



New York Police Academy

College Point, New York

Technical Report 1:

ASHRAE Standard 62.1-2007 & Standard 90.1-2007 Compliance Analysis

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Executive Summary:

The New York Police Academy is a campus that will provide a centralized location for the training and academic facilities of the New York Police Department. The purpose of this technical report is to analyze the New York Police Academy's (NYPA) compliance with ASHRAE Standards 62.1-2007 and ASHRAE Standard 90.1-2007.

ASHRAE Standard 62.1 has been established to specify the minimum ventilation rates and measures that need to be taken to provide acceptable indoor air quality in buildings. Acceptable indoor air quality is intended to minimize adverse health effects for human occupants. Thus, this report analyzes the measure taken by the designers of the NYPA to maintain acceptable indoor air quality.

The NYPA has successfully complied with Standard 62.1. Specifically, this report focuses on Section 5 and Section 6 of the Standard. These sections verified that the ventilation equipment and the ventilation system matched the criteria for acceptable indoor air quality set forth by ASHRAE. Also a Ventilation Rate Procedure was calculated for the Academy to analyze if acceptable quantities of outdoor air have been properly allocated to all occupied spaces. It was verified that the supply of outdoor air to necessary spaces will exceed the minimum requirements.

ASHRAE Standard 90.1 has been written for the purpose of providing minimum energy efficient requirements for the design of a building. This particular ASHRAE standard provides information and guidelines about what acceptable criteria is for building envelopes, mechanical systems, lighting systems and their relationship to the energy consumption in buildings.

After performing a thorough and comprehensive investigation of the New York Police Academy's compliance with ASHRAE Standard 90.1, it is safe to state that the NYPA complies with the energy standards set forth by ASHRAE. This report summarized some of the major sections of Standard 90.1 in which the NYPA academy complied with. Construction assemblies, equipment specifications, and lighting usages were several of the key topics discussed in the Standard 90.1 section of this report. Overall, the NYPA successfully represents itself as being compliant with ASHRAE Standards 62.1 and 90.1.

Building Overview:

The New York Police Academy (NYPA) is a building project which is to start construction in October of 2010 and be completed by the end of 2013. This Academy is intended to consolidate the New York Police Department's training and academic center into one campus. The NYPA is going to be built in College Point, New York, which is a subsection of Queens, New York. The total site consists of 2,400,000 gross square feet which will consist of an East Campus Building, West Campus Building, football field, outdoor track, muster court, parking lots, and landscaped areas. There will be an exposed drainage ditch that will symbolically and physically separate the East and West campus. The East Campus Building will house the academic and office spaces of the academy. The West Campus Building will house the athletic facilities, training facilities, and the central mechanical plant.



Figure 1: Site Plan Courtesy of New York City Department of Design and Construction



Figure 2: New York Police Academy Aerial Rendering Courtesy of Perkins + Will

New York Police Academy

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The architectural design of the NYPA has been headed by Perkins + Will and the joint venture leadership of Turner Construction Company and STV Construction Company is leading the construction management services of the project. The New York City Department of Design and Construction (DDC) will also be responsible for overseeing the progression of the design and construction of the project. The architectural aesthetics of the building has been designed to assure a modern and clean look. The sharp aluminum paneling mixed with a pre-cast concrete façade offers a building envelope with a strong character that builds upon a simple rectangular shape.



Figure 3: New York Police Academy Rendering Courtesy of Perkins + Will

Sustainability has influenced the design of the academy; the project has a minimum requirement of reaching United States Green Building council LEED[®] Silver. However, the project also has the potential to be LEED[®] Gold. Perkins + Will and associate architect Michael Fieldman have developed a design for the Academy that introduces an inclusive sustainable design that relies on high performing equipment, waste water management and innovative and creative design techniques.

The Academy is providing a minimum of 14% energy cost reduction with hopes of a 30% energy reduction to comply with the 2030 Challenge. Energy simulations will be performed on the building and the impact of certain energy efficient measures will prove the energy cost reduction. Just a few of the energy efficient measures integrated into this building include a high performance envelope/glazing, carbon dioxide sensor for control of ventilation, and variable speed chillers, equipment and pumps.

The New York Police Academy will become an integral facility for the training of future New York City Police Officers. It will serve as a very important building for the citizens of New York City for many years to come.

Mechanical Systems Overview:

Due to the size of the building WSP Flack + Kurtz (Project MEP Engineers) decided to house a central utility plant in the West Campus. The central utility plant will be responsible for the hydronic needs of the entire Academy as well as air conditioning needs for the West Campus. The decision to house a central utility plant for the entire Academy will increase the distribution energy use for pumping water. However, the ability to house all the mechanical equipment in a central location will allow for larger equipment to run at larger loads thus running more efficiently. Also the centralized location will allow for easier maintenance and accessibility of the equipment. Some of the equipment included in the central plant are chillers, boilers, generators, expansions tanks, heat exchangers, and pumps.

The air conditioning needs of the building will be met by 63 chilled water Air Handling Units (AHUs). The capacity of the AHUs range from 3,000 CFM to 30,000 CFM. The 63 Air Handling Units will be housed in different sections of the campus. 18 AHUs will reside in the Central Plant, 26 AHUs will reside in the West Campus, the final 19 AHUs will be located in the East Campus. Indoor air quality needs will also be addressed with precautions such as a no smoking policy, indoor CO₂ sensors, and appropriate placement of air intakes that will limit outdoor contaminants entering the building.

There are three water tube boilers that are located in the central plant that will be responsible for introducing the hot water for the entire campus. Along with the boilers there will be (8) 1350 bHp chillers that will supply all the cold water needs of the Academy.

The fire suppression system is a mixture of wet-pipe, dry-pipe, and pre-action sprinkler systems. There also will be electric driven centrifugal pumps to supply the necessary water to the suppression systems. In the event of an emergency and lack of utility power, the electric driven pumps will have an automatic transfer switch for emergency power. Also smoke dampers will be installed in the ventilation system to suppress the oxygen delivered to potential fires.

ASHRAE Standard 62.1 Overview:

The purpose of ASHRAE Standard 62.1 is to specify the minimum ventilation rates and measures that need to be taken to provide acceptable indoor air quality in buildings. Acceptable indoor air quality is intended to minimize adverse health effects for human occupants. ASHRAE defines acceptable indoor air quality as: air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.

Section 5.1: Natural Ventilation

Natural Ventilation is not a major source of ventilation for the New York Police Academy. Operable windows or operable skylights have not been included in the design of either the East or West Campus. The New York Police Academy is not inclined to include a high level of window control-ability to its occupants for security reasons. The NYPA is intended to be a very secure building and inoperable windows are deemed more important than the benefits of natural ventilation.

Section 5.2: Ventilation Air Distribution

The New York Police Academy provides proper documentation in their MEP specifications (Specification 23 05 93-6) that outlines the general requirements for the air balance testing and the quality assurance measures that will be provided. Quality assurance measures for ventilation air distribution will be periodically practiced throughout the construction and life of the NYPA. The design on the ventilation air distribution is in compliance with ASHRAE Standards and the calculations can be seen under Section 6.1 of this report. Controls of the ventilation system will assure that the air distribution needs meets the minimum air flow requirements. Nonetheless, the academy has been designed to exceed all minimum ventilation rates.

Section 5.3: Exhaust Duct Location

Exhaust ducts that contain potentially harmful contaminants will be negatively pressured relative to the spaces they pass so that exhaust air does not leak into occupied spaces. The NYPA primarily consists of academic and training facilities. Contaminated air will primarily originate from the physical training areas and equipment rooms which are housed in the West Campus. Designated exhaust fans and properly constructed duct systems in compliance with the specifications will minimize the potential for re-introducing contaminated air into spaces.

Section 5.4: Ventilation System Controls

A Building Management and Control System (BMCS) will be provided in the academy that will perform both monitoring and control of HVAC and electrical equipment for building management, energy conservation, and environmental control (Specification 23 09 23-7). This BMCS specifically targets ventilation system controls, and the systems is designed to exceed the minimum outdoor air flow that has been calculated under Section 6 of ASHRAE Standard 60.1-2007.

Section 5.5: Airstream Surfaces

The airstream surfaces in equipment and ducts in the heating, ventilating and air conditioning systems must be designed and constructed to resist mold growth and resist erosion. Sheet metal surfaces and metal fasteners are the only exception. The NYPA complies with this section by detailing all HVAC equipment to resist the growth of mold and to resist erosion.

Section 5.6: Outdoor Air Intakes

Outdoor intakes for the NYPA's ventilation system is safely designated in appropriate areas. The outdoor intakes are located on the second, third, and fourth floor of the western face of the West Campus, and also the roofs of both the East Campus and West Campus house. The locations of these intakes safely comply with the minimum separation distances of Table 5-1 of ASHRAE Standard 60.1-2007. Also natural ventilation was not part of the ventilation design therefore there are no doors or windows that need to be cross reference with Table 5-1.

Section 5.7: Local Capture of Contaminants

All discharge from non-combustion equipment that captures the contaminants generated by the equipment must be ducted outdoors. The NYPA directly releases all the discharge from the equipment through the roof of the building. Also discharge is released on the upper floors of the West Campus. Nonetheless, all discharge is directed outdoors.

Section 5.8: Combustion Air

All breeching and stacks that will be responsible for the adequate removal of combustion products shall be factory built and shall be listed by the Underwriters Laboratories (UL Labeled). All

breaching and stacks will be sealed and pressure tight at the maximum operating pressure. The manufactures of this equipment must certify that the pressure integrity will be maintained at the prescribed level. Also all breaching and stacks will be installed according to the manufacturer's installation instructions. (Specification 23 51 00-5)

Section 5.9: Particulate Matter Removal

All Air-Handling Units are specified to contain filters to be efficiency of MERV 13 (Specification 23 73 00-11). This is compliant with ASHRAE Standard 62.1 Section 5.9, which calls for filters to be efficiency of MERV 6 or greater. All filters will also include an air filter gauge which will be helpful in the proper maintenance of the filters. In accordance with ASHRAE the pre -filter of each AHU will have a minimum efficiency of 20% and the final filter will have a minimum filter of 90%.

Section 5.10: Dehumidification Systems

The relative humidity of the NYPA will be limited to less than 65% in compliance with ASHRAE. There will be a natatorium located in the West Campus of the NYPA. Due to the increased latent load of this zone there will be specialized dehumidification equipment installed in the natatorium's Air Handling Unit.

Section 5.11: Drain Pans

According to the Air-Handling Units (Specifications 23 73 00-10) all cooling coils displayed on the drawings shall be fitted with drain pans. The drain pans must be fitted with 16 gauge 304 stainless steel and each pan shall be tripled pitch with the sufficient slope (at least .125 in/ft) to prevent standing water in the unit. Also all drain pans will have attached drain connections for proper drainage. The prevention of standing water will eliminate breeding grounds for bacteria fungus, and other potentially harmful living organisms.

Section 5.12: Finned-Tube Coils and Heat Exchangers

Drain pans will be provided under all dehumidifying cooling coil assemblies and condensate producing heat exchangers. The specifications of these drains pans have been described in Section 5.1. Also Water coils in the building will designed and installed to withstand the working pressure of the service and all coils must be in accordance with ARI 410-72(Specification 23 73 20-1).

Section 5.13: Humidifiers and Water Spray-Systems

Electric steam humidifiers will be used in the building and the quality of water must originate directly from a potable source. The water for the humidifiers will be connected to the make-up domestic water supply and chemically treated water will not be used for the humidifiers (Specification 23 84 20-3). Also all equipment installed downstream of the humidifiers shall be installed according to the manufactures specifications.

