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New York Police Academy

College Point, New York

Technical Report 3:

Mechanical Systems: Existing Conditions Evaluation

Prepared for: Professor William Bahnfleth, PhD, PE

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Mechanical Option
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Executive Summary

This technical report is intended to provide a clear and concise summary of the mechanical systems of the New York Police Academy (NYPA). The report begins with outlining the design objectives and external influences that affected the design of the NYPA. Architecture, sustainability, structural design, and electrical systems are all part of the design process that affect the design of the entire building and in turn influence the mechanical system design.

The mechanical system is explained in this report by first introducing the information about the site design conditions and the calculated loads of the building. Next the major mechanical equipment and their relationship in the entire mechanical system is explained. Lastly, a LEED assessment has been performed to describe how the mechanical system design performs within the LEED guidelines.

The NYPA's mechanical system is designed around a central heating and cooling plant that is located in the West Campus building of the Academy. The central plant provides all the heating and cooling needs of the entire academy which serves sixty three air handling units that provide all the ventilation and thermal comfort demand of the building. The NYPA is striving for LEED Silver Certification and the mechanical system design contributes to the sustainably friendly design. The NYPA should easily achieve LEED Silver and possibly even LEED Gold.

Overall, this report provides a summary of the mechanical system design of the New York Police Academy. Factors that influence the design as well as the functionality of the design are all explained within this mechanical systems existing conditions evaluation.

Design Objectives

Architecture

The New York Police Academy is a building consisting of an academic building on the east side of the site and a physical training building on the west side of the site. The two separate building are connected by a bridge that runs over a flowing stream which is actually a water management stream.

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 facade offers a complementing facade with a strong character which is all built upon a simple shape.

Sustainability

The New York City Department of Design & Construction (DDC) is responsible for the construction of the civic facilities and structures of New York. The New York City DDC has taken an initiative to develop sustainable and high performing buildings. The New York Police Academy which will be built in College Point, Queens falls under the DDC jurisdiction and is to be constructed with conscientious attempt towards sustainability.

The New York Police Academy has a minimum project requirement of reaching 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 all 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 cost reduction values. 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.

Also the buildings site has a very unique drainage ditch that separates the East and West campuses. The drainage ditch appears to be a stream flowing through the site but it is actual an integral part to a sustainable waste water management system. Storm water discharge from this site will be reduced by 25% and the collected storm water will be used for irrigation of the native vegetation throughout the site. Sustainable water management will also be reflected in the plumbing fixtures used throughout the building

Overall, the New York Police Academy is continuing the goal of DDC in building sustainable buildings. The New York Police Department is an integral part of New York City and their Academy will set a good example for other New York City institutional buildings.

Structure

The predominant architectural shape of the New York Police Academy is a rectangle. Both the East Campus and the West Campus have a typical rectangular shape that allows for structural steel to be arranged in square bays. The bays are typically structured with wide flange beams spaced at 10 feet and girders spaced at 30 feet. The foundation of the academy begins with steel piles that each have a 100 ton capacity and are 16in diameter. There may be anywhere from two to eleven of these steel piles for each concrete pad on the ground floor. The slab on grade is 14 inches thick while all other floors are 4concrete slabs on metal decking.

Structural bracing can be found running diagonally across the vertical bays that provide structural stiffening. This technique is also used to support the main atrium of the building and it provides a pleasant architectural aesthetic.

Electrical/Lighting

The total electrical load in the building is 8644kW. Eighteen percent of the load (1542kW) is attributed to the lighting needs, nineteen percent (1668 kW) is attributed to the power needs, and the final sixty three percent (5434 kW) is needed for the HVAC needs. Also the generators provide 1219kW of emergency power and 3361kW of standby power for a total of 4580kW of emergency power potential.

The electrical system will run off a high voltage and low voltage design. There will be 460/265V 3-phase high voltage power delivered to certain points of the building, then this high voltage will be stepped down to 120/208V-(3 phase) low voltage further down the electrical system. The transformers will range in size from 3KVA to 2500 KVA. 2.5MW/3.12MVA 460V diesel generators will be placed in the central plant to provide reliable power in the event of a utility power failure.

There will be a variety of lighting fixtures used throughout the building. Also 90% of individual work areas (offices and open plan workstations) will include task lighting incorporated in the workstation areas. There will be easy control-ability of lights so that spaces can easily be lit one section at a time. This will limit the use of lights in areas where people do not reside. Natural day lighting is prevalent along the perimeter of the entire academic building with a repeating window pattern that lines the building. There is also large central atrium that provides natural day light that can penetrate deep into the building.

Mechanical Systems Overview:

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 CO_2 sensors, and appropriate placement of air intakes that will limit outdoor contaminants entering the building.

There are five 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 six 1350 ton chillers that will supply all the cold water needs of the Academy. The central plant serves both the East and West Campus. The capacity of the central plant has been oversized both for redundancy and the intent for future expansion of the New York Police Academy.

Design Factors

Site

Currently, the New York Police Department's training facilities are scattered among New York City and the Academy will aim to consolidate these faculties into one campus. The New York Police Academy will be built in College Point, Queens New York. It will be in close proximity with the John F. Kennedy International Airport and Citi Field, home of the New York Mets. The design consists of approximately 2.4 million square feet, 1 million square feet with consist of the actual building. The building will house academic, training, office, and related support spaces. The other parts of the site will include such things as an outdoor track, field, parking, and waste water management stream.

Cost

The joint venture leadership of Turner Construction Company and STV Construction Company is leading the construction management services of the New York Police Academy. The New York City Department of Design and Construction (DDC) will also be responsible for overseeing the progression of the project. The proposed dates of construction will be from October 1, 2010 to December 31, 2013 and the total contract cost is $656,000,000.

Specific cost information in regards to the mechanical system was unavailable for distribution. This building is in the midst of construction and specific contractual cost information may be sensitive information that is not available for review at this time. Thus, at this time mechanical first cost, total cost and cost per square foot is unavailable.

Energy Cost- East Campus

In order to accurately verify the energy cost per square foot of a building it is useful to have both the typical utility rates charged to a building as well the actual energy consumption of a building. This report has been written prior to the construction of the New York Police Academy thus assumptions had to be made. Assumptions made include the cost per kWh of electricity and the cost of natural gas. These prices were gathered from the United States Department of Energy's: Energy Information Administration. New York State has one of the highest prices for electricity and natural gas in the United States. It was assumed that the price per kWh was .1611 $/kWh and the price for natural gas was $11.858/1000 ft^3 of natural gas. The electricity price was assumed to be an average commercial electricity rate for New York State in the year 2010 and the natural gas price was an annual average from 2004-2010. See appendix for the Energy Information Administration's tables.

