ADAM J. SENK
MECHANICAL OPTION

PENNSYLVANIA STATE UNIVERSITY
CHEMISTRY BUILDING
TECHNICAL ASSIGNMENT #1

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Pennsylvania State University Chemistry Building was evaluated using ASHRAE Standard 90.1 to determine a load analysis of the building along with its energy consumption on a annual basis. The Chemistry Building is 5 stories with a basement and a mechanical penthouse. The building contains offices, laboratories, conferences, seminars and classrooms as far as educational spaces. Public spaces include lounges, atriums and entryways. Proper ventilation is required in order to have a healthy learning environment.

The laboratories are ventilated using three of the four air handlers. They are ventilated using a constant air volume system. The laboratory air handler's supply CFM ranges from 72,500-100,000 CFM. Supply air consists of 100% outdoor air.

The offices and conference areas are ventilated using the fourth air handler. The spaces served by this air handler are ventilated using a variable air volume system. The supplied from the air handler is comprised of 100% outdoor air, and supplied to the spaces at 72,000 CFM. No heat recovery devices are installed for the system.

The air handlers contain preheat, heating, and cooling coils. The heating and preheating coils receive their hot water from an exchanger on site which converts steam energy produced at the University Cogeneration Plant to hot water. The cooling coil receives chilled water which is produced off site at a central chiller plant and rechilled upon entering the building before it is supplied to the coil.

Although the Chemistry Building includes some sustainable, environmentally healthful features, it did not meet LEED compliance. It scored 21 points out of a possible 69 points.

Load Calculations were performed for the building using mechanical drawings and design documents and Carrier's Hourly Analysis Program. Climate data for Williamsport, PA was used in the analysis. Design loads for the 4 Air Handling Units were calculated for a schedule with a peak performance hour during a typical 8 am- 5 pm day. The total load for the Chemistry Building heating was 5591438 kBTU, and the total cooling load was 5581032 kBTU.

General Cost information was generated using Carrier's Hourly Analysis Program and information from Allegheny Power. Only 6.7% of the total building was lost to mechanical space. The majority of this space was located in the Basement. In addition, the Penthouse was not included in the calculation.

The percent of the total cost of the mechanical and plumbing were based off the multiple prime contracts. HVAC cost was $10,896,000 which equated to $57.05 per sq ft. The plumbing cost was 3,637,000 which equated to $19.04 per sq ft. The HVAC and plumbing cost account for 23% of the total cost of the building.

The emissions for the building were 1121278.6 Ilb of particulates, 153804.8 Ilb SO_2, 89038.6 Ilb NO_x, 25834404.8 Ilb CO_2. The emission data for this report were calculated long hand due to Carrier HAP not being capable of running the particular setup the Chemistry Building possesses. Emission data for power source was taken from Prof. Freihaut's Emission Table which he generated using information from the DOE/EIA website.

SYSTEMS

The laboratories are ventilated using three of the four air handlers. They are ventilated using a constant air volume system. The laboratory air handler's supply CFM ranges from 72,500-100,000 CFM. Supply air consists of 100% outdoor air.

The offices and conference areas are ventilated using the fourth air handler. The spaces served by this air handler are ventilated using a variable air volume system. The supplied from the air handler is comprised of 100% outdoor air, and supplied to the spaces at 72,000 CFM.

The system has three chillers at 1350 tons. The building also processes four cooling towers and two exchangers which make hot water for the heating coils from steam. The steam is received from the university steam plant.

ASSEMBLIES

The building contains three wall types:

Wall Type I:
5/8 Gypsum Board, 6" Air Space, 2" R7 Insulation, 1"Air Space, 4" Face Brick: Overall U-Value 0.055 BTU/ (hr-ft ^ 2-F)

Wall Type II:
5/8 Gypsum Board, 3.5" Air Space,8" Concrete Block, 2" R7 Insulation, 1"Air Space, 4" Face Brick: Overall U-Value 0.050 BTU/ (hr-ft ^ 2-F)

Wall Type III:

5/8 Gypsum Board, 3.5" Air Space, 16" Concrete: Overall U-Value 0.317 BTU/ (hr-ft ^ 2-F)

Entrance Doors:
Glass doors (140 sq ft): Overall U-Value 0.580 BTU/ (hr-ft ^ 2-F)

Windows:
Double-pane Windows: Overall U-Value 0.580 BTU/ (hr-ft ^ 2-F)