Section 5.14: Access for Inspection, Cleaning, Maintenance

The HVAC equipment has been designed and laid out in an efficient manner for the routine inspection, cleaning and maintenance of the equipment. A majority of the HVAC equipment is housed in the Central Utility Plant of the West Campus. The Central Utility Plant is designated strictly for the buildings utility equipment. Large equipment rooms provide sufficient space for all equipment. Also all AHU's are provided with hinged access doors in all sections of the AHU for easy maintenance access (Specification 23 73 00-14).

Section 5.15: Building Envelope and Interior Surfaces

The NYPA's building envelope will be provided with a weatherproofing membrane that will prevent water penetration and resistance to weathering. The applied barrier will be UV resistant and self-sealing (Specification 07 27 26-1). Silicone rubber weather sealant will provide protection for all exterior joints, seams, and penetrations to prevent air leakage and the intrusion of water (Specification 07 92 00-1).

Section 5.16: Buildings with Attached Parking Garages

The New York Police Academy does not include any indoor parking garages. All parking for the facility will be outdoor parking lots. Therefore, vehicular exhaust being dispersed indoors will not be an issue for this project.

Section 5.17: Air Classification and Recirculation

There are two different types of air classifications for the Academy. A majority of the building falls under Air Class 1. These spaces include the office space, the classrooms, corridors, and meeting spaces. The spaces that are primarily associated with the academic and business side of the academy carry an Air Class 1 rating. The NYPA also has several spaces that carry an Air Class 2 Rating. These spaces include the dining areas, the shop areas, fitness rooms, and pool area. Air Class

1 is considered air with low contaminant concentration and Air Class 2 is considered air with a moderate contaminant concentration. Recirculation requirements depend on providing the proper amount of outdoor ventilation air to each space. The NYPA complies with this section of Standard 60.1 which can be verified in Section 6 of this report.

Section 5.18: Classification

The East Campus and West Campus of the New York Police Academy will be smoke free. Smoking will be permitted in certain areas outside of the Academy buildings, but only in designated areas. Also smoking areas will be located away from any potential outdoor air intakes of the ventilation system.

Section 6.1.1: Ventilation Rate Procedure

The Ventilation Rate Procedure has been performed for the entire NYPA. The academy is a very large campus and the ventilation procedure was not performed on a room by room basis. Rather, the procedure was performed based on larger ventilation zones. Mechanical zoning plans were available for the West Campus and these zones and areas were used for the West Campus ventilation calculations. However, the mechanical zoning plans for the East Campus were not available for review. Nonetheless, I took it upon myself to designate zones for the East Campus based on architectural layout and similar occupancies. It is important to note that the East Campus zoning does not depict the work of WSP Flack + Kurtz (NYPA MEP Engineers).

Air Handling Unit Schedules were provided for the entire academy, for summary of schedules see Appendix A.2. As stated before, the mechanical zoning drawings for these AHU's were only available for the West Campus. Thus, proving ASHRAE Standard 60.1 outdoor air compliance can only be verified for the West Campus zones. However, the Ventilation Rate Procedure has been performed for the East Campus but the calculations cannot be cross referenced for compliance with Standard 60.1.

Variables & Equations:

Variable	Description	Units
Az	Zone Floor Area	[ft ²]
Pz	Zone Population	[occupants]
Ra	Outdoor Air Flow per unit area	[cfm/ft ²]
Rp	Outdoor Air Flow per person	[cfm/occupant]
Ez	Zone air Distribution Effectiveness	[no units]
Voz	Zone Outdoor Airflow	[cfm]
Vbz	Breathing Zone Outdoor Airflow	[cfm]
Vpz	Zone Primary Airflow	[cfm]

Equation	Description	Standard 62.1 Location
$V_{bz}=R_p \cdot P_z + R_a \cdot A_z$	Breathing Zone Outdoor Airflow	Equation 6-1
$V_{oz}=V_{bz}/E_z$	Zone Outdoor Airflow	Equation 6-2
$Z_p=V_{oz}/V_{pz}$	Zone Primary Outdoor Air Fraction	Equation 6-5

Ventilation Rate Procedure/Example:

Step 1:

Determine Occupancy Category and square footage of zone.

-ex: Office Space, Az= 5000 [ft²]

Step2:

Determine Outdoor Air Flow per unit area and per person. (Ra & Rp)

-ex: Ra= 0.06 [cfm/ft²], Rp= 5 [cfm/person] (Table 6-1)

Step3:

Determine/Calculate Occupant Density (Pz). The default occupant density (occupants/1000ft², also found in Table 6-1) shall be used when actual occupant density is not known.

-ex: Office Space: (5 person(s) /1000ft²) * (5000 ft²)= 25 persons

Step 4:

*Calculate Breathing Zone Outdoor Airflow. (Vbz=Rp *Pz + Ra *Az)*

-ex: Vbz= 5 [cfm/person]*25 [persons] + 0.06 [cfm/ft²]*5000[ft²]= 425 [cfm]

Step 5:

Determine Zone Air Distribution Effectiveness (Ez) (Table 6-2)

-ex: $Ez=1.0$, because air distribution configuration is “ceiling supply of cool air.”

Step 6:

Calculate Zone Outdoor Air flow. ($V_{oz}=V_{bz}/Ez$)

-ex: $V_{oz}= 425 \text{ [cfm]}/ 1.0= 425 \text{ [cfm]}$

Step 7:

Calculate Primary Outdoor Air Fraction. ($Z_p=V_{oz}/V_{pz}$)

-ex: $Z_p= 425 \text{ [cfm]} /1415 \text{ (example } V_{pz}) \text{ [cfm]}= .3 \text{ or } 30\%$

West Campus Outdoor Air Flow Compliance Summary

Area Designation		New York Police Academy Design			ASHRAE Standard 60.1 Calculations		
Floor	Space Type	Total Air Flow CFM	Outside Air Flow CFM	% OA	Voz (cfm)	Zp (%)	Compliance
West G	Central receiving	10000	2500	25%	338	3%	Yes
West G	Recruit Dining Room	29000	14500	50%	11174	39%	Yes
West G	East Pedestrian Walkway	29000	7300	25%	387	1%	Yes
West G	Tactical Training Room	15000	4500	30%	2569	17%	Yes
West G	Recruit Defib Training Room	15000	7500	50%	1543	10%	Yes
West G	Bulk Storage	1500	1500	100%	114	8%	Yes
West G	Equipment Storage	4600	4600	100%	232	5%	Yes
West G	Inventory Storage	7800	7800	100%	355	5%	Yes
West G	Grounds Equipment	7500	7500	100%	305	4%	Yes
West G	West Pedestrian Walkway	29000	7300	25%	475	2%	Yes
West G	Baton Training Room	20000	6000	30%	2365	12%	Yes
West G	Tactical Training Room	10000	3000	30%	1346	13%	Yes
West G	Tactical Training Room	10000	3000	30%	1351	14%	Yes
West G	Tactical Training Room	10000	3000	30%	1344	13%	Yes
West G	South Corridor	29000	7300	25%	1196	4%	Yes
West 2	Central Receiving Retail	10000	2500	25%	865	9%	Yes
West 2	Recruit Dining	29000	14500	50%	2252	8%	Yes
West 2	Admin Office	29000	7300	25%	992	3%	Yes
West 2	East Pedestrian Walkway	29000	7300	25%	2645	9%	Yes
West 2	NE Calisthenics Gym	29000	14500	50%	1753	6%	Yes
West 2	E Calisthenics Gym	29000	14500	50%	1815	6%	Yes
West 2	SE Calisthenics Gym	29000	14500	50%	1797	6%	Yes
West 2	West Pedestrian Walkway	29000	7300	25%	3335	12%	Yes

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West 2	Fitness Training	15000	4500	30%	1516	10%	Yes
West 2	NW Calisthenics Gym	29000	14500	50%	2026	7%	Yes
West 2	W Calisthenics Gym	29000	14500	50%	1815	6%	Yes
West 2	SW Calisthenics Gym	29000	14500	50%	2069	7%	Yes
West 2	South Corridor	29000	7300	25%	455	2%	Yes
West 2	HVAC & Plumbing Shop	3100	3100	100%	396	13%	Yes
West 2	Paint Shop, Paint Storage	2900	2900	100%	119	0%	Yes
West 2	Carpentry Shop	4300	4300	100%	559	13%	Yes
West 2	Electrical/Thermostat Shop	2200	2250	102%	282	13%	Yes
West 2	Central Plant Corridor	12500	3750	30%	174	1%	Yes
West 2	Admin	3000	750	25%	172	6%	Yes
West 3	Central Receiving Retail	10000	2500	25%	268	3%	Yes
West 3	Recruit Dining	29000	14500	50%	2311	8%	Yes
West 3	Admin Offices	29000	7300	25%	873	3%	Yes
West 4	Chiller Room	29000	29000	100%	443	2%	Yes
West 4	Control Room	1050	219	21%	20	2%	Yes
West 4	Central Plant Corridor	12500	3750	30%	173	1%	Yes

*AHU Schedules, West Campus & East Campus Ventilation Rate Procedure Calculations can be found in Appendix A.

ASHRAE Standard 62.1 Summary:

The NYPD has successfully complied with Standard 62.1. Specifically, this report focuses on Section 5 and Section 6 of the Standard. These sections verified that the ventilation equipment and the ventilation system matched the criteria for acceptable indoor air quality set forth by ASHRAE. Also ventilation rates were calculated for the Academy to analyze if acceptable quantities of outdoor air has been properly allocated to all occupied spaces. It was verified that the supply of outdoor air to spaces will exceed the minimum requirements.

ASHRAE Standard 90.1 Overview:

ASHRAE Standard 90.1 has been written for the purpose of providing minimum requirements for the design of buildings in an energy efficient manner. This particular ASHRAE Standard provides information and guidelines about what the acceptable criteria is for the design of building envelopes, mechanical systems, lighting systems and their relationship to the energy consumption of buildings. This standard excludes low-rise residential buildings.

Section 5.1: Climate Zone

The New York Police Academy will be built in College Point, New York. College Point is a section of Queens, New York. The climate zone in which the site will reside is in Zone 4-A according to Table B-1 of ASHRAE Standard 90.1-2007.

