leah Devlin	LD	PSU Abington – Science & Eng.	cld5@psu.edu
George Conklin	GC	PSU Physical Plant	grc2@psu.edu
Bill Dreibelbis	BD	PSU Physical Plant	wgd1@psu.edu
Scott Rhoads	SR	PSU Physical Plant	SWR101@nw.opp.psu.edu
Tom Wojcik	TW	PSU Physical Plant	tmw16@nw.opp.psu.edu
Richard Linsky	RL	NAI	Linsky@NallsArch.com
Mike Witkowski	MW	McHugh Engineering	mwitkowski@mchugheng.com

COPIES TO:

All In Attendance			
Robert Nalls	RN	NAI	Nalls@NallsArch.com

DISCUSSION ITEMS:

Action By:

5.01 There was a general discussion regarding the intended use of the labs on the 2nd floor and the implications for the mechanical system:

A. BD noted that if the space is a lab, the air needs to be exhausted.

B. It was noted that volume of exhaust could be reduced for an unoccupied mode vs. occupied.

C. EHS would need to review a list of chemicals and experiments planned for the 2nd floor labs to determine the exact hazard level and exhaust requirements. (Post Meeting Note: LD distributed a list to TW on 2/24/11)

D. It was noted that Prep. and Storage would need to be exhausted like a lab @ 6-10 ACH.

5.02 The proposed fume hood room on the second floor was discussed in detail:

A. It was noted that some experiments in the inorganic (2nd floor) labs require exhaust. Snorkels were discussed, but it was agreed that they a) obstruct views and b) do not provide sufficient capture for many volatile compounds. The fume hood room would provide an alternative.

B. The logistics of using a shared hood room could be difficult depending on class schedules.

C. It was agreed that NAI would revise the plan to eliminate the shared hood room and instead locate fume hoods in the two second floor teaching labs. As a result, all of the second floor spaces will be assumed to be chemical laboratory spaces that require 100% exhaust.

5.03 It was agreed that the third floor is all 100% exhaust due to the fume hood requirements in all of the spaces.

A. The HVAC system design needs to assume that all hoods will be on at the same

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time. It was confirmed that all of the hoods in the teaching lab will be used at the same time.
   - B. It was noted that the exhaust can be reduced to a minimum level for an unoccupied mode.
   - C. It was confirmed that the research labs should be assumed to function 24/7.

5.04 Fume hood face velocities were discussed:
   - A. BD noted that 100 FPM is the current standard. In some cases they may be 80 FPM but no less.
   - B. NIH doesn't fund below 80 FPM.

5.05 Electric metering was discussed:
   - A. MW requested meter information for the Woodland Building for analysis.
   - B. FZ noted that Abington does not have sub-metering on electric the electric service.

5.06 The chiller for the Woodland building was discussed:
   - A. MW noted more information on chiller capacity would be useful.
   - B. FZ noted chiller is maxed out.
   - C. FZ noted that there is one Carrier chiller and one cooling tower.
      - a. Automated Logic can look at trending.
      - b. MW can call AL to investigate.

Post-Meeting Notes:
1) During a post-meeting walk-through it was noted that Abington had two chillers.
2) Since the meeting, MW found out that Automated Logic checked PSU Abington's BAS. They do not track the chillers' usage.
3) Since the meeting, MW asked Carrier if they could check the memory of the chiller. Carrier said the chiller would not have data back to the last summer (for peak conditions).

5.07 TW noted that commissioning will be required on the project. NAI convey this item to the cost estimator.

5.08 NAI will revise plans and distribute PDFs

The minutes above represent Nalls Architecture, Inc.'s understanding of the meeting's discussions and decisions. If corrections to these minutes are not received within 7 days of issuance, they will be considered an accurate representation of the meeting's content.

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Cost Estimate

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Chemistry Lab Renovation

Design Study

Prepared:

April 13, 2011

by:

MOSS CONSTRUCTION COST MANAGEMENT INC

General Notes

Purpose and use of estimate: The intent of this estimate is to reflect fair market value for the construction of this project. It is not a prediction of lowest, or any, bid. It is intended as a tool for cost control during the design process. The estimator can not and does not guarantee that bids, proposals or actual construction costs will not vary from any such estimate or study.

Sufficiency of design and funding: The estimator has no control over the quality, completeness, intricacy, constructability, or coordination of design documents, or over the amount of funds available for this project. Therefore, the estimator is not responsible for design revision costs in the event that the estimate is in excess of the established budget.

Scope of work: The line items included in the estimate represent the estimators understanding of the scope of work as communicated by the documents identified in the basis of estimate below. Any apparent discrepancies and/or significant differences in understanding should be brought to the estimators' attention as soon as possible so that interpretation of scope can be clarified.

Basis of Estimate:

Estimate is based upon the following:

Architectural Basis of Design, Draft (by Nalls)	Received	30-March-11
Drawing – existing second floor plan	Received	30-March-11
Drawing – existing third floor plan	Received	30-March-11
Drawing – existing site plan	Received	30-March-11
Drawing – proposed second floor plan	Received	30-March-11
Drawing – proposed third floor plan	Received	30-March-11
MEP Memorandum (By McHugh Engineering)	Received	31-March-11
Spec Sections 15821 & 15750	Received	13-April-11
Hood exhaust table	Received	13-April-11
Revised MEP Memorandum (McHugh Eng.)	Received	13-April-11

Estimate Issue information:

This issue: Preliminary for Owner & A/E comments

Summary:

Estimated gross construction costs are as follows:

Base:	**$2,306,843**
Alternate 1:	**$6,613**
Alternate 2:	**$17,417**

Pricing Basis:

This estimate assumes:

Scope/Pricing:

Current Prevailing/union wage labor rates for Abington, PA as of December 2010

Competitive bid contract procurement, minimum of five bidders for prime contract

Adequate subcontractor coverage, minimum 3 bidders per package

Normal working hours, except for off-hour demolition work and necessary utility service outages

Markups for contingencies, OHP, insurances/bonding totaling approximately 40% are included.

Schedule:

For escalation purposes, a Construction mid-point of 4Q 2011 has been assumed based on anticipated bid date of 2Q 2011.

General Exclusions:

This document is an estimate of probable construction cost of those components normally included within the hard construction budget. Estimation of other disciplines and project costs, including the following, is excluded.

Items marked "FFE", "NIC" or specifically excluded within the estimate detail

Supply cost of Owner Furnished, Contractor Installed (OFCI) items

Supply & Installation cost of Owner Furnished, Owner Installed (OFOI) items

Project “soft costs” including Owner project administration, Design (A/E) and related Consulting fees

Construction administration costs, and/or owner’s representative fees

Construction Contingency

System development charges or utility company surcharges

Future project phases

Phasing allowances, if project phased

Project Specific Assumptions & Exclusions

Estimate assumes that mechanical room is within 250LF of project area for purposes of calculating pipe runs to AHU's.

Estimate assumes the following in regard to casework:

1. Items designated "Mobile Bench" assumed fully mobile units
2. Items designated "Lab Bench" assumed fixed bench and sink bases with moveable cabinetry beneath. Estimate allows 2LF cabinetry per 5LF of face.
3. All other casework fixed.
4. No overhead service chases required.

The following are excluded from the estimate:

Hazardous material abatement

Mechanical and plumbing risers, except as specifically described

Sprinkler system standpipes and fire mains

Electrical feeders, risers and switchgear except as specifically described

Telecom & IT backbone, equipment and cabling

Laboratory equipment

Bio Safety Cabinets

Furniture & furnishings, EXCEPT MOBILE CABINETRY DESCRIBED ABOVE

A/V equipment, projectors & screens except as specifically described

Work in adjacent spaces

Work to existing exteriors except break-through necessary for new addition(s)

Category	Percent	Total
Direct Cost of Construction		**$1,667,273**
Design/Estimating Allowance	15.00 %	$250,091
Subtotal		**$1,917,364**
General Requirements, OH&P	18.00 %	$345,126
Subtotal		**$2,262,490**
Warranty/Bonding/Insurances	1.50 %	$33,937
Subtotal		**$2,296,427**
Escalation to MP=4Q11	1.50 %	$34,446
Grand Total	**7,302 GSF**	**$2,330,873**

Item Description		Total	Markup Amount	Gross Total
--- Base Estimate ---				
B10	**Superstructure**	**$16,229**	**6,460**	**22,689**
B20	**Exterior Enclosure**	**$57,600**	**22,926**	**80,526**
C10	**Interior Construction**	**$60,063**	**23,906**	**83,968**
C30	**Interior Finishes**	**$71,846**	**28,596**	**100,441**
D20	**Plumbing**	**$118,453**	**47,146**	**165,599**
D30	**HVAC**	**$369,270**	**146,975**	**516,246**
D40	**Fire Protection Systems**	**$21,906**	**8,719**	**30,625**
D50	**Electrical Systems**	**$225,762**	**89,857**	**315,619**
E10	**Equipment**	**$172,964**	**68,842**	**241,806**
E20	**Furnishings**	**$456,677**	**181,765**	**638,442**
F20	**Selective Demolition**	**$71,514**	**28,464**	**99,978**
Z10	**General Requirements**	**$7,800**	**3,105**	**10,905**
	--- Base Estimate --- Total	**$1,650,084**	**656,759**	**2,306,843**
Add Alternate #1 - weatherproof sound attenuated generator housing				
D50	**Electrical Systems**	**$4,730**	**1,883**	**6,613**
	Add Alternate #1 - weatherproof sound attenuated generator housing Total	**$4,730**	**1,883**	**6,613**
Add Alternate #2 - 2nd floor rooftop condensing unit in lieu of chilled water				
D30	**HVAC**	**$12,458**	**4,959**	**17,417**
	Add Alternate #2 - 2nd floor rooftop condensing unit in lieu of chilled water Total	**$12,458**	**4,959**	**17,417**
	Grand Total	**$1,667,273**	**663,600**	**2,330,873**

Row #	Item Description	QTY	Unit	Total Unit Price	Total
	--- Base Estimate ---				
	2nd Floor				
3	**B10 Superstructure**	**7,302**	**GSF**	**0.35**	**$2,555.70**
4	flash patch flooring	3,651	SF	0.70	$2,555.70
6	**C10 Interior Construction**	**7,302**	**GSF**	**3.48**	**$25,387.28**
7	GWB, partition, 3-5/8" metal stud, 5/8" GWB type X, w/ mineral fiber insulation	1,627	SF	6.78	$11,025.47
8	GWB, partition, furring @ existing walls, EXCLUDED		EXCL		$0.00
9	GWB, shaft partition, 2-1/2" C-H studs, 5/8" GWB, double layer, fire rated for 2 hour, 1" wall liner on shaft side	82	SF	5.91	$484.35
10	misc. metals & supports, allowance	1	LS	1,000.00	$1,000.00
11	partition, masonry, CMU, EXCLUDED		EXCL		$0.00
12	partitions, 18ga horizontal studs reinforcement at casework	619	LF	1.40	$866.60
13	sealants	285	LF	1.60	$454.93
14	door hardware installation	18	HRS	58.29	$1,020.08
15	door hardware set, single	5	SET	565.00	$2,825.00
16	interior glazing, 4' high	24	SF	60.16	$1,443.80
17	metal frame 3'0"w x 7'0"h	5	EA	257.97	$1,289.86
18	wood door, 3'0"w x 7'0"h	5	LVS	410.93	$2,054.65
19	wood door, fire rated, suite entry, EXCLUDED (ETR)		EXCL		$0.00
20	coat rail, wall mtd	2	EA	114.57	$229.15
21	corner guard	117	LF	16.18	$1,893.40
22	fire extinguisher cabinet, extinguishers by Owner	2	EA	400.00	$800.00
24	**C30 Interior Finishes**	**7,302**	**GSF**	**4.97**	**$36,318.06**
25	painting, walls	2,668	SF	0.69	$1,839.49
26	wall finishes/ patch & prep existing walls to receive paint	2,292	SF	0.50	$1,147.33
27	base, rubber	522	LF	2.78	$1,448.72
28	flooring accessories, transitions and the like, allowance	1	LS	100.00	$100.00
29	flooring, VCT	3,590	SF	4.20	$15,093.69
30	ACT ceiling system	3,590	SF	4.65	$16,688.83

Row #	Item Description	QTY	Unit	Total Unit Price	Total
32	**D20 Plumbing**	**7,302**	**GSF**	**8.20**	**$59,869.59**
33	plumbing fixture, lab distilled water system & piping, allowance	1	LS	10,000.00	$10,000.00
34	plumbing fixture, lab faucet w/eyewash, incl. tempering valve	5	EA	571.59	$2,857.97
35	plumbing fixture, lab sink, epoxy resin, incl. rough-in	5	EA	519.76	$2,598.80
36	domestic water, piping, allowance	3,651	GSF	0.81	$2,957.31
37	sanitary/acid/waste/vent piping, allowance	3,651	GSF	2.00	$7,302.00
38	lab gas connections, fume hoods	7	EA	228.88	$1,602.16
39	lab gas piping, (CA/G)	830	LF	32.92	$27,326.36
40	lab gas piping, quad outlet/dual gas @ bench islands	6	EA	400.00	$2,400.00
41	lab gas piping, single outlet/dual gas @ fume hoods	7	EA	350.00	$2,450.00
42	lab gas piping, valve	6	EA	62.50	$374.99
44	**D30 HVAC**	**7,302**	**GSF**	**12.89**	**$94,119.29**
45	damper, 0.012/sf	44	EA	45.11	$1,985.01
46	diffusers/grilles, 0.013/sf	48	EA	133.93	$6,428.85
47	ductwork, insulation/sound liners, rectangular ducts	3,300	SF	4.60	$15,180.00
48	ductwork, rectangular, steel, allow 1.5#/SF	5,500	LB	8.81	$48,455.00
49	controls allowance, includes tie-in to existing system	3,651	GSF	5.00	$18,255.00
50	thermostat, include conduit/wiring, reconnect to existing	4	EA	453.86	$1,815.43
51	balancing, testing, inspections	20	HRS	100.00	$2,000.00
53	**D40 Fire Protection Systems**	**7,302**	**GSF**	**1.50**	**$10,953.00**
54	sprinkler system, modification allowance	3,651	GSF	3.00	$10,953.00
56	**D50 Electrical Systems**	**7,302**	**GSF**	**10.75**	**$78,514.46**
57	electrical demolition, load center, 2nd floor lab	1	EA	438.48	$438.48
58	electrical demolition, panelboard, LP21S-1, 208/120V, 3P, 4W	1	EA	438.48	$438.48
59	electrical device/conduit & cabling, allowance	3,651	GSF	3.50	$12,778.50
60	electrical power and distribution, allowance	3,651	GSF	3.00	$10,953.00
61	electrical testing & inspection	1	LS	1,000.00	$1,000.00
62	equipment connections, fume hoods	7	EA	212.00	$1,484.00

Row #	Item Description	QTY	Unit	Total Unit Price	Total
63	panelboard, LP21S, 208/120V, 3P, 4W, modification allowance	1	EA	1,753.92	$1,753.92
64	panelboard, LP21S-1, 208/120V, 3P, 4W, replacement	1	EA	3,410.14	$3,410.14
65	panelboard, LP22S, 408/277V, 3P, 4W, modification allowance	1	EA	1,753.92	$1,753.92
66	devices, duplex receptacle, ceiling, for projector	2	EA	109.29	$218.57
67	lighting devices/conduit/cabling, allowance	3,651	GSF	2.30	$8,397.30
68	lighting fixture, allowance	3,651	GSF	7.60	$27,747.60
69	fire alarm, audible/visual device, allowance	5	EA	123.90	$619.48
70	fire alarm, modification, allowance	3,651	GSF	1.50	$5,476.50
71	tele/data outlets incl rough in @drops	3,651	GSF	0.56	$2,044.56
72	tele/data,cabling, EXCLUDED		EXCL		$0.00
74	**E10 Equipment**	**7,302**	**GSF**	**7.57**	**$55,247.28**
75	drying rack above sink, assumed	5	EA	400.00	$2,000.00
76	laboratory equipment, fume hood, 60", CFCI	7	EA	6,781.04	$47,467.28
77	laboratory equipment, lab prep carts, OFOI	1	FFE		$0.00
78	laboratory equipment, lab prep table, OFOI	1	FFE		$0.00
79	laboratory equipment, storage cabinets, OFOI	110	FFE		$0.00
80	laboratory equipment, undercounter dishwashers, OFOI	5	FFE		$0.00
81	laboratory equipment, undercounter refrigerators, OFOI		FFE		$0.00
82	teaching walls, marker/tackboards, 4'-0" high	126	SF	30.00	$3,780.00
83	equipment, projectors - rough-in & mount only	2	EA	1,000.00	$2,000.00
84	projection screens, manually operated, assumed not required (teaching walls)		NIC		$0.00
86	**E20 Furnishings**	**7,302**	**GSF**	**20.89**	**$152,502.56**
87	coat hooks w/cubbies, 60" height	31	LF	175.37	$5,436.47
88	laboratory casework, adjustable wall shelving	23	LF	292.56	$6,728.81
89	laboratory casework, cabinets, base, acid/flammable storage, @ fume hoods, 36" deep	42	LF	510.24	$21,430.01
90	laboratory casework, cabinets, base, door/drawer front/knee space, 12" deep	7	LF	221.22	$1,548.54

Row #	Item Description	QTY	Unit	Total Unit Price	Total
91	laboratory casework, cabinets, base, door/drawer front/knee space, 22" deep	58	LF	331.83	$19,246.10
92	laboratory casework, cabinets, base, door/drawer front/knee space, 30" deep	5	LF	442.44	$2,212.20
93	laboratory casework, cabinets, lab bench, 22", counter M/S	17	LF	121.81	$2,070.77
94	laboratory casework, cabinets, lab bench, 30", counter M/S	38	LF	154.71	$5,878.79
95	laboratory casework, cabinets, lab bench, 60", counter M/S	48	LF	230.26	$11,052.30
96	laboratory casework, cabinets, sink base @ lab bench, 24" deep	15	LF	331.83	$4,977.45
97	laboratory casework, counter tops, epoxy resin @ base cabinets	250	SF	50.84	$12,710.40
98	laboratory casework, lab bench tops, epoxy resin @ lab bench	95	SF	50.84	$4,829.95
99	laboratory casework, lab bench tops, epoxy resin @ lab bench (island)	269	SF	50.84	$13,676.39
100	laboratory furniture, mobile cabinets @ lab bench, 24"w x 22"d, assumed 1 per 5LF	4	EA	884.88	$3,539.51
101	laboratory furniture, mobile cabinets @ lab bench, 24"w x 30"d, assumed 1 per 5LF	28	EA	1,327.32	$37,164.89
102	laboratory furniture, movable lab table, 5'x6', OFOI	6	FFE		$0.00
103	loose furniture & equipment, OFOI		FFE		$0.00
105	**F20 Selective Demolition**	**7,302**	**GSF**	**4.73**	**$34,502.90**
106	dumpster pulls/ trash hauling	4	EA	449.44	$1,797.77
107	electrical demolition, misc, allowance	3,651	GSF	0.99	$3,602.72
108	HVAC demolition, misc, allowance	3,651	GSF	2.00	$7,302.00
109	plumbing demolition, distilled water system, incl. plumbing	1	EA	257.76	$257.76
110	plumbing demolition, lab sink, incl. plumbing	6	EA	128.88	$773.28
111	remove casework, base cabinet, & counter	62	LF	10.00	$620.00
112	remove casework, base cabinet, & counter, island	112	LF	20.00	$2,240.00
113	remove casework, shelving unit, to 84" height	33	LF	12.60	$415.80
114	remove casework, wall cabinet	25	LF	11.90	$297.50
115	remove existing equipment/fixtures, allowance	1	LS	1,000.00	$1,000.00
116	remove existing, fume hood & duct work	2	EA	214.44	$428.88
117	selective demolition, base cabinets @ fume hood, include countertop	8	LF	15.00	$120.00

Row #	Item Description	QTY	Unit	Total Unit Price	Total
118	selective demolition, demo masonry wall	2,162	SF	3.82	$8,253.36
119	selective demolition, remove existing ceiling suspension system	3,651	SF	0.48	$1,742.00
120	selective demolition, remove existing flooring	3,651	SF	0.77	$2,811.09
121	selective demolition, remove existing GWB partitions, EXCLUDED		EXCL		$0.00
122	selective demolition, remove interior double, door & frame	1	EA	26.55	$26.55
123	selective demolition, remove interior single, door & frame	6	EA	17.70	$106.20
124	temporary barriers, dust control, allowance	1	LS	2,708.00	$2,708.00
126	**Z10 General Requirements**	**7,302**	**GSF**	**0.21**	**$1,500.00**
127	hazardous material abatement (asbestos present) EXCLUDED		EXCL		$0.00
128	lead-based paint abatement (lead paint on door frames) EXCLUDED		EXCL		$0.00
129	maintain /coordinate utilities to occupied spaces, allowance	1	LS	1,500.00	$1,500.00
131	**2nd Floor Total**				**$551,470.12**
	3rd Floor				
134	**B10 Superstructure**	**7,302**	**GSF**	**0.35**	**$2,555.70**
135	flash patch flooring	3,651	SF	0.70	$2,555.70
137	**C10 Interior Construction**	**7,302**	**GSF**	**4.75**	**$34,675.24**
138	GWB, partition, 3-5/8" metal stud, 5/8" GWB type X, w/ mineral fiber insulation	1,624	SF	6.78	$11,005.14
139	GWB, partition, furring @ existing walls, EXCLUDED		EXCL		$0.00
140	GWB, shaft partition, 2-1/2" C-H studs, 5/8" GWB, double layer, fire rated for 2 hour, 1" wall liner on shaft side	1,182	SF	5.91	$6,981.75
141	masonry, cut in and install lintel	5	LF	40.00	$200.00
142	masonry, tooth-in new masonry jambs	1	EA	250.00	$250.00
143	misc. metals & supports, allowance	1	LS	1,000.00	$1,000.00
144	partition, masonry, CMU, EXCLUDED		EXCL		$0.00
145	partitions, 18ga horizontal studs reinforcement at casework	648	LF	1.40	$907.20
146	sealants	465	LF	1.60	$742.26