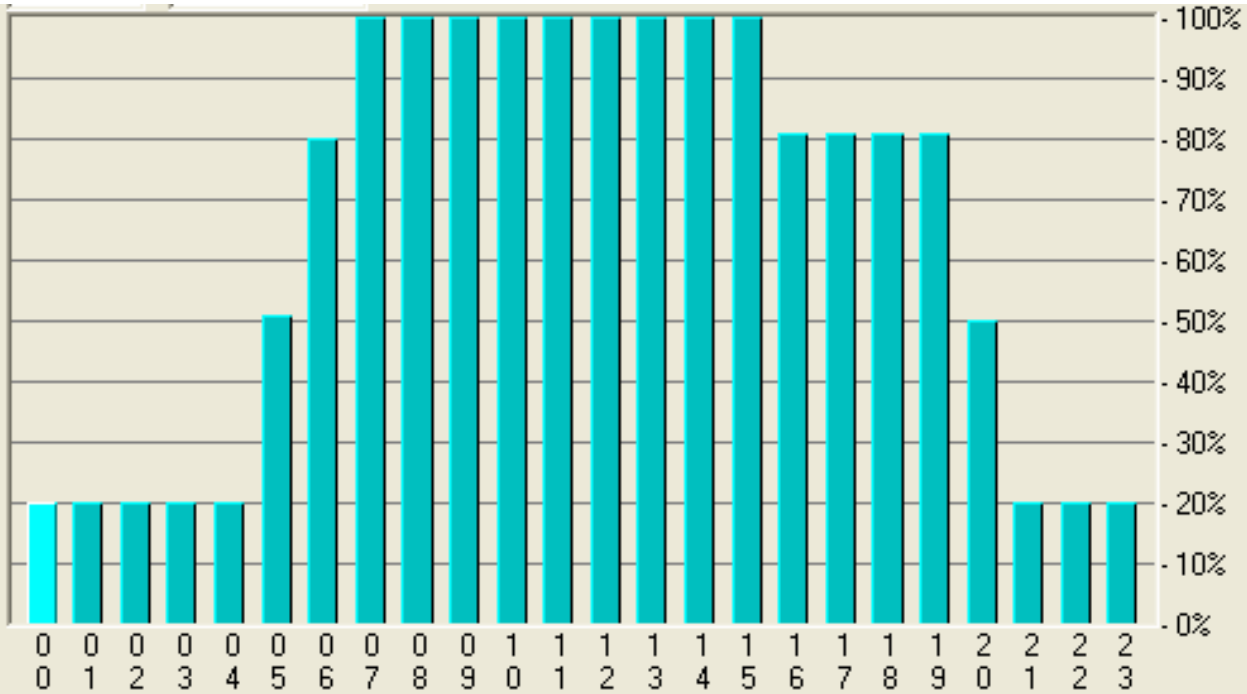
After consulting the mechanical design engineer, it was suggested to consider the penthouse a conditioned space. However, it was not needed to consider the penthouse in design considerations due to the fact that it was heated by the equipment in which it contained. Therefore after this assumption is made it can be assumed that there is no roof on the building.

LOCATION DATA

Due to the lack information for weather data concerning the State College Area, the closest suitable replacement was Williamsport and Harrisburgh.

City Name	**Williamsport**	
Location	**Pennsylvania**	
Latitude	**41.3**	Deg.
Longitude	**76.9**	Deg.
Elevation	**525.0**	ft
Summer Design Dry-Bulb	**90.0**	°F
Summer Coincident Wet-Bulb	**73.0**	°F
Summer Daily Range	**20.3**	°F
Winter Design Dry-Bulb	**2.0**	°F
Winter Design Wet-Bulb	**0.3**	°F
Atmospheric Clearness Number	**1.00**	
Average Ground Reflectance	**0.20**	
Soil Conductivity	**0.800**	BTU/(hr-ft-°F)
Local Time Zone (GMT +/- N hours)	**5.0**	hours
Consider Daylight Savings Time	**No**	
Simulation Weather Data	**Harrisburg (TMY)**	
Current Data is	**2001 ASHRAE Handbook**	
Design Cooling Months	**January to December**	

DEMAND SCHEDULE



The design loads were calculated from this schedule. Because the lab areas will be occupied mostly by graduate students, the hours of operation are long throughout the day and have partial occupation in the later evening hours. In addition, because the building is mostly science labs which need to be at a negative pressure, infiltration will be high. This causes a partial load of 20 percent recommended by the original design team of the building. Also contributing to the partial load is the large amounts of glass which surround other parts of the building.

FIRST COST/PERCENT OF TOTAL COST

The percent of the total cost of the mechanical and plumbing were based off the multiple prime contracts. HVAC cost was $10,896,000 which equated to $57.05 per sq ft. The plumbing cost was 3,637,000 which equated to $19.04 per sq ft. The HVAC and plumbing cost account for 23% of the total cost of the building.