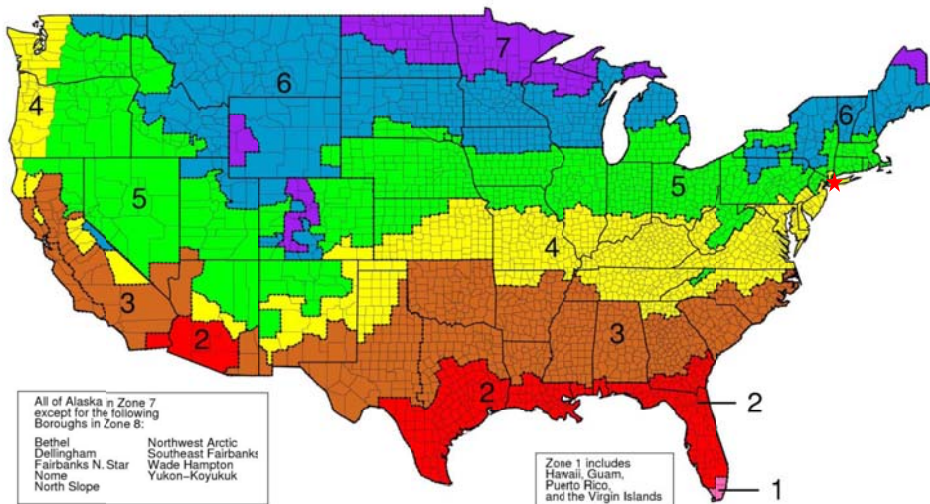


Figure 4: ASHRAE Standard 90.1 Climate Zones Courtesy of ASHRAE Standard 90.1-2007

Section 5.4: Mandatory Provisions

The envelope of the NYPA must be property sealed, caulked, gasketed, or weather stripped in particular areas of the building that may allow air leakage. The exterior performance requirements of the academy call for exterior enclosure assemblies and construction to included permanent resistance measures to air leakage and must be tested in compliance with ASTM E 283 (Specification 08 01 00-12). Exterior enclosure assemblies included exterior doors/entrances, exterior wall access panels, fixed window units and other vertical fenestrations. The NYPA's building envelope will be provided with a weatherproofing membrane that will prevent water penetration and resistance to weathering (Specification 07 27 26-1).

Section 5.5: Prescriptive Building Envelope Option

Below are three tables that analyze the NYPA's compliance with Section 5.5 of ASHRAE Standard 90.1. The three tables analyze the Building Glazing Area, Glazing Material Properties and Building Envelope requirements.

Building Glazing Area

ASHRAE Standard 90.1 Table 5.5-4: Building Envelope Requirements for Climate Zone 4 (A,B,C)

Building	Glazing Area (ft ²)	Wall Area (ft ²)	NYPA Glazing (%)	90.1 Glazing (%)	Compliance
East Campus	44,220	174,592	25.32	40	Yes
West Campus	35,520	203,840	17.43	40	Yes

Glazing Material Properties

ASHRAE Standard 90.1 Table 5.5-4: Building Envelope Requirements for Climate Zone 4 (A,B,C)

Fenestration	90.1 Prescribed Assemblies		Actual Assemblies		Standard 90.1
Vertical Glazing	Assembly Max. U	Assembly Max SHGC	Assembly Max. U	Assembly Max SHGC	Compliance
Metal Framing (all other)	U-0.55	SHGC-0.40	U-0.45	SHGC-0.35	Yes

*Thermal resistance (U-value) and Solar Heat Grain Coefficient (SHGC) can be found in Spec 08 44 13-1.

Building Envelope Requirements

ASHRAE Standard 90.1 Table 5.5-4: Building Envelope Requirements for Climate Zone 4 (A,B,C)

Non Residential Building Envelope Requirements		90.1 Prescribed Assemblies		Actual Assemblies		Compliance
Building Area	Elements	Assembly Maximum	Insulation Minimum	Assembly Maximum	Insulation Minimum	
Roof	Insulation Entirely above deck	U-0.048	R-20.0 c.i.	U-0.33	R-29.88	Yes
Walls Above Grade	Mass	U-0.104	R-9.5 c.i.	U-0.49	R-20.25	Yes
Walls Below Grade	Below-Grade Wall	C-1.140	NR	n/a	n/a	n/a
Floors	Mass	U-0.087	R-8.3 c.i.	U-0.7	R-14.25	Yes
Slab on Grade Floors	Unheated	U-0.700	-	U-0.4	R-28	Yes

*R-values/U-Values were calculated based on typical roof, wall, and floor assemblies.

Section 6.2: Compliance Path(s)

The “Simplified Approach Option for HVAC Systems” (ASHRAE Standard 90.1.6.3) could not be used because the NYPA does not comply with the necessary criteria. Two examples of non-compliance to this approach are the NYPA's HVAC system serves multiple zones, and the outdoor air quantity supplied is great than 3000 cfm. Therefore, “Mandatory Provisions” (ASHRAE Standard 90.1.6.4) the “Prescriptive Path” (ASHRAE Standard 90.1.6.5) will be the compliance path of

choice.

Section 6.4: Mandatory Provisions

This section of ASHRAE Standard 90.1 dictates the minimum equipment efficiencies and the standard rating and operating conditions of the equipment. Equipment must comply with the information provided in ASHRAE Standard 90.1 Table 6.8.1A- 6.8.1J. See Section 6.8 of this report for compliance analysis.

Section 6.5: Prescriptive Path

Section 6.4 describes the prescriptive path the must be taken for certain control systems and equipment types in the buildings. Section 6.5.2.3 dictates where humidification controls are to be provided, the controls must prevent reheating and mixing of hot and cold streams. The largest latent load will develop in the NYPA's pool area. However, the pool has a specialized AHU with humidification controls that is directly responsible for the pools humidity levels and to isolate the pool as its own mechanically ventilated space. The NYPA uses a hydronic piping system but does not incorporate a three pipe system in the design which is compliant with Section 6.5.2.2.1. Fan power limitations have been placed on the fan systems of NYPA which will comply with Table 6.5.3.1.1A.

Section 6.8: Minimum Equipment Efficiency Tables

Water Chilling Packages

ASHRAE Standard 90.1 Table 6.8.1.C: Water Chilling Packages-Minimum Efficiency Requirements

Equipment Type	Capacity	Minimum Efficiency	NYPA Chiller Efficiency	Standard 90.1 Compliance
Water Cooled, electrically operated positive displacement	>300 Tons	5.50 COP	5.74 COP	Yes

ASHRAE Standard 90.1 Table 6.8.1.J Minimum Efficiency for Centrifugal Chillers >300 Tons

Leaving CHW Temp.	Condenser Entering Water Temp.	Standard 90.1 COP	NYPA Centrifugal Chiller COP	Standard 90.1 Compliance
42° F	85° F	5.11 COP	5.74 COP	Yes

*There are eight identical electric operated water chillers. All chillers are have a nominal capacity of 1350 tons. All chillers comply with Standard 90.1.

See Appendix B.1 for Chiller Schedule.

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Boilers

ASHRAE Table 6.8.1.F: Gas and Oil Fired Boilers, Minimum Efficiency Requirements

Equipment Types	Subcategory	Size	Minimum Efficiency	Efficiency as of 3/2/2010	Efficiency as if 3/2/2020	Actual Efficiency	Standard 90.1 Compliance
Hot Water Boiler	Gas –fired	>2,500,00 Btu/h	80%	82%	82%	84%	Yes
Hot Water Boiler	Oil-Fired	>2,500,00 Btu/h	83%	84%	84%	84%	Yes

*There are five identical 25,110 MBH dual fuel water tube boiler. All boilers comply with Standard 90.1

See Appendix B.2 for Hot Water Boiler Schedule.

Cooling Towers

ASHRAE Table 6.8.1.G: Performance Requirements for Heat Rejection Equipment

Equipment Type	Subcategory (Temps)	NYPA (Temps)	Performance Requirement	NYPA Performance	Standard 90.1 Compliance
Propeller or axial fan cooling towers	95°F Entering Water 85°F Leaving Water 75°F Outdoor WB	100°F Entering Water 85°F Leaving Water 78°F Outdoor WB	>38.2 gpm/hp	45 gpm/hp	Yes

See Appendix B.3 for Cooling Tower Schedule.

Duct Insulation

ASHRAE Standard 90.1 Table 6.8.2B: Minimum Duct Insulation R-Value, Combined Heating and Cooling Supply Ducts and Return Ducts

Combined Heating and Cooling Supply Ducts				
Climate Zone	Unconditioned Space	Insulation Thickness	Approximate R-Value	Standard 90.1 Compliance
4	R-3.5	1-1/2"	R-4.9	Yes

Return Ducts				
Climate Zone	Unconditioned Space	Insulation Thickness	Approximate R-Value	Standard 90.1 Compliance
4	None	1"	R-3.25	Yes

*Thicknesses of glass fiber blanket insulation are designated in Specification 23 07 00-4. R-Values of insulation were not designated. R-Values have been by approximated by the equation $3.25 = \text{Average R-Value/inch of glass fiber blanket insulation}$.

Ex: 1" Glass Fiber Blanket Insulation Thickness = $3.25 [\text{R-Value/inch}] * 1 [\text{inch}] = 3.25 [\text{R-value}]$

Section 7: Service Water Heating

Section 7 outlines information regarding service water heating system standards of a building. The section includes information about service water equipment, controls and insulation. The NYPA’s water heating equipment meets the minimum standards outlined in Table 7.8 “Performance Requirements for Water Heating Equipment”. Also the Building Management Controls System (BMCS) will service the water heating controls (Specification 23 09 23-7). Below is a table that compares the minimum acceptable pipe insulation thicknesses with the actual pipe insulation thicknesses of the NYPA.

Pipe Insulation

ASHRAE Standard 90.1 Table 6.8.3: Minimum Pipe Insulation Thickness

Heating System											
Operating Temp. °F	Standard 90.1 <1”	NYPA <1”	Standard 90.1 1” to 1-1/2”	NYPA 1” to 1-1/2”	Standard 90.1 1-1/2” to 4”	NYPA 1-1/2” to 4”	Standard 90.1 <1” 4” to 8”	NYPA <1” 4” to 8”	Standard 90.1 >8”	NYPA >8”	Standard 90.1 Compliance
>350	2.5	n/a	3	n/a	3	n/a	4	n/a	4	n/a	n/a
251-350	1.5	n/a	2.5	n/a	3	n/a	3	n/a	3	n/a	n/a
201-250	1.5	1	1.5	1.5	2	2	2	2	2	2.5	No
141-200	1	1.5	1	1.5	1	2	1.5	2	1.5	2.5	Yes
105-140	0.5	n/a	0.5	n/a	1	n/a	1	n/a	1	n/a	n/a

Cooling System											
Operating Temp. °F	Standard 90.1 <1”	NYPA <1”	Standard 90.1 1” to 1-1/2”	NYPA 1” to 1-1/2”	Standard 90.1 1-1/2” to 4”	NYPA 1-1/2” to 4”	Standard 90.1 <1” 4” to 8”	NYPA <1” 4” to 8”	Standard 90.1 >8”	NYPA >8”	Standard 90.1 Compliance
40-60	2.5	n/a	3	n/a	3	n/a	4	n/a	4	n/a	n/a
<40	1.5	n/a	2.5	n/a	3	n/a	3	n/a	3	n/a	n/a

*Pipe Insulation Thickness and insulation thermal conductivity for the New York Police Academy can be found in Specification 23 07 00-2.

Section 8: Power Distribution Systems

This section of ASHRAE Standard 90.1 describes the standards for power distribution systems in the building. Specifically, all feeders in the NYPA are to be sized with a maximum voltage drop of 2% at design load. All branch circuit conductors are to be sized for a maximum voltage drop of 3% at design load. The construction documentation of the NYPA includes single-line diagrams of the buildings electrical distribution system and floor plans indicating areas served by the distribution. Operation manuals and maintenance manuals are required for each piece of electrical equipment and a complete narrative of how the distribution system works is also required.

Section 9: Lighting

Section 9 describes the prescriptive requirements for lighting systems and equipment in a building. There are two primary methods of calculating the interior lighting power allowance of a building; The Building Area Method and the Space by Space Method. The building area method was performed for the NYPA. To calculate the interior lighting power allowance for the building, building lighting power densities were chosen from Table 9.5.1. In cases, where spaces in Table 9.5.1 were not listed a similar space was used. Unfortunately, a lighting schedule for the building was not attainable for the NYPA. Therefore, it is not possible to declare compliance or non-compliance for Section 9 of ASHRAE Standard 90.1. However, the overall Lighting Power Allowance was calculated for each campus. A summary of the lighting power allowance can be seen below and the area calculations can be found in Appendix A.5-A.6.