Row #	Item Description	QTY	Unit	Total Unit Price	Total
147	door hardware installation	21	HRS	58.29	$1,224.09
148	door hardware set, single	2	SET	565.00	$1,130.00
149	door hardware set, unbalanced	2	SET	1,190.00	$2,380.00
150	metal frame 3'0"w x 7'0"h	2	EA	257.97	$515.94
151	metal frame 4'6"w x 7'0"h	2	EA	313.77	$627.54
152	wood door, 3'0"w x 7'0"h	2	LVS	410.93	$821.86
153	wood door, double, unbalanced, 1'6"/3'0"w x 7'0"h	2	PR	759.41	$1,518.82
154	wood door, fire rated, suite entry, EXCLUDED (ETR)		EXCL		$0.00
155	coat rail, wall mtd	5	EA	114.57	$572.86
156	corner guard	63	LF	16.18	$1,019.52
157	fire extinguisher cabinet, extinguishers by Owner	5	EA	400.00	$2,000.00
158	wallguard, @ vestibules	82	LF	21.69	$1,778.25
160	**C30 Interior Finishes**	**7,302**	**GSF**	**4.87**	**$35,527.71**
161	painting, walls	3,416	SF	0.69	$2,355.20
162	wall finishes/ patch & prep existing walls to receive paint	2,546	SF	0.50	$1,274.47
163	base, rubber	634	LF	2.78	$1,759.56
164	flooring accessories, transitions and the like, allowance	1	LS	100.00	$100.00
165	flooring, VCT	3,393	SF	4.20	$14,265.43
166	ACT ceiling system	3,393	SF	4.65	$15,773.04
168	**D20 Plumbing**	**7,302**	**GSF**	**8.02**	**$58,583.34**
169	plumbing fixture, lab distilled water system & piping, assume not required at 3/F		EXCL	10,000.00	$0.00
170	plumbing fixture, lab faucet w/eyewash, incl. tempering valve	13	EA	571.59	$7,430.72
171	plumbing fixture, lab sink, epoxy resin, incl. rough-in	13	EA	519.76	$6,756.88
172	domestic water, piping, allowance	3,651	GSF	0.81	$2,957.31
173	sanitary/acid/waste/vent piping, allowance	3,651	GSF	2.00	$7,302.00
174	lab gas connections, fume hoods	16	EA	228.88	$3,662.08
175	lab gas piping, (CA/G)	530	LF	32.92	$17,449.36
176	lab gas piping, quad outlet/dual gas @ bench islands	17	EA	400.00	$6,800.00
177	lab gas piping, single outlet/dual gas @ fume hoods	16	EA	350.00	$5,600.00

Row #	Item Description	QTY	Unit	Total Unit Price	Total
178	lab gas piping, valve	10	EA	62.50	$624.99
180	**D30 HVAC**	**7,302**	**GSF**	**12.95**	**$94,573.15**
181	damper, 0.012/sf	44	EA	45.11	$1,985.01
182	diffusers/grilles, 0.013/sf	48	EA	133.93	$6,428.85
183	ductwork, insulation/sound liners, rectangular ducts	3,300	SF	4.60	$15,180.00
184	ductwork, rectangular, steel, allow 1.5#/SF	5,500	LB	8.81	$48,455.00
185	controls allowance, includes tie-in to existing system	3,651	GSF	5.00	$18,255.00
186	thermostat, include conduit/wiring, reconnect to existing	5	EA	453.86	$2,269.29
187	balancing, testing, inspections	20	HRS	100.00	$2,000.00
189	**D40 Fire Protection Systems**	**7,302**	**GSF**	**1.50**	**$10,953.00**
190	sprinkler system, modification allowance	3,651	GSF	3.00	$10,953.00
192	**D50 Electrical Systems**	**7,302**	**GSF**	**11.39**	**$83,164.48**
193	add bkr, 50A/3P, in (E) panel, to feed relocated transformer	1	EA	190.06	$190.06
194	electrical demolition, enclosed circuit breaker @ transformer	1	EA	146.16	$146.16
195	electrical demolition, transformer	1	EA	438.48	$438.48
196	electrical device/conduit & cabling, allowance	3,651	GSF	3.50	$12,778.50
197	electrical power and distribution, allowance	3,651	GSF	3.00	$10,953.00
198	electrical testing & inspection	1	LS	1,000.00	$1,000.00
199	equipment connections, fume hoods	16	EA	212.00	$3,392.00
200	panelboard, LP31S, 208/120V, 3P, 4W, modification allowance	1	EA	1,753.92	$1,753.92
201	panelboard, LP31S-1, 208/120V, 3P, 4W, w/125A main	1	EA	3,640.57	$3,640.57
202	panelboard, LP32S, 408/277V, 3P, 4W, retrofit allowance	1	EA	2,753.92	$2,753.92
203	relocate transformer in ceiling	1	EA	1,584.64	$1,584.64
204	lighting devices/conduit/cabling, allowance	3,651	GSF	2.30	$8,397.30
205	lighting fixture, allowance	3,651	GSF	7.60	$27,747.60
206	fire alarm, audible/visual device, allowance	7	EA	123.90	$867.27
207	fire alarm, modification, allowance	3,651	GSF	1.50	$5,476.50
208	tele/data outlets incl rough in @drops	3,651	GSF	0.56	$2,044.56

Row #	Item Description	QTY	Unit	Total Unit Price	Total
209	tele/data, conduit/cabling, EXCLUDED		EXCL		$0.00
211	**E10 Equipment**	**7,302**	**GSF**	**16.12**	**$117,716.64**
212	drying rack above sink, EXCLUDED		EXCL	400.00	$0.00
213	laboratory equipment, fume hood, 60", CFCI	16	EA	6,781.04	$108,496.64
214	laboratory equipment, storage cabinets, OFOI	55	FFE		$0.00
215	laboratory equipment, undercounter refrigerators, OFOI		FFE		$0.00
216	teaching walls, marker/tackboards, 4'-0" high	274	SF	30.00	$8,220.00
217	equipment, projectors - rough-in & mount only, 3F, none shown, assumed	1	EA	1,000.00	$1,000.00
218	projection screens, manually operated, assumed not required (teaching walls)		NIC		$0.00
220	**E20 Furnishings**	**7,302**	**GSF**	**41.66**	**$304,174.91**
221	coat hooks w/cubbies, 60" height	19	LF	175.37	$3,332.03
222	laboratory casework, cabinets, base, acid/flammable storage, @ fume hoods, 36" deep	96	LF	510.24	$48,982.88
223	laboratory casework, cabinets, base, door/drawer front/knee space, 30" deep	21	LF	442.44	$9,291.22
224	laboratory casework, cabinets, lab bench, 30", counter M/S	82	LF	154.71	$12,685.81
225	laboratory casework, cabinets, lab bench, 60", counter M/S	59	LF	230.26	$13,585.12
226	laboratory casework, cabinets, sink base @ lab bench, 30" deep	24	LF	375.00	$9,000.00
227	laboratory casework, counter tops, epoxy resin @ base cabinets	288	SF	50.84	$14,642.38
228	laboratory casework, lab bench tops, epoxy resin @ lab bench	289	SF	50.84	$14,693.22
229	laboratory casework, lab bench tops, epoxy resin @ lab bench (island)	293	SF	50.84	$14,896.58
230	laboratory casework, wall cabinets @ lab bench	91	LF	206.85	$18,823.75
231	laboratory furniture, lab bench, mobile island, 60" deep, incl. base cabinets	41	LF	1,557.58	$63,860.67
232	laboratory furniture, lab bench, mobile island, add for epoxy resin top	205	SF	50.84	$10,422.52
233	laboratory furniture, mobile cabinets @ lab bench, 24"w x 30"d, assumed 1 per 5LF	33	EA	1,327.32	$43,801.47
234	laboratory furniture, reagent shelving @ mobile islands	82	LF	318.99	$26,157.26

Row #	Item Description	QTY	Unit	Total Unit Price	Total
235	loose furniture & equipment, OFOI		FFE		$0.00
237	**F20 Selective Demolition**	**7,302**	**GSF**	**4.83**	**$35,248.54**
238	dumpster pulls/ trash hauling	4	EA	449.44	$1,797.77
239	electrical demolition, misc, allowance	3,651	GSF	0.99	$3,602.72
240	HVAC demolition, misc, allowance	3,651	GSF	2.00	$7,302.00
241	remove casework, base cabinet, & counter	101	LF	10.00	$1,010.00
242	remove casework, base cabinet, & counter, island	68	LF	20.00	$1,360.00
243	remove casework, wall cabinet	50	LF	11.90	$595.00
244	remove existing equipment/fixtures, allowance	1	LS	1,000.00	$1,000.00
245	remove existing, fume hood & duct work	15	EA	214.44	$3,216.60
246	selective demolition, base cabinets @ fume hood, include countertop	53	LF	15.00	$795.00
247	selective demolition, demo masonry wall	1,850	SF	3.82	$7,062.31
248	selective demolition, demo masonry wall for new door opening	32	SF	3.82	$122.16
249	selective demolition, remove existing ceiling suspension system	3,651	SF	0.48	$1,742.00
250	selective demolition, remove existing flooring	3,651	SF	0.77	$2,811.09
251	selective demolition, remove existing GWB partitions, EXCLUDED		EXCL		$0.00
252	selective demolition, remove interior single, door & frame	7	EA	17.70	$123.90
253	temporary barriers, dust control, allowance	1	LS	2,708.00	$2,708.00
255	**Z10 General Requirements**	**7,302**	**GSF**	**0.21**	**$1,500.00**
256	hazardous material abatement (asbestos present) EXCLUDED		EXCL		$0.00
257	lead-based paint abatement (lead paint on door frames) EXCLUDED		EXCL		$0.00
258	maintain /coordinate utilities to occupied spaces, allowance	1	LS	1,500.00	$1,500.00
260	**3rd Floor Total**				**$778,672.71**
	Rooftop HVAC				
263	**B10 Superstructure**	**7,302**	**GSF**	**1.52**	**$11,118.03**

Row #	Item Description	QTY	Unit	Total Unit Price	Total
264	AHU mech support, W section, allowance	4	TON	2,640.86	$11,118.03
266	**B20 Exterior Enclosure**	**7,302**	**GSF**	**7.89**	**$57,600.00**
267	AHU mech screen, louvered, 8' high, allowance	144	LF	400.00	$57,600.00
269	**D30 HVAC**	**7,302**	**GSF**	**24.73**	**$180,578.00**
270	AHU, 2nd floor, roof top, allowance	5,600	CFM	5.75	$32,200.00
271	AHU, 3rd floor, roof top, allowance	12,800	CFM	5.75	$73,600.00
272	exhaust fan allowance, generator	3,500	CFM	1.10	$3,850.00
273	exhaust fan, for 2nd floor, roof top, allowance	5,600	CFM	1.28	$7,168.00
274	exhaust fan, for 3rd floor, roof top, allowance	12,800	CFM	1.28	$16,384.00
275	HVAC pipe, CH/HW/S&R, to mechanical rooms, assume connection point 250LF Maximum	1,260	LF	30.00	$37,800.00
276	HVAC pipe, insulation	1,260	LF	7.60	$9,576.00
278	**D50 Electrical Systems**	**7,302**	**GSF**	**1.97**	**$14,368.29**
279	add bkr, to (E) panel, to feed new rooftop AHU's	1	LS	6,000.00	$6,000.00
280	equipment connections, HVAC	4	EA	217.07	$868.29
281	new feeders to rooftop HVAC equipment, allowance	1	LS	7,500.00	$7,500.00
283	**Z10 General Requirements**	**7,302**	**GSF**	**0.66**	**$4,800.00**
284	commissioning agent (independent commissioning authority)	40	HRS	120.00	$4,800.00
286	**Rooftop HVAC Total**				**$268,464.32**
	Basement				
289	**D50 Electrical Systems**	**7,302**	**GSF**	**6.81**	**$49,714.78**
290	reconfigure feeders @ generator	1	LS	5,000.00	$5,000.00
291	ATS, 100A, auto transfer switch	1	EA	2,669.28	$2,669.28
292	ATS, 60A, auto transfer switch	1	EA	1,584.64	$1,584.64
293	generator, 40kW, diesel, w/ 8hr tank (incl. exhaust/piping/vents/fill alarm), allow	1	LS	30,000.00	$30,000.00
294	panelboard, emergency only power, panel replacement	1	EA	3,410.15	$3,410.15
295	panelboard, normal/emergency power, panel replacement	1	EA	3,410.15	$3,410.15

Row #	Item Description	QTY	Unit	Total Unit Price	Total
296	panelboard, standby power, 208/120V, 3P, 4W, w/125A main	1	EA	3,640.57	$3,640.57
298	**F20 Selective Demolition**	**7,302**	**GSF**	**0.24**	**$1,762.53**
299	electrical demolition, generator, 30kW, natural gas	1	EA	1,762.53	$1,762.53
301	**Basement Total**				**$51,477.31**
303	**--- Base Estimate --- Total**	**7,302**	**GSF**	**225.98**	**$1,650,084.46**
	Add Alternate #1 - weatherproof sound attenuated generator housing				
	Basement				
307	**D50 Electrical Systems**	**7,302**	**GSF**	**0.65**	**$4,730.39**
308	generator, weatherproof/sound attenuated housing	1	EA	4,730.39	$4,730.39
310	**Basement Total**				**$4,730.39**
312	**Add Alternate #1 - weatherproof sound attenuated generator housing Total**	**1**	**LS**	**4,730.39**	**$4,730.39**
	Add Alternate #2 - 2nd floor rooftop condensing unit in lieu of chilled water				
	Rooftop HVAC				
316	**D30 HVAC**	**7,302**	**GSF**	**1.71**	**$12,458.24**
317	DX condensing unit, 22 ton, rooftop mounted	1	LS	21,458.24	$21,458.24
318	AHU, DX coil in lieu of CH coil, INCLUDED		INCL		$0.00
319	HVAC pipe, CH S&R, allow reduction for add alt 2	-300	LF	30.00	($9,000.00)
320	**Rooftop HVAC Total**				**$12,458.24**
322	**Add Alternate #2 - 2nd floor rooftop condensing unit in lieu of chilled water Total**	**1**	**LS**	**12,458.24**	**$12,458.24**
325	**Grand Total**	**7,302**	**GSF**	**228.33**	**$1,667,273.09**

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University Review, Comments and Responses

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MEMO

McHugh Engineering Associates, Inc.
550 Pinetown Road, Suite 205
Fort Washington, PA 19034

Phone: (215)641-1158
Fax: (215)641-0194
Email: general@mchugheng.com

Date: May 18, 2011

To: Richard Linsky - Nalls Architecture

From: Mike Witkowski / Brian Malloy

Re: Penn State University Abington - Chemistry Lab #10.115

<u>Architectural:</u>

Nalls pg. 3 "Equipment" - make sure type of fume hoods and controls are selected and coordinated with HVAC to optimize energy savings

Response by Nalls Architecture, Inc.: The fume hood basis of design has been amended to include the following in coordination with the mechanical basis of design: "Fume hoods shall be restricted bypass type with integrated sash position and occupancy sensors configured for interconnection to the HVAC system to optimize energy savings. Coordinate alarm and airflow indicator device requirements with the building automation system." Further refinement and coordination should occur as the design progresses.

1. Provide occupancy sensing regardless of whether multi scene controls are provided.

Response: Multi-scene control and vacancy detection will be provided to offer the most flexibility and energy efficiency.

2. 100A seems too much for Life Safety, confirm that the breakers between LS and Standby shouldn't be reversed. (IE 100A for Standby)

Response: The 100A ATS (208/120V, 3 ø, 4w) gives complete replacement capabilities to the 150A (120/240V, 1 ø, 3 w) ATS that is being removed. The new standby power will be increased from 60 Amp to 200 Amp to allow for the hood exhaust fan to be provided with back-up power. In addition, the genset will be increased to 80 kW.

3. Blair Malcom emails dated 5-09-11 and 5-10-11 regarding Woodland power factor.

Response: Under the new PECO tariff, the 'penalty' for low power factor is increasing the measured demand by the ratio of the standard power factor and the measured power factor. Example: Measured power factor is 0.81. Standard power factor is 0.90 (for demands up to 2500 kW). 0.9 ÷ 0.81 = 1.11. The demand is increased by 11% for a measured peak of 1,000 kW, the billed kW is 1111 kW. At $3.59 per kW, the *'penalty' is "398.49 (for one month).*

We agree that further investigation into this is required. The capacitor installation could be 10's of thousands of dollars. The payback, given the present tariff, needs to be verified. This investigation is not part of the present scope of work. We can provide a fee to perform this investigation and design. Please advise.

Further, the existing Square D meter on the 750 kVA substation is not operational. We recommend that a Square D technician or qualified electrical contractor be hired to determine the metering issue.

<u>Mechanical:</u>

1. (McHugh Memo - "Second Floor HVAC") - Determine winter humidification requirements.

Consult with User to establish indoor temperature and humidity control requirements to meet chemistry lab criteria.

It is important to (1) review design parameters with the safety officers and scientific staff, (2) determine limits that should not be exceeded, and (3) establish the desirable operating conditions. For areas requiring variable temperature or humidity, these parameters must be carefully reviewed with the users to establish a clear understanding of expected operating conditions and system performance.

If humidification is required, evaluate least energy & maintenance intensive options. Ultrasonic has much lower energy requirements than steam generating type, but it does require high water quality. Might be an opportunity to combine with option for RO/DI system for lab water.

Response: As part of the next phase, specific operating conditions will be reviewed with the end user. We will add a cost line item for humidification and review options during design.

2. (McHugh Memo 1. b) - Are there any high hazard safety risks at any hoods that would require them to have standby electrical power to enable them to run through loss of normal power?

A generator replacement is being planned. It might not be a huge incremental cost to add capability at this point.

Response: As part of the next phase, this question will be reviewed with the end user.

We will increase the size of the generator for pricing. We will anticipate the research lab hoods and chemical prep hoods will go on the generator.

3. (McHugh Memo pg. 1 “Mechanical”) - Connecting to chilled water plant would be preferable if plant has sufficient capacity. Avoid more compressors and DX control issues if possible.

Try to check with design engineer of chiller plant to see if there was any diversity/future capacity planned.

Response: We have sent an email requesting PSU to check with the previous engineers - Highland Associates.

4. (McHugh Memo pg. 2 “Mechanical” 1. C)

Fume hood exhaust can't have fire dampers. Coordinate requirements for fire rated shafts and/or fire rated duct fire wrap assembly.

Consider variable geometry discharge dampers to maintain required discharge velocity with fan speed control if potential energy savings has significant benefit for lowest life cycle cost of system.

Response: The fire dampers are for the supply ductwork. Fire dampers will not be used in the hazardous exhaust. Variable geometry dampers will be reviewed during the actual design.

5. (McHugh Memo pg. 2 “Mechanical” 1. D) - Has it been confirmed there is no antifreeze in existing system?

Are there any other units in existing system that have been subject to freezing that would benefit by adding glycol to whole system?

Response: The existing chilled water system has glycol. We will remove cost requirement.

6. (McHugh Memo pg. 3 “Mechanical” Third Floor 2. b) - Consider variable geometry discharge dampers to maintain required discharge velocity with fan speed control if potential energy savings has significant benefit for lowest life cycle cost of system.

Response: Variable geometry dampers will be reviewed during the actual design.

7. (McHugh Memo pg. 4 “Plumbing” 2. d) - From recent project experience, Duriron is expensive, brittle and possibly proprietary. If acid waste piping is determined to be needed inside building, typically it is now often done

with plastic, either CPVC (such as Charlotte Pipe "ChemDrain" or Spears "LabWaste") or polypro systems for corrosive waste piping - except in areas/plenums requiring 25/50 smoke ratings.

Response: Duriron was noted to match existing piping and was noted in the University specifications on line for outdoor piping. We noted Duriron to be consistent. We can revise the piping to one of the suggested styles.

8. (McHugh Memo pg. 4 “Plumbing” - 2. c) - Review most energy-efficient options to supply the level of water purity required for the project. Distillation vs. RO/DI/UV. Distillation might be the most energy, water, and maintenance intensive and might not provide the purity level preferred.