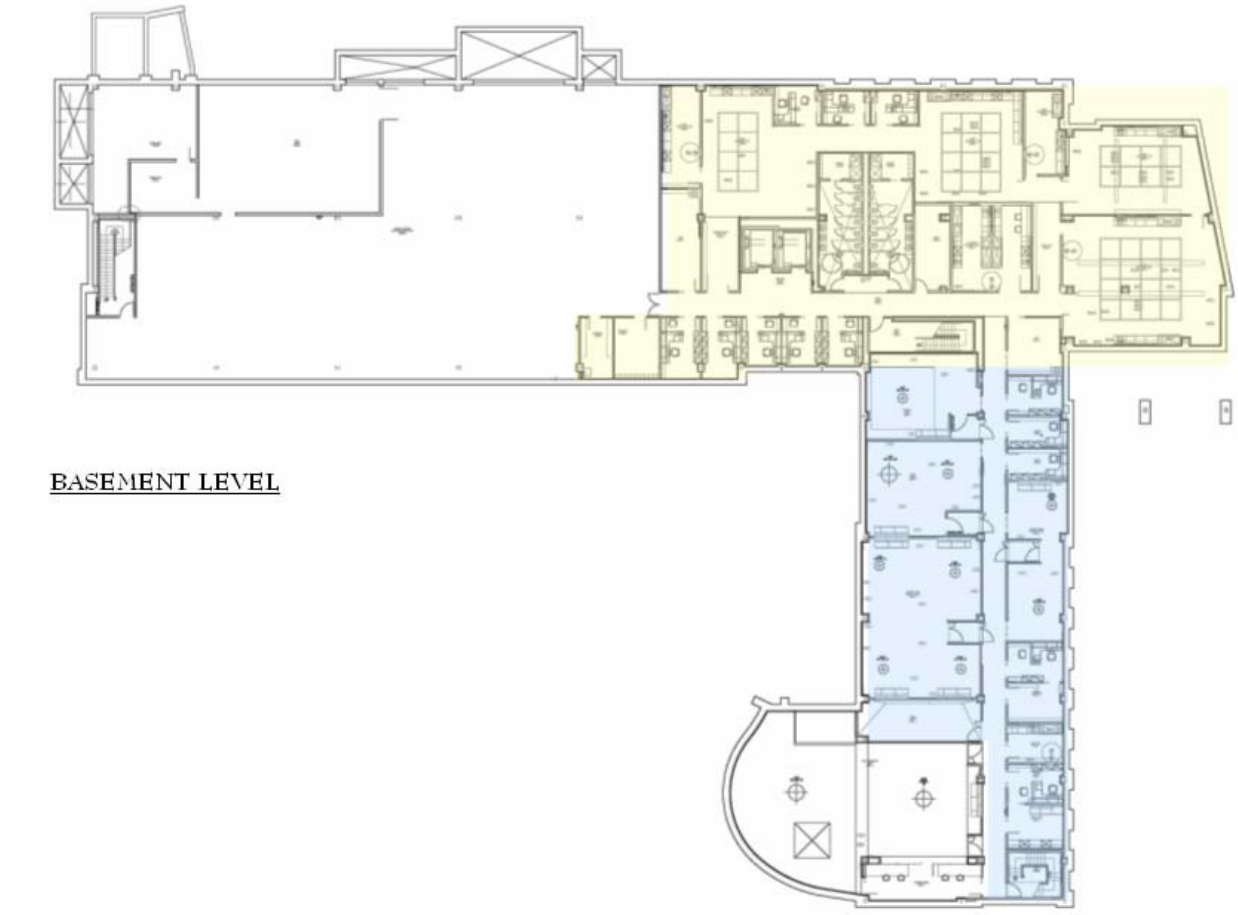
ANNUAL COST SUMMARY

BUILDING ELECTRIC USE			
SOURCE	**KW/hr**	**RATE ($/(KW/hr))**	**OPERATION COST**
AHU	5581031.78	$0.06	$334,861.91
LIGHTING	988486	$0.06	$59,309.16
EQUIPMENT	681136	$0.06	$40,868.16
COND. PUMP	525	$0.06	$31.50
SUPPLY FAN	3459906	$0.06	$207,594.36
TOTAL:	10711085	$0.06	$642,665.09