Lighting Power Allowance

Campus	Lighting Power Allowance	Standard 90.1 Compliance
NYPA West Campus	320.336 kW	n/a
NYPA East Campus	333.347 kW	n/a

Section 10: Other Equipment

Mandatory provisions for electric motor efficiency have been outlined in Section 10 of ASHRAE Standard 90.1. There are four different types of chilled water pumps that are used in the Central Plant located in the West Campus of the NYPA. These pumps do not comply with the Section 10 of Standard 90.1. However, these pumps will be fit with variable frequency drives (VFD) that will allow them to match their intended loads at a much great efficiency. The VFD's will not only allow the pumps to match their intended loads more precisely they will effectively lower the frictional head of the system. This energy savings is not reflected in the overall efficiency of the pumps which may be another reason why the efficiency percentages do not strictly match those of ASHRAE 90.1. It is assumed that these pumps would be sufficient according to ASHRAE standards if the VFDs were considered in their design.

Pump Motors

ASHRAE Standard 90.1 Section 10 Table 10.8: Minimum Nominal Efficiency for General Purpose Design A and Design B Motors

Quantity of Pumps	Motor Size (hp)	Synchronous Speed (RPM)	Standard 90.1 Efficiency	NYPA Efficiency	Standard 90.1 Compliance
11	200	1800	95 %	85.3%	No
5	150	1800	95 %	80.3%	No
4	2	1800	84 %	53.2%	No

See Appendix B.4 for Pump Schedule

ASHRAE Standard 90.1 Summary:

After performing a thorough and comprehensive investigation of the New York Police Academy's compliance with ASHRAE Standard 90.1, it is safe to state that the NYPA complies with the energy standards set forth by ASHRAE. This report summarized some of the major sections of Standard 90.1 in which the NYPA academy complied with. Construction assemblies, equipment specifications, and lighting usages were several of the key topics discussed in the Standard 90.1 section of this report.

References:

ANSI/ASHRAE. (2007). *Standard 62.1 - 2007, Ventilation for Acceptable Indoor Air Quality*. Atlanta, GA:

American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

ANSI/ASHRAE. (2007). *Standard 90.1 - 2007, Energy Standard for Buildings Except Low-Rise Residential*

Buildings. Atlanta, GA: American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

Turner Construction Company. *New York Police Academy Construction Documents*. New York, New York. (2010)

Turner Construction Company. *New York Police Academy Specifications*. New York, New York. (2010)

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Appendix:

Appendix A.1: West Campus Ventilation Rate Procedure Summary

Area Designation			Equipment	New York Police Academy Design			60.1 Calculations		
Floor	Space Type	Category	AHU	Total Air Flow CFM	Outside Air Flow CFM	% OA	Voz (cfm)	Zp (%)	Compliance
West G	Central receiving	Shipping/Receiving	AHU-211-2-2	10000	2500	25%	338	3%	Yes
West G	Recruit Dining Room	Restaurant	AHU-211-2-3	29000	14500	50%	11174 (MAX)	39%	Yes
West G	East Pedestrian Walkway	Corridors	AHU-211-2-5	29000	7300	25%	387	1%	Yes
West G	Tactical Training Room	Health Club Room	AHU-211-2-11	15000	4500	30%	2569	17%	Yes
West G	Recruit Defib Training Room	Health Club Room	AHU-211-2-12	15000	7500	50%	1543	10%	Yes
West G	Bulk Storage	Storage Rooms	AHU-311-G-2	1500	1500	100%	114	8%	Yes
West G	Equipment Storage	Storage Rooms	AHU-311-G-3	4600	4600	100%	232	5%	Yes
West G	Inventory Storage	Storage Rooms	AHU-311-G-4	7800	7800	100%	355	5%	Yes
West G	Grounds Equipment	Storage Rooms	AHU-311-G-5	7500	7500	100%	305	4%	Yes
West G	West Pedestrian Walkway	Corridors	AHU-311-2-2	29000	7300	25%	475	2%	Yes
West G	Baton Training Room	Health Club Room	AHU-311-2-4	20000	6000	30%	2365	12%	Yes
West G	Tactical Training Room	Health Club Room	AHU-311-2-1	10000	3000	30%	1346	13%	Yes
West G	Tactical Training Room	Health Club Room	AHU-311-2-6	10000	3000	30%	1351	14%	Yes
West G	Tactical Training Room	Health Club Room	AHU-311-2-7	10000	3000	30%	1344	13%	Yes
West G	South Corridor	Corridors	AHU-311-2-9	29000	7300	25%	1196	4%	Yes
West 2	Central Receiving Retail	Shipping/Receiving	AHU-211-2-1	10000	2500	25%	865	9%	Yes
West 2	Recruit Dining	Restaurant	AHU-211-2-3	29000	14500	50%	2252	8%	Yes
West 2	Admin Office	Office Space	AHU-211-2-4	29000	7300	25%	992	3%	Yes
West 2	East Pedestrian Walkway	Health Room	AHU-211-2-5	29000	7300	25%	2645	9%	Yes
West 2	NE Calisthenics Gym	Health Room	AHU-211-2-6	29000	14500	50%	1753	6%	Yes
West 2	E Calisthenics Gym	Health Room	AHU-211-2-7	29000	14500	50%	1815	6%	Yes
West 2	SE Calisthenics Gym	Health Room	AHU-211-2-8	29000	14500	50%	1797	6%	Yes
West 2	West Pedestrian Walkway	Health Room	AHU-311-2-2	29000	7300	25%	3335	12%	Yes
West 2	Fitness Training	Health Club Room	AHU-211-2-10	15000	4500	30%	1516	10%	Yes
West 2	NW Calisthenics Gym	Health Room	AHU-311-2-3	29000	14500	50%	2026	7%	Yes
West 2	W Calisthenics Gym	Health Room	AHU-311-2-5	29000	14500	50%	1815	6%	Yes
West 2	SW Calisthenics Gym	Health Room	AHU-311-2-8	29000	14500	50%	2069	7%	Yes
West 2	South Corridor	Corridors	AHU-311-2-9	29000	7300	25%	455	2%	Yes
West 2	HVAC & Plumbing Shop	Wood/Metal Shop	AHU-311-2-14	3100	3100	100%	396	13%	Yes
West 2	Paint Shop, Paint Storage	Storage Rooms	AHU-311-2-15	2900	2900	100%	119	0%	Yes
West 2	Carpentry Shop	Wood/Metal Shop	AHU-311-2-16	4300	4300	100%	559	13%	Yes
West 2	Electrical/Thermostat Shop	Wood/Metal Shop	AHU311-2-17	2200	2200	100%	282	13%	Yes
West 2	Central Plant Corridor	Corridors	AHU-311-5-5	12500	3750	30%	174	1%	Yes
West 2	Admin	Office Space	AHU-311-5-3	3000	750	25%	172	6%	Yes
West 3	Central Receiving Retail	Shipping/Receiving	AHU-211-2-2	10000	2500	25%	268	3%	Yes
West 3	Recruit Dining	Restaurant	AHU-211-2-3	29000	14500	50%	2311	8%	Yes
West 3	Admin Offices	Office Space	AHU-211-2-4	29000	7300	25%	873	3%	Yes
West 4	Chiller Room	Equipment Rooms	AHU-311-5-1	29000	29000	100%	443	2%	Yes
West 4	Control Room	Equipment Rooms	AHU-311-5-2	1050	219	21%	20	2%	Yes
West 4	Central Plant Corridor	Corridors	AHU-311-5-5	12500	3750	30%	173	1%	Yes

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Appendix A.2: AHU Service Schedule

Designation	Service	Location	Total Air Quantity (cfm)	Outside Air Quantity (cfm)	OA (%)
AHU-111-8-1	2 nd Floor Office	8 th Floor MER	15000	2550	17%
AHU-111-8-2	7 th Floor Admin Office	8 th Floor MER	7500	1300	17%
AHU-111-8-3	Pedestrian Walkway	8 th Floor MER	29500	5000	17%
AHU-111-8-4	Lockers	8 th Floor MER	15000	2550	17%
AHU-111-8-5	Classroom	8 th Floor MER	30000	10800	36%
AHU-111-8-6	Classroom	8 th Floor MER	30000	10800	36%
AHU-111-PH-1	Corridor	West Penthouse MER	30000	5100	17%
AHU-111-PH-2	Classroom	West Penthouse MER	30000	12000	40%
AHU-111-PH-3	Classroom	West Penthouse MER	30000	12000	40%
AHU-111-PH-4	Auditorium	West Penthouse MER	15000	4800	32%
AHU-111-PH-5	Auditorium	West Penthouse MER	15000	4800	32%
AHU-111-PH-6	Atrium	West Penthouse MER	25000	6400	26%
AHU-131-PH-1	Atrium	East Penthouse MER	25000	6400	26%
AHU-131-PH-2	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-3	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-4	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-5	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-6	Library	East Penthouse MER	16000	6000	38%
AHU-131-PH-7	Library	East Penthouse MER	16000	6000	38%
AHU-211-2-1	Central Receiving Retail	Physical Training West Mech. 2 nd Floor	10000	2500	25%
AHU-211-2-2	Central Receiving Misc.	Physical Training West Mech. 2 nd Floor	10000	2500	25%
AHU-211-2-3	1 st Floor Dining	Physical Training West Mech. 2 nd Floor	29000	14500	50%
AHU-211-2-4	Administration	Physical Training West Mech. 2 nd Floor	29000	7300	25%
AHU-211-2-5	East Pedestrian Walkway	Physical Training East Mech. 2 nd Floor	29000	7300	25%
AHU-211-2-6	NE Calisthenics Gym	Physical Training East Mech. 2 nd Floor	29000	14500	50%
AHU-211-2-7	E Calisthenics Gym	Physical Training East Mech. 2 nd Floor	29000	14500	50%
AHU-211-2-8	SE Calisthenics Gym	Physical Training East Mech. 2 nd Floor	29000	14500	50%
AHU-211-2-9	North Defib Training	Physical Training East Mech. 2 nd Floor	7500	7500	100%
AHU-211-2-10	Fitness Training	Physical Training East Mech. 2 nd Floor	15000	4500	30%
AHU-211-2-11	Tactical Training	Physical Training East Mech. 2 nd Floor	15000	4500	30%
AHU-211-2-12	South Defib Training	Physical Training East Mech. 2 nd Floor	1500	7500	50%
AHU-311-2-1	Tactical Training	Central Plant 2 nd Floor	10000	3000	30%
AHU-311-2-2	W Pedestrian Walkway	Central Plant 2 nd Floor	29000	7300	25%
AHU-311-2-3	NW Calisthenics Gym	Central Plant 2 nd Floor	29000	14500	50%
AHU-311-2-4	1 st Floor Baton Training Room	Central Plant 2 nd Floor	20000	6000	30%
AHU-311-2-5	W Calisthenics Gym	Central Plant 2 nd Floor	29000	14500	50%
AHU-311-2-6	Tactical Training	Central Plant 2 nd Floor	10000	3000	30%