Response: We were directed by the end users to use distillation. During design, we can evaluate operating costs both from energy and maintenance perspective.

9. (McHugh Memo pg. 4 “Plumbing” Second Floor - 2. C) - Spears LXT might be a viable alternative for high purity water distribution. Easier to install and modify than heat fusion joints of polypro. But might not be satisfactory depending on specific researcher requirements.

http://www.spearsmfg.com/prod_brochures/LXT-2-1002_0408_web.pdf

Response: As part of the next phase, we can review with the end user. The current price is the more expensive option.

10. (McHugh Memo pg. 4 “Plumbing” 2. d) - Review project specific acid waste system requirements with OPP.

From recent project experience, Duriron is expensive, brittle and possibly proprietary. If acid waste piping is determined to be needed inside building, typically it is now often done with plastic, either CPVC (such as Charlotte Pipe "ChemDrain" or Spears "LabWaste") or polypro systems for corrosive waste piping - except in areas/plenums requiring 25/50 smoke ratings.

Response: Duriron was noted to match existing piping and the University specifications on line for outdoor piping. We noted Duriron to be consistent. We can revise to one of the suggested styles.

11. Acid neutralization tanks have been problematic and can become hazardous sites. Review with John Gaudlip, Utility Systems EngineerJwg3@nw.opp.psu.edu814-863-8741

Typical PSU EHS policy is not to allow acids/hazardous chemicals to be dumped into drains.

Also check with local sewer authority.

Response: According to John Gaudlip the centralized site acid tank has been removed.

12. (McHugh Specification Section 15750 2.05 f.) Bearings shall be regreaseable, minimum L10 life of 200,000 hours (preferred, but no less than L10 life of 100,000 hours - Note: L50 life of 200,000 hours is NOT acceptable.)

Response: L-10 will be specified.

13. (McHugh Specification Section 15750 2.06 C) include motor shaft grounding.

Response: Motor shaft grounding will be included.

14. (McHugh Specification Section 15750 2.07 C2) Review. Why cupro-nickel in lieu of copper? Why 0.035" in lieu of more typical 0.020-0.025". Is the additional cost justified?

Response: We can reduce the requirement to copper and .025" thickness.

15. (McHugh Specification Section 15750 2.06 E) Used fixed pullies on all units with variable frequency drives.

Response: Fixed pullies will be used or direct drive units could be incorporated if PSU allows.

16. (McHugh Specification Section 15750 2.07 C1.) good.

17. (McHugh Specification Section 15750 2.07 D) Review. Why cupro-nickel in lieu of copper? Why 0.035" in lieu of more typical 0.020-0.025". Is the additional cost justified?

Response: We can reduce the requirement to copper and .025" thickness.

18. (McHugh Specification Section 15750 2.07 E 3) Coordinate with item 8 below.

19. (McHugh Specification 15750 2.07 E 8) Is this "electro-fin" a proprietary name or process? We agree with need for protecting the coil. Just asking for specs to try to be non-proprietary and/or call out protective requirements.

Response: Electro-fin is a proprietary process, but is it not propriety to this AHU *manufacturer. We believe this process to be durable. We recommend a protective coating be applied for this application. We can specify any coating PSU desires.*

20. (McHugh Specification Section 15750 2.11 E) Omit - does not apply in this section.

Response: Item will be deleted.

21. (McHugh Specification Section 15750 2.12 D) Run a dedicated 120v circuit for lights and receptacles.

If the main protective device trips or is shut off in building distribution panel, the light and receptacles are off as well if on a single connection with transformer.

Response: A separate dedicated circuit will be provided.

BM/MW:ec

cc:

X:\ARCHITECTS CLIENTS - ACTIVE\Nalls Architecture, Inc\Penn State Abington Chem Lab\2011 5-18 OFFICE MEMO to Richard Linsky RE Comments .wpd

Cost Estimate Supplement

The following cost information is provided as a supplement to the construction cost estimate produced by Moss Construction Cost Management, Inc. It has been developed in response to items noted in the University Review comments.

Engineering Review Responses

Humidification

As noted in the enclosed memo, McHugh Engineering has added humidification sections to the air handling unit specifications in the report. Moss Construction Cost Management, Inc. estimates that this revision would add a gross cost of $10,000 - 20,000 to the overall gross project cost on page 6 of the original estimate, included in this report. The revision, if accepted, would impact the estimate as follows:

Moss Estimate, Page 6, Total Gross Cost	$2,330,873
Add Alternate #3 - Humidification	+$12,000
Revised Total Gross with Humidification:	$2,342,873

Emergency Generator

As noted in the enclosed memo, McHugh Engineering has increased the size of the emergency generator equipment and related panels and switches to accommodate added load. Moss Construction Cost Management, Inc. estimate that this revision will add $22,000 to the overall gross project cost on page 6 of the original estimate, included in this report. The revision, if accepted, would impact the estimate as follows:

Moss Estimate, Page 6, Total Gross Cost	$2,330,873
Add Alternate #4 - Generator Size Increase	+$22,000
Revised Total Gross with Humidification:	$2,352,873

Revised Total Estimate Including All Revisions:

The revised gross total cost, including all alternates, would be calculated as follows:

Moss Estimate, Page 6, Total Gross Cost	$2,330,873
Add Alternate #3 - Humidification	$12,000
Add Alternate #4 - Generator Size Increase	+$22,000
Revised Total Gross with Humidification:	$2,364,873

The Pennsylvania State University

Penn State Abington (OZ) Campus

Woodland Building - HVAC Upgrade Study

PSU Project No. 01-02921.01
PS&S Project #03822-006

DRAFT Report
13 January 2012

PS&S
integrating design & engineering

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Table of Contents

A. Executive Summary

The objective of this study was to observe the general condition and age of the existing equipment and systems in the Woodland Building on the PSU Abington Campus, and provide recommendations for HVAC utility and infrastructure upgrades. Additionally the study evaluated the potential for energy savings and improved operation from the seven HVAC Design Initiatives provided by PSU, and reviewed the HVAC concepts for the planned upgrade of the Chemistry Lab facilities on the Second and Third floors of the East Wing.

The majority of the HVAC systems and equipment were installed during a major renovation of the building conducted circa 2004/2005, and is in relatively good condition. There are, however, some individual pieces of equipment that are older (some dating back to the original construction in the early 1970s) and in need of replacement; in addition, some items from the recent renovations are not operating properly (e.g., heating hot water pump VFDs). The report includes proposed upgrades based on age and condition, with construction cost estimates for each.

Many of the recommended design/construction elements of the PSU Design Initiatives that were reviewed were found to be in place already (for example: Design Initiative IV HVAC Zone Valve Replacement, describes nine potential causes of problems with zone valves, only one of which was observed in the building; this same initiative describes four potential strategies for implementing the initiative, only one of which was found to be applicable). Even so, there was at least one element of each of the seven HVAC Design Initiatives that was found to be missing, and therefore a potential to address. The report includes a prioritized list of Design Initiatives to be implemented, with construction cost estimates for each.

The HVAC concepts proposed by Nalls Architecture Inc. (NAI) and McHough Engineering Associates (MEA) appear to be appropriate for the upcoming Chemistry Lab renovation project, although we do have several comments/questions (primarily regarding their assessment of the new equipment load, and the amount of air flow for the Third Floor teaching lab).

Our detailed observations and recommendations appear in the sections below.

B. Introduction/Background

The Woodland Building on the PSU Abington Campus is a large academic facility that has four main floor levels that include a ground floor and first through third floors. This structure houses traditional classrooms and laboratories, the main campus library and a large fixed seat lecture hall. The east wing of this facility was reported to have been originally constructed in 1971 and a subsequent west wing was constructed in 1973.

The objective of this study was to observe the general condition and age of the existing equipment and systems and provide recommendations for HVAC utility and infrastructure upgrades. Additionally the study evaluated the potential for energy savings and improved operation from the seven HVAC design initiatives provided by PSU.

PS&S reviewed the existing drawings furnished by the client and surveyed the major HVAC equipment in order to ascertain age and general physical condition. In addition, PS&S performed a screening level assessment and field verification at the Woodland Building with respect to the specific items that were identified from the seven Design Initiatives provided by PSU as potential ways to improve building efficiency and operation. With assistance from the PSU Abington Facilities department and the building automation department at PSU University Park, the status of representative pieces of HVAC equipment were observed, the corresponding BAS screens reviewed and the equipment was exercised to determine operability and functionality under actual and simulated conditions, as needed.

Our observations and recommendations appear in the sections below.

C. Existing Systems and Equipment

Existing Systems Overview

The primary source of heating for this facility is three natural gas fired hydronic boilers. These boilers generate heating water that is circulated to the east side of the building via two 10 HP pumps and to the west side of the building via two 5 HP pumps. The hot water is pumped through finned tube radiators, hot water coils in blower coils, unit ventilators and air handling units and duct mounted re-heat coils to provide heating during the winter months. The Pacific Boiler (PB) boiler was installed during the last renovation circa 2004. The other two boilers are Weil McLain boilers. One was installed in 1991 while the other is from original building construction in 1971. The boiler installed in 1971 is inoperable and has been deemed unnecessary.

The primary source of cooling for this facility is from two Carrier screw chillers (installed during the last renovation circa 2004, along with the cooling tower and all of the chilled water and condenser water pumps and distribution piping) which provide chilled glycol-water mixture for comfort cooling. The chilled water is circulated through chilled water coils in blower coils, unit ventilators and air handling units located throughout the facility via two 40 HP pumps with variable frequency drives. The heat generated from the cooling process is rejected to a condenser water system. This condenser water is pumped with two 30 HP pumps through the chillers and ultimately to a two-cell roof mounted Baltimore Air Coil cooling tower where the building heat is rejected.

The unit ventilators are Magic Aire through-the-wall vertical units and provide both heating & cooling. The unit ventilators serve the classrooms, laboratories & offices located primarily along the exterior. The blower coils are Magic Aire units & provide heating & cooling to building corridors, interior laboratories & classrooms. The roof mounted air handlers serve primarily the 3rd floor spaces with a few exceptions. RTU-1E is a dedicated multi-zone unit serving the 3-story library. Supply ductwork is brought down to the first floor through building shaft space. RTU-2E is a constant volume air handling unit dedicated to the 2nd floor lecture hall. RTU-3E is a variable volume air handling unit serving offices & corridors on the 2nd and 3rd floors as well as the 1st floor lobby. The balance of the air handlers are on the west wing roof and serve all classrooms, computer rooms & laboratories on the 3rd floor. The CUVs, BCs and RTUs were all installed as part of the previous major HVAC renovation circa 2004, except for RTU-2E which was installed in 2009.

A variety of roof mounted utility set fans provide laboratory exhaust for the laboratories in the east wing. They are from the original building construction and operate via local control.

<u>Existing Equipment Conditions:</u>
The PB boiler located in the boiler room was installed during the last renovation (circa 2004 – 2005) and is relatively new. It also appeared to be in good operating condition.

The Weil-McLain boiler installed in 1991 is operating without any reported issues and appears to be in good physical condition. It has not exceeded its median service life of 25 years as determined by ASHRAE HVAC Applications 2011 data.

The Weil McLain boiler installed in 1971 that is not operational should be removed to allow for future expansion.

There is an existing Cleaver Brooks steam boiler (for laboratory process steam) in the boiler room. It was installed in 1990 and has not exceeded its median service life of 25 years. It appears to be in good physical condition.

There is an existing AO Smith hot water heater and storage tank installed during the original building construction. They appear to be in poor condition and have exceeded their median service life of 20 years as determined by ASHRAE HVAC Applications 2011 data.

The hot water pumps in the boiler room installed circa 2004 that serve the east side of the building are relatively new and are in good operating condition and have not exceeded their median service life of 20 years.

The hot water pumps installed in 1972 that serve the west side of the building are from the original building construction. They are in fair condition but have exceeded their median service life of 20 years as determined by ASHRAE HVAC Applications 2011 data.

There are two existing John Wood air compressors, one located in each mechanical room. They provide compressed air for the laboratories and were installed during original building construction. They appear to be in poor condition and have exceeded their median service life of 20 years as determined by ASHRAE HVAC Applications 2011 data.

The three exhaust fans located in the boiler room have ceased to function. They were installed as part of the original building construction and have exceeded their median service life of 20 years as determined by ASHRAE.

The existing two Carrier screw chillers, two chilled water pumps, cooling tower and two condenser water pumps are located in the chiller room and were all part of the latest renovation circa 2004. All of this equipment is relatively new, operating properly and in good condition. None of this equipment has exceeded its median service life (i.e., 23 years for chillers, 20 years for cooling towers, and 20 years for pumps).

The existing unit ventilators, blower coils & air handlers were all installed as part of the latest renovation circa 2004. All of this equipment is relatively new, were functioning and appeared to be in good condition. None of this equipment has exceeded its median service life (i.e., 20 years for unit ventilators and blower coils, and 15 years for rooftop air handlers).

The laboratory fans on the building roof are from the original building construction circa 1972. They are stand-alone fans with local controls. They are completely rusted over and the name plates are illegible. The fans have exceeded their median service life of 20 years as determined by ASHRAE.

The existing generator in the boiler mechanical room, manufactured by Onan, appears to be original equipment, in which case it exceeds its median service life of 20 years; however, it is reportedly in good working order and exercised on a regular basis. We would expect that this equipment could remain; however, we note that the Chemistry Lab Upgrade project scope prepared by Nalls Architecture Inc. (NAI) and McHough Engineering Associates (MEA) calls for it to be replaced with a larger unit (increasing from 30 kW to 80 kW) to provide additional capacity for the Chemistry Lab program.

D. Proposed Equipment Upgrades and Improvements Due to Condition and Age

- The exhaust fans in the boiler room should be replaced with new. The fans should be interlocked with the outside air dampers & control tied into the BMS system. They should operate via thermostatic control to prevent extreme temperature swings during the summer and winter months. Also, the motor controls for these fans, located in the MCC in the electrical room adjacent to the Boiler Room, are also reportedly in bad condition; replacement of the fans should include replacement of the fan controls in the MCC. We estimate the cost to implement this project to be about $30,000. A breakdown of this cost estimate is included in Appendix B.
- The VFDs for the heating pumps serving the east side have failed and consequently the pumps are running at full flow. It is PS&S's recommendation that the VFDs be replaced. (This is also discussed under part D, Review of PSU Design Initiatives, of this report.)
- The heating pumps serving the west side are from the original building construction and should be replaced with new. PS&S recommends that VFDs be provided as well. (This is also discussed under part D, Review of PSU Design Initiatives, of this report.)
- The laboratory fans on the building roof should be replaced with new.
- It was observed that no zone or local control valves exist in the majority of the perimeter heating system, resulting in overheated corridors. PS&S recommends either zone or local control valves be installed. (This is also discussed under part D, Review of PSU Design Initiatives, of this report.)
- The VFDs on RTU-1W and RTU-3E have failed and need to be replaced. (This is also discussed under part D, Review of PSU Design Initiatives, of this report.)
- It was brought to PS&S's attention that some Belimo control valves located on the heating and cooling system seat too tightly. PS&S did not observe any valves in this condition during the field checks for the PSU Design Initiatives. If concerns persist, PS&S recommends this functionality be further investigated.
- It was brought to PS&S attention that two-way and three-way valves at the blower coils have been leaking. PS&S observed ceiling damage at these locations throughout the building, although we did not observe valves leaking. (Many of the control valves observed were un-insulated, which could lead to condensation

which could cause the observed ceiling damage; roof leaks may also have caused or contributed to the observed ceiling damage.) If concerns persist, PS&S recommends this functionality be further investigated.

- It was brought to PS&S's attention that water has been condensing on the chilled water pipes in the ceiling, reportedly due to an inadequate vapor barrier. PS&S observed damaged ceiling tiles and insulation as a result of water damage throughout the building. As noted in the item above, many of the control valves observed were un-insulated, which could lead to condensation which could cause the observed ceiling damage (and possibly the observed insulation damage); roof leaks may also have caused or contributed to the observed ceiling damage. PS&S recommends that the pipe insulation be further investigated and that these areas be re-insulated as needed. We estimate the unit cost to insulate a ¾" control valve to be about $50 each.
- The existing AO Smith hot water heater and storage tank should be replaced with new. We estimate the cost to replace the existing domestic hot water heater and storage tank to be about $37,700. A breakdown of this cost estimate is included in Appendix B.
- The Weil McLain boiler that is currently inoperable should be removed in its entirety. (No replacement is required, as it has been determined that this boiler is not necessary.) We estimate the cost to demolish the boiler to be about $6,275. A breakdown of this cost estimate is included in Appendix B.
- The two existing John Wood air compressors located in both the boiler and chiller mechanical rooms should be replaced with new in preparation for future lab work. We estimate the cost to implement this project to be about $18,000. A breakdown of this cost estimate is included in Appendix B.

E. Review of PSU Design Initiatives

PS&S performed a screening level assessment and field verification at the Woodland Building with respect to the specific items that were identified from the seven Design Initiatives provided by PSU as potential ways to improve building efficiency and operation. With assistance from the PSU Abington Facilities department and the building automation department at PSU University Park, the status of representative pieces of HVAC equipment were observed, the corresponding BAS screens reviewed and the equipment was exercised to determine operability and functionality under actual and simulated conditions, as needed.

The Design Initiatives are discussed below in the order in which they appear on the list furnished by PSU.

<u>I. Chemical Treatment Initiative</u>
PS&S found no major deficiencies with the chemical treatment system in the boiler room. The shot feeder appears to be old and may need to be replaced. The glycol tank is in good condition. Overall, the piping appeared to be in good condition. At the present time there is no way of metering the water.

PS&S recommends installing an automatic meter and a new shot feeder. We estimate the cost for these upgrades to be about $10,400. A breakdown of this cost estimate is included in Appendix B.

PS&S found no major deficiencies with the chemical treatment system in the chiller room. The shot feeder, coupon rack and glycol tank appear to be in good condition. Overall, the piping appeared to be in good condition. At the present time there is no way of metering the water.

PS&S recommends installing an automatic meter. We estimate the cost for this upgrade to be about $7,500. A breakdown of this cost estimate is included in Appendix B.

<u>II. Exhaust Fan Control Initiative</u>
The existing constant volume exhaust fans that serve the laboratories are from the original building construction and the construction of the West Wing addition. They are stand-alone fans and are in poor physical condition. It is recommended that the laboratory exhaust fans be replaced as needed, and as individual labs are renovated as part of the laboratory design. In cases where the entire HVAC system is being renovated as part of a laboratory renovation project, PS&S recommends that new fans be provided with VFDs to match the usage of the hoods and be tied into the existing BMS system to modulate the make-up air as appropriate. The scheduled operation of the

fans, and whether or not to provide a VFD, will ultimately depend on the usage of the new laboratories and whether or not the existing make-up air equipment is being re-used or replaced. For the laboratories in the West Wing, which are not currently slated for renovation, we recommend the replacement of the eight existing exhaust fans with new. The cost to implement this project is estimated at $80,100. A breakdown of this cost estimate is included in Appendix B.

III. Outdoor Air and Economizer ACF Control Initiative

A) Outdoor air: Many of the air handling systems in buildings at the University Park Campus are providing more outdoor air (OA) than is required. This initiative evaluates the contributing factors that can be resolved through a design and construction effort. These factors include but are not limited to:

1. *Systems were designed prior to ASHRAE Standard 62-2007 and the IMC 2009.*
    a. The required OA based on the above are significantly less than that required by most previous standards and codes. The existing design parameters were compared to IMC 2009 and ASHRAE Standard 62-2007 requirements. It was determined that the required outdoor air based on the current standards is less than that required by the previous code. Appendix A contains a unit by unit summary of the OA quantities required per design versus that which is required by the current code requirements.
2. *Systems have no means for demand control ventilation to reduce OA for off peak occupancy conditions.*
    a. BAS controls for all of the rooftop air handling units (RTUs) serving the Woodland building include some form of demand control ventilation (DCV) based on CO2 concentration in the space(s) or in the return air ductwork. The DCV function for RTU-3E has been inhibited in the BAS.
3. *OA damper controls are not working properly.*
    a. Operational testing was conducted on the outside air (OA) dampers for representative RTUs, classroom unit ventilators (CUVs) and blower coils (BCs) that are equipped with OA dampers. The majority of the units tested were found to be operating properly, except as noted in the tables below.

Table 1 OA Damper Conditions

Unit	Condition
RTU-7W	OA dampers found locked at 15% open in BAS; operational
RTU-3E	OA dampers found locked at 15% open in BAS; operational
RM 313 CUV-11E	OA dampers found locked at 0% open in BAS; operational
RM 313 CUV-12E	OA damper reportedly removed due to failure
RM 126 CUV-2E	CUV is failed
RM 123 CUV-3E	OA dampers found locked at 50% open in BAS; operational
RM 124 CUV-4E	OA dampers found locked at 0% open in BAS; operational

RM 220 CUV-6E	Fan switched is off; HHW valve is locked 100% open
RM 135A CUV-8W	Unit not in service

We recommend repairing the units listed above. For those units that have the OA dampers or other settings manually overridden in the BAS, the underlying cause should be identified and resolved.