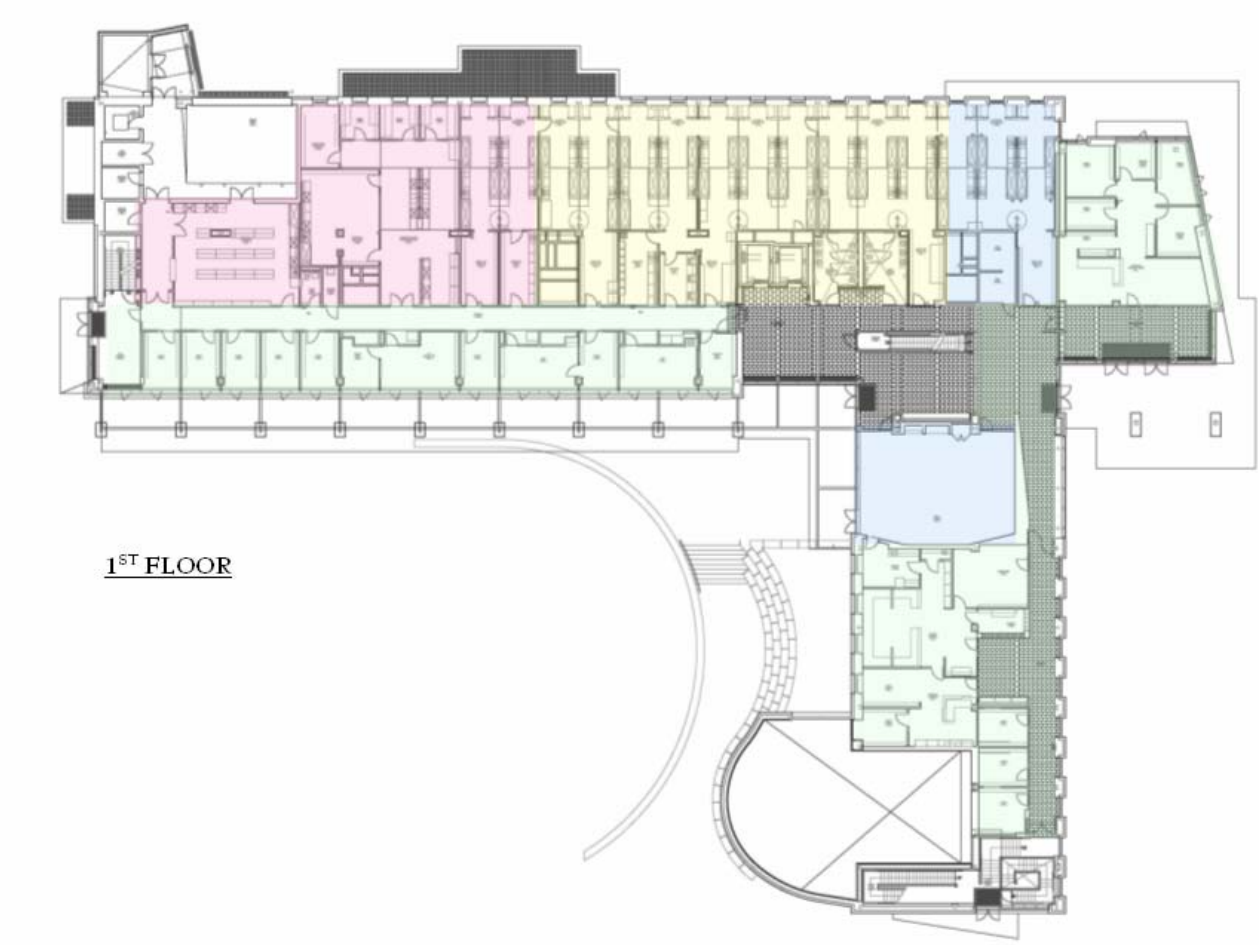
BUILDING ZONES

The building is split into four major zones per floor, except for the basement which is split into two major zones. Each of the zones is fed by one air handler. Laboratories are fed by air handlers 1-3, while offices are fed by air handler 4. All of the laboratories are on a constant air volume system with an outdoor air making up 100% of the supply air. Offices are fed by a variable air volume system with outdoor making up 100% of supply air. All air handlers are located in the mechanical penthouse. The following floor plans illustrate the location of the zones throughout the building.

	CFM	OA	MANUF.	TYPE	LOCATION	COLOR
AHU-1	90000	90000	CARRIER	CV	PENTHOUSE	
AHU-2	100000	100000	CARRIER	CV	PENTHOUSE	
AHU-3	72500	72500	CARRIER	CV	PENTHOUSE	
AHU-4	72000	72000	CARRIER	VV	PENTHOUSE	