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AHU-311-2-7	Tactical Training	Central Plant 2 nd Floor	10000	3000	30%
AHU-311-2-8	SW Calisthenics Gym	Central Plant 2 nd Floor	29000	14500	50%
AHU-311-2-9	South Corridor	Central Plant 2 nd Floor	29000	7300	25%
AHU-311-2-18	Lobby	Central Plant 5 th Floor	4000	2000	50%
AHU-311-5-1	Chiller Room	Central Plant 5 th Floor	29000	29000	100%
AHU-311-5-3	Admin Office	Central Plant 5 th Floor	3000	750	25%
AHU-311-5-5	Corridor	Central Plant 5 th Floor	15000	3750	25%
AHU-311-5-6	Not Used	Not Applicable	0	0	0%
AHU-311-5-7	Not Used	Not Applicable	0	0	0%
AHU-311-G-2	Bulk Storage	Central Plant Ground Floor	1500	1500	100%
AHU-311-G-3	Equipment Storage	Central Plant Ground Floor	4600	4600	100%
AHU-311-G-4	Inventory Storage	Central Plant Ground Floor	7800	7800	100%
AHU-311-G-5	Ground Equipment	Central Plant 5 th Floor	7500	7500	100%
AHU-311-2-14	HVAC Shop	Central Plant 2 nd Floor	3100	3100	100%
AHU-311-2-15	Paint Shop	Central Plant 2 nd Floor	2900	2900	100%
AHU-311-2-16	Carpentry Shop	Central Plant 2 nd Floor	4300	4300	100%
AHU-311-2-17	Thermostat Shop	Central Plant 2 nd Floor	2250	2250	100%
AHU-311-5-2	Control Room	Central Plant Fifth Floor	1050	219	21%

Appendix A.3: West Campus Ventilation Rate Procedure Calculations

Space Description			Az	Rp	Ra	Occupant Load	Occupants	Rp*Pz	Ra*Az	Vbz	Ez	VoZ	Zp	Service	Air Flow
Campus	Space Type	ASHRAE Category	Ft2	cfm/occ	cfm/ft2	Occ/100sf	Occ.	cfm	cfm	cfm		cfm	%	-	cfm
West G	Loading Dock	Shipping/Receiving	3223	0	12%	0	1	0	386.8	386.76	1	386.76	4%	EF-341-G-1	10000
West G	Sprinkler Room	Equipment Rooms	746	0	6%	0	1	0	44.76	44.76	1	44.76	4%	EF-211-G-1	1200
West G	Domestic Water Room	Equipment Rooms	2805	0	6%	0	1	0	168.3	168.3	1	168.3	4%	EF-311-G-6	4200
West G	Fire Pump Room	Equipment Rooms	1862	0	12%	0	1	0	223.4	223.44	1	223.44	4%	EF-311-G-6	6200
West G	Fuel Oil Storage Room	Storage Rooms	1483	0	12%	0	1	0	178	177.96	1	177.96	4%	EF-311-G-8	5000
West G	Fuel Oil Storage Room	Storage Rooms	1506	0	12%	0	1	0	180.7	180.72	1	180.72	4%	EF-311-G-9	5000
West G	Fuel Oil Storage Room	Storage Rooms	1512	0	12%	0	1	0	181.4	181.44	1	181.44	4%	EF-311-G-10	5000
West G	Future Fuel Oil Storage	Storage Rooms	1529	0	12%	0	1	0	183.5	183.48	1	183.48	4%	EF-311-G-11	5000
West G	Toilet	Health Room	528	20	6%	10	5.28	106	31.68	137.28	1	137.28	0%	TX-211-2-1	0
West G	Stair	Corridors	353	0	6%	0	0	0	21.18	21.18	1	21.18	0%	SF-311-R-1	0
West G	Stair	Corridors	307	0	6%	0	0	0	18.42	18.42	1	18.42	0%	SF-311-R-2	0
West G	Toter Wash Down	Laundry Rooms	774	5	12%	10	7.74	38.7	92.88	131.58	1	131.58	0%	AHU-341-G-1	0
West G	Kitchen	Restaurant	4803	7.5	18%	70	336	2522	864.5	3386.1	1	3386.1	17%	KX-311-R-1	20000
West G	Central receiving	Shipping/Receiving	2818	0	12%	0	1	0	338.2	338.16	1	338.16	3%	AHU-211-2-2	10000
West G	Recruit Dining	Restaurant	15850	7.5	18%	70	1110	8321	2853	11174	1	11174	39%	AHU-211-2-3	29000

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Room	Room														
West G	East Pedestrian Walkway	Corridors	6456	0	6%	0	0	0	387.4	387.36	1	387.36	1%	AHU-211-2-5	29000
West G	Tactical Training Room	Classroom (age 9 Plus)	5467	10	12%	35	191	1913	656	2569.5	1	2569.5	17%	AHU-211-2-11	15000
West G	Recruit Defib. Training Room	Classroom (age 9 Plus)	3283	10	12%	35	115	1149	394	1543	1	1543	10%	AHU-211-2-12	15000
West G	Chemical Storage	Storage Rooms	561	0	12%	0	1	0	67.32	67.32	1	67.32	3%	AHU-211-5-6	2000
West G	Custodial Office	Office Space	1285	5	6%	5	6.43	32.1	77.1	109.23	1	109.23	5%	AHU-311-G-1	2000
West G	Bulk Storage	Storage Rooms	951	0	12%	0	1	0	114.1	114.12	1	114.12	8%	AHU-311-G-2	1500
West G	Equipment Storage	Storage Rooms	1935	0	12%	0	1	0	232.2	232.2	1	232.2	5%	AHU-311-G-3	4600
West G	Inventory Storage	Storage Rooms	2955	0	12%	0	1	0	354.6	354.6	1	354.6	5%	AHU-311-G-4	7800
West G	Grounds Equipment	Storage Rooms	2544	0	12%	0	1	0	305.3	305.28	1	305.28	4%	AHU-311-G-5	7500
West G	West Pedestrian Walkway	Corridors	7913	0	6%	0	0	0	474.8	474.78	1	474.78	2%	AHU-311-2-2	29000
West G	Baton Training Room	Health Club Room	9097	20	6%	10	91	1819	545.8	2365.2	1	2365.2	12%	AHU-311-2-4	20000
West G	Tactical Training Room	Health Club Room	5175	20	6%	10	51.8	1035	310.5	1345.5	1	1345.5	13%	AHU-311-2-1	10000
West G	North Locker Room	Health Club Room	4343	20	6%	10	43.4	869	260.6	1129.2	1	1129.2	11%	MAV-311-2-3	10000
West G	Pool Locker Rooms	Health Club Room	3638	20	6%	10	36.4	728	218.3	945.88	1	945.88	9%	MAV-311-2-2	10000
West G	Tactical Training Room	Health Club Room	5198	20	6%	10	52	1040	311.9	1351.5	1	1351.5	14%	AHU-311-2-6	10000
West G	South Locker Room	Health Club Room	6138	20	6%	10	61.4	1228	368.3	1595.9	1	1595.9	6%	MAV-311-2-1	29000
West G	Tactical Training Room	Health Club Room	5171	20	6%	10	51.7	1034	310.3	1344.5	1	1344.5	13%	AHU-311-2-7	10000
West G	South Corridor	Corridors	19935	0	6%	0	0	0	1196	1196.1	1	1196.1	4%	AHU-311-2-9	29000
West G	Central Plant Corridor	Corridors	2921	0	6%	0	0	0	175.3	175.26	1	175.26	0%	AHU-311-5-5	0
West G	Central Plant Lockers	Health Club Room	1163	20	6%	10	11.6	233	69.78	302.38	1	302.38	0%	AHU-311-5-4	0
West G	PT Pool	Swimming	6283	0	48%	0	0	0	3016	3015.8	1	3015.8	15%	DU-311-2-1	20000
West 2	Transformer Room	Equipment Rooms	3081	0	6%	0	1	0	184.9	184.86	1	184.86	2%	EF-311-2-4	8000
West 2	Mechanical Room	Equipment Rooms	11099	0	6%	0	1	0	665.9	665.94	1	665.94	0%	EF-311-2-6/7	0
West 2	Toilet	Health Room	186	20	6%	10	1.86	37.2	11.16	48.36	1	48.36	0%	TX-211-3-1	0
West 2	Mechanical Room	Equipment Rooms	5182	0	6%	0	1	0	310.9	310.92	1	310.92	0%	EF-211-3-2	0
West 2	Toilet	Health Room	397	20	6%	10	3.97	79.4	23.82	103.22	1	103.22	0%	TX-311-2-1	0
West 2	Toilet	Health Room	425	20	6%	10	4.25	85	25.5	110.5	1	110.5	0%	TX-311-2-2	0
West 2	Stairs	Corridors	336	0	6%	0	0	0	20.16	20.16	1	20.16	0%	SF-311-R-1	0
West 2	Stairs	Corridors	307	0	6%	0	0	0	18.42	18.42	1	18.42	0%	SF-311-R-2	0
West 2	Central Receiving Retail	Shipping/Receiving	7209	0	12%	0	1	0	865.1	865.08	1	865.08	9%	AHU-211-2-1	10000
West 2	Recruit Dining	Restaurant	3195	7.5	18%	70	224	1677	575.1	2252.5	1	2252.5	8%	AHU-211-2-3	29000