4. *Systems do not have air flow station (AFS) to determine actual OA cfm*.
    a. RTU-2E has an Ebtron flow measurement station that measures OA airflow. All other RTUs do not have an OA airflow station.
5. *Systems do not have proper schedule or sequences for providing OA during occupied periods only.*
    a. All systems are occupied from 5:00 AM to 10:00 PM and are otherwise unoccupied. This schedule is in effect six days per week (unoccupied mode on Sundays), year round. OA quantities provided during occupied modes are controlled by demand controlled ventilation (DCV) or economizer operation.

B) Economizer: Many of the air handling systems in buildings at the University Park Campus are not operating in the economizer mode as efficiently as possible. This initiative evaluates the contributing factors that can be resolved through a design and construction effort. These factors include but are not limited to:

1. *OA, RA, and EA dampers are not working properly.*
    a. The return air (RA) dampers for the constant volume RTUs and all CUVs are interlocked with the OA dampers and the operation was checked for representative units as discussed in the section above. The only RTU with integral exhaust air (EA) dampers (and EA fan) is RTU-2E; all other RTUs do not have any EA dampers. RTU 1-E has a duct-mounted relief air vent. The CUVs and BCs do not have EA dampers.
    b. The economizer mode was checked for representative RTUs and CUVs by simulating the appropriate outdoor air conditions and room conditions, and where necessary (for RTUs), overriding the demand control ventilation (DCV) function. The OA damper status was then observed at the BAS. The economizer mode was found to be operational for the units examined, with the exception of the units whose OA dampers were inhibited in the BAS or otherwise non-functional, as noted in Table 1.
2. *Temperature and humidity sensors are not reading correctly.*
    a. PS&S checked the accuracy of the OA temperature and OA relative humidity data provided by the Woodland building's central OA station located on the exterior of the east wall of the West Wing of the Woodland building. At 12:53 PM on November 11, 2011, the BAS was reading 47.5°F and 45% RH. PS&S obtained a temperature reading of 48°F at that time in close proximity to the central station sensors. According to climatological data for Northeast Philadelphia at that time was 46.9°F and 44% RH. The OAT and OARH data reported by the BAS appear to be reasonable based on these observations.
    b. A second accuracy check was conducted on November 23, 2011: at 8:33 AM the BAS was displaying 45.7°F and 98.0% RH. An independent reading of 46°F was obtained by PS&S at about the same time in the vicinity of the central station. It was raining at the time, corroborating the 100% RH reading.
    c. A third accuracy check was conducted on December 6, 2011 at 11:42 AM, the BAS OA temperature was reading 59.1°F and the OA relative humidity was reading 98.1%. PS&S obtained an independent temperature measurement at that time of 59°F in the vicinity of the central station. It was raining at the time, corroborating the 100% RH reading.

d. Archived OA temperature and relative humidity trend data for the period December 2, 2011 through December 8, 2011 was extracted from the BAS by PSU and qualitatively compared by PS&S to publicly-available climatological data for the same general region for the same time period. The close correlation of the data further supports the relative accuracy of the OA data for the Woodland building.

e. It should be noted that the above checks are not a substitute for a true instrument calibration.

3. *Improper BAS sequences.*
The BAS sequences economizer functions for most of the RTUs were found to be permitted based on OA temperature and OA enthalpy conditions and a comparison of the OA enthalpy and return air enthalpy, which is generally consistent with the economizer provisions of the *PSU Sequence of Operation Guideline Air Handling Units – Variable Air Volume* (VAV Guideline SOO). The economizer routines for all RTUs are subordinated to DCV routines. The economizer functions for the CUVs are permitted based on OA enthalpy only.

The combination of these conditions results in many hours of unnecessary energy use for heating and cooling. Some of the expected strategies would include:

1. *Installation of Ebtron air flow station (AFS).*
   a. Section D, *Minimum Outside Air/Demand Based Ventilation Control of the PSU Sequence of Operation Guideline Air Handling Units – Variable Air Volume* (VAV Guideline SOO) requires an airflow station to monitor the minimum OA airflow and also requires monitoring of the OA damper position by the BAS. Two of the RTUs serving the Woodland Building are variable air volume (VAV) units: RTU-3E and 1W, however both are currently operated as constant volume systems due to problems with the VFDs. RTU-2E, which serves the Lecture Hall, is equipped with VFDs for the supply and exhaust; however the system operates as a constant volume unit. RTU-2E has an OA airflow monitoring station, separate OA and RA dampers, and monitors the OA damper position. RTU-3E and 1W do not have these provisions. All of the other RTUs serving the Woodland building are packaged constant volume units and are also not equipped with these features. Given the age of the existing RTUs, the costs of retrofitting OA flow stations, the other necessary cabling and hardware, and changes to the BAS that would be needed to monitor and control the OA dampers based on actual OA airflow, we do not recommend the installation of OA airflow stations. The return on investment is not justified and we instead recommend resetting the OA airflows described under Item #4 below.
2. *Utilizing enthalpy control with inputs from central OPP temp and enthalpy sensors (building return air and outdoor enthalpy, and temp are too difficult to maintain properly).*
   a. The PSU Abington campus does not have a central OA station, and the BAS controls for the Woodland building are referenced to the Woodland building's central OA station.
3. *Use of standard PSU sequences.*
   a. The PSU *Guide Sequence of Operation for Air Handling Units – Variable Air Volume* (dated November 2101)was obtained here:

http://www.opp.psu.edu/planning-construction/design_and_construction_standards/division-25-integrated-automation

No guide sequences of operation were found for constant volume air handling units, classroom unit ventilators (CUVs), or blower coil units (BCs).

The OA and economizer sequence for RTU-2E (installed in 2009) appears to be generally consistent with the VAV Guideline SOO. However, the other VAV equipped RTUs lack the necessary hardware specified in the VAV Guideline SOO, including separate OA and RA dampers, and OA flow station.

We recommend that the VFDs for RTU-3E and 1W be repaired or replaced as appropriate. See Section VI, Air Handling Unit Fan VFD Initiative for more information.

4. *Design based on ASHRAE Standard 62-2007 and the IMC 2009.*
    a. The newer codes require less outdoor air than the earlier code requirements providing an opportunity to reduce OA airflows and conserve energy. The RTUs, blower coils, and unit ventilators can all be rebalanced to provide less outside air. It is recommended that for operation during the occupied mode, the existing minimum OA airflows be reduced as follows:
        i. Reduce the minimum OA airflow for RTUs, CUVs and applicable BCs to the proposed OA airflows listed in Appendix A and modify the BAS programming accordingly.
        ii. For additional savings, modify the BAS to close the OA damper when the CO2 concentration for the space served is below 400 ppm (adjustable) during the occupied mode. (This could potentially result in periods when spaces are lightly occupied but no outdoor air is being introduced; it may be necessary to confirm with the local code enforcement authorities that this additional step is acceptable. Note that if this step is implemented and results in indoor air quality complaints, it can be eliminated through re-programming only.)
        iii. The cost to accomplish these tasks is estimated to be about $33,200. A breakdown of this cost estimate is included in Appendix B.
5. *Return air CO2 sensors, occupancy sensors, or some type of input for demand control ventilation.*
    a. All of the RTUs have existing provisions for DCV including return air CO2 sensors, occupancy sensors, or some type of input for demand control ventilation.
6. *Belimo damper actuators.*
    a. Belimo damper actuators are currently in use in the RTUs, CUVs, and BCs.

IV. HVAC Zone Valve Replacement Initiative

Operational testing was conducted on a variety of zone control valves, including applications for variable air volume (VAV) boxes, library fin tube radiation (FTR), and duct-mounted reheat coils (RHC). Valves were driven from the BAS and flow was confirmed qualitatively based on perceived temperature changes in the piping.

It was brought to PS&S's attention that some of the Belimo control valves used at the HHW and CHW coils have been problematic, including leaking and seating too tightly. During our field activities, we did not encounter specific instances of these issues. Defective control valves should be replaced. We estimate the unit cost to replace a ¾" 2-way motorized control valve to be $390 each. A breakdown of this estimate is included in Appendix B.

Some of the HVAC hydronic water systems in buildings at the University Park Campus have problems at the zone valve control level. This lack of performance results in both energy waste and poor thermal comfort. This initiative evaluates the contributing factors that can be resolved through a design and construction effort. These factors include but are not limited to:

1. *Valves stick in a particular position.*
    a. No valves examined were found in this condition.
2. *Valves do not seat properly and allow flow when intended to be full closed.*
    a. No valves examined were found in this condition.
3. *Valve body or actuator failure.*
    a. No valves examined were found in this condition.
4. *3-way valves resulting in constant system flow.*
    a. The existing control valves for FTR, VAV terminal boxes and RHC are 2-way; see design initiative V, Air Handling Unit Valve Replacement Initiative for related discussion.
5. *Valves for one reason or another do not position themselves as intended by the control sequences.*
    a. No valves examined were found in this condition.
6. *Zones have no control valves and operate as wild coils.*

a. PS&S identified a total of four two-way hydronic zone valves that serve FTR zones on the east wall of the library on the ground, first and second floors. No other zone valves for the FTR were identified in the BAS or in the field. Many sections of FTR throughout the building were found to have had the isolation valves closed; reportedly to reduce overheating. The existing FTR zone valves are monitored by the BAS and are controlled based on the respective zone temperatures.

7. *Zone control does not communicate with building BAS*.
   a. No valves examined were found to have this condition.
8. *Valve screens or flow characterizing devices are clogged and restricting flow.*
   a. No issues concerning clogging and/or flow restriction were observed.
9. *Valve pressure differential at that point in the system requires pressure compensation for proper control and/or shutoff*.
   a. No issues concerning valve pressure differential were observed.

The design and construction effort should result in zone control that provides thermal comfort, minimizes pump and thermal energy. Some of the expected strategies would include:

1. *Installation of Belimo ball valves per PSU valve selection options*.
   a. We recommend the installation of 2-way control valves to create additional zones for the FTR system. We estimate the cost to implement this project, based on the creation of approximately 24 new zones in the existing FTR system, to be about $65,300. A breakdown of this cost estimate is included in Appendix B.
2. *Use of standard PSU sequences*.
   a. No guideline PSU SOO for this equipment was found.
3. *Piping package accessories per PSU per PSU selection options*.
   a. PSU Design Standards for Division 23 were reviewed here: http://www.opp.psu.edu/planning-construction/design_and_construction_standards/division-23-heating-ventilating-hvac#section-51
   b. Coil connections that were observed during field activities generally conformed to the requirements contained in Section 23 21 13 03, Hydronic Specialties.
4. *ALC BAS controls*.
   a. The existing ALC BAS system is controlling the existing four hydronic zone valves. As new zone valves are installed for FTR or other equipment, the ALC system should be modified to accommodate them.

V. Air Handling Unit Valve Replacement Initiative

Operational testing was conducted on representative control valves at several of the RTUs, CUVs and blower coil (BC) units. Valves were driven from the BAS and flow was confirmed qualitatively based on perceived temperature changes in the piping.

It was brought to PS&S's attention that some of the Belimo control valves used at the HHW and CHW coils have been problematic, including leaking and seating too tightly. During our field activities, we did not encounter specific instances of these issues. Defective control valves should be replaced. We estimate the unit cost to replace a ¾" 2-way motorized control valve to be $390 each. A breakdown of this estimate is included in Appendix B.

Some of the air handling unit hydronic water and steam valves in buildings at the University Park Campus have problems. This lack of performance results in both energy waste and poor thermal comfort. This initiative evaluates the contributing factors that can be resolved through a design and construction effort. These factors include but are not limited to:

1. *Valves stick in a particular position*.
   a. No valves examined were found in this condition.
2. *Valves do not seat properly and allow flow when intended to be full closed.*
   a. No valves examined were found in this condition.
3. *Valve body or actuator failure*.
   a. No valves examined were found in this condition.

4. *3-way valves resulting in constant system flow*.
    a. The CHW control valves for the RTUs are 3-way. The HHW control valves for the BCs are 3-way. RTU-1E is equipped with 3-way control valves for both HHW and CHW.
5. *Valves for one reason or another do not position themselves as intended by the control sequences.*
    a. No valves examined were found in this condition.
6. *Valve controller does not communicate with building BAS.*
    a. No valves examined were found in this condition.
7. *Valve screens or flow characterizing devices are clogged and restricting flow*.
    a. No issues concerning clogging and/or flow restriction were observed.
8. *Valve pressure differential at that point in the system requires pressure compensation for proper control and/or shutoff*.
    a. No issues concerning valve pressure differential were observed.

The design and construction effort should result in valve flow control that provides thermal comfort, minimizes pump and thermal energy. Some of the expected strategies would include:

1. *Installation of Belimo valves per PSU valve selection options*.
    a. Existing RTUs, BCs and CUVs observed all utilize Belimo valves.
2. *Use of standard PSU sequences*.
    a. No guideline PSU SOO for this equipment was found.
3. *Piping package accessories per PSU per PSU selection options*.
    a. PSU Design Standards for Division 23 were reviewed here: http://www.opp.psu.edu/planning-construction/design_and_construction_standards/division-23-heating-ventilating-hvac#section-51
    b. Coil connections that were observed during field activities generally conformed to the requirements contained in Section 23 21 13 03, Hydronic Specialties.
4. *ALC BAS controls*.
    a. Existing RTUs, BCs and CUVs observed all utilize ALC BAS controls.

Consistent with recommendations for variable pumping listed under Section VII, Pump VFD Initiative, we recommend replacing the existing 3-way control valves for the CHW coils for the RTUs (12), the 3-way HHW control valves for the BCs (17), and the 3-way control valves for both HHW (1) and CHW for RTU-1E (1) with 2-way control valves. We estimate the cost to implement this project to be about $34,200. A breakdown of this cost estimate is included in Appendix B.

VI. Air Handling Unit Fan VFD Initiative

Three of the building's twelve RTUs are equipped with VFD controlled fans: RTU-1W, RTU-3E and RTU-2E. The VFDs for RTU-1W and RTU-3E are not operational and the controls have been overridden so that the fans are currently operating in constant volume mode at 100%. RTU-2E serves the Lecture Hall; RTU-3E serves offices and corridors on the Second and Third floors of the East Wing (along with the First Floor "Lounge" space); RTU-1W offices on the Second and Third floors of the link between the two wings. The supply air fan for RTU-2E is operating in a constant volume mode at 90% (reportedly locked during balancing) and the associated exhaust air fan modulates based on the amount of OA airflow. All other RTUs are constant volume units. RTU-2E was installed in 2009; the other eleven RTUs were reportedly installed circa 2004/2005.

The BCs are belt driven constant volume units, with motors rated from ½ to 1 ½ HP. The CUVs are direct drive constant volume units and the fan motors are rated at 1/8 HP.

Many older air handling unit fans in buildings at the University Park Campus operate as constant volume systems. Many newer air handling unit fans in buildings at the University Park Campus operate as variable volume systems but are not as energy efficient as possible. These conditions result in excess fan energy consumption. This initiative evaluates the contributing factors that can be resolved through a design and construction effort. These factors include but are not limited to:

1. *Constant volume fan control.*
    a. Three of the RTUs are equipped with VFD controls for the fans as described above.
2. *Inherently inefficient and/or malfunctioning variable inlet vane control.*

   a. There are no inlet guide vanes in use for any of the air handling units serving the Woodland building.
3. *Malfunctioning remote static pressure sensor.*
   a. Per the PSU Building Automation Group, the static pressure sensors associated with the VFD-equipped RTUs listed above appear to be working.
4. *BAS sequences lack or do not have and effective remote static pressure setpoint reset.*
   a. None of the BAS sequences for the RTUs contains a remote static pressure setpoint reset.
5. *Inefficient motors and belt drive assemblies.*
   a. All of the RTUs have belt-driven fans. Fan motor efficiencies are not indicated on the motor nameplates for the constant volume RTUs (RTU-1E, RTU-2W through 9W) nor are they indicated on the motor nameplates for RTU-1W. Fan motors were not accessible for RTU-1E and RTU-2E. The fan motor efficiency for RTU-3E is 91.7%. The return fan motor for RTU-1E is likely of lower efficiency, as the equipment schedule identifies this fan as an existing fan that was reused circa 2005. The efficiency rating of the fan motors in the CUVs and BCs was not available.

The design and construction effort should result in control that minimizes fan energy. Some of the expected strategies would include:

1. *Installation of VFD for variable air systems and existing constant volume systems.*
   a. Given the age of the packaged RTUs, retrofitting the existing constant volume RTUs is not recommended due to the age of the equipment and the marginal return on investment. We recommend repair or replacement of the existing VFDs for RTU-3E and 1W. We estimate the cost to replace these two VFDs at $5,100. A breakdown of this cost is included in Appendix B. The existing BCs and CUVs are not suitable for VFD retrofits.
2. *Installation of efficient motors and belt drive assemblies.*
   a. We recommend replacing the existing fan motors in the constant volume RTUs with high efficiency motors as needed due to failure or per the normal maintenance schedule. The efficiency of the fan motors that were not accessible should be confirmed as appropriate for the application. The return fan motor for RTU-1E should be replaced upon failure with high efficiency model. Similarly, motors for the BCs and CUVs should also be replaced as needed, as part of regular maintenance, with high efficiency models. In our experience, replacing functioning motors with higher efficiency models as an energy conservation measure generally does not provide a good return on investment; however, we note that in accordance with the Energy Independence and Security Act of 2007 (EISA), covered motors that are manufactured or imported for distribution in commerce in the United States on or after December 19, 2010, must comply with the applicable EISA energy conservation standards. As a result, replacement motors and motors furnished as a component of another piece of equipment after this date are required to be built, certified and labeled to NEMA premium efficiency standards. This means that any covered motors that are replaced after December 19, 2010 will automatically be premium efficiency motors.
3. *Installation of variable volume zone airflow.*
   a. Given the age of the packaged RTUs, retrofitting the existing constant volume RTUs is not recommended due to the age of the equipment and the marginal return on investment.
4. *Use of standard PSU sequences.*
   a. The SOO for RTU-2E is generally consistent with the VAV Guideline SOO. The equipment configuration of the VAV RTUs (RTU-3E and 1W) is not consistent with the requirements in the VAV Guideline SOO. Upgrading the hardware in order to follow the VAV Guideline SOO is not expected to provide a good return on investment and is therefore not recommended.
5. *ALC BAS controls.*
   a. Existing RTUs, BCs and CUVs observed all utilize ALC BAS controls.

VII. Pump VFD Initiative

The 10 HP heating hot water (HHW) circulation pumps tagged P-5 and P-6 (duty/standby) serving the the west wing are constant volume. The 5 HP HHW circulation pumps tagged P-1E and P-2E (duty/standby) serving the East Wing were installed circa 2005 with VFDs. The VFDs for P-1E and P-2E are no longer operational and the pumps are being operated in a constant volume mode at 100% with the VFD in bypass.
Two 30 HP condenser water (CW) circulation pumps tagged P-1 (duty/standby) are constant volume.
Two 40 HP chilled water (CHW) circulation pumps tagged P-2 (duty/standby) have VFD controlled motors that were reported to be operating properly. The CHW and CW loops were not in service during our on-site survey activities.
Many older closed loop hydronic systems in buildings at the University Park Campus operate as constant volume systems. Many newer closed loop hydronic systems in buildings at the University Park Campus operate as variable volume systems but are not as energy efficient as possible. These conditions result in excess pump energy consumption. This initiative evaluates the contributing factors that can be resolved through a design and construction effort. These factors include but are not limited to:

1. *Constant volume pump control.*
    a. The presence of 3-way control valves on both the chilled water loop (i.e., the 12 RTUs) and the heating hot water loops (i.e., the 17 BCs and RTU-1E) indicates that these loops are acting as constant volume loops, despite the presence of VFDs on their associated pumps. The condenser water loop is also acting as a constant volume loop; however, water cooled chillers normally require constant volume condenser water flow.
2. *Multiple strainers and balance valves adding unnecessary pressure drop.*
    a. This condition was not observed,
3. *Malfunctioning remote differential pressure sensor.*
    a. Per the PSU Building Automation Group, the static pressure sensors associated with the VFD-equipped pumps listed above appear to be working.
4. *BAS sequences lack or do not have effective differential pressure setpoint reset.*
    a. The East Wing HHW loop is set to maintain a constant differential pressure setpoint of 16 psi and the CHW circulation loop is set to maintain a constant differential pressure setpoint of 25 psi. There are currently no provisions for differential pressure setpoint reset.
5. *Inefficient motors.*
    a. The table below summarizes the efficiency (and VFD status) of the various pump motors.

Circulation Pump Motor Summary			
Service	**HP**	**Efficiency**	**VFD Status**
West Wing HHW	10	84%	Constant volume
East Wing HHW	5	91.7%	VFDs not in service – operating as constant volume at 100%
Condenser Water	30	92.4%	Constant volume
Chilled Water	40	94.5%	VFD controlled

Please refer to VI. Air Handling Unit Fan VFD Initiative, Strategy Item #2 for clarification in regard to electric motor efficiency requirements now in effect based on EISA 2007.