Table 1.1: Electric Utility Costs- East Campus

Source	Energy Cost	Electricity Consumption [kWh/yr]	Utility Price [$ /yr]	Utility Price [$/ ft^2 • yr]
Primary Heating	$.1611 /kWh	10,176	$1,639.35	$.0043/ ft^2 • yr
Primary Cooling	$.1611 /kWh	1,787,982	$288,043.90	$.767/ ft^2 • yr
Auxiliary	$.1611 /kWh	9,964	$16,05.20	$.0043/ ft^2 • yr
Lighting	$.1611 /kWh	2,986,304	$481,093.57	$1.28/ ft^2 • yr
Receptacle	$.1611 /kWh	839,635	$135,265.20	$0.36/ ft^2 • yr
Totals	$.1611 /kWh	5,634,031	$907,642.39	$2.42/ ft^2 • yr

Table 1.2: NYPA East Campus Total Utility Costs-East Campus

Energy Cost	Energy Consumption	Building Size (East Campus Only)	Utility Price/ ft^2 • yr
$.1611 /kWh	5,634,061 kWh/yr	375,405 ft^2	$2.42 / ft^2 • yr
$11.858/1000 ft^3 NG	5,530,679 kBtu/yr	375,405 ft^2	$.1699/ ft^2 • yr
		Total Utility Cost:	**$2.59/ ft^2 • yr**
		Annual Cost:	**$971,428/yr**

*High Heating Value for Natural Gas was used 1ft^3=1028 Btu in accordance with specification of boiler.

Outdoor Design Considerations

Table 1.3: Location Information: College Point, Queens

ASHRAE Handbook of Fundamentals

Station	Latitude	Longitude	Elevation	Heating DB (99.6%)	Cooling DB 0.4%	Cooling MCWB 0.4%	Evaporation WB 0.4%	Evaporation MCDB 0.4%	Dehumid. DP 0.4%	Dehumid HR 0.4%	Dehumid MCDB 0.4%
New York, LaGuardia Aprt	40.78N	73.88W	30	12.6	92.2	74.4	77.2	87.2	74.3	185.5	81.0

Information	Input
Air Density	0.0760 lb/ft^3
Air Specific Heat	0.244 Btu/lb •°F
Density-Specific Heat Product	1.1147 Btu/h •cfm °•F
Latent Heat Factor	4906.9 Btu •min/h• ft^3
Enthalpy Factor	4.5604 lb•min/hr • ft^3
Summer Design Dry Bulb	89°F
Summer Design Wet Bulb	73°F
Winter Design Dry Bulb	15°F
Summer/Winter Clearness Number	0.85°F
Summer/Winter Ground Reflectance	0.20°F
Carbon Dioxide Level	400 ppm

Indoor Design Considerations

There is 1,000,000 SF of building space in the New York Police Academy. The are several different types of spaces and the indoor design temperatures will slightly vary depending on occupancy and room usage. However, typical spaces in the academy have an indoor design temperature set point 72 °F.

Ventilation Requirements

Table 1.4: Ventilation Results- East Campus

	[cfm]	[cfm/ft^2]
Outside Airflow	98,265	0.26
Cooling Airflow	234,422	.62
Heating Airflow	73,890	.20
Return Airflow	270,912	.72
Exhaust Airflow	134,754	.36

Design Heating and Cooling Loads

Table 1.5: Heating and Cooling Load- East Campus

	Tons	ft^2/ton	MBh	Btu/hr ft^2
Cooling Load	1235.5	303.84	14826.4	39.49
Heating Load	-	-	-10,104.2	-26.92

Annual Energy Usage

Table 1.6: Electricity Consumption- East Campus

Source	Electricity Consumption [kWh]	Total Building Electricity
Primary Heating	10,176 (does not include gas consumption)	22.5%
Primary Cooling	1,787,982	24.7%
Auxiliary	9,964	.1%
Lighting	2,986,304	41.2%
Receptacle	839,635	11.6%
Totals	5,634,031	100%

Major Equipment Schedules

Boiler Schedule

Hot Water Boiler												
Designation	Service	Location	Boiler H.P.	Pass Arrangement	Design Pressure (PSIG)	Min. Efficiency at Load (%)	Entering Temp. (°F)	Leaving Temp (°F)	Gas Type	Volts/Phase	Motor H.P.	Starter Type
B-311-3-1	Hot Water	Central Plant	750	5	250	84	165	190	NG	460/3	30	VFD
B-311-3-2	Hot Water	Central Plant	750	5	250	84	165	190	NG	460/3	30	VFD
B-311-3-3	Hot Water	Central Plant	750	5	250	84	165	190	NG	460/3	30	VFD
B-311-3-4	Hot Water	Central Plant	750	5	250	84	165	190	NG	460/3	30	VFD
B-311-3-5	Hot Water	Central Plant	750	5	250	84	165	190	NG	460/3	30	VFD

Chiller Schedule

Electric Water Chiller				Evaporator Information				Condenser Information				Compressor Information			
Designation	Service	Location	Nominal Tons	Chilled Water (GPM)	Entering Water (°F)	Leaving Water (°F)	Press. Drop (Ft)	Cond. Water (GPM)	Entering Water (°F)	Leaving Water (°F)	Cond. Press Drop (Ft)	KW (Each Motor)	KW/ Ton	FLA (Each Motor)	Volts/ Phase
CH-311-3-1	Chilled Water	Central Plant	1350	2025	58	42	14	2700	85	100	12	826	0.612	1152	480/3
CH-311-3-2	Chilled Water	Central Plant	1350	2025	58	42	14	2700	85	100	12	826	0.612	1152	480/3
CH-311-3-3	Chilled Water	Central Plant	1350	2025	58	42	14	2700	85	100	12	826	0.612	1152	480/3
CH-311-3-4	Chilled Water	Central Plant	1350	2025	58	42	14	2700	85	100	12	826	0.612	1152	480/3
CH-311-3-5	Chilled Water	Central Plant	1350	2025	58	42	14	2700	85	100	12	826	0.612	1152	480/3
CH-311-3-6	Chilled Water	Central Plant	1350	2025	58	42	14	2700	85	100	12	826	0.612	1152	480/3
CH-311-3-7	Chilled Water	Central Plant	1350	2025	58	42	14	2700	85	100	12	826	0.612	1152	480/3

Cooling Tower Schedule

Cooling Tower									
Designation	Location	Type	Total Flow (GPM)	Ent. Water Temp (°F)	Lvg. Water Temp (°F)	Amb. Air Temp (°F W.B.)	Fan RPM	Volts/Phase	Starter
CT-311-R-1	Roof Level	Induced Draft Counter Flow	2700	100	85	78	1800	460/3	VFD
CT-311-R-1	Roof Level	Induced Draft Counter Flow	2700	100	85	78	1800	460/3	VFD
CT-311-R-1	Roof Level	Induced Draft Counter Flow	2700	100	85	78	1800	460/3	VFD
CT-311-R-1	Roof Level	Induced Draft Counter Flow	2700	100	85	78	1800	460/3	VFD
CT-311-R-1	Roof Level	Induced Draft Counter Flow	2700	100	85	78	1800	460/3	VFD
CT-311-R-1	Roof Level	Induced Draft Counter Flow	2700	100	85	78	1800	460/3	VFD
CT-311-R-1	Roof Level	Induced Draft Counter Flow	2700	100	85	78	1800	460/3	VFD