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West 2	Admin Office	Office Space	11669	5	6%	5	58.3	292	700.1	991.87	1	991.87	3%	AHU-211-2-4	29000
West 2	East Pedestrian Walkway	Health Room	10172	20	6%	10	102	2034	610.3	2644.7	1	2644.7 (MAX)	9%	AHU-211-2-5	29000
West 2	NE Calisthenics Gym	Health Room	6742	20	6%	10	67.4	1348	404.5	1752.9	1	1752.9	6%	AHU-211-2-6	29000
West 2	E Calisthenics Gym	Health Room	6979	20	6%	10	69.8	1396	418.7	1814.5	1	1814.5	6%	AHU-211-2-7	29000
West 2	SE Calisthenics Gym	Health Room	6913	20	6%	10	69.1	1383	414.8	1797.4	1	1797.4	6%	AHU-211-2-8	29000
West 2	West Pedestrian Walkway	Health Room	12828	20	6%	10	128	2566	769.7	3335.3	1	3335.3	12%	AHU-311-2-2	29000
West 2	Fitness Training	Health Club Room	5829	20	6%	10	58.3	1166	349.7	1515.5	1	1515.5	10%	AHU-211-2-10	15000
West 2	NW Calisthenics Gym	Health Room	7792	20	6%	10	77.9	1558	467.5	2025.9	1	2025.9	7%	AHU-311-2-3	29000
West 2	W Calisthenics Gym	Health Room	6979	20	6%	10	69.8	1396	418.7	1814.5	1	1814.5	6%	AHU-311-2-5	29000
West 2	SW Calisthenics Gym	Health Room	7958	20	6%	10	79.6	1592	477.5	2069.1	1	2069.1	7%	AHU-311-2-8	29000
West 2	South Corridor	Corridors	7581	0	6%	0	0	0	454.9	454.86	1	454.86	2%	AHU-311-2-9	29000
West 2	HVAC & Plumbing Shop	Wood/Metal Shop	1043	10	18%	20	20.9	209	187.7	396.34	1	396.34	13%	AHU-311-2-14	3100
West 2	Paint Shop, Paint Storage	Storage Rooms	995	0	12%	0	1	0	119.4	119.4	1	119.4	0%	AHU-311-2-15	29000
West 2	Carpentry Shop	Wood/Metal Shop	1470	10	18%	20	29.4	294	264.6	558.6	1	558.6	13%	AHU-311-2-16	4300
West 2	Electrical/Thermostat Shop	Wood/Metal Shop	741	10	18%	20	14.8	148	133.4	281.58	1	281.58	13%	AHU311-2-17	2200
West 2	Central Plant Corridor	Corridors	2900	0	6%	0	0	0	174	174	1	174	1%	AHU-311-5-5	12500
West 2	F-Locker (OP), M-Locker (OP)	Health Club Room	1807	20	6%	10	18.1	361	108.4	469.82	1	469.82	9%	AHU-311-5-4	5100
West 2	Admin	Office Space	2027	5	6%	5	10.1	50.7	121.6	172.3	1	172.3	6%	AHU-311-5-3	3000
West 2	TC, EC	Equipment Rooms	266	0	6%	0	1	0	15.96	15.96	1	15.96	0%	AC-211-2-1	0
West 2	Mechanical Room	Equipment Rooms	2413	0	6%	0	1	0	144.8	144.78	1	144.78	0%	EF-211-3-1	0
West 2	Laundry	Laundry Rooms	82	5	12%	10	0.82	4.1	9.84	13.94	1	13.94	0%	EF-211-3-3	0
West 3	Laundry Room	Laundry Rooms	76	5	12%	10	0.76	3.8	9.12	12.92	1	12.92	0%	EF-211-3-3	0
West 3	Mechanical Room	Equipment Rooms	5940	0	6%	0	1	0	356.4	356.4	1	356.4	0%	EF-211-3-2	0
West 3	Generator Room	Equipment Rooms	1938	0	6%	0	1	0	116.3	116.28	1	116.28	0%	EF-311-4-2	0
West 3	Elec. Dist Room	Equipment Rooms	2269	0	6%	0	1	0	136.1	136.14	1	136.14	0%	EF-311-4-6	0
West 3	Generator Room	Equipment Rooms	1976	0	6%	0	1	0	118.6	118.56	1	118.56	0%	EF-311-4-3	0
West 3	Toilet	Health Room	131	20	6%	10	1.31	26.2	7.86	34.06	1	34.06	12%	TX-311-5-1	275
West 3	Stair	Corridors	336	0	6%	0	0	0	20.16	20.16	1	20.16	0%	SF-311-R-1	0
West 3	Stair	Corridors	307	0	6%	0	0	0	18.42	18.42	1	18.42	0%	SF-311-R-2	0
West 3	Central Receiving Retail	Shipping/Receiving	2231	0	12%	0	1	0	267.7	267.72	1	267.72	3%	AHU-211-2-2	10000
West 3	Recruit Dining	Restaurant	3278	7.5	18%	70	229	1721	590	2311	1	2311	8%	AHU-211-2-3	29000
West 3	Admin Offices	Office Space	10271	5	6%	5	51.4	257	616.3	873.04	1	873.04	3%	AHU-211-2-4	29000
West 3	Chiller Room	Equipment Rooms	7376	0	6%	0	1	0	442.6	442.56	1	442.56	0%	AHU-311-5-1	0

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West 3	Control Room	Equipment Rooms	329	0	6%	0	1	0	19.74	19.74	1	19.74	0%	AHU-311-5-2	0
West 3	Central Plant Corridor	Corridors	2854	0	6%	0	0	0	171.2	171.24	1	171.24	0%	AHU-311-5-5	0
West 3	Boiler Room	Equipment Rooms	5470	0	6%	0	1	0	328.2	328.2	1	328.2	0%	HV-311-5-1,2	0
West 3	Electrical/Telecom Rooms	Equipment Rooms	279	0	6%	0	1	0	16.74	16.74	1	16.74	0%	AC-211-2-1	0
West 3	Mechanical Room	Equipment Rooms	2418	0	6%	0	1	0	145.1	145.08	1	145.08	0%	EF-211-3-1	0
West 4	Chiller Room	Equipment Rooms	7376	0	6%	0	1	0	442.6	442.56	1	442.56	2%	AHU-311-5-1	29000
West 4	Control Room	Equipment Rooms	329	0	6%	0	1	0	19.74	19.74	1	19.74	2%	AHU-311-5-2	1050
West 4	Central Plant Corridor	Corridors	2889	0	6%	0	0	0	173.3	173.34	1	173.34	1%	AHU-311-5-5	12500
West 4	Boiler Room	Equipment Rooms	5470	0	6%	0	1	0	328.2	328.2	1	328.2	1%	HV-311-5-1,2	40000
West 4	Generator Room	Equipment Rooms	1938	0	6%	0	1	0	116.3	116.28	1	116.28	0%	EF-311-4-2	0
West 4	Elec. Room	Equipment Rooms	2269	0	6%	0	1	0	136.1	136.14	1	136.14	0%	EF-311-4-6	0
West 4	Generator Room	Equipment Rooms	1976	0	6%	0	1	0	118.6	118.56	1	118.56	0%	EF-311-4-4	0
West 4	Toilet	Health Room	131	20	6%	10	1.31	26.2	7.86	34.06	1	34.06	0%	TX-311-5-1	0
West 4	Stair	Corridors	336	0	6%	0	0	0	20.16	20.16	1	20.16	0%	SF-311-R-1	0
West 4	Stair	Corridors	307	0	6%	0	0	0	18.42	18.42	1	18.42	0%	SF-311-R-2	0

Appendix A.4: East Campus Ventilation Rate Procedure Calculations

Space Description			Az	Rp	Ra	Occupant Load	Occupants	Rp*Pz	Ra*Az	Vbz	Ez	Voz	Zp	Srv.	Air Flow
Level	Space Type	ASHRAE Category	ft ²	Cfm /occ	cfm/ft ²	Occ/100sf	Occ.	cfm	cfm	cfm		cfm	%	-	cfm
East G	Office	Office Space	18951	5	6%	5	94.755	473.775	1137	1610.8	1	1610.8	N/a	N/a	N/a
East G	Atrium Lobby	Lobbies	22187	5	6%	150	3328.05	16640.25	1331	17971	1	17971	N/a	N/a	N/a
East G	North Entrance	Lobbies	2475	5	6%	150	371.25	1856.25	148.5	2004.8	1	2004.8	N/a	N/a	N/a
East G	East Entrance	Lobbies	4454	5	6%	150	668.1	3340.5	267.2	3607.7	1	3607.7	N/a	N/a	N/a
East 2	Server/ Electrical Rooms (RA-207)	Equipment Rooms	14650	0	6%	0	0	0	879	879	1	879	N/a	N/a	N/a
East 2	Offices (RA-217)	Office Space	4200	5	6%	5	21	105	252	357	1	357	N/a	N/a	N/a
East 2	Passenger Elevator Lobby (RA-231)	Lobbies	1512	5	6%	150	226.8	1134	90.72	1224.7	1	1224.7	N/a	N/a	N/a
East 2	East Offices (RA-235)	Office Space	4454	5	6%	5	22.27	111.35	267.2	378.59	1	378.59	N/a	N/a	N/a
East 3	Medium Lecture (RA-317)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a
East 3	Medium Lecture (RA-323)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5	N/a	N/a	N/a
East 3	Corridor (RA-309)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 3	Classroom (RA-314)	Classroom (age 9 Plus)	3704	10	12%	35	129.64	1296.4	444.5	1740.9	1	1740.9	N/a	N/a	N/a
East 3	Classroom (RA-308)	Classroom (age 9 Plus)	4229	10	12%	35	148.015	1480.15	507.5	1987.6	1	1987.6	N/a	N/a	N/a
East 3	Passenger Elevator Lobby (RA-331)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 3	Large Conference North (RA-334)	Office Space	8359	5	6%	5	41.795	208.975	501.5	710.52	1	710.52	N/a	N/a	N/a
East 3	Large Conference South (RA-372)	Office Space	7430	5	6%	5	37.15	185.75	445.8	631.55	1	631.55	N/a	N/a	N/a
East 4	Medium Lecture (RA-421)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a

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East 4	Medium Lecture (RA-423)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5	N/a	N/a	N/a
East 4	Corridor (RA-401)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 4	Classroom (RA-411)	Classroom (age 9 Plus)	3704	5	6%	5	18.52	92.6	222.2	314.84	1	314.84	N/a	N/a	N/a
East 4	Classroom (RA-407)	Classroom (age 9 Plus)	4229	5	6%	5	21.145	105.725	253.7	359.47	1	359.47	N/a	N/a	N/a
East 4	Passenger Elevator Lobby (RA-428)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 4	Large Conference North (RA-433)	Office Space	8359	5	6%	5	41.795	208.975	501.5	710.52	1	710.52	N/a	N/a	N/a
East 4	Large Conference South (RA-465)	Office Space	7430	5	6%	5	37.15	185.75	445.8	631.55	1	631.55	N/a	N/a	N/a
East 5	Medium Lecture (RA-517)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a
East 5	Medium Lecture (RA-522)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5 (MAX)	N/a	N/a	N/a
East 5	Corridor (RA-501)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 5	Classroom (RA-512)	Classroom (age 9 Plus)	3704	10	12%	35	129.64	1296.4	444.5	1740.9	1	1740.9	N/a	N/a	N/a
East 5	Classroom (RA-507)	Classroom (age 9 Plus)	4229	10	12%	35	148.015	1480.15	507.5	1987.6	1	1987.6	N/a	N/a	N/a
East 5	Passenger Elevator Lobby (RA-526)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 5	Large Conference North (RA-533)	Office Space	8359	5	6%	5	41.795	208.975	501.5	710.52	1	710.52	N/a	N/a	N/a
East 5	Large Conference South (RA-563)	Office Space	7430	5	6%	5	37.15	185.75	445.8	631.55	1	631.55	N/a	N/a	N/a
East 6	Medium Lecture (RA-618)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a
East 6	Medium Lecture (RA-623)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5 (MAX)	N/a	N/a	N/a
East 6	Corridor (RA-601)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 6	Classroom (RA-611)	Classroom (age 9 Plus)	3704	10	12%	35	129.64	1296.4	444.5	1740.9	1	1740.9	N/a	N/a	N/a
East 6	Classroom (RA-607)	Classroom (age 9 Plus)	4229	10	12%	35	148.015	1480.15	507.5	1987.6	1	1987.6	N/a	N/a	N/a
East 6	Passenger Elevator Lobby (RA-627)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 6	Large Conference North (RA-632)	Office Space	8359	10	12%	35	292.565	2925.65	1003	3928.7	1	3928.7	N/a	N/a	N/a
East 6	Large Conference South (RA-664)	Office Space	7430	10	12%	35	260.05	2600.5	891.6	3492.1	1	3492.1	N/a	N/a	N/a
East 7	Demonstration Lecture (RA-709)	Classroom (age 9 Plus)	7000	10	12%	35	245	2450	840	3290	1	3290	N/a	N/a	N/a
East 7	Lobby (RA-701)	Lobbies	6334	5	6%	150	950.1	4750.5	380	5130.5	1	5130.5	N/a	N/a	N/a
East 7	Assembly (RA-808)	Multi Use Assembly	5873	7.5	6%	100	587.3	4404.75	352.4	4757.1	1	4757.1	N/a	N/a	N/a
East 7	Passenger Elevator Lobby (RA-728)	Lobbies	895	5	6%	150	134.25	671.25	53.7	724.95	1	724.95	N/a	N/a	N/a
East 7	Computer Classrooms (RA-731)	Computer Lab	12074	10	12%	25	301.85	3018.5	1449	4467.4	1	4467.4	N/a	N/a	N/a
East 7	Library (RA-758)	Library	5573	5	12%	10	55.73	278.65	668.8	947.41	1	947.41	N/a	N/a	N/a
East 8	Mechanical Room (RA-806)	Equipment Rooms	7000	0	6%	0	0	0	420	420	1	420	N/a	N/a	N/a
East 8	Lobby (RA-802)	Lobbies	6334	5	6%	150	950.1	4750.5	380	5130.5	1	5130.5	N/a	N/a	N/a
East 8	Passenger Elevator Lobby (RA-813)	Lobbies	895	5	6%	150	134.25	671.25	53.7	724.95	1	724.95	N/a	N/a	N/a
East 8	Conference Rooms (RA-816)	Office Space	12074	5	6%	5	60.37	301.85	724.4	1026.3	1	1026.3	N/a	N/a	N/a
East 8	Library (RA-833)	Library	5573	5	12%	10	55.73	278.65	668.8	947.41	1	947.41	N/a	N/a	N/a