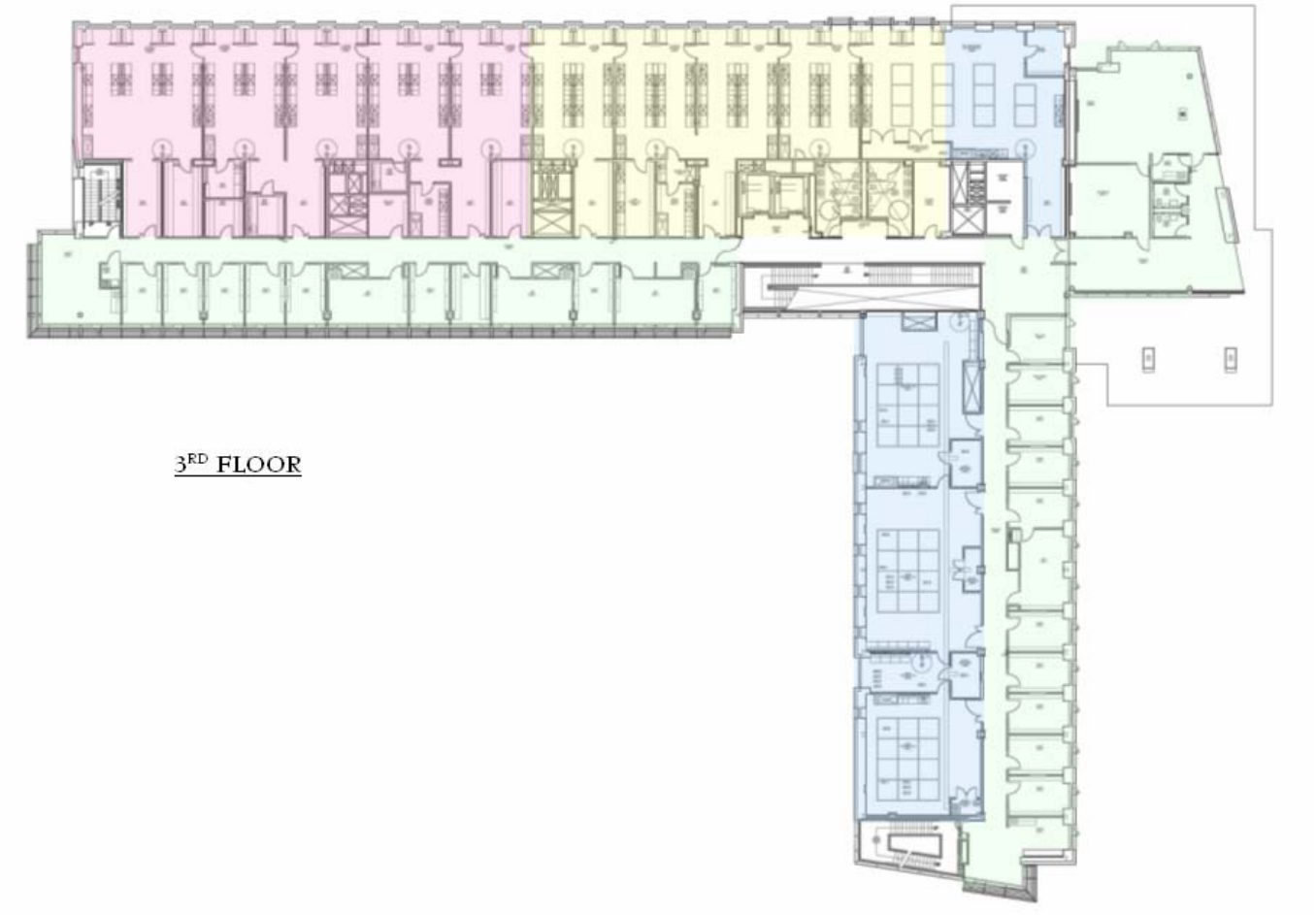


BASEMENT LEVEL



1ST FLOOR

2ND FLOOR



3RD FLOOR

4TH FLOOR

5TH FLOOR

LOST RENTABLE SPACE

Lost rentable space is the space taken by mechanical shafts and rooms which house equipment to sustain the building environment that could be rented to a tenant for a profit to the owner.

The basement space has 10,303 sq ft occupied by mechanical rooms and shafts. In addition each floor above grade has 480 sq ft occupied by mechanical shafts and rooms. The roof area is totally occupied by two levels of mechanical equipment which spans the footprint of the building. Because the penthouse is located on the roof, it will be considered uninhabitable for this exercise. This yields that 6.7% of the building space is occupied by mechanical equipment.

ENERGY UTILIZATION & EMMISSION ANALYSIS

The following information for the total building loads were generated using the Carrier HAP Program. Because of the building receiving chilled water from a central plant on campus, and receiving its steam used to generate the hot water for AHU coils from the Penn State Cogeneration Plant, HAP could not be used to generate overall power use nor could it be used to generate an emission report. This resulted in the hand calculation of these values.

Table 2.1 represents the electricity generated in order to produce hot water for the heating cycle of the building. This includes the preheat and heating coils. The total kBTU where calculated from the HAP report for year long use. The efficiency of the exchanger was given in the schedule located in the plan set. The boiler efficiency and energy generated per pound coal (Bituminous Coal) was found in Steam Generation & Use by Babcocks and Wilcocks (1973). The particulate and emission data was generated by using a table Prof. Jim Freihaut generated using the DOE/EIA website.