6. *Oversized pumps or inefficient pump selections.*
    a. PS&S did not perform calculations to review pump selections; however, oversized/inefficient pump selections typically result in significant throttling of flow with the triple duty or balancing valve at the

pump discharge, which is wasteful of energy. PS&S did not observe signs of significant throttling at the pumps in the field. Review of balancing or commissioning data for the pumps (which was not made available to PS&S) could better indicate whether or not there are concerns with pump selections.

The design and construction effort should result in control that minimizes pump energy. Some of the expected strategies would include:

1. *Installation of VFD for variable pumping systems.*
    a. PS&S recommends the repair/replacement as necessary of the two existing VFDs for East Wing HHW circulation pumps. The replacement cost for two VFDs is estimated to be about $6,150.

       We also recommend the installation of 2 new circulation pumps with new high efficiency inverter-rated motors and VFDs for the West Wing HHW loop, and revised programming for the existing ALC BAS, including revised logic for variable volume hydronic circulation pumps that is consistent with the PSU VFD Pumps Guideline SOO. We estimate the cost to implement this project to be about $57,600. A breakdown of this cost estimate is included in Appendix B.
       Note that the installation of VFDs for these pumps will not result in energy savings without also implementing the corresponding control valve replacements noted in Section V, Air Handling Unit Valve Replacement Initiative.
2. *Installation of efficient motors and pumps.*
    a. See #5 and #6 above.
3. *Use of standard PSU sequences.*
    a. Currently the BAS automatically rotates the CHW pumps and the CW pumps on weekly basis. The HHW pumps for the East and West wings are currently manually rotated on a weekly basis. The weekly rotation schedule for variable volume and constant volume pumps does not conform to the respective exercise cycle requirements contained in the PSU Guideline SOO pump sequences for variable and constant volume pumps (dated November 2008). Revising the SOOs for all of the pumping systems is recommended, including differential pressure setpoint reset per PSU VFD Pumps Guideline SOO as appropriate.
4. *ALC BAS controls.*
    a. Controls are currently installed to operate the circulation pumps for the existing West Wing HHW loop, the CHW loop, and the CW loop. The existing ALC BAS program should be revised as discussed in #3 above.

<u>Other Observations Made During Field Review of PSU Design Initiatives:</u>

1. The room numbers on the BAS screens in many cases do not correspond to the actual room numbers served.
2. The supply temperature for the heating hot water circulation loops for both the East Wing and the West Wing are reportedly reset based on the outside air temperature as follows: at 0°F OAT, HHW temperature is 180 °F; at 60°F OAT, HHW temperature is 120°F.
3. The heat wheel on RTU-2E has reportedly been out of service since shortly after installation of the unit in 2009. The associated alarm has been suppressed within the BAS.
4. The RTU-1E SF motor has reportedly been replaced three times over a 7 year period.
5. The filters on RTU-1W and RTU-2E were observed dirty and filter cartridges were not marked with the replacement date.
6. It was reported that the HVAC systems were commissioned upon installation circa 2005; however, no commissioning documentation was available.
7. The FTR sections in the Library should be cleaned and debris should be removed.
8. The as-built drawings for the HVAC upgrades that were reportedly constructed circa 2005 are dated 7-24-2002 and contain some inconsistencies with respect to conditions observed in the field and within the BAS.

9. RTUs 2W through 9W and RTU-3E were observed with the face and bypass damper open 100% with HHW CV simultaneously open 100%.
10. Facilities staff reported that the HHW loop serving the West Wing requires manual bleeding of the air trapped within the system on an annual basis. This was reportedly performed on December 6, 2011. The piping configuration and the presence of an appropriate air vent arrangement at the high point in the system should be confirmed
11. There is insulation missing from CHW piping and control valves above the ceiling that is resulting in condensation and damage to ceiling tiles.

Other Recommendations (Based on the Field Review of PSU Design Initiatives):

1. Repair the heat recovery wheel RTU-2E
2. Fix the room tagging in the BAS.
3. Update the as-built drawings for the building.
4. Insulate CHW piping and control valves above ceilings.
5. Develop a detailed RetroCx plan for the building to be implemented during a period when classes are not in session.

F. Proposed HVAC Improvements to Reduce Energy Consumption and Improve Building Operations

Based on the review of the PSU Design Initiatives described in detail above, PS&S prioritizes the recommended "Design Initiatives" improvements as follows:

1. AHU Fan VFD Initiatives: Repair or replace the existing non-functional VFD's for RTU-3E and RTU-1W ($5,100 ±); restore VFD operation of RTU-2E.
2. OA and Economizer Control Initiative: Revise minimum OA for RTUs, CUVs and BCs, with appropriate controls modifications ($33,200 ±).
3. Chemical Treatment Initiatives: Install automatic meter on make-up water and replace shot feeder for heating hot water system ($10,400 ±); install automatic meter on make-up water for chilled water system ($7,500 ±).
4. HVAC Zone Valve Replacement Initiative: Install 2-way control valves to create approximately 24 additional zones in the finned tube radiation system ($65,300 ±).
5. Exhaust Fan Control Initiative: Replace eight existing West Wing exhaust fans with new, tied into the ALC BAS system ($80,100 ±).

6a. AHU Valve Replacement Initiative: Replace the existing 3-way control valves with 2-way control valves for the CHW system (12 RTUs) and the HW system (17 BCs and 1 RTU) ($34,200 ±).

6b. Pump VFD Initiatives: Repair or replace the existing non-functional VFD's for the East Wing HHW circulation pumps ($6,150 ±); replace the existing West Wing HHW circulation pumps (including new VFDs and control revisions) ($57,600 ±).

The AHU Fan VFD Initiative has the advantage of the lowest first cost, and the potential to generate significant fan energy savings for the systems that were originally designed and installed to operate as VAV systems.

The OA and Economizer Control Initiative has the third lowest cost of the various measures considered, but has a substantially higher potential for energy savings than the measure with the second lowest cost (Chemical treatment Initiatives), and is therefore given higher priority. (As shown in Appendix A, this measure could result in reducing the total OA introduced by all of the RTUs, BCs and CUVs from 30,105 CFM to 18,133 CFM, a reduction of nearly 40%.)

The Chemical Treatment Initiatives do not appear to have potential for significant energy savings; however, the presence of meters on the make-up water connections will provide a valuable diagnostic tool.

The HVAC Zone Valve Replacement Initiative, while more expensive than the AHU Valve Replacement Initiative, has the potential to generate energy savings in and of itself by reducing Heating Hot Water usage – unlike the AHU

Valve Replacement Initiative, which depends upon the implementation of the Pump VFD Initiative in order to generate significant pumping energy savings.

The Exhaust Fan Control Initiative has the potential to save significant fan energy savings, but is relatively costly to implement. Consider implementing this initiative in a phased manner, as individual exhaust fans require replacement.

The AHU Valve Replacement and Pump VFD Initiatives are ranked together because neither measure is expected to generate significant energy savings without also implementing the other. Because the portion of the Pump VFD Initiative for the East Wing has a significantly lower cost ($6,150 ±) than the portion for the West Wing ($57,600 ±), it may make sense to implement this measure in a phased manner, beginning with the East Wing AHU Valves and Pump VFDs.

G. HVAC Recommendations for Upcoming Chemistry Lab Renovations

PS&S has reviewed the Chemistry Lab HVAC Systems Concepts prepared by Nalls Architecture Incorporated (NAI) and McHugh Engineering Associates (MEA) in their report dated April 15, 2011 and revised on June 23, 2011.

In general, we agree that the overall concepts put forth by NAI and MEA are acceptable and appropriate for the project space layout and fume hood layout prepared by NAI, although we do have some comments.

We summarize these concepts in the paragraphs below, followed by a discussion of our comments.

Second Floor Suite HVAC

The Chemistry Lab HVAC System Concept for the Second Floor suite put forth in the NAI/MEA report can be summarized as follows:

- Provide a custom built rooftop unit with heat pipe energy recovery; 22 tons cooling/325 MBH heating (chilled water and hot water from the existing plant); 5,600 CFM maximum capacity with VFD drives for the fan motors; integral humidification section.
- Provide two belt drive high plume dilution fans for the suite exhaust with inlet bypass to maintain 3,000 FPM discharge velocity; VFD drives for the fan motors; lead/lag controls; 5,600 CFM capacity each (presumably one duty and one standby).
- Provide insulated ductwork to the space with fire dampers at penetrations of floors or other rated assemblies; exhaust ductwork to be 316 stainless steel, welded construction.
- Provide chilled water and hot water piping from the existing building central plant to the rooftop unit.
- Each laboratory exhaust hood shall have a sash monitor interconnected to a flow control valve; valves shall be pressure independent. (This was subsequently modified to include the use of restricted bypass fume hoods, in response to a comment from PSU.)
- All controls shall integrate with the existing ALC BAS.
- Demolish existing HVAC systems serving the space (including, but not limited to, ceiling mounted Blower Coil units, wall mounted Classroom Unit Ventilators, piping, ductwork, existing, "fume hoods" (which are actually down-draft exhaust tables, with some of the exhaust ductwork run above the ceiling of the rooms on the First Floor below the Chemistry suite), controls, etc.
- Direct Expansion Alternate: In lieu of the chilled water system, the unit shall have a DX coil and a roof mounted air-cooled condensing unit. (This alternate would be implemented if the existing chilled water plant does not have sufficient spare capacity to serve the additional chilled water load for the two rooftop units under the base HVAC systems for the Second and Third Floors (which is anticipated to be approximately 28 tons more than the connected load currently serving the existing Chemistry suites).)

Third Floor Suite HVAC

The Chemistry Lab HVAC System Concept for the Third Floor suite put forth in the NAI/MEA report can be summarized as follows:

- Provide a custom built rooftop unit with heat pipe energy recovery; 51 tons cooling/649 MBH heating (chilled water and hot water from the existing plant); 12,800 CFM maximum capacity with VFD drives for the fan motors; integral humidification section.
- Provide two belt drive high plume dilution fans for the suite exhaust with inlet bypass to maintain 3,000 FPM discharge velocity; VFD drives for the fan motors; lead/lag controls; 12,800 CFM capacity each (presumably one duty and one standby).
- Provide insulated ductwork to the space with fire dampers at penetrations of floors or other rated assemblies; exhaust ductwork to be 316 stainless steel, welded construction.
- Provide chilled water and hot water piping from the existing building central plant to the rooftop unit.
- Each laboratory exhaust hood shall have a sash monitor interconnected to a flow control valve; valves shall be pressure independent. (This was subsequently modified to include the use of restricted bypass fume hoods, in response to a comment from PSU.)
- All controls shall integrate with the existing ALC BAS.
- Demolish existing HVAC systems serving the space (including, but not limited to, ceiling mounted Blower Coil units, wall mounted Classroom Unit Ventilators, piping, ductwork, existing, fume hoods, controls, etc.

Common HVAC Work

The Chemistry Lab HVAC System Concept common to the Second and Third Floors put forth in the NAI/MEA report can be summarized as follows:

- Provide a new generator exhaust fan (4,500 CFM $\pm$) and generator exhaust pipe insulation for the upgrade of the existing emergency generator from 30 kW to 80 kW.

Assumptions Addressed in Meeting Minutes/Report:
The Chemistry Lab HVAC System Concepts described above are based on the following assumptions documented in the Meeting Minutes portion of the NAI/MEA report; each assumption should be confirmed or refuted, as the design process progresses, and changes to the concepts should be made as needed:

- The PSU Environmental Safety Group (ESG) has determined that recirculation of environmental air (i.e., air other than that exhausted from fume hoods),during occupied periods is **not** acceptable and appropriate for this project, and that 100% OA systems (i.e., “once through air”) are required for this project (although the air flow rates can be reduced during unoccupied periods);
- The Research Lab and Prep Room fume hoods are required to run independent of the Teaching Lab fume hoods, 24/7 (Note: this implies that separate, dedicated exhaust fans for the Research Lab and Prep Room fume hoods may be preferred, although the scope outlined by NAI/MEA does not provide dedicated exhaust fans);
- The PSU standard for fume hood face velocity is 100 FPM; lower face velocities may be allowed, but in no case should the face velocity be reduced below 80 FPM;
- The Second Floor Storage Room will not have a fume hood but will require exhaust at 6 to 10 Air Changes per Hour (ACH);
- Separate, dedicated exhaust fans will **not** be provided for each fume hood; each fan will be arranged for constant discharge air volume/high plume height;
- “Snorkel” exhaust is not appropriate, or anticipated, for this program;
- The existing roof structure is capable of supporting new rooftop HVAC equipment; and
- The existing ALC BAS system will be modified and expanded as needed to control the new systems and equipment.

Design Considerations to be Confirmed:

The following design considerations/assumptions did not appear to be addressed in the Meeting Minutes or elsewhere in the report prepared by NAI/MEA; they should be confirmed or refuted, as the design process progresses, and changes to the concepts should be made as needed:

- The only spaces involved in this project that need to meet the critical acoustic requirements outlined in the PSU Design Standards, are the Teaching Labs, or Classroom spaces (i.e., Rooms 222, 224 and 307 on the layouts prepared by NAI);
- The location of any rooftop fume hood exhaust fans will be coordinated with any new or existing OAI locations so as to provide a separation distance mutually agreed-to in consultation with the PSU ESG;
- Supply and return ductwork, VAV terminals, reheat coils, and duct-mounted sound attenuators (if needed) will be routed in concealed space above hung ceilings in all rooms;
- Hot water duct heating coils or VAV re-heat coils, if provided, will be controlled by fully-modulating two-way control valves;
- The space layout and fume hood layout prepared by NAI is appropriate for PSU's needs;
- The HVAC Systems Design Criteria (e.g., Outdoor Design Conditions; Indoor Design Conditions; Internal Heat Gain from Lighting, Equipment and Occupants; Air Filtration Requirements; Air Change Rates and Space Pressurization Criteria; and Noise and Vibration Criteria) utilized for preliminary sizing and selection/specification of HVAC systems are acceptable to PSU.

Comments on NAI/MEA Proposed HVAC System Concepts

PS&S has the following specific comments on the Chemistry Lab proposed HVAC System Concepts contained in the report prepared by NAI/MEA:

- MEA notes that their "preliminary design estimates require an additional 28 tons of cooling and an additional 158 MBH of heating above the existing connected load for the existing 2nd and 3rd floor class rooms." Comparing the preliminary unit capacities outlined by MEA (i.e., 22 tons cooling/325 MBH heating for Second Floor, 51 tons cooling/649 MBH heating for the Third Floor) to the connected load documented on the design drawings for the HVAC renovations circa 2004 (i.e., 21 tons cooling/324.5 MBH heating for Second Floor, 24 tons cooling/870.9 MBH heating for Third Floor), confirms their statement regarding the additional cooling, but indicates that the proposed systems will require approximately 221 MBH **less** heating than the existing connected loads. The source of this discrepancy should be explored with NAI/MEA, to determine whether or not it is cause for concern.
- The number of fume hoods in Room 307 (i.e., twelve, at 800 CFM of exhaust each, for a total of 9600 CFM of exhaust from the room) leads to a very high air flow rate in Room 307 when the fume hoods are in use (i.e., 48 air changes per hour; 6.8 CFM per square foot). The use of low-flow fume hoods for this space (such as Kewaunee's Dynamic Barrier Low-Flow fume hood, Lab Crafters' Air Sentry fume hood, or others) could lower the exhaust flow and air change rate, resulting in reduced energy usage; however, this would also result in face velocities below 80 FPM at the hoods, which would violate one of the project criteria established with PSU. PSU may want to consider revisiting the face velocity criteria in light of this condition.
- Another drawback to the high air flow rate for Room 307 (9600 CFM) is that there is limited ceiling space available for supply and exhaust ductwork. Any reduction in supply and exhaust air requirements for Room 307 will have a corresponding reduction in the space required above ceilings for ductwork.
- The tabulation of air flow rates that was prepared by MEA indicates that when hoods are not in use, the system air flow will be reduced to approximately 2 air changes per hour. For the Third Floor air handling system, this is a total air flow of approximately 968 CFM, which is less than 8% of the unit's maximum flow rate of 12,800 CFM. VFD's for fans have a lower limit on how far they can be turned down, which is usually on the order of about 20% of the maximum flow rate. If this unit's maximum flow rate is not revised downward through the use of low-flow fume hoods, the minimum air flow for this unit may have to be designed to be approximately 2560 CFM, or 2.6 times the theoretical minimum of 968 CFM, resulting in additional energy costs (compared to the theoretical minimum).
- The existing Third Floor teaching lab uses a system of make-up air ducted directly to the fume hoods (with heating only, no air conditioning) to reduce supplement the room exhaust, thus reducing the room air flow rate and the energy usage. Perhaps a similar system should be considered for Room 307, if the use of low-flow fume hoods cannot be implemented.

- The system description prepared by MEA calls for “heat pipe” energy recovery in the air handling units. Heat pipes typically utilize supply and exhaust air streams that are side-by-side in the same air handling equipment, while the systems in question will have 100% outdoor air rooftop units with separate exhaust fans and ductwork. Presumably, MEA intends to use energy recovery coils in the rooftop units and in the exhaust ductwork, with run-around piping loops (perhaps in the Third Floor ceiling, or above the roof). Run-around piping loops will require space for installation, plus power and control wiring for their pumps; MEA should verify that the cost of the piping loops, pumps, power and controls are included in their construction cost estimate.
- The construction cost estimate furnished with the NAI/MEA report uses $5.75 per CFM as a budgetary unit cost for the air handling units; given the specialized nature of these units (e.g., 100% OA, with energy recovery), this may be a little on the low side.
- The construction cost estimate furnished with the NAI/MEA report uses $1.28 per CFM as a budgetary unit cost for the high-plume laboratory exhaust fans; given the specialized nature of these units, this appears be on the low side.
- The NAI/MEA report does not appear to call for the replacement of the existing laboratory air compressors; our observations indicate that they should be replaced.

Appendix A: Outside Airflow Summary

TABLE A1 – ROOF TOP UNITS

UNIT	EXISTING OUTSIDE AIR (CFM)	PROPOSED OUTSIDE AIR (CFM)
RTU-1E	4340	3160
RTU-2E	3000	3381
RTU-3E	1410	665
RTU-1W	300	140
RTU-2W	735	445
RTU-3W	450	280
RTU-4W	450	362
RTU-5W	450	362
RTU-6W	450	237
RTU-7W	450	237
RTU-8W	450	339
RTU-9W	660	906
Total	13145	10514

TABLE A2 – BLOWER COIL UNITS

UNIT	EXISTING OUTSIDE AIR (CFM)	PROPOSED OUTSIDE AIR (CFM)
BC-1E	1000	257
BC-2E	750	222
BC-3E	750	190
BC-4E	750	221
BC-5E	1000	241
BC-6E	750	185
BC-1W	40	23
BC-2W	160	63
BC-3W	160	59
BC-4W	345	100
BC-5W	300	64
BC-6W	150	83
BC-7W	1530	237
BC-8W	160	59
BC-9W	160	58
BC-10W	160	58
BC-11W	600	121
Total	8765	2241

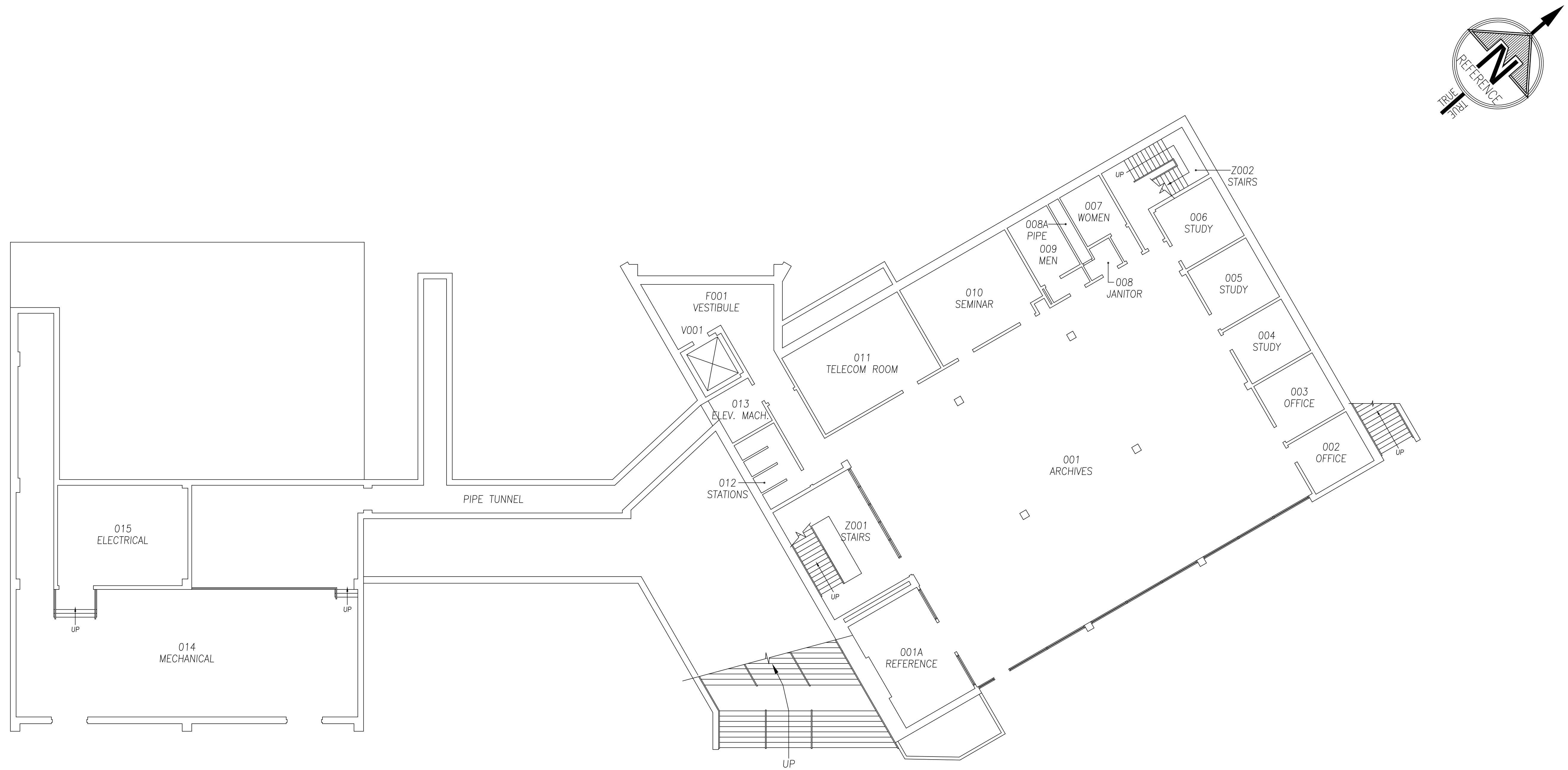
TABLE A3 – UNIT VENTILATORS

UNIT	EXISTING OUTSIDE AIR (CFM)	PROPOSED OUTSIDE AIR (CFM)
CUV-1E	187	90
CUV-2E	187	90
CUV-3E	190	341
CUV-4E	190	376
CUV-5E	300	295
CUV-6E	450	282
CUV-7E	225	267

TABLE A3 – UNIT VENTILATORS (Continued)

UNIT	EXISTING OUTSIDE AIR (CFM)	PROPOSED OUTSIDE AIR (CFM)
CUV-8E	225	267
CUV-9E	225	225
CUV-10E	225	225
CUV-11E	375	273
CUV-12E	375	273
CUV-13E	450	273
CUV-14E	225	362
CUV-15E	225	362
CUV-16E	225	27
CUV-17E	225	28
CUV-18E	225	98
CUV-1W	300	276
CUV-2W	300	276
CUV-3W	300	254
CUV-4W	300	254
CUV-5W	150	44
CUV-6W	450	430
CUV-7W	750	374
CUV-8W	750	400
CUV-9W	195	26
CUV-10W	1100	31
CUV-11W	300	300
CUV-12W	300	300
Total	8195	5378

It was also determined that all the roof top units have a means of demand control ventilation to reduce outdoor air for off peak occupancy conditions.