Pump Schedule

Pumps													
Designation	Service	Location	Flow Rate (GPM)	Pump Head (FT)	Suct. Press (PSIG)	Disch. Press. (PSIG)	Casing Press. (PSIG)	Brake H.P.	Max H.P.	RPM	Volts/Phase	Pump Type	Starter Type
PCHW-311-3-1	Chilled Water	Central Plant	2025	200	125	125	150	119.9	200	1800	460/3	Horz. Split Case	VFD
PCHW-311-3-2	Chilled Water	Central Plant	2025	200	125	125	150	119.9	200	1800	460/3	Horz. Split Case	VFD
PCHW-311-3-3	Chilled Water	Central Plant	2025	200	125	125	150	119.9	200	1800	460/3	Horz. Split Case	VFD
PCHW-311-3-4	Chilled Water	Central Plant	2025	200	125	125	150	119.9	200	1800	460/3	Horz. Split Case	VFD
PCHW-311-3-5	Chilled Water	Central Plant	2025	200	125	125	150	119.9	200	1800	460/3	Horz. Split Case	VFD
PCHW-311-3-6	Chilled Water	Central Plant	2025	200	125	125	150	119.9	200	1800	460/3	Horz. Split Case	VFD
PCW-311-3-1	Condenser Water	Central Plant	2700	130	125	125	150	110.3	150	1800	460/3	Horz. Split Case	VFD
PCW-311-3-2	Condenser Water	Central Plant	2700	130	125	125	150	110.3	150	1800	460/3	Horz. Split Case	VFD
PCW-311-3-3	Condenser Water	Central Plant	2700	130	125	125	150	110.3	150	1800	460/3	Horz. Split Case	VFD
PCW-311-3-4	Condenser Water	Central Plant	2700	130	125	125	150	110.3	150	1800	460/3	Horz. Split Case	VFD
PCW-311-3-5	Condenser Water	Central Plant	2700	130	125	125	150	110.3	150	1800	460/3	Horz. Split Case	VFD
PCW-311-3-5	Condenser Water	Central Plant	2700	130	125	125	150	110.3	150	1800	460/3	Horz. Split Case	VFD
PHW-311-3-1	Hot Water	Central Plant	2010	200	125	125	150	119.2	200	1800	460/3	Horz. Split Case	VFD
PHW-311-3-2	Hot Water	Central Plant	2010	200	125	125	150	119.2	200	1800	460/3	Horz. Split Case	VFD
PHW-311-3-3	Hot Water	Central Plant	2010	200	125	125	150	119.2	200	1800	460/3	Horz. Split Case	VFD
PHW-311-3-4	Hot Water	Central Plant	2010	200	125	125	150	119.2	200	1800	460/3	Horz. Split Case	VFD
PHW-311-3-5	Hot Water	Central Plant	2010	200	125	125	150	119.2	200	1800	460/3	Horz. Split Case	VFD
GWP-211-G-1	Loading Dock	Loading Dock	50	50	125	125	150	1.19	2	1800	208/3	Vert. Inline	DOL
GWP-211-G-2	Loading Dock	Loading Dock	50	50	125	125	150	1.19	2	1800	208/3	Vert. Inline	DOL
GWP-311-G-1	Grounds Equipment	Grounds Equip.	50	50	125	125	150	1.19	2	1800	208/3	Vert. Inline	DOL
GWP-311-G-2	Grounds Equipment	Grounds Equip.	50	50	125	125	150	1.19	2	1800	208/3	Vert. Inline	DOL

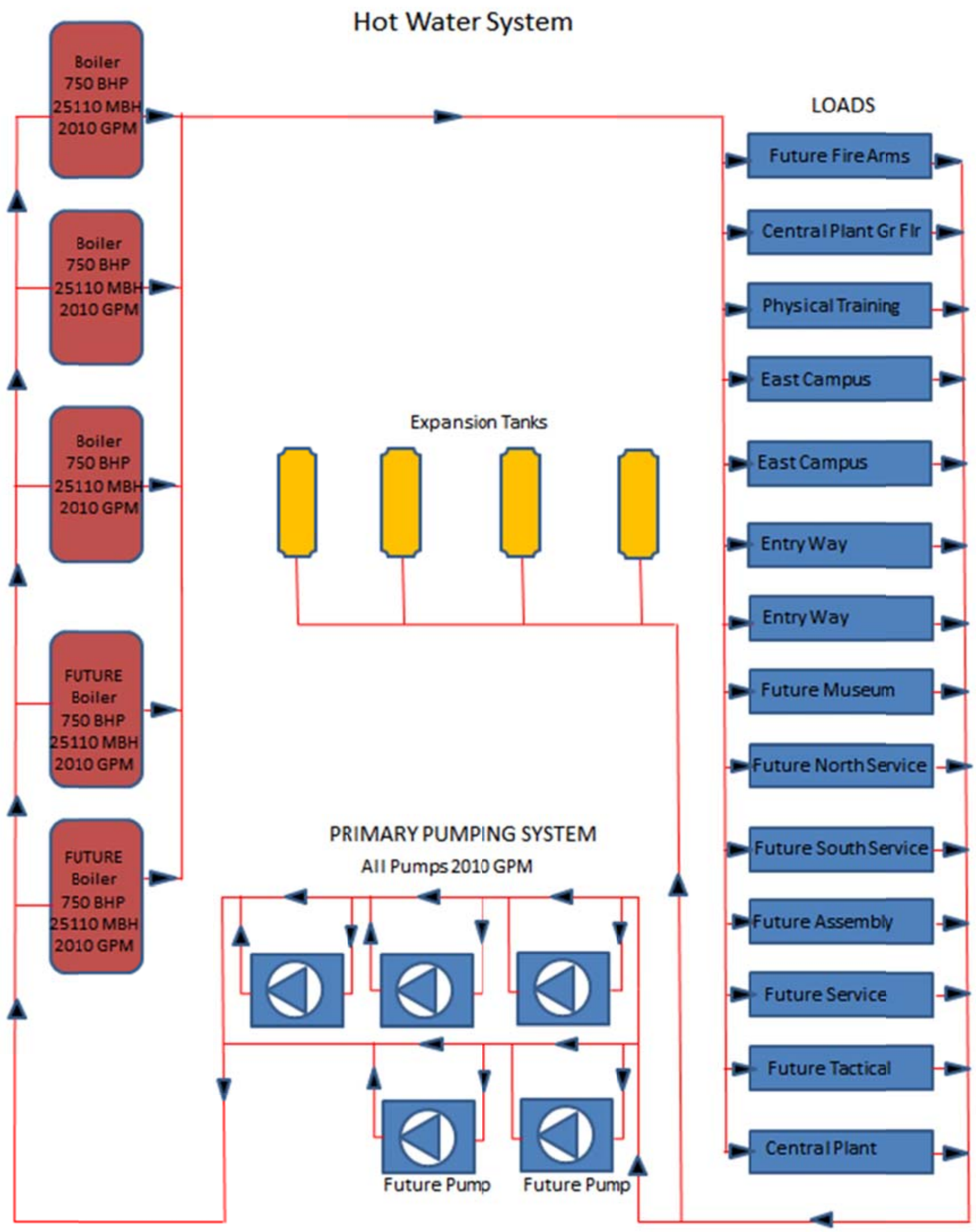
Air Handling Unit Schedule

Designation	Service	Location	Total Air Quantity (cfm)	Outside Air Quantity (cfm)	OA (%)
AHU-111-8-1	2nd Floor Office	8th Floor MER	15000	2550	17%
AHU-111-8-2	7th Floor Admin Office	8th Floor MER	7500	1300	17%
AHU-111-8-3	Pedestrian Walkway	8th Floor MER	29500	5000	17%
AHU-111-8-4	Lockers	8th Floor MER	15000	2550	17%
AHU-111-8-5	Classroom	8th Floor MER	30000	10800	36%
AHU-111-8-6	Classroom	8th 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%

