Design Considerations

Energy Sources and Rates

The Hilton Hotel at BWI Airport is serviced by both electricity and natural gas energy sources. Since the hotel is still under construction, the energy rates were assumed based on information gathered from the websites of both energy providers.

The natural gas service is provided by Washington Gas, and the rates and tariffs were found on their website (http://www.washgas.com/). The natural gas rates were determined to be from rate schedule Number 2, which is for Firm Commercial and Industrial Sales service.

The natural gas rates are divided into the system charge and the distribution charge. The distribution charge is broken down based on the amount of gas (therms) used in one month. Please see Table 2 – Natural Gas Rates for the breakdown.

Table 2 - Natural Gas Rates

System Charge		
	$36.25	per customer
Distribution Charge		
First 300 therms:	$0.3158	per therm
Next 6700 therms:	$0.2152	per therm
Over 7000 therms:	$0.1573	per therm

The electric service in the Linthicum Heights area is provided by Baltimore Gas and Electric (BGE). The appropriate electric rates and tariffs were obtained from BGE's website (http://www.bge.com/) and with the assistance of a customer service representative. The rate schedule used for the BWI Hilton is the General Service Large (GL).

The electric service rates are separated out into delivery service customer charge, demand charges, energy charges, and delivery service charge. The energy charges are divided into peak, intermediate, and off-peak periods. The electric rates breakdown is shown below in Table 3 – Electric Rates.

Table 3 - Electric Rates

GENERAL SERVICE LARGE -- ELECTRIC SCHEDULE GL		
Delivery Service Customer Charge:	$110	per month
Demand Charges:	Summer	Non-Summer
Generation Market-Priced Service:	(per kW)	(per kW)
Type II	-	-
Transmission Charge for Market-Priced Service:		
Type II	$1.05	$1.05
Delivery Service	$2.67	$2.67
Energy Charges:		
Generation Market-Priced Service (¢/kWh): (Excludes Rider 8 – Energy Cost Adjustment)	Summer	Non-Summer
Type II		
Peak	9.319	5.534
Intermediate	8.802	5.406
Off-Peak	8.464	5.118
Delivery Service Charge:	1.239	¢/kWh
Hours:	Summer	Non-Summer
Peak	10 am - 8 pm	7 am - 11 am 5 pm - 9 pm
Off-Peak	11 pm - 7 am	9 pm - 7 am
Intermediate	7 am - 10 am 8 pm - 11 pm	11 am - 5 pm

Outdoor and Indoor Design Conditions

The outdoor design conditions for Maryland – Baltimore, BWI Airport were found in Chapter 27 of the 2001 ASHRAE Fundamentals Handbook. This information for the Hilton Hotel at BWI Airport was gathered from the values for the most extreme conditions listed (at either 0.4% or 99.6%). Carrier's Hourly Analysis Program (HAP), which was used to model the building's energy usage, also used these same values to simulate the weather. Please see Table 4 – Outdoor Design Conditions for the summer and winter design conditions.

Table 4 - Outdoor Design Conditions

Summer Cooling		Winter Heating	
Design DB	93.0 ^{o}F	Design DB	11.0 ^{o}F
Coincident WB	75.0 ^{o}F	Coincident WB	8.6 ^{o}F

The indoor design conditions for the BWI Hilton were originally defined in the Sequence of Operations. The dry bulb and relative humidity conditions are set at typical setpoints for buildings. The winter heating relative humidity is not explicitly defined, and it often drops to 30% or below during the winter heating season. These conditions are shown below in Table 5 – Indoor Design Conditions.

Table 5 - Indoor Design Conditions

Summer Cooling		Winter Heating	
DB	74.0 ^{o}F	DB	70.0 ^{o}F
RH	50%	RH	N/A

Design Ventilation Requirements

The minimum required ventilation rates for the Hilton Hotel at BWI Airport were found using ASHRAE Standard 62.1-2004. The existing air-side equipment serving the building includes the four air handling units (AHUs) and six rooftop units (RTUs). The ventilation rates used in the RTUs are shown in Table 6 – RTU Ventilation Summary. The ventilation rates used in the AHUs are shown in Table 7 – AHU Ventilation Summary.