WOODLAND BUILDING
PSU BUILDING NAME

GROUND FLOOR PLAN
BUILDING FLOOR LEVEL

THE ABINGTON COLLEGE, PENN STATE ABINGTON, ABINGTON, PA
PSU CAMPUS LOCATION

PENNSTATE

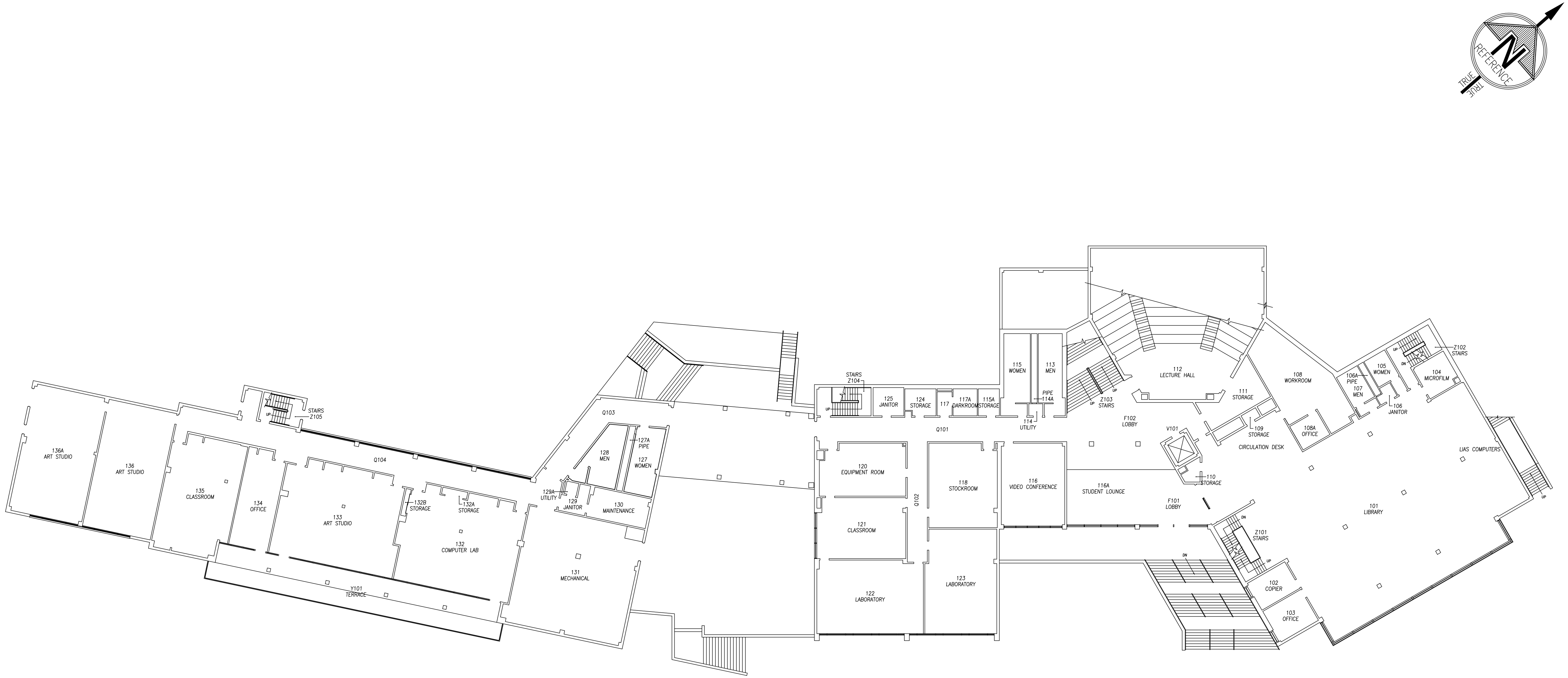
FACILITIES RESOURCES AND PLANNING
THE PENNSYLVANIA STATE UNIVERSITY
BENEDICT HOUSE
UNIVERSITY PARK, PA 16802
OFFICE: 814.865.1595 FAX: 814.865.1610 www.facilities.psu.edu

SCALE 0 5' 10' 15' 20' 40'

6/23/05
CREATION DATE
4/9/12
REVISED DATE

Campus block plans are for referential use only. Drawings are not to be used for architectural engineering purposes.

0979-008
BUILDING NUMBER
1 OF 4
SHEET NUMBER
G
FLOOR LEVEL



WOODLAND BUILDING
PSU BUILDING NAME

FIRST FLOOR PLAN
BUILDING FLOOR LEVEL

THE ABINGTON COLLEGE, PENN STATE ABINGTON, ABINGTON, PA
PSU CAMPUS LOCATION

PENNSTATE

FACILITIES RESOURCES AND PLANNING
THE PENNSYLVANIA STATE UNIVERSITY
BENEDICT HOUSE
UNIVERSITY PARK, PA 16802
OFFICE: 814.865.1595 FAX: 814.865.1610 www.facilities.psu.edu

SCALE 0 4' 8' 12' 16' 32'

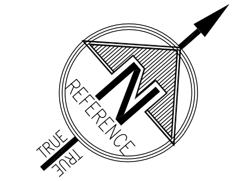
6/23/05 CREATION DATE
4/9/12 REVISED DATE

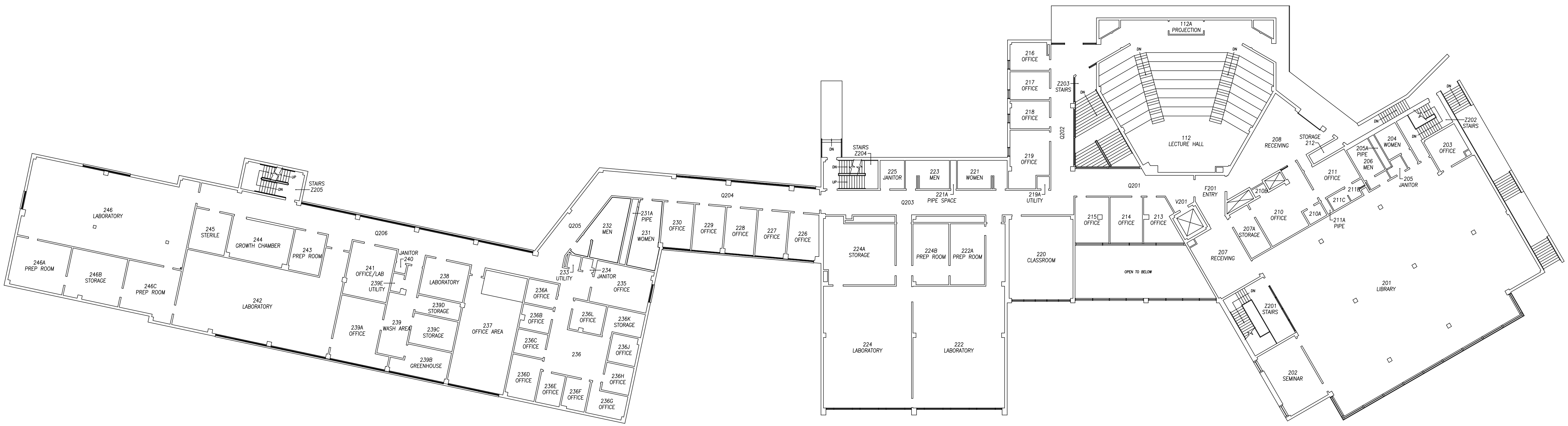
Campus block plans are for referential use only. Drawings are not to be used for architectural or engineering purposes.

0979-008
BUILDING NUMBER

2 OF 4
SHEET NUMBER

1
FLOOR LEVEL





WOODLAND BUILDING
PSU BUILDING NAME

SECOND FLOOR PLAN
BUILDING FLOOR LEVEL

THE ABINGTON COLLEGE, PENN STATE ABINGTON, ABINGTON, PA
PSU CAMPUS LOCATION

PENNSTATE

FACILITIES RESOURCES AND PLANNING
THE PENNSYLVANIA STATE UNIVERSITY
BENEDICT HOUSE
UNIVERSITY PARK, PA 16802
OFFICE: 814.865.1595 FAX: 814.865.1610 www.facilities.psu.edu

SCALE 0 4' 8' 12' 16' 32'

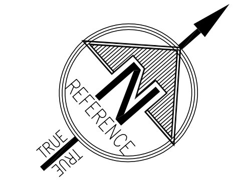
6/23/05 4/9/12
CREATION DATE REVISED DATE

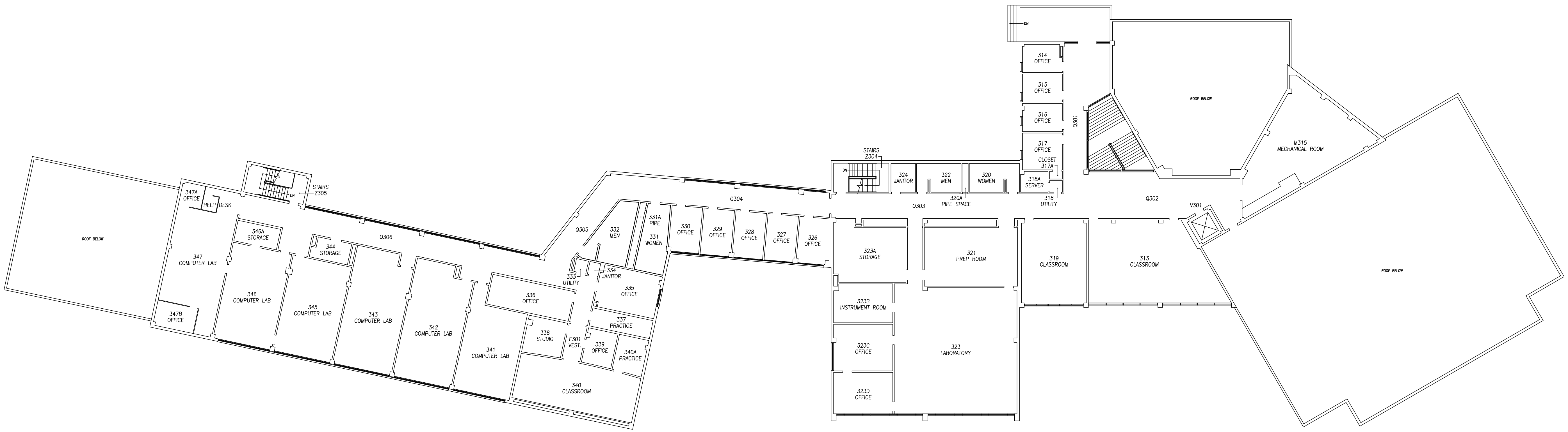
Campus block plans are for referential use only. Drawings are not to be used for architectural or engineering purposes.

0979-008
BUILDING NUMBER

3 OF 4
SHEET NUMBER

2
FLOOR LEVEL





WOODLAND BUILDING
PSU BUILDING NAME

THIRD FLOOR PLAN
BUILDING FLOOR LEVEL

THE ABINGTON COLLEGE, PENN STATE ABINGTON, ABINGTON, PA
PSU CAMPUS LOCATION

PENNSTATE
FACILITIES RESOURCES AND PLANNING
THE PENNSYLVANIA STATE UNIVERSITY
BENEDICT HOUSE
UNIVERSITY PARK, PA 16802
OFFICE: 814.865.1595 FAX: 814.865.1610 www.facilities.psu.edu

SCALE 0 4' 8' 12' 16' 32'

6/23/05 CREATION DATE
4/9/12 REVISED DATE

Campus block plans are for referential use only. Drawings are not to be used for architectural or engineering purposes.

0979-008
BUILDING NUMBER

4 OF 4
SHEET NUMBER

3
FLOOR LEVEL

PENNSTATE

1855

NON-BINDING ARCHITECT AND ENGINEER FEE SCHEDULE

Project: Woodland Building Renovation,
Penn State Abington

Firm Name: ____________________

	Hours	Fee
Programming/Site Analysis (confirmation)		
Schematics		
Design Development		
Construction Documents		
Bids		
Construction Administration		
Subtotal		
Reimbursements (allowance)		
Total		

Please include a listing of your billable rates that will be used for this project.

Please return completed form by December 10, 2012 @ Noon to:

David Zehngut
University Architect
The Pennsylvania State University
200 Physical Plant Building
University Park, PA 16802-1118
Phone (814) 863-3158, fax (814) 863-7757

Note: Include any costs for consultants within amounts listed, not separately.

Form of Agreement 1-P

THE PENNSYLVANIA STATE UNIVERSITY

OWNER AND PROFESSIONAL

AGREEMENT

THIS AGREEMENT made this ____________________ day of_________________________________

in the year Two Thousand _____________, by and between THE PENNSYLVANIA STATE UNIVERSITY, a non-profit corporation and an instrumentality of the Commonwealth of Pennsylvania, having its principal offices at University Park, Centre County, created and existing under the laws of the Commonwealth of Pennsylvania, hereinafter called the "Owner," and

____

____

____

hereinafter called the "Professional," for the following Project:

____

____

____.

(Title of Project should match the documents, must include project number)

In consideration of the promises set forth herein, and with intent to be legally bound, the parties agree to the terms set forth within this Agreement.

TABLE OF CONTENTS

12.8 Terms/General Conditions

ARTICLE 13: SCHEDULE OF EXHIBITS

DEFINITIONS:

Contract Documents consist of the General Conditions of the Contract, Drawings, Specifications, Addenda issued prior to receipt of Trade Contract bids, Form of Proposal, other documents listed in the Agreement and those modifications to the Contract as follows: Owner's written authorization to the Contractor for changes to the Scope of Work, a Change Order, and a written order for a minor change in the Work issued by the Professional.

Contractor means the person or entity retained by the Owner to perform Work for the project and includes the Contractor's Representative.

Construction Budget means the project construction cost limit established by the Owner.

Construction Cost Estimate means a detailed breakdown of all costs associated with the scope of work required to meet the project requirements projected to the mid-point of construction.

Final Completion means the point at which the project is fully completed in accordance with the Contract Documents (this includes *all* physical/construction obligations, administrative obligations, and punch list obligations).

The **Owner** is The Pennsylvania State University, a non-profit corporation created and existing under the laws of the Commonwealth of Pennsylvania, and an instrumentality of the Commonwealth of Pennsylvania; this term shall include the Owner and/or the Owner's authorized representative.

The **Pennsylvania State University Design and Construction Standards** means those design and construction standards as set forth at: http://www.opp.psu.edu/planning-construction/design_and_construction_standards/standards-and-forms.

The **Professional** is the person lawfully licensed to practice architecture or engineering, or the firm employed to provide architectural or engineering services, for the referenced project. The term "Professional" shall mean the Professional or the Professional's authorized representative.

The **Project** shall comprise the Work defined by the Contract Documents and may include work by the Owner or other Separate Contractors, Trade Contractors, Sub-Trade Contractors or the Professional.

The **Scope of Work** means the work reasonably contemplated, required, implied, or reasonably inferable by the Contract Documents or normal standards of the building trades, whether or not explicitly contained in the Contract Documents.

Services means the services provided by the Professional and/or by consultants retained by the Professional for the Project.

Substantial Completion shall mean that stage in the progression of the Work when the Work is sufficiently complete in accordance with this Contract that the Owner can enjoy beneficial use or occupancy of the Work and can utilize the Work for its intended purpose.

Work means the construction and services necessary or incidental to fulfill the Contractor's or Professional's obligations for the Project in conformance with the agreement between the Owner and Contractor or the Owner and Professional.

ARTICLE 1: PROFESSIONAL'S RESPONSIBILTIES

1.1 General Responsibilities

1.1.1 The Professional shall furnish or provide the architectural and engineering services as outlined herein, and any other relevant data, specifications or documents, as necessary for a complete project. The Professional shall expeditiously perform said services in a manner consistent with professional skill, care, and the orderly progress of the work. In carrying out all obligations pursuant to this Agreement, including the furnishing of Construction Documents, the Professional shall in all respects conform to the applicable professional standard of care.

1.1.2 By executing this Agreement, the Professional represents to the Owner that the Professional possesses the requisite skill, expertise, and credentials to perform the required services, and that Professional is licensed to practice by all public entities having jurisdiction over the Professional and the Project. The Professional further represents to the Owner that the Professional will maintain all necessary licenses, permits, or other authorizations necessary to act as Professional for the Project until the Professional's remaining duties hereunder have been satisfied. The Professional assumes full responsibility to the Owner for the negligent acts and omissions of the Professional's consultants or others employed or retained by the Professional in connection with the Project.

1.1.3 Execution of this Agreement by the Professional constitutes a representation that the Professional has become familiar with the Project site and the local conditions under which the Project is to be implemented.

1.1.4 The Professional shall provide the services required by this agreement in conformance with the most recent project schedule approved by the Owner.

1.1.5 The Professional shall provide Professional Services, per Exhibit A and per this agreement, in accordance with The Pennsylvania State University Design and Construction Standards referenced in Exhibit C.

1.1.6 The Professional is responsible for additional submission and presentation requirements as outlined for Board of Trustee approval or other administrative approval.

1.1.7 If a Construction Manager is hired by the Owner it will be the responsibility of the Professional to collaborate and work in concert with the Construction Manager throughout the duration of the project. Furthermore, the Professional shall reconcile all cost estimates with the Construction Manager.

1.1.8 (OPTIONAL) Payment of the Professional's fees, as per in Article 9, is contingent upon completion of the documents per the attached schedule. (NOTE: Attach Schedule as Exhibit D if schedule has been developed.)

1.1.9 (OPTIONAL) Adherence to Time Schedule. The Professional shall strictly adhere to submission schedules as set forth in this Agreement. Should the Professional become aware that he will be unable to meet any of the dates set forth in this Agreement, the Professional shall immediately notify the Owner in writing.

- The Professional shall include in the notice the reason(s) for the Professional's inability to meet the date(s) and a request that the Owner amend the time schedule.
- The Owner shall review the Professional's notice and determine whether or not to amend the time schedule.

If the Owner determines that the delay is **due to the fault of the Professional**, the Owner may amend the schedule and direct the Professional to expeditiously proceed with the design of the project, in which case **the Owner may hold the Professional responsible for any costs attributable to the delay**, or terminate the Agreement for default of the Professional, in accordance with the provisions of this Agreement.