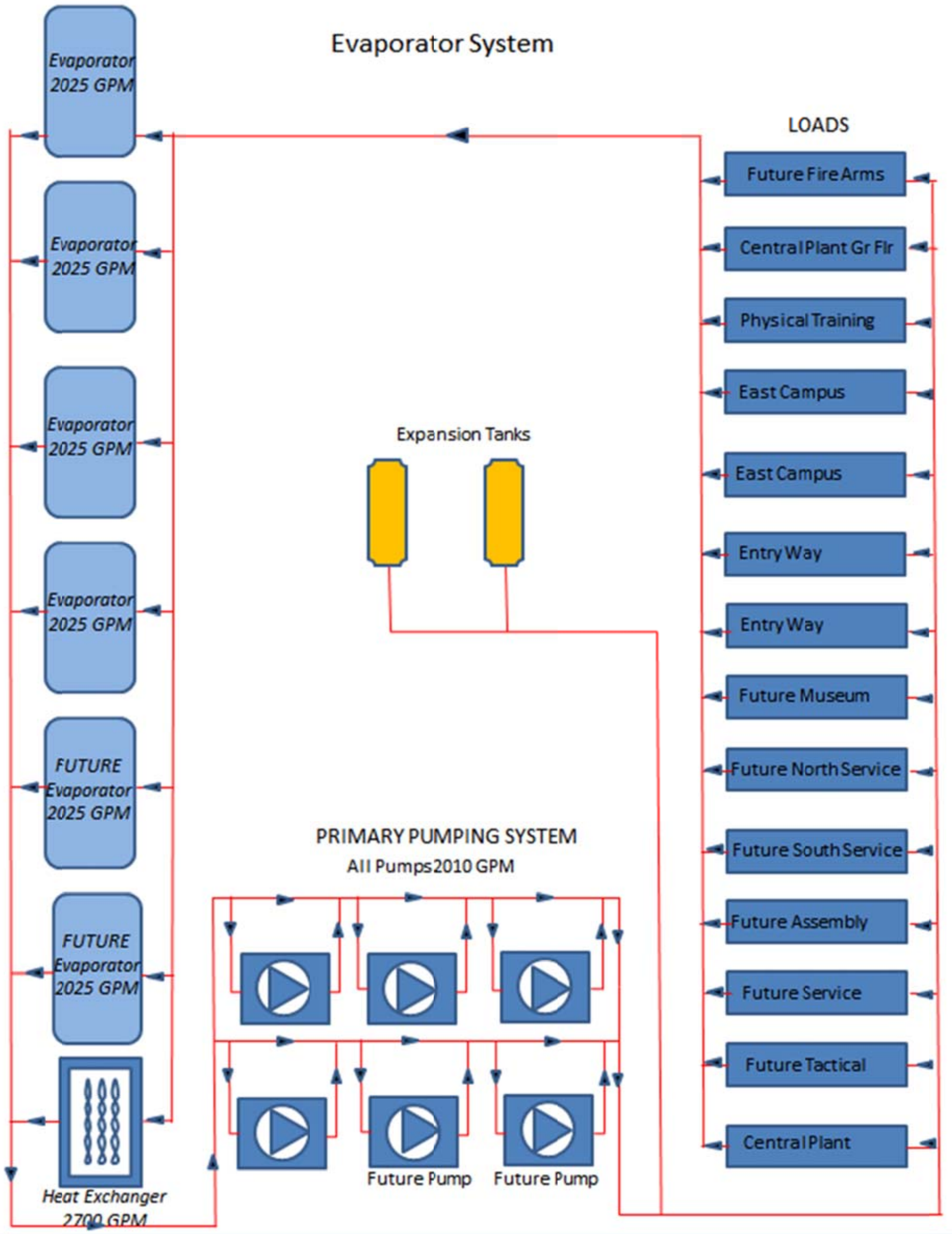
AHU-131-PH-2	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-3	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-4	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-5	Admin Office	East Penthouse MER	25000	6400	26%
AHU-131-PH-6	Library	East Penthouse MER	16000	6000	38%
AHU-131-PH-7	Library	East Penthouse MER	16000	6000	38%
AHU-211-2-1	Central Receiving Retail	Physical Training West Mech. 2nd Floor	10000	2500	25%
AHU-211-2-2	Central Receiving Misc.	Physical Training West Mech. 2nd Floor	10000	2500	25%
AHU-211-2-3	1st Floor Dining	Physical Training West Mech. 2nd Floor	29000	14500	50%
AHU-211-2-4	Administration	Physical Training West Mech. 2nd Floor	29000	7300	25%
AHU-211-2-5	East Pedestrian Walkway	Physical Training East Mech. 2nd Floor	29000	7300	25%
AHU-211-2-6	NE Calisthenics Gym	Physical Training East Mech. 2nd Floor	29000	14500	50%
AHU-211-2-7	E Calisthenics Gym	Physical Training East Mech. 2nd Floor	29000	14500	50%
AHU-211-2-8	SE Calisthenics Gym	Physical Training East Mech. 2nd Floor	29000	14500	50%
AHU-211-2-9	North Defib Training	Physical Training East Mech. 2nd Floor	7500	7500	100%
AHU-211-2-10	Fitness Training	Physical Training East Mech. 2nd Floor	15000	4500	30%
AHU-211-2-11	Tactical Training	Physical Training East Mech. 2nd Floor	15000	4500	30%
AHU-211-2-12	South Defib Training	Physical Training East Mech. 2nd Floor	1500	7500	50%
AHU-311-2-1	Tactical Training	Central Plant 2nd Floor	10000	3000	30%
AHU-311-2-2	W Pedestrian Walkway	Central Plant 2nd Floor	29000	7300	25%
AHU-311-2-3	NW Calisthenics Gym	Central Plant 2nd Floor	29000	14500	50%
AHU-311-2-4	1st Floor Baton Training Room	Central Plant 2nd Floor	20000	6000	30%
AHU-311-2-5	W Calisthenics Gym	Central Plant 2nd Floor	29000	14500	50%
AHU-311-2-6	Tactical Training	Central Plant 2nd Floor	10000	3000	30%
AHU-311-2-7	Tactical Training	Central Plant 2nd Floor	10000	3000	30%
AHU-311-2-8	SW Calisthenics Gym	Central Plant 2nd Floor	29000	14500	50%
AHU-311-2-9	South Corridor	Central Plant 2nd Floor	29000	7300	25%
AHU-311-2-18	Lobby	Central Plant 5th Floor	4000	2000	50%
AHU-311-5-1	Chiller Room	Central Plant 5th Floor	29000	29000	100%
AHU-311-5-3	Admin Office	Central Plant 5th Floor	3000	750	25%
AHU-311-5-5	Corridor	Central Plant 5th 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 5th Floor	7500	7500	100%
AHU-311-2-14	HVAC Shop	Central Plant 2nd Floor	3100	3100	100%
AHU-311-2-15	Paint Shop	Central Plant 2nd Floor	2900	2900	100%
AHU-311-2-16	Carpentry Shop	Central Plant 2nd Floor	4300	4300	100%
AHU-311-2-17	Thermostat Shop	Central Plant 2nd Floor	2250	2250	100%
AHU-311-5-2	Control Room	Central Plant Fifth Floor	1050	219	21%