Appendix A.5: West Campus Lighting Power Allowance Calculations

Campus Floor	Space Type	Similar ASHRAE Category	SF	W/SF	W
West G	Loading Dock	Transportation	3223	1	3223
West G	Sprinkler Room	Warehouse	746	0.8	596.8
West G	Domestic Water Room	Warehouse	2805	0.8	2244
West G	Fire Pump Room	Warehouse	1862	0.8	1489.6
West G	Fuel Oil Storage Room	Warehouse	1483	0.8	1186.4
West G	Fuel Oil Storage Room	Warehouse	1506	0.8	1204.8
West G	Fuel Oil Storage Room	Warehouse	1512	0.8	1209.6
West G	Future Fuel Oil Storage	Warehouse	1529	0.8	1223.2
West G	Toilet	Office	528	1	528
West G	Stair	Office	353	1	353
West G	Stair	Office	307	1	307
West G	Toter Wash Down	Restrooms	774	0.9	696.6
West G	Kitchen	Dining: Cafeteria/Fast food	4803	1.4	6724.2
West G	Central receiving	Warehouse	2818	0.8	2254.4
West G	Recruit Dining Room	Dining: Cafeteria/Fast food	15850	1.4	22190
West G	East Pedestrian Walkway	Office	6456	1	6456
West G	Tactical Training Room	School/University	5467	1.2	6560.4
West G	Recruit Defib. Training Room	Dining: Cafeteria/Fast food	3283	1.4	4596.2
West G	Chemical Storage	Warehouse	561	0.8	448.8
West G	Custodial Office	Office	1285	1	1285
West G	Bulk Storage	Warehouse	951	0.8	760.8
West G	Equipment Storage	Warehouse	1935	0.8	1548
West G	Inventory Storage	Warehouse	2955	0.8	2364
West G	Grounds Equipment	Warehouse	2544	0.8	2035.2
West G	West Pedestrian Walkway	Corridor	7913	0.5	3956.5
West G	Baton Training Room	School/University	9097	1.2	10916.4
West G	Tactical Training Room	School/University	5175	1.2	6210
West G	North Locker Room	Gymnasium	4343	1.1	4777.3
West G	Pool Locker Rooms	Gymnasium	3638	1.1	4001.8
West G	Tactical Training Room	Gymnasium	5198	1.1	5717.8
West G	South Locker Room	Gymnasium	6138	1.1	6751.8
West G	Tactical Training Room	Gymnasium	5171	1.1	5688.1
West G	South Corridor	Corridor	19935	0.5	9967.5
West G	Central Plant Corridor	Corridor	2921	0.5	1460.5
West G	Central Plant Lockers	Gymnasium	1163	1.1	1279.3
West G	PT Pool	Gymnasium	6283	1.1	6911.3
West 2	Transformer Room	Warehouse	3081	0.8	2464.8
West 2	Mechanical Room	Warehouse	11099	0.8	8879.2

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West 2	Toilet	Restrooms	186	0.9	167.4
West 2	Mechanical Room	Warehouse	5182	0.8	4145.6
West 2	Toilet	Restrooms	397	0.9	357.3
West 2	Toilet	Stairs-Active	425	0.6	255
West 2	Stairs	Stairs-Active	336	0.6	201.6
West 2	Stairs	Stairs-Active	307	0.6	184.2
West 2	Central Receiving Retail	Warehouse	7209	0.8	5767.2
West 2	Recruit Dining	Dining: Cafeteria/Fastfood	3195	1.4	4473
West 2	Admin Office	Office	11669	1	11669
West 2	East Pedestrian Walkway	Corridor	10172	0.5	5086
West 2	NE Calisthenics Gym	Gymnasium	6742	1.1	7416.2
West 2	E Calisthenics Gym	Gymnasium	6979	1.1	7676.9
West 2	SE Calisthenics Gym	Gymnasium	6913	1.1	7604.3
West 2	West Pedestrian Walkway	Corridor	12828	0.5	6414
West 2	Fitness Training	Gymnasium	5829	1.1	6411.9
West 2	NW Calisthenics Gym	Gymnasium	7792	1.1	8571.2
West 2	W Calisthenics Gym	Gymnasium	6979	1.1	7676.9
West 2	SW Calisthenics Gym	Gymnasium	7958	1.1	8753.8
West 2	South Corridor	Corridor	7581	0.5	3790.5
West 2	HVAC & Plumbing Shop	Workshop	1043	1.4	1460.2
West 2	Paint Shop, Paint Storage	Warehouse	995	0.8	796
West 2	Carpentry Shop	Workshop	1470	1.4	2058
West 2	Electrical/Thermostat Shop	Workshop	741	1.4	1037.4
West 2	Central Plant Corridor	Corridor	2900	0.5	1450
West 2	F-Locker (OP),M-Locker (OP)	Gymnasium	1807	1.1	1987.7
West 2	Admin	Office	2027	1	2027
West 2	TC,EC	Warehouse	266	0.8	212.8
West 2	Mechanical Room	Warehouse	2413	0.8	1930.4
West 2	Laundry	Office	82	1	82
West 3	Laundry Room	Office	76	1	76
West 3	Mechanical Room	Warehouse	5940	0.8	4752
West 3	Generator Room	Warehouse	1938	0.8	1550.4
West 3	Elec. Dist Room	Warehouse	2269	0.8	1815.2
West 3	Generator Room	Warehouse	1976	0.8	1580.8
West 3	Toilet	Restrooms	131	0.9	117.9
West 3	Stair	Stairs-Active	336	0.6	201.6
West 3	Stair	Stairs-Active	307	0.6	184.2
West 3	Central Receiving Retail	Warehouse	2231	0.8	1784.8
West 3	Recruit Dining	Dining: Cafeteria/Fastfood	3278	1.4	4589.2
West 3	Admin Offices	Office	10271	1	10271
West 3	Chiller Room	Warehouse	7376	0.8	5900.8
West 3	Control Room	Warehouse	329	0.8	263.2
West 3	Central Plant Corridor	Warehouse	2854	0.8	2283.2
West 3	Boiler Room	Warehouse	5470	0.8	4376
West 3	Electrical/Telecom Rooms	Warehouse	279	0.8	223.2
West 3	Mechanical Room	Warehouse	2418	0.8	1934.4

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West 4	Chiller Room	Warehouse	7376	0.8	5900.8
West 4	Control Room	Warehouse	329	0.8	263.2
West 4	Central Plant Corridor	Warehouse	2889	0.8	2311.2
West 4	Boiler Room	Warehouse	5470	0.8	4376
West 4	Generator Room	Warehouse	1938	0.8	1550.4
West 4	Elec. Room	Warehouse	2269	0.8	1815.2
West 4	Generator Room	Warehouse	1976	0.8	1580.8
West 4	Toilet	Restrooms	131	0.9	117.9
West 4	Stair	Stairs-Active	336	0.6	201.6
West 4	Stair	Stairs-Active	307	0.6	184.2
West Campus Lighting Power Allowance:					320336

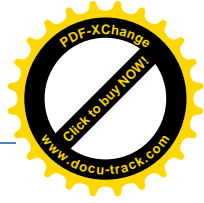
Appendix A.6: East Campus Lighting Power Allowance Calculations

Floor	Space Type	Similar ASHRAE Category	SF	W/SF	W
East G	Office	Office	18951	1	18951
East G	Atrium Lobby	Office	22187	1	22187
East G	North Entrance	Office	2475	1	2475
East G	East Entrance	Office	4454	1	4454
East 2	Server/ Electrical Rooms (RA-207)	Warehouse	14650	0.8	11720
East 2	Offices (RA-217)	Office	4200	1	4200
East 2	Passenger Elevator Lobby (RA-231)	Office	1512	1	1512
East 2	East Offices (RA-235)	Office	4454	1	4454
East 3	Medium Lecture (RA-317)	School/University	7700	1.2	9240
East 3	Medium Lecture (RA-323)	School/University	8250	1.2	9900
East 3	Corridor (RA-309)	Corridor	4288	0.5	2144
East 3	Classroom (RA-314)	School/University	3704	1.2	4444.8
East 3	Classroom (RA-308)	School/University	4229	1.2	5074.8
East 3	Passenger Elevator Lobby (RA-331)	Office	395	1	395
East 3	Large Conference North (RA-334)	Office	8359	1	8359
East 3	Large Conference South (RA-372)	Office	7430	1	7430
East 4	Medium Lecture (RA-421)	School/University	7700	1.2	9240
East 4	Medium Lecture (RA-423)	School/University	8250	1.2	9900
East 4	Corridor (RA-401)	Corridor	4288	0.5	2144
East 4	Classroom (RA-411)	School/University	3704	1.2	4444.8
East 4	Classroom (RA-407)	School/University	4229	1.2	5074.8
East 4	Passenger Elevator Lobby (RA-428)	Office	395	1	395
East 4	Large Conference North (RA-433)	Office	8359	1	8359
East 4	Large Conference South (RA-465)	Office	7430	1	7430
East 5	Medium Lecture (RA-517)	School/University	7700	1.2	9240
East 5	Medium Lecture (RA-522)	School/University	8250	1.2	9900
East 5	Corridor (RA-501)	Corridor	4288	0.5	2144
East 5	Classroom (RA-512)	School/University	3704	1.2	4444.8
East 5	Classroom (RA-507)	School/University	4229	1.2	5074.8

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East 5	Passenger Elevator Lobby (RA-526)	Office	395	1	395
East 5	Large Conference North (RA-533)	Office	8359	1	8359
East 5	Large Conference South (RA-563)	Office	7430	1	7430
East 6	Medium Lecture (RA-618)	School/University	7700	1.2	9240
East 6	Medium Lecture (RA-623)	School/University	8250	1.2	9900
East 6	Corridor (RA-601)	Corridor	4288	0.5	2144
East 6	Classroom (RA-611)	School/University	3704	1.2	4444.8
East 6	Classroom (RA-607)	School/University	4229	1.2	5074.8
East 6	Passenger Elevator Lobby (RA-627)	Office	395	1	395
East 6	Large Conference North (RA-632)	Office	8359	1	8359
East 6	Large Conference South (RA-664)	Office	7430	1	7430
East 7	Demonstration Lecture (RA-709)	School/University	7000	1.2	8400
East 7	Lobby (RA-701)	Office	6334	1	6334
East 7	Assembly (RA-808)	School/University	5873	1.2	7047.6
East 7	Passenger Elevator Lobby (RA-728)	Office	895	1	895
East 7	Computer Classrooms (RA-731)	School/University	12074	1.2	14488.8
East 7	Library (RA-758)	School/University	5573	1.2	6687.6
East 8	Mechanical Room (RA-806)	Warehouse	7000	0.8	5600
East 8	Lobby (RA-802)	Office	6334	1	6334
East 8	Passenger Elevator Lobby (RA-813)	Office	895	1	895
East 8	Conference Rooms (RA-816)	Office	12074	1	12074
East 8	Library (RA-833)	School/University	5573	1.2	6687.6
		East Campus Lighting Power Allowance:			333347