TABLE 2.1

HEAT EXCHANGER EMISSIONS						
AHU	COIL		EXCHANGER EFFICIENCY	STEAM kBTU	BOILER EFFICIENCY	COAL kBTU
	kBTU PREHEAT	kBTU HEAT				
1	83242	210925	0.85	346079	0.89	387981
2	2358252	123553	0.85	2919771	0.89	3273285
3	1279817	437140	0.85	2019949	0.89	2264517
4	1041437	57072	0.85	1292364	0.89	1448838

HEAT EXCHANGER EMISSIONS (CONTINUED)						
AHU	llb COAL	COAL KW/hr	llb PARTICULATES	llb SO_2	llb NO_X	llb CO_2
1	27516.4	113706	125.1	1455.4	842.6	244467.8
2	232147.9	959305	1055.2	12279.1	7108.5	2062506.5
3	160604.1	663665	730.0	8494.9	4917.8	1426878.8
4	102754.5	424613	467.1	5435.0	3146.4	912917.0
		TOTAL:	2377.4	27664.5	16015.1	4646770.1

Table 2.2 represents the electricity generated in order to produce chilled water for the cooling cycle of the building. The total Kbtu where calculated from the HAP report for year long use. The efficiency of the chiller was given in the schedule located in the plan set. The emissions for this piece of equipment will be calculated later in another table.

TABLE 2.2

CHILLER ELECTRIC USE				
AHU	kBTU	EFFICIENCY	HOURS (Year)	KW/hr
1	2547556	0.8	8760	933361
2	3396133	0.8	8760	1244258
3	5885009	0.8	8760	2156120
4	3404415	0.8	8760	1247293
			TOTAL:	5581032

Table 2.3 represents the electrical distribution of electrical use for the Chemistry Building. The information for Lighting and Equipment was generated in the Carrier HAP program, while the chiller electric information was generated in the table preceding this paragraph. The information for the condensate pump was supplied by Spirax Sarco.

TABEL 2.3

BUILDING ELECTRIC USE	
SOURCE	**KW/hr**
AHU	5581032
LIGHTING	988486
EQUIPMENT	681136
COND. PUMP	525
SUPPLY FAN	3459906
TOTAL:	10711085

Table 2.4 represents the total electric use in KW/hr and emissions generated during production. The service provider for the Chemistry Building is Allegheny Power. Allegheny Power generates 95% of its power by coal and the remaining 5% by nuclear. The emissions for this power production were calculated by using a table Prof. Jim Freihaut generated using the DOE/EIA website.

TABLE 2.4

EMISSIONS FROM ELECTRICITY PRODUCTION						
PRODUCTION ENERGY SOURCE	**PERCENTAGE**	**YEARLY ELECTRICITY USE (KW/hr)**	**Ilb PARTICULATES**	**Ilb SO_2**	**Ilb NO_X**	**Ilb CO_2**
COAL	95	10711085	1119308.4	130246.8	75400.7	21877390.7
NUCLEAR	5	10711085	0.0	0.0	0.0	0.0
		TOTAL:	1119308.4	130246.8	75400.7	21877390.7

Table 2.5 represents the total emissions for the building calculated in **Table 2.4** and **Table 2.1**.

TABLE 2.5

BUILDING TOTAL EMISSIONS				
SOURCE	**lb PARTICULATES**	**lb SO_2**	**lb NO_X**	**lb CO_2**
ALLEGHENY POWER	1119308.4	130246.8	75400.7	21877390.0
STEAM COGENERATION PLANT	2377.4	27664.5	16015.1	4646770.1
TOTAL:	1121685.8	157911.3	91415.8	26524160.1

LEED COMPLIANCE

The US Green Building Council (USGBC) has established a system for rating the sustainability or energy efficiency of a building's design. The Leadership in Engineering and Environmental Design (LEED) has developed a rating system to promote the adoption of sustainable, environmentally conscious building design. The rating is based off points earned in the areas of site, water, energy, materials, and indoor environment design and life cycle performance. Depending on the number of points earned in these areas determines the rating of Certified 26-32, Silver 33-38, Gold 39-51, Platinum 52-69. The rating for The Pennsylvania Chemistry Building follows this section.

Site development and selection both scored points for Sustainable Sites due to the selection and use of a max density area. Also points were earned for Reduced Site Disturbance because of the minimized site disturbance in order to save Pine Cottage. Additional Points were also earned for alternative forms of transportation for the bus and bicycle access. No further points were earned for reuse of an existing building, or Stormwater Management, Landscape & Exterior Design to Reduce Heat Island, and Light Pollution Reduction.