Mechanical System Schematics

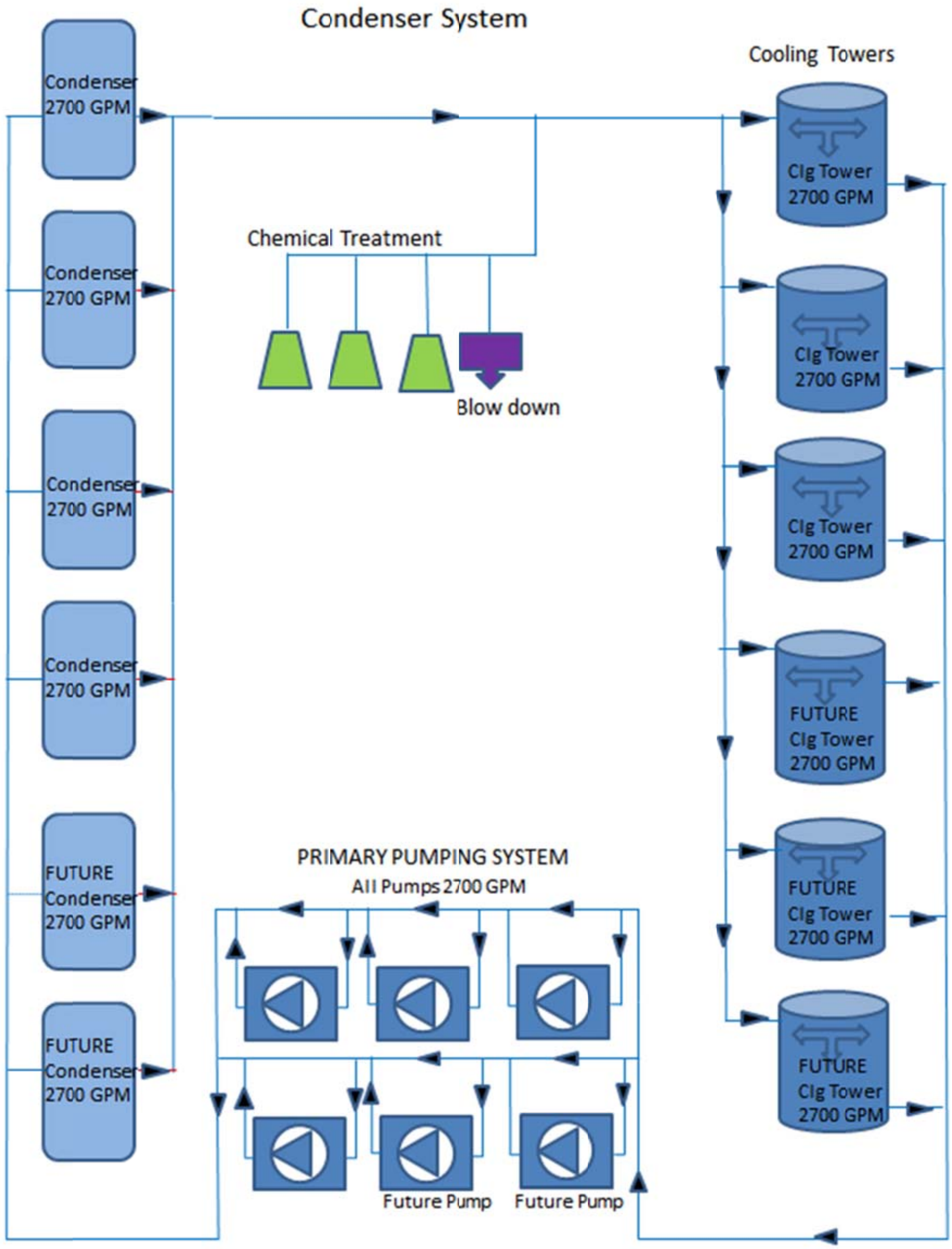
Hot Water System Schematic



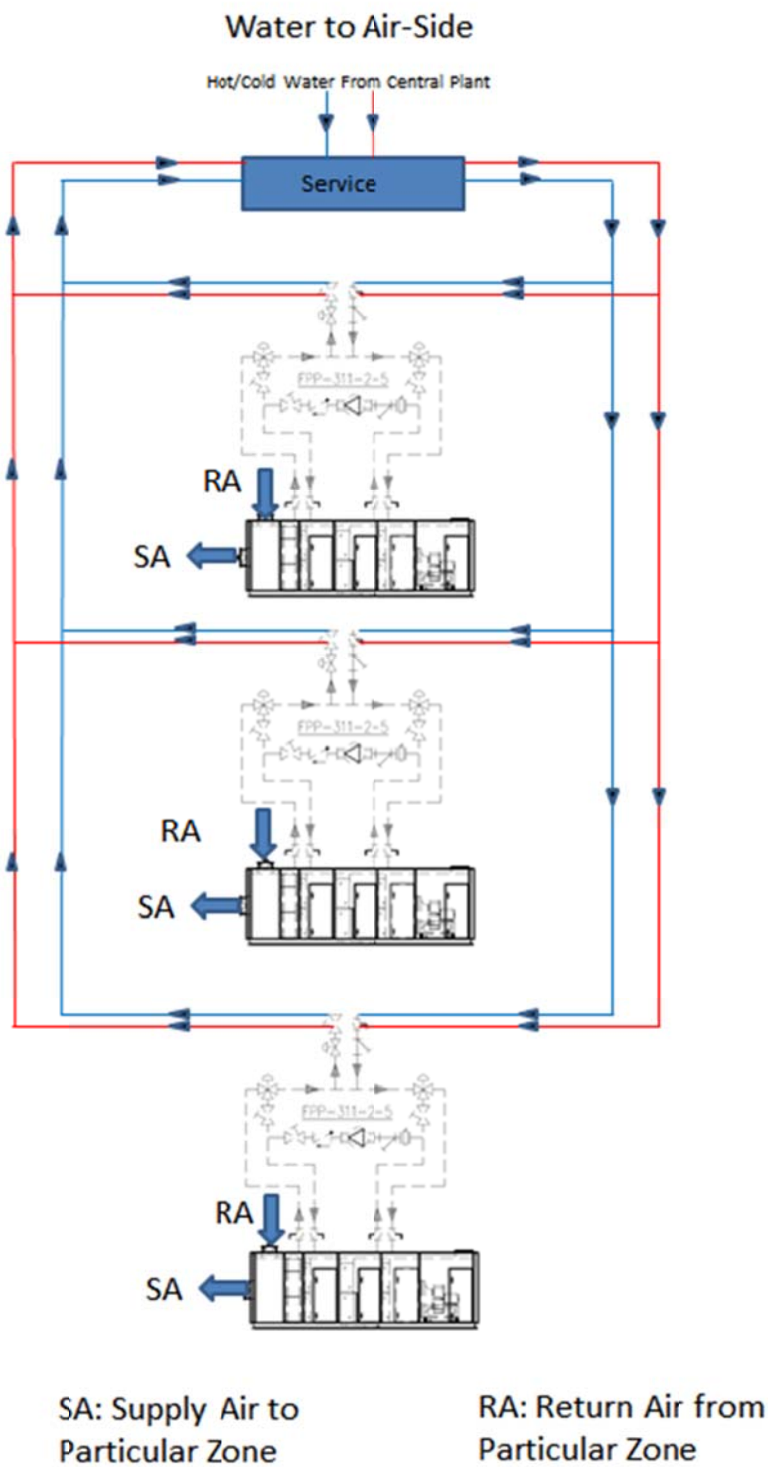
Evaporator System Schematic



Condenser System Schematic



Water to Air Side System Schematic



System Operation

The New York Police Academy's mechanical system operates around a central heating and cooling plant located in the West Campus Building. Boilers, chillers, and cooling towers provide the necessary hot and cold water needs for the campus. The central plant operates on a primary secondary pumping system. The primary pumps are located in the central plant and they distribute water to the cooling towers and air handling units located throughout the entire campus. The primary pumping systems can be seen in the Hot Water System Schematic, Evaporator System Schematic, and the Condenser System Schematic. These pumping system help to distribute the hot/cold water to and from the particular loads. The loads include sixty three air handling units of various sizes throughout the campus. The air handling units are supplied with hot/cold water from the central plant which allows for hot and cold air to be distributed to the intended zones (see *Mechanical System Schematics*). An example of this water to air system can be seen in the *Water to Air Side System Schematic.*

The central plant contains five 25110 MBH hot water boilers (two of which are for future use), six 1350 ton electric water chillers (two of which are for future use), one 2700 GPM heat exchanger, and the roof of the central plant house six 2700 GPM cooling towers (three of which are for future use). The central plant also houses seventeen water pumps: six for chilled water, six for condenser water, and five for hot water (six of these pumps are for future use). For a more detailed description of the equipment see the previous *Major Equipment Schedule Section.*

The chillers and boilers will vary on and off based on the load demand. Below is a summary of what chiller/boiler will be switched on/off in reference to the load demand.

THE CHILLERS SHOULD BE STAGED ON IN ACCORDANCE WITH THE FOLLOWING TABLE:

STEP	LOAD PERCENT	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6
1.	0%-90%	ON	OFF	OFF	OFF	OFF	OFF
2.	40%-90%	ON	ON	OFF	OFF	OFF	OFF
3.	50%-90%	ON	ON	ON	OFF	OFF	OFF
4.	60%-90%	ON	ON	ON	ON	OFF	OFF
5.	70%-90%	ON	ON	ON	ON	ON	OFF
6.	75%-90%	ON	ON	ON	ON	ON	ON

THE CHILLERS SHOULD BE STAGED OFF IN ACCORDANCE WITH THE FOLLOWING TABLE:

STEP	LOAD PERCENT	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6
1.	90%-70%	ON	ON	ON	ON	ON	ON
2.	90%-65%	OFF	ON	ON	ON	ON	ON
3.	90%-55%	OFF	OFF	ON	ON	ON	ON
4.	90%-45%	OFF	OFF	OFF	ON	ON	ON
5.	90%-35%	OFF	OFF	OFF	OFF	ON	ON
6.	90%-0%	OFF	OFF	OFF	OFF	OFF	ON

Figure1: Chiller Operation Schedule

THE BOILERS SHOULD BE STAGED ON IN ACCORDANCE WITH THE FOLLOWING TABLE:

STEP	LOAD PERCENT	B-1	B-2	B-3	B-4	B-5
1.	0%-90%	ON	OFF	OFF	OFF	OFF
2.	45%-90%	ON	ON	OFF	OFF	OFF
3.	55%-90%	ON	ON	ON	OFF	OFF
4.	60%-90%	ON	ON	ON	ON	OFF
5.	70%-90%	ON	ON	ON	ON	ON

THE BOILERS SHOULD BE STAGED OFF IN ACCORDANCE WITH THE FOLLOWING TABLE:

STEP	LOAD PERCENT	B-1	B-2	B-3	B-4	B-5
1.	90%-65%	ON	ON	ON	ON	ON
2.	90%-60%	OFF	ON	ON	ON	ON
3.	90%-50%	OFF	OFF	ON	ON	ON
4.	90%-40%	OFF	OFF	OFF	ON	ON
5.	90%-0%	OFF	OFF	OFF	OFF	ON

Figure 2: Boiler Operation Schedule

The chillers and boilers vary the amount of hot water and cold water to each Air Handling Unit. As stated above, there are sixty three AHU's located in this academy. This report is not intended to describe the system operation of each individual AHU. However, this report is intended to provide a concise summary of the entire mechanical system of the academy. Generally, each AHU is fitted with variable speed supply and return fans. The variable speed fans are intended to provide the proper amount of air for ventilation and thermal comfort requirements. Some AHU's serve several zones, where this is applicable variable air volume boxes are strategically placed to vary the volume of air flow to meet each particular zones needs. The AHU's that serve a single zone are not outfitted with VAV boxes.

The basic premise of the operation of this mechanical system stems from a central plant that serves AHU's located throughout the building. These AHU then provide the air conditioning needs and ventilation needs of the occupied spaces.

Lost Usable Space

Table 2.1: Lost Usable Space Breakdown

Campus Floor	Space Type	SF
East 1	Mechanical Room	4716
East 2	Mechanical Room	5760
East 2	Mechanical Room	3120
East 2	Mechanical Room	5760
East 2	Mechanical Room	4900
East 8	Mechanical Room	9344
West G	Domestic Water Room	2805
West G	Fire Pump Room	1862

West G	Fuel Oil Storage Room	1483
West G	Fuel Oil Storage Room	1506
West G	Fuel Oil Storage Room	1512
West G	Future Fuel Oil Storage	1529
West G	Equipment Storage	1935
West G	Central Plant Corridor	2921
West 2	Mechanical Room	11099
West 2	Mechanical Room	5182
West 2	Central Plant Corridor	2900
West 2	Mechanical Room	2413
West 3	Mechanical Room	5940
West 3	Generator Room	1938
West 3	Generator Room	1976
West 3	Chiller Room	7376
West 3	Control Room	329
West 3	Central Plant Corridor	2854
West 3	Boiler Room	5470
West 3	Mechanical Room	2418
West 4	Chiller Room	7376
West 4	Control Room	329
West 4	Central Plant Corridor	2889
West 4	Boiler Room	5470
West 4	Generator Room	1938
West 4	Generator Room	1976

Table 2.2: Total Lost Usable Space

Campus	Mechanical Space Allocation
East Campus	33,060 SF
West Campus	85,426 SF
Total	118,486 SF

Operating History

The New York Police Academy is not yet constructed and actual operating history information is not available at this time. Also energy usage and fuel utilization data for this building is unavailable.