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Appendix B.1: Electric Water Chiller Schedule

ELECTRIC WATER CHILLER (YORK 'YD' AS STANDARD)																												
DESIGNATION	SERVICE	LOCATION	NOMINAL TONS	EVAPORATOR SIDE							CONDENSER SIDE							COMPRESSOR ELECTRIC DATA						OIL PUMP ELECTRIC DATA				
				CHILLED WATER FLOW RATE (GPM)	EVAPORATOR TEMPERATURE (DEGREES F)	LVA WATER TEMPERATURE (DEGREES F)	CHILLED WATER PRESS. (H2O P.T. @ INLET)	NUMBER OF PASSES	FORMING FACTOR	COND. WATER FLOW RATE (GPM)	ENT. WATER TEMPERATURE (DEGREES F)	LVA WATER TEMPERATURE (DEGREES F)	COND. WATER PRESS. (H2O P.T. @ INLET)	NUMBER OF PASSES	FORMING FACTOR	NUMBER OF COMPRESSORS	KW (EACH MOTOR)	SHAFT HP EACH MOTOR	KW TOTAL	UNIT KW /TON	UNIT IRLV	FLA (EACH MOTOR)	LVA (EACH MOTOR)	BRUSH AMPS	VOLTS /PHASE	FLA	VOLTS /PHASE	OPERATING WEIGHT (LBS)
CH-311-3-1	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2025	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-2	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2025	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-3	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2025	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-4	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2025	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-5	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2025	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-6	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2025	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293

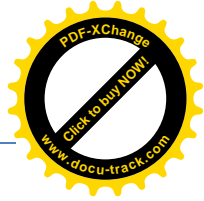
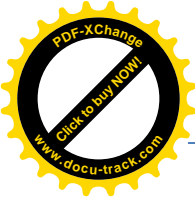
*3RD CHILLER WILL BE UNDER ENERGY POWER BUT ONLY ONE WILL RUN.

Appendix B.2: Hot Water Boiler Schedule

HOT WATER BOILER LOW NOx (UNILUX AS STANDARD)																												
DESIGNATION	SERVICE	LOCATION	BOILER HP.	NET OUTPUT (MBS)	PASS ARRANGEMENT	DESIGN PRESSURE (PSIG)	ROOF VALVE SET POINT (F50s)	MINIMUM EFFICIENCY AT RATED LOAD (%)	HOT WATER DATA				GAS BURNER DATA				DRIFT BLOWER DATA		ELECTRICAL POWER		UNIT/ MFC/ LOOSE MODIFIED STARTER	STARTER PROVIDED BY	STARTER TYPE	VARIABLE SPEED	REMARKS			
									FLOW RATE (USGPM @ 60% CYCLO)	ENT. TEMP (DEGREES F)	LVA TEMP (DEGREES F)	PRESS. DROP WATERGAE (PSI)	GAS TYPE	GAS HEAT CONTENT (BTU/CT)	RATED FLOW (GPH)	GAS INLET PRESSURE (PSIG)	STRAKE (PSI)	PIPE INLET SIZE (IN)	MOTOR HP	VOLTS/PHASE						MODEL NUMBER	OPERATING WEIGHT (LBS)	NORMAL POWER
B-311-3-1	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	T80	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	372900H-1-250/250	38,000	YES	YES	UNIT	MECH	VFD	YES	DUAL FUEL
B-311-3-2	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	T80	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	372900H-1-250/250	38,000	YES	YES	UNIT	MECH	VFD	YES	DUAL FUEL
B-311-3-3	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	T80	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	372900H-1-250/250	38,000	YES	NO	UNIT	MECH	VFD	YES	DUAL FUEL
B-311-3-4	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	T80	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	372900H-1-250/250	38,000	YES	NO	UNIT	MECH	VFD	YES	DUAL FUEL (FUTURE)
B-311-3-5	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	T80	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	372900H-1-250/250	38,000	YES	NO	UNIT	MECH	VFD	YES	DUAL FUEL (FUTURE)

*LOW NOx ON GAS FIRING < 30 PPM

ITEMS GROSS INPUT, TOTAL HEATING SURFACE, FURNACE VOLUME, AIR QUALITY AND VIBRATION ISOLATION DERIVED FROM SCHEDULE.



Appendix B.3: Cooling Tower Schedule

COOLING TOWERS (MARLEY AS STD)																							
DESIGNATION	LOCATION	TYPE	TOTAL FLOW RATE (GPM)	ENT. WATER TEMPERATURE (DEGREES F)	LVC. WATER TEMPERATURE (DEGREES F)	AMBIENT AIR TEMP (DEGREES F, W.B.)	GPM PER CELL	NUMBER OF CELLS	FAN MOTOR DATA				MODEL NUMBER	OPERATING WEIGHT W/O STEEL SUPPORT	BASIN HEATER NO. & KW	VIBRATION ISOLATION		ELECTRICAL POWER		VARIABLE SPEED	UNIT / MCC / LOOSE MOUNTED STARTER	STARTER PROVIDED BY	STARTER TYPE
									NUMBER OF FAN MOTORS	HP PER FAN MOTOR	RPM	VOLTS/PHASE				SPECIFICATION TYPE	STATIC DEFLECTION (INCHES)	NORMAL POWER	EMERGENCY POWER				
CT-311-R-1	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	YES	YES	LOOSE	MECH	VFD
CT-311-R-2	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	YES	YES	LOOSE	MECH	VFD
CT-311-R-3	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-4	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-5	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-6	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-7	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD

*TWO COOLING TOWERS WILL BE UNDER ENERGY POWER BUT ONLY ONE WILL RUN.

Appendix B.4: Pump Schedule

PUMPS (ARMSTRONG AS STANDARD)																								
DESIGNATION	SERVICE	LOCATION	FLOW RATE (GPM)	TOTAL PUMP HEAD (FT. OF WATER)	SUCTION PRESSURE (PSIG)	DISCHARGE PRESSURE (PSIG)	CASING PRESSURE (PSIG)	MINIMUM PUMP EFFICIENCY (%)	MOTOR DATA				MODEL NUMBER	PUMP TYPE	MANUFACTURER	VIBRATION ISOLATION		ELECTRICAL POWER		VARIABLE SPEED	UNIT / MCC / LOOSE MOUNTED STARTER	STARTER PROVIDED BY	STARTER TYPE	
									BRAKE HP	MAXIMUM HP	MINIMUM MOTOR HP	RPM				VOLTS/PHASE	SPECIFICATION TYPE	STATIC DEFLECTION (INCHES)	NORMAL POWER					EMERGENCY POWER
PCHW-311-3-1	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	2025	200	125	125	150	85.3	119.9	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	YES	YES	MCC	MECH.	VFD
PCHW-311-3-2	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	2025	200	125	125	150	85.3	119.9	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	YES	YES	MCC	MECH.	VFD
PCHW-311-3-3	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	2025	200	125	125	150	85.3	119.9	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCHW-311-3-4	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	2025	200	125	125	150	85.3	119.9	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCHW-311-3-5	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	2025	200	125	125	150	85.3	119.9	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCHW-311-3-6	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	2025	200	125	125	150	85.3	119.9	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCW-311-3-1	CONDENSER WATER	CENTRAL PLANT 3RD FLOOR	2700	130	125	125	150	80.3	110.3	150	-	1800	460/3	SERIES-4600 10-8-14H	SPLIT CASE	ARMSTRONG	-	-	YES	YES	YES	MCC	MECH.	VFD
PCW-311-3-2	CONDENSER WATER	CENTRAL PLANT 3RD FLOOR	2700	130	125	125	150	80.3	110.3	150	-	1800	460/3	SERIES-4600 10-8-14H	SPLIT CASE	ARMSTRONG	-	-	YES	YES	YES	MCC	MECH.	VFD
PCW-311-3-3	CONDENSER WATER	CENTRAL PLANT 3RD FLOOR	2700	130	125	125	150	80.3	110.3	150	-	1800	460/3	SERIES-4600 10-8-14H	SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCW-311-3-4	CONDENSER WATER	CENTRAL PLANT 3RD FLOOR	2700	130	125	125	150	80.3	110.3	150	-	1800	460/3	SERIES-4600 10-8-14H	SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCW-311-3-5	CONDENSER WATER	CENTRAL PLANT 3RD FLOOR	2700	130	125	125	150	80.3	110.3	150	-	1800	460/3	SERIES-4600 10-8-14H	SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCW-311-3-6	CONDENSER WATER	CENTRAL PLANT 3RD FLOOR	2700	130	125	125	150	80.3	110.3	150	-	1800	460/3	SERIES-4600 10-8-14H	SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PCW-311-3-7	CONDENSER WATER HEAT RECOVERY																							
PHW-311-3-1	HOT WATER	CENTRAL PLANT 3RD FLOOR	2010	200	125	125	150	85.2	119.2	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	YES	YES	MCC	MECH.	VFD
PHW-311-3-2	HOT WATER	CENTRAL PLANT 3RD FLOOR	2010	200	125	125	150	85.2	119.2	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	YES	YES	MCC	MECH.	VFD
PHW-311-3-3	HOT WATER	CENTRAL PLANT 3RD FLOOR	2010	200	125	125	150	85.2	119.2	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PHW-311-3-4	HOT WATER	CENTRAL PLANT 3RD FLOOR	2010	200	125	125	150	85.2	119.2	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
PHW-311-3-5	HOT WATER	CENTRAL PLANT 3RD FLOOR	2010	200	125	125	150	85.2	119.2	200	-	1800	460/3	SERIES-4600 8-6-15H	HORIZ SPLIT CASE	ARMSTRONG	-	-	YES	NO	YES	MCC	MECH.	VFD
GMP-211-G-1	LOADING DOCK	LOADING DOCK	50	50	125	125	150	53.20	1.19	2	-	1800	208/3	SERIES-4380 1.5-1.5-BH	VERT INLINE	ARMSTRONG	-	-	YES	NO	NO	LOOSE	MECH.	DOL
GMP-211-G-2	LOADING DOCK	LOADING DOCK	50	50	125	125	150	53.20	1.19	2	-	1800	208/3	SERIES-4380 1.5-1.5-BH	VERT INLINE	ARMSTRONG	-	-	YES	NO	NO	LOOSE	MECH.	DOL
GMP-311-G-1	GROUND EQUIPMENT	GROUND EQUIPT	50	50	125	125	150	53.20	1.19	2	-	1800	208/3	SERIES-4380 1.5-1.5-BH	VERT INLINE	ARMSTRONG	-	-	YES	NO	NO	LOOSE	MECH.	DOL
GMP-311-G-2	GROUND EQUIPMENT	GROUND EQUIPT	50	50	125	125	150	53.20	1.19	2	-	1800	208/3	SERIES-4380 1.5-1.5-BH	VERT INLINE	ARMSTRONG	-	-	YES	NO	NO	LOOSE	MECH.	DOL

*TWO PUMPS PER SYSTEM WILL BE UNDER EMERGENCY POWER, BUT ONLY ONE WILL RUN.