Under the heading Water Efficiency, points were earned for reducing use in landscaping by 50%, and not having potable use or irrigation. No other points were earned.

For the heading Energy & Atmosphere, there are three areas required Fundamental Building Systems Commissioning, Minimum Energy Performance, CFC Reduction in HVAC&R Equipment. These areas are required and do not count in the points earned. Additionally, points were earned for Optimize Energy Performance, and Measurement & Verification.

No points were earned for Material & Resources due to no recycled or rapidly renewable resources were used on the project besides the required of Storage & Collection of Recyclables.

Several points were scored in the area of Indoor Environmental Quality. Like the other section there are the minimum requirements, for this section the requirements are Minimum IAQ Performance and Environmental Tobacco Smoke Control all are areas which Penn State has adopted in their building code. Because of the building being mostly comprised of laboratory spaces, the spaces are constantly monitored for ventilation requirements and contaminants such as CO_2 eight points were scored in this area. Other points were earned for Thermal Comfort, and Daylight & Views. Points were not earned in this area were due to the materials installed in the buildings because of cost were not Low-Emitting Materials.

The last section to be assessed is Innovation & Design Process. No points were earned in this area accept that building was designed by an accredited professional.

In conclusion, this building is not LEED accredited. Out of a possible 69 points The Pennsylvania State Chemistry Building scored 21, which does not meet the lowest level of certification of Certified 26-32 points.

LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

LEED-NC Version 2.1 Registered Project Checklist

Project Name
Project Location

Yes	?	No			
6		**8**	**Sustainable Sites**		**14** Points
Y			Prereq 1	**Erosion & Sedimentation Control**	Required
X			Credit 1	**Site Selection**	1
X			Credit 2	**Development Density**	1
		X	Credit 3	**Brownfield Redevelopment**	1
X			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
X			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
		X	Credit 4.3	**Alternative Transportation**, Alternative Fuel Vehicles	1
X			Credit 4.4	**Alternative Transportation**, Parking Capacity and Carpooling	1
X			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
		X	Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
		X	Credit 6.1	**Stormwater Management**, Rate and Quantity	1
		X	Credit 6.2	**Stormwater Management**, Treatment	1
		X	Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
		X	Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
		X	Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
2		**3**	**Water Efficiency**		**5** Points
X			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
X			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		X	Credit 2	**Innovative Wastewater Technologies**	1
		X	Credit 3.1	**Water Use Reduction**, 20% Reduction	1
		X	Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No			
2		6	**Energy & Atmosphere**		**17** Points
Y			Prereq 1	**Fundamental Building Systems Commissioning**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
X			Credit 1	**Optimize Energy Performance**	1 to 10
		X	Credit 2.1	**Renewable Energy**, 5%	1
		X	Credit 2.2	**Renewable Energy**, 10%	1
		X	Credit 2.3	**Renewable Energy**, 20%	1
		X	Credit 3	**Additional Commissioning**	1
		X	Credit 4	**Ozone Depletion**	1
X			Credit 5	**Measurement & Verification**	1
		X	Credit 6	**Green Power**	1

continued…

Yes	?	No			
		13	**Materials & Resources**		**13** Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
		X	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
		X	Credit 1.2	**Building Reuse**, Maintain 100% of Shell	1
		X	Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
		X	Credit 2.1	**Construction Waste Management**, Divert 50%	1
		X	Credit 2.2	**Construction Waste Management**, Divert 75%	1
		X	Credit 3.1	**Resource Reuse**, Specify 5%	1
		X	Credit 3.2	**Resource Reuse**, Specify 10%	1
		X	Credit 4.1	**Recycled Content**, Specify 5% (post-consumer + ½ post-industrial)	1
		X	Credit 4.2	**Recycled Content**, Specify 10% (post-consumer + ½ post-industrial)	1
		X	Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
		X	Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
		X	Credit 6	**Rapidly Renewable Materials**	1
		X	Credit 7	**Certified Wood**	1

Yes ? No

10		5	**Indoor Environmental Quality**	15 Points

Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
X			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
X			Credit 2	**Ventilation Effectiveness**	1
X			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
X			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
		X	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
		X	Credit 4.2	**Low-Emitting Materials**, Paints	1
		X	Credit 4.3	**Low-Emitting Materials**, Carpet	1
		X	Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber	1
X			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
X			Credit 6.1	**Controllability of Systems**, Perimeter	1
X			Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
X			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
X			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
X			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
		X	Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1
Yes	?	No			

1		4	**Innovation & Design Process**	5 Points

		X	Credit 1.1	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.2	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.3	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.4	**Innovation in Design**: Provide Specific Title	1
X			Credit 2	**LEED™ Accredited Professional**	1
Yes	?	No			