LEED New Construction Version 2.2 Analysis

LEED Assessment

The New York Police Academy has a minimum project requirement of LEED Silver as mandated by the New York City Department of Design and Construction. The project will be following the criteria of LEED New Construction Version 2.2. Perkins + Will, the lead architecture firm, has developed a plan to target 35 LEED points with a possibility of up to 44 points. LEED Silver certification is 33 points and LEED goal certification is 39 points. The NYPA should safely reach their goal of LEED Silver certification and could potential be LEED Gold.

Below is a summary of the achievable points from the Water Efficiency, Energy and Atmosphere, and Indoor Environmental Quality sections of LEED NC v2.2 that are directly related to the mechanical systems of the New York Police Academy.

Water Efficiency

WE-C1.1 Water Efficiency Landscaping-Reduce by 50%

Credit Requirements: Reduce potable water consumption for irrigation by 50% from calculated mid-summer baseline case. Reductions shall be attributed to any combination of the following items:

-Plant Species Factor
-Irrigation Efficiency
-Use of captured rainwater
-Use of recycled wastewater
-Use of water treated & conveyed by a public agency specifically for non-potable uses

The NYPA will be able to achieve this credit by specifying native or adaptive vegetation for the local landscaping. Also collected storm water will be harvested and redistributed for irrigation purposes.

WE-C.2 Innovative Wastewater Technologies- Reduce 50% or Treat 50% on Site

Option 1
Reduce potable water use for building sewage conveyance by 50% through the use of water conserving fixtures (water closets, urinals) or non-potable water (captured rainwater, recycled greywater, and on-site or municipally treated waste water).

Option 2
Treat 50% of waste water on-site to tertiary standards. Treated water must be infiltrated or used on-site.

The NYPA will achieve this credit because storm water will be collected for toilet flushing use in the Physical Training Building of the West Campus.

WE-C.3 Water Use Reduction-20%/30% Reduction

Employ strategies that in aggregate use 20% (or 30% for two points) less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements.

The NYPA aims to receive two points for this credit by reducing water by 30% by installing low-flow plumbing fixtures that include:

-Dual flush toilets (1.6 GPF/1.1 GPF)
-Low flow lavatories with electronic controls (0.5 GPM)
-Low flow showerheads (1.5 GPM)
-Collected Stormwater
- Collected stormwater will be used to flush toilets in PT building.
- Additional Innovation credit is achievable for Exemplary Performance (40% reduction).
- Additional Innovation credit is achievable for using collected stormwater for cooling tower make-up (equivalent to 10% reduction in Process water).

In summary, collecting and reusing stormwater on the site is related to 7 LEED points:
- WE-c1 - No potable water for irrigation (2 pts.)
- WE-c2 - 50% reduction potable water for sewage conveyance (1 pt.)
- WE-c3 - 30% reduction potable water for plumbing fixtures (2 pts.)
- ID credit - 40% reduction potable water for plumbing fixtures (1 pt.)
- ID credit - 10% reduction potable water for cooling towers (process water) (1 pt.)

Energy and Atmosphere

EA-p1Fundamental Commissioning (Cx) of the Building Energy Systems

The following Cx process activities shall be completed by the Cx Team, in accordance with LEED-NC 2.2 Reference Guide.

(1) Designate an individual as the Cx Authority (CxA) to lead, review and oversee the completion of the Cx process activities.

a) The CxA shall have documented commissioning authority experience in at least two building projects.

b) The individual serving as the CxA shall be independent of the project's design and construction mgt., though they may be employees of the firms providing those services. The CxA may be a qualified employee or consultant of the Owner.

c) The CxA shall report results, findings and recommendations directly to the Owner.

d) For projects smaller than 50,000 gross sq. ft., the CxA may include qualified persons on the design or construction teams who have the required experience.

(2) The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents.

(3) Develop and incorporate Cx requirements into the construction documents.

(4) Develop and implement a Cx Plan.

(5) Verify the installation and performance of the systems to be commissioned.

(6) Complete a summary Cx Report.

EA-p2 Minimum Energy Performance

Design the building project to comply with both —

- Mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Std, 90.1-2004 (without amendments); AND
-Prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Std. 90.1-2004 (without amendments).

EA-p3 Fundamental Refrigerant Management

Zero use of CFC-based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phaseout conversion prior to project completion.
Phase-out plans extending beyond the project completion date will be considered on their merits.

These prerequisites must be completed for LEED certification, thus the NYPA is planning on completing these prerequisites.

EA-c1.1 Optimize Energy Performance

- Mandatory 14% energy cost reduction (2 points)

- Flack + Kurtz (MEP Engineers) is performing energy simulation, which will quantify impact of energy efficiency measures (EEM's)relating to building envelope, mech. systems, lighting and controls, etc. Separate energy models will be done for LEED and Local Law 86 compliance.

Proposed Energy Efficiency Measures include:

- High performance envelope/ glazing
- High SRI roof surfaces
-Variable speed chillers, equipment, pumps in CUP
-Free cooling
-CO2 sensor control for ventilation
-Displacement ventilation in atrium
-Reduced lighting power densities
- Daylight and occupancy controls for interior lighting
-Potential for cogeneration microturbines (currently being evaluated; seeking outside funding)
- Process energy default: 25% of total energy cost for baseline building, unless documented otherwise.
Process energy same in baseline and proposed design models unless Exceptional Calc. Method is performed.
- Process energy includes equipment & computer plug loads, elevators, kitchen cooking & refrigeration, laundry washing/drying, non-regulated lighting.
- 30% energy cost reduction required for 2030 Challenge compliance (6 LEED pts.)

EA-C4 Enhanced Refrigerant Management

OPTION 1
Do not use refrigerants.
OR
OPTION 2
Select refrigerants and HVAC&R that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming. The base building HVAC&R equipment shall comply with the following formula, which sets a maximum threshold for the combined contributions to ozone depletion and global warming potential.

- Flack + Kurtz (MEP Engineers) has confirmed that all refrigerants will comply with LEED criteria
- Flack + Kurtz (MEP Engineers) has confirmed that fire suppression systems will comply with LEED criteria
- This credit typically covers major base-building refrigeration equipment. Small non-base building mech. equipment (e.g., CRAC units) typically do not need to comply.

EA-C6 Green Power

Provide at least 35% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

New York City purchases wind credits for city projects, which qualify for LEED green power credits. Our *understanding is that the City will purchase Renewable Energy Certificates (REC's) to achieve this credit and possible Innovation credits.*

Indoor Environmental Quality

EQ-p1 Minimum IAQ Performance

Meet the minimum requirements of Sections 4 through 7 of ASHRAE 62.1-2004, Ventilation for Acceptable Indoor Air Quality. Mechanical ventilation systems shall be designed using the "Ventilation Rate Procedure" or the applicable local code, whichever is more stringent. Naturally ventilated buildings shall comply with ASHRAE 62.1-2004, paragraph 5.1.