If the Owner determines that the delay is not due to the fault of the Professional, the Owner may amend the time schedule. The Professional agrees that such an amendment of the time schedule is his exclusive remedy for a delay and that he may not make any claims against the Owner for increased costs due to the delay.

1.1.10 Building Information Modeling (BIM). The project will be designed, constructed, and operated using Building Information Modeling (BIM). The BIM project scope is defined in The Pennsylvania State University Office of Physical Plant BIM Contract Addendum (BIM Addendum). This addendum applies to all projects exceeding a Total Project Cost of $5 Million new construction, substantial renovation, or as directed by the Office of Physical Plant Project Manager. On qualifying projects, professionals shall use BIM application(s) and software to develop project designs and assist in the coordination of construction.

The Pennsylvania State University is committed to utilizing BIM technologies and processes to execute the design, construction, and operations of its new High Performance buildings and the updating of all existing structures and infrastructure. The intent is to achieve the following goals: facilitate a collaborative project environment between all project stakeholders beginning at project conception through facility operations; improve facility system coordination to streamline design and constructions processes and minimize change orders; deliver a better overall facility design, visualize construction processes, avoid field conflicts, develop building life cycle costs, accurately project cost estimates, and seamlessly transition into facilities operations; develop high performance buildings in accordance to The Pennsylvania State University sustainability goals; incorporate the Record Model and As-Built Models, including infrastructure and building systems, into the existing Enterprise Asset Management system (EAM) to create an As-Maintained Facilities Management Model; and establish a technology platform and provide continuous support to incorporate future technologies into existing processes.

The Professional shall provide all deliverables in compliance with the BIM Addendum at stages described in the BIM Plan. The BIM Model is an instrument of service and is considered to be a component of Design and Construction Documents governed by Article 7 of this Agreement and within the BIM Addendum, without exception.

The Professional shall lead the development of a project specific BIM Execution Plan (BIM Plan), documenting the collaborative process in which BIM will be implemented throughout the life cycle of the project, during the design phase. An initial BIM Plan shall include the Professional's requirements identified in the BIM Addendum and the Office of Physical Plant Plan Template. It shall be submitted for approval by The Pennsylvania State University prior to the contract execution. A collaborative BIM Plan shall be developed with the Contractor/CM prior to completion of the schematic design phase. In the event that a Contractor is not procured for preconstruction services, the Professional Team and Owner shall develop the collaborative BIM Plan. The BIM Plan shall be revisited with the entire project team prior to Construction and submitted to the Office of Physical Plant for final approval. Payment may be held at each development phase until the BIM Plan is approved.

All costs associated with BIM, including model updates during construction, shall be included in the base contract price (contract Article 9.1.1). A breakdown of any cost associated with the implementation of BIM must be disclosed in the BIM Addendum.

Any questions or variations from this language shall be submitted in writing and agreed upon with the Office of Physical Plant BIM Manager or Manager of Design Services.

1.1.11 Contractor Design-Assist. The Owner anticipates utilizing contractor/vendor design-assist on some aspects of the project. If utilized, the Professional will assume the responsibility for incorporation of the design assist information into the overall design.

1.1.12 (OPTIONAL, If there is a cost impact for not meeting the LEED certification level, it should be outlined as a penalty in this section.) LEED Responsibility for Project. The Professional shall ensure that the LEED target certification level for the project is achieved. The Professional shall be primarily responsible for identifying the listing of credits to be achieved during the project in an effort to meet the certification level. The Professional shall also be responsible for preparing all documentation required for submission. The Professional shall use as a guide The Pennsylvania State University LEED Policy to be provided by the Owner.

1.2 Schematic Phase

The Professional shall review and comply with the Project program and The Pennsylvania State University Design and Construction Standards, both as furnished by the Owner, and shall conduct appropriate visits to the Project site. The Professional shall then provide to Owner a preliminary evaluation of the program and schedule and a preliminary construction cost estimate. The Professional shall review with the Owner alternative approaches to project design and construction, as may be required.

After the Owner has approved the Project scope, cost estimate and schedule as submitted by the Professional, the Professional shall prepare and submit to the Owner, for approval, Schematic Design Documents and any other documents required by the Owner. Refer to the Design Phase Submittal Requirements document available on the Office of Physical Plant web page for a listing of submission requirements for the Schematic Phase.

Following approval of Schematic Design Documents and any other documents required at such phase by the Owner, The Professional shall submit a Construction Cost Estimate. The estimate shall be determined by the Professional using the most accurate means available.

1.3 Design Development Phase

After approval by the Owner of the Schematic Design Documents, and any Owner-authorized changes in Project scope or construction budget, the Professional shall prepare and submit, for approval by Owner and any government authorities, Design Development drawings and any other documents required by the Owner for said approval. These drawings and other documents shall fix building size, delineate and describe the various construction materials to be used, and indicate the structural, mechanical, and electrical systems upon which the design is based. Refer to the Design Phase Submittal Requirements document available on the Office of Physical Plant web page for a listing of submission requirements for the Design Development Phase (noted as Preliminary and Design Phase in the document).

The Professional shall provide an update of the Construction Cost Estimate and schedule and advise the Owner immediately of any adjustments.

1.4 Construction Document Phase

After approval by the Owner of the Design Development Phase documents, and any further Owner-authorized changes in Project scope or construction budget, the Professional shall prepare and submit to the Owner, for approval, Construction Drawings and Specifications/Project Manual (hereinafter referred to as the "Construction Documents") required by the Owner for said approval. These Construction Documents shall delineate, detail, and completely specify all materials and equipment required to fully complete construction of the Project in every respect, consistent with current standards of the profession. The Construction Documents shall completely describe all work necessary to bid and construct the Project. Refer to the Design Phase Submittal Requirements document dated August 2006 (or any subsequent updates), available on the Office of Physical Plant web page, for a listing of submission requirements for the Construction Document Phase.

Any review and approval by the Owner of the Construction Documents shall not be deemed to diminish the Professional's obligations under this Agreement.

The Professional shall provide an update of the Construction Cost Estimate and schedule and shall advise the Owner immediately of any adjustments.

The Professional shall be responsible for completing all of the appropriate planning modules, soil and erosion control plans, and other documents which may be required.

The Professional shall be responsible for obtaining, on behalf of the Owner, whatever approvals are necessary to connect to non-Owner-owned utility lines.

The Professional shall coordinate the Construction Documents for all of the Separate Prime Contracts or trade packages, as required, and shall employ all reasonable and necessary efforts to prevent omissions, conflicts, overlaps, or duplications of any items of work or materials on the Project.

The Professional shall coordinate the services of all design consultants for the Project, including those retained by the Owner.

1.5 Bidding Phase

After approval by the Owner of the Construction Documents, the Professional shall prepare and distribute all necessary bidding correspondence and documents, evaluate bid proposals, attend pre-bid or pre-award meetings, clarify the scope or intent of the Construction Documents, evaluate proposed subcontractors, and assist in the preparation of construction contracts.

1.6 Construction Phase

The Professional shall issue a set of construction documents that incorporate all bidding documents and revisions per addenda prior to the start of construction.

The Professional's responsibility under this Agreement for Construction Phase services commences with the execution of the Contract(s) between the Contractor(s) and the Owner and terminates no earlier than the expiration of the Contractor's one-year guarantee period against defective materials, equipment, and/or workmanship. This paragraph is not intended to, and shall not be construed as, affecting in any way the calculation of any applicable legal statutes of limitation.

Administration, by the Professional, of the construction contract(s) shall be as outlined below and in accordance with the General Conditions of the Contract for Construction. The Professional agrees to perform all of its obligations under this Agreement consistent with said General Conditions. The extent of the Professional's duties and responsibilities and the limitations of its authority as specified thereunder shall not be modified without written agreement between the Owner and the Professional.

The Professional shall not be responsible for the Contractor's construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the work. However, if the Professional has actual knowledge of safety violations, the Professional shall immediately alert the relevant Contractor or Subcontractor and shall give prompt written notice to the Owner.

The Professional shall not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Professional shall not be deemed to have control over or charge of acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons performing portions of the Work. However, the Professional shall provide all required assistance to the Contractor, Subcontractors and/or agents and employees in order to facilitate the appropriate and timely performance of the Work. Furthermore, Professional is responsible for notifying the Owner and the Contractor of the Contractor's failure to carry out the Work in accordance with the Contract Documents upon observing such failure by the Contractor.

1.6.1 Schedule of Values. Upon receipt, the Professional shall carefully review and examine the Contractor's Schedule of Values, together with any supporting documentation or data which the Owner or the Professional may require from the Contractor. The purpose of such review and examination will be to protect the Owner from an unbalanced Schedule of Values which allocates greater value to certain elements of the Work than is indicated by such supporting documentation or data or than is reasonable under the circumstances. If the Schedule of Values is found to be inappropriate, or if the supporting documentation or data is deemed to be inadequate, and unless the Owner directs the Professional to the contrary in writing, the Schedule of Values shall be returned to the Contractor for revision or supporting documentation or data. After making such examination, if the Schedule of Values is found to be appropriate as submitted or, if necessary, as revised, the Professional shall sign the Schedule of Values thereby indicating the Professional's informed belief that the Schedule of Values constitutes a reasonable, balanced basis for payment of the Contract Price to the Contractor. The Professional shall not sign such Schedule of Values in the absence of such belief unless directed to do so, in writing, by the Owner. The Professional shall provide the Owner with a signed copy of the Schedule of Values after approval.

1.6.2 Access to Work. The Professional and its authorized representatives shall have full and safe access to the work at all times.

1.6.3 Visits to the Site/Inspection. The Professional and any consultants retained by the Professional, or an authorized and qualified representative, shall visit the Project periodically as required by the Owner during periods of active construction in order to review the progress of the work, and take such actions as are necessary or appropriate to achieve the requirements of the Construction Documents in the work of the responsible Contractors, including advising the Owner's representatives as to particular matters of concern. It shall also be the duty of the Professional to have its Consultants visit the site periodically as required during their respective Phases of the work, at such intervals as may reasonably be deemed necessary by the Owner and the Professional, to review their respective Phases of the work in order to achieve the requirements of the Construction Documents.

The purpose of such site visits and reviews will be to determine the quality, quantity, and progress of the Work in comparison with the requirements of the Construction Documents. In making such reviews, the Professional shall exercise care to protect the Owner from defects or deficiencies in the Work, from unexcused delays in the schedule, and from overpayment to the Contractor. Following each such review, the Professional shall submit a written report within (5) calendar days of such review, together with any appropriate comments or recommendations, to the Owner.

Whenever, in the Professional's opinion, it is necessary or advisable, the Professional shall require special inspection or testing of the Work in accordance with the provisions of the Construction Documents whether or not such Work is fabricated, installed, or completed. The Professional shall advise the Owner of all such occurrences requiring special inspection or testing of the Work and shall obtain prior approval from Owner before any funds are committed for inspection, beyond what has already been budgeted.

1.6.4 Approval of Payment to Contractors. Based on the Professional's review of the Project, the Professional will recommend, within seven (7) calendar days after receipt, approval or rejection of payment on the Application-Certificate of Payment. Approval of the Certificate of Payment shall constitute a representation by the Professional to the Owner that the work has progressed to the point indicated on the Application, and that to the best of the Professional's knowledge, information, and belief, the quality of the work is in accordance with the Contract Documents.

The Professional shall make recommendations to the Owner for the withholding of any payment, or portion thereof, due to inadequate progress and/or performance of the Contract.

The Professional agrees that time is of the essence with respect to this provision.

1.6.5 Interpreter. The Professional will be, in the first instance, the interpreter of the requirements of the Contract Documents. The Professional will, within a reasonable time as determined by the Owner, render such interpretation as it may deem necessary for the proper execution or Progress of the Work. All interpretations by the Professional shall be defined in writing and/or by drawing and shall be consistent with the intent of the Contract Documents.

In addition to the above, the Professional shall be required to attend, at the determination of the Owner, any and all Project site conferences dealing with interpretation of the Contract Documents.

The Professional's decisions, with Owner's prior approval, shall in matters relating to aesthetic effect be final if consistent with the intent of the Construction Documents.

1.6.6 Review of Contractor's Shop Drawings and Materials. The Professional shall review, approve, and process, subject to the right of review by the Owner, Shop Drawings to ensure compliance with the Contract Documents and all product data, samples, materials, and other submissions of the Contractor required by the Contract Documents for conformity to and in harmony with the design concept of the Project and for compliance with the requirements of the Contract Documents. The Professional shall not approve any substitution of specified materials and/or equipment without first obtaining the Owner's consent. Approval by the Professional of the Contractor's submittal shall constitute the Professional's representation in accordance with Article 5 of the General Conditions of the Contract for Construction to the Owner that such submittal is in conformance with the Contract Documents.

When the Contractor is required by the Contract Documents to provide professional certification of performance characteristics of materials, systems, or equipment, the Professional shall be entitled to rely upon such certification to establish that the materials, systems, or equipment will meet performance criteria required by the Contract Documents.

Based on the priorities of the construction schedule, the Prime Contractor(s) shall submit a shop drawing submittal schedule on or before the Second Regular Job Conference. The Professional shall review and check the shop drawing submittal schedule within fourteen (14) calendar days of receipt from the Contractor.

The Professional shall return the approved shop drawings, or detailed notation for resubmission, if required, within fourteen (14) calendar days after receipt from the Contractor unless mutually agreed otherwise by the Professional, Owner, and Contractor. The Professional shall act on any resubmissions within seven (7) calendar days of receipt thereof unless mutually agreed otherwise by the Professional, Owner, and Contractor. A detailed log shall be maintained by the Professional as to time of receipt of the shop drawings and time of return, with adequate notes as to their disposition.

Refer to 1.6.12 for electronic scanning and submission requirement of approved project shop drawings at the completion of the project.

The Professional is responsible to incorporate into the shop drawings comments by the Owner or Owner's authorized representative prior to the shop drawings being returned to the Contractor.

The Professional agrees that time is of the essence of this provision.

1.6.7 Job Conference Reports. The Professional shall take and retain a verbatim record of the biweekly Job Conference meetings and shall prepare and distribute summary minutes in a format approved by the Owner of each meeting within five (5) calendar days to the Owner, the Contractors, and all other interested parties.

1.6.8 Change Orders. The Professional shall review all Change Order requests within seven (7) calendar days and shall advise Owner, in writing, with respect to the necessity or advisability of same. The Professional shall also determine whether the cost is fair and reasonable for the additional work associated with the Change Order. In so doing, Professional shall provide all pertinent documents and data to the Owner, who shall make all decisions regarding approval or rejection of Change Order requests. The Professional shall maintain an appropriate Change Order log. The Professional may, after consultation with the Owner, authorize minor changes in the Work which do not involve an adjustment in the Contract sum or an extension of the Contract time and which are consistent with the intent of the Contract Documents.

1.6.9 Rejection of Work. The Professional is authorized and obligated to reject work which does not conform to the Contract Documents and shall immediately notify the Owner to stop a Contractor's work whenever, in the Professional's reasonable opinion, such action is necessary for the proper performance of the Construction Contract Work. The Professional shall not be liable to the Owner for the consequences of any recommendation made by the Professional in good faith, and in the exercise of due care in recommending to stop or not to stop the work.

1.6.10 Substantial Completion, Final, and One-Year Guarantee Inspections. The Professional and its consultants shall participate in Substantial Completion and Final Inspections to affix the dates of Substantial and Final Completion and shall concur in the report of Final Completion to the Owner prior to approving the Contractor's application for Final Payment. The Professional shall produce the punch list document and provide follow-up to ensure all items are completed to the satisfaction of the Owner. The Professional shall also acquire for Owner the Certificate of Occupancy.

The Professional and its consultants shall participate in an inspection prior to the expiration of the one (1) year guarantee period against defective materials, equipment, and/or workmanship to determine any defects in materials, equipment, and/or workmanship since the date of Substantial Completion. The Professional shall produce the (1) year guarantee period punch list document for distribution to the Contractor(s) and provide follow-up to ensure all items are completed to the satisfaction of the Owner.

1.6.11 Operations and Maintenance Data. At the time of Substantial Completion of the Project, the Professional shall review and approve all required close-out documentation required per the Specifications including, but not limited to, manufacturers' operating instructions, maintenance instructions, certificates, warranties, guaranties, and other pertinent operating and maintenance data.

The Professional shall electronically scan all reviewed and approved Operation and Maintenance data being returned to the Contractor and provide a complete set of Operation and Maintenance data for the Project in electronic .pdf format (organized by building system) to the Owner within (1) month after receipt from the Contractor.

1.6.12 Record Drawings. At the time of Final Completion of the Project, the Professional shall collect from the Prime Contractor(s) their complete sets of as-built drawings and will, within 30 days after receipt from the Contractors, transpose all the changes recorded by the Contractors, onto a full set of reproducible drawings which shall become the record (as-built) drawings of the Project. The record drawings must also be put on electronic media compatible with the Owner's ACAD system. The Professional shall submit the as-built drawing set to the Owner in both ACAD dwg format and electronic pdf format (if project is utilizing Building Information Modeling an additional record drawing format shall be required and approved by the Owner).

The Professional shall electronically scan all approved shop drawings being returned to the Contractor and provide a complete set of the approved shop drawings for the Project in electronic pdf format (organized by CSI division) to the Owner within (1) month after Substantial Completion of the project.

1.6.13 Corrections. The Professional shall, without additional compensation, promptly correct any errors, omissions, deficiencies, or conflicts in its work product.

1.6.14 Errors and Omissions. If it becomes necessary during the course of construction to issue change orders which increase the cost of the Project because of the Professional's failure to produce proper and coordinated specifications and drawings, the Professional shall be assessed as follows:

1.6.14.1 Omission Change Order: A change order will be considered to be an omission change order when the additional work is necessitated by the Professional's omission of required elements or specifications in the Construction Documents, and where no work must be removed or replaced in order to carry out the change order. In such cases, the Professional shall be assessed in an amount equal to the difference between the amount of the change order and what the Owner would have paid had the omission not occurred, plus administrative costs incurred by the Owner.

1.6.14.2 Error Change Order. A change order will be considered to be an error change order when the additional work is necessitated by a failure of the Professional to conform to the applicable professional standard of care, resulting in an error which may be rectified only by removal and/or replacement of work which has been performed. In such cases, the

Professional shall be assessed in an amount equal to the difference between the amount of the change order and what the Owner would have paid had the error not occurred.

At the completion of the project, the parties shall exercise good faith in seeking to amicably resolve any disputes that may exist regarding change orders. In the event that the parties are unable to reach an amicable resolution, the dispute resolution provision of Article 12.1 shall apply.

ARTICLE 2: ADDITIONAL RESPONSIBILITIES OF PROFESSIONAL

2.1 Compliance

The Professional is responsible for the compliance of the Construction Documents with all applicable permits, laws, regulations, and ordinances of all commissions, agencies and governments, federal, state and local, insofar as they are applicable to, and have jurisdiction over, the Project. The Professional shall make all required submittals with the advance knowledge of the Owner to, and shall obtain all required approvals from, the applicable agency in a timely manner so as not to cause delays to the Project. The Professional shall also attend all hearings/meetings required for securing necessary approvals and permits.

The Professional shall be responsible for producing a submission document set for approval by Labor and Industry as required by the Commonwealth of Pennsylvania to obtain the necessary building permit. The Professional shall also be responsible for additional submissions as required by the Labor and Industry Building permit processes and procedures throughout the project design and construction.

2.2 Cooperation With Local Bodies

During the design of the Project, the Professional shall keep informed and comply with the requirements of all local zoning, planning, and supervisory bodies. Should these requirements substantially increase the cost of the Project, or should any required approvals be withheld by the local bodies, the Professional shall immediately notify the Owner.

2.3 Proprietary Items, Copyrights, Patents

The Professional shall not include in the design of the Project unless directed by the Owner any equipment, material, or mode of construction which is proprietary or which contains a copyright or patent right relating to designs, plans, drawings, or specifications, unless the equipment, material, or mode of construction is different and fairly considered superior in quality and performance. If the Professional includes in the design of the Project any equipment, material, or mode of construction which is proprietary, it shall have prior approval by the Owner and it shall only be because the item is different and fairly considered superior in quality and performance, and not for the purpose of preventing or restricting competitive bidding. Professional may not knowingly list as acceptable any item which cannot comply with the Steel Products Procurement Act.

ARTICLE 3: OPTIONAL ADDITIONAL SERVICES

Unless required by the Project Scope, the services performed by the Professional, Professional's employees, and Professional's consultants as outlined in this Article are not included in Basic Services and shall be paid for by the Owner as provided in this Agreement in addition to the compensation for Basic Services.

None of these services shall be provided by the Professional, whether they are requested by the Owner or required due to circumstances unknown at the time of the execution of the Agreement, until approval in writing has been given by the Owner.

3.1 Project Representation

If more extensive representation at the site by the Professional is required by the Owner than is provided for under Basic Services, Paragraph 1.6, Construction Phase, the Professional shall provide one or more Project representatives to assist in carrying out such additional on-site representation.