Table 6 - RTU Ventilation Requirements

Space / Function	People Outdoor Air Rate R_p (cfm/person)	Area Outdoor Air Rate R_a (cfm/sf)	Default Occ. Density (#/1000 sf)
Corridor	0	0.06	0
Communications Room	0	0.5	0
Housekeeping Area	7.5	0.06	20
Vending Area	0	0.5	0
Elevator Lobby	0	0.5	0
Bedroom/Living Room	5	0.06	10
Kitchen	15	0.06	20
Storage Room	0	0.12	0
Office Space	5	0.06	5
Laundry Area	7.5	0.06	20
Service Elevator Lobby	0	0.5	0
Elevator Machine Room	0	0.5	0

Table 7 - AHU Ventilation Summary

Space / Function	People Outdoor Air Rate Rp (cfm/person)	Area Outdoor Air Rate Ra (cfm/sf)	Default Occ. Density (#/1000 sf)
Conference/Meeting Room	5	0.06	50
Lobby/Pre-function Area	7.5	0.06	120
Restaurant Dining Rooms	7.5	0.18	70
Toilet Room	0	0.2	0
Electrical Room	0	0.5	0
Bar	7.5	0.18	100
Telephone/Data Entry	5	0.06	60
Office Space	5	0.06	5
Corridor	0	0.06	0
Storage Room	0	0.12	0
Elevator Lobby	0	0.5	0
Mechanical Room	0	0.3	0
Health Club/Aerobics Room	20	0.06	40
Cafeteria	7.5	0.18	100

The new mechanical design incorporates the use of two new dedicated outdoor air (DOAS) units. The minimum ventilation rates for the new DOAS units are shown in Table 8 – DOAS Ventilation Requirements.

Table 8 - DOAS Ventilation Requirements

Space / Function	People Outdoor Air Rate R_p (cfm/person)	Area Outdoor Air Rate R_a (cfm/sf)	Occupancy (persons)
Guest Room	5	0.06	4

Building Energy Simulation Model

A means of predicting the annual energy usage of a building is a major component of the mechanical systems design procedure. For this system design, Carrier's Hourly Analysis Program (HAP) was used extensively to compare design options and energy consumption of all the mechanical equipment.

Much time and care was used in entering design conditions for all the spaces in the BWI Hilton. All the equipment used in the systems was intended to be modeled as an accurate representation of how it will actually operate. Despite this effort to model the spaces, systems, central plants, and building as accurately as possible, it was necessary to make assumptions throughout the process. Default values provided in HAP were used in situations when the actual values were unknown or could not be found. All these assumptions and default

values are not listed anywhere in this report because they do not make a huge impact on the overall building energy usage.

In order to accurately simulate the energy usage of the building, it is also critical to accurately define the occupancy and other types of schedules. However, all these schedules were unknown for the whole building, including the guest rooms. Since they were unknown, they were assumed to be equivalent to those defined by ASHRAE/IES Standard 90.1-1989 in Table 13-3: Building Schedule Percentage Multipliers.

For the occupancy schedule used in HAP for all the public, private, and service spaces, please refer to Table 9 – Hotel Occupancy Schedule. For the lighting schedule used in HAP, please refer to Table 10 – Hotel Lighting Schedule. For the HVAC schedule used in HAP, please refer to Table 11 – Hotel HVAC Schedule.

Table 9 - Hotel Occupancy Schedule

		Hour																							
Schedule	**Day**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Hotel Occupancy	Weekday	90	90	90	90	90	90	90	70	40	40	20	20	20	20	20	20	30	50	50	50	70	70	80	90
	Saturday	90	90	90	90	90	90	90	70	50	30	30	30	30	30	30	30	30	30	50	60	60	60	70	70
	Sunday	80	70	70	70	70	70	70	70	70	50	50	50	30	30	20	20	20	30	40	40	60	60	80	80

Table 10 - Hotel Lighting Schedule

		Hour																							
Schedule	**Day**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Hotel Lighting	Weekday	30	20	15	10	10	10	20	40	50	40	40	25	25	25	25	25	25	25	25	60	80	90	80	60
	Saturday	30	20	20	10	10	10	10	30	30	40	40	30	25	25	25	25	25	25	25	60	70	70	70	60
	Sunday	30	30	30	20	20	20	20	30	40	40	30	30	30	30	20	20	20	20	20	50	70	80	60	50

Table 11 - Hotel HVAC Schedule

		Hour																							
Schedule	**Day**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Hotel HVAC	Weekday	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on
	Saturday	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on
	Sunday	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on	on