21		39	**Project Totals** (pre-certification estimates)	69 Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

REFERENCES

- 2005 ASHRAE Handbook of Fundamentals. ASHRAE Incorporated. Atlanta, GA. 2005
- 2005 ASHRAE Handbook Systems and Equipment. ASHRAE Incorporated. Atlanta, GA. 2005
- Steam Generation and Use. Babcocks and Wilcocks. NY, NY 1973
- ASHRAE/IESNA Standard 62-2004. ASHRAE Incorporated. Atlanta, GA. 2004
- ASHRAE/IESNA Standard 90.1-2004. ASHRAE Incorporated. Atlanta, GA. 2004
- Adam Senk's Technical Report 1 for AE 481W
- Carrier. 2004. Hourly Analysis Program (HAP), Version 4.20a
- LEED Green Rating System. 2002. US Green Building Council , Version 2.1
- ASHRAE/IESNA Addendum n to ASHRAE/IESNA Standard 62-2004. ASHRAE Incorporated. Atlanta, GA. 2004

APPENDIX

Monthly Simulation Results for AHU-1

Project Name: Tech 2
Prepared by: Penn State
11/12/2005
02:35PM

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kBTU)	Central Cooling Coil Load (kBTU)	Central Heating Coil Load (kBTU)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	297230	676	52631	24976	19985	40666
February	229347	103	34019	22314	18145	36403
March	125774	9672	23772	24369	20228	39820
April	39822	106732	18065	24321	19372	39245
May	310	216469	1198	25163	19619	40243
June	0	520071	0	24640	19981	38822
July	0	632929	0	25915	19985	40666
August	0	599088	0	25248	20228	39820
September	119	305220	162	24663	19372	39245
October	31454	130500	7589	25267	19985	40666
November	102401	24974	28556	23525	19615	38399
December	214980	1123	44933	24977	19985	40666
Total	**1041437**	**2547556**	**210925**	**295379**	**236502**	**474658**

Monthly Simulation Results for AHU-2

Project Name: Tech 2
Prepared by: Penn State
11/12/2005
12:56PM

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kBTU)	Central Cooling Coil Load (kBTU)	Central Heating Coil Load (kBTU)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	365265	6565	27377	28656	23476	68317
February	281843	5229	24437	25624	21314	61156
March	154563	24556	16880	28089	23761	66896
April	48937	152880	9123	28053	22755	65930
May	381	307097	292	29113	23045	67606
June	0	667092	0	28396	23471	65219
July	0	801544	0	29772	23476	68317
August	0	765917	0	29063	23761	66895
September	146	414697	131	28502	22755	65930
October	38654	197149	5292	29223	23476	68317
November	125840	44291	17069	27136	23041	64508
December	264188	9120	22952	28721	23476	68317
Total	**1279817**	**3396135**	**123553**	**340350**	**277806**	**797409**

Monthly Simulation Results for AHU-3

Project Name: Tech 2
Prepared by: Penn State

11/12/2005
12:52PM

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kBTU)	Central Cooling Coil Load (kBTU)	Central Heating Coil Load (kBTU)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	673053	75395	102787	21276	18543	158396
February	519338	70279	80592	19082	16836	141796
March	284805	109956	51824	21045	18769	155111
April	90173	289554	31669	20968	17974	152863
May	702	491203	4614	21834	18203	156745
June	0	1085155	74	21236	18539	151229
July	0	1311090	0	22259	18543	158396
August	0	1237136	0	21785	18769	155111
September	270	659239	1106	21344	17974	152863
October	71226	339394	21418	21881	18543	158396
November	231878	134386	53407	20309	18199	149578
December	486806	82224	89649	21371	18543	158396
Total	**2358252**	**5885009**	**437140**	**254391**	**219435**	**1848881**

Monthly Simulation Results for AHU-4

Project Name: Tech 2
Prepared by: Penn State

11/12/2005
01:03PM

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kBTU)	Central Cooling Coil Load (kBTU)	Terminal Heating Coil Load (kBTU)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	10828	15377	33850	4543	16681	29040
February	13312	13595	12769	4245	15145	25996
March	19874	23898	128	5854	16882	28436
April	10359	147649	0	7930	16169	28025
May	204	279637	0	10099	16376	28738
June	0	683812	0	11721	16675	27723
July	0	856384	0	13252	16681	29040
August	0	768278	0	11898	16882	28436
September	76	385269	0	10263	16169	28025
October	5874	177945	0	8529	16681	29040
November	14691	35602	272	5415	16370	27421
December	8023	16968	10054	4648	16681	29040
Total	**83242**	**3404415**	**57072**	**98396**	**197393**	**338958**