Additional Project representative(s) shall be selected, employed, and directed by the Professional with the approval of the Owner, and the Professional shall be compensated therefore as mutually agreed, in advance, between the Owner and the Professional. Such supplemental agreement letter shall also delineate the duties and responsibilities of the additional Project representative(s).

3.2 Revisions to Approved Drawings and Specifications Prior to Construction Phase

3.2.1 Making revisions to the drawings and specifications requested by the Owner subsequent to the Owner's approval of the Construction Documents as outlined in Paragraph 1.4, Construction Document Phase, unless required to keep the estimated Construction Costs within the amount budgeted for same.

3.2.2 Making revisions to the drawings and specifications required by the enactment or revisions of codes, laws, or regulations subsequent to the completion of the Construction Documents as approved by the Owner.

3.3 Preplanning

Providing special analysis of the Owner's needs such as selection, planning, and development of the site; economic, demographic, and/or financial feasibility; preliminary design criteria and budget estimates; or other special studies except as herein provided as part of Basic Services.

3.4 Specialized Consultants

Providing unusual or specialized Consultant services other than those consistent with the inherent requirements of the Project scope and required to meet the functional needs of the Project.

3.5 Surveys

Providing a complete topographic survey and/or related aerial photography, ground control, photogrammetric plotting, property boundary survey, and the preparation of a metes and bounds legal description and a related plot.

3.6 Special Studies

Providing services related to the preparation of Environmental Assessments and/or Environmental Impact Statements, Energy Impact Statements, Analysis, or Feasibility Studies as may be required by local, state or federal government agencies, provided such services are in addition to the Project scope requirements.

3.7 Other Services

Providing services mutually agreed to that are not otherwise included in this Agreement.

ARTICLE 4: INDEMNIFICATION

To the fullest extent permitted by law, The Professional shall indemnify and hold harmless the Owner and the Owner's respective officers, directors, agents, servants, and employees from and against any and all liability, claims, losses, costs, expenses or damages, including reasonable attorneys' fees, costs and expenses, for property damage, bodily injury or death, that may arise as a result of the failure of the Professional or Professional's agents, employees or consultants, to comply with the applicable professional standards of care in rendering services in connection with this Agreement. Nothing in this indemnity section shall be construed to limit the insurance obligations agreed to herein.

ARTICLE 5: OWNER'S RESPONSIBILITIES

5.1 Basic Information

The Owner shall provide the Professional all information available at the time regarding requirements for the Project. Such information shall include:

5.1.1 A Project Program setting forth the Owner's objectives, space requirements and relationships, special equipment, and systems and site requirements.

5.1.2 A Project Budget including the amount allocated for the Construction Cost and all other anticipated costs and expenses.

5.1.3 A Project Schedule setting forth the times allotted for the Design and Construction Phases of the Project.

If the information furnished is not sufficient for the process of initiation of design solutions, the Professional shall notify the Owner immediately.

5.2 Surveys

The Owner shall furnish to the Professional, as available, surveys describing (as applicable) grades and lines of streets, alleys and pavements; the location of all rights-of-way restrictions, easements, encroachments, zoning classification, boundaries and contours of the site; location, dimensions and other necessary data pertaining to any existing buildings, other improvements and trees; information concerning existing utilities throughout the site, including inverts and depth; and shall establish a Project benchmark.

5.3 Geotechnical Engineering Services

The Owner shall pay the costs of all geotechnical engineering services required for the Project and requested by the Professional and Owner. Such services shall include, but are not limited to, tests borings, samples, field and laboratory reports, final soil reports and logs, and foundation engineering evaluations and recommendations.

5.4 Miscellaneous Tests, Inspections, and Reports

The Owner shall furnish, at the Owner's expense, air and water pollution, hazardous material, environmental, and any other miscellaneous laboratory tests, inspections, and reports as may be required.

5.5 Approval or Disapproval of Design Work

Any approval or failure of the Owner to disapprove or reject design work submitted by the Professional shall not constitute an acceptance of the work such as to relieve the Professional of his full responsibility to the Owner for the proper and professional performance of all design work on the Project.

5.6 Owner Response

The Owner shall act with reasonable promptness on all submissions from the Professional, which require action by the Owner, in order to avoid unreasonable delay in the progression of the Project through the various Phases outlined in Article 1.

5.7 Notice of Nonconformance

The Owner shall notify the Professional immediately if the Owner becomes or is made aware of any fault or defect in the Project or nonconformance by any party with the Contract Documents.

5.8 Copies of Owner's Documents

The Owner shall supply the Professional with copies of the Owner's Form of Agreement between Owner and Contractor and General Conditions of the Contract for Construction for inclusion, by the Professional, in the Bidding Documents. It shall be the Professional's responsibility to access, review, and implement The Pennsylvania State University Design and Construction Standards information provided by the Owner on the Office of Physical Plant web page. Refer to web page content listing in Exhibit C.

5.9 (OPTIONAL) Preconstruction Services

The Owner intends to independently retain a Construction Management firm to provide preconstruction and construction services. The Professional will assist the Owner in reviewing proposals and allow for two full days of meetings to interview and rank prospective construction management firms.

ARTICLE 6: CONSTRUCTION COST

6.1 Project Cost Determination

The Construction Cost for all work described in the Construction Documents, as approved by the Owner shall be determined as outlined below, with precedence in the order listed:

6.1.1 For completed construction, the total cost to the Owner for such construction work less the amount of any change order work necessary because of errors or omissions on the part of the Professional as defined in Subparagraph 1.6.14 Errors and Omissions.

6.1.2 If the Project is not constructed, the sum of the lowest bona fide bids(s) received for all of the work, providing said bids do not exceed the fixed limitation of Construction as defined in Paragraph 9.1.4 or as amended by written agreement by the Owner and Professional as the basis for design. If such bids exceed the limitation previously agreed upon, said limitation shall become the basis of cost.

6.1.3 If bids are not received, the latest Construction Cost Estimate prepared by the Professional, provided such estimate does not exceed the fixed limitation of construction as defined in Paragraph 9.1.4 or as amended by written agreement by the Owner and Professional as the basis for design.

6.2 Notification

It shall be the Professional's responsibility to promptly notify the Owner if, in the Professional's opinion, the Project cannot be designed and constructed within the fixed limitation on the cost of construction as authorized by the Owner. It is the Professional's responsibility to so notify the Owner as soon as such a situation becomes, or should have become, apparent to the Professional.

6.3 Owner Options

If, without written acknowledgment by the Owner, the Professional permits the Construction Contracts to be bid, and if the fixed limitation on the cost of Construction is exceeded by the lowest bona fide bid(s) or negotiated proposal, the Owner may: (1) give written approval of an increase in such fixed limit; (2) authorize rebidding or renegotiating of the Project; (3) terminate the Project and this Agreement in accordance herewith; or (4) cooperate in revising the Project scope or quality, or both, as required to reduce the construction cost. In the case of (4), the Professional, without additional charge to the Owner, shall consult with the Owner and shall revise and modify the Construction Documents as necessary to achieve compliance with the fixed limitation on construction cost. Absent negligence on the part of the Professional in making its estimates of probable construction cost, such modifications and revisions shall be the limit of the Professional's responsibility arising from the establishment of such fixed limitation of construction costs, and having done so, the Professional shall be entitled to compensation for all other services performed, in accordance with this Agreement.

If, after notification to the Owner by the Professional that the Project cannot be designed and constructed within the fixed limitation on the cost of construction, the Professional is by written authorization by the Owner instructed to proceed without a change in the Project program, design, or in the fixed limitation on the cost of construction, the Professional shall not be responsible for the cost of any subsequent redesign.

ARTICLE 7: OWNERSHIP AND USE OF DOCUMENTS

All preliminary studies, Construction Documents, as-built documents, record drawings, special requirements, cost estimates, building information models and all other data compiled by the Professional under this Agreement shall become the property of the Owner and may be used for any purpose desired by the Owner except to use for the construction of an identical facility not covered by this Agreement. The Professional shall not be liable for any reuse of these documents by the Owner.

ARTICLE 8: PROFESSIONAL'S EXPENSES

8.1 Billable Hourly Rates

8.1.1 Direct personnel expense is defined as the direct salaries of the principals, associates, and employees of the firm who are assigned to and are productively engaged on the Project, including clerical employees.

8.1.2 Billable hourly rates for this project are included in the personnel listing in Exhibit B. Billable hourly rates shall be the direct personnel expense rate for any principal's time and a multiple of a maximum of (2.5) the direct personnel expense per hour for the Professional's employees which shall include mandatory and customary benefits such as employment taxes, statutory employee benefits, insurance, sick leave, holidays, vacations, pensions, and similar contributions and benefits.

8.1.3 The billable hourly rates set forth in Exhibit B may be adjusted annually, subject to the Owner's approval, in accordance with generally accepted salary review practices of the profession. Payroll certification shall be provided by the Professional to the Owner upon demand.

8.2 Reimbursable Expenses

Reimbursable expenses are in addition to compensation for Basic and Additional Services and include those expenses as follows for which the Professional shall be reimbursed a not-to-exceed amount for his direct "out-of-pocket" costs (no mark-up allowed on reimbursable expenses). Reimbursable expenses shall be submitted with supporting documentation, which shall include detailed, itemized receipts. Where requested or authorized by the Owner, the following shall be reimbursable:

8.2.1 Out-of-town and out-of-state travel expenses and any necessary fee or permit payment required and paid to any governing body or authority having jurisdiction over the Project. Air travel expenses shall be approved in advance by the Owner. Maximum individual per diem expenses for travel to the job site shall be based on the Owner’s allowable per diem for lodging and meals for that location.

8.2.2 Expense of reproductions including reproductions of record drawings, postage and handling of Drawings, Specifications, and other documents including the preparation and distribution of all necessary bidding correspondence and documents, receipt of bid proposals, and construction contract preparation. Reproductions made for the Professional’s own use or review shall not be included.

8.2.3 Expense of renderings, models, mock-ups requested by the Owner, and/or discs for electronic format submissions of record drawings.

8.2.4 Expenses of specialized consultants identified as optional additional services in Article 3 of this Agreement.

8.2.5 Reimbursable expenses for individual travel, meals, and lodging expenses are limited to individuals under the direct employ of the Professional or their approved consultants.

8.3 Cost for Consultants (consultants not included in the Basic Services proposal/procured after award)

The Professional shall be reimbursed on a multiple of one and one-tenth (1.1) times the amounts billed to the Professional for such services.

ARTICLE 9: COMPENSATION AND PAYMENT

9.1 Compensation and Payment

9.1.1 The Owner agrees to pay the Professional as compensation for those Basic Services described in Article 1, Article 2, and any other agreed upon services described in Article 3: (Insert information in appropriate option below.)

(Option #1) __% of the authorized and approved Construction Cost as defined in Article 6.

(Option #2) an amount not to exceed ______________________________ Dollars ($__________) for the Professional's Personnel Expense as defined in Paragraph 8.1 and cost for Consultants.

(Option #3) a fixed sum of ________________________________ Dollars ($________).

9.1.2 Payment for Basic Services will be made monthly by the Owner in proportion to the service actually performed, but not to exceed the following percentages at the completion of each Phase.

Schematic Phase	15%
Design Development Phase	20%
Construction Document Phase	35%
Bidding Phase	5%
Construction Phase/Close-Out	25%

The close-out portion of the project refers to the development of the punch list and required follow-up, the submission of the as-built documents and other close-out document requirements, ongoing commissioning support, ongoing support of design-related project issues, and the performance of the (1) year bond inspection and punch-list development.

9.1.3 Reimbursable Expenses

The Owner agrees to pay the Professional as compensation for the Professional's Reimbursable Expenses, as defined in Paragraph 8.2, an amount not to exceed __________________________________ Dollars ($___________).

9.1.4 The fixed limitation on the cost of construction as defined by this Agreement shall be ____ Dollars ($____________).

9.2 Optional Additional Services Compensation

If approved, the Owner agrees to compensate the Professional for Optional Additional Services beyond Basic Services, as defined in Article 3 in accordance with the rates defined in Exhibit B and as approved by the Owner.

9.3 Payment Procedures

9.3.1 Payments are due and payable forty-five (45) days from the date that the Professional's invoice is approved by the Owner.

9.3.2 Submission of the Professional's invoice for final payment and reimbursement shall further constitute the Professional's representation to the Owner that, upon receipt from the Owner of the amount invoiced, all obligations of the Professional to others, including its consultants, incurred in connection with the Project will be paid in full.

9.3.3 Documentation accurately reflecting the time expended by the Professional and its personnel and records of Reimbursable Expenses shall be maintained by the Professional and shall be available to the Owner for review and copying upon request.

9.4 Owner’s Right to Withhold Payment

In the event that the Owner becomes credibly informed that any representation of the Professional provided pursuant to Articles 8 or 9 is wholly or partially inaccurate, the Owner may withhold payment of sums then or in the future otherwise due to the Professional until the inaccuracy, and the cause thereof, is corrected to the Owner's reasonable satisfaction.

ARTICLE 10: INSURANCE

10.1 Professional Liability Insurance

The Professional shall secure and maintain, at its sole cost and expense, Professional Liability Insurance to protect against loss resulting from design errors and omissions, failure to coordinate the Construction Documents of the Project, and failure to execute the construction administration duties for the Project.

10.1.1 Unless otherwise specifically provided in this Agreement, the Professional shall secure and maintain Professional Liability Insurance with limits not less than $1,000,000, or the total of the Professional’s fee, whichever is greater.

10.1.2 The Professional shall secure and maintain Professional Liability Insurance, as required above, up to and including one year after the date of the (1) year guarantee inspection of the contracts under the Project.

10.2 General Liability Insurance

The Professional shall secure and maintain, at its sole cost and expense, adequate General Liability Insurance to protect the Owner and the Owner's respective officers, agents, servants, and employees against claims arising out of the Professional's services during the design and construction of the Project for damages in law or equity for property damage and bodily injury, including wrongful death. The Owner shall be named as an additional insured in the policy, and the Professional shall submit a Certificate of Insurance to the Owner prior to execution of the Agreement. The limits of coverage shall be not less than $1,000,000. The Professional is required to secure and maintain General Liability Insurance, up to and including one year after the date of the (1) year guarantee inspection of the contracts under the Project.

10.3 Certificate of Insurance

The Professional shall furnish to the Owner annually, unless otherwise requested, during the active terms of this Agreement, a Certificate from an Insurance Carrier authorized to do business in Pennsylvania indicating: (1) the existence of the insurance required under this Article; (2) the amount of the deductible; and (3) the amount of coverage of such insurance. The Professional shall submit a Certificate of Insurance covering the Professional Liability Insurance requirement up to and including one year after the date of the (1) year guarantee inspection of the contracts under the Project.

10.4 Failure to Comply with Insurance Requirements

During any period in which the Professional is not in compliance with the terms of this Article, no compensation shall be paid by the Owner to the Professional.

ARTICLE 11: TERMINATION, ABANDONMENT, SUSPENSION, REACTIVATION

11.1 Termination by Owner

The Owner shall have the right at any time, for any reason, to terminate this Agreement upon not less than seven (7) calendar days' written notice to the Professional. The Professional shall comply with all reasonable instructions of the Owner then or subsequently given relating to such termination, including but not limited to: instructions concerning delivery of drawings, sketches, and other architectural/engineering data to the Owner; discontinuance of the work on outstanding contracts; and furnishing to the Owner information concerning all action to be taken respecting outstanding agreements with consultants, contracts, awards, orders, or other matters.

Copies of Construction Documents and any other materials in existence as of the date of termination will be furnished to the Owner as requested.

11.2 Compensation in the Event of Termination

In the event of termination, the Professional shall be compensated for its services to the termination date based upon services performed on any Phase to the termination date in accordance with the Compensation and Payment schedule contained herein at Article 9.1.2.

Such compensation shall be the Professional's sole and exclusive remedy for termination.

11.3 Suspension of Work

The Owner may, at any time, direct the Professional to suspend all work on the Project, or on any part thereof, pending receipt of further notice from the Owner. In all such cases the Owner and the Professional shall agree upon an appropriate phasing-out of the work in such a manner that the work may be resumed with a minimum of added cost to the Owner, but in no event shall the work be continued beyond the completion of the Phase in which it then is. The Professional shall be compensated as if the Agreement had been terminated at the completion of the agreed Phase. If work is suspended during the Construction Phase, compensation shall be paid for all Professional services provided to the date of suspension, but no additional compensation shall be paid during the period of suspension.

11.4 Reactivation Compensation

When a Project has been suspended or terminated for a longer time than six (6) months and is subsequently reactivated using the same Professional, the Owner and the Professional shall agree, prior to the beginning of the reactivation work, upon a lump sum, or other basis, of reimbursement to the Professional for its extra start-up costs occasioned as a result of the work having been suspended or terminated.

ARTICLE 12: MISCELLANEOUS PROVISIONS

12.1 Dispute Resolution / Applicable Law

After Final Completion of the Project, any and all claims, disputes or controversies arising under, out of, or in connection with this Agreement, which the parties shall be unable to resolve within sixty (60) days of the time when the issue is first raised with the other party, shall be mediated in good faith. The party raising such dispute shall promptly advise the other party of such claim, dispute or controversy, in writing, describing in reasonable detail the nature of such dispute. By not later than five (5) business days after the recipient has received such notice of dispute, each party shall have selected for itself a representative who shall have the authority to bind such party, and shall additionally have advised the other party in writing of the name and title of such representative. By not later than ten (10) business days after the date of such notice of dispute, the parties shall mutually select a Pennsylvania-based mediator, and such representatives shall schedule a date for mediation, not to exceed one (1) day in length, and less where applicable. The mediation session shall take place on the University Park Campus of The Pennsylvania State University, or upon the campus where the Work was performed, at the option of the Owner. The parties shall enter into good faith mediation and shall share the costs equally.

If the representatives of the parties have not been able to resolve the dispute within fifteen (15) business days after such mediation hearing, the parties shall have the right to pursue any other remedies legally available to resolve such dispute in the Court of Common Pleas of Centre County, Pennsylvania, jurisdiction to which the parties to this Agreement hereby irrevocably consent and submit.

Notwithstanding the foregoing, nothing in this clause shall be construed to waive any rights or timely performance of any obligations existing under this Agreement.

In all respects, this Agreement shall be interpreted and construed in accordance with the internal laws (and not the law of conflicts) of the Commonwealth of Pennsylvania.

12.2 Successors and Assigns

This Agreement shall be binding on the successors and assigns of the parties hereto.

12.3 Assignment

Neither the Owner nor the Professional shall assign, sublet, or in any manner transfer any right, duty, or obligation under this Agreement without prior written consent of the other party.

12.4 Extent of Agreement

This Agreement, including any and all schedules, proposals and/or terms and conditions attached hereto, represent the entire and integrated agreement between the Owner and the Professional and supersedes all prior negotiations, representations, or agreements, either written or oral. This Agreement may be amended only by written instrument signed by both the Owner and the Professional. In the event of a conflict between the provisions of this Agreement and those of any other document, including any that are attached hereto, the provisions of this Agreement shall prevail.

12.5 Third Party

Nothing contained in this Agreement shall create a contractual relationship with or a cause of action in favor of a third party against either the Owner or the Professional.

12.6 Hazardous Material

Unless otherwise provided in this Agreement, the Professional and its consultants shall have no responsibility for the discovery, presence, handling, removal, or disposal of, or exposure of persons to hazardous materials in any form at the Project site, including but not limited to asbestos, asbestos products, polychlorinated biphenyl (PCB), or other toxic material.

If the Professional encounters or suspects hazardous or toxic material, the Professional shall advise the Owner immediately.

12.7 Promotional Material

The Professional shall not issue or disclose to third parties any information relating to the Project without prior consent of the Owner, except to the extent necessary to coordinate the Work with the Owner's agent, Contractors, Subcontractors, etc. The Professional may, with written consent of the Owner, include design representation of the Project, including interior and exterior photographs, among the Professional's promotional and professional materials.

12.8 Terms/General Conditions

Terms contained in this Agreement and which are not defined herein shall have the same meaning as those in the Owner's Form of Agreement between Owner and Contractor and the Owner's General Conditions of the Contract for Construction, current as of the date of this Agreement.

ARTICLE 13: SCHEDULE OF EXHIBITS

The attached Exhibits are part of this agreement:

Exhibit A: Professional's proposal dated _____________ (proposal is attached for scope of work reference **only**. By execution of this agreement, additional terms and conditions that may be included in the Professional's proposal are **not** considered part of this agreement).

Exhibit B: Professional's Billable Hourly Rates.

Exhibit C: The Pennsylvania State University Design and Construction Standards listing (screen print from the Office of Physical Plant web page).

(OPTIONAL) Exhibit D: Project Schedule (including design submission dates).

(PROFESSIONAL COMPANY NAME)
THE PENNSYLVANIA STATE UNIVERSITY
OWNER

________________________________	________________________________
Title	ATTEST, Secretary

(PROFESSIONAL COMPANY NAME)
PROFESSIONAL

________________________________	________________________________
Signature	ATTEST, Secretary

Name:____________________________
(print name of person signing above)

Title:_____________________________
(print title of person signing above)

Federal ID Number:_________________

Attachments