EQ-p2 Environmental Tobacco Smoke (ETS) Control

-Prohibit smoking in the building.
-Locate any exterior designated smoking areas at least 25 ft. away from entries, outdoor air intakes and operable windows.

These prerequisites must be completed for LEED certification, thus the NYPA is planning on completing these prerequisites.

EQ-c1 Outdoor Air Delivery Monitoring

Install permanent monitoring systems that provide feedback on ventilation system performance to ensure that ventilation systems maintain design min. ventilation requirements. Configure all monitoring equipment to generate an alarm when the conditions vary by 10% or more from setpoint, via either a building automation system alarm building operator or via a visual or audible alert to the building occupants.

- Flack + Kurtz (MEP Engineers) confirmed that project will include CO2 sensors to meet LEED criteria for O.A. Delivery Monitoring
-For all densely occupied spaces (25 people / 1,000 sq.ft.) - CO2 sensors required
- For all non-densely occupied spaces - outdoor airflow measurement devices required
-CO2 sensors to be connected to Building Automation System (BAS)

EQ-c3.1 Construction IAQ Management Plan: During Construction

Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows:

- During construction meet or exceed the recommended Control Measures of the Sheet Metal & Air Conditioning National Contractors Association (SMACNA) IAQ

Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.

-Protect stored on-site or installed absorptive materials from moisture damage.

-If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grille, as determined by ASHRAE 52.2-1999. Replace all filtration media immediately prior to occupancy.

These Credit requirements will be included in project specifications (Division 1).

EQ-c7.1 Thermal Comfort: Design

Design HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy. Demonstrate design compliance in accordance with the Section 6.1.1 Documentation.

- Flack + Kurtz (MEP Engineers) confirmed that mech. design will comply with referenced ASHRAE standard.

- Winter humidification is not required in 2004 version of the ASHRAE standard.

Overall Evaluation

The New York Police Academy is a very large construction project that is intended to provide a very important function for the City of New York upon its completion. The Academy will be the main headquarters for the academic and physical training facilities of the New York Police Department's recruits. The intention of this project is to consolidate all the facilities of the New York Police Academy. Currently, the NYPD has training facilities dispersed around the several different sites in the greater New York City area. Consolidating, the academy under one roof will increase efficiency in several ways in regards to the building function. From a mechanical system standpoint, the maintainability of one central academy will be much easier than to provide maintenance support for dozens of remote locations.

The Academy has been designed to house a central plant. The decision to house a central plant to provide all heating and cooling needs of the entire academy provides several benefits. The maintenance of the equipment will be much easier having all the equipment in a centralized location.

The central plant has been designed to be greatly oversized for future expansion. There are several extra chillers, boilers, pumps, cooling towers that are integrated in the design if the academy needs the extra capability. Depending on the actual likelihood of expansion, the added initial cost for the equipment could be questioned. One disadvantage to the centralized plant is the increased pumping energy needed to distribute the water throughout the entire academy. It may be worthwhile to evaluate the added pumping energy needed to have a centralized pumping system versus having several smaller mechanical rooms located throughout the academy.

Overall, it is understandable why a central plant with a primary/secondary pumping system arrangement was designed into the NYPA. However, there are several avenues for analysis in determining if a central plant with all the added equipment was truly worthwhile.

References:

ASHRAE. (2009). *Handbook of Fundamentals.* Atlanta, GA:
American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

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"U.S Energy Information Adminstration: *Independednt Statistcs Analysisis"* Accessed October 15, 2010. <http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html>

Appendices:

Appendix A: Utility Cost Information

Average Retail Price of Electricity (DOE)

Table 5.6.B. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through July 2010 and 2009 (Cents per kilowatthour)

Census Division and State	Residential		Commercial[1]		Industrial[1]		Transportation[1]		All Sectors	
	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009
New England	**16.5**	**17.86**	**14.87**	**16.44**	**12.76**	**12.06**	**8.81**	**8.58**	**15**	**15.93**
Connecticut	19.35	20.37	16.54	16.89	14.78	16.51	12.17	12.06	17.52	18.28
Maine	15.44	15.48	12.38	12.82	9.19	10.23	--	--	12.62	13.12
Massachusetts	15.26	17.71	14.99	18.25	13.34	11.39	6.96	6.72	14.54	15.87
New Hampshire	15.98	16.54	13.99	15.31	12.6	14.08	--	--	14.57	15.61
Rhode Island	15.82	16.13	13	13.75	13.51	12.72	13.37	--	14.19	14.47
Vermont	15.34	14.78	13.32	12.78	9.38	9.27	--	--	13.08	12.67
Middle Atlantic	**15.67**	**14.78**	**13.86**	**13.36**	**8.56**	**8.34**	**13.12**	**13**	**13.57**	**12.97**
New Jersey	16.39	16.44	13.99	14.6	11.68	11.33	13.83	14.3	14.68	14.92
New York	18.55	17.52	16.11	15.09	9.71	10.09	14.71	14.42	16.35	15.44
Pennsylvania	12.71	11.55	10.14	9.56	7.66	7.25	7.75	7.77	10.34	9.61

Average Natural Gas Price (DOE)

Natural Gas Prices

(Dollars per Thousand Cubic Feet, except where noted)

Area: New York **Period:** Annual

Download Series History Definitions, Sources & Notes

Show Data By: Data Series / Area	2004	2005	2006	2007	2008	2009	View History
Wellhead Price	6.98	7.78	7.13	8.85	8.94		1967-2008
Imports Price	6.44	9.11	7.50	7.43	9.36		1989-2008
Exports Price	6.99	--	--	12.07	--		1999-2008
Pipeline and Distribution Use Price	--	--					1967-2005
Citygate Price	6.36	8.22	9.22	9.02	10.07	7.35	1984-2009
Residential Price	12.50	14.89	15.35	15.73	16.75	15.08	1967-2009
Percentage of Total Residential Deliveries	100.00	100.00	100.00	100.00	100.00		1989-2008
Commercial Price	10.11	11.80	11.91	11.82	12.86	10.90	1967-2009
Percentage of Total Commercial Deliveries	100.0	100.0	100.0	100.0	100.0	100.0	1990-2009
Industrial Price	8.05	10.76	10.56	11.43	12.30	10.82	1997-2009
Percentage of Total Industrial Deliveries	10.7	14.7	11.7	12.3	11.4	9.9	1997-2009
Vehicle Fuel Price	8.45	11.52	13.10	13.45	18.55		1990-2008
Electric Power Price	6.65	9.24	7.75	8.09	10.85	5.24	1997-2009

- = No Data Reported; -- = Not Applicable; **NA** = Not Available; **W** = Withheld to avoid disclosure of individual company data.

Notes: Prices are in nominal dollars. Gas volumes delivered for use as vehicle fuel are included in the State annual totals through 2008 but not in the State monthly components. Through 2001, electric power price data are for regulated electric utilities only; beginning in 2002, data also include nonregulated members of the electric power sector. See Definitions, Sources, and Notes link above for more information on this table.

Release Date: 9/29/2010
Next Release Date: 10/